CURRENT RESEARCH IN THE PLEISTOCENE

Volume 25 2008

A Peopling of the Americas Publication

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From the Editor

When you turn to the next page of this volume of *CRP*, you will immediately notice something new. We are excited to present the first in what we hope will become a regular feature of *CRP*—special full-length reports presenting new and significant results from the fields of archaeology, paleoanthropology, and Quaternary studies. In the pages that follow, Arturo H. González González and colleagues present new details about the discovery and dating of early human remains from submerged caves in Quintana Roo, Mexico.

With the addition of this "Special Report" section to *CRP*, we hope to better serve our contributors and readers, by providing extra space for the presentation of significant results directly related to the problem of the peopling of the Americas. We will do this, however, without impacting the regular format of the journal. We will continue to solicit and publish short papers (<750 words) as we always have.

CRP turns 25 this year. The journal continues to grow—in number of pages, number of papers published, and number of committed subscribers. Still, the number of libraries subscribing to *CRP* is not increasing. We need your help to change this. If you are a professor or student at a college or university, ask your library to purchase this volume of *CRP*, and ask them to purchase a complete set of back issues if they don't already have them.

And watch *CRP* continue to grow.

Ted Goebel

Special Report

The Arrival of Humans on the Yucatan Peninsula: Evidence from Submerged Caves in the State of Quintana Roo, Mexico

Arturo H. González González, Carmen Rojas Sandoval, Alejandro Terrazas Mata, Martha Benavente Sanvicente, Wolfgang Stinnesbeck, Jeronimo Aviles O., Magdalena de los Ríos, and Eugenio Acevez

Submerged caves near Tulum in the Mexican state of Quintana Roo, on the Yucatan peninsula, contain a diverse megafaunal assemblage of latest Pleistocene age. Abundant coeval prehistoric evidence (e.g., hearths with burned bones, artifacts) indicates that human settlement in the region also reaches back to the end of the Pleistocene. Among the highlights of our ongoing multidisciplinary research are three human skeletons of preceramic age, 70–90 percent complete and mostly articulated. These corpses, which skeletized in situ, appear to have been intentionally buried at a time when the caves were still dry, i.e., prior to the early-Holocene rise of sea level. The three individuals are the oldest skeletons found so far in southeastern Mexico and are among the oldest known from the American continent.

The northern part of the Yucatan peninsula is one of the most inhospitable regions in the world as a result of the paucity of fertile soil, scarcity of drinking water, and shortage of other natural resources. Except for cenote sinkholes and caves with groundwater, most of Yucatan would be a waterless plain. Neverthe-

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less, one of the sophisticated pre-Columbian civilizations, the Maya, adapted to and survived under these adverse environmental conditions. Recent archaeological discoveries in the Mexican state of Quintana Roo suggest that humans occupied the region during the Archaic period, several thousand years prior to the classic Mayan civilization. Evidence for an even older settlement in northern Yucatan was absent, however, and it was generally accepted that groups of preceramic foragers never reached the area (García-Bárcena, pers. comm. 2000).

This situation has profoundly changed in recent years, as a consequence of advances in scuba diving. This technological progress now allows for relatively safe access to the subaqueous system of caves and cenotes on the Yucatan peninsula and has resulted in a boom in cenote diving activities. The cave system is explored by scuba divers and underwater speleologists from all over the world. On one hand, the new technologies now allow archaeologists and paleoanthropologists to explore sites previously inaccessible. But on the other hand, the new situation threatens the preservation of these sites, which are now accessible by inexperienced laymen and exposed to vandalism and robbery.

A completely unexpected result of the systematic exploration of the Yucatan system of submerged caves and rivers by cave divers such as James Coke and members of the Quintana Roo Speleological Survey is a significant record of the recent geological, paleontological, and cultural history of the area. These explorations have yielded, besides colonial and Mayan artifacts and human skeletons, materials dating to the beginning of the Holocene and before 10,000 RCYBP, to the Pleistocene. In this paper we present materials recovered from some of these first explorations, specifically those from Aktun Ha, La Chimenea, Naranjal Cave System (Naharon and Las Palmas), and El Templo.

Background: Geology of the Yucatan Peninsula

The Yucatan peninsula forms a single physiographic province that includes the Mexican states of Quintana Roo, Yucatan, and Campeche, as well as Belize and parts of northern Guatemala in Central America (Figure 1). The geology of the region is homogenous and relatively simple, mostly consisting of a 3000-m-thick sequence of shallow-water limestone of early- to late-Cretaceous to

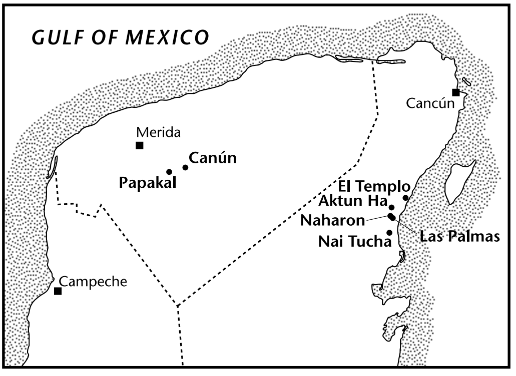

Figure 1. Location of submerged caves containing prehistoric evidence near the east coast of the Yucatan peninsula, state of Quintana Roo and Yucatan, Mexico.

subrecent age, overlying a metamorphic basement detected in the subsurface (Lopez Ramos 1983; Ward et al. 1985, 1995).

Except for a few isolated faults (e.g., Ticul fault, Rio Hondo fault, Chetumal graben), the sediment sequence of northern Yucatan (the Mexican part) is unaffected by tectonic uplift or compression, and strata remain in an almost horizontal position, with a dip of < 2 percent to the north and northeast. Young sediments of Mio-Pliocene or even Pleistocene age are therefore found in this area, whereas the oldest rocks of Cretaceous age outcrop to the south, in northern Guatemala and Belize. As a consequence of the almost horizontal position of the strata, much of northeastern Yucatan is a flat plateau. In the Mexican part of the peninsula, maximum elevations reach 150 m in the Sierrita de Ticul and 300 m in eastern Campeche, but most of Quintana Roo is elevated just a few meters above sea level.

Karst develops because limestone is soluble in water charged with carbon dioxide gas (Figure 2). Owing to the predominance of carbonate lithologies, the tropical climate, high precipitation, and important changes in past sea

Figure 2. Entrance to Naitucha cave. The sedimentary rock is typical of karst topography.

level, mostly during the Pleistocene, the Yucatan peninsula has suffered significant karstification. In the northern and eastern part of the peninsula, the major surface karst phenomena are circular collapsed sinkholes with vertical or funnel-shaped walls, locally known as *cenotes* (a Mayan term). They are the entrances to one of the most extensive cave systems known to date. The majority of these caves are submerged. For instance, an underground river system in the municipality of Solidaridad in Quintana Roo, more than 638 km long, includes 161 underwater caves and 529 cenotes. Among these are the four longest subterraneous rivers known on Earth and the longest cave known in the Mexican Republic (QRSS 2007).[1]

Instead of running off on the surface, water almost instantaneously infiltrates the permeable carbonate bedrock and percolates downward into underlying strata, reaching phreatic levels only a few meters below surface. From here groundwater is rapidly discharged, directed towards the coast. Consequently, even though annual precipitation is high (1000–1500 mm [Back 1985]), the enormous degree of karstification and limestone permeability prevents the existence of surface rivers in the region, except for Rio Hondo east of Chetumal and some minor tributaries.

Origin of the Yucatan Cenote System

The cenote system of northern Yucatan was formed during periglacial periods of the Pleistocene when sea level was low and the Mio-Pliocene carbonate sequence was exposed to subaerial erosion. Groundwater must then have passed through very low levels of the cave system. Since rainwater infiltrated the karstic surface instantaneously, much of the peninsula must have been a waterless plain, completely devoid of surface rivers and lakes. Even the upper levels of caves were mostly dry and probably decorated by speleothems (Figure 3). Indeed, stationary fossil water levels of possible Pleistocene age are occa-

Figure 3. Typical underwater cave landscape, with abundant speleothem decoration. These could only be formed when the cave was dry.

[1] Data published by the Quintana Roo Speleological Survey (QRSS). Underground rivers are cave systems with two or more openings, whereas caves only present a single access to the surface. Cenotes are collapsed sinkholes that give access to caves and subterraneous river systems.

sionally recognized at various levels of depth in the caves by color changes on the cave walls.

Blanchon and Shaw (1995) calculate the difference between recent and late-Pleistocene (13,000 RCYBP) sea level, based on the presence of *Acropora palmata* in fossil reefs on the shelf surrounding the Yucatan coast. *Acropora palmata,* a dominant component of recent reefs in the Caribbean Sea, usually forms monotypic colonies in waters < 5 m in depth to a maximum depth of 17 m (Blanchon and Shaw 1995). The sea level of the Quintana Roo coastline may have been > 100 m below recent sea level, based on karstification reaching this depth. The eustatic rise of sea level, caused by deglaciation at the end of the Pleistocene between 13,000 and 7600 RCYBP, was considered "catastrophic" by Blanchon and Shaw (1995). Sea level reached present-day levels around 7600 RCYBP (about 8400 CALYBP) (Figure 4).

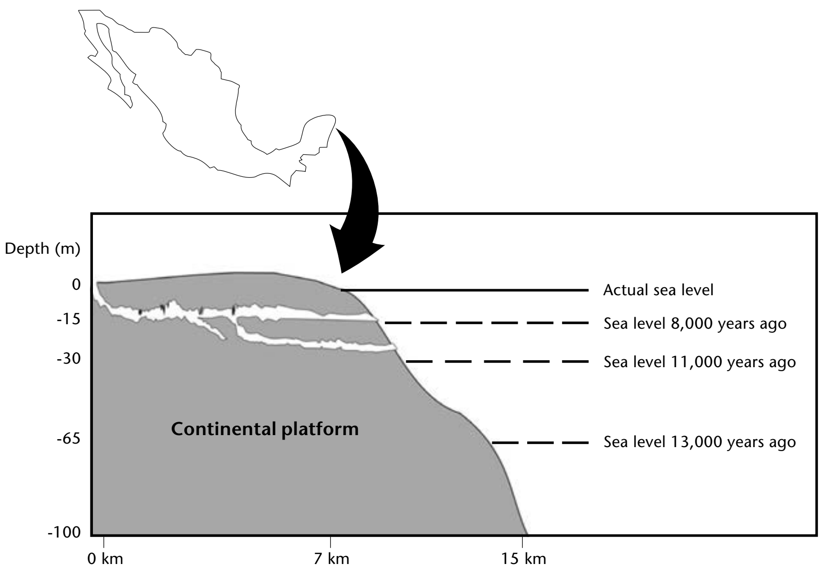

Figure 4. Minimum sea levels and their relation with Quintana Roo caves on the oriental coast (modified from Blanchon and Shaw 1995).

The late-Pleistocene coastline of Yucatan was also different from today. Low sea level exposed the continental shelf towards the north and west of the peninsula (the Campeche Bank off the states of Campeche and Quintana Roo). In sharp contrast to the broad shelf or bank in the Gulf of Mexico, the Caribbean shelf on the eastern margin of the peninsula (Quintana Roo, Belize) is very narrow, frequently only 5–10 km wide, and a depth of > 500 m is rapidly reached in the Yucatan Channel.

The Origins of Native Americans

How and when the first groups of humans arrived on the American continent remains highly polemic and is a question of multidisciplinary debate among paleoanthropologists, archaeologists, and geoscientists from different fields (e.g., paleontologists, geologists, geochemists). Models based on archaeological, anthropophysical, genetic, and linguistic evidence explain the origin and also the number of migrations. The Clovis-first theory suggests ancestral Native Americans came from central Siberia, then crossed Beringia and arrived in North America about 13,500 to 13,000 CALYBP, after a trek between the recently separated Canadian ice sheets (e.g., Fiedel 2006; Haynes 2006). Evidence for this hypothesis is the ubiquitous Clovis fluted point, found throughout Canada and the U.S., and the stylistically derivative Fishtail points of Mexico and Central and South America (Fiedel 2006; Morrow and Morrow 1999).

Other theories postulate multiple pre-Clovis migrations, including trans-Pacific (Rivet 1945), trans-Atlantic (cf. Straus 2000) or coastal (Fladmark 1979) voyages through ice-free corridors by the ancestors of modern Mongolians, Siberians, Australians, Melanesians, or Ainu (Avila 1940; Chatters 2000; González-José et al. 2005) (Figure 5). These new hypotheses are based on archaeological finds in Chile and Brazil as well as on new analyses of crania and molecular data (e.g., Bate and Terrazas 2002; Powell and Neves 1999;

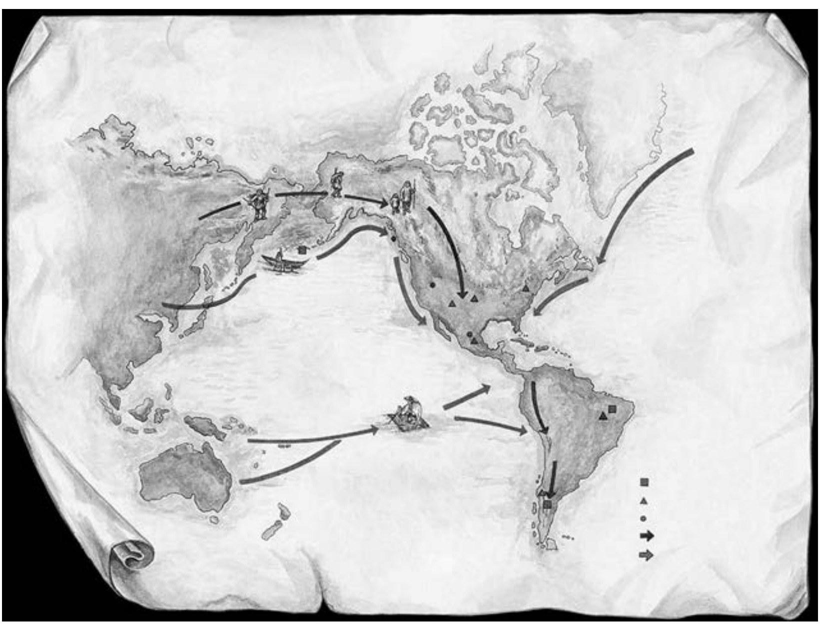

Figure 5. Possible migration routes for the first Americans.

Pucciarelli 2004). In such scenarios, the Americas were colonized thousands of years earlier than Clovis and by several waves of migration. For instance, a human campsite at Monte Verde in southern Chile contains human artifacts and gomphothere bones suggesting an age of 14,000–14,500 (MV II) or even 33,000 CALYBP (MV I) for this prehistoric site (Dillehay 1997, 2002), and human occupations as early as 50,000 CALYBP have been claimed at Pedra Furada in Brazil (Guidon and Delibrias 1986). The anthropological evidence from these sites and their ages, however, remain highly controversial and are considered dubious by many archaeologists, especially from North America (e.g., Fiedel 2006).

Soon after the arrival of Paleoamericans, a massive extinction of megafauna is recognized on the North American continent, now dated to the short period between 13,300 and 12,900 CALYBP (e.g., Fiedel and Haynes 2004). These end-Pleistocene extinctions were abrupt and highly selective, essentially terminating large mammals such as the well-known *Glyptotherium, Glossotherium/Paramylodon, Smilodon, Tapirus, Equus, Camelops, Hemiauchenia, Mammuthus,* and *Gomphotherium,* among many others. Current theories suggest that the ultimate cause for these selective extinctions may have been a combination of repeated rapid climate shifts and human hunting that led to ecosystem instability and population collapse, but there is no unambiguous proof for that (Haynes 2006).

The Prehistoric Record of Southern Mexico

Hammond (1982) suggests that the first settlers could have reached the southern Mexico peninsula by about 11,000 RCYBP, during the so-called "first migration" beginning 30,000–15,000 RCYBP. Archaeological materials associated with this period are Fishtail points of early-Cenolithic age (11,500–9000 RCYBP) from Los Grifos cave in Chiapas, and of late-Cenolithic age (9000–4500 RCYBP) from a number of sites (García-Bárcena 2001). Prehistoric sites with preceramic ages in the proximity of the Yucatan peninsula are also known from the Loltún cave in the state of Yucatan and Santa Marta cave in Chiapas, as well as Los Tapiales in Guatemala and several sites in eastern Belize (MacNeish et al. 1980). At Loltún, fossil bones of American horse (*Equus conversidens*) and extinct bison *(Bison antiquus)* were recovered from layers that also contain lithic tools (Álvarez and Polaco 1982). At San Martha, ancient hearths were identified and dated to 9280 and 9330 RCYBP (García-Bárcena 1976). Organic matter from Los Grifos also yielded ^{14}C ages of 8930 to 9300 RCYBP (García-Bárcena 1978, 1980). Los Tapiales, located in Quiché valley in the Tierras Altas of western Guatemala, was interpreted to be a campsite for hunters. The base of a fluted point from this site was indirectly ^{14}C-dated to 10,700 RCYBP (Brown 1980; Gruhn et al. 1977; Stross et al. 1977). Along the coast of Belize, MacNeish et al. (1980) located several sites with ages between 11,000 and 4000 RCYBP. None of these sites, however, contained human bone material.

Prehistoric Evidence from Yucatan

Until recent years it was believed that the first humans to reach Yucatan were the Mayas. Older archaeological evidence was not known to exist. It was thought that Pleistocene fossils or human bones from preceramic periods could not have been preserved on the surface of the Yucatan peninsula because of dense jungle vegetation, high rate of precipitation, and humic acids from decomposing vegetation. Moreover, the thick limestone bedrock prevents the generation of soil and the flat surface topography is absent of depressions necessary for depositing sediment. The combination of these factors truly impedes the preservation of fossils.

The report of fossil bones found during diving activities, however, and the fact that the Yucatan peninsula forms the heartland of Mayan civilization caught the attention of the Instituto Nacional de Antropología y Historia (INAH), which in Mexico regulates all archaeological, paleoanthropological, and paleontological activities. In 2000, INAH initiated a project to explore the Yucatan cenotes and register important fossil and archaeological sites in the cave system ("Atlas Arqueológico Subacuático para el Registro, Estudio y Protección de los Cenotes en la Península de Yucatán"). So far, seven sites have been identified in the area containing prehistoric evidence associated with early human settlement; four additional sites contain only Pleistocene fossils. The material collected for the prehistoric part of the "Atlas" includes fossil animal bones of late-Pleistocene to early-Holocene age, lithic tools, sediment samples, and charcoal, as well as three nearly complete human skeletons of preceramic age. The human remains are the oldest known from southern Mexico and Central America, and could even be among the oldest known from the American continent. They are thus of special importance in evaluating the age of arrival and migration routes of the first Americans.

All fossil, archaeological, and paleoanthropological remains are housed in the collections of INAH, Mexico City. The three human skeletons were brought to the Área de Prehistoria y Evolución Humana en el Instituto de Investigaciones Antropológicas of the Universidad Autónoma de México (UNAM), Mexico City.

Methods

Despite advances in technology, cave diving remains dangerous. Divers easily lose their orientation in the dark or by stirred-up sediment, or get stuck in narrow openings or between speleothems. Consequently, underwater archaeology in submerged caves is a difficult and logistically complex task that requires many safety measures. A dive partner who can provide assistance in a difficult situation is obligatory, as are redundant tanks, masks, and air provision. The dive is discussed in detail before commencing. When exploring underwater, strings called base lines are unrolled that indicate the direction and distance towards the next exit. The time researchers remain on site is extremely restricted and varies greatly according to the distance from the cave entrance and depth of the immersion. In deep sites (water depth > 25 m), most of the time is used for decompression on the way up, which reduces the amount of time at the archaeological site to just a few minutes.

For the present project, methodologies were implemented that allowed us to improve the effectiveness of dives and increase the amount of time on location. Evidence was first registered and documented using base lines for three-dimensional mapping of the caves. To minimize the stirring-up of sediment and resulting low visibility, bones covered by fine-grained sediment were excavated and registered at the end of a dive. Evidence was collected sequentially during separate dives. For documentation, underwater digital cameras, video cameras, and 35-mm photography were used (Figure 6). These technologies considerably improved our scientific output, since evidence could be analyzed on television screens immediately on completing a dive. This procedure partly compensated for the limited amount of time on site and the limited number of researchers that could enter the narrow caves. For collecting we used water-filled boxes that were closed immediately after taking a sample. This procedure assured that the geochemical composition of the water remained unchanged. For example, samples of archaeological materials taken from salt water may decompose on contact with fresh water. Upon arrival at the laboratory, samples were hardened and stabilized using a mixture of formaldehyde and distilled water.

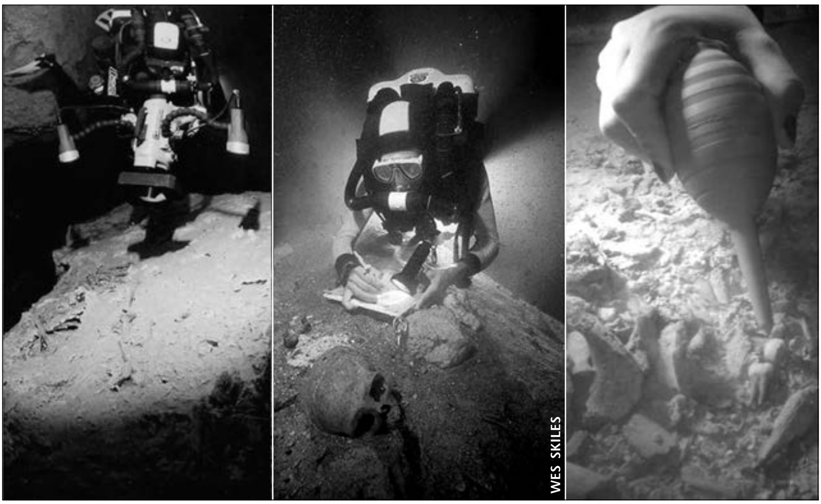

Figure 6. Methodologies for interpreting archaeological context (film, drawings, and excavation).

Results

During our ongoing research, prehistoric sites containing human evidence (skeletons, hearths, rare artifacts) and associated early-Holocene and Pleistocene faunal elements were identified mainly in submerged caves in the Mexican state of Quintana Roo. This concentration, however, may be a consequence of a higher concentration of cenote diving activities and casual discoveries by amateurs around the tourist centers in this region (e.g., Cancun, Playa del Carmen, Cozumel, Tulum). So far, our explorations have been concentrated on sites from which evidence was reported to us (Figure 7).

Aktun Ha

The Aktun Ha cenote is located 8 km west of the intersection that connects Tulum and Coba. The Aktun Ha cave system was formed in limestone bedrock of Miocene age. It is approximately 60 m long in a north-south direction and up to 15 m wide. Two entrances exist, located on the longitudinal ends of the cenote.

The entrance at the Aktun Ha cenote opens into an underwater chamber locally known as the "Chamber of Ancestors," whose entrance is approxi-

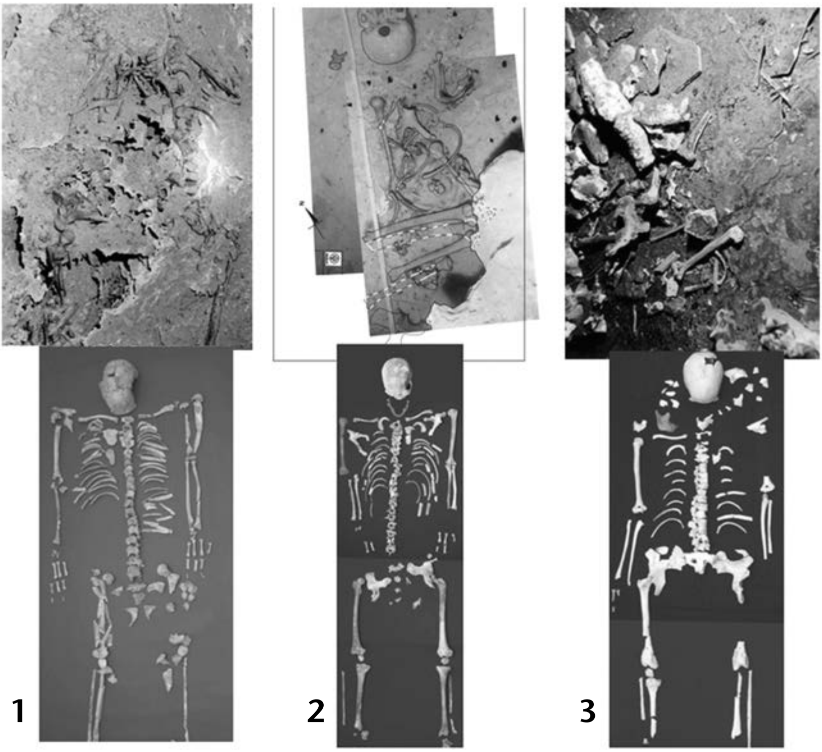

Figure 7. Preceramic skeletons: **1,** El Templo; **2,** Las Palmas; **3,** Naharon. These are from the oldest and most complete collection for southeast Mexico and among the oldest for the American continent.

mately 130 m from the entrance of the cenote, on the right side of a large decorated room. Access is through a small hole covered by heavy decoration (e.g., stalagmites). A small tunnel about 4 m long within the halocline is passable by only one diver at a time. The chamber is 70 m long, up to 30 m wide and 10 m high, with the lowest cave levels reached at a depth of approximately 27 m.

Charcoal concentrations were identified in various places within this chamber. The most interesting feature within this chamber is a small cavity, located about 60 cm above the cave floor, in a tear-shaped limestone rock approximately 2 m high located near the center of the cave (Figure 8). The cavity is approximately 40 cm wide, 40 cm high, and 35 cm deep. Charcoal composition in this niche varied from ash size to pieces up to 10 cm in diameter. In addition, partially burnt wood remains are present. The situation clearly suggests that this charcoal concentration is intentional, the residue from a human hearth. It appears unlikely to us that partially burnt wood and coals could have floated in from the outside and then concentrated in a specific niche, 60 cm above the surface of the cave floor, in a single chamber of the cave system (Figure 9).

Four charcoal samples were collected and dated: Beta-1666199 and UGA-

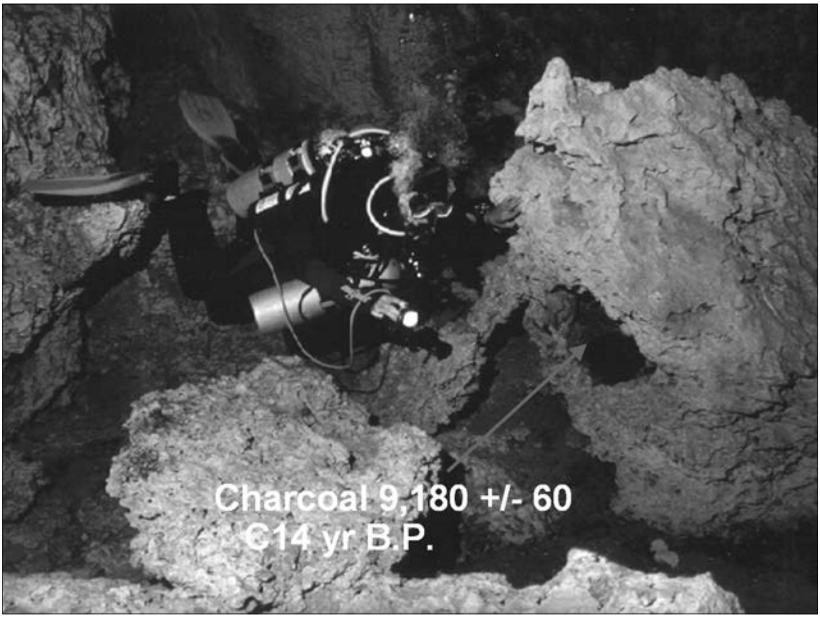

Figure 8. "Chamber of Ancestors" at Aktun Ha, showing a niche in which charcoal was found, indicating the presence of an ancient fireplace.

6637 by AMS ^{14}C, and INAH-2009 and INAH-2011 conventionally. Resulting ages are 9180 ± 60 (Beta-1666199), 9318 ± 37 (INAH-2009), 9139 ± 23 (INAH-2011), and 9524 ± 84 (UGA-6637) RCYBP. They clearly show that the hearth dates to the earliest Holocene.

Associated with the hearth in this "Chamber of Ancestors" at Aktun Ha were possible lithic tools (González et al. 2001, 2002, 2003a).

La Chimenea

The La Chimenea site, which forms part of the Taj Mahal cenote and cave system, is located 26.5 km south of Playa del Carmen, 19 km north of Tulúm, and west of Xpuha in the state of Quintana Roo. Taj Mahal is a well-advertised tourist site on federal road 307 that offers a variety of snorkel and cave diving facilities. The cave system is up to 27.7 m deep, but mostly near the 10 m level, and the halocline is at a depth of 11 m. Water temperatures are about 25°C for fresh water and 27°C for salt water. Access to the La Chimenea prehistoric site is from the Taj Mahal cenote via a complex system of tunnels and chambers, as well as a restriction of approximately 7 m. Base lines are placed, but two jumps are necessary. Swimming to the site, a distance of approximately 130 m, takes about 10 minutes.

At La Chimenea, charcoal is concentrated at a depth of 23 m. Associated with the charcoal we recovered molars, a large fragment of a mandible, vertebrae, and several large fractured bones of a camelid (*Hemiauchenia macrocephala)*. The fossil material is partly burnt, and several bones show cutmarks, parallel grooves

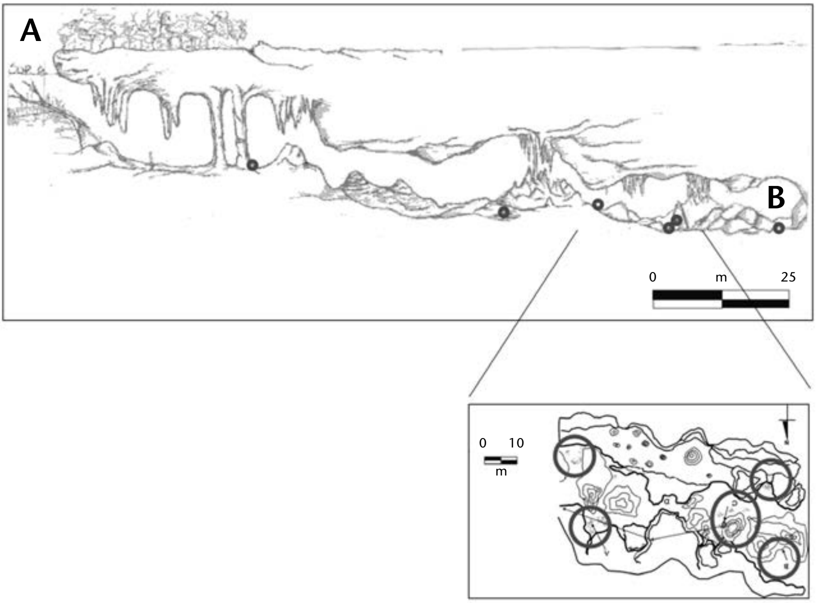

Figure 9. Aktun Ha cave and the location of the "Chamber of Ancestors," where charcoal from an ancient fireplace was found. **A,** cave opening; **B,** "Chamber of Ancestors." Drawing by Octavio del Rio.

3–4 cm long apparently made by a lithic instrument. Unfortunately, stabilizing this material has taken longer than expected, which to date has prevented verifying the issues. A fireplace was found containing charcoal and bones covered with a thin layer of white sediment. The situation is clear evidence for an ancient fireplace in which a camelid was cooked and consumed by humans. It is important to note that *Hemiauchenia macrocephala* is among the mammals considered to have disappeared near the end of the Pleistocene approximately 13,300–12,900 CALYBP (Fiedel and Haynes 2004) (Figure 5). The evidence suggests that humans were possibly present at La Chimenea before the extinction event, during at least the latest Pleistocene.

The Naranjal Cave System

This fully submerged cave system (more than 20 km explored at present) is located about 4.5 km southwest of the city of Tulum, extending for at least 3 km in a northwest-southeast direction north and south of the road connecting Tulum with Chetumal. Eight entrances to the system are known, among them the Naharon, Mayan Blue, and Las Palmas cenotes, which are used for cave diving by local diving schools. The system varies between 10 and 25 m deep, with the halocline at 12 to 16 m, and is well decorated with stalagmites and stalactites.

Naharon. Naharon cave, also called "Crystal Cave," lies 4.5 km southwest of Tulum, west of the Tulum-Felipe Carrillo road, approximately 128 km south of Cancún and 6 km from the coastal line. The Naharon cenote is a large sinkhole 30–45 m in diameter. The skeleton of a woman, covered by 3–5 cm of ine-grain lime mud, was found 368 m north of the cenote on the surface of he cave floor at a depth of 22.6 m.

The skeleton, more than 80 percent complete, is well preserved although ragmented (Figure 10). The female was 20–30 years old at time of death and tood approximately 140 cm tall, judging by the size of the left radius and right ıumerus. Her weight was calculated at 53 kg (Terrazas and Benavente 2006). Bones were dispersed over an area of 3 by 3 m; only a few articulated vertebrae emained in their anatomically correct positions. It appears that the archaeoogical context was altered by cave divers who disturbed some of the bones, ince water currents in the cave are not strong enough to move the bones, let ılone fine-grain sediment.

The remains of this individual were AMS ^{14}C dated to 11,670 ± 60 RCYBP UCR-4000/CAMS-87301), about 14,500 CALYBP. Analyses by other laboratoies, however, have not been able to confirm this date owing to the absence of ufficiently preserved organic material.

Las Palmas. A second skeleton was found in the Naharon system 369 m west of the Las Palmas cenote (also called "Jail House"), in the lowermost levels of ı large chamber at a depth of 22.6 m (Figure 11). It was covered by a layer of ine lime mud 1–6 cm thick. At a distance of 15 m from the skeleton we dentified a charcoal deposit covering an area of approximately 7m^2.

The Las Palmas skeleton is > 90 percent complete and in excellent condi-

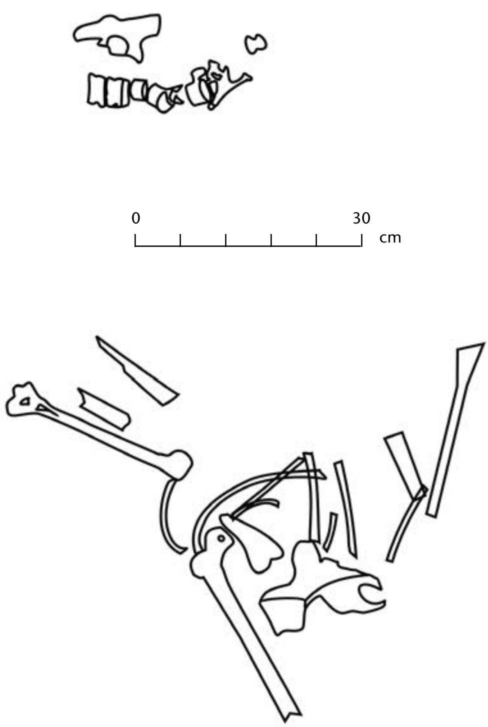

Figure 10. The Naharon skeleton.

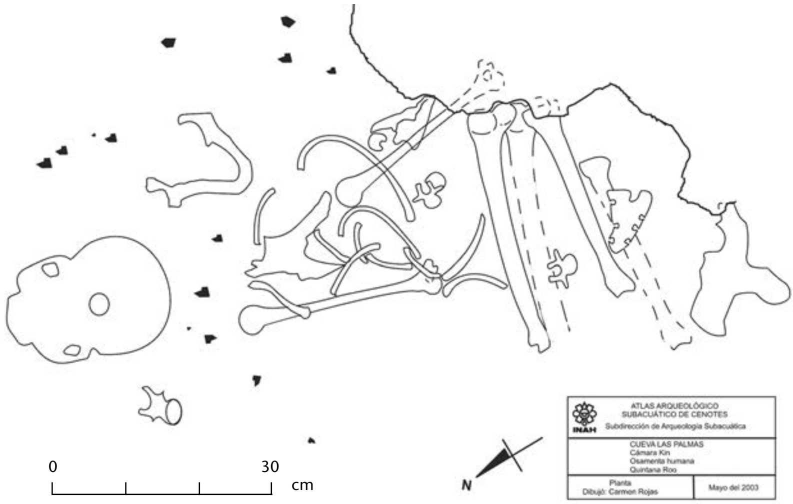

Figure 11. The Las Palmas skeleton.

tion. The bones have a light brown color, and the individual is mostly articulated, with only minor disintegration owing to the effects of gravity. The skeleton was found next to the cave wall in a lying position, bent to the left, with arms and legs angled and drawn towards the body (Figure 12). This situation strongly suggests that the original position of the body was upright and seated against the cave wall, possibly wrapped in a mortuary shroud

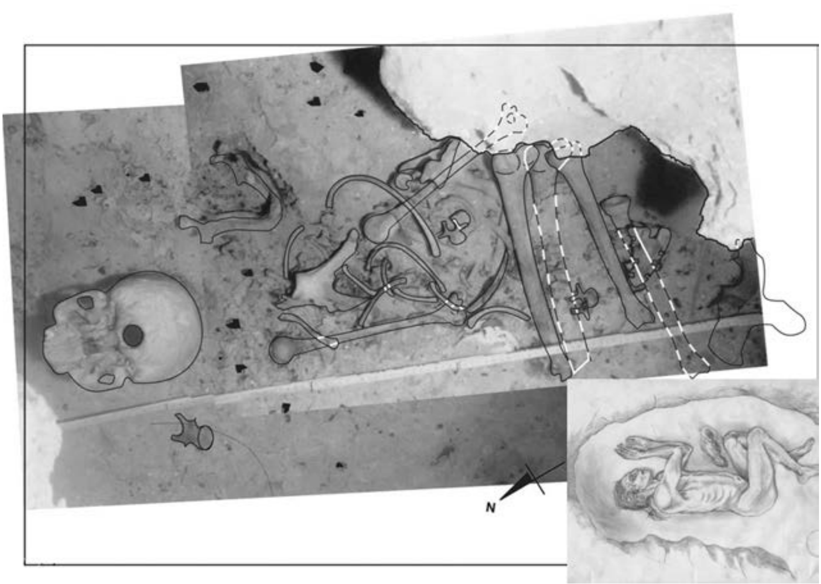

Figure 12. Adult female from Las Palmas cave. Note that the body was found in a flexed position bent to the left side. About 90 percent of the skeleton has been recovered.

(sack). This interpretation indicates an intentional funerary deposit because in a natural death in place, "rigor mortem" would have caused stretching of the corpse, contrary to the flexed position encountered here. Morphometric measurements by Terrazas and Benavente (2006) suggest the Las Palmas skeleton is that of a female 152 cm tall and weighing 58 kg, who was between 44 and 50 years at time of death.

Initial radiometric ages were obtained using both AMS ^{14}C and Uranium-Thorium (U/Th) techniques. Direct AMS dating of the bone (UGA-6828) yielded an age of 8050 ± 130 RCYBP (about 8587–9305 CALYBP). U/Th dating of the bone at Oxford University yielded an age of 10,000–12,000 CALYBP (A. Pike, pers. comm. 2004).

At a distance of 15 m from the skeleton and separated by a natural wall, there is a dense concentration of charcoal and the cave-floor sediment changes to a dark color. The charcoal stain strongly indicates the presence of an ancient hearth and thus suggests human occupation of the cave. Two charcoal samples conventionally ^{14}C-dated at the INAH laboratory in Mexico City yielded ages of 8941 ± 39 (INAH-2123) and 7740 ± 39 RCYBP (INAH-2119). Calibration using Calib Rev 5.1 yields 2-sigma intervals of 9916 –10,205 CALYBP and 8432–8590 CALYBP, respectively.

We recovered the remains of a small fox, *Urocyon cinereoargenteus*, 17 m from the human skeleton. No artifacts have been found in association with the Las Palmas human skeleton.

El Templo

A third skeleton was discovered in El Templo cave, located 18 km north of Tulum and 1.5 km south of Chemuyil. Access to this site is through a low cavern with a floor covered by a few centimeters of water. This "cat walk" cavern leads to the entrance of a submerged wide cave, from there into a tunnel 2 m high and 2.5 m wide. Navigation is made relatively simple by a white-knotted base line that initiates at the roof of the cave entrance. No jumps are needed. The maximum depth reached during submersion is 17 m, mean depth is around 14 m, and the halocline is at a depth of 11 m. Water temperatures are around 25°C in fresh water and 27°C in salt water. Distance from the entrance to the prehistoric site is approximately 185 m.

The El Templo skeleton (Figure 13) was found 185.5 m from the cenote entrance at a depth of 23.5 m. Registering and collecting this individual took us more than 20 submersions over a period of nine months. Difficulties resulted from a peculiar aggressive dissolution of the limestone underlying the bones, producing a soft vesicular surface resembling swiss cheese. Not only were most of the bones fragile and fragmented, they were spread out at the edge of a natural step about 1 m deep. The El Templo individual is a male 25 to 30 years old at time of death (Terrazas and Benavente 2006) (Figure 9). The skeleton was mostly articulated and in an extended position. Remains, however, are poorly preserved as a result of saltwater erosion. Bones are very light, fragmented in situ, and superficially dissolved, with almost the entire organic material lost. Although approximately 70 percent of the skeleton was recovered, the poor preservation prevents ^{14}C dating.

Figure 13. The El Templo skeleton.

Sites with Paleontological Evidence Unrelated to Human Activity

Literature on the Pleistocene faunal assemblage of the Yucatan peninsula is scarce. The few existing reports come from dry caves and cenotes. Mercer (1975), Hatt et al. (1953) and Ray (1957) report on discoveries of *Equus conversidens* and the giant sloth, *Paramylodon* sp. Alvarez (1983), in an unpublished INAH report, mentions the presence of fossil marsupials, insectivores, lagomorphs, carnivores, and perissodactyls, among them abundant *Equus conversidens* from Loltún cave in the state of Yucatán. Polaco (1998) described the first proboscidian gomphothere from this locality.

As we know now, the submerged cenotes and caves of Quintana Roo and the state of Yucatan are rich in fossil remains of late-Pleistocene age, although it remains difficult to establish a direct correlation between them and human occupations. For example, at Nai Tucha, a cenote of the Tuhx Cubaxa system located 19 km north of Tulum in the municipality of Solidaridad, Quintana Roo, we located the articulated remains of a proboscidean (*Gomphotherium* sp.) and a tapir *(Tapirus bairdii)*. Interestingly, the gomphothere bones are partially covered by a stalagmite. At Taj Mahal, we identified remains of the American horse (*Equus conversidens*). At Papakal, in the state of Yucatan, the fossil assemblage includes camelid (*Hemiauchenia* sp.), giant armadillo (*Glyptotherium* cf. *G. floridanum*), American horse (*Equus conversidens*), and rabbit (*Sylvilagus* sp.) (Polaco et al. 2002).

Discussion: Arrival of Humans on the Yucatan Peninsula

When was Yucatan settled? Prior to this research the oldest artifacts and human remains known from the region belonged to Mayan or pre-Mayan civilizations and were assigned ages of between 2000 and 3500 RCYBP. Nevertheless, a much earlier settlement during the so-called "first migration," about 11,000 RCYBP, was theoretically thought possible (Hammond 1982). Now we know that evidence for this hypothesis is preserved in the submerged caves of Quintana Roo. With the new results at hand, it becomes clear that humans did arrive in Yucatan early, during the late Pleistocene or earliest Holocene. There are several lines of evidence for this interpretation, as reviewed below.

Decoration of the Subterraneous Chambers. The submerged caves and cenotes of Quintana Roo are fully decorated by stalactites and stalagmites from near surface levels down to at least 40 m. The presence of these kinds of speleothems clearly indicates that caves must have been dry for many thousands of years. From the geological situation it is clear that the cave system formed during periods of low sea level, i.e., during glacial periods of the Pleistocene. The system was subsequently drowned during the early Holocene between 13,000 and 7600 RCYBP, as sea level rose with melting of ice caps in the Northern Hemisphere. The presence of gomphothere bones with stalagmitic overgrowth (e.g., at Nai Tucha) clearly suggests that these fossils date from the dry phase of the case, with a minimum age of 7600 RCYBP (about 8200 CALYBP).

The Paleontological Assemblage. A late-Pleistocene age is clearly indicated for the assemblage of fossil mammals found in the cave system of Quintana Roo and Yucatan. We identified American horse (*Equus conversidens*), camelids (*Hemiauchenia* sp.), giant armadillo (*Glyptotherium* cf. *G. floridanum*), tapir (*Tapirus bairdii*), and proboscidians (*Gomphoterium* sp.). Some of these remains have been dated radiometrically using U-Th isotopes (A. Pike, Oxford, pers. comm.). For instance, *Tapirus bairdii* and *Gomphotherium* sp., both collected at Nai Tucha, were dated by U-Th to approximately 40,000 CALYBP, and the camelid *Hemiauchenia* sp. from Papakal may even be as old as 150,000 CALYBP. These animals disappeared from the American continent 13,300-12,900 CALYBP (Fiedel and Haynes 2004) during a massive extinction event near the end of the Pleistocene.

Although a direct correlation with coeval human occupation of the caves is difficult to establish at present, indirect evidence exists. For instance, at La Chimenea cenote charcoal is concentrated at a depth of 23 m, suggesting an ancient hearth. The charcoal is associated with molars and bones of the camelid *Hemiauchenia macrocephala*. According to our initial research, the fossil bones are partially burned, and some of these bones show possible cutmarks, indicating that the animal may have been cooked and consumed by humans. Thus in the Yucatan cenotes a possible correlation exists between the presence of humans and *Hemiauchenia macrocephala*, a species that disappeared at the end of the Pleistocene.

The assemblage of fossil mammals identified during our research also suggests that the surface of Yucatan was considerably dryer during the late Pleistocene. Horses (*Equus conversidens*), camelids (*Hemiauchenia* sp.), giant armadillos (*Glyptotherium* cf. *G. floridanum*), and proboscideans (*Gomphoterium* sp.), all widely known from coeval strata of the American continent, are regularly associated with open grassland or shrub vegetation, clearly unlike the low jungle of today (Alvarez 1983) (Figure 14).

Taphonomy. The human skeletons of El Templo, Las Palmas, and Naharon are found at depths of 20–30 m of the cave system, levels that were flooded during early stages of the Holocene sea-level rise, and at distances of 160 m to almost 400 m from the nearest entrance. Could bodies have floated to their present locations during the transgression or later? To us, this scenario is unlikely. It

Figure 14. Underwater collection of a proboscidean at Nai Tucha, likely a gomphothere. Late-Pleistocene faunal evidence from Nai Tucha has not yet been related to human activity.

would mean that individuals, after floating for several hundred meters through a cave system of tunnels and open galleries decorated with speleothems, were subsequently deposited almost intact, without major disintegration of bones. At least the Las Palmas and the El Templo skeletons are almost fully articulated, even with the anatomical connections of hand carpals and foot tarsals in their corresponding positions. These structures are the first to disintegrate and fall off a body floating in water for a long period of time (Haglund 1993). Their remarkable state of preservation clearly indicates an in situ skeletization of the bodies that could only have occurred in a dry cave. Although amateur cave divers appear to have altered the position of some bones of the Naharon skeleton and removed some of them, making it difficult to interpret anatomical positions, the otherwise remarkable condition of the Naharon skeleton begs a similar interpretation as for the Las Palmas and the El Templo skeletons.

Some cenotes in Quintana Roo and Yucatan also contain abundant Mayan skeletons; however, these were deposited differently. These later individuals were thrown into the water, where they floated for some time and finally sank to the ground and became deposited. These bodies are always disintegrated, and cranial, foot, and finger bones are usually dispersed over a large area (González González et al. 2006).

The flexed position of the Las Palmas woman even suggests an intentional situation, likely a funeral, in which the corpse was likely wrapped in a sack. This is suggested by the angled position of the legs and arms, which were drawn to the body, and the originally upward position. A funeral would clearly require a place which was dry at the time when the bodies were placed. In the deep parts of the Yucatan cave system (below 20 m depth) these conditions only existed during the late Pleistocene and initial stages of the early-Holocene sea-level transgression.

Radiometric Ages. The human skeletons of Las Palmas and Naharon have been dated by AMS ^{14}C techniques by laboratories of the University of California at Riverside, University of Georgia at Atlanta, Beta Analytic, and Instituto Nacional de Antropología e Historia. U/Th analyses were completed at University of Liverpool and Oxford University. The U/Th analyses were presented in the 2nd International Symposium "El Hombre temprano en América" in Mexico City, September 6–10, 2004. Results are compiled in Table 1. These preliminary ages, ranging from 7740 ± 39 to 11,670 ± 60 RCYBP,

Table 1. Radiocarbon ages obtained by analyses of samples from submerged caves on the Yucatan península. Ages were calibrated based on data presented by Bronk Ramsey (1995, 2001). Laboratories: University of California at Riverside (UCR) University of Georgia (UGA), Instituto Nacional de Antropología e Historia, Mexico City (INAH), and Beta Analytic, Florida (Beta).

Cave	Sample	Material	Radiocarbon age (RCYBP)	Calibrated age (CALYBP) 1 sigma	2 sigma
Naharon	UCR-4000	Human bone	11,670 ± 60	13,610–13,430	13,700–13,370
Las Palmas	UGA-6828	Human bone	8050 ± 130	9130–8710	9400–8550
	INAH-2123	Charcoal	8941 ± 39	10,200–9940	10,210–9910
	INAH-2119	Charcoal	7740 ± 39	8560–8450	8600–8430
Aktun Ha	Beta-1666199	Charcoal	9180 ± 60	10,410–10,250	10,500–10,230
	INAH-2009	Charcoal	9318 ± 37	10,580–10,440	10,660–10,400
	INAH-2011	Charcoal	9139 ± 23	10,285–10,235	10,390–10,230
	UGA-6637	Charcoal	9524 ± 84	11,080–10,690	11,150–10,550

suggest an early settlement of Yucatan during the latest Pleistocene or earliest Holocene, placing the skeletons among the oldest from southeastern Mexico. Caution is required, however, in the case of the Naharon skeleton (11,670 RCYBP), as bone material used for this analysis almost entirely lacked collagenous organic tissue. This date may be too old.

The direct dates on human skeletons are supported by dates obtained from anthropogenic charcoal horizons at Aktun Ha and Las Palmas (Table 1). Charcoal at Aktun Ha was discovered approximately 60 cm above the ground surface of the cave in a small niche of an isolated rock. This concentration is clearly anthropogenic in origin. Ages of 9139 ± 23, 9180 ± 60, 9524 ± 84, and 9318 ± 37 RCYBP for the Aktun Ha charcoal and 8941 ± 39 and 7740 ± 39 RCYBP for Las Palmas are well established owing to the great amount of preserved organic matter. These ages, comparable to those obtained from the human skeletons, also indicate that human colonization of Yucatan dates to at least the earliest Holocene.

Cranial Morphology. According to preliminary morphometric analyses (Terrazas and Benavente 2006), cranial morphologies of the three Yucatan skeletons (especially Las Palmas) differ considerably from those of pre- and post-Hispanic Mayas, and from typical prehistoric Native American material known from the U.S. and Mexico. Craniomorphometry rather resembles older (late-Pleistocene/early-Holocene) Paleoamerican skulls from North and South America. Interestingly, the greatest similarities are with individuals recovered from Tc50-5 from Tehuacan Valley in central Mexico, (Anderson 1967) and Upper Cave 3 (China), two generalized skulls considered "premongoloids" (for Upper Cave 3 see Cunningham and Jantz, 2003).

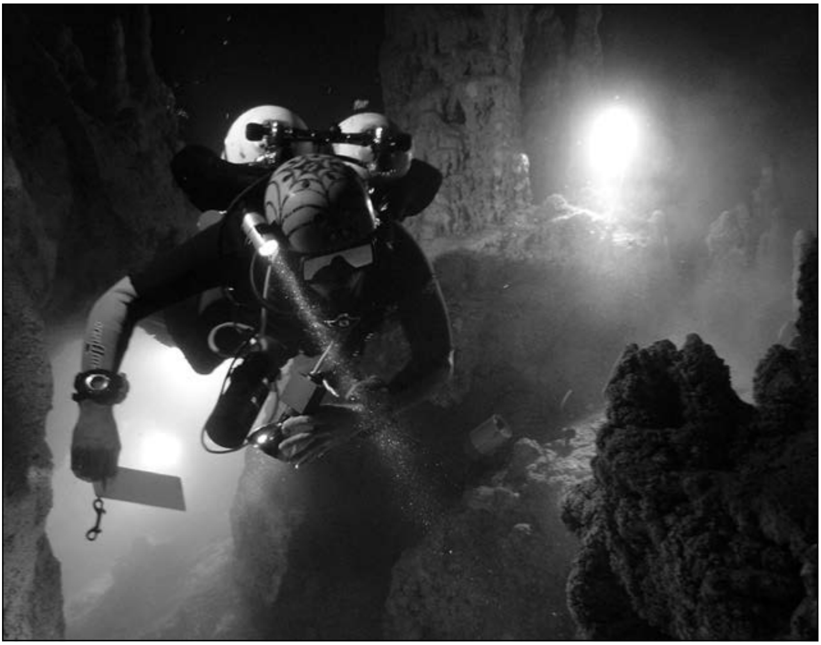

Figure 15. The findings in these caves only show a small part of their real potential. Unfortunately, because of tourist developments, a lot of these sites are being destroyed.

Conclusions

Submerged caves near Tulum in the state of Quintana Roo, southeastern Mexico, are rich in fossil and prehistoric evidence, shedding light on the early settlement of the Yucatan peninsula (Figure 15). Within seven years of our ongoing research, we discovered an abundant and diverse fossil assemblage previously unknown from the region. The association, dating to the late Pleistocene, consists of American horse (*Equus conversidens),* camelids (*Hemiauchenia* sp.), giant armadillo (*Glyptotherium* cf. *G. floridanum*), tapir (*Tapirus bairdii),* and proboscideans (*Gomphoterium* sp.) among others. These mammals became abruptly extinct in other parts of the North American continent in a short period of time, between 13,300 and 12,900 CALYBP (Fiedel and Haynes 2004).

In some cases, a direct correlation was established between the presence of these animals and human occupation of the cave system. At La Chimenea, for example, fossil bones of the camelid *Hemiauchenia macrocephala* are partially burned as a result of cooking in an ancient hearth.

A late-Pleistocene to early-Holocene settlement of Yucatan is also indicated by the presence of other charcoal concentrations interpreted by us as human-produced hearths. At Las Palmas ages range from ca. 9000 to 7700 RCYBP, and at Aktun Ha they date to ca. 9200–9100 RCYBP. Associated with the hearth from Aktun Ha are four possible lithic tools.

Our most important discoveries are three human skeletons, which are almost complete (more than 80 percent of bones recovered) and mostly articulated. The taphonomic circumstances suggest that at least two skeletons, Las Palmas and El Templo, were intentionally interred when the caves were dry. We propose that these skeletons also date to the latest Pleistocene or early Holocene. This interpretation is based on three lines of evidence: (1) radiometric ages, (2) cranial morphology, and (3) taphonomy. The Naharon individual, a female aged 20–30 years, was AMS ^{14}C-dated to ca. 11,670 RCYBP; the Las Palmas individual, a female aged 44–50 years, was AMS ^{14}C-dated to ca. 8100 RCYBP and U/Th dated to 10,000–12,000 CALYBP. The ^{14}C age for Naharon needs to be considered with caution, however, given the poor preservation of the remains. Cranial morphology indicates similarities with other late-Pleistocene/early-Holocene Paleoamerican skulls from central Mexico and South America, and differences with morphologies of pre- and post-Hispanic Mayas and other prehistoric Native American crania. The possible ritual associated with the El Templo and Las Palmas individuals and in situ skeletization of all three bodies must have occurred when the caves were dry, before the early-Holocene sea-level transgression. Present-day levels were reached at about 7600 RCYBP, but the three skeletons were found in deeper levels of the cave system, at depths of between 20 and 30 m. Drowning of these levels of the karstic system must have occurred hundreds or even thousands of years earlier.

Identification and registration of submerged prehistoric caves in Quintana Roo and Yucatan was only possible due to the great support of cave divers of the region. Without their collaboration and dedicated participation in our work, this research would not have been possible. We are especially grateful to James Cook, William Phillips, Robert Schmittner, Roberto Hashimoto, Luis. F. Martínez, Sebastian Genijovich, Flor de Maria Curiel, Marco Rotzinger, Germán Yañez, Octavio del Río, Andreas Mattens, Scott Carnahan, Sergio Granuchi, Karin Boucher, Fernando Rosado, Enrique Soberánes, and Raul González, as well as to our cave diving friends and collaborators from the beginning, Samuel Meachan, and Roberto Chavez. In a multidisciplinary project, the participation and support of academic collaborators from different areas is highly important. We thank Pilar Luna, Luis Alberto Martos, Donald Keith, Larry Murphy, Solveig Turpin, Herb Elling, Adriana Velásquez M, Santiago Analco (†), Guillermo Acosta, Joaquín García-Bárcena, Joaquín Arroyo, Oscar Polaco, Paul Blanchon. Luis Marín, Elva Escobar, Magdalena de los Ríos, Erv Taylor, Alistair Pike, Thomas Highman, Silvia González, José C. Jiménez, Mónica López Portillo, Carlos Serrano, Jorge Juárez, Fernando Sánchez, Sergio Grosejan, Felipe Bate, Ximena Chávez, Fidencio Rojas, Aldo Castro, Rodrigo González, Liliana Pulido, Marianela Fuentes, Susana Xelhuatzin, Paolo Testelli, Froylan

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Archaeology: Latin America

A Preliminary Review of the Canid Remains from Junius Bird's Excavations at Fell's and Pali Aike Caves, Magallanes, Chile

Thomas Amorosi and Francisco Juan Prevosti

This preliminary note presents our review of the canid materials Junius Bird excavated from Fell's and Pali Aike caves in 1936–37 and his subsequent work at Fell's Cave in 1969–70 (Bird 1988). These materials are currently curated at the Division of Anthropology at the American Museum of Natural History (AMNH) under catalog entries 41.1/1993–1994 for Fell's Cave and 41.1/1891–1892 for Pali Aike. These remains along with Bird's other excavations at Cañadon Leona, Cerro Sota and the Navarino Island environmental samples (zooarchaeological, human remains, and soil samples) are currently being analyzed (Amorosi 2006; Amorosi n.d.; Amorosi et al. 2007; Prevosti and Amorosi n.d.; Wisner 2008).

Fell's and Pali Aike caves are a set of late-Pleistocene/early-Holocene rockshelters from southernmost continental Patagonia (Magallanes, Chile). They contain a large sample of canids. Some of these materials were studied by Clutton-Brock in 1978 and subsequently published in Bird (1988). Clutton-Brock identified the remains of gray fox (*Dusicyon griseus*), culpeo fox (*D. culpaeus*) and dogs (*Canis familiaris*). If the *C. familiaris* determination is reliable, this would be one of the oldest records of dogs in the Americas (Raisor 2005; Synder and Moore 2006). Other researchers, however, have questioned this assignment and suggest that these canids should be assigned to the extinct large fox (*Dusicyon avus*) (Caviglia 1978, 1986). Caviglia notes similarities between some of the canid remains from Fell's Cave and known examples of *D. avus,* specifically the absence of a cusp (entoconulid) between the metaconid and the entoconid of the m1. It must be noted that the presence of an entoconid in *Canis* m1 is not constant. Caviglia's work only included the data of Clutton-Brock's (1978) report and some of the canid remains deposited in Punta Arenas (Chile). He did not examine specimens curated at the AMNH and originally studied by Clutton-Brock. Thus it is

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necessary to review the specimens assigned by Clutton-Brock to investigate Caviglia's interpretation further.

Our review confirms the presence of *D. griseus*, *D. culpaeus,* and *D. avus*. Specimens of *D. avus* m1 can be generally characterized as larger than *D. culpaeus* m1. The m1 of *D. avus* has a large hypoconulid, the premolars have acute principal cusps, and p4 normally has a secondary distal accessory cusp and a high, acute distal cingulum (Figure 1). The specimens assigned to *C. familiaris* by Clutton-Brock agree with this description and differ from *C. familiaris* in the presence of more acute and weak cusps, the shape of the premolars, and a weaker horizontal mandibular ramus.

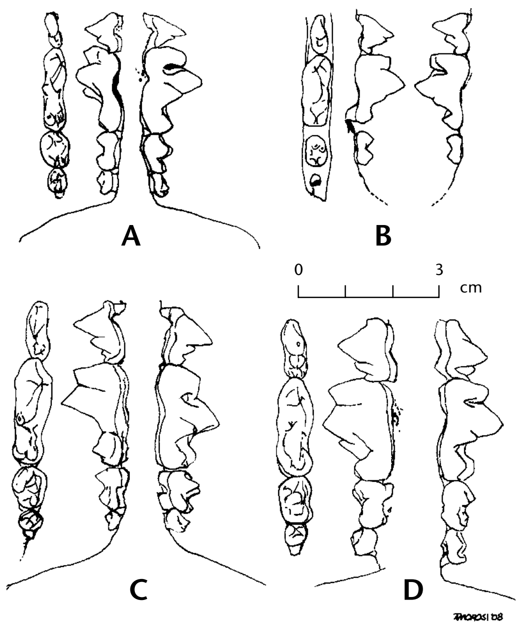

Figure 1. A comparison of the lower right premolar 4 and molars. **A,** *Dusicyon griseus*; **B,** *D. culpaeus*; **C,** *D. avus*; **D,** *Canis familiaris*. *Dusicyon griseus* from Pali Aike, Bird Field Designation P21, Level III, 54–60″, Area C, AMNH 41.1/1891–1892. *D. Culpaeus* from Fell's Cave, Bird Field Designation 20437, layer II, AMNH 41.1/1994. *D. avus* from Pali Aike, Bird Field Designation P14-4, Level III, 42–48″, Area D, AMNH 41.1/1891–1892. *Canis familiaris* from Amorosi reference collection, 3-40. (Modern specimen and the illustration were prepared by Thomas Amorosi.)

Our study concludes that there is no evidence for domestic dog at Fell's or Pali Aike caves. The AMNH collections coupled with the study of the variation in modern foxes will allow a careful revision of aspects of *D. avus* and the other foxes, including intraspecific variation in stratigraphic distribution, by means of determining diet through ecomorphologica, stable isotopic analysis, and probable aDNA analyses.

We would like to thank the following at the Division of Anthropology, AMNH, for their kind help: Samantha Aldersen, Sumru Aricanli, Paul Beelitz, Karl Knauer, Judith Levinson, Kristen Mable, Chuck Spencer, and Ian Tattersall. At CONICET, Buenos Aires, we thank G. Lorena L'Heureux. Finally, thanks to Jennifer Hersh for looking over the final editorial changes.

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First Notice of Open-Air Paleoamerican Sites at Lagoa Santa: Some Geomorphological and Paleoenvironmental Aspects, and Implications for Future Research

Astolfo G. M. Araujo and James K. Feathers

Lagoa Santa, a karstic region in central Brazil, is known for the discovery of more than 250 Paleoamerican human skeletons (Neves and Hubbe 2005), all from sheltered contexts. Despite study since the 1830s (Neves et al. 2007), no Paleoamerican sites have been found outside caves until very recently.

A surface survey complemented by 15-m-interval probes with a motorized auger was conducted recently along the shores of doline Lake Sumidouro, resulting in the discovery of three open-air lithic sites: Lund, Coqueirinho, and Sumidouro. The lithics, similar to those found in the rockshelters, represent a generalized core technology (Teltser 1991), lacking formalized tools and made

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almost entirely on hyaline quartz and quartzite with some chert. The Lund site returned late-Holocene ^{14}C dates, but the other two sites appear to date to the Paleoamerican period. Only Sumidouro is discussed here.

The site, found by augering, is located near the lake shore on the lower portion of a 380-m 14-percent slope. Soils consist of a reddish micro-aggregated horizon overlying a yellowish prismatic horizon, a typical pattern in Lagoa Santa (Piló 1998). Lower stratigraphic layers contain gleyed and mottled horizons subject to the water level.

At least three discrete layers of archaeological materials are present. The upper occupation contains ceramics, lithics and burnt earth concentrated at a depth of 15–40 cm and with ^{14}C dates of 510 ± 40 (Beta-234512) and 340 ± 40 (Beta-234518) RCYBP. A middle occupation at a depth of 70–80 cm contains mainly lithics and is bracketed by ^{14}C dates of 2210 ± 40 (Beta-234510) and 1350 ± 40 (Beta-234517) RCYBP. The lower occupation, at a depth of 160–210 cm, consists only of lithics and is dated by ^{14}C on charcoal at 8310 ± 40 RCYBP. Some anomalously recent dates obtained from lower in the stratigraphy are suspected to result from contamination from the water table.

Tropical sites are often heavily bioturbated, although the discrete archaeological levels suggest vertical movement may not be severe. However, charcoal, being less dense and having a different geometry from lithics, may not behave the same way and may thus be more prone to movement. For this reason and because of the anomalous dates mentioned above, an alternative dating technique, luminescence dating, was employed on five sediment samples. We applied single-grain dating using optically stimulated luminescence (OSL) not only to cross-check the ^{14}C chronology but to provide evidence of any mixing (Jacobs and Roberts 2007).

Only equivalent dose (D_e), the numerator of the age equation, is determined on single grains, the dose rate being obtained from the bulk sample. Variation in D_e values among grains can be evaluated by over dispersion, a measure of variation beyond that accounted for by differential precision. Unmixed, single-aged samples generally have over-dispersion values of 10–20 percent, but the Sumidouro samples have values ranging from 30–60 percent (Table 1). We have ruled out microvariations in dose rate as a probable cause for such high values, and have concluded the variation represents different-aged grains, either because of insufficient sunlight exposure during colluvial deposition or because of post-depositional mixing. Table 1 shows ages computed (1) by assuming random post-depositional mixing so that the central tendency reflects the depositional age and (2) by assuming insufficient exposure so that the youngest grains represent the depositional age. The ages from the central tendency are in the correct stratigraphic order and agree with the ^{14}C results in the lower part of the profile. The minimum ages contain one stratigraphic inversion but agree with ^{14}C dates in the upper part. We are currently trying to sort out these processes, and it is possible both are involved, but the lowest lithic occupation appears to date to 9000–12,000 CALYBP.

The ^{14}C ages suggest a strong increase in soil-accretion rates after 5000 RCYBP, rising from 0.07 mm/year to 0.27 mm/year. We attribute this 400-percent increase to mid-Holocene drying, also responsible for human de-

Table 1. OSL dates for soil samples from the Sumidouro site.

Sample*	Depth (m)	Over-dispersion (%)	Age, central tendency (ka)	Age, minimum value (ka)
UW1388	1.96	33.7	12.5 ± 0.9	8.6 ± 0.9
UW1389	1.60	40.2	10.1 ± 0.7	4.8 ± 0.4
UW1390	1.37	39.0	9.9 ± 0.7	6.3 ± 0.6
UW1391	0.70	38.2	4.3 ± 0.3	2.7 ± 0.2
UW1392	0.27	64.2	1.9 ± 0.2	0.8 ± 0.1

*All samples processed at the University of Washington

population in central Brazil (Araujo et al. 2005). Reduced vegetation and heavy seasonal rains could increase erosion from slopes above the lake. This also suggests that open sites along lakes will be deeply buried and not likely to be found accidently because the artifacts are non-diagnostic. The lake shores are a good starting point for surveys, but we do not know if all karstic lakes were active during the Pleistocene.

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The Early Holocene in Central Brazil: New Dates from Open-Air Sites

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Early-Holocene occupations have been identified in different parts of central Brazil, mainly associated with rockshelters (Bueno 2007; Kipnis 2003; Prous and Fogaça 1999; Rodet 2006; Schmitz 1987; Vialou 2005). Recent research,

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however, conducted in the Lajeado region of north-central Brazil, has revealed the existence of open-air sites related to this same period of occupation (Bueno 2007; Bueno and de Blasis 2005; de Blasis and Robrhan-González 2003). Despite the proximity with the *Lajeado Sierra*, where many rockshelters with a great density of rock art are found (Berra 2003), until now these rockshelters offered few early archaeological samples and dates, with the exception of one site (Morales 2005).

The open-air sites from which we obtained new dates are located on the left side of the Tocantins River in a chain of sand dunes located 1 km from the river bank and about 400 m above sea level. These sites, the highest places in the area, have great views of the Tocantins River valley and its smaller tributaries. This chain of sand dunes, situated in front of the *Lajeado Sierra*, was formed by erosion and eolian deposition of the sandstone that makes up the mountains. The ^{14}C dates obtained from the sand-dune sites indicate a formation that is at least late-Pleistocene in age, but it could be even more ancient since geological test pits indicate the existence of an unconsolidated sand layer reaching 30 m in depth.

Until now five of ten known sites have been partially excavated: MT 1, MT 2, MR 2, LJ 18 and CA 5 (Table 1). With the exception of CA 5, 50 km distant from the others, these sites are close to one another, with distances varying from 400 m to 2 km. The size and composition of the sites are variable. MT 1 presents an area of approximately 150 by 100 m and has an archaeological layer reaching from 1.6 to 2.5 m in depth, while MR 2 has an area of 90 by 60 m and is 1.5 to 1.8 m deep.

Table 1. Radiocarbon dates for the open-air sand dune sites of the Lajeado region.

	Provenience	Age, RCYBP	Age, CALYBP	Sample no.
MT 1	N36E06 Level 18	9670 ± 60	11,190–10,750	Beta 190081
MT 1	T1B Level 17	9790 ± 70	11,270–11,120	Beta 148339
MT 1	N36E12 Level 24	9990 ± 60	11,670–11,230	Beta 168605
MT 1	N01E12 Level 17	10,530 ± 90	12,920–12,060	Beta 190080
MT 2	N60E63 Level 15	9890 ± 80	11,350–11,160	Beta 190082
MR 2	S4 Level 16	9940 ± 60	11,570–11,210	Beta 160599
LJ 18	S11 Level 7	10,300 ± 60	12,630–12,470	Beta 179198
CA5	S3 Level 13	8980 ± 70	10,240–9910	Beta 160594
CA5	S7 Level 15	9410 ± 60	10,750–10,500	Beta 179197
CA5	S7 Level 18	9850 ± 70	11,330–11,160	Beta 160595
CA5	S6 Level 15	10,050 ± 80	12,260–12,250	Beta 179196

All the dates obtained for those sites came from charcoal samples directly associated with the lithic remains and were collected in the unit during excavation. There is a clear correspondence between the amount of lithic and charcoal remains in the stratigraphy and the spatial distribution of those within the sites. In the levels where we found a concentration of lithic remains there were always plenty of charcoal deposits, and all the samples were dated by a standard radiometric process.

Table 1 shows these five sites within an occupation of 1,600 years, between 8900 and 10,500 RCYBP. These dates, if related to a wider context of Central

Brazil, indicate a characteristic pattern of this macro-region, marked by the existence of a discrete and well-defined occupation period. This period comprehends exactly the time between 10,500 and 9000 RCYBP. Dates before and after this period are extremely rare. There are just a few sites dated before 10,500 RCYBP, and from 9000 RCYBP most occupied regions present a regional process of abandonment characterized by the absence of remains, which can last for almost 3,000 or 4,000 years. In the Lajeado context, for example, after 8900 RCYBP we have a period of almost 3,000 years without any kind of archaeological record until its reappearance at 6000 RCYBP.

The lithic assemblage associated with these early occupations bears the same technological characteristics within the five sites dated, with variations in size, density and diversity. The predominant raw material is fine silicified sandstone, but there are also remains of chert and, in lesser amounts, quartz and quartzite. The fine silicified sandstone represents the most suitable lithic raw material in the region for flaking; although abundant, its source locations are somewhat restricted compared with those for quartz and quartzite, which are widely dispersed and available in the region. The main sources of this silicified sandstone are found between the sand dunes and the beaches along the Tocantins River. Blocks appear in a series of small quarries, close to which we have found cores and large cortical flakes. Artifacts made on the fine silicified sandstone are *façonnage*, retouching and resharpening flakes, mostly of unifacial artifacts, but also of bifacial ones (although none appear to represent projectile points). The most characteristic unifacial artifact is the *limace*. The lithic remains are a unique material record found at these sites. No faunal or botanical remains were preserved.

These characteristics contribute importantly to the discussion of lithic technological organization and mobility patterns; they also expand meager data on open-air sites during this period in central Brazil. These data amplify detailed discussions about similarities and differences among these distinct places and the diversified occupation processes for this macro-region during this period.

The scenario presented for this region is related to a wider discussion concerning the occupation process of South America, which involves issues such as the antiquity and regional diversification of this process. Continuing excavations of these sites and intensifying survey activities on the *Lajeado Sierra* will enable us to refine the data obtained, resulting in a more detailed characterization of the technological organization and mobility patterns related to this occupation period.

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Human Occupations in the Lake Calafquen Temperate Rain Forest (39°S), Chile, during the Pleistocene-Holocene Transition

Christian García P.

With the exception of the archaeological site of Monte Verde, dated to 12,500 RCYBP (Dillehay and Pino 1997), initial occupations in the south of Chile have not been recognized, a situation which has led to a chrono-cultural gap between these and mid-Holocene occupations in the Pacific coast zone (Navarro and Pino 1999) and central valley (Navarro and Pino 1984). Nevertheless, research carried out between 1999 and 2001 in the Lake Calafquen area (Valdivia Province, X Region) has changed this scenario through the discovery of numerous occupations in rockshelters in the northeastern area of the lake, contributing to the understanding of early hunter-gatherer settlement in the Andean zone of south Chile.

Particularly important are the findings at Marifilo-1 rockshelter (39° 30′ 48″ S), located in an environment dominated by temperate rain forest, active volcanoes, and great lakes. In this site, the research team revealed a long occupation sequence beginning in the late Pleistocene and ending ca. 500 RCYBP (Mera and García 2004).

From this sequence we highlight two occupations dated during the Pleistocene-Holocene transition and the early Holocene, which are part of the

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early cultural component of this site. The earliest one, dated 10,190 ± 120 RCYBP (Beta-164475), would have existed at the time of rapid expansion of the thermophilous component of the Valdivian rain forest (*Prumnopitis andina* and *Nothofagus dombeyi* type), under paleoenvironmental conditions of increasing temperature and decreasing precipitation (Heusser 1984), after a great eruption of the Mocho-Choshuenco volcanic system, evidenced by plinian pumice stone present in local stratigraphy. This first occupation is characterized by the presence of a small fireplace next to the wall of the rockshelter, with which are associated 15 unmodified basalt flakes (Jackson and García 2006), bones of *Pudu pudu* and *Pseudalopex griseus* with intentional fractures and combustion marks, burnt *Diplodon chilensis* valves, and plant remains. After this occupation, the rockshelter would have been sporadically visited by carnivores, possibly by *Felis concolor,* signified by the presence of coprolites and bones of *Pudu pudu* with digestive acid corrosion marks.

Separated from the former occupation both spatially and stratigraphically is the second occupation of the rockshelter, dated to 8420 ± 40 RCYBP (Beta-138919), a period in which paleoenvironmental conditions were warmer and dryer, and Gramineae predominated (Heusser 1984). The evidence includes 18 unmodified basalt flakes, an ovoid pebble stone with use marks on one surface suggesting milling activities or its use as a polishing tool (Jackson and García 2006), bone remains of *Pudu pudu* with combustion marks, a bone artifact of unknown use made on a fragment of a *Pudu pudu* femur (García 2006), and burnt *Diplodon chilensis* valves and plant remains associated with a hearth.

This occupational evidence of similar features reflects the exploitation of this lake and surroundings by hunter-gatherers who made use of natural shelters during their incursions in the area since the late Pleistocene. These occupations reveal the practice of expedient technology, as evidenced by lithic (Jackson and García 2006) and bone instruments (García 2006), a consequence of immediately available raw materials that required minimum energy to produce. Economic utility of vegetal species and freshwater molluscs from Lake Calafquen was also important, as were small mammals, probably captured with traps (Velásquez and Adán 2002). The absence of extinct mammal remains and formed flaked tools in Marifilo-1 reflects differences from the Monte Verde site and thereby expands our knowledge of the diversity of early human adaptations in the temperate rain forests of South America.

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New Analysis of Lithic Artifacts from the Ayacucho Complex, Peru

Elmo León Canales and Juan Yataco Capcha

Evidence of final-Pleistocene (i.e., Pre-Clovis) human presence in South America is scarce but still significant in the debate of the early peopling of the Americas (Dillehay 1999).

Some of the most crucial data on the earliest Central Andean occupation are those from the Ayacucho complex, Peru, despite criticisms about the incomplete and unintelligible form of the published final report of this material (e.g., Rick 1988:16). Further critiques address the lack of detailed definitions of individual lithic types and comparisons with other known types of the Andes (Dillehay 1985:196); suspicious ^{14}C dating of bone samples, some with problematic associations (Lynch 1974, 1990, 1981, 1983; Rick 1988:13); absence of evidence of fire (Rick 1988:14); and serious doubts about the credibility of supposed human-made lithic artifacts of the Pacaicasa complex (Bonavia 1991:89; Rick 1988:13). Certainly these deficiencies seem not to be the case for the overlying phase called Ayacucho. According to Rick (1988:16), Ayacucho-phase materials are in a different status because there are a significant number of lithics of exogenous raw material and the probability that they were found in situ, some even occurring in "concentrations" despite problems

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in the manner in which the material was presented. In fact, a taphonomic study could be a key contribution in this regard, but this exceeds the scope of this manuscript that addresses some lithic artifacts from this phase.

Dillehay (1988:199) himself asks for a detailed description of the lithic artifacts, which is not given in the original Pikimachay volumes (MacNeish et al. 1980, 1983). For this reason we are currently undertaking a thorough review of the stone tools from Pikimachay cave that are stored in the Museum of Archaeology, San Marcos University, Lima, applying the *chaîne opératoire* approach (e.g., Pelegrin 1995). Consequently we searched for and found a part of the collection of the Botanical Archaeological Project of Ayacucho in the Museum. We examined this collection and present some preliminary results here.

Pikimachay Cave is located halfway up the slope of a mountain at 2,850 m.a.s.l. in Ayacucho, central Peru (MacNeish 1979; MacNeish et al. 1980). The oldest component of this cave was defined as the Pacaicasa complex, which occurs in four zones, layers "k", "j", "i", and "i1". These layers yielded 96 megafauna bones, 73 lithic artifacts, and around 100 flakes (MacNeish et al. 1983:2). Four ^{14}C measurements on sloth bones have been used to date this material to approximately 25,000–15,000 RCYBP (Dillehay 1985:198). Nevertheless, the above-mentioned criticisms make it difficult to accept these oldest levels with confidence.[1]

Two further overlying layers, named "h1" and "h," were ascribed to the Ayacucho complex. For the first time, it appears that we are dealing with human-made lithic artifacts (cf. Rick 1988). These have been found in both layers. This phase is composed of 212 artifacts, more than 1,000 debitage pieces, and 517 animal bones (MacNeish et al. 1983:3,5). The occurrence of possibly thermo-fractured rocks suggests the presence of fire (Dillehay 1985:198). A ^{14}C sample of a *Scelidotherium* (ground sloth) bone obtained from zone "h" was dated to 14,150 ± 180 RCYBP (UCLA-1464), which corrected (ShCal04) gives the result of 17,221–16,560 CALYBP. Although this sample came from an unmodified bone, a coherent concentration of artifacts found gives it some credibility (cf. MacNeish 1979). In fact, the Ayacucho phase, associated with apparently valid stone and bone artifacts, has been accepted by many scholars as a credible pre-Clovis component (Dillehay 1985:199).

Bearing this opinion in mind, let us now review briefly the part of the Ayacucho collection that we found in the collection. Except for the bone point, all pieces come from zone "h" (i.e., the Ayacucho component). Probably the most interesting specimen is a bifacial stemmed point (Figure 1F [cf. MacNeish et al. 1980:49, Figure 2-1]) that was found associated with sloth vertebrae and other debris along the margin of a concentration of remains (catalog number Ac100 231-VIIdd). It was probably made of a flake of volcanic tuff. The outline was also probably achieved by employing a soft hammer with partial retouching. The final fracture seems to have been caused by a technical failure in finishing the piece rather than by use.

[1] Readers interested in an in-depth review of this issue should consult the original publication (MacNeish et al. 1979).

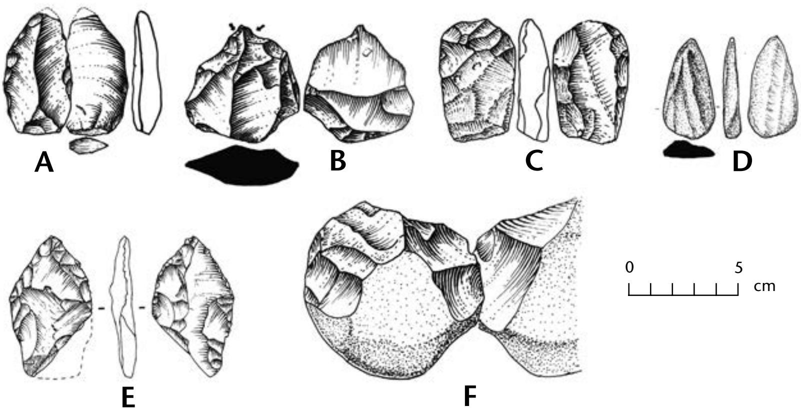

Figure 1. Lithic artifacts from the Ayacucho complex, central Peru, possibly dating to around 17,200–16,560 CALYBP.

Seven unifacial artifacts have also been located (cf. MacNeish et al. 1980:190-200). Among them there are four modified flakes, mostly of volcanic tuff. Furthermore, a modified flake could also be classified as a knife made of silicified sandstone (Figure 1A), despite its being considered a unifacial point by MacNeish et al. (1980:49, Figure 2-1) (catalogue number Ac100 274, 1a). The two negative removals on the superior face show that it was detached from a core delivering elongated flakes. The "retouch" could have been produced by use due to its irregular shape. Also a perforator has been recorded. After the organization of the dorsal negatives, it is likely that it was made of a bifacial reduction flake (Figure 1B) (cf. MacNeish 1979:Figure 23). This is a good example of *économie de debitage*. This piece seems to be made of flint by means of hard percussion.

The collection also contains a possible eroded small bifacial preform (Figure 1C) (without catalog number) made of metamorphic material (cf. MacNeish et al. 1980:195, Figure 5-4). The centripetal orientation of the removals partially shown on both faces indicates bifacial reduction. It was trimmed by hard percussion. This artifact may be a bifacial point preform.

Additionally, a polished bone point of ground sloth (Figure 1D) (cf. MacNeish 1979:Figure 23) and a chopping tool made of a volcanic raw material (Figure 1E) (cf. MacNeish 1979:Figure 22) have been identified. The bone point displays clear linear traces that seem to have originated during manufacture. A volcanic square-shaped core is also recorded.

The debitage is composed mostly of flakes of basalt, quartz, and volcanic raw materials (cf. MacNeish et al. 1980:190, 193, 198). In this case these specimens are marked "h" and "h1." The shapes and organization of the negatives suggest they are the result of activities related to reducing cores and bifacial thinning.

In sum, if we assume the validity of the ^{14}C date of the Ayacucho complex and its possible associations within the same strata, we would be able to perceive interesting (and even somewhat premature) traits among these terminal-Pleistocene Andean flintknappers: They produced intentional elongated flakes (blade-like flakes) and bifacial pieces of fine-grained rocks, and maximized use of raw material by salvaging debitage to make new artifacts. Despite the small collection of pieces examined, we advance some interesting finds when analyzing in detail further possible terminal-Pleistocene collections of the Central Andes.

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New Evidence of Human Occupation during the Pleistocene-Holocene Transition in Central Patagonia

César Méndez, Omar Reyes, Héctor Velásquez, Valentina Trejo, and Antonio Maldonado

Sites with terminal-Pleistocene/early-Holocene occupations are infrequent in central Patagonia. This rarity is particularly significant near the Andean mountain range, where, at this writing, no ^{14}C assays have yielded dates earlier than 9500 RCYBP (Mena et al. 2000; Velásquez and Mena 2006). Nonetheless, sporadic surface finds of diagnostic stone tool types, such as fishtail projectile point blanks and discoidal stones (Bate 1982; Jackson and Méndez 2007), indicated the presence of a probable "Fell I cultural unit" (Massone 2004) within the region of Aisén (Chile). Current archaeological research in the wider Patagonian region assigns dates of around 11,000–10,500 RCYBP as the most consistent temporal markers for the earliest human occupation (Borrero 1999).

Since 2005, our research team (FONDECYT 1050139) has carried out systematic archaeological surface and stratigraphic surveys in the steppe area of the Cisnes basin (~44° S; 71° 15′ W), east of the Andes along a Pacific drainage system. Surface finds of one discoidal stone and an endscraper (closely resembling those of the earliest Fell's Cave lithic assemblage [Bird 1993]) at the Appeleg 1 site (CIS 009) suggested a possible human presence during the Pleistocene-Holocene transition (Méndez et al. 2006). Complementary paleoenvironmental studies of sediment records at Lake Shaman, placed on an inter-moraine depression, indicated that local glacial withdrawal occurred around 15,580 ± 50 RCYBP (Beta-224300), thus leaving an open area available for early occupation. Excavations carried out at El Chueco, just 6 km from Lake Shaman, and 10 km from Appeleg 1, confirmed this hypothesis.

El Chueco is a rhyolite volcanic formation with several caves and rockshelters along its western margin. Stratigraphic surveys were conducted at four sheltered areas, but only at the main site (CIS 042), a cave 12 m wide and 9 m deep, were significant occupations uncovered. A 4-m^2 test unit revealed

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several short-term, possibly seasonal, occupations throughout the Holocene, ranging from 2700 to 8300 RCYBP (Reyes et al. 2007). At ca. 2 m deep, excavations uncovered a single marginally retouched flake (micro-granodiorite) associated with dispersed charcoal, AMS dated to 10,010 ± 60 RCYBP (Beta-227703, 11,760–11,260 CALYBP). Even though the deposit is formed mainly of rocks collapsed from the cave walls with low silt content, the stratigraphy is ordered, as shown by coherent ^{14}C dates, the presence of four hearth features in stratigraphic sequence, and evidence of a constant depositional rate (Reyes et al. 2007). Lithic assemblages throughout the excavated sample are small but highly diagnostic, since they consist mainly of instruments. This is noteworthy for the early occupation, since the only formal artifact yet recovered shows consistent typological attributes, such as "ultra-marginal" edge modification on massive flakes (Jackson 2002). Bones are restricted to the upper levels (ca. 10–80 cm) and consist mainly of well-preserved remains of rodents and occasionally frogs. Although our samples are significantly small, the cave seems to have been used as a brief camp, where only few tasks were carried out.

As the result of our finds, El Chueco contributes to filling a geographical gap in the exploration routes within Patagonia (Borrero 1999)and provides previously lacking Pleistocene-Holocene transitional dates for the central portion of the region (as stated previously by Miotti and Salemme 2004:181). Consistent with archaeological predictions for the first human arrival (Borrero and Franco 1997), the site shows a significantly low density occupation and the use of locally available rocks in the form of expedient tools. Also, as all of the early sites in Patagonia, El Chueco is a sheltered place beneath a rock overhang, although lithic evidence in the proximity of the site is suggestive of another possible open air camp. As yet no faunal association has been identified at the site; nonetheless, regional evidence is consistent with at least five extinct species within the region (Mena et al. 2000; Velásquez and Mena 2006). Finally, our recent research clearly raises more questions than answers; its most straightforward response is to continue excavations and intensify the search for other possible functionally integrated sites.

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Paleomagnetic Results from the Urupez Paleoindian Site, Maldonado Department, Uruguay

Hugo G. Nami

The Urupez site (34° 49′ 15″ S, 55° 19′ 02″ W) is located in the Tarariras Creek basin, ca. 300 m north of the Río de la Plata (Maldonado department, Republic of Uruguay, Figure 1A). Archaeological excavations yielded a remarkable buried Paleoindian record in a deposit with two stratigraphic levels named "I" and "II," which belong to the same soil formation horizon (Figure 1B). Level I is dark gray homogeneous, compact, and plastic silty sand, and level II is yellowish brown highly compacted silty clay (Bossi 1983; Meneghin 2004). The Paleoindian level is ca. 5 cm thick and covers more than 100 m^2 at the base of level I in contact with level II. The Paleoindian record is composed of lithic artifacts—mostly debitage—and diverse unifacial and bifacial flaked tools. Among them are two projectile points, one of which is a typical "fishtail" specimen (cf. Nami 2007:Fig. 7b–c). Two charcoal samples recovered 50 m distant from each other yielded the following AMS uncalibrated dates: 10,680 ± 60 (Beta-165076) and 11,690 ± 80 (Beta-211938) RCYBP (Meneghin 2004, 2006).

A vertical paleomagnetic sampling (n = 13) was performed to study the geomagnetic field (GMF) directions in the deposit. To collect samples, cylindrical plastic containers 2.5 cm long and 2 cm diameter were carefully pushed into levels I (samples 1 to 7) and II (8 to 13 [8 to 11 belong to the Paleoindian level]), overlapping each other by about 50 percent. Their strike and dip were

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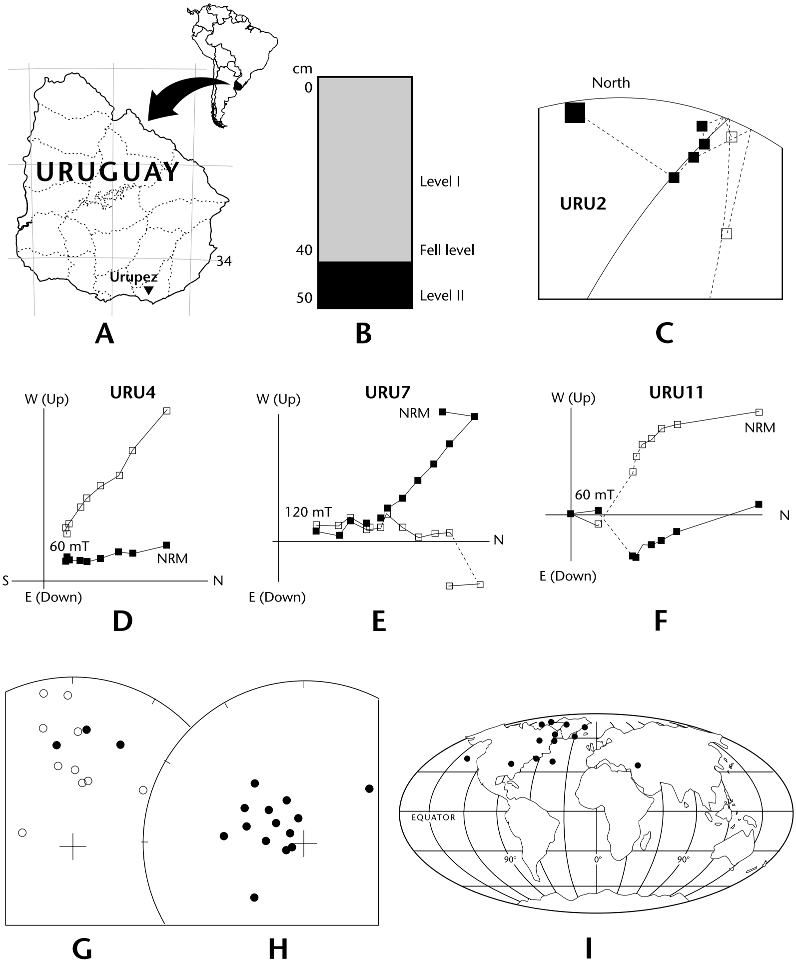

Figure 1. **A,** Location of Urupez site; **B,** schematic stratigraphic profile showing levels I and II; **C,** great circle observed during demagnetization process; **D–F,** typical Zijderveld diagrams of the samples (solid and open symbols correspond to the projection onto the horizontal and vertical planes respectively); **G,** stereoplot with the directional data (solid and open circles represent positive and negative values, respectively); **H–I,** stereoplot and world map showing the VGPs location.

measured using a Brunton compass and inclinometer; they were consolidated with sodium silicate after removal and numbered from top to bottom. All samples were subjected to progressive AF demagnetization in steps of 3, 6, 9, 12, 15, 20, 25, 30, 40 and 60 mT in a 3-axis static degausser attached to a 2G cryogenic magnetometer. Additional steps from 80 to 120 mT were used in some samples (Figure 1E). In most specimens, less than 30 percent of the NRM remained at fields of 60 mT (Figure 1D, F). Some cores showed positive and negative inclination moving in a great circle (Figure 1C). Characteristic remnant magnetization (ChRM) was calculated using principal-components analysis (Kirschvink 1980), with the best-fitting line going to the origin in the Zijderveld diagrams (Figure 1D–F). Maximum angular deviations were generally within low values (≤ 10 degrees). Some samples had univectorial behavior (Figure 1D), while some showed two or three components (Figure 1E, F). ChRM shows either high (Figure 1D) or low negative inclinations (Figure 1F); a few showed westerly and northeasterly directions. The stereoplot (Figure 1G) shows that some directions with positive inclination values are far from the present GMF, especially those from the archaeological level. Similar results were obtained in nearby late-Pleistocene/Holocene records from northeastern Argentina. Comparable directions were observed at Arroyo Yarará (Misiones province), Barranca Pelada, San Juan, Santa Lucía (Corrientes province), and Lomas del Mirador (Buenos Aires province) (Nami 1999, 2006, in prep.). Virtual geomagnetic pole positions (VGP) calculated from the declination and inclination data are located in the Northern Hemisphere between 90° and 30° latitude, mainly in North America and Greenland (Figure 1H–I). These positions coincide with VGPs previously isolated in a number of latest-Pleistocene and Holocene sections (Mena and Nami 2002; Nami 1995, 1999, 2006, in prep.).

In summary, data from Urupez showed paleomagnetic directions similar to other latest-Pleistocene/Holocene sections in the southern cone of South America. In this sense, paleomagnetic research at this site shows that at ca. 11,000 RCYBP there were intermediate directions of magnetism. This sampling, therefore, is an additional record of GMF behavior in southeastern South America from the terminal Pleistocene to very recent times.

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Archaeology: Eurasia

Is It Really That Old? Dating the Siberian Upper Paleolithic Site of Afontova Gora-2

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Afontova Gora-2, a microblade-rich late Upper Paleolithic (LUP) site located within the city of Krasnoiarsk, central Siberia, was excavated from 1912 to 1925 (Auerbakh and Sosnovskii 1924; Sosnovskii 1934, 1935). Early excavations produced a rich inventory of > 20,000 artifacts, including stone tools, osseous tools and jewelry, and human skeletal remains of two individuals. The site, however, was excavated long before the introduction of ^{14}C dating, so its age has remained a mystery. Here I present three new AMS assays on dispersed charcoal collected from the lowest cultural layer (C_3) during Auerbakh and Sosnovskii's excavations.

The first attempt to date Afontova Gora-2 occurred in 1962, when geologists visited the site, described a stratigraphic profile located about 40 m from the site's original excavation area, and collected charcoal from a lens thought to correlate with C_3 (Tsetlin 1979). The conventional ^{14}C assay of this sample, 20,900 ± 300 (GIN-117) RCYBP (Table 1), has for years caught the attention of researchers interested in microblade origins and the spread of humans into northern Siberia (Davis 1998; Goebel 1999, 2002; Vasil'ev et al. 2002; Yi and Clark 1985), since it potentially represents one of the earliest microblade industries in Siberia.

In the early 1960s, Astakhov (1999) revisited Afontova Gora-2 and after careful study of original site reports, asserted that C_3 was deposited during interstadial conditions, not during the cold, xeric last glacial maximum suggested by Tseitlin (1979). Astakhov contended that C_3 likely dated to about 16,000 RCYBP, a warm interval of the Oldest Dryas stadial. Recently, Drozdov and Artem'ev (1997, 2007) excavated an area about 200 m northeast of Afontova Gora-2, exposing a series of cultural layers and dating them to 15,000–12,500 RCYBP (Table 1).

Afontova Gora-2 is situated within colluvial deposits blanketing the second terrace (14–16 m) of the Enisei River (Abramova et al. 1991; Astakhov 1999; Tseitlin 1979). The original stratigraphic profile contained a thick cobble bed at its base, overlain by a 450-cm-thick set of alluvial sediments. Overtop this was a 450-cm-thick series of colluvial sediments that contained four cultural horizons, C_3, C_0, C_2, and C_1, with C_3 being the oldest. The upper portion of the

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Table 1. Radiocarbon dates from the Afontova Gora-2 site. (All material is dispersed charcoal.)

Provenience	Lab number	Age estimate	Age estimate range (2σ)
Afontova Gora-2, Tseitlin Profile			
?	GIN-117	20,900 ± 300	21,500–20,300
Afontova Gora-2, Main Excavation			
Cultural Layer C_3/D-2 Square	AA-68663	13,970 ± 80	14,130–13,810
Cultural Layer C_3/D-2 Square	AA-68664	13,870 ± 80	14,030–13,710
Cultural Layer C_3/D-1 Square	AA-68662	12,280 ± 80	12,440–12,120
Afontova Gora-2, Drozdov and Artem'ev Excavation			
Stratum 12	GrA-5554	14,180 ± 60	14,300–14,060
Stratum 12	GrA-5555	12,400 ± 60	12,520–12,280
Stratum 11-10/Cultural Layer 5	SOAN-3251	15,130 ± 795	16,720–12,745
Stratum 9/Cultural Layer 4	SOAN-3075	14,070 ± 110	14,290–13,850
Stratum 9/Cultural Layer 4	GIN-7541	13,930 ± 80	14,090–13,770
Stratum 9/Cultural Layer 4	GIN-7540	13,650 ± 70	13,790–13,510
Stratum 6	GrN-22275	13,930 ± 260	14,190–13,410
Stratum 5/Cultural Layer 3b	SOAN-3077	14,300 ± 95	14,205–14,015
Stratum 5/Cultural Layer 3b	GrN-22274	13,990 ± 110	14,210–13,770
Stratum 5/Cultural Layer 3a	GIN-7539	13,350 ± 60	13,470–13,230
Stratum 5/Cultural Layer 2	GrA-5556	14,200 ± 60	14,320–14,080
Stratum 5/Cultural Layer 2	GIN-7542	13,330 ± 140	13,610–13,050

profile was characterized by loess that contained cultural layers B_2 and B_1. Sosnovskii (1935) found C_3 to be concave in cross section in the profile and concluded that it must represent a dwelling structure; however, given the site's colluvial context, Astakhov (1999) argued that it resulted from landslide deformation. In their nearby excavations, Drozdov and Artem'ev (1997, 2007) also found colluvial deposits resulting from landslide processes. Age reversals in their ^{14}C datelist support this interpretation.

Astakhov (1999) warned that we cannot be sure dates obtained by Drozdov and Artem'ev (1997) directly correlate to and accurately reflect the age of cultural layer C_3 from the Afontova Gora-2 site. Therefore, while visiting the Hermitage State Museum, St. Petersburg, in 2005, I obtained three wood charcoal samples from the cultural layer C_3 collection and submitted them to NSF-Arizona AMS facility in Tucson. The resulting ages, 13,970 ± 80 (AA-68663), 13,870 ± 80 (AA-68664), and 12,280 ± 80 (AA-68662) (Table 1), support Drozdov and Artem'ev's (1997, 2007) interpretations that the Afontova Gora area was first visited during the Bølling-Allerød, not during or just after the last glacial maximum. Despite the site's poor depositional context, I conclude that data from both sets of excavations represent recurrent occupations between about 14,000 and 12,000 RCYBP (17,000–14,000 CALYBP) by LUP foragers.

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Use-Wear Analysis of Kamiyama-type Burins in Sugikubo Blade Industry, Central Japan: New Evidence for Versatile Lithic Tool Use

Akira Iwase and Kazuki Morisaki

This paper presents use-wear analysis of Kamiyama-type burins of the Sugikubo blade industry from the fifth excavation locality of the Uenohara site in Nagano Prefecture, central Japan (36° 48′ 42″ N, 138° 12′ 03″ E). The Uenohara site is a multicomponent Paleolithic site, and a total of 12,863 lithic artifacts were recovered from an excavated area of about 3,400 m^2. A total of 1,182 lithic artifacts of the Sugikubo industry were separated from other

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Paleolithic components by spatial distribution and techno-typological characteristics. Various raw materials including hard shale, tuff, andesite, and obsidian form this assemblage, and all but andesite are generally of high quality. Hard shale, tuff, and andesite could have been collected in the vicinity of the site, while obsidian sources are 60–70 km distant (Nakamura et al. 2008).

The Sugikubo industry, concentrated in a relatively small area of northern central Japan (Figure 1A), existed roughly 18,000–20,000 RCYBP. This blade industry has only a few formal tool types such as the Sugikubo-type point (Figure 1B-C) and the Kamiyama-type burin; the latter typically has a retouched platform on the ventral face of the blade blank, from which burin spalls were detached obliquely (Figure 1D-E). Compared with blade industries across the high latitudes, human groups equipped with such poor lithic tool types as the Sugikubo industry may have had a versatile lithic technology and less specialized subsistence strategy (Morisaki 2004), since the wide exploitation of diverse resource patches in temperate forests with small patches of grasslands could have existed in central Japan. Although it is possible that there were other implements made of non-lithic materials such as bone, the Kamiyama-type burin, the only possible formal processing implement, is also likely to have been used for several unspecialized purposes. If this was the case, microscopic analysis of the burins is expected to detect evidence of multipurpose use.

The method of use-wear analysis applied here is the high-power approach (Keeley 1980). To observe polishes and striations on lithic surfaces we used a digital microscope (KEYENCE VHX), following Midoshima (1986) as the reference of identification of use-wear types.

From a total of 163 Kamiyama-type burins, 30 obsidian artifacts were sampled for analysis. Eighteen specimens showed traces of use. Two examples of the analyzed sample, along with four representative photos of use wear, are shown in Figure 1. Specimen 12RA8-33 shows a bright, smooth, and very flat polished surface with no distinctive striations on the ventral edge of the distal end (Figure 1F), as well as polish with a slightly rounded margin (Figure 1G). Larger numbers of micro-scars were found on the dorsal edge than on the ventral edge. These use-wear features indicate that this artifact was used for scraping or whittling a hard material such as bone, antler, tusk, or shell. Specimen 12RB4-120 has two working edges at each end. Figures 1H and 1I show marked striations running parallel to each working edge. The striations were formed both on the ventral and dorsal sides of the edges. Polish was not recognized. The location and direction of the striations indicate that both working edges were used for cutting or sawing something. The above results suggest that Kamiyama-type burins had various functions including scraping/whittling and cutting/sawing.

Our results show that Kamiyama-type burins had many functions, clearly demonstrating that they were versatile tools. This also implies the Sugikubo industry is another phenotype of Mode-4 (Clark 1977) blade industries. We need further studies of various expressions of Mode-4 technology to further understand and explain how these technologies were adapted to the temperate forests of Asia's middle latitudes as well as to cold and arid environments of Asia.

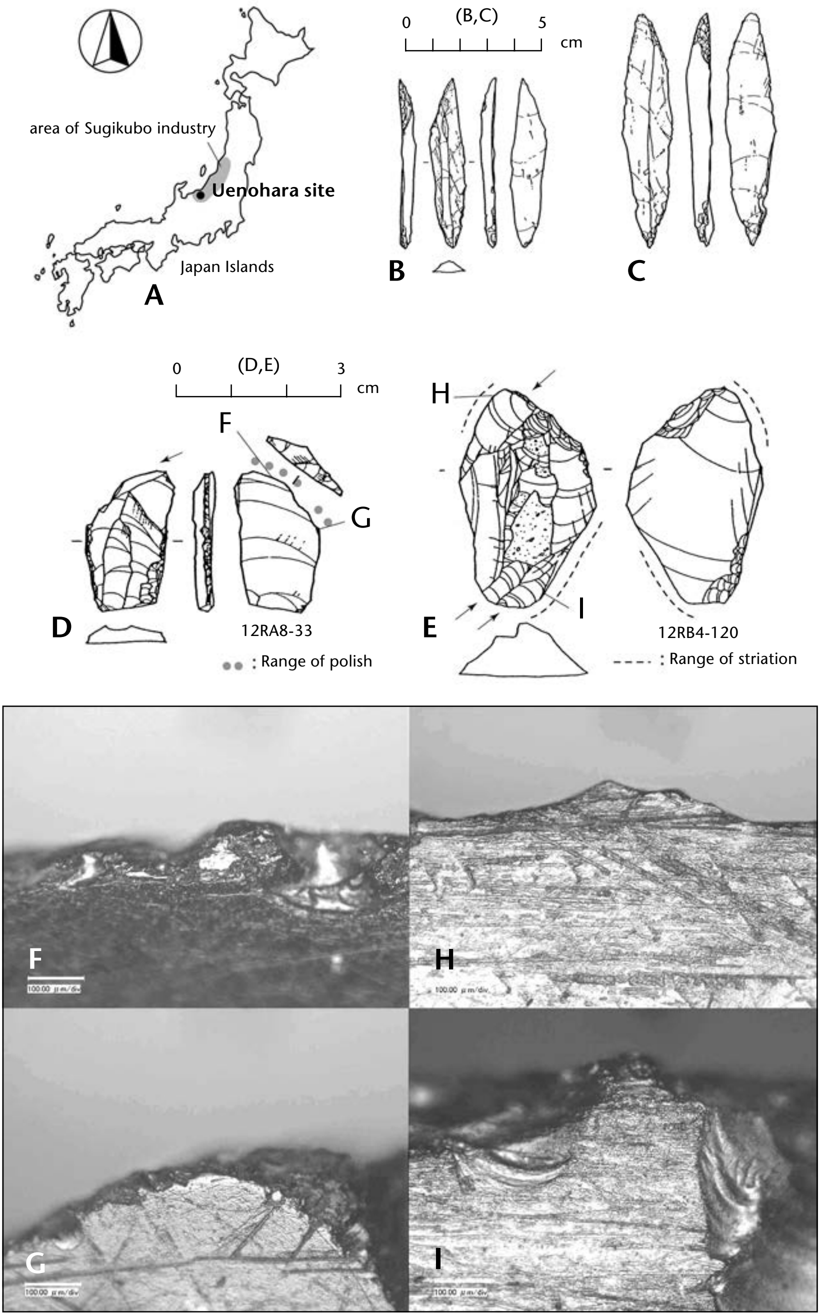

Figure 1. **A,** map showing location of Uenohara site; **B–C,** examples of Sugikubo-type points; **D–E,** Kamiyama-type burins; **F–I,** microscopic traces of use-wear on the burins.

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Specialization of Hunting in the Early Upper Paleolithic of the Transbaikal Region, Siberia

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A major research problem in Paleolithic archaeology is reconstructing subsistence and settlement systems. This is especially the case for the period of the Middle to Upper Paleolithic transition, when some basic changes in human behavior are thought to have occurred, including emergence of specialized hunting, planning, and seasonal use of resources (McBrearty and Brooks 2000). Zooarchaeological analysis of faunal remains recovered from excavations of a series of early Upper Paleolithic sites in the Transbaikal region of south Siberia provides invaluable material for reconstructing seasonal occupation of settlements, hunting strategies, and character of human mobility.

As a rule, the early Upper Paleolithic sites known to us in the Transbaikal are situated on wide foothill slopes. We believe this zone was used intensively, based on evidence of settlements representing palimpsests of repeated occupations. Cultural layers often have thicknesses of 30–40 cm. This complicates precise analysis of lithic and faunal assemblages; however, the generalized data resulting from several episodes of use allow us to identify average impressions of subsistence activities For layers 2 and 3 of the Khotyk sites (dating to 25,000–28,000 and 34,000–38,000 RCYBP, respectively), we have generated distribution maps of artifacts and faunal remains (Lbova, 2002; Kuzmin et al., 2006).

Layer 2 represents a complex of long-term occupations. Four large concentrations of cultural debris were found. These included lithic artifacts, artificially broken long-bone shafts, boulders reaching 5–6 m in length, and pits lined with stone plates to a depth of 50–60 cm containing large parts of

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animal carcasses (represented by skulls and other bones). These concentrations appear to represent dwelling features. This complex is rich in zooarchaeological material. Prevalent are the remains of Mongolian gazelle (*Procapra gutturosa*, 18 individuals), horse (*Equus sp.*, 5 individuals), woolly rhinoceros (*Coelodonta antiquitatis*, 5 individuals), rock sheep (argali) (*Ovis ammon*, 2 individuals), noble deer (one individual), and bison (one individual) (Table 1). Rodents are also common and indicate the presence of arid steppe landscapes in the Khotyk area. Specific analysis of Mongolian gazelle, horse, and sheep remains are problematic since most of the bones are highly fragmented. Nonetheless, the age structure of the ungulates is variable, with young, adult, and old individuals being represented among horse, rhinoceros, gazelle, and sheep. Identification of young individuals of *Procapra gutturosa* (through data on the fusion of epiphyses of the postcranial skeleton) suggests they were hunted year-round in the Khotyk vicinity, primarily in summer (June to early September) (43 percent) and winter to spring (28.5 percent) (Table 2).

Table 1. Large-mammal species composition and remains numbers from Khotyk site.

Species	Level 2 NISP/MNI	Level 3 NISP/MNI	total
Carnivora			
Canis lupus	41/3	22/1	63/4
Vulpes corsac	9/2	8/2	17/4
Vulpes vulpes	1/1		1/1
Ursus sp.		1/1	1/1
Crocuta sp.		1/1	1/1
Perissodactyla			
Coelodonta antiquitatis	94/5	40/3	134/8
Equus sp.	217/5	329/5	546/10
Equus (Hemionus) hemionus		4/1	4/1
Artiodactyla			
Cervus elaphus	9/1	1/1	10/2
Capreolus sp.	3/1		3/1
Bison sp.	3/1	6/1	9/2
Procapra gutturosa	754/20	309/13	1063/33
Ovis ammon	32/2	22/1	54/3
Bovinae gen. indet.	3/1	3/1	6/2
Total	1166/42	746/31	1912/73

Layer 3 of the Khotyk site is expressed in the form of concentrations of artifacts with precise borders formed by vertically established plates. In these concentrations, bones of exploited animals are numerous, and most aspects of the faunal assemblage are similar to layer 2 (Table 1). The remains of Mongolian gazelle (13 individuals), horse (6 individuals) and rhinoceros (2 individuals) are most common. Bones are strongly shattered, as in layer 2, so that it is not possible to reconstruct specific butchering activities. Seasonal prevalence of Mongolian gazelle hunting, however, is obviously expressed—67 percent of young individuals were taken during the summer (Table 2).

Table 2. Season of death of Mongolian gazelle (*Procapra gutturosa*).

	Procapra gutturosa ■				*Gazella gazella*
	Khotyk, Layer 2		Khotyk, Layer 3		Age of fusion
Skeletal element	NISP/MNI	Period of death	NISP/MNI	Period of death	(months)▲
Distal humerus	7/4	mid Aug–beginning of Sept	3/2	mid Aug–beginning of Sept	~2
Phalanx 1	4/2	Nov–Dec			~5–8
Distal tibia	3/2	Feb–March	1/1	Feb–March	~8–10
Proximal femur	3/2	April–May			~10–16
Distal femur	2/1	April–May	1/1	April–May	~10–18
Calcaneum	3/2	April–May			~10–16
Distal MP	2/1	April–May			~10–16
Proximal ulna	2/1	June–July	2/1	June–July	~12–18
Proximal tibia	2/1	June–July	1/1	June–July	~12–18

■Season of birth: mid June–beginning of July.

▲Based on the state of fusion of postcranial bones of *Gazella gazella* (Davis 1980).

The layer 3 lithic assemblage is similar to the Kamenka-A complex in Transbaikal. The Kamenka-A complex has produced well-preserved faunal assemblages, which have been extensively zooarchaeologically analyzed (Germonpre and Lbova 1996; Lbova 1999). Two basic kinds of mammals make up this assemblage—horse (*Equus caballus*,12 individuals) and Mongolian gazelle (*Procapra gutturosa*, 8 individuals). Only 8.1 percent of the bones, however, are whole; 17.1 percent bear probable traces of human use (burning, crushing, presence of helicoid flakes), and 1 percent bear traces of cutting by dint of their location likely connected with butchering and skinning. This evidence suggests that Kamenka-A layer 3 was occupied for a relatively short time. A complete skeleton of Mongolian gazelle further suggests that animals were killed near the site and transported whole to the site for butchering. Bones of horse suggest a different situation. Parts of the vertebral column and axial skeleton are not well represented, although in one case there is a complete axial skeleton. Possibly it was transported to the site in a butchered condition. It is also possible that it too may have been transported whole (Germonpre and Lbova 1995; Marean and Kim 1998) and that missing bones were too strongly fragmented for precise identification.

Thus, on the basis of the zooarchaeological analysis presented here, we can conclude that the Khotyk site was occupied in the late summer/autumn or at the beginning of winter. The zoological data confirm our independent interpretation, based on features of the lithic assemblage, that the site represents a short-term hunting camp with intensive recycling of stone materials used to conduct the primary processing of animal carcasses (Ribin et al. 2005). In our opinion, the high mobility of the population during the early Upper Paleolithic can be a manifestation of their adaptation to specialized hunting of mobile and gregarious mammals in arid steppe landscapes.

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Radiocarbon Chronology of the "Mammoth Cemetery" and Paleolithic Site of Volchia Griva (Western Siberia)

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The Volchia Griva [*Wolf's Ridge*] locality (geographic coordinates 54° 40′ N, 80° 21′ E) is a unique place with one of the largest concentrations of woolly mammoth (*Mammuthus primigenius* Blum.) remains in the world. It is situated in the Baraba forest steppe region of the southern West Siberian Plain. The locality occupies an area of about 20,000 m^2; its exact position is on the eastern edge of the Volchia Ridge, which is 8 km long and 1 km wide with relative

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elevation of 10 m above the aggradation plain. The origin of the main body of the ridge's sediments appears to be subaqueous (Zenin 2002). Numerous mammoth bones, teeth, and tusks, and some Upper Paleolithic artifacts are found in the uppermost part of the ridge's deposits, which consist of loess-like sandy loam of subaerial genesis (Orlova et al. 2003). The estimated number of mammoth remains (as of 2001) is about 5,000, representing more than 50 individuals. Mammoth remains constitute about 98 percent of the total fossils, and bones of Pleistocene horse, bison, and grey wolf were also identified. The formation of Volchia Griva is due to the existence of a mineral lick [beast solonetz], which attracted animals (Leshchinskiy 2001).

The bone-bearing horizon of Volchia Griva is divided into three levels, with a total thickness of 0.5 m. In the uppermost level, the general appearance of mammoth remains is weathered and fragile, while in the two lower levels the preservation of fossils is quite good (Alekseeva and Volkov 1969; authors' observation). Most of the mammoth skeletal fragments in all levels are in articulated position, which testifies in favor of a quick burial after death and in situ localization, without visible post-depositional disturbance. Bones are often found in a non-horizontal position. This can be explained by the trampling of carcasses into the soft loess-like loam by living mammoths, a phenomenon well known for modern elephants in Africa and many fossil localities (Haynes 1991). The age and sex identifications for 19 mammoths (materials collected in 1991, 2000, and 2001) show that 58 percent of them are adults (older than 17 years), and 42 percent are immature individuals (including two newborns; two younger than 1 year; one 1–2 years old; and three 6–17 years old). Among the 11 adult mammoths, nine are females and two are males. According to bone morphology, there are two kinds of mammoths, smaller (with a shoulder height of 2.1 m) and larger (up to 3.75–3.85 m at shoulder height) ones. It seems that smaller mammoths lived at later times than the larger ones. These data support the assumption that Volchia Griva is a place with a particular mammoth death pattern due to animal concentrations in the mineral lick area.

Archaeological materials from Volchia Griva are not numerous (Okladnikov et al. 1971; Zenin 2002). Before 1991, only seven stone artifacts were found during the 1968 and 1975 field seasons. The major excavation campaign conducted in 1991 led to the recovery of 30 stone artifacts and about 2,500 mammoth bones; tools are mainly blades, blade fragments, and some microblades (Zenin 2002:35–36). Artifacts are found in close association with mammoth remains.

Initial ^{14}C dating of the mammoth bones from Volchia Griva was performed in the early 1970s (Firsov and Orlova 1971), and led to dates of ca. 14,200–13,600 RCYBP (Table 1). Additional samples collected during 1991, 2000, and 2001 gave new ^{14}C values, some of them significantly older than the first dates. For example, two samples from the western part of the site without associated archaeological material revealed ages of ca. 17,700–16,100 RCYBP. A tooth fragment from the 1991 main excavation yielded the oldest ^{14}C date of ca. 34,000 RCYBP, and other materials from the same pit feature yielded dates ca. 14,300–11,800 RCYBP. The youngest ^{14}C date of ca. 11,100 RCYBP was gener-

Table 1. Radiocarbon dates of the mammoth remains at the Volchya Griva (after Firsov and Orlova 1971; Stuart et al. 2002; Orlova et al. 2003; this paper).

Lab code and no.	^{14}C date (RCYBP)	Material dated	Year collected; provenance feature; depth	Bone-bearing levels
AA-60770	34,000 ± 1200	Mandible tooth	1991; main excavation pit; 0.98 m	upper/middle?
AA-60831*	17,650 ± 140	Tusk fragment	2001; test pit in western part of locality; 0.8 m	upper/middle?
GIN-11463*	17,800 ± 100	Tusk fragment	2001; test pit in western part of locality; 0.8 m	upper/middle?
AA-60832	16,090 ± 110	Limb bone	2001; test pit in western part of locality; 0.95 m	middle/lower?
SOAN-4292	14,280 ± 285	Limb bone	2000; 1991 main excavation pit, grid E-10; 1.0 m	middle?
SOAN-78	14,200 ± 150	Limb bones	1970; 1968 excavation pit; 0.7–2.0 m	upper/middle?
SOAN-111	13,600 ± 230	Limb bones	1970; 1968 excavation pit; 0.7–1.5 m	upper/middle?
SOAN-4293	12,520 ± 150	Limb bone	2000; 1991 main excavation pit, grid E-10; 0.8 m	middle
AA-60771	11,815 ± 90	Mandible tooth	1991; main excavation pit; 0.86 m	upper
SOAN-4291	11,090 ± 120	Limb bone	2000; 1991 test pit in western part of locality; 0.75 m	upper

*Dates are produced for the same sample (average value ca. 17,730 RCYBP).

ated on a sample from the western part of Volchia Griva, also without artifacts. The "reversed" age-depth relationship between the ^{14}C values AA-60831 and AA-60832 (Table 1) shows that mammoth remains penetrated into the matrix, and as a result bones from the upper levels can produce older ages than those from the lower part of the site.

Stratigraphic observations and the relationship between the archaeological material and ^{14}C-dated mammoth remains show that humans occupied this site for a short time after the formation of the lower part of the bone bed, and that the final stage of the mammoth bone accumulation took place without any evidence of human activity (Zenin 2002).

The duration of Volchia Griva's existence, initially assumed to be quite short, 14,800–13,600 RCYBP (Table 1) or even 12,000–10,000 RCYBP (Alekseeva and Volkov 1969), can now be stretched from 11,100 RCYBP back to at least 17,700 RCYBP, and possibly to 34,000 RCYBP. The quite "young" ^{14}C dates, less than 12,000 RCYBP, suggest that this locality was one of the extra-Arctic refugia for mammoths in the Late Glacial of northern Eurasia (Stuart et al. 2002). Volchia Griva attracted animals for a long time, and during certain periods Paleolithic humans visited it.

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Archaeology: North America

The John A. Hill Clovis Point Base, Albany County, Wyoming

Richard Adams

On December 17, 1950, Mr. John A. Hill found the base of a Clovis point while artifact hunting. The point was stored, unrecognized, in a small manila envelope in the John A. Hill collection until late 2007. Also in the manila envelope were a late-prehistoric projectile-point fragment and a chert flake. There is no information on the spatial relations among the three artifacts.

Mr. Hill wrote legal and verbal descriptions on the envelope, describing how the artifacts were found near the edge of an alkali lake in the Big Hollow, Albany County, Wyoming, at about 7250 feet (2210 m) above sea level (Figure 1). The site is on private land.

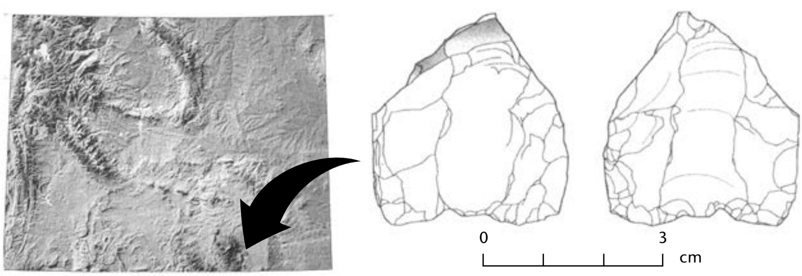

Figure 1. The John A. Hill Clovis base and a map of Wyoming showing where it was found.

The Big Hollow is a large deflation hollow (Mears 1970:363; Lageson and Spearing 1988:54), and is dotted with several Pleistocene playa lakes.

The Clovis point base is made from either Casper Formation or Hartville Formation Pennsylvanian dark purple chert with pinkish blotches that likely came from the east, either the Laramie Range or the Hartville Uplift (Love and Christiansen 1985).

Only the base is present. When it first came out of the envelope, the base had traces of pale tan sediment, the same color as playas in the Big Hollow. It measures 35.4 mm long by 32.4 mm wide by 6.8 mm thick. Both edges are

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ground. Both faces are fluted. Remnants of an isolated fluting platform are present. The tip and midsection are broken off by a complex fracture. There is possible use on the broken edge.

Also in the envelope were 1) a late-prehistoric projectile-point midsection (missing base, notches, and tip) made from grey, white, and black chert; and 2) a patinated translucent pink chert tertiary-flake fragment.

All three artifacts were donated to the University of Wyoming by the grandchildren of John A. Hill, and have been curated at the University of Wyoming Archaeological Repository. The site number is 48AB1808.

According to the most recent Wyoming Cultural Records Office data (WYCRO Database accessed 8/25/08), three Clovis points are known from Albany county and 43 Clovis points/sites are known in the entire state. Notable Clovis sites in Wyoming are the Colby Mammoth site (Frison and Todd 1986) and the Sheaman site (Frison and Stanford 1982).

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AMS Re-dating of the Carlo Creek Site, Nenana Valley, Central Alaska

Peter M. Bowers and Joshua D. Reuther

The Carlo Creek site is located 620 m.a.s.l. within a narrow constriction of the Nenana River Valley, central Alaska Range. Excavations in 1976–77 exposed an area of some 45 m^2 at depths as great as 3.5 m below surface (mbs). Site geology consists of four major lithostratigraphic units: the lowermost, Unit 1 (> 6 mbs), fluvial gravel/sand; Unit 2 (2–6 mbs), cross-bedded fluvial sand; Unit 3 (0.3–2mbs), alluvial fan sand/silt; and Unit 4 (0–0.3 mbs), loess

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containing modern forest soils and discontinuous lenses of the 3660 RCYBP Hayes tephra (Beget et al. 1991; Bowers 1979; Riehle et al. 1990). Original interpretation of ^{14}C data suggested an age of the oldest occupation of about 8500 RCYBP (Bowers 1977, 1980).

The site contains 2 cultural components; the uppermost, C2, consisted of 637 rhyolite flakes. Deeply buried C1 occurs within a < 5-cm-thick paleosol located just above an unconformity between Units 2 and 3. C1 occupation centered upon two hearths on a former stabilized point bar of the Nenana River, subsequently buried by alluvial-fan sediments. C1 encompasses a nearly flat paleosurface, dominated by biface-reduction debris, including more than 8,300 argillite flakes. Although one hornfels macroblade was recovered, no microblades, cores, or burins were found. Nine bifaces and biface fragments were recovered during the 1970s excavations; an additional three were later observed eroding from the site (Bowers and Mason 1992). These specimens were made from locally available argillite and hornfels, were likely heat-treated, and probably functioned as preforms, knives, handaxes/choppers, or scrapers. In addition, one cobble anvilstone, two bone points, and one possible metapodial awl were recovered. No lanceolate points were found. Well-preserved fauna from the site included *Rangifer* sp. (MNI = 1), *Ovis dalli* (MNI = 1), and *Citellus* sp. (MNI = 9). C1 was likely a late-summer/fall occupation, having closest affinities with the non-microblade biface workshop areas[1] of the Denali complex C2 at Dry Creek, located 38 km downriver (Bowers 1980:168–69; Mason et al. 2001:526; cf. Powers et al. 1983; Thorson 2006).

In the 1970s, four conventional ^{14}C assays produced dates ranging from 5000 to 10,000 RCYBP (Table 1). Dates GX-5131, GX-5132, and WSU-1700 were produced from several charcoal samples recovered from two separate hearth features; these were combined into larger samples for dating. Combining multiple pieces can introduce variation among assays due to potential mixing of non-contemporaneous materials, short- and long-lived woody species, and multiple sources of organic and inorganic carbon (McGeehin et al. 2001; Taylor 1987).

In 2007, three C1 charcoal samples identified as willow (*Salix* sp.; Alix n.d.) and one caribou metapodial were dated at the NSF-Arizona Accelerator Mass Spectrometry Laboratory following standard acid-alkaline-acid pretreatments for collagen and cellulose extraction and AMS combustion and graphitization protocols (Bird 2007; Hodgins et al. n.d.; Jull and Geertsema 2006). Three charcoal samples were selected from the sample matrices of the hearths that produced the original conventional C1 dates. An age assay was conducted on alkaline-soluble fractions (humic acid) from two charcoal samples to determine the potential for contaminants that could skew the ages toward a potentially younger than expected assay.

The close replication of assays on cellulose and alkaline-soluble fractions indicates relatively small potential for charcoal contamination that could

[1] Powers et al. (1983:182–208, 307–47) report that 9 out of 14 (64%) of the artifact clusters from Dry Creek C2 are non-microblade, suggesting to us that intrasite variability and site function need to be carefully considered, and that the presence of microblade technology is not necessarily the paramount characteristic that defines the Denali complex (cf. West 1967).

Table 1. Carlo Creek Component 1, all radiocarbon dates.

Lab no.	Material	Provenience	^{14}C Age (RCYBP)	SD	CALYBP range (1σ)■
WSU–1727	soil humic acid	Component I; bulk soil (average of many samples)	5120	265	5606–6133 6136–6182
WSU–1700	charcoal	Component I; Hearth 1	8400	200	9091–9548
GX–5132	charcoal	Component I; Hearth 2	8690	330	9419–10,218
GX–5131	charcoal	Component I; Hearth 1	10,040	435	10,884–10,924 11,084–12,393
AA–75049	AMS, bone	Component I	9872	65	11,209–11,344
AA–75050	AMS, charred wood	Component I; Hearth 1; from sample GX–5131	9647	60	10,812–10,845 10,866–10,953 11,069–11,179
AA–75051	AMS, charred wood (split)	Component I; Hearth 1; from sample GX–5131	9902	50	11,238–11,345 11,380–11,385
AA–75051	AMS, humates (split)	Component I; Hearth 1; from sample GX–5131	9763	50	11,175–11,232
AA–75052	AMS, charred wood (split)	Component I; Hearth 2; from sample GX–5132	9979	50	11,289–11,298 11,306–11,410 11,430–11,495 11,531–11,539 11,546–11,601
AA–75052	AMS, humates (split)	Component I; Hearth 2; from sample GX–5132	10,035	50	11,397–11,629 11,671–11,698

■Calibrations based on the IntCal04 curve (Reimer et al. 2004) using Calib 5.0.

cause wide diversions in ages and skewing toward more recent ages. AMS dates corroborate the conventional 10,040 ± 435 RCYBP (GX-5131) date as a valid representation of actual age of C1, and suggest that the original more recent conventional dates on bulk charcoal samples may have been contaminated with younger sources of carbon. The best approximation for the age of Carlo Creek C1 is derived from an average of all six AMS dates, providing an age estimate of 9866 ± 55 RCYBP (11,217–11,314 CALYBP).

We thank Greg Hodgins, Sarah LaMotta, Tim Jull and the Student Internship Program at the NSF-Arizona AMS Laboratory. Claire Alix (Alaska Quaternary Center) provided wood identification of the AMS samples. The research at Carlo Creek has benefited from thoughtful discussions over the years with Robert Ackerman, E. James Dixon, Jr., Thomas Hamilton, Charles Holmes, David Hopkins, Owen Mason, Ben Potter, and Robert Thorson.

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Early Maritime Technology from Western San Miguel Island, California

Todd J. Braje and Jon M. Erlandson

Although a relatively large number of early shell middens have been recorded on California's Channel Islands, chipped-stone tool assemblages are usually

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small and consist mostly of expedient core and flake tools (Rick et al. 2005). Recent archaeological studies on the Northern Channel Islands have produced a growing number of early tool types, however, including Channel Island Barbed (a.k.a. Arena) points and crescents, providing valuable new data about Paleocoastal subsistence and technologies (Braje 2007; Erlandson 2005; Erlandson and Braje 2007; Glassow et al. 2007).

In December 2007, Braje found an Arena point and crescent preform (Figure 1) while investigating CA-SMI-614H, a multicomponent site located on the beach at Adams Cove near Point Bennett on western San Miguel Island (see Braje and Erlandson 2007). We have identified 10 early-Holocene shell middens in the Point Bennett area, showing that it was heavily used by Paleocoastal peoples.

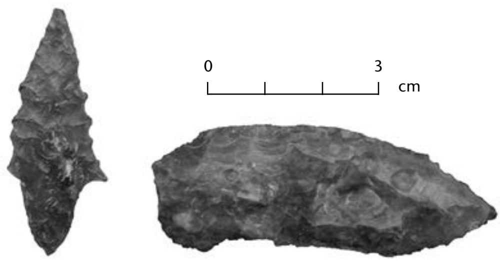

Figure 1. An Arena point (left) and crescent preform fragment from CA-SMI-614H.

CA-SMI-614H is a historic abalone processing and pinniped hunting camp marked by an eroded scatter of historic artifacts, hearth features, and abalone shell piles associated with 19th- and 20th-century Chinese and Euro-American occupations. Recent pinniped activity, wave action, and coastal erosion have disturbed the site, mixing modern flotsam with historic debris and earlier artifacts from nearby prehistoric sites. Until the recovery of the Arena point and crescent, no early-Holocene component was known from CA-SMI-614H, which is found in historic dune and beach sand. However, intact remnants of the Simonton Soil, formed during the terminal Pleistocene and early Holocene, are present immediately to the north. Reconnaissance of these exposures yielded no evidence of intact early-Holocene cultural deposits, but the area has been heavily disturbed by pinnipeds and erosion. It seems likely that the early artifacts eroded from Simonton Soil exposures once present within the site area.

The Arena point and crescent were made of Monterey chert, probably obtained from eastern San Miguel (see Erlandson et al. 2008). The point, which has a long contracting stem, small barbs, and lightly serrated margins, is 42.2 mm long, 17.6 mm wide, 3.9 mm thick, and weighs 2.1 g. The crescent preform fragment is 60.5 mm long, 21.0 mm wide, 8.9 mm thick, and weighs 12.6 g. These artifacts add to the growing evidence for early maritime occupations that were widespread on the Northern Channel Islands.

Recent research has documented Arena points in several sites dated between about 9500 and 8400 CALYBP, including CA-SMI-575-NE (ca. 8500 CALYBP, Erlandson and Braje 2007), CA-SMI-608 (ca. 9600–8700 CALYBP, Braje

2007; Erlandson et al. 2005), and CA-SCRI-109 (ca. 8400 CALYBP, Glassow et al. 2008). Along the California Coast, crescents appear to be diagnostic of terminal-Pleistocene and early-Holocene occupations (Erlandson 2005; Jertberg 1986), and recent work on San Miguel and Santa Rosa islands has yielded numerous crescents and Arena points closely associated with middens dated between ca. 12,000 and 11,000 CALYBP. Further research at early Channel Island sites will help refine the chronology and function of Paleocoastal technologies that appear to be part of an ancient maritime adaptation.

Our research has been supported by Channel Islands National Park, the National Science Foundation, the Marine Conservation Biology Institute, Western National Parks and Monuments, and the University of Oregon. We thank Ann Huston, Kelly Minas, and Ian Williams for supporting our work and Bob DeLong for hosting us during our research trip and providing access to the Pt. Bennett area.

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Paleoamerican and Early-Archaic Occupations of the Widemeier Site (40Dv9), Davidson County, Tennessee

John B. Broster, Mark R. Norton, Bobby Hulan, and Ellis Durham

In 2005, Cumberland Research Group, Inc. undertook a cultural resource management-testing project to determine if any human burials would be disturbed with the construction of two ponds on private land. (A Mississippian village had been previously recorded within the property boundaries.) Two possible burials were located during the testing. Both these burials were on the margins of the project and could easily be avoided during construction. Investigations were then terminated since the conditions of the contract had been met; however, a scatter of late-Paleoamerican and early-Archaic artifacts were recorded in several of the backhoe trenches (Allen 2005; Broster et al. 2006).

The Tennessee Division of Archaeology acted as monitors of this contract work. We strongly felt that further research was warranted, and we were permitted to conduct archaeological evaluations during construction activities. Accordingly, backdirt from three of the trenches was sifted for artifacts, profiles were drawn, and further excavation units were dug into sterile clay. A total of 13 m^2 was examined to a maximum depth of 90 cm below ground surface. A very high density of Paleoamerican and early-Archaic artifacts was found. Numerous charcoal samples were obtained for the early-Archaic levels, while extremely small amounts of charcoal were found in the Paleoamerican levels.

A total of 17 Paleoamerican projectile points were recovered during dirt removal from the ponds, including three Clovis, two Cumberland, four unfluted Cumberland, six Beaver Lake, one Quad, and one Dalton point. Early-Archaic projectile points are represented by the following: 20 Greenbrier, 2 Harpeth River, 23 Big Sandy, 17 Lost Lake, 2 Plevna, 3 Decatur, 70 Kirk corner-notched, and one Lecroy. Sixteen early-Archaic Cobbs knives were also recorded. Numerous unifacial endscrapers, sidescrapers, blade knives, and unutilized blades were found in disturbed context. Figure 1 illustrates three of the early-Paleoamerican points and two early-Paleoamerican point performs. The majority of blade tools appear to be assignable to a rather extensive Clovis occupation on at least three areas of the property. A shallow pit feature containing one Clovis preform, one blade, and two chert blocks was excavated in one of the test units. A total of 61 Clovis performs were recovered from the

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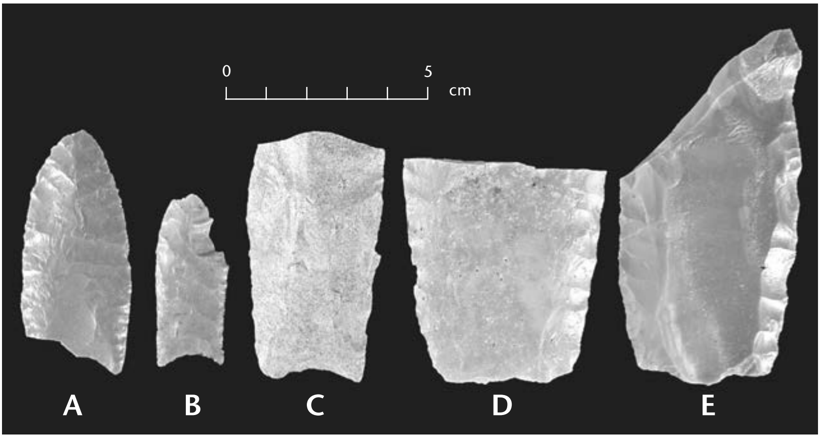

Figure 1. Clovis projectile points (**A–C**) and preforms (**D–E**) from site 40Dv9.

site. Numerous burnt areas and shallow pits were found within the early-Archaic components. A charcoal sample from one of these burned areas, containing a Cobbs knife, yielded a ^{14}C age of 9390 ± 50 RCYBP (10,730 to 10,500 CALYBP) (Beta-234592).

It is unfortunate that a more controlled excavation of this site could not be conducted. Most of the deposits were removed and used to reclaim a landfill some 2 km southeast of the site. Hundreds of early performs and projectile points are known to have been collected from this landfill. We are presently trying to track down these collectors and get their permission to record their finds.

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A Preliminary Report on the Schumann Cache: An Early-Paleoindian Find in Southeastern Minnesota

Dillon Carr, Robert Boszhardt, Andy Bloedorn, Daniel Winkler, and Stephen Wagner

In 2007 a Paleoindian-age cache of silicified sandstone artifacts was rediscovered in storage at the Olmstead County Historical Society, Minnesota. Museum records indicate the cache, donated in 1965 by Mr. Alfred Schumann, had been found near the town of Eyota in southeastern Minnesota. Recent interviews with Mr. Schumann and his brother Adolf provided important contextual information pertaining to discovery of the cache. According to the Schumann brothers, Adolf initially encountered the cache while plowing a field during the late 1930s or early 1940s and both brothers later collected fragments of 23 bifaces and 47 complete flake blanks from what they describe as a "cluster" of artifacts buried approximately 6 inches below the surface. Although the find spot, located on a small rise near the headwaters of the Whitewater River, had been thoroughly searched, Alfred noted that additional materials likely remain at the site.

Technological characteristics of the Schumann Cache bifaces indicate a consistent pattern of biface thinning involving the sequential removal of large expanding bifacial thinning flakes. Several of these bifaces display the regular use of overshot (*outre passé*) flaking during thinning. Subsequent to thinning, a clear pattern of collateral flaking is observed on a number of the bifaces, and in two instances fine pressure flaking occurs along the entire lateral margins. Remnant striking platforms imply the regular use of heavy (often very heavy) grinding. Although related technologically, the cached bifaces, including four extremely large specimens, vary considerably in both overall size and gross morphology. Very large specimens such as these are commonly found within Paleoindian-age caches (Carr and Boszhardt 2003; Frison and Bradley 1999; Morse 1997).

Because the cache lacks diagnostic tool forms, its age must be inferred largely through technological similarities with other caches of known cultural affiliation. Technological characteristics such as the extreme size of the bifaces, occurrences of overshot and collateral flaking, and heavy platform grinding all suggest a probable Paleoindian age for the cache. Moreover, these characteristics indicate the cache may have closer affinities with an early-Paleoindian,

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rather than late-Paleoindian/early-Archaic, occupation. In fact, late-Paleoindian silicified sandstone caches known from the region typically comprise finished bifaces that were intentionally damaged prior to being deposited (Buckmaster and Paquette 1988; Carr and Boszhardt 2003; Mason and Irwin 1960; Ritzenthaler 1972). This suggests that the Schumann Cache may be related to early-Paleoindian biface caches known from the northern Plains and northwest United States rather than the western Great Lakes region.

Visual inspection of the silicified sandstones suggests the use of two high-quality sources that outcrop in western Wisconsin: Hixton Silicified Sandstone (HSS) and Cataract Silicified Sandstone (CSS). The preferential use of an HSS source is a common trait among Paleoindian lithic assemblages in the western Great Lakes region (Carr and Boszhardt n.d.; Loebel 2005). However, the more common use of CSS observed in the Schumann Cache deviates from the regional pattern, but may be due, in part, to the cache's location outside the normal range of movement for Paleoindian artifacts manufactured from HSS.

The Schumann Cache presents a number of potential opportunities for additional research. Initial examination suggests that the silicified sandstones are a mix of CSS and HSS. In an effort to better determine the lithic material sources utilized, individual pieces from the Schumann cache will be analyzed using a Niton portable EDXRF analyzer at the University of Wisconsin–Milwaukee to identify their elemental composition. Positively identifying the raw material sources has specific implications for interpreting the cultural context of the cache. Research planned for the cache find-spot include pedestrian survey of the field, some small-scale excavation, and a possible geomorphological survey of the locality. Additionally, a detailed lithic analysis will be performed on the cache to facilitate comparison with other Paleoindian assemblages to better understand the temporal and spatial context of the Schumann Cache.

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Morphometric Variation in Great Basin Fluted and Unfluted Concave-based Projectile Points from Pleistocene Lake Tonopah and Mud Lake, Nevada

Sam Coffman and Gary Noyes

Temporal placement of fluted and unfluted concave-based projectile points in the Great Basin has remained problematic, since nearly all have come from surface contexts. The Gary D. Noyes collection is an extensive private collection of Great Basin cultural materials from the Tonopah region, south-central Nevada. Pleistocene Lake Tonopah was one of several enormous pluvial lakes that occupied large parts of the Great Basin in the Pleistocene and early Holocene. This playa, located near the southern end of Big Smoky Valley, had a lake area of 246 km^2 with an estimated depth of 24 m (Snyder et al. 1964). Nearby Mud Lake, separated from Lake Tonopah by the San Antonio Mountain range, occupies the southern end of Ralston Valley. Estimates of the size of Mud Lake during the Pleistocene are about 427 km^2 with a depth of 36 m (Snyder et al. 1964).

The Lake Tonopah area is important as a source of information about Nevada fluted points. Of the 114 fluted points from Nevada that were studied by Taylor (2002, 2005), 41 are from Lake Tonopah. The majority of fluted and unfluted projectile points examined by us from the Noyes collection were found along an ancient shoreline of Pleistocene Lake Tonopah (n = 53, including 24 fluted points, 27 unfluted points, and 2 unfinished fluted bifaces (Rondeau and Coffman 2007)), while another 34 points in the collection were found on a remnant shoreline of Mud Lake and along the western edge of the Mud Lake playa (10 fluted, 20 unfluted, 4 questionable fluted points (Rondeau and Coffman 2007)).

Of the 87 projectile points in this study's sample, 6 were dismissed as being either not fluted or of a type generally considered to have been in use later in time. The remaining 81 are concave-based and either fluted (n = 34; Rondeau and Coffman 2007) or unfluted (n = 47; Coffman and Noyes 2007). These latter specimens were subjected to a morphometric analysis to determine if there are statistical differences between fluted and unfluted projectile points from the study area. Metric data (Table 1) were collected from each specimen, and MiniTab version 15 was then utilized to perform a T-test analysis on each attribute to statistically determine whether significant differences occurred between the two point types. The metric variables that guided this analysis came from two sources. The first, Morrow and Morrow (1999), contributed variables which will allow the results of this study to be

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Table 1. Mean metric data and T-test results on fluted and unfluted concave-based projectile points from the Noyes collection.

	Max. width	Basal width	Max. thickness	Basal concavity	Basal width: max. width	Basal concavity: basal width
Fluted mean (mm) n = 34	28.73	22.20	6.30	4.23	0.7712	0.1952
Unfluted mean (mm) n = 47	25.18	17.99	5.238	2.52	0.7163	0.1411
T-test results	T = 3.89 P = <0.001 DF = 70	T = 5.36 P = <0.001 DF = 61	T = 4.82 P = <0.001 DF = 59	T = 4.76 P = <0.001 DF = 58	T = 3.65 P = 0.001 DF = 78	T = 3.08 P = 0.003 DF = 65

compared to other fluted points at a continent scale. The second source for variables was taken from Taylor (2002, 2005) to be consistent with her data on Great Basin fluted points. However, some variables were omitted because they only apply to fluted points, i.e., number of flutes per-side, length of flute, etc. Total metric data consisted of the following measurements: maximum width, basal width, maximum thickness, basal concavity, basal width/maximum width, and basal concavity/basal width. The kind of raw material was also noted. The data presented here are only from finished projectile points.

T-test analysis revealed statistically significant differences between the means of all six variables measured between the two projectile point types (Table 1). Thus, fluted projectile points in the Tonopah/Mud Lake collection are significantly wider (in terms of both maximum width and basal width) and have significantly more concave bases than unfluted projectile points in the collection. Another interesting difference noted during our study is that the fluted points are typically made on obsidian (n = 18, 47 percent obsidian; n = 16, 53 percent ccs) while the unfluted concave-based points are made on cryptocrystalline silicate (ccs) (n = 44, 94 percent ccs; n = 3, 6 percent obsidian). These results are from an initial study into the relationship between the two projectile point forms. It is possible, given the difference in raw material use, that early hunter-gatherers preferred obsidian for producing fluted points, given its predictable fracturing properties. However, the differences noted between the two forms of concave-based points are much greater than just the kind of raw material used or whether they were fluted or unfluted. We therefore conclude that they represent types that differ either culturally or temporally. Future research will help clarify whether metric variation is present within these point types throughout the Great Basin as a whole, and to determine if this is a matter of regional variation. Additionally, a clearer picture may be developed once these data are submitted to the Paleoindian Database of the Americas (PIDBA) to be compared with other larger data from across the continent.

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Evidence for Pre-Clovis Occupation at the Gault Site (41BL323), Central Texas

Michael B. Collins and Bruce A. Bradley

Gault is a prehistoric site in a creek valley where permanent springs, Edwards chert, and a concentration of riparian plant and animal resources occur (Collins 2002, 2007). An Archaic (ca. 10,000–500 CALYBP) burnt-rock midden that covers much of the site has been plundered and little of it remains intact. Excavations since 1991 documented stratified Clovis, Folsom, various late-Paleoamerican, and early-Archaic components in fluvial, colluvial, and alluvial fan deposits below the midden. A 0.8-by-0.5-m test unit (near N1160E1082) was dug in 2002 specifically to investigate artifacts underlying Clovis. No excavation occurred between May 2002 and February 2007 when a second deep unit, 1 by 1 m (N1160E1083), was excavated. This is a preliminary account of the findings in these two units.

Both tests were dug in arbitrary levels and both penetrated two geologic strata separated by an unconformity (Figure 1). The upper unit is a dark silty clay loam with soft carbonate nodules, the lower a limonitic clay with hard carbonate nodules.

Cultural materials were recovered from each arbitrary level in both tests. The upper unit yielded several items diagnostic of Clovis lithic technology.

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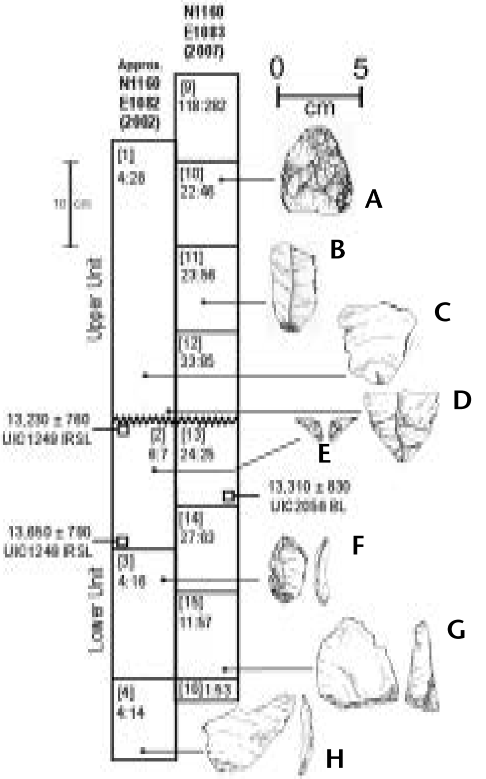

Figure 1. Schematic representation of the upper and lower geologic units, unconformity, arbitrary excavation levels, flake counts, luminescence dates, and selected artifacts (most of which were piece-plotted) from the two deep test excavations at the Gault site. Not shown are overlying strata and midden. Single numbers in brackets identify arbitrary levels; paired numbers with colon report the flake: flake fragment ratio for each level. Specimens: **A,** 4826-1; **B,** 4834-4; **C,** 4250-6; **D,** 4756-3; **E,** 4756; **F,** 4757; **G,** 4844-3; **H,** 4760-1.

These are one fragmentary Clovis point preform (Figure 1A), two Clovis blade fragments (Figure 1B), and several broad bifacial thinning flakes with distinctive platforms (Figure 1C–D). Of non-diagnostic pieces larger than 6 mm, the upper unit (level 1 in ~N1160E1082 and levels 9–12 in N1160E1083) yielded 200 flakes, 497 flake fragments, an angular core fragment, 2 small biface fragments, a small fragment of burned bone, 2 non-diagnostic projectile point fragments, 2 retouched flakes, and 99 angular chert fragments. The lower unit (levels 2–4 in ~N1160E1082 and levels 13-16 in N1160E1083) yielded a very small fragment of a thin biface (Figure 1E), 77 flakes (Figure 1F–H), 235 flake fragments, and 5 angular chert fragments.

Technologically, flaking debris from the lower unit lacks distinctive attributes of Clovis knapping. There is no blade-production debitage nor Clovis-style biface-production debris such as overshot flakes, broad thinning flakes with prominent but small platforms, or channel flakes. This raises the possibility that a different flaked-stone assemblage is present below the Clovis component in this part of the Gault Site.

One BL and two IRSL luminescent ages greater than 13,200 CALYBP determined on quartz and feldspar grains from the upper 20 cm of the lower unit (Figure 1) further suggest that the unit and the artifacts found within it predate the Clovis interval (Waters and Stafford 2007), especially the lower 30 cm of the unit.

We thank the following for their contributions to this report: Gault staff Sam Gardner, excavator of unit ~N1160E1082 in 2002, and Clark Wernecke, who drafted the profile for Figure 1; Pam Hendrick, artifact drawings; University of Exeter students Sophie Thorogood, Ann Oldroyd, Matt Palmer and Nick Tingley, excavators of unit N1160E1083 in 2007; and Steve Forman of the Luminescence Dating Research Laboratory, University of Illinois at Chicago, for collecting and analyzing the luminescence samples.

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The Brushy Creek Clovis Site: A Paleoamerican Occupation in Hunt County, Texas

Wilson W. Crook III and Mark D. Hughston

The Brushy Creek Site (41HU74) is located in an alluvial exposure along Brushy Creek in western Hunt County, Texas, approximately 500 m east of the Hunt-Collin County line. An initial program of archaeological testing and geologic study is in progress by the authors. This paper provides a preliminary description of the site, its geologic context, and the recovered lithic assemblage to date.

The Brushy Creek Clovis site was discovered in July 2004 when the authors found a single Clovis point exposed in a large point bar immediately below a major embankment along Brushy Creek. The site is situated on the western edge of the Sulfur River drainage system. Unlike the Trinity River basin to the west, Brushy Creek does not have a well-developed terrace system. Instead, Brushy Creek is an intermittent stream with little to no water at some times of the year while at others it is in high-velocity flood stage. As a result, both Holocene and Pleistocene sediments are exposed in a deep cut lying unconformably on weathered portions of the late-Cretaceous Marlbrook Marl of the Taylor Group (Upper Campanian Stage). Pleistocene and Holocene soils are gray-black to black organic-rich calcareous clays typical of the Black-

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land Prairie physiographic province. These soils are characterized by low permeability, which inhibits the growth of trees except along major waterways thereby creating an alternating terrain of open prairie uplands interlaced by a serpentine network of woodlands. Precise identification of the contact boundary between the units and their relative ages is still being worked out.

Archaeological investigation to date has revealed a number of additional tools of apparent Clovis affinity including a large Clovis perform broken during manufacture, five large blades, five bladelets, two broken fragments of bifaces, six unifacial thumbnail endscrapers produced on both blades and flakes, three multi-point gravers, two large flakes with unilateral retouch, a single well-used hammerstone, a large overshot flake, a small bladelet constructed of mussel shell, a broken fragment of an apparent limestone gorget, and a well-worn piece of red ocher. The Clovis point (Figure 1) was found with an extensive coating of red ocher near the tip. X-ray powder diffraction analysis confirmed the material as hematite, Fe_2O_3.

Figure 1. Clovis point from Brushy Creek site (41HU74), Hunt County, Texas. Dark coloration near tip is red ocher, identified as the mineral hematite, Fe_2O_3.

Measurement and plotting of the large blades on a triangular configuration diagram as developed by Collins (1999) and Collins and Lohse (2004) show they have a close affinity in terms of length, width, and thickness ratios to similar blades from Oklahoma Clovis sites, including Domebo, Anadarko, and Cedar Creek. All the blades from Brushy Creek have extensive unilateral or bilateral retouch.

Notably, with the exception of a single flake graver and the small hammerstone, all lithic materials recovered are of non-local origin. A similar observation of a preference for imported lithic material was observed by Ferring (2001) at the Aubrey site (41DN479) some 50 km to the northwest.

Edwards chert, Boone chert, a coarse-grained opalescent quartzite (possibly Tecovas), and a number of other unidentified cherts constitute the artifact assemblage.

To date, virtually all the artifacts have been found within the eastern margins of the point bar. Only the broken Clovis perform was found in situ in the adjacent embankment. Subsequent excavation, however, showed the soil block containing the perform had been dislodged by erosion from above. Initial archaeological testing on the embankment has yet to produce any materials that are definitely in situ. However, the fragile nature of many of the artifacts, coupled with lack of noticeable stream polish, especially on the blades, has led us to conclude that artifacts eroding out of the embankment are bring trapped immediately in the point bar below.

No Pleistocene faunal remains have been found directly at the site. In a second point bar located 50 m downstream, however, fragments of mastodon (*Mammut* sp.) tooth enamel and horse (*Equus* sp.) teeth have been recovered. Local collectors report both bison and mammoth bones from a small tributary of Brushy Creek further downstream. Future work will focus on determining the age of the site as well as a comparison of the large blades with other Texas Clovis localities (Gault, Pavo Real, Keven Davis, etc.) and the Clovis affinity of the bladelets.

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New Support for a Late-Pleistocene Coastal Occupation at the Indian Sands Site, Oregon

Loren G. Davis

Archaeological investigations at the Indian Sands site (35CU67c) on Oregon's southern coast produced evidence of repeated cultural occupation beginning in the late Pleistocene into the Holocene (Davis et al. 2004; Moss and Erlandson 1998). Previous papers have dealt with the site's geoarchaeological context (Davis 2006; Davis et al. 2004), lithic technology (Willis 2004, 2005), and marine

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faunal remains (Moss and Erlandson 1998). This paper presents new thermoluminescence (TL) assays that support claims for a late-Pleistocene occupation.

Archaeologically relevant stratigraphic units at 35CU67c include pedogenically altered aeolian sediments of the 3Ab horizon, which are unconformably overlain by aeolian sands of the 2C horizon (Figure 1). Davis et al. (2004) argue that the lower part of 3Ab contains a late-Pleistocene cultural occupation based on a 10,430 ± 150 RCYBP (12,300 ± 490 CALYBP) date from wood charcoal excavated in situ in the lower part of the 3Ab horizon in direct stratigraphic association with lithic artifacts, positioned ca. 10 cm above the 3Ab-4Bsb contact. The position of this AMS date is plausible given its stratigraphic position relative to other chronometric dates at the site (Figure 1).

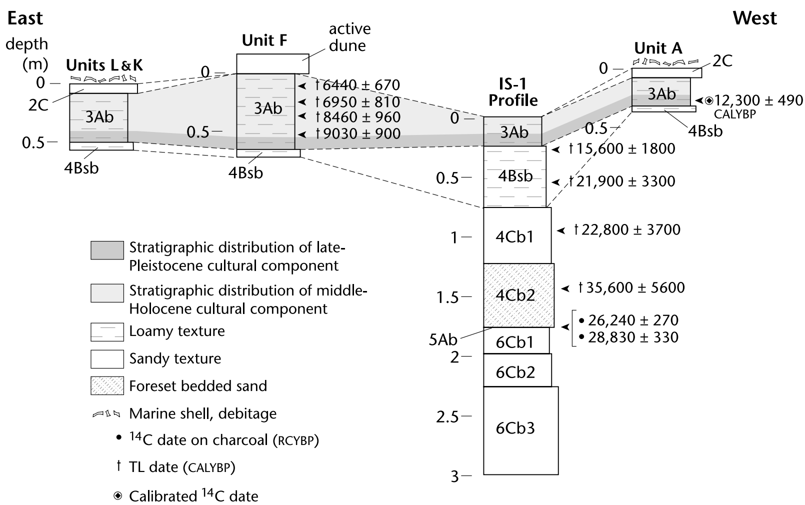

Figure 1. Stratigraphic correlation, position of new thermoluminescence dates from excavation Unit F, and distribution of buried archaeological components at the Indian Sands site (35CU67c), southern Oregon coast. Details on pedogenic horizonation and undiscussed chronometic ages are reported in Davis et al. (2004).

In 2003, a vertical series of four TL samples were collected from the 3Ab horizon in excavation Unit F to test the site chronostratigraphy established by Davis et al. (2004). TL samples were collected in copper tubes 10 cm long and 3 cm in diameter, driven into a freshly cleaned profile in Unit F. Background radiation samples were taken 2 cm above and below each of the TL sample tubes. These samples were sent to Nicholas Debenham at Quaternary TL Surveys in Nottingham, UK, and were studied following a standardized set of pretreatment and analytical methods (available at http://www.users.globalnet.co.uk/~qtls/index.htm#contents). These four TL samples returned ages between 9030 ± 900 CALYBP and 6440 ± 670 CALYBP (Figure 1).

Luminescence dating of pedogenic horizons can be problematic owing to mixing of sediments with widely variable exposure histories; however, in a depositional context where sediments accumulate slowly and are subjected to limited vertical mixing, the use of luminescence dating may reveal when a stratigraphic unit was completely buried and no longer subject to the processes of bioturbation. As sediments gradually accumulate, this zone of bioturbation is incrementally elevated and deeper portions of the deposit no longer receive light-exposed sediments. Once sediments achieve this level of stability they begin to accumulate a TL signal. In this context, a TL date from the 3Ab horizon indicates when that portion of the site was fully buried and no longer influenced by bioturbation. Thus these new TL ages provide minimum limiting ages on deposition since the timing of sedimentation must be older than their associated TL age. The 3Ab TL chronology supports the previous interpretation made by Davis et al. (2004) that early hunter-gatherers occupied Indian Sands during the terminal Pleistocene and provides a means of separating early from later cultural components.

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Recent Observations about Late-Paleoamerican Adaptations in Northern New Mexico

Robert D. Dello-Russo and Patricia A. Walker

It has recently been argued that late Paleoamericans in western North America, specifically in Wyoming and Colorado, were adapted to both Plains and foothills-mountain environments (Frison 1991, 1992; Jodry 1999; Pitblado 2003). The foothills-mountain adaptations were characterized by a variety of lanceolate, stemmed, and fishtail projectile points, flaked in a parallel-oblique

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pattern and generally made of locally available raw materials. The use of these materials suggests relatively limited ranges of mobility for late Paleoamericans compared with Clovis or Folsom groups. These formal tools have also been associated with the hunting of small numbers of mountain sheep and mule deer (Frison 1992).

Recently discovered projectile points and projectile point fragments (Table 1) provide further evidence of a late-Paleoamerican (ca. 9400–7900 CALYBP) presence in New Mexico (cf. Shackley and Vierra 2005). Also noteworthy are the geographic settings for these points (Table 1), which may suggest late-Paleoamerican foothills-mountain adaptations in both northern and central New Mexico.

Table 1. Locational data for seven recently discovered late-Paleoamerican projectile points in New Mexico.

Site number or name	Point types	General location	Environmental zone	Reference
LA148949/Chamita Ridge I; LA148950/ Chamita Ridge II; LA148951/ Chamita Knoll	James Allen; Scottsbluff Sierra Vista-like [1]	Northern NM near Chama	Mountain foothills/ major elk migration route into south San Juan Mts./ adjacent to river tributary	Dello-Russo 2005, 2006b
LA145364/Agua del Cañoncito	Sierra Vista-like	West of Albuquerque, NM; east slopes of Mount Taylor	Upland-Lowland transition/ near spring	Dello-Russo 2006a
LA149129 & nearby isolate	2 James Allen-like or Sierra Vista-like	West of Socorro, NM	Magdalena Mountains and foothills/adjacent to major arroyo drainage	Walker & Dello-Russo 2005
LA134764/Water Canyon	Scottsbluff	West of Socorro, NM	Basin-mountain transition/ adjacent to major drainage from Magdalena Mts.	Dello-Russo 2001

[1] Sierra Vista points have been attributed to late-Paleoamerican occupations in southern Colorado (Jodry 1999:96). The Sierra Vista–like point from Chama is a stemmed, fish-tail (or expanding), concave-base point that may be more similar to the Pryor Stemmed type seen in Wyoming (Husted 1969:52, Figure 23).

X-ray fluorescence (XRF) source data for points from sites near Chama, New Mexico (Dello-Russo 2005, 2006b; Shackley 2005), indicate that late Paleoamericans obtained obsidian from the El Rechuelos source on the northern flanks of the Jemez Mountains in northern New Mexico (James Allen point), dacite from the Newman Dome source near Taos, New Mexico (unnamed Sierra Vista-like or Pryor Stemmed-like point), and dacite from the San Antonio Mountain source northwest of Taos (Scottsbluff point). In each case the source is no farther than 88 km from the related projectile point, thus suggesting that the mobility of the late Paleoamericans (at least for toolstone procurement) was relatively local in scope. The XRF data from the Chama sites also underscore the probable existence of two distinct north-south corridors of late-prehistoric mobility between the San Luis valley in southern Colorado and the Jemez Mountains—one through the Rio Grande valley (cf. Vierra et al. 2005) and another through the Rio Chama valley.

Finally, in addition to the several late-Paleoamerican projectile-point types, both fossilized bone (species currently undetermined) and butchering tools have been recovered at the Chama sites. These discoveries, coupled with the fact that the Chama sites now fall within a major elk migration route, make this suite of sites an ideal archaeological laboratory to examine the nature of late-Paleoamerican subsistence and technology in the foothills of northern New Mexico.

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A Method of Platform Preparation on Clovis Blade Cores at the Gault Site (41BL323), Texas

William A. Dickens

Researchers of Clovis lithic technology have identified a number of diagnostic reduction techniques related to biface and blade manufacture (Bradley 1991; Callahan 1979; Collins 1999; Sanders 1990). As more assemblages are studied, new techniques continue to be revealed (Dickens 2005). One such technique noted in the assemblage from the Gault site in Bell County, Texas, involves platform preparation on blade cores.

Examination of blade cores from Texas A&M excavations in Area 8 demonstrated that both conical and wedge-shaped cores retained deeply concave flake scars on platform surfaces. These flakes vary in size (Figure 1) but in cross section are consistently "V-shaped" like a bird wing. This flake form is present in geographically and chronologically diverse cultures such as the Mousterian Levallois, Egyptian Neolithic, and Near Eastern Bronze Age, where they are noted in debitage assemblages from both flake and blade industries (Inizan et al. 1992:80–82). They are detached by consistently striking the same point on a core face directly below the previous winged-flake removal, increasing the size and depth of the bulb of percussion with each subsequent detachment.

Recently I examined 63 winged flakes recovered from Area 8 (Dickens 2005:215–20). Like their Old World counterparts, lateral edges of these flakes flare upwards from a central, or slightly lateral, concavity. The nadir of this trough truncates the proximal end of a preexisting blade scar, while lateral edges intrude into more recent blade scar removals. The depth of the concave surface suggests that Clovis knappers employed a number of purposeful sequential removals to create their depth and size. Multiple flake scars may overlap on the same core. The specimens from Gault are generally wider than they are long, with depths up to 37.0 mm. Many of these flakes fit comfortably within the concavities noted on blade cores, but no refits have been found to date. Both secondary and tertiary cortical forms are represented. Platforms are primarily unfaceted; thicknesses range from 2.1 to 5.2 mm and widths range from 9.2 to 23.8 mm.

Experimental replication showed that as each flake was detached the lateral margins of the flake became steeper, forming a slight promontory on the core surface, while the distal end of the winged flake tended to slightly dive into the core surface. Twenty-seven percent terminated in hinge or step fracture. This results in single or multiple sequences that form a prominent and isolated platform on the edge of a core that requires only minimal abrading or flaking to create an appropriate striking angle for subsequent blade removal. Therefore, removal of winged flakes appears to have been a purposeful technique

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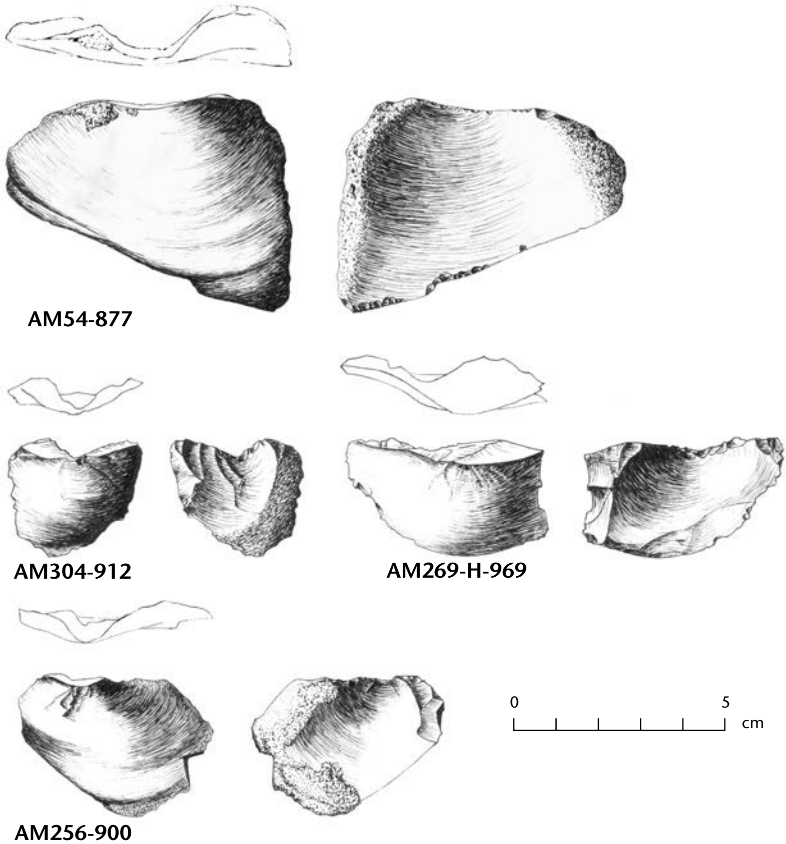

Figure 1. Selected winged flakes from the Gault site (41BL323), Texas. Illustrations by Richard McRenolds.

used to create and isolate a platform for further blade detachment. The presence of cortical wing flakes suggests that this method was employed during initial platform preparation, not just in later stages of blade-core reduction.

At present, among Clovis assemblages this flake form has only been reported for the Gault site; however, future work may lead to its recognition at other sites.

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Two Chipped-Stone Crescents from CA-SMI-680, Cardwell Bluffs, San Miguel Island, California

Jon M. Erlandson, Todd J. Braje, and Grant J. Snitker

Found in early sites across much of western North America (Tadlock 1966), roughly 100 chipped-stone crescents are known from the California Coast, where they are usually found in early-Holocene sites (Fenenga 1984; Jertberg 1984). Nearly half this total came from California's Channel Islands, most from amateur or antiquarian collections with limited provenience and little chance of secure dating (e.g., Wardle 1913). Erlandson (2005) reported the first securely dated island crescent, a specimen from Daisy Cave (CA-SMI-261) found in a shell-midden stratum dated ca. 10,200–8600 CALYBP. Erlandson and Braje (2008) also described five crescents from CA-SMI-679, a site recently ^{14}C-dated to the terminal Pleistocene, one of three sites (with CA-SMI-678 and -680) that constitute a large quarry/workshop complex located on the bluffs overlooking Cardwell Point on eastern San Miguel.

Here we describe two crescentic bifaces found on the deflated surface of CA-SMI-680, the northernmost of the Cardwell Bluffs sites, which caps an ancient dune ridge between two major chert sources (see Erlandson et al. 1997, 2008). Heavily eroded, CA-SMI-680 contains lithic debris scattered across three loci on terraces that rise from the southeast to the northwest. The southeast locus produced several leaf-shaped bifaces and two crescents, but no in situ organic remains for radiocarbon dating. The northwest locus contains an undated shell midden and artifacts probably deposited in the late Holocene. An intermediate locus produced numerous biface preform fragments and appears to contain a mixture of early and later materials.

The two crescentics from CA-SMI-680 resemble Tadlock's (1966:663) Type I/II (Quarter or Half Moon) crescents (Figure 1; see also Justice 2002). Both

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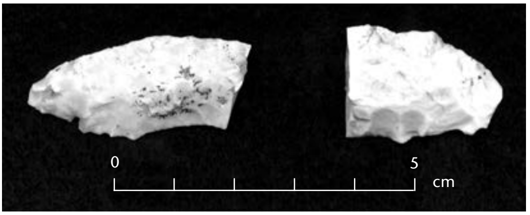

Figure 1. Crescentic fragments from CA-SMI-680 (left: SMI-680-51; right: SMI-680-52).

are made from local Cico chalcedonic chert, available as cobbles in a raised beach deposit immediately to the south and in a large dike eroding from bedrock exposures a short distance to the north. Both specimens are heavily patinated and show signs of abrasion from sandblasting associated with dune erosion and deflation. CA-SMI-680-51 (38.4 mm long, 16.5 mm wide, 5.1 mm thick, 3.15 g) is finely flaked and represents 70–75 percent of a finished crescent. CA-SMI-680-52 (26.1 mm long, 19.6 mm wide, 6.9 mm thick, 3.8 g) is more crudely flaked and appears to represent ca. 40 percent of a crescent preform. Two small protuberances on one side of the preform are characteristic of several other crescents found at CA-SMI-678 and CA-SMI-679 (see Erlandson and Braje 2008:40).

Elsewhere in the western United States, chipped-stone crescents may extend into the middle Holocene, but numerous Channel Island sites dated ca. 7500–5000 CALYBP have been excavated or examined and none have produced crescents. Recently, moreover, crescents found in several Northern Channel Island sites have been found in contexts ^{14}C dated to the terminal Pleistocene or early Holocene, where they are associated with other early time markers.

The function of crescents in California and the Great Basin has been long debated, but their contexts on the Channel Islands suggest that they were part of a hunting technology. Given the very limited terrestrial fauna on the Channel Islands, we suspect they were transverse points used in hunting birds. Finally, the CA-SMI-680 crescents provide additional evidence for a substantial presence of early maritime peoples on California's Channel Islands. Across western North America, the similarity of crescents suggests either a common origin for early coastal and interior peoples or extensive interaction between them.

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New Paleoindian Sites from the Central Great Basin: Jakes Valley, Nevada

Mark B. Estes

During the summer of 2006, archaeologists sponsored by the Sundance Archaeological Research Fund at the University of Nevada, Reno, conducted pedestrian survey in Jakes Valley, a small pluvial lake basin about 25 km west of Ely, Nevada (Figure 1). Project goals were to locate, document, collect, and analyze Paleoindian-site assemblages (Estes and Goebel 2007). Sampled areas included fossil beach ridges, the deltas of the two main streams flowing into the valley, and areas of slightly higher and lower elevations than where previously recorded Paleoindian sites had been found.

Seven new Paleoindian archaeological sites (four single-component and three multicomponent) were documented. Two single-component Western Clovis point sites yielded three fluted points or point fragments, a crescent, numerous bifaces, scrapers and debitage. Raw materials consist primarily of cryptocrystalline silicates (CCS) (tools: 95 percent [n = 21]; debitage: 97 percent [n = 176]), with small amounts of obsidian (tools: 5 percent [n = 1]; debitage: 2 percent [n = 4]), and very little exploitation of other materials (rhyolite) (debitage: 1 percent [n = 1]). Two single-component and 3 multicomponent Paleoindian-Archaic sites contained 16 examples of complete and fragmentary stemmed points, 3 of which were manufactured from CCS, 2 from obsidian (one isolated find found in the southern portion of the valley), and 11 on fine-grained volcanic rock (FGVR). Diagnostic Paleoindian artifacts were collected from multicomponent sites, and also debitage if it was clearly separated from later Archaic materials. The Great Basin Stemmed Series (GBSS) assemblages contained a much higher frequency of FGVR (tools: 52 percent [n = 16]; debitage: 18 percent [n = 32]), lower frequency of CCS (tools: 35 percent [n = 11]; debitage: 75 percent

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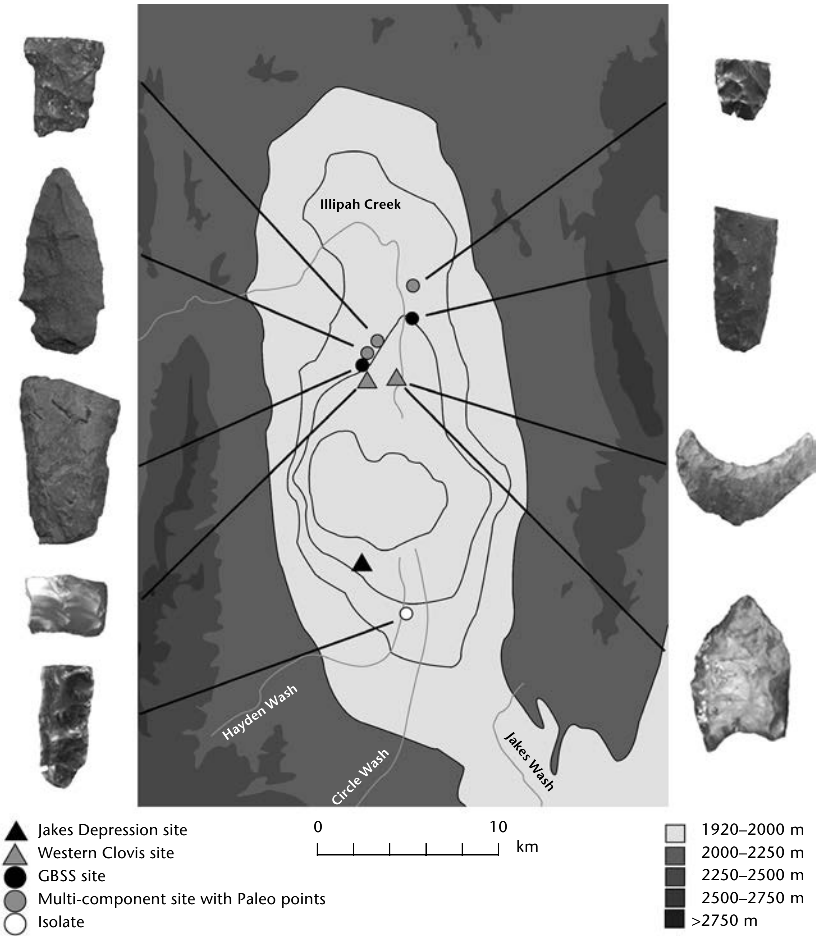

Figure 1. Location of Paleoindian sites and associated tools found during the 2006 survey of Jakes Valley in relation to the Jakes Depression site, a large Paleoindian site collected in 2003 by the University of Nevada, Reno.

[n = 137]), and low frequency of obsidian (tools: 13 percent [n = 4]; debitage: 7 percent [n = 13]).

Because Northwest Research Obsidian Studies Laboratory offers easily attainable sourcing information, obsidian artifacts are used to highlight differences in Jakes Valley Paleoindian conveyance zones. Results suggest that Western Clovis makers generally utilized obsidian sources south of Jakes Valley (Wild Horse Canyon, UT (230 km) [n = 1], and Montezuma (240 km) [n = 2] and Queen (320 km) [n = 1] in southwestern Nevada) with little utilization of sources to the north (Browns Bench, ID (280 km) [n = 1]). GBSS makers similarly utilized two sources (Wild Horse Canyon, UT [n = 1]; and Browns Bench [n = 1]), along with Obsidian Butte (260 km) (n = 13), and

Tempiute Mountain (160 km) (n = 2), both in southern Nevada. These results, although from a small sample, are consistent with those reported in Estes (2008) and show a preference of GBSS makers for Obsidian Butte obsidian, whereas fluted-point makers had no such clear preference. Further sampling is needed in the Jakes Valley obsidian assemblage to determine if this pattern holds. The results of this study will provide further data on the little-understood Paleoindian occupation of the central Great Basin by describing obsidian conveyance zones utilized within a small valley in eastern Nevada, and will add to the overall picture of Paleoindian toolstone acquisition within the Great Basin.

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An Unfinished Folsom Point Base from NE Arizona

Phil R. Geib and Julie Solometo

Few Paleoindian sites are reported for the Colorado Plateau of the North American Southwest (Davis 1985, 1989; Hesse et al. 1996, 1999; Mabry 1998). Aside from erosion and burial, part of the reason for this may be the heavy overlay of artifactual debris from intensive use of the region by subsequent farming populations that swamps the diffusely scattered remains from the earliest temporal intervals. A probable example of this problem came to light in June 2005 during an excavation project (James Madison University field school) on the Sitgreaves National Forest in Arizona. From the surface of a large (34,500 m^2) site dating to the late-prehistoric period (ca. AD 850–1300), the second author recovered the basal section of a Folsom projectile point (Figure 1). No other Paleoamerican artifacts were located on the surface or in a shallow (10 cm) 1–m^2 test unit excavated in the immediate vicinity, but characteristics of the point fragment reveal that it is a production mistake and thus likely to have been deposited close to its find location, rather than an instance of inadvertent loss or a scavenged artifact.

The point is made from a fossiliferous grey chert perhaps derived from gravel deposits along the Little Colorado River 50 km north of the site. The

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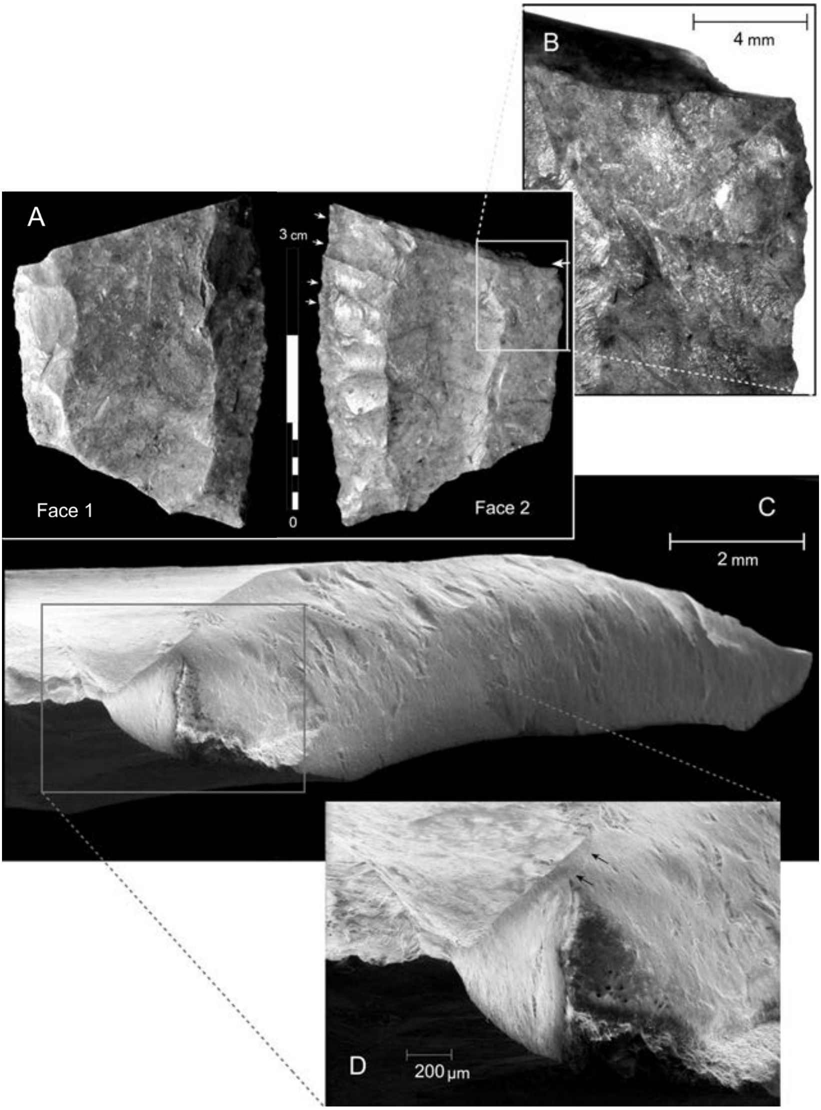

Figure 1. Images of the unfinished Folsom point base from site AR 03-01-02-0292 (USFS), Sitgreaves National Forest, Arizona. **A,** standard digital photographs of both faces with small white arrows showing the pressure flake scars that partially invade the flute scar of Face 2; **B,** digital microphotograph at 20x that shows the post-flute pressure flake on face 2 that truncated the biface; **C,** SEM image at 30x showing oblique edge-on view of the perverse fracture and the remnant scar of the initiating pressure flake; **D,** SEM image at 100x of the point of initiation; note the angled crack (small black arrows) that clearly reveals the direction of fracture away from the point of initiation.

point is fluted on both faces but unfinished; it lacks edge abrasion or preparation of the base for hafting. A corner of the base is missing on account of a crenated fracture. Maximum dimensions of the recovered basal fragment are 33 mm long to the break, 28.5 mm wide, and 4.9 mm thick; within the flutes the point is 3.5 mm thick at the break and just 2 mm thick in the bulbar swelling. The first flute is 14–17 mm wide, averaging 15.5 mm, while the second flute is 11–13 mm wide averaging 12 mm. The second flute is well-centered but shallow (something of a "skimmer"), rising toward the distal end. This channel flake scar is invaded by lateral pressure flakes near the distal break, and one of these has a deep initiation that truncated the piece by perverse fracture, as is shown in Figure 1. The post-flute retouch on face 2 appears to be directed at reforming the surface topography on this face, perhaps simply to reduce the thickness from an inadequate channel flake removal, but perhaps with the intent of attempting to reflute this face.

In either case, the unfinished nature of the point, combined with a lack of evidence for later modification or use, suggests that this point was recovered from the approximate location of final production. If fluting itself was not actually attempted on site, at least the flaking directed at modifying face 2 surface topography of the distal end occurred there. This is one example on the Colorado Plateau where the abundant remains from Puebloan occupation might be obscuring a small Folsom assemblage. More detail about this find can be found at www.jmu.edu/archaeology.

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Obsidian from the Late-Pleistocene Walker Road Site, Central Alaska

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The Walker Road site (HEA-130) is located about 12 km north of Healy, Alaska, in the northern foothills of the central Alaska Range (Goebel et al. 1996). From 1984 to 1990 archaeologists under the direction of W. R. Powers conducted excavations at the site. Chief among their discoveries was a terminal-Pleistocene cultural component (called component I) dating to about 11,300–11,000 RCYBP (Goebel et al. 1996; Hamilton and Goebel 1999). The artifact assemblage from component I contained 4,491 lithic pieces, 184 of which were retouched into a variety of forms, including endscrapers, sidescrapers, bifaces, bifacial points, gravers, cobble tools, and notches/denticulates (Goebel et al. 1991). This assemblage became the "type-assemblage" for the Nenana complex, the first group of Beringian archaeological sites unequivocally dated to at least the age of Clovis in temperate North America (Hoffecker and Elias 2007; Hoffecker et al. 1993).

In the 1980s, as the Walker Road site was being excavated, analyses of the artifact assemblage focused on typological comparisons with other assemblages (Goebel et al. 1991), and little attention was paid to reconstructing technological activities and toolstone provisioning at the site. To rectify this, the paper's lead author is currently engaged in a detailed reanalysis of the Walker Road and other Nenana complex collections (Graf and Goebel in press). The coauthors recently initiated a large-scale obsidian-sourcing program in Alaska, and here we present together the results of geochemical analysis of obsidian artifacts in the Walker Road assemblage.

Lithic raw materials in the component I assemblage are primarily cherts, chalcedonies, and fine-grained volcanic rocks (e.g., rhyolite and basalt) (96 percent), while obsidians make up less than 1 percent of the assemblage. The obsidian artifacts (n = 24), however, present an interesting case, since this toolstone type does not occur naturally in the Nenana valley and central North Alaska Range, unlike the other more prevalent raw materials. We anticipated that all of the obsidians were transported a great distance to the site, and thus could provide information about long-distance transport of lithic materials and potential relationships with other late-Pleistocene complexes in Alaska.

The 24 obsidian artifacts include 20 debitage pieces and 4 tools. Nearly all the debitage pieces are very small in size (< 1 cm^2), and they include biface

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thinning flakes (3), retouch chips (i.e., pressure flakes) (4), retouch chip fragments (8), flake fragments (2), angular shatter fragments (2), and a blade-like flake fragment (1). Significantly, none bear cortex on their dorsal faces or platforms. Of the 20 debitage pieces, 15 are likely the product of secondary reduction, while none are unequivocally the product of primary reduction. The tools include two retouched blade fragments, an endscraper, and a retouched flake.

We subjected 19 of the 24 obsidian artifacts from the component I assemblage to geochemical analysis, 17 using X-ray fluorescence (XRF) and 2 by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Results indicate that two sources are represented: Wiki Peak and Unknown Group A′. Wiki Peak is located in the northern Wrangell Mountains, along the Alaska-Canada border about 450 km east-southeast of Walker Road. The geologic source of Group A′ (also known as Ringling) is unknown, but based on its overall geographic distribution across central Alaska, a source area near Gulkana is hypothesized. This would put the source about 200 km southeast of Walker Road. Six artifacts are attributable to Wiki Peak (4 debitage pieces, an endscraper, and a retouched flake), while 13 are attributable to Group A′ (11 debitage pieces and 2 retouched blades). The higher proportion of Group A′ artifacts is probably not a reflection of higher use of this obsidian source, since all the debitage pieces could have been detached from the four tools represented.

The early evidence for use of Group A′ and Wiki Peak at Walker Road adds more evidence that late-Pleistocene humans in central Alaska utilized multiple sources of obsidian that were widely separated across the region. Nearby Dry Creek (component II) yielded obsidian artifacts sourced to Wiki Peak, Batza Tena, and unknown Group K, and the Chindadn component at Healy Lake yielded artifacts from Wiki Peak, Group A′, Batza Tena, and unknown Group H (Cook 1995). An obsidian artifact from Batza Tena also was found in one of the late-Pleistocene occupations at Broken Mammoth (Cook 1995), and artifacts identified as Batza Tena and unknown Group H occur in the early assemblages (cultural zones 3 and 4, respectively) at Swan Point (Speakman et al. 2007) and among potentially early artifacts from Nogahabara (Odess and Rasic 2007) (although the obsidian artifacts in this assemblage may relate to a younger middle-Holocene occupation). The wide distribution of these sources throughout central Alaska's late-Pleistocene archaeological sites points to the existence of extensive lithic conveyance zones, developed through pervasive exchange networks and/or large-scale mobility within settlement systems (Holmes 2001). In all these cases, however, the proportion of obsidian artifacts to artifacts made on other toolstones is very low, indicating obsidian procurement was a small facet of the complete lithic technological systems of Alaska's earliest residents.

XRF and LA-ICP-MS analyses were conducted at the Smithsonian Institution's Museum Conservation Institute. Many thanks to John Cook, Natalia Slobodina, Jeff Rasic, Nicole Little, and Javier Iñañez for their assistance with various aspects of this project. All data generated by this study have been incorporated into the Alaskan Archaeological Obsidian Database, a joint-venture of the Smithsonian Institution, National Park Service, and University of Alaska Fairbanks.

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New Investigations of the Cody-age Finley and Scottsbluff Bison Bone Beds

Matthew E. Hill, Jr.

During a study of regional and temporal variation in Paleoamerican land use and subsistence strategies (Hill 2007), I analyzed the extant bison assemblages from the Scottsbluff (25SF2) (Barbour and Schultz 1932, 1936; Schultz and Eiseley 1935, 1936; Todd et al. 1990) and Finley (48SW5) (Frison 1991; Haspel and Frison 1987; Mayer 2003; Todd and Hofman 1987) sites to gain a better understanding of site age, assemblage composition, and formational history.

The Nebraska State Museum excavated the Scottsbluff Bison Quarry in 1932 (Barbour and Schultz 1932; Schultz and Eiseley 1935). The site is located near the confluence of Spring and Kiowa creeks in the southwestern corner of Scottsbluff County, Nebraska. The bone bed was situated within a 2-m-thick

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alluvial deposit composed of coarse sand and boulders. Todd et al. (1990) have previously interpreted the site as a late-spring or summer (N+0.1 to 0.3)[1] kill locality.

The Finley site is located within the Killpecker dune field in the Green River basin of Sweetwater County, Wyoming. The faunal remains described here come from the University of Wyoming (UW) 1970s and '80s excavations of a pot-hunted bison kill/processing locality (Station B) (Haspel and Frison 1987; Miller 1987). Bison remains previously recovered by the University of Pennsylvania in a different part of the site (Station A) are not included in this study (Hack 1943; Howard 1943; Moss 1951). Todd and Hofman (1987) suggest the bison excavated by UW died in the fall (N + 0.6).

New purified-collagen AMS ^{14}C dates were obtained from museum bone samples from both sites. Two different humeri from Scottsbluff dated to 8939 ± 85 RCYBP (AA-67443) and 8680 ± 85 RCYBP (AA-67442). This is the first radiometric age estimate for the Scottsbluff-type locality. Since the older date had better collagen preservation and resulted in a higher carbon yield, it is thought to be the more reliable estimate. Three different petrous bones from the Finley collection dated to 9306 ± 87 RCYBP (AA-74895), 9145 ± 88 RCYBP (AA-74896), and 9158 ± 84 RCYBP (AA-74897). These dates are considered reliable and overlap at the 95 percent confidence level. They are also compatible with prior dates for the site (Craigie 1985:49; Frison 1991:Table 2.2).

My 2005 inventory of the entire Scottsbluff bison assemblage recorded 1,461 specimens. Major limb bones, crania, and cervical vertebrae compose the majority of the collection. Very small and easily disarticulated elements, such as sesamoids and accessory portions of the metapodials, were noticeably missing. Scottsbluff bones were mostly whole and showed limited evidence for damage from carnivores, subaerial weathering, or root etching. The numerous broken bone fragments reported present in the bone bed during excavations are missing from the museum collection (Barbour and Schultz 1936; Schultz and Eiseley 1935). Definitive human butchery or impact marks were not identified. I estimate an MNI of 26 animals, and measurements of 40 calcanei (MNI = 23) suggest a cow-calf herd (13 percent adult bulls, 35 percent adult cows, and 52 percent calves) is represented. In addition, skeletal element abundance is strongly correlated ($r_s = -.58$, $p < 0.05$) with estimates for the fluvial transport potential of bison bones (Todd 2003). This suggests that water action caused significant winnowing of small, light bones and possibly artifacts away from the site. This conclusion fits with the bone bed's being located in a high-energy alluvial deposit and the surfaces of many bones showing striations suggestive of tumbling in a stream.

The 2006 analysis of the UW Finley bison assemblage involved the examination of 8,033 appendicular elements and cranial (petrous) bones and fragments. This study examined substantially more of the collection than did earlier work by Haspel and Frison (1987) or Todd and Hofman (1987). A

[1] This notation system refers to the time, measured in 0.1-year intervals (ca. 36 days), since the presumed spring birth pulse for bison (N). For example, assuming a normal spring birth pulse (ca. end of April), a dental-age estimate of N + .1 to N + .3 would suggest the animals were killed sometime between the beginning of June and the middle of August.

minimum of 82 bison are represented in the Finley collection, and measurements from 134 calcanei (MNI = 64) suggest the site represents predation on a cow-calf herd (38 percent adult bulls, 20 percent adult cows, and 42 percent calves), which contrasts with earlier suggestions that the Finley site represented a bull herd (Haspel and Frison 1987).

Although highly fragmented, all major limb elements are well represented in the Finley collection (percent MAU = 75–96 percent), including small limb bones such as carpals, tarsals, and phalanges (percent MAU values > 65 percent). That petrous fragments suggest a percent MAU value of 88 percent for crania may indicate that axial elements are also be well preserved at the site. Just 19 cutmarks and one impact fracture were identified in the collection, although damage by pothunters' excavations probably obscures additional evidence for human butchery. Overall, despite the prior vandalism at the site and some selective recovery (¼-inch screen) by archaeologists during and after excavations, it would appear that originally the Finley site contained mostly complete skeletons.

In conclusion, this new work provides a new perspective on these important Cody-age sites. The Scottsbluff type-site probably represents a late-spring or early-summer kill of 26 bison. The bone bed has been extensively reworked by fluvial actions, and as a result the association between the artifacts and bison bone from the site may not be as secure as previously believed. Previous studies of the Finley assemblage suggested a much smaller kill event and a more biased faunal collection than may actually be the case. Despite intense pot-hunting disturbance, the Finley collection may still retain much research potential.

George Corner of the Nebraska State Museum facilitated access to the Scottsbluff site collection, and George Frison, Marcel Kornfeld, Martha Rodgers, and Danny Walker of the University of Wyoming helped with my analysis of the Finley collection. The Haury Fund of the Department of Anthropology at the University of Arizona and George C. Frison Institute of the University of Wyoming provided financial support for this research. The NSF-Arizona AMS Laboratory, Greg Hodgin, and Sarah LaMotta supported the ^{14}C dating of material from the Scottsbluff and Finley sites.

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2007 Excavations at the O. V. Clary Site, Ash Hollow, Garden County, Nebraska

Matthew G. Hill, David W. May, David J. Rapson, Thomas J. Loebel, and James L. Theler

In 2007 a third and final season of investigations was undertaken at the O. V. Clary site, a high-integrity stratified late-Paleoindian (Allen/Frederick complex) locality in western Nebraska (Hill et al. 2006, 2007, 2008; May et al. 2008). A primary objective of the 2007 field campaign was to expand excavations around a hearth remnant identified in Component 2 to further document late-Paleoindian domestic activities and diet at a winter-season residential base camp. The Component 2 occupation is situated on the floor of an old channel of Ash Hollow Draw. Eruption/wear patterns of molars in several bison dentitions, gestational ages of fetal bison remains, and stratigraphic information indicate that this material was deposited over the course of a single occupation stretching from mid/late summer to very late winter/early spring.

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The 2007 excavations increased the total excavated area to nearly 50 m^2. Although not spatially expansive, the diversity and density of artifactual and ecofactual material recovered in situ and from waterscreen matrix here is exceptional. Preliminary totals include approximately 19,000 unmodified flakes (mostly microdebitage), 89 chipped-stone tools, 27 bird-bone beads, and 4 bone tools. The vast majority of chipped-stone tools are either scrapers or edge-modified flakes manufactured from White River Group silicates (Koch and Miller 1996). The sample of ecofacts includes some 28,000 faunal remains, 10,000 fragments of red and yellow ocher, and 2,700 charcoal flecks. The faunal assemblage is composed predominantly of bison or probable bison remains. A small amount of bird (raven, great horned owl, and indeterminate small/medium passerine), box turtle, canid, and fetal bison are also present.

Some appreciation for the density, diversity, and horizontal distribution of selected classes of material mapped in situ in Component 2 is offered by the composite plan map in Figure 1. The greatest concentration of material occurs around and to the southeast of the hearth remnant. The general configuration and content of the respective spatial areas here suggest the

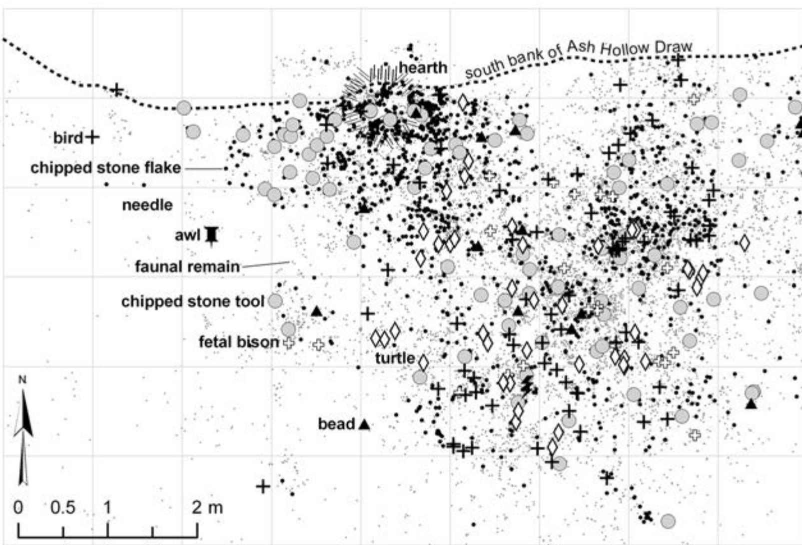

Figure 1. Distribution of selected classes of piece-plotted ecofacts and artifacts in Component 2, O. V. Clary Paleoindian site.

presence of well-defined drop and toss zones (Binford 1978). Perhaps most interestingly, the southwestern portion of the excavated area is essentially devoid of material. The comparative absence of debris here may be related to the presence of some form of ground cover that effectively prevented most items from making their way into the underlying sediment. Ongoing research promises to shed light on this issue and other questions related to the structure and function of Component 2 within the broader context of late-Paleoindian settlement/subsistence behavior in the region.

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The Mockingbird Gap Clovis Site: 2007 Investigations

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From May 29 to June 29, 2007, students of the University of New Mexico Summer Archaeological Field School excavated Locus 1214, a spatially discrete Clovis occupational locus of the huge Mockingbird Gap Clovis site (LA

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26748) (Huckell et al. 2006, 2007; Weber 1997; Weber and Agogino 1997). The site is located approximately 40 km southeast of Socorro, New Mexico, in the desert grassland of the northern Jornada del Muerto. Occupation occurs in surface and near-surface contexts along a low ridge paralleling Chupadera Wash. In 2006, we discovered Locus 1214 at the northern end of the site; two 1-m^2 test pits (units 12 and 14, thus the designation) produced nearly 60 flaked-stone artifacts, including the basal corner of a Clovis point (Huckell et al. 2007). Weber previously recovered three Clovis point fragments from the surface at the slightly eroded northern edge of this locus. These results demonstrated that excavation would be productive. The goals of the 2007 investigations were: 1) to determine the internal organization and kinds of activities undertaken; 2) to investigate Clovis lithic technological organization; and 3) to assess lithic evidence for Clovis mobility patterns through source identifications of recovered artifacts.

After creating a 1-m grid system encompassing the 10-by-19-m probable extent of the locus, we chose a 10 percent random sample of units (19); we completed 14. Within all excavated units we encountered a distinctive stratigraphy. The uppermost deposit is a sand with a 5- to 25-cm-thick reddish brown Bw soil horizon that gives way to a 2- to 10-cm-thick underlying gley (Bg) horizon. This deposit is separated by an erosional contact from an older reddish brown Pleistocene sand that exhibits a well-developed Btb horizon. Excavation was carried out by these natural divisions—Stratum 1 being the Bw, Stratum 2 the Bg, and Stratum 3 the Btb—and by arbitrary 5-cm levels within each stratum.

The excavations yielded one Clovis point base, 4 biface fragments, 9 small whole and fragmentary flake tools, 5 gravers, 4 utilized flakes, and 956 pieces of debitage. Fifty-eight percent were recovered from Stratum 3, 19 percent from Stratum 2, and 23 percent from Stratum 1 or at the modern surface. No evidence of post-Clovis occupation was found. Twenty-eight small pieces of tooth enamel were recovered, morphologically consistent with bison or, less likely, camel or horse. Also recovered were 13 small, highly weathered large-mammal bone splinters. The stratigraphic distribution of the enamel and bone fragments mirrored that of the stone artifacts. Taken as a whole, the assemblage suggests that Locus 1214 is a short-term camp and processing area.

The most abundant lithic material (49.2 percent) was a chert varying from light green to dark green to black from an unknown, but perhaps nearby, source. Second in abundance (15.9 percent) was a red rhyolite locally known as Socorro jasper, available from sources in the Chupadera Mountains 55 km west of the site. Third most abundant (4.1 percent) was Chuska chert, derived from the Chuska Mountains approximately 400 km to the northwest. Present in smaller quantities (2.7 percent) was Correo China chert, found in the eastern Zuni Mountains ca. 200 km to the northwest, and two flakes of Mt. Taylor (Grants Ridge) obsidian from near the town of Grants 190 km to the northwest. A third obsidian flake is likely from Cerro Toledo in the Jemez Mountains. These data suggest a general northwest-to-southeast path of travel that brought the occupants to this locus.

Stratigraphic studies in Chupadera Wash adjacent to the site continued in 2007 using a Giddings soil-coring rig. We now have four cores that approached or penetrated 11 m deep, all refusing in bedded sand and gravel encountered at ca. 10 m below present ground surface. These fluvial deposits are overlain by 2–3 m of dark, organic-rich gray-to-black mud with interbedded sand and gypsite of lacustrine/palustrine origin. Radiocarbon dating of bulk decalcified samples from the carbonaceous muds in core 07-9 yielded ages of 10,285 +115/-110 RCYBP (745-765 cm; A-14713); 11,245 ± 180 RCYBP (830-845 cm; A-14714); 11,870 +230/-225 RCYBP (857-876 cm; A-14790); 11,665 ± 135 RCYBP (930-950 cm; A-14791). Undoubtedly the stream/marsh setting on the floor of the wash attracted both animals and people.

The 2007 investigations were carried out with the support of the Department of Anthropology, University of New Mexico, under New Mexico State Land Office Right of Entry Archaeological Excavation Permit ROE-1503 and Department of Cultural Affairs-Historic Preservation Division Excavation Permit SE-253. Particular thanks go to David Eck (NM State Land Office) and Michelle Ensey (DCA-HPD) for their aid and support. New Mexico Tech housed the field school, and Malcolm Montgomery was tireless in his efforts to make our stay at NMT comfortable. The Argonaut Archaeological Research Fund (AARF) of the University of Arizona supported the stratigraphic studies along Chupadera Wash. Field portable XRF analysis supported by the Stahl Endowment for Archaeological Research, University of California, to Shackley. Special thanks to the students who participated in the field school. Huckell, Holliday, Hamilton, Sinkovec, Merriman, and Shackley were saddened by the passing of Robert H. Weber after this manuscript was submitted. He was a fine and generous man, and we will all miss him.

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Macy Locality-15, a Late-Paleoindian Site along the Caprock Escarpment of Texas

Stance Hurst, Eileen Johnson, and Doug Cunningham

Macy Locality-15 is a Paleoindian site located on a small terrace overlooking the South Fork of the Double Mountain Fork of the Brazos River near the edge of the Southern High Plains escarpment. This escarpment is a major source of

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lithic raw materials (Banks 1990; Holliday and Welty 1981), springs and topography providing shelter and hunting and gathering opportunities for hunter-gatherer groups. The only Paleoindian sites that have been published in detail in the vicinity of the Caprock escarpment are the Lake Theo (Buchanan 1998; Harrison and Killen 1978; Johnson et al. 1982) and Rex Rodgers (Hughes and Willey 1978; Speer 1978) bison kill and butchering localities.

Macy Locality-15 is on a terrace, and all materials were located and mapped during a systematic survey. The collection consists of a late-Paleoindian projectile point, broken biface, graver bifacial tool, basal projectile-point thinning flake, two cores, four pieces of debitage, a split chert nodule, and a hearthstone (Figure 1). A profile along an eroded edge of the terrace and a shovel test on the terrace revealed the artifacts are associated with a sandy loam (5YR5/4) aeolian deposit (0–40 cm depth) that has a modern A-horizon and lower Bk horizon that lies above stratified alluvial/colluvial deposits (40–172 cm depth).

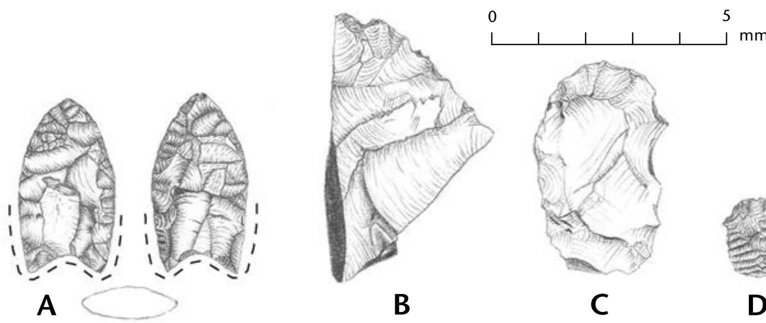

Figure 1. Selected lithic artifacts from the Macy Locality-15 Paleoindian site: **A,** late-Paleoindian point (TTU-A1-154447); **B,** broken biface (TTU-A1-154448); **C,** bifacial graver (TTU-A1-154449); **D,** basal thinning flake (TTU-A1-154450).

The late-Paleoindian point (35.45 mm long, 20.00 mm wide, 5.81 mm thick) is made from a local Ogallala Formation chalcedony. The hafting element is unfluted, basally thinned, and well ground, and the tip has been resharpened. Evidence of basal thinning instead of fluting indicates the projectile point dates to the late-Paleoindian period. The broken biface (Edwards Formation chert) is in Stage 4 (Callahan 1979) reduction (40-degree edge angle, 10.83 mm thick). A chert cobble gathered from the Ogallala gravels was used in manufacturing the bifacial graver tool (41.32 mm long, 27.19 mm wide, 7.73 mm thick). A flake (Edwards chert) removed in basally thinning another projectile point has a parallel oblique flaking pattern indicative of late-Paleoindian times. The rest of the lithic assemblage attests to the working of local materials from the Ogallala Formation.

The paucity of artifacts at Macy Locality-15 suggests this site was a brief stop for a Paleoindian group to discard or retool their lithic tool kit. The flaked-stone evidence suggests a heavy reliance upon local lithic raw materials for the production of both curated (e.g., the projectile point) and expedient stone tools. High-quality non-local Edwards chert from the south also is an important part of the curated lithic inventory. The use of both local and non-local lithic raw material sources is a common pattern found at late-Paleoindian sites (Bamforth 2003).

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The Clovis Occupation of the Schmeling Site (47JE833) in Jefferson County, Wisconsin

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University of Wisconsin–Milwaukee archaeologists are currently conducting research at two sites near Lake Koshkonong in southeastern Wisconsin, the Crescent Bay Hunt Club (47JE904) and the Schmeling site (47JE833). Both

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sites contain Oneota occupations, and the Schmeling site also has a Clovis occupation. Previous relevant archaeological and environmental research at this location has been conducted since the 1980s (Gibbon n.d.; Goldstein and Kind 1983; Hanson 1996; Hunter 2002; Jeske 2000; Musil 1987; Kolb and Goldstein 1991; Rawling III 1998; Richards and Jeske 2002; Stout and Skavlem 1908). Previous investigation of nearby Paleoamerican components focused on the nearby Kelly North tract of Carcajou Point (Jeske et al. 2002).

The Schmeling site is located along a till-covered limestone ridge that runs parallel to Lake Koshkonong, approximately 300 m west and 8 m above the lake elevation (Jeske et al. 2003). Lake Koshkonong is a shallow impoundment of the Rock River. Originally created by an ice dam at the end of the Pleistocene, it is maintained at current levels by a modern dam. Soils, elevations, and archaeological data suggest that the current lakeshore is near the same elevation as it was during late-Pleistocene/early-Holocene times (Glocker 1979; Jeske 2002).

Mr. Kevin Schmeling has recovered artifacts from the site for more than 40 years, but the site has probably been collected for more than a century (Stout and Skavlem 1908). Schmeling owns materials representing early-Paleoamerican, middle-Archaic, late-Archaic, late-Woodland, and Oneota periods. In 2006, UWM archaeologists conducted survey and testing at the Oneota locus of the Schmeling property, uncovering significant late-prehistoric materials and features. Excavations were not conducted in the area of the Paleoamerican deposits.

Mr. Schmeling allowed access to his collection, including 12 Clovis hafted bifaces or fragments and one Clovis preform. Schmeling collected all the Clovis material from the area immediately surrounding the head of a draw that flows southeast down the ridge toward the lake. The well-drained high ground around the drainage head affords excellent views down the ridge toward the lake to the south, east, and northeast, and across the rolling upland topography to the west.

Of the 12 Clovis hafted bifaces, 5 were manufactured from Hixton Silicified Sandstone, while the other 7 were manufactured from locally available Galena, Platteville, and Prairie du Chien cherts. One was thermally altered. Eight were broken, four were complete. The complete bifaces were small, and all showed signs of reworking or reuse, including bipolar recycling. The complete bifaces average 44.7 mm long, 24.2 mm thick, 6.6 mm wide, and 7.6 g weight. Two of the complete bifaces were manufactured from Hixton; the other two were Galena chert. An additional Clovis hafted biface manufactured of Hixton, found by Mr. Schmeling in late 2007, has not been measured for the purposes of this study. The presence of large numbers of Clovis bifaces at one location is often interpreted as an indication of a base camp (Lepper and Meltzer 1991), and we suggest that the Schmeling site may be viewed in this manner.

The Paleoamerican component of the Schmeling site likely represents a long-term or repeatedly occupied location where occupants used a subsistence strategy involving the use of multiple resource zones. Rich wetland and aquatic resource zones, as well as upland forest or grassland resource zones, were easily monitored and accessible from this location. It appears that Paleoamerican mobility systems in southeast Wisconsin may have been logistically organized, although the high proportion of Hixton for knapping materials indicates relatively easy acquisition of long-distance resources. The relatively sedentary settlement system tentatively proposed is supported in the occupants' use of local raw materials, the use of heat alteration to increase material quality, and the use of bipolar technology to prolong tool use life. A similar model for the late-Paleoamerican occupants of the nearby Carcajou Point site has previously been presented, supported by excavated data (Jeske et al. 2002). Carcajou point is approximately 5 km northeast of the Schmeling site, on a lower elevation nearer the shore of Lake Koshkonong. Overstreet et al. (2005) suggest a similar logistical organization for the Plainview component of the Dalles site in southwest Wisconsin. An expansion of our research at Lake Koshkonong and other sites in southeast Wisconsin will provide new insights into Paleoamerican mobility and subsistence in an area that was extremely rich in a mosaic of ecological resources by the end of the Pleistocene.

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Tahoka-Walker: A Minimum Analytical Nodule Analysis of the Paleoindian Component

Eileen Johnson, Stance Hurst, and Vance T. Holliday

The Tahoka-Walker site (41LY53), on the Southern High Plains of Texas, is located 2 km south of the town of Tahoka (Lynn County). Paleoindian sites on the High Plains surface generally occur within 1 km of a playa (small lake basin) (Hester and Grady 1977; Holliday 1997; Johnson 1995;), and Tahoka-Walker is 0.92 km north of a playa and overlooks a drainageway. The site is on city-owned land, and the surrounding topography and part of the site have been disturbed by city construction activities.

A local resident, after collecting from the site for a number of years, contacted the Museum of Texas Tech University about recording and researching the site. He had accumulated a collection of Paleoindian points and thought the site reflected only a Paleoindian occupation. Subsequent mapping and surface collection of the site recovered over 1,000 lithics, more than 350 hearthstones, a hammerstone, and manuports. Projectile points included Folsom, late-Paleoindian, and late-Archaic types.

Two isolated test units were placed to explore whether intact deposits and buried materials existed. Lithics, a hearthstone, and hematite were recovered in situ from the test units, although no cultural features or diagnostics were found. Deposits were intact, and the artifacts came from primarily a 15-cm range starting at 6 cm below the surface.

Two cores and four auger tests provide information on the depth and type of sediment cover and stratigraphy. The site is shallowly buried by sandy loam,

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locally up to 15 cm thick, but missing altogether over significant parts of the site. A soil with a weakly expressed Bt horizon has formed in this surface cover. A sandy loam in this upland position and with this degree of soil development is likely a Holocene sand sheet, common throughout the region (Holliday 2001). Below is a sandy clay loam with a soil exhibiting a well-expressed Ab-Btb soil profile (with 7.5YR hues and continuous clay films). The lithology and soil horizonation of this buried layer are very similar to that of the Pleistocene Blackwater Draw Formation, the surface cover across the region (Holliday 1989). The ages of these two layers indicate that the surface of the Blackwater Draw Formation probably was the Paleoindian occupation surface. The artifacts recovered from the upper sand sheet, then, are either from a younger occupation (late Archaic) or represent Paleoindian materials mixed upward via bioturbation.

While mapping the site, artifacts appeared to be concentrated into distinct clusters that might correlate to separate occupations. To test this observation, lithic artifacts were aggregated into Minimum Analytical Nodules (MANs) (Larson 1994; Larson and Kornfeld 1997) for delineating spatial patterns in the distribution of artifacts. Four analytical nodules types were discerned (Hall 2004). Central mean and standard distance geostatistics were used in calculating the location and relative density of MAN clusters (Hodder and Orton 1976:207–208; Mitchell 2005:26–44).

MANs with Paleoindian points formed a dense cluster, indicating the focus of site activity at that time. Although MANs with late-Archaic points were not spatially distinct from the Paleoindian activity area, they produced a broader footprint of activity that overlay the Paleoindian one. The aggregation of Paleoindian artifacts into MANs, however, allowed for additional observations. Two MANs were associated with Folsom points. One of the MANs had a Folsom point made from an unidentified chert source with no associated debitage. The other contained a Folsom point with a biface fragment and three pieces of debitage from nonlocal Edwards Formation chert (Banks 1990; Holliday and Welty 1981) that suggested the manufacture or maintenance of Folsom points at the site. All the late-Paleoindian points were in MANs without associated debitage and were made from Edwards Formation (4), Tecovas (1), and unidentified cherts (2).

Tahoka-Walker is a multicomponent site that appears to reflect repeated camping activities, including retooling. In particular, Folsom groups are using the site to refurbish points from raw material already partially reduced at another location. A curated staged-reduction technological strategy for manufacturing stone tools is a common pattern documented for the Folsom period on the Southern Plains (Hofman 1991). In contrast, none of the late-Paleoindian points are associated with debitage. Late-Paleoindian points were not manufactured or maintained on site. The projectile points may have been discarded in favor of replenishing their tool kits with local materials rather than relying upon a curated portable technology.

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A New Perspective on the DeStaffany Site, an Early Lithic Site in the San Juan Islands, Washington

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Recent analyses favor reinterpretation of a previously described lithic site in the San Juan Islands in northwest Washington State. The DeStaffany site (45SJ414) on San Juan Island was described as an early-Holocene/late-Pleistocene hunting site (Kenady et al. 2002). No faunal remains were preserved and the lithic assemblage contained an unusual concentration of finely made lanceolate projectile points and cutting tools in various stages of manufacture. The site was interpreted as a possible sea-mammal monitoring station based on its topographic setting on top of a 25-m-high bedrock eminence with excellent concealment qualities and a vista of modern sea-mammal haulouts. However, new information on relative sea levels in the San Juan Islands and eastern Strait of Juan de Fuca and on potentially available late-Pleistocene faunal resources (Kenady et al. 2007; Schalk et al. 2007; Wilson et al. 2003, 2007, 2008), along with analyses of previously unanalyzed lithics from the DeStaffany site, suggest a different interpretation of both the site's environmental setting and function.

Evidence of complex late-Pleistocene isostatic processes, relative sea-level changes, and regional pollen sequences indicates the existence of an emergent landscape, supporting a lodgepole-pine parkland–meadow mosaic, that nearly connected the mainland with Vancouver Island (Wilson et al. 2007, 2008). The shoreline of that landform approximated or exceeded the modern -50 m bathymetric contour ca.10,000 RCYBP based on readings for submerged landforms near Victoria, British Columbia, and southeast Lopez Island (D. Dethier, pers. comm. 2008; Linden and Schurer 1988). When the maximum shoreline extent is drawn relative to the DeStaffany site and the present shoreline (Figure 1), it is apparent that the modern embayment containing the sea-mammal haulouts probably would have been emergent with meadow or parkland in the early Holocene/late Pleistocene.

Radiocarbon dating of recently discovered *Bison antiquus* from nearby Orcas Island demonstrates that this species occupied the newly emergent landscape for at least a millennium, with ^{14}C dates ranging between 11,760

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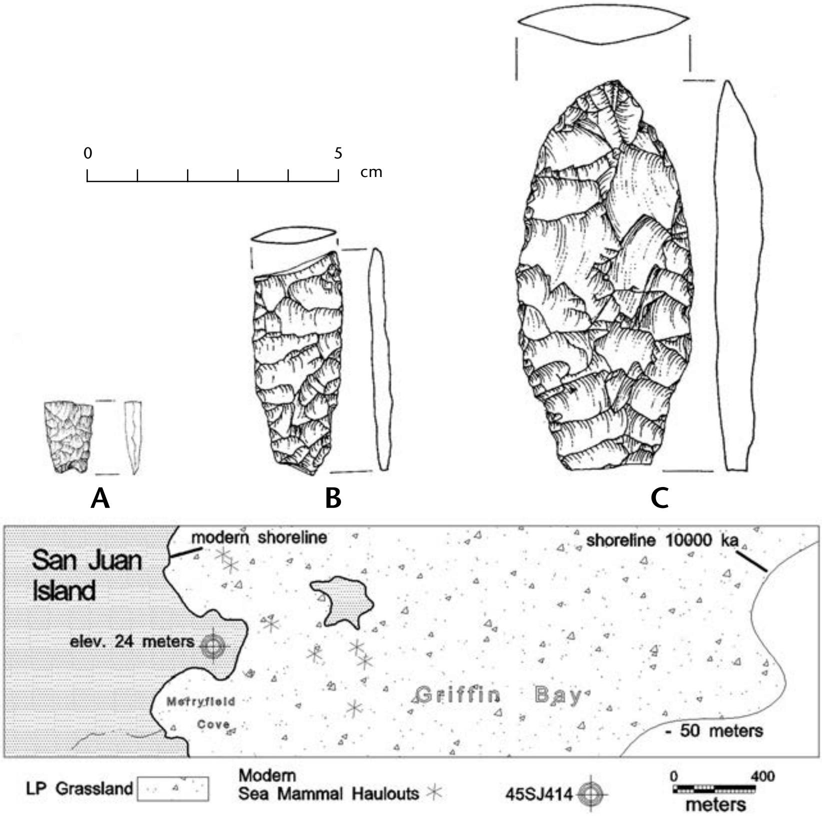

Figure 1. DeStaffany site (45SJ414) overlooking modern sea-mammal haulouts and now-submerged late-Pleistocene grassland once occupied by bison at maximum extent. Late-Pleistocene or early-Holocene ^{14}C dates have been obtained on deposits at other Pacific Northwest sites yielding projectile point types morphologically similar to **A–C,** which were excavated at the site.

and 10,800 RCYBP (Kenady et al. 2007). One bison that was dated to 11,760 RCYBP exhibits evidence of butchering (Kenady 2008, Kenady et al. 2007).

Kenady (2002 et al.) described several projectile points, including 1B and 1C (Figure 1), similar in form to others classified as "Western Stemmed" points in other studies (e.g., Craven 2004; Huckleberry et al. 2003; Irwin and Moody 1978; Sheppard et al. 1984). Recent analysis of 4073 previously unanalyzed lithic specimens from the DeStaffany site revealed another projectile-point base with basal grinding (Figure 1A). This point conforms in shape and size with others referred to as "Windust" (Rice 1972:Figure 12a), and points with similar attributes have been reported from several other late-Pleistocene and early-Holocene assemblages (e.g., Brauner et al. 1990:Figure 29a,d; Cressman et al. 1960:Figure 41a,g; Dumond and Minor 1983:Plate 5b). "Western Stemmed" and "Windust" points are ^{14}C-dated between 10,800 and 8000 RCYBP (Ames 1981). These broad terms are most useful in identifying a time period and region in which multiple distinct but as yet unnamed point types have been described. The DeStaffany points mirror many of these in form.

Importantly, the newly analyzed DeStaffany debitage assemblage reflects a bifacial-reduction technology with 85 percent bifacial thinning flakes and the use of non-local toolstone. This contrasts with the cobble-based lithic technologies dependent on local toolstone associated with later-Holocene site assemblages in the Northwest. These characteristics together with the multiple early point types, some of which have basal grinding, place the site most likely in late-Pleistocene/early-Holocene context.

New information on relative sea levels and bison suggests that the site was likely surrounded by parkland/grassland that persisted through the terminal Pleistocene at least into the early Holocene and that ungulates such as bison, not sea mammals, were more plausibly among the resources exploited at the DeStaffany site during that period.

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Evidence for Multiple Paleoindian Components at the Lindenmeier Site, Larimer County, Colorado

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The Smithsonian Institution excavated the Lindenmeier site of northern Colorado between 1934 and 1940, recovering extensive evidence of a Folsom occupation (Roberts 1935, 1936; Wilmsen and Roberts 1978). In 1935, the Colorado Museum of Natural History[1] excavated alongside the Smithsonian, placing ca. 17 test pits across the site, 7 units near the bison kill on the eastern side of the site and 10 others primarily west of the main Smithsonian excavations (Cotter 1978). The CMNH concentrated their excavation on the particularly productive and Folsom-rich Hole 13, which measured 30 by 30 ft (83.6 m^2).

Hole 13 also contained evidence of a late-Paleoindian component based on John Cotter's observation (1978:183) that "it is interesting to note that at least four artifacts from hole 13 fail to coincide with the accepted classification of the 'Folsom type' point." The Smithsonian's Frank Roberts echoed, noting (1936:22) that

> the Denver Museum party obtained, in its large pit, four specimens which in a broad sense of the word might be called Yuma. Two of these were from the contact line between the black and the basic substratum. The others were from a higher level in

[1] The Colorado Museum of Natural History (CMNH) is now named the Denver Museum of Nature & Science (DMNS).

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> the black. . . . Furthermore, they are only a minor factor, as only 0.05 percent of the points from the site can be classified as Yuma, and some of these are of such a nature that their inclusion is highly debatable.

Roberts thought the Yuma points from the lowest horizon might have been introduced from above and that Yuma points overlapped in age only slightly with Folsom, but were generally younger.

Cotter suggests there were at least four Yuma-like points obtained from the CMNH excavations; reanalysis of the DMNS collection from the site reveals a minimum of five "Yuma-type" projectile points. The first artifact is the resharpened midsection and base of a lanceolate point made of local quartzite. The lack of parallel oblique flaking combined with other attributes suggests a Goshen (or Plainview) affiliation; however, the resharpening is similar to many projectile-point knives common in later James Allen assemblages. The second specimen is a chert point midsection containing a pronounced medial ridge, likely an Eden point. The third specimen is a narrow straight-based projectile point, likely an Eden base made from oolitic chert from Wyoming. The fourth item is a Scottsbluff base and midsection made of chert. The final piece is the base and midsection of a quartzite lanceolate point, missing two snapped ears. The point does not appear to be Folsom in type, although a specific identification is not possible. Finally, there is a complete Yuma point mentioned by Cotter (1978:183–84; correspondence between John Cotter and Jesse Figgins, 8/27/1935, DMNS Archives); however, the point is no longer in the DMNS collections. The presence of these five forms (six, if including the missing point) from Hole 13 suggests there are at least two or three Paleoindian components in this portion of the site, including the Folsom, a Cody (Scottsbluff/Eden), and perhaps a Goshen or James Allen component.

Importantly, post-Folsom materials were recovered from areas other than the CMNH Hole 13. In fact, nearly every excavated area contains evidence for late-Paleoindian occupations, albeit of a less-intensive nature than that of the Folsom component(s). Moving across the site from west to east, late-Paleoindian materials are present in Hole 13, Trench B (Roberts 1936:21–22), Trench A (Roberts 1936:21–22), Area 2 (Wilmsen and Roberts 1978:60–62, 64–65), Trench E (Wilmsen and Roberts 1978:60-62, 64–65), Area II (Wilmsen and Roberts 1978:60–62, 64–65), and the Bison Pit (Roberts 1937:74). These seven locations are spread across a distance of over 500 m. Identified forms include Cody complex types including Alberta, Eden, Scottsbluff, and possibly Firstview, several lanceolate concave-based points, and later forms such as Gypsum Cave examples. The Coffin family (the site discoverers) also recovered a variety of late-Paleoindian forms from their own site excavations (Coffin 1937; Gantt 2002:105–06, 114). Middle-Holocene Archaic-era hearths are also known from the site, including one documented in the early 1990s (Anderson 1992; Cummings and Puseman 1991). Finally, recent surface mapping of the site revealed a late-Archaic corner-notched dart point on the surface, in the immediate vicinity of the Bison Pit (Parks and LaBelle 2008).

The presence of a possible Goshen projectile point in the Lindenmeier collection suggests that a component coeval or perhaps older than Folsom may exist at the site. Later-Paleoindian Cody components are also present in Hole 13 and elsewhere on the site. The Cody-era ^{14}C samples collected by Haynes (2003; Haynes et al. 1992) further suggest that early-Holocene deposits may be found in several additional areas. Renewed work at Lindenmeier must include the recognition of the multicomponent nature of the site (Paleoindian and later) and the need to better sort out the stratigraphy of these components.

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An Analysis of Great Basin Stemmed Point Variability: Function or Style?

Linsie M. Lafayette

Variability in Great Basin stemmed point morphology has long been recognized (Tuohy and Layton 1977). This variation could represent: 1) temporal differences; 2) stylistic differences; 3) functional differences; or 4) degree of resharpening. Currently, temporal differences do not appear to account completely for this variation because many stemmed point types date to 7000–11,200 RCYBP (Beck and Jones 1997). Resharpening also does not appear to be a factor because caches of unused Parman and Haskett types have been found (Amick 2004; Sargeant 1973). These facts suggest that variability in stemmed point morphology may therefore be related to either style or function.

To address this question, I conducted a study of the experimental use of stemmed point replicas and use-wear analysis of both these replicas and stemmed points from buried contexts at archaeological sites (herein referred to as prehistoric stemmed points). Similar studies have illustrated the applicability of experimental and use-wear analysis to addressing questions of artifact function (Collins 1993; Keeley 1980; Odell and Odell-Vereecken 1980). James C. Woods, an expert flintknapper with several decades of experience, produced six Parman, six Haskett, and six Windust types made from obsidian for use in the experiment. I hafted half the replicas on shafts and used them as projectiles that I threw at a deer carcass. It is not possible to distinguish between wear patterns on projectiles thrust, thrown, projected from an atlatl, projected from an arrow, or thrown by a man or woman (Dockall 1997; Schmitt and Churchill 2003). Therefore, I threw the spears while standing approximately 2 m from the deer carcass target. Subsequently, I used the other half as knives to butcher the carcass.

After use, I examined the replicas under magnification (6–120x) for use-wear and compared them with 59 artifactual stemmed points (20 Parman, 21 Windust, 13 Haskett, and 5 Cougar Mountain types) from sites in the northwestern Great Basin. The replicated sample, although small, provided good examples of use-wear features such as crushing, hinged breaks, feathered flake terminations, and burins. The primary goal of the experiment was to determine whether the prehistoric stemmed points had been used for purposes (e.g., cutting, scraping) other than as projectiles.

The results of this experiment provide several insights into the form and function of Great Basin stemmed points. Experimentally, the Parman replicas performed well both as projectiles and knives, and comparisons of the 20 artifactual Parman points with the replicas suggest that they were used primarily for other purposes as well as for projectiles. The Windust replicas performed well as projectiles; however, they did not function well as knives

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because they commonly came loose in the haft. Since the 21 prehistoric Windust points appear to have been used almost equally for other purposes and as projectiles, such points may have been hafted differently from those used experimentally. Alternatively, they may have been used in the past for purposes not recreated in the experiment. Experimentally, the Haskett replicas were not efficient as either projectiles or knives. The 13 prehistoric Haskett points were primarily used for other purposes and rarely used as projectiles. Therefore, I suggest that Haskett points may have been used primarily for a purpose not recreated in this experiment. Cougar Mountain replicas were not available, but based on their similarity in form to the Parman type, I propose that they may have performed similarly to the Parman replicas. The five artifactual Cougar Mountain points appear to have been used primarily as projectiles with secondary use for other purposes.

In addition to the above findings, two important trends were noted. First, the burin scars on breaks, large burins on point tips (i.e., "chisel tips"), and breaks on the proximal and distal ends of stemmed points interpreted by Tuohy (1969) to represent intentionally produced features, can also be produced unintentionally through use as projectiles and knives. Second, Beck and Jones (1993) have proposed that the wear found on the edges and bases of many stems is mainly the result of haft wear. I found no correlation between the degree of basal and lateral wear on artifactual stemmed points, which might be expected if both were the product of hafting abrasion. Instead, these findings may suggest that basal wear was intentionally produced on many stemmed points.

Based on the results of this study, variability in Great Basin stemmed point morphology does not appear to be related to function. Cougar Mountain, Parman, and Windust types all appear to have been used as projectiles and for other purposes. This supports Beck and Jones's (1993) argument that stemmed points were multipurpose tools. Haskett types performed poorly as both projectiles and knives. This may suggest that they were used for purposes other than those conducted in the study or that there was a problem in the way they were hafted for the experiment. If we can rule out differences in the age, degree of resharpening, or function of the majority of these types, then variation in stemmed point morphology may result in part from stylistic differences among individuals, groups, or cultures.

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Recording Paleoindian Projectile Points in Georgia

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Detailed recording of Paleoindian projectile-point data has been underway in Georgia for over 20 years. This paper represents the first update since an extensive period of reporting took place during the first decade of the survey (Anderson et al. 1986, 1987, 1990a, 1990b, 1994; Ledbetter et al. 1992, 1996). In the intervening years the sample of recorded artifacts has grown dramatically, from 216 points reported in 1990 to 1,445 at present, April 2008. The quality of the information has likewise improved. A standard recording form has been used since the start of the survey, and digital color photographs of the obverse and reverse side of each point now exist for the great majority of recorded specimens, and line drawings sometimes accompany the forms where there is time to produce them. An extensive series of measurements are also taken from each point. Summary data on points by type and county as well as individual artifact attribute data are posted on the Paleoindian Database of the Americas (PIDBA) website http://pidba.utk.edu/, and pdf images of each form have been produced to facilitate circulation of the primary information.

The current sample includes 1,386 points, for which specific site or county-level provenience data exist, that can be used in distributional analyses (Figure 1). While there are still obvious gaps and biases in coverage, especially as represented by those counties for which little or no data have currently been

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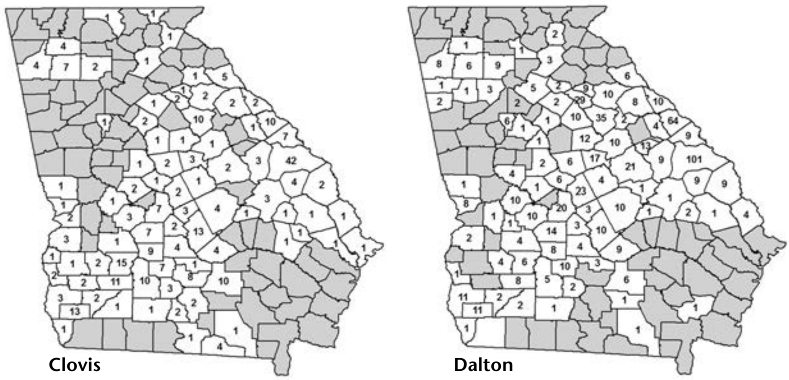

Figure 1. The distribution of Clovis and Dalton projectile points in Georgia by county, April 2008.

recorded, large numbers of points tend to occur in a diagonal band running from southwest to northeast and encompassing the inner coastal plain and lower piedmont portions of the state. The largest numbers of Clovis and Dalton points in Georgia occur in Burke County, immediately west of the Savannah River below the Fall Line. This area, and the area immediately to the east in Allendale County, South Carolina, is where major outcrops of high-quality and easily exploited Coastal Plain chert occur, and large numbers of early points have been recorded (Goodyear 1999; Goodyear and Charles 1984; Goodyear et al. 1990). The area appears to have been a locus of early and prolonged settlement from Clovis times onward.

County-level provenience data are available for 316 Clovis, 55 Suwannee, 77 Simpson, and 704 Dalton points. Lesser numbers of other point types are also present, including 3 Cumberland, 21 Redstone, 19 Wheeler, 15 Beaver Lake, and 29 Quad. A total of 105 points are what we have placed into an "unfluted lanceolate" category; these appear to be early but do not conform to identified types, and may be unfluted or unfinished Clovis or later-Paleoindian types. A little under 10 percent of the Dalton points in the sample (n = 66) exhibit basal fluting or pronounced thinning, a pattern noted during our earlier work (Anderson et al. 1990a:83), and suggesting possible continuity with earlier fluted forms. Perhaps the greatest lesson our work demonstrates is that recording projects such as this must continue for a long time if we are to hope to attain a widespread and fairly representative coverage of the occurrence of Paleoindian artifacts, sites, and assemblages.

Most of the artifacts were documented with the help of members of the Georgia avocational and professional archaeological community, whose support for this effort is deeply appreciated. A single individual (RJL) has recorded most of the primary data directly, and information about Paleoindian sites and artifacts found in Georgia should be directed to his attention.

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Preliminary Analysis of Turtle Material from the Gault Site, Texas

Ashley Lemke and Cinda Timperley

American archaeologists have frequently debated subsistence strategies of Clovis Paleoamericans (Bryan 1991; Dillehay 2000:15–17; Waguespack and Surovell 2003). Zooarchaeological assemblages often are interpreted as reflecting either generalized or specialized strategies. Such remains from Great Plains and Southern High Plains sites suggest generalized strategies, a database that increasingly underscores the validity of revising the Clovis-as-big-game-hunter model. The diversity of faunal taxa at such sites as Aubrey,

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Kincaid, and Wilson-Leonard suggests an array of resources available along ecotonal boundary zones (Balinsky 1998; Collins et al. 1989; Ferring 2001). Turtle and other vertebrate remains from the Gault site, central Texas, also reflect an array of resources found at multiple environmental edges in close proximity to the site.

The condition and extent of faunal skeletal preservation at Gault is limited as a consequence of groundwater activity and other taphonomic processes (Collins 2002; Timperley et al. 2003). Of 20,483 vertebrate specimens recovered from sediments of Clovis, Folsom, and Archaic age, 127 of the 1,724 identifiable elements are turtle. All specimens closely associated with lithic artifacts are moderately to poorly preserved carapace and plastron fragments. The majority of turtle material recovered from all temporal designations was burnt (80 percent), a taphonomic factor contributing to the overall more robust preservation of this portion of the vertebrate assemblage. Despite this, much surface detail is lacking owing to heavy taphonomic degradation, which has obliterated or obscured taxonomically diagnostic features and any possible cut marks.

Since the assemblage lacks complete skeletal elements, morphologically diagnostic attributes of shell texture and shape (vertebrals, costals, and marginals) were used to aid in identification. Owing to the poor preservation, only 28 of the 127 turtle specimens (22 percent) could be taxonomically identified. Twenty-two were identified as members of Kinosternidae, a family of approximately 25 species including mud and musk turtles (Pecor 2003a). One specimen was further identified as *Sternotherus odoratus* (stinkpot turtle). Five specimens were identified as Emydidae, the most diverse turtle family, comprising approximately 33 genera of box and pond turtles (Pecor 2003b). Two of the five are marginals that compare favorably with *Terrapene* (box turtles). However, surface feature deterioration and the lack of a diagnostic flair made positive species identification impossible.

Of the 127 turtle specimens, 62 were recovered from Clovis context. Of these, 26 percent were identifiable: Kinosternidae (n = 14, 13 burned), *Sternotherus odoratus* (n = 1, burnt), and *Terrapene* sp. (n = 1, not burnt). One of the larger and more complete specimens in this assemblage, a fragmented plastron, was recovered from Clovis context, but could not be taxonomically identified. Two burnt specimens of indeterminate taxon were from Folsom context. Of 60 specimens recovered from cultural context of undetermined age, 20 percent were identifiable: Kinosternidae (n = 8, 7 burnt), Emydidae (n = 3, 3 burnt), and *Terrapene* (n = 1, burnt). Three other specimens, burnt and taxonomically unidentified, were from mixed cultural context.

The larger, more diverse family identified in this study, Emydidae, consists of both freshwater and terrestrial turtles found on every continent except Australia and Antarctica. Genus *Terrapene*, within Emydidae, comprises the North American box turtles, which are terrestrial (Niedzielski 2002). Family Kinosternidae occurs only in slow-moving bodies of water in the New World and can be seasonally active depending on local climate (Pecor 2003a). *Sternotherus odoratus* occurs today in slow-moving freshwater and is rarely found on land (Ward and Cash 2001).

Buttermilk Creek, a spring-fed water system that drains the Gault site, historically has never run dry. The occurrence of *S. odoratus* in Clovis context suggests that in prehistory the Buttermilk Creek valley offered constant flowing water. However, it is as likely that this specimen may have been collected or hunted from a similar area, presumably no further than nearby drainages. The presence of *Terrapene* sp. is evidence of terrestrially oriented subsistence sources, such as utilization of the local upland environment.

The variegated discoloration of dark gray to white on most of the burnt specimens suggests exposure to intense and fluctuating heat for an extended period of time (Bennett 1999). The brief exposure and low temperatures of a prairie fire would not cause such extensive change to the bone, but a campfire or cooking fire would (Bellomo 1993). While mud turtles would be expected in sediments near a stream, the relative abundance and close cultural association indicates that these were not simply part of the background biota, but deliberately taken as regular part of the overall Clovis subsistence strategy.

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A Probable Hafted Uniface from the Clovis Occupation at the Topper Site, 38AL23, Allendale County, South Carolina

D. Shane Miller and Albert C. Goodyear

The Topper site, a prehistoric chert quarry on an upland bluff adjacent to the Savannah River, shows human utilization spanning some 13,500 years and possibly more (Goodyear 2005a, 2005b). The site has a prominent Clovis occupation associated with the quarry (Goodyear and Steffy 2003; Steffy and Goodyear 2006). In 2004, an impressive Clovis occupation was discovered on the hillside resulting in yearly excavations from 2004 to 2007. As of the 2007 season, a total of 186 m^2 had been excavated. The largest of these excavations is a 64-m^2 block dug in 2006, the assemblage from which has been recently analyzed (Miller 2007).

As more Clovis sites in North America are excavated, increasing attention is being paid to defining the lithic inventories beyond just projectile points such as those from presumed kill sites (Collins 2007). In the 2006 hillside block excavation, an unusual uniface was recovered within the Clovis deposit that merits special attention.

The tool, made on a thick flake formed by unifacial retouch on all margins, is 11.0 cm long, 7.3 cm wide, 6.3 cm thick, and weighs 155.55 g. In plan view it is nearly rectangular and has a strong trapezoidal cross section (Figure 1). Steep systematic percussion flaking was conducted from the ventral face of the flake with more than one series on the bit. These flake scars do not indicate that the tool was made from a former blade core. The bit is essentially straight with a minor depression in the direct center. The bit is sharp but exhibits several stages of flaking and step fracturing, probably indicating prior use and resharpening. The bit edge angle is steep, ranging from 80 to 90 degrees. Because of this steep angle, the tool probably functioned more in a scraping-chopping mode. Adzing seems unlikely, since the bit face interferes with the required low angle of an adze bit. Morphologically, it might be described as a scraper-plane. However, there is no microchipping or nibbling on the ventral face of the bit indicating it was pushed.

Perhaps the most significant aspect of the tool is the heavily ground lateral

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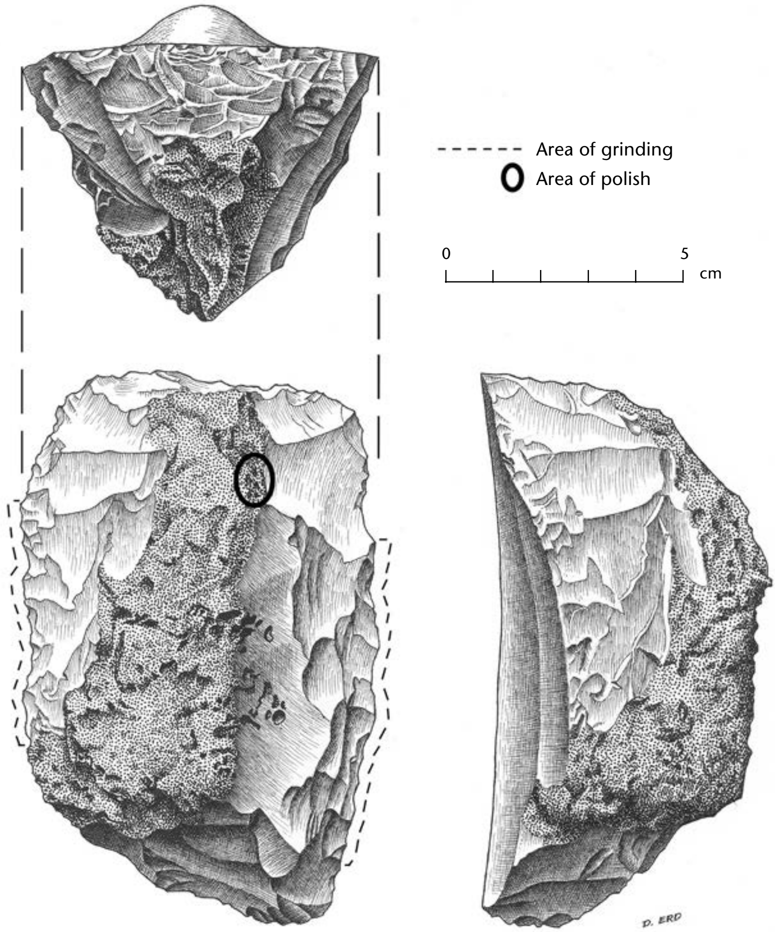

Figure 1. Three views of a probable hafted uniface from the 2006 Topper Clovis Hillside Firebreak excavation.

margins, which strongly suggest haft preparations. Grinding is so heavy as to have removed flake scars on the immediate margin. The sheer heft of this tool coupled with probable hafting indicates a heavy-duty scraping-chopping implement. The location of very bright polish on the dorsal surface of the tool in the cortex area is not consistent with functional polish; rather likely the polish resulted from wear from an organic form of lashing used to secure the piece to its haft. Similar core/tools have been described for Wells Creek Crater (Dragoo 1973:41,43) in Tennessee and particularly the Adams site (Sanders 1990:107) in Kentucky, but with no mention of edge grinding. Such a hafted tool may indicate intensive woodworking by the Clovis occupants of Topper, an activity that might have been combined with seasonal uses of the chert quarry, where large cores and choppers would have been readily available.

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Organization of Clovis Mobility and Settlement at the Mueller-Keck Site Complex in Southwestern Illinois

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This paper considers lithic analysis of the Clovis component from the Mueller-Keck site complex in southwestern Illinois to explore possible variability in site function (Morgan 2008). The data used for this project consist of Paul Keck's unsystematic surface collections at Mueller-Keck from 1974 to 2003. These sites, situated in the uplands adjacent to American Bottom, are located about 1 km apart. They also represent two of the largest Clovis lithic assemblages in

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the Midwest (Amick and Koldehoff 2005; Koldehoff and Walthall 2004; Maroney 2006). The predominant raw material in the collection is Attica chert, whose source originates 350 km from the site in west-central Indiana and which constitutes 87.4 percent of the Mueller assemblage and 97.7 percent of the Keck assemblage. The overwhelming abundance of exotic material in both these assemblages indicates a relationship between the sites despite their separation over the landscape. It also suggests substantial movement across this region and begs critical questions about the relationship of lithic procurement to settlement and subsistence strategies (Seeman 1994).

The research reported in this paper focuses on one key question: Do Mueller (11-S-593) and Keck (11-S-1319) represent functionally distinct settlement types? It was hypothesized that Keck (n = 177) may have served as a satellite hunting camp subsidiary to Mueller (n = 597), which functioned as a base camp. This hypothesis developed in part because of the size differences between the assemblages, contrasts in assemblage contents, and Keck's having a more strategic location for intercepting game (Koldehoff and Walthall 2004).

Tankersley (1998) proposed three distinct functional types among early-Paleoindian sites in eastern North America: quarries, base camps, and food-procurement locations. A base camp generally displays tools used for a wide variety of maintenance tasks, whereas a food-procurement site exhibits tools associated with extractive activities. Under this model, Mueller seems to be a base camp because of the wide diversity and function of tools in the large assemblage. Evidence suggests a large amount of hide processing was occurring at Mueller: nearly 32 percent of this assemblage consists of endscrapers, sidescrapers, and scraper fragments. It appears that maintenance tasks were predominant at Mueller, which reflects a base camp function. Mueller also contains proportionally more scrapers and early-stage bifaces, while Keck exhibits proportionally more debitage and late-stage bifaces (following Callahan's 1979 typology). Statistical analysis supports these observations, since there is a significant difference in frequency of flake tools and debitage between the assemblages ($\chi^2 = 10.1$, df = 1, $p = 0.001$). In addition, the comparatively higher ratio of projectile points and preforms to endscrapers at Keck indicates hunting activities may have been more important there than hide processing.

There are many overall similarities between these assemblages, but these two functionally important contrasts deserve closer attention. As mentioned above, more hunting activities seem to have been occurring at Keck than at Mueller because of its higher proportion of hunting weapons and butchery tools versus hideworking tools. Statistical comparison of the frequency of late-stage bifaces (Callahan Stage 5: Fluted Preform and Callahan Stage 6: Fluted Point) versus endscrapers confirms that Keck contains a significantly greater frequency of essential hunting gear versus hideworking tools ($\chi^2 = 7.85$, df = 1, $p = 0.005$). Closer inspection of the biface assemblage shows that only 55 percent (n = 43) of the Mueller bifaces are late-stage compared with 72 percent (n = 18) of the Keck bifaces. Despite this apparent contrast, there is not a statistically significant difference in the frequency of early-stage (Callahan Stages 1–3) versus late-stage bifaces (Callahan Stages 5–6) between these assemblages ($\chi^2 = 3.22$, df = 1, p = 0.073). Furthermore, when comparing Attica with Holland, the other important material in the assemblages (found in southwestern Indiana), there is significantly more Holland at Mueller than at Keck ($\chi^2 = 14.57$, df = 1, p = 0.000). One of several possible explanations for this difference could be that a small Clovis group coming from the Holland source area joined a larger group going from the Attica quarry to Mueller.

This analysis illustrates a few of the challenges in distinguishing functional variation among Clovis assemblages in the Midwest (Shott 1997). Ongoing statistical comparisons of the debitage and conditions of tools within specific types may increase understanding of the process of manufacture, use life, and abandonment related to differences in activities at these two sites. However, the more diverse assemblage represented at Mueller could simply be due to its larger size. This possibility can be addressed by comparing the unsystematic Keck collection with repeated systematic collections obtained by Loyola University Chicago at these sites (Amick and Koldehoff 2005). In summary, the current analysis indicates that Mueller possesses important characteristics of a base camp, but its possible relationship with Keck remains unclear.

We wish to thank Paul Keck and the entire Keck family for graciously supporting our ongoing research. Brad Koldehoff has been instrumental in organizing and assisting this project. Funding assistance has been generously provided by the Mulcahy Scholarhip Fund of the College of Arts and Sciences at Loyola University Chicago.

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A Probable Holcombe Point from Northeastern Minnesota

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Island Lake Reservoir in northeastern Minnesota contains numerous pre-Contact archaeological sites associated with original waterways (Harrison et al. 1995). Ball's Beach (21SL314), adjacent to the Otter River, yielded abundant debitage from the submerged beach (Mulholland and Rapp 1991:9), although nothing from existing reservoir shorelines (Mulholland and Rapp 1993:8). Unit materials were sparse (Mulholland et al. 1995:12), but surface materials were recovered over several years (Mulholland et al. 1996:12).

A complete projectile point of Knife Lake siltstone is identified as Holcombe. The point is generally lanceolate in shape with convex edges diverging from the base to the widest point slightly below the center. Longitudinal section is biconvex, with one side slightly more convex. Cross section is slightly convex to almost planar on one face and more strongly convex on the other. The base is concave, with three early-stage thinning flakes (Romano, pers. comm. 2008) 7.82 to 19.44 mm long on one face (Figure 1A). The other face exhibits several small retouch flakes less than 4 mm long (Figure 1B). The lower lateral edges and basal concavity are strongly ground.

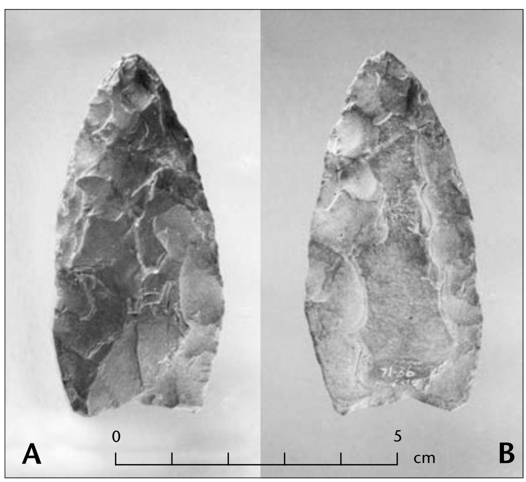

Figure 1. Holcombe point from Ball's Beach site. **A,** obverse; **B,** reverse.

Measurements are at the upper range for Holcombe (Ellis 1986; Fitting et al. 1966; Justice 1987:242): 62.58 mm long, 30.29 mm wide, basal width 22.92 mm, basal concavity 3.02 mm deep. The maximum thickness (7.46 mm) includes a small node toward the middle; however, five measurements exclud-

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ing the node average 5.66 mm. This point is slightly wider and thicker than reported Holcombe measurements, but variations probably reflect the material type, which is difficult to knap. Alternatively, the "Holcombe-like" variant of Hi-Lo (Ellis 2004:62) may more closely fit these atypical measurements (Ellis, pers. comm. 2008).

The Holcombe point type was first identified from sites on Holcombe Beach in Michigan (Fitting et al. 1966; Wahla and DeVisscher 1969) and remains best known from southeastern Michigan (Halsey 1999:68). Geographic range includes southern Ontario and Ohio to the east (Justice 1987:24; Woodley 2004:194), and northern Ontario (MacNeish 1952:41) and Wisconsin (Mason 1997:106) to the west. The few Holcombe points recorded in Minnesota (Florin 1996:205) include two in Cook County. However, it was recently concluded that one does not fit Holcombe (Mulholland et al. 2007); the other, although not reviewed, appears to lack definite basal thinning flakes (Florin 1996:231b; Platcek 1965:plate 1).

Ball's Beach contains a Holcombe or Holcombe-like projectile point indicative of the late part of the early-Paleoindian or the early part of the late-Paleoindian period. This point type is relatively rare in Minnesota, the western edge of the reported range.

We thank Dr. A. D. Romano for comments clarifying the knapping sequence on the point. A special thanks goes to Dr. Christopher Ellis for reviewing the manuscript on a short schedule and for his comments regarding the point identification.

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An Overview of Paleoamerican Lithics at the Carson-Conn-Short Site (40Bn190), Benton County, Tennessee

Mark R. Norton and John B. Broster

The Tennessee Division of Archaeology has undertaken excavations and surface collecting at 40Bn190 for the last 15 years (Broster and Norton 1993, 1996; Broster et al. 1994, 1996; Nami et al. 1996; Stanford et al. 2006). Eight areas of concentration have been recorded, with high numbers of fluted performs, projectile points, and uniface tools within four of these areas. The majority of lithic artifacts excavated and recorded on the surface have been of Clovis age and pertain to the manufacture of Clovis fluted points and blade tools. Unfortunately, no ^{14}C dates have been obtained from our excavations. A total area of 16 m^2 has been excavated to a maximum depth of 70 cm. The majority of Clovis artifacts have been found 35–55 cm below surface. Upper deposits contain a mixture of Clovis, late-Paleoamerican, and early Archaic materials. At the time of this writing, we have recovered 39 Clovis, 5 Cumberland, 10 unfluted Cumberland, 22 Beaver Lake, 32 Quad, and 8 Dalton projectile point/knives. Some of the Clovis points are shown in Figure

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1. Additionally, 540 Clovis performs, 27 channel flakes, and 125 *outre passé* flakes have been recorded. Unifacial tools based on prismatic blades include 183 endscrapers, 35 spurred endscrapers, 480 sidescrapers, 406 blade knives, 88 gravers, 963 blades, 216 blade cores, and 23 core tablet flakes.

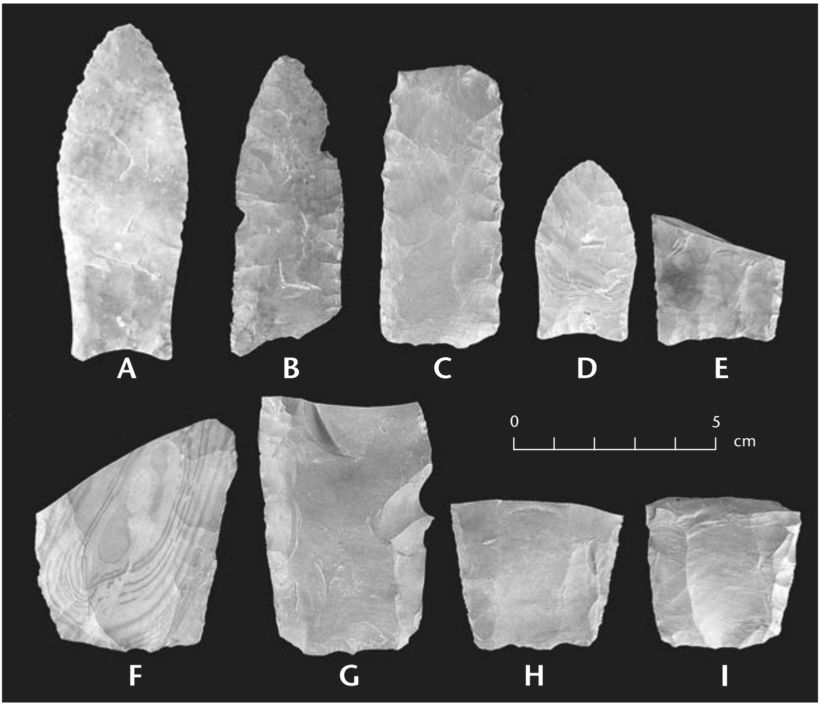

Figure 1. Clovis projectile points (**A–E**) and Clovis preforms from 40Bn190.

We believe that since it is located within 200 m of a high-quality chert resource, the site is a combination quarry-workshop and base camp. Sites of this nature along the Tennessee River are not at all rare. The Kirk Point site (40Hs174) (McNutt et al. 2008), located directly across the river from 40Bn190, contains a similar configuration of early lithic artifacts. Clovis projectile points and blade tools are found there (Figure 1), although the majority of artifacts date to the late-Paleoamerican and early-Archaic time periods. The famous Nuckolls site (40Hs60) (Lewis and Kneberg 1958), located 41 km downriver, contained Clovis, Cumberland, and late-Paleoamerican occupations. The outcropping of abundant fine-grained cherts in the general area appears to have been a major draw for hunter-gatherers for several thousand years.

Senior graduate students from the University of Kentucky, University of Memphis, and University of Tennessee are presently undertaking studies of Paleoamerican assemblages and components from these sites. We believe that these sites will be of great importance in the understanding of the late-Pleistocene/early-Holocene occupation of this area of the Midsouth.

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The Sage Hen Gap Fluted-Point Site, Harney County, Oregon

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The Sage Hen Gap site (35HA3548) is a fluted-point site on the northern perimeter of the Harney Basin. It is only the second site containing more than one fluted point recorded in Oregon. The site is located at the crest of a long draw between westerly uplands and the Harney Valley to the east. Buck Springs obsidian occurs naturally on site. The site also provides a panoramic view of the "gap" through which both animal and human traffic would have passed. The site was initially recorded in 1984 (Crespin 1984) and remained unevaluated until 2007, when Scott Thomas of the Burns District BLM relocated the site form. Sketches of one fluted point and one Black Rock Concave Base point prompted Thomas to make a site visit in February 2007, during which his crew collected two fluted points. In June, a fourth fluted point was

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found by BLM archaeologists and volunteers from the Oregon Archaeological Society (OAS).

A cooperative agreement brought the University of Oregon Archaeological Field School to the site in July and August of 2007. They excavated 6.15 m^3 in the form of 24 probes and 5 test units (17 m^2). Some 1,300 artifacts were mapped with a laser transit, and all formed tool fragments were collected. All artifacts were gathered from four collection blocks, resulting in a 4800-m^2 sample (approximately 20 percent of the site). During these operations, a fifth fluted point was found. A sixth fluted-point fragment was identified during analysis of the site lithics (Rondeau 2007). All six of the points are surface finds. All bear evidence of livestock trampling. The fluted-point base and concave-base point collected in 1984 have not been relocated to date.

The five fluted points collected in 2007 have been described by Rondeau (2007). Specimen 07-001, a concave-base fragment, lacks the blade element and a basal ear (Figure 1). It measures 36.87 mm long, 35.65 mm wide, and 6.53 mm thick, and has a basal depth of 8.1 mm and basal width of 31.04 mm. Single flute scars are present on both sides. A single guide scar runs adjacent to one flute, while guide scars are present on both sides of the opposite flute. Flute abrasions are noted on both sides, and edge grinding is present on portions of the basal and lateral margins. The point is made of Buck Springs

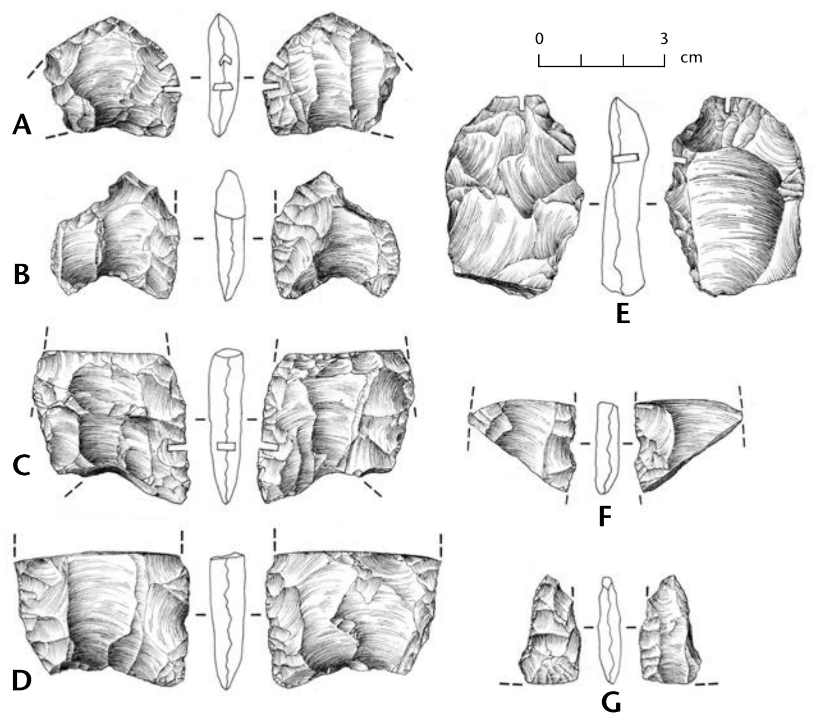

Figure 1. Fluted points (**A–D, F**) and bifaces (**E, G**) from the Sage Hen Gap site (**A,** 07-002; **B,** 07-298; **C,** 07-001; **D,** 07-297; **E,** 07-005; **F,** T-156; **G,** T-135). Illustration by Eric Carlson.

obsidian, with a hydration measurement of 9.7 microns (Skinner 2007). Specimen 07-002, which lacks both basal ears and much of the basal margin, measures 28.56 mm long, 32.11 mm wide, and 6.16 mm thick, and has a basal depth of 1.51 mm and basal width of 25.24 mm. The distal portion has been retouched into a blunt tip. One undamaged lateral margin has edge grinding. One side has a single flute scar; the other has two. No flute scratches are present. Big Stick obsidian was used, and the point has two hydration measurements of 7.3 microns (Skinner 2007). Specimen 07-297 is a large concave-base fragment with edge grinding on all margins and flute abrasions on both sides. It is 34.49 mm long, 41.74 mm wide, and 8.25 mm thick, and has a basal depth of 5.52 mm and basal width of 34.55 mm. A single flute scar is present on one side; the other side has two. The artifact has not been submitted for obsidian analysis. Specimen 07-298, a concave-base fragment, has visible edge grinding on only one lateral margin. It is 29.64 mm long, 30.14 mm wide, and 6.52 mm thick, and has a basal depth of 4.05 mm and basal width of 24.61 mm. Both sides of the biface bear single flute scars and channel abrasions. Specimen T-156, identified during the lithic analysis, is a triangular midsection fragment with single flute scars on both faces and scratches in the flutes that appear to be unintentional. It is 21.47 mm long, 25.96 mm wide, and 6.03 mm thick. One of the three sides is a lateral margin; the two other sides are breaks that culminate at a remnant portion of the opposite lateral margin. No edge grinding is present.

Rondeau (2007, 2008) identified other artifacts that can be associated with fluted-point sites. They include 2 fluted bifaces, 13 flute flakes, 3 gravers, 10 bifaces with overshot flake scars, 12 biface overshot flakes, and 7 nodule overshot flakes. A stemmed point base, two Elko Series points, and a single arrow point midsection were also found. The relative absence of more recent cultural materials is intriguing, especially since obsidian, edible and medicinal plants, and nearby game corridors would still have been attractions at later times. Obsidian studies and other analyses are pending.

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OSL Dating the Paleoamerican Heath Site (5GN3418), Gunnison Basin, Colorado

Bonnie L. Pitblado, Melissa S. Jackson, Joel L. Pederson, and Tammy M. Rittenour

In June 2007, Utah State University (USU) archaeologists test-excavated the Heath site, 15 km north of Lake City, Colorado. The site occupies a strath terrace along the west bank of the Lake Fork of the Gunnison River, 2542 m asl. Previous surveys yielded a dozen diagnostic projectile points extending from Paleoamerican through protohistoric time. The Paleoamerican surface assemblage included one Agate Basin, one Jimmy Allen, and three Angostura points (Pitblado 2003), suggesting that initial occupation could have begun as early as 12,800 CALYBP and ended as recently as 8250 CALYBP (10,500–7500 RCYBP).

The USU team identified four depositional units, A–D, with six soil horizons imprinted over them (Figure 1). The lowest strata D and C are culturally sterile. Stratum D is pebble-cobble fluvial gravel deposited by the Pleistocene Lake Fork River at a grade 26 m higher than at present. Based on incision rates of bedrock in the region (Dethier 2001), we suggest the gravels are associated with marine-isotope stage 4 or 6 (Bull Lake) alpine glaciation upstream, ranging from 60,000 to 150,000 CALYBP (e.g., Phillips et al. 1997). Poorly sorted stratum C is a late-Pleistocene or earliest-Holocene debris flow from the neighboring hillslope-gully system.

Strata B and A are slopewash colluvium, with A more enriched with eolian sediments than B. Stratum A contains two occupations, one Ute, represented by a roasting pit with brown ware pottery sherds; the other is late Archaic, indicated by a hearth ^{14}C-dated to 2740–2470 CALYBP (2520 ± 40 RCYBP) (Beta-235213). Despite including a parallel-obliquely flaked biface tip reminiscent of a Jimmy Allen spear point (provenience shown in Figure 1), the myriad cultural remains in stratum B offered no definitive evidence for occupation age, nor any organics to ^{14}C-date.

To achieve age control, we collected five optically stimulated luminescence (OSL) samples, four from stratum B and one from A (Table 1). These reveal the time elapsed since the sediments were deposited and buried after exposure to light during transport. After processing samples to purified quartz, we analyzed them in a RISO TL/OSL-DA reader with blue-green light stimulation following the single-aliquot regenerative-dose protocol (Murray and Wintle 2000). As Figure 1 shows, the stratum A sample dated to 4060 ± 280 CALYBP. Collectively, the four stratum B dates and artifacts indicate that deposition and human occupation occurred between 10,860 and 7840 CALYBP with

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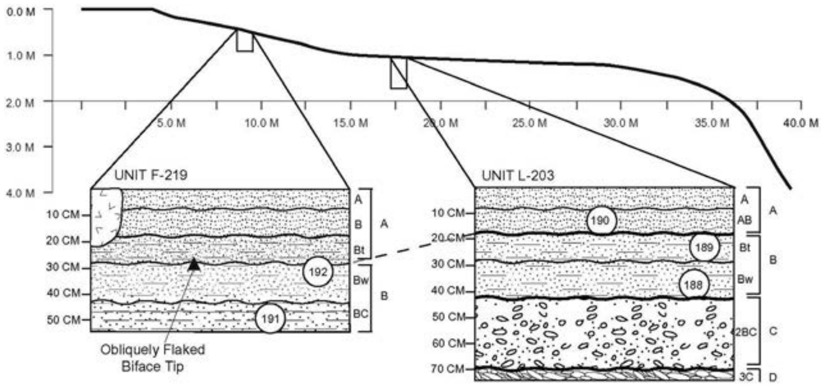

Figure 1. Locations of five OSL samples in two 1-by-1-m Heath site test units. Strata designations **A–D** are shown to the right of soil horizon labels. OSL dates obtained from the five samples (188-192) are shown in Table 1. Strata **D** and **C** are culturally sterile. Stratum **A** yielded Ute and late-Archaic features and an OSL date of 4060 CALYBP. Culturally rich stratum **B** produced four OSL dates ranging from 10,860–7840 CALYBP with one-sigma uncertainty. We infer that stratum **B** artifacts are of Paleoamerican origin.

one-sigma uncertainty. This interval overlaps the accepted time frames for the Agate Basin, Jimmy Allen, and Angostura projectile points found on the site surface (Pitblado 2003:120).

Table 1. OSL results.

Deposit location	Sample	Depth (m)	No. disks	Dose rate (Gy/ka)	De (Gy)	Age ± error (ka)
L-203	USU-190	0.14	20	3.75 ± 0.20	15.21 ± 2.39	4.06 ± 0.28
F-219	USU-192	0.31	21	3.77 ± 0.25	32.03 ± 2.97	8.49 ± 0.62
F-219	USU-191	0.52	25	3.90 ± 0.27	33.21 ± 5.58	8.52 ± 0.68
L-203	USU-189	0.23	21	3.71 ± 0.27	31.96 ± 4.82	8.61 ± 0.71
L-203	USU-188	0.38	22	3.21 ± 0.26	31.70 ± 8.20	9.86 ± 1.00

In the absence of in situ diagnostic projectile points and ^{14}C-dating potential, OSL provided an alternative to establish the age of stratum B occupation at the Heath site. We can now add 5GN3418 to a growing database of Paleoamerican sites in the southern Rocky Mountains, and we can continue excavations with a clearer sense of the timing of human occupation relative to deposition of stratum B.

We gratefully acknowledge the financial support of the Hinsdale County Historical Society, the Colorado Historical Society-State Historical Fund (grant # 2007-AS-004), the Brigham Young University Charles Redd Center for Western Studies, and the OSL laboratory at USU. We also thank all the talented 2007 USU field school students and volunteers who so carefully test-excavated the Heath Site. Finally, we thank landowners Bruce and Parry Heath and the Colorado Department of Transportation for their support of our efforts, and Lake City's Mike Pearce for recording 5GN3418, for bringing the site to our attention, and for spoiling the whole crew with goodies on many occasions.

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Little Delta Dune Site: A Late-Pleistocene Multicomponent Site in Central Alaska

Ben A. Potter, Joshua D. Reuther, Peter M. Bowers, and Carol Gelvin-Reymiller

Recent surveys in central Alaska yielded eight buried prehistoric sites dating from the late Pleistocene to the mid-Holocene within a ca. 2000-acre inactive dune field (Potter et al. 2007). One of these, the Little Delta Dune site (49XBD-298), contains four components in well-stratified contexts (Figure 1), with the oldest component securely dated to the late Pleistocene. The site is located near the confluence of the Tanana and Little Delta Rivers on the crest of a 5- to 6-m-high linear loess-mantled sand dune feature. Preliminary investigations to date include a 16-m^2 block excavation, 20 shovel tests, and 5 auger cores.

Stratigraphy consists of over 520 cm of aeolian silts and fine-to-medium sands. Four lithostratigraphic units were defined at the site (from the top down): Unit IV, massive silt; Unit III, medium-sized sand; Unit II, massive silt; Unit I, fine-to-medium laminated sands. Soil development is confined to Unit IV, with the modern boreal forest (Typic Cryochrept) in the uppermost 60 cm, and numerous weakly expressed Ab horizons between 80–160 cm below surface, similar to Typic Cryorthents described at the nearby Broken Mammoth and Swan Point sites (Dilley 1998:211).

Initial stabilization of the dune feature and deposition of Unit I sand occurred prior to 11,320 ± 30 RCYBP. Silt aggradation (Unit II) began about this time and continued throughout the Holocene, lessening after about 8800 ± 40 RCYBP. Within these stratified deposits, four cultural components (C1–C4) were

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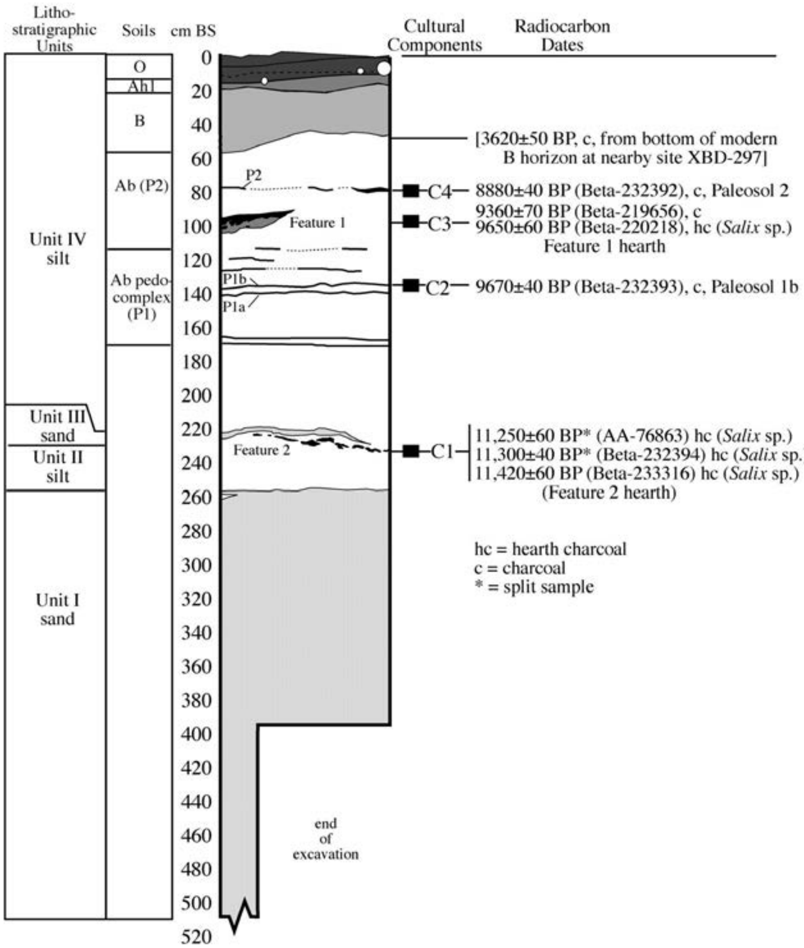

Figure 1. Generalized stratigraphic profile of the Little Delta Dune site.

identified, separated by sterile sediments (nearly 100 cm between C1 and C2, 40 cm between C2 and C3, and ca. 20 cm between C3 and C4).

Based on limited testing, Component 1 consists of 17 tertiary chert flakes and 320 faunal fragments (18.3 g) directly associated with a hearth feature (Feature 2) dating to 11,320 ± 30 RCYBP (13,269–13,124 CALYBP), the average of three statistically contemporaneous dates (two split samples and one cross-check sample). All dated samples were charred willow twigs (*Salix* sp.) and thus provide a good age estimate for site occupation. Flotation of Feature 2 yielded 28 carbonized seeds of the edible common bearberry (*Arctostaphylos uva-ursi*), which ripens in autumn and may have been consumed by site occupants.

Identifiable faunal specimens include long bones and phalanges from multiple species of waterfowl (Family Anatidae, swan-sized and mallard-sized), large artiodactyl tooth enamel (e.g., bison, moose, or wapiti), small mammal remains, and a medium-sized canid upper P4 tooth (likely fox, *Vulpes* sp.) (total NISP = 14). All specimens were fragmented and interspersed among the lithics and hearth charcoal in a thin cultural layer. While the sample size is small, these data do correspond to the nearby Broken Mammoth CZ4 faunal assemblage dating to the same time period, composed largely of waterfowl, bison, and wapiti (Yesner 1996). A fall occupation is inferred based on the bearberry seeds and on the presence of waterfowl; waterfowl vulnerability is high when energy demand is high, which occurs during the early autumn molt (generally a two week time period) followed by fat accumulation prior to fall migration. Areas where staging occurs during migration is also a time of high vulnerability, especially for young birds unfamiliar with the location (Dehorter and Tamisier 1997; Hickman et al. 1988).

Three other components consist of diffuse scatters of lithic artifacts and date to the early Holocene. Component 3 lithic materials, including a resharpened lanceolate/oblanceolate bifacial projectile point, are associated with a dated hearth feature (Feature 1) and burnt medium to very large sized mammal bone (maximum cortical thickness of 1.3 mm). Components 2 and 4 consist primarily of lithic debitage with no associated fauna.

If the Clovis complex dates from 11,050 to 10,800 RCYBP (Waters and Stafford 2007; but see Haynes et al. 2007), then Component 1 is pre-Clovis, slightly younger than Swan Point CZ4, and coterminous with Broken Mammoth CZ4 and four components in the Nenana basin (Goebel et al. 1991; Holmes 1996, 2004; Powers and Hoffecker 1989). While no formal tools have been discovered with the limited testing to date, the stratigraphic and spatial integrity of the component, the presence of well-preserved identifiable fauna and a dated cultural feature at this early date indicates the potential to yield significant information on the earliest populations to enter the New World. As most Alaskan late-Pleistocene sites are associated with loess depositional episodes beginning ca. 12,000 RCYBP, like Swan Point, Dry Creek, and Walker Road (Holmes 1996; Powers et al. 1983; Dilley 1998; Hamilton and Goebel 1999), the potential to test deeper eolian sediments for earlier components adds to the significance of this site and the area as a whole. A long-term multi-disciplinary research project is now being developed for sites within this dune field.

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Clovis in Wyoming

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The spatial distribution and abundance of fluted projectile points across North America are central to many interpretations of the colonization process. Researchers use fluted projectile-point distributional databases to infer regional patterns of early-Paleoindian mobility and land use (Amick 1996;

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Holen 2001; Meltzer 1988; Tankersley et al. 1990), as well as to address such large-scale questions as the origin of fluted-point technology, and the mode and tempo of colonization and subsequent population spread (Anderson 1990a; Anderson and Faught 1998, 2000; Anderson and Gillam 2000; Kornfeld 2006; Morrow and Morrow 1999; Steele et al. 1998).

Although archaeologists have conducted fluted-point surveys and assembled distributional databases for many decades (McCary 1947), such data have not always been widely accessible. With the advent of the Paleoindian Database of the Americas (PIDBA; Anderson et al. 2005; online at http://pidba.utk.edu/), a continental-scale compilation, researchers can easily access Paleoindian projectile-point data for much of North America, including counts of typed Paleoindian points by county for much of the United States. With PIDBA and its predecessors (Anderson 1990b; Anderson and Faught 1998, 2000; Faught et al. 1994), it became possible to use fluted-point distributions to discuss large-scale issues relating to New World colonization. However, PIDBA is a work in progress, as readily acknowledged by its authors, who continue to actively call for projectile-point data. To this end, we provide preliminary counts of Clovis points by county for the state of Wyoming (Figure 1). These counts are based on site file searches of the Wyoming Cultural Records Office, our own notes of private collections, and other published sources.

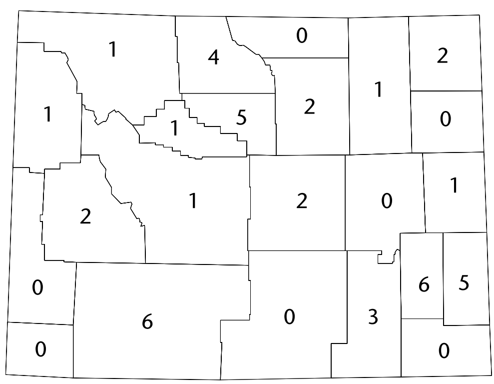

Figure 1. Distribution of Clovis points in Wyoming by county.

Forty-three Clovis points are documented to the county level in Wyoming. An additional six points have been documented from southwestern Wyoming (Bozovich 1996) and three from the Spanish Diggings area of southeastern Wyoming (Saul 1969). One additional Clovis point can be documented to the state level, for a total of 53 points. As a whole, Clovis points are relatively rare in Wyoming compared with some other areas of the U.S. (Anderson et al. 2005). Although Clovis point distribution is significantly related to factors affecting point visibility such as modern population density, cultivation, intensity of archaeological research, and environmental productivity, these factors do not entirely explain the relatively low density of Clovis points across Wyoming (Prasciunas 2008). Other factors that potentially bias point distribution might include geologic visibility, ground cover, collector efforts, and site-formation processes. Alternatively, the low density of Clovis points across Wyoming could truly be reflective of low early-Paleoindian population densities. Perhaps, as argued by Anderson (1990a; Anderson and Faught 1998, 2000; Anderson and Gillam 2000), greater early-Paleoindian population densities were limited to resource-rich locations capable of providing better access to critical resources. The continued compilation of fluted point data is essential for differentiating among these possibilities, and crucial to furthering our understanding of early Paleoindian settlement patterns and land-use strategies. We intend to update the distribution of Clovis points across Wyoming as more data become available, and we encourage anyone with knowledge of points not included in this study to contact the authors.

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Further Investigations of the Lucy Site in Central New Mexico

William T. Reitze

The Lucy site, near the railroad siding of Lucy, central New Mexico, played a significant role in early discussions of the Sandia complex and peopling of the New World (Miller 2000; Roosa 1956, 1968). Field work at the site in the 1950s resulted in the recovery of Sandia, Clovis, Folsom, Midland, late-Paleoamerican, Archaic, and late-prehistoric artifacts from blowouts among sand sheets and dunes on the southeast side of the Estancia Basin, which held paleo-lake Estancia in the late Pleistocene (Roosa 1956, 1968). The site was controversial, however, owing to disagreement over the type Sandia site (Sandia Cave). In the ensuing decades it faded into obscurity owing to lack of publication of the research. Field work in 1998 demonstrated problems with initial interpretations of the age and stratigraphy of the site (Miller 2000) related to minimal publication of the Lucy record. More recent investigation of the original site records from the Lucy site, discovered at the Maxwell Museum of Anthropology, has the potential to clarify these issues. Specifically, these documents and collections allow for exploring relationships between Sandia and other Paleoamerican materials.

Excavations at Lucy were conducted between 1955 and 1957, and again in 1959, with William Roosa acting as field director. Roosa (1956, 1968) incorporated the Lucy material into his Ph.D. research, focusing on developing and stratigraphically dating the Sandia cultural complex. Supplemental geologic and microstratigraphic work was also conducted at the site (Harbor 1956, 1958). Roosa (1968) suggested that the Lucy site included occupation areas from a variety of Paleoamerican groups; the central feature was a Sandia proboscidean kill.

In 1998, the site was revisited by the Southern Methodist University (SMU) QUEST archaeological program to assess the stratigraphy and geochronology of Lucy to better contextualize the site's archaeological material (Miller 2000). An effort was made to relocate Roosa's original trenches, understand

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the stratigraphy, and collect material for ^{14}C dating (Miller 2000). Researchers concluded that the "marker beds" used for dating at Lucy were considerably younger than Roosa believed, making it unlikely that the Sandia material was as old as previously suggested (Miller 2000).

Earlier this decade, archival materials from Lucy were found in a house occupied by Roosa just before his death and sent to the University of Waterloo where Roosa had taught. These were then donated to the Maxwell Museum, where I had the opportunity to examine them. The materials provide a surprisingly complete record of work at Lucy, including hundreds of photographs of in situ artifacts, the site, and its stratigraphy. Documents include plane-table maps, field notes, summary reports, and correspondences. There are reports by both Roosa and Frank Hibben (the first archaeologist at Lucy and Roosa's advisor) summarizing the field work and a handful of speeches and newsletters about Lucy. Additionally, the collection contains 24 field books from the 1954–1959 field seasons containing daily logs of excavation, often with detailed drawings and descriptions of artifacts and stratigraphy. These records have the potential to significantly clarify and expand our understanding of the Lucy site and the field work Roosa undertook there.

The Lucy site is generally considered a Sandia locality (Lyons 1969; Miller 2000; Wormington 1957), but the newly found archives indicate that Lucy is a large site complex that yielded discrete, diagnostic Clovis, Folsom, and later-Paleoamerican artifact assemblages from a number of blowouts. Based on field notes and maps of Lucy, Roosa considered an area of several thousand square meters to be the site. He divided the site into a series of loci, which correspond to different blowouts. Harbor's (1956, 1958) stratigraphic trenches crossed the north-south and east-west axes of Lucy and intersected near the Sandia locus of the site. Further, Roosa identified two separate Folsom localities and a Clovis locus with associated proboscidean remains. By examining the archival records, we are able to parse the palimpsest at Lucy and identify individual Sandia, Clovis, and Folsom assemblages and occupation areas. While more work is necessary, it may be possible to treat the loci at Lucy as single-component occupations.

The archival materials from the Maxwell Museum provide an exciting new avenue of research for the Lucy Site. While research reported by Miller (2000) may be the final word on the dates of the Sandia component at the site, the possibility of definable Folsom and Clovis components at Lucy offer a new direction for further research on early Paleoamerican occupation in central New Mexico. The discovery of these documents is an example of the opportunities available for reinvestigations of museum collections.

Thanks to Dave Phillips and the Maxwell Museum of Anthropology for help and access to the materials, Christopher Ellis for ensuring that Roosa's records returned to the Maxwell with the rest of the collection, Christina Sinkovec and Katrina Erickson for help with the collections, and Vance Holliday, Kacy Hollenback, Bruce Huckell and Christina Sinkovec for their comments.

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An Arena Point and Crescent from Santa Rosa Island, California

Torben C. Rick

Chipped-stone Arena points (Channel Islands barbed points) and crescents were important technologies for some of the earliest peoples to occupy California's Northern Channel Islands (Erlandson and Braje 2007, 2008). Most specimens were recovered by early antiquarians, however, and lack detailed provenience or chronology. Several crescents or Arena points were recently identified at four ca. 10,000–8000 CALYBP sites on San Miguel Island (Erlandson 2005; Erlandson and Braje 2007, 2008; Erlandson et al. 2005) and three Arena points were found in ca. 8500–7800 CALYBP deposits on Santa Cruz Island (Glassow et al. 2008). Recent ^{14}C dating on San Miguel and Santa Rosa islands suggests that some of these artifacts, especially crescents, may be as old as 11,500 CALYBP (Erlandson and Rick unpublished data). Unfortunately, little is known about the distribution of these early artifact types on the Channel Islands.

In 2006, an Arena point and crescent were recovered during surface collection at CA-SRI-207, a lithic scatter and deflated shell midden covering about 40 by 40 m on bluffs overlooking Bechers Bay, Santa Rosa Island. Although Jones collected crescents and Arena points from Santa Rosa in 1901 (Heizer and Elsasser 1956), the CA-SRI-207 specimens are the first to be reported from a specific Santa Rosa Island site.

The artifacts were made of chert, whitish tan (point) and blonde (crescent), probably obtained from San Miguel or Santa Cruz Island chert sources. Similar to an artifact reported by Glassow et al. (2008), the point appears unfinished and is 43.7 mm long, 22.8 mm wide, 7.1 mm thick, and weighs 4.0 g. The crescent fragment is comparable to non-eccentric crescents described

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by Tadlock (1966), and is 34.2 mm long, 15.3 mm wide, 5.0 mm thick, and weighs 2.7 g (Figure 1).

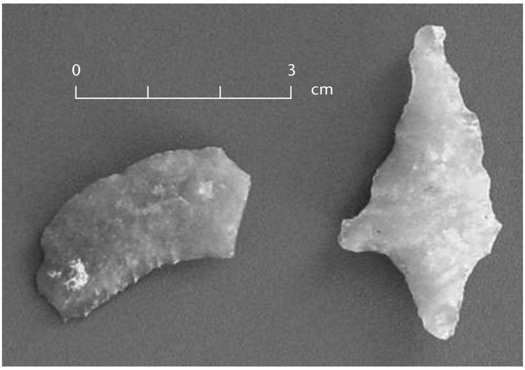

Figure 1. Early-Holocene crescent (left) and Arena point (right) from CA-SRI-207.

Because the two artifacts reported here were found on the CA-SRI-207 site surface, their precise age is unknown. The morphology and measurements of the artifacts, however, are consistent with Arena points and crescents dated to ca. 10,000 to 8000 CALYBP (and possibly as early as 11,500 CALYBP) on San Miguel Island (Erlandson and Braje 2007, 2008; Erlandson and Rick unpublished data). The Arena point, moreover, differs in dimensions and form from middle and late-Holocene stemmed dart and arrow points from the Channel Islands. Collectively, these factors suggest that the CA-SRI-207 crescent and Arena point probably date to at least 10,000–8000 CALYBP. Groundstone bowl fragments and a contracting stem point also indicate a separate middle-Holocene site component.

Researchers have speculated that Arena points were used to hunt sea otters (Erlandson and Braje 2007) or spear fish (Glassow et al. 2008), and that crescents may have been used to hunt aquatic birds, as cutting/scraping tools, and even as surgical implements (see Erlandson and Braje 2008; Fenenga 1984). Until more specimens are found in stratified contexts with associated faunal remains, the precise function of both artifact types remains unclear. Nevertheless, their presence in several Channel Island localities suggests they were important technologies for some of the earliest coastal peoples in North America.

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An Antler Tool from the Goshen Level of the Jim Pitts Site, South Dakota

Frederic Sellet, James Donohue, and Matthew G. Hill

The faunal assemblage at the Jim Pitts site in South Dakota contains an unusual antler artifact. The object in question (Figure 1) is the proximal portion of an antler beam cut off short of the first prong. Identification of the species is tentative mainly due to the poor preservation of the tool, but elk seems probable (a very large mule deer is also possible). The artifact was found in a bone bed that also yielded Goshen projectile points and lithic artifacts indicative of camp activities (Donohue and Sellet 2002; Sellet 2001; Sellet et al. in press). Radiocarbon dating of the Goshen level produced an average age of 10,185 ± 25 RCYBP (Donohue and Sellet 2002; Sellet et al. in press).

Antler tools are rare at Paleoindian sites, and the one found at Jim Pitts differs from other published specimens (Bamforth 2007:190–91; Frison 1982; Hill et al. in press; Wheat 1979:134–36). This alone complicates any inference of its function. The short list of Paleoindian antler billets mentioned above includes a 115-by-38-by-32-mm billet from the Jurgens site in Colorado. The Jurgens specimen, however, bears a stronger resemblance to the billets used by modern knappers; both longer and thinner than the Jim Pitts tool, it may be

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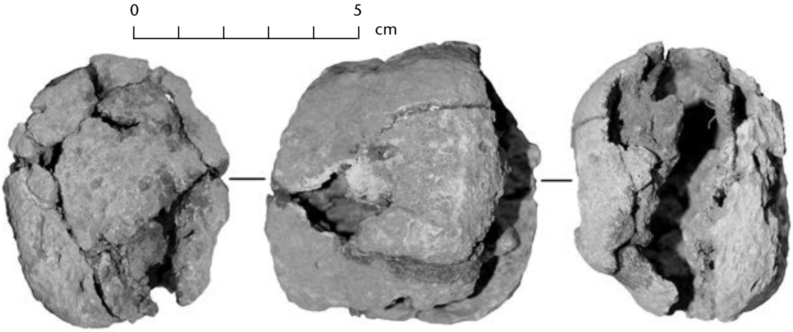

Figure 1. Antler tool from the Goshen level at the Jim Pitts site. From left to right: proximal view, side view and distal view.

held as a hammer. A better match in terms of morphology would be a mule-deer antler recovered from the Paleoindian levels at the Medicine Lodge Creek site in Wyoming (Frison 1982; Frison and Walker 2007:51). This artifact was found in association with a core, a piece of red ocher, and a sandstone abrader, suggesting a flintknapping toolkit. The maximal diameter for the Medicine Lodge billet is 47 mm (the length extrapolated from the illustration is 108 mm). It is, thus, both thinner and longer than the one discussed here.

The Jim Pitts antler has an oval cross section with a maximal diameter of 66.72 mm. Length is 60.72 mm, weight around 84.2 g. The distal end has a bevel that could be a vestige of its manufacture or may be related to its function. The object was recovered in an activity area associated with the production of flakes, in the immediate vicinity of a core and several flakes that refitted together. This location points to its possible use as a knapping tool. An alternative function is indicated by similarities in morphology and size to an ivory billet from the Blackwater Draw site. The Blackwater Draw specimen is 36–46 mm in diameter and 73.5 mm long. It has been interpreted as a burnisher (Saunders et al. 1991) A deer-antler billet from the Allen site in Nebraska is also thought to have been a burnisher (Bamforth 2007:191). The Jim Pitts tool does have some polish on its surface as well, but the poor preservation does not allow us to surmise much more about its possible function. Multiple uses such as a flintknapping tool and a burnisher cannot be precluded at this point.

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Results from the XRF Analysis of Pre-Archaic Projectile Points from Last Supper Cave, Northwest Nevada

Geoffrey M. Smith

Last Supper Cave is located in the High Rock Country of northwest Nevada. The site, excavated in 1968 and 1973–74 under the direction of T. Layton and J. Davis, contained a rich record of human occupation spanning the Holocene. Layton and Davis (1978) obtained radiocarbon dates on charcoal (n = 2) and freshwater shell (n = 2) from the cave's basal deposits ranging from 8260 ± 90 (WSU-1706) to 8960 ± 190 (TX-2541) RCYBP. More recently, I obtained a radiocarbon date of 10,280 ± 40 (Beta-231717) RCYBP on charcoal from a hearth-like feature in the lowest cultural stratum. Numerous stemmed projectile points, diagnostic of terminal-Pleistocene/early-Holocene occupations in the Great Basin (Beck and Jones 1997), were recovered from the lowest strata.

As part of an ongoing effort to elucidate pre-Archaic toolstone-procurement patterns in northwest Nevada, I submitted 35 obsidian stemmed points from the site to the Northwest Research Obsidian Studies Laboratory for nondestructive X-ray fluorescence (XRF) analysis. These points consist primarily of Parman and Cougar Mountain varieties of the Great Basin Stemmed Series (Tuohy and Layton 1977). Eight known and one unknown geochemical types were identified in the sample (Table 1). Sources of these materials, at distances of 1 to 91 km from the site, are located throughout northwest Nevada and, to a lesser extent, southern Oregon and northeast California. Most of the points (62.7 percent; n = 22) are made on Massacre Lake/Guano Valley obsidian. This fact is not surprising, given that the site lies near the center of the known distribution of that material and sources of the toolstone lie within

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Table 1. Geochemical types represented in the sample of obsidian pre-Archaic projectile points from Last Supper Cave.

Geochemical type	N	Percentage	Distance to nearest source (km)
Badger Creek (NV)	1	2.9	26
Beatys Butte (OR)	4	11.4	76
Bog Hot Spring Unknown 1	1	2.9	Unknown
Bordwell Springs/Pinto Peak/Fox Mountain (NV)	2	5.7	56
Buck Mountain (CA)	1	2.9	90
Coyote Spring (NV)	1	2.9	22
Double H/Whitehorse (NV/OR)	1	2.9	91
Hawks Valley (NV/OR)	2	5.7	21
Massacre Lake/Guano Valley (NV/OR)	22	62.7	1
Total	35	100.0	

1 km of the cave. Other geochemical types of toolstone from more distant sources are represented in relatively even but low frequencies.

The results of this analysis approximate those obtained through similar studies of pre-Archaic assemblages from other locations in northwest Nevada, including the Parman localities (Smith 2007), Rock Creek (Konoske et al. 2005), the East and West Arms of the Black Rock Desert (Amick 1997; Camp et al. 2008), and neighboring areas (Smith 2005). Like those assemblages, the sample of points from Last Supper Cave lacks obsidian from sources south of the Black Rock Desert. This trend supports earlier assertions (Smith 2005) that the lithic conveyance zones (*sensu* Jones et al. 2003) represented in pre-Archaic assemblages from northwest Nevada are like those inferred for the northern Great Basin (e.g., Connolly 1999; Oetting 1993) because they do not entail extended transport distances reflected in assemblages in the central or eastern Great Basin (e.g., Jones et al. 2003). This difference may be a function of regional variation in topography: The central and eastern Great Basin are characterized by north-south-trending valleys, while northwest Nevada and southern Oregon are characterized by volcanic tablelands. A second possibility, previously suggested by Jones et al. (2003), is that variation in lithic conveyance zones within the Great Basin reflects the presence of geographically discrete foraging territories during the terminal Pleistocene/early Holocene.

Funding for the XRF analysis of the projectile points included in this study was provided by a Desert Research Institute Lander Grant. Craig Skinner conducted the XRF analysis of the artifacts from the site. Special thanks to Tom Layton for making the projectile points and fieldnotes from Last Supper Cave available for study as well as establishing much of the foundation for pre-Archaic research in the Black Rock Desert–High Rock Country.

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Three Saylors: An Appalachian Mountain Clovis Site in Southeastern Kentucky

Kenneth B. Tankersley

For more than a half century, archaeological surveys of Clovis sites have focused on major river valleys and quality stone source areas. The relative absence of Clovis sites in mountainous areas suggested that late-Pleistocene subsistence and settlement was restricted to relatively flat terrains with open environments such as plains, prairies, and strandlines. This economic model was based, in part, on the assumption that the human population of late-Pleistocene North America was sparse and late.

Recently, this view has been challenged on two fronts. First, it is clear that people were in North America before Clovis (Lepper and Bonnichsen 2004) and, second, Paleoindian sites have been found in the foothills and mountain slopes of Wyoming and the Allegheny Plateau of New York (Frison 1992;

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Tankersley et al. 1995, 1996). Given that paleoeconomic studies need to focus on all aspects of human livelihood, determining the use of high-peak mountainous terrain by Clovis people is crucial to our understanding of their subsistence strategies (Tankersley and Isaac 1990).

Three Saylors is a Clovis site located near the Harlan County border, approximately 5 km from Saylor, Leslie County, Kentucky. Physiographically, this area is known as the Southeastern Mountain Coal Fields, which includes the highest peaks in Kentucky and among the highest mountain ranges in Appalachia, with elevations more than 1,250 m asl and local relief exceeding 1,300 m. While Clovis sites have been documented in all physiographic areas of the Ohio River valley, Three Saylors is the first open habitation documented in the high peak range of the Appalachian Mountains (Tankersley 1990).

Three Saylors is situated on a flat to slightly sloping terrace of Spruce Pine Creek at the mouth of Deep Gap Hollow, headwaters of the Kentucky River, a tributary of the Ohio River. Between 1978 and 1990, pedestrian surveys of the plowed surface were opportunistically examined by Darla Saylor-Jackson and Dale Wilson with nearly 100-percent surface visibility. Their surveys, recently brought to the attention of the author, identified a variety of Clovis flaked-stone artifacts on the late-Pleistocene (T1) surface.

Representative Clovis artifacts include 23 broken and heavily reworked Clovis points (7 manufactured from Fort Payne chert and 16 from Monteagle chert), 11 bifacial preforms (8 manufactured from Fort Payne chert and 3 from Monteagle chert), and 12 unifacially flaked stone tools including 7 triangular-shaped endscrapers (2 manufactured from Fort Payne chert and 5 from Monteagle chert) and 5 sidescrapers (one manufactured from Fort Payne chert and 4 from Monteagle chert). Both these cherts co-occur in Mississippian age limestone throughout the Appalachian Mountains, from Alabama to Kentucky. Outcrops of both cherts can be found within 150 km of the site.

One of the most noteworthy aspects of the Three Saylors site is that it continued to be used throughout prehistory. A plethora of Archaic, Woodland, and Fort Ancient flaked-stone artifacts also have been recovered from the site. These artifacts demonstrate that the site was periodically occupied for ca. 13,000 years, that is, during the Allerød warming, Younger Dryas cooling, post–Younger Dryas warming, 8200 CALYBP Cold Event, Holocene Climatic Optimum warming, post-Holocene Climatic Optimum cooling, Medieval Warm Period, and the Little Ice Age (Clarke et al. 2004, Pielke 1995). In other words, the location of the Three Saylors site remained important to the indigenous population regardless of the frequency or duration of warm and cold climatic events.

Late-Pleistocene terraces in the Appalachian Mountains have been subjected to rapid degradation because of their location in valleys with high relief and steep gradients. Three Saylors is preserved because it occurs in a tributary headwater valley, Spruce Pine Creek, and is protected by the bedrock walls of Deep Gap Hollow. Without these variables, the site would have been eroded away during the Holocene.

Our record of Clovis sites in the Appalachian Mountains is at best imperfect, obscured by weathering and erosion processes. The occurrence of Clovis sites in geologically active landscapes is a rare phenomenon. Therefore, the scarcity of Clovis sites is not necessarily related to the avoidance of mountainous terrain because of an embedded subsistence strategy or settlement pattern. Rather, most of the Clovis-age sediments, surfaces, and their associated cultural deposits in the Appalachian Mountains have been lost to mass wasting and stream action. These geological caveats should be heeded when interpreting Clovis paleoeconomies (Tankersley et al. 1996:104–105).

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Two Chipped-Stone Crescents from Eastern Colorado

Michael L. Terlep and Steven R. Holen

The known distribution of Paleoindian chipped-stone crescents is in the Great Basin, with some also recovered in the Columbia Plateau and California (Justice 2002). Two examples have been recovered at sites in Wyoming (Bostrom 2003), and one crescent was associated with the Fenn Cache from the tri-state boundary area of Utah, Wyoming, and Idaho (Frison and Bradley 1999). However, the

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discovery by private collectors of two lunate-form crescents in eastern Colorado has proven to be an oddity. From all published literature discussing the presence of crescents, it appears that these Colorado artifacts are the eastern-most examples of Paleoindian crescents in the United States.

Crescents are commonly found in surface contexts near ancient lake beds and streams associated with Stemmed Point Tradition and Clovis artifacts. Hypotheses as to the tool form's purpose range from transversely hafted projectile points for hunting waterfowl (Tadlock 1966) to cutting knives similar to an Inuit *ulu* (Justice 2002). Experiments conducted by Amick (2007) support the waterfowl-hunting hypothesis, but other possible uses cannot be completely dismissed.

The first Colorado crescent was collected in northeastern Colorado near the city of Sterling (Figure 1). The crescent is made of light purple quartzite from the "Spanish Diggings" of the Hartville Uplift in east-central Wyoming. This artifact is 32.8 mm long, 12.9 mm wide, and 5.9 mm thick. The crescent has evidence of grinding on the concave and convex edges of the midsection of the artifact. Narrow parallel pressure flaking is present on both faces. The second crescent, from Crowley County, southeastern Colorado, is made of Black Forest petrified wood that commonly outcrops on the Palmer Divide southeast of Denver. This crescent has narrow irregular flaking along all edges of one face. The opposite face displays flaking along the midsection and one edge. The artifact is 48.7 mm long, 18.8 mm wide, and 5.2 mm thick. No additional Paleoindian artifacts were found in association with these crescents. Both Colorado crescents appear to be most closely related to Type I "Quarter-moon" crescents of the Great Basin (Tadlock 1966), which average 53 mm long, 19 mm wide, and 5.2 mm thick. Material identification was conducted using comparative lithic samples housed at the Denver Museum of Nature & Science.

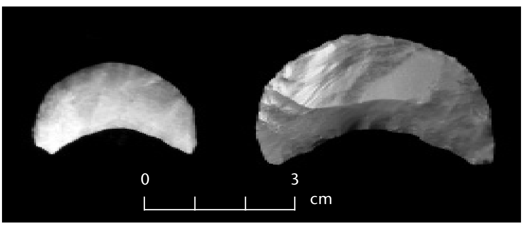

Figure 1. A quartzite crescent (left) found near Sterling, Colorado, and a Black Forest silicified wood crescent (right) found in Crowley County Colorado.

The presence of these two crescents in eastern Colorado extends the range of this unique artifact type east of the Rocky Mountains. While both crescents were found near water sources (the South Platte River in northeast Colorado and Horse Creek in southeastern Colorado) there is not enough evidence to support the waterfowl hunting hypothesis.

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Recent Fluted-Point Finds at Lake on the Trail, Harney County, Oregon

Scott P. Thomas, Patrick O'Grady, Dianne Ness, and Daniel Braden

Lake on the Trail, a large playa south of Riley, Oregon, has recently caught the attention of Burns District Bureau of Land Management (BLM) archaeologists because of the abundance of stemmed points and other early-Holocene artifacts present along its shorelines. The artifacts were noted during fire-rehabilitation surveys in 2001. Repeated trips to the location were undertaken as part of a systematic BLM effort to identify Paleoamerican sites on agency lands. They have resulted in the collection of numerous diagnostic artifacts attributed to Western Stemmed, Haskett, Great Basin Transverse, and fluted point typologies. Two fluted points collected at Lake on the Trail are the focus of this report. Both were found by BLM archaeological technician Dianne Ness.

Specimen 04-337 has a single flute scar on one face. (Figure 1.) There is no conclusive evidence of flute flake removal on the opposite face. It was surface-collected near the inlet where Big Stick Creek empties into the playa. There is no evidence of edge grinding or channel scratches on this artifact. The specimen measures 31.45 mm long, 25.44 mm wide, and 6.51 mm thick, and has a basal depth of 6.03 mm and basal width of 23.8 mm (Rondeau 2007). The point is made of Whitewater Ridge obsidian with a hydration measurement of 7.2 µ (Skinner and Thatcher 2005; Thomas and O'Grady 2006). Whitewater Ridge is a broadly dispersed obsidian source found in Silvies Valley, 90 km north of Lake on the Trail. Obsidian hydration measurements, less accurate than radiometric dating techniques, can be useful to gauge the relative age of obsidian artifacts. A measure of 7.2 µ suggests an early-Holocene age.

Specimen 04-368, collected on the northwestern shoreline, is considered to be a fluted-point variant because of its small size. It has been heavily reworked

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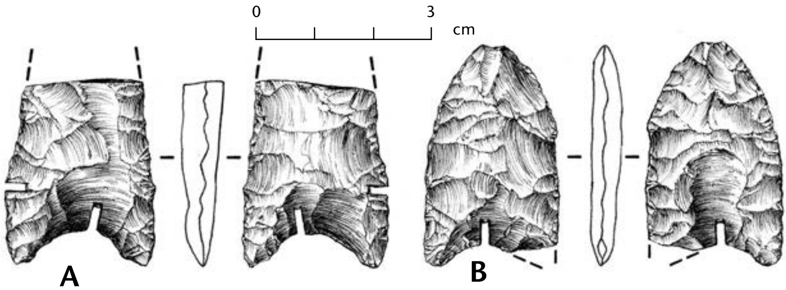

Figure 1. Fluted points from Lake of the Trail, Oregon. **A,** specimen 04-337, a fluted-point base; **B,** specimen 04-368, a nearly complete fluted point.

on both proximal and distal portions (Rondeau 2007). Edge grinding, present on the basal margin and one lateral margin, appears to have been removed elsewhere by pressure flaking. There is no evidence of channel abrasion. A single flute scar is present on one face. The opposite has a basal scar that may be an attempt at fluting through pressure flaking. It is 27.54 mm long, 22.99 mm wide, and 4.73 mm thick, has a basal depth of 3.94 mm, and a basal width of 23.0 mm. It is made of locally available Buck Springs obsidian and has a hydration measurement of 8.9 μ (Skinner and Thatcher 2002). A hydration measurement of 8.9 μ suggests an early-Holocene age.

Based on the BLM surveys, Lake on the Trail and nearby playas have elevated frequencies of early-Holocene artifacts compared with other non-lacustrine associated Burns District lands. Exploratory excavations and systematic pedestrian surveys are being conducted to identify site locations and evaluate their potential for stratified deposits.

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The Shuermann Finds at Cedar Creek, Western Oklahoma

Don G. Wyckoff

In Washita County, western Oklahoma, Cedar Creek has long been a prime drainage in which to find Paleoindian points. Hofman (1990, 1993) notes the many Folsom specimens recovered there, but Plainview and other early-Holocene lanceolate forms are also abundant (Bell 1954; Gettys 1984). A brief geoarchaeological survey of the creek was undertaken in the late 1970s (Nials 1977), but no definitive sources were identified for the many late-Pleistocene/early-Holocene artifacts found there. Recently, and somewhat unexpectedly, a few San Patrice projectile points were documented from the creek drainage, and these were included in a study of San Patrice distributions, raw material use, mobility, and interaction between the woodlands and southern Plains some 10,100 RCYBP (Jennings 2008). Reported here are two projectile points that were not available to Jennings (2008) but believed relevant to questions about San Patrice technological and formal ties.

Found on separate occasions by Rick and Donna Schuermann (Ft. Cobb, Oklahoma), the two specimens in Figure 1 are both of chert from the Edwards Plateau, Texas, material often represented by Paleoindian points found in western Oklahoma. Figure 1A is of the Georgetown variety, so a bedrock source some 500 km south is likely. Figure 1B is tan mottled with gray and might have come from only 350 km to the south-southwest. Symmetrically lenticular in cross section, both artifacts lack their tips (due to bend breaks) and one "ear" on their stems. Both retain segments of convex blade edges; narrow, short stems; downward projecting "ears" on their stems; and concave bases. Very slight abrasion is manifest on the lateral edges of the stems. The blades show collateral flake scars, with the larger specimen showing flakes from the left side overlapping those on the right. Fairly well centered, and running nearly half the length of the most complete specimen (Figure 1B) and all the length of the shorter example (Figure 1A), are flute scars; on both specimens these originate from the existing bases. On the short specimen, this base is 0.8 cm below the blade-stem juncture, whereas on the larger example the base is very near the blade-stem juncture owing to the very concave base. Figure 1A is 4.1 cm long, 2.86 cm in maximum blade width, and 0.66 cm in maximum thickness (outside the flute scar). Specimen 1B is 8.1 cm long, 3.1 cm in maximum blade width, and 0.73 cm in maximum thickness. Both are 0.6 cm thick where fluted.

Given the many Folsom points reportedly found along Cedar Creek (Hofman 1990, 1993), the above two specimens might be questioned as being Folsom examples retouched by later people frequenting this drainage. Using 27 sufficiently complete Folsom points of Edwards chert from Cedar Creek

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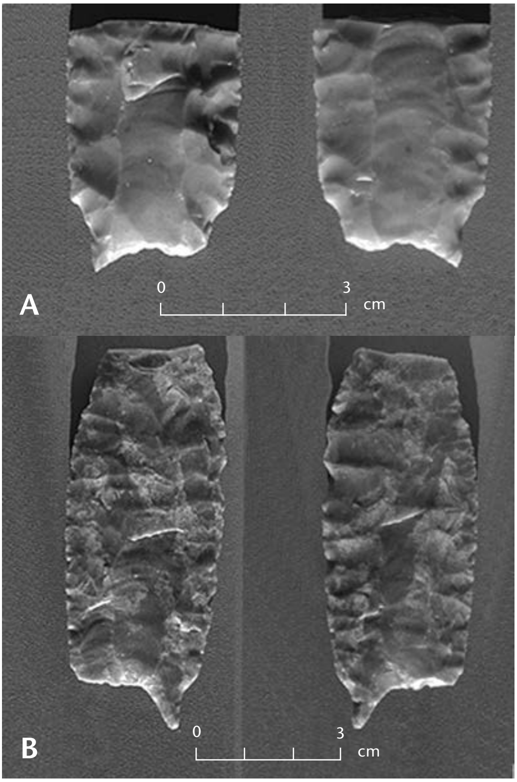

Figure 1. Two fluted San Patrice points from the Cedar Creek drainage in western Oklahoma. Both are of Edwards chert.

and other streams within 50 km of Cedar Creek, measurement ranges and averages have been compiled on 27 specimens: maximum width (n = 27; range 1.62 to 3.4 cm; average, 2.02 cm); maximum thickness (n = 26; range 0.31 to 0.7 cm; average, 0.43 cm); and thickness within the flutes (n = 16; range, 0.22 to 0.47; average, 0.29 cm). Compare these figures with those listed for the Shuermann finds, and the latter are larger and thicker by 50 to 200 percent. These findings, plus the homogeneous patination over all parts of the Shuerman finds, support the conclusion that these bifaces were made, fluted, and stem-formed by non-Folsom individuals.

Long considered common to the Gulf Coastal Plains of Louisiana and Texas, San Patrice points are now well documented (Jennings 2008) north along the Interior Highlands (Ozark Plateau and Ouachita Mountains) into southwestern Missouri at the Big Eddy site (Lopinot et al. 2000). There, they co-occur with Dalton materials in a deposit dated to some 10,100 RCYBP. Jennings (2008) reports them well out on the plains, including the Southern High Plains. Though not numerous, a lanceolate variety ("Brazos") of San Patrice sporadically occurs from central Texas (Horn Shelter) (Redder 1985), to southwestern Oklahoma (Howard Gully) (Hurst 2007), and the Texas Panhandle (Rex Rodgers;) (Willey et al. 1978). At Howard Gully, unfluted lanceolate Brazos forms date to 10,200 RCYBP (Hurst 2007), perhaps just a few generations after Folsom. Fluted lanceolate forms are rare, one being reported from Shackleford County, Texas (Hester and Newcomb 1990). The Shuermann finds augment this number, increase the range much farther north, and add to evidence that the Brazos variety of San Patrice originally probably had technological ties to Folsom.

My thanks to Ricky and Donna Shuermann for allowing me to study their finds, to Dean Gamel for his assistance and friendship, and to Tom Jennings and Stance Hurst for their stimulating work on late Pleistocene-early Holocene assemblages and adaptations on the Southern Plains. This article is dedicated to the memory of Lawrence LeVick, a southwestern Oklahoman who taught many of us about prehistory there.

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A Folsom Point Fragment from 3300 m.a.s.l. in the Wind River Range, Fremont County, Wyoming

Chris Young, Tory Taylor, and Richard Adams

In 2005, the second author found a Folsom point fragment on the eastern slope of the Continental Divide at 3301 m (10,830 ft) above sea level in the Wind River Range, Fremont County, Wyoming. (Figure 1.) It was found on an alpine pass with high prehistoric-site density, near toolstone sources, and in prime bighorn sheep habitat, during an ongoing high-altitude archaeological inventory of the Fitzpatrick Wilderness of the Shoshone National Forest.

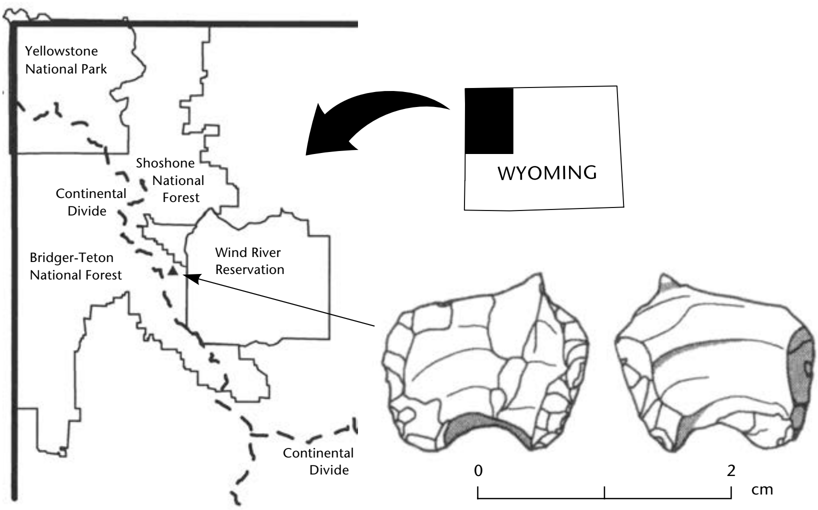

Figure 1. Map of greater Yellowstone ecosystem showing location of high-altitude Folsom point fragment at 48FR6264.

The Folsom fragment came from a multicomponent lithic scatter under, and adjacent to, a nearly perennial snowbank straddling alpine tundra and stunted willow wetland, on an 8-degree slope experiencing periglacial soil creep, frost heave, and size sorting. This dense lithic scatter is known as 48FR6264, and we found chronologically diagnostic Paleoindian, Archaic, and late-prehistoric projectile points.

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The Folsom fragment is made from nondescript opaque white chert, possibly from the Arrow Mountain chert quarry (48FR5014), about an hour's walk distant. It measures 15 mm long by 15.2 mm wide by 2.4 mm thick. Both faces have been fluted. About 9 mm of one lateral margin is present and exhibits the fine retouch found on other Folsom points. It is neither a base nor a tip, but rather a small piece of the margin from a point's midsection.

An examination the Wyoming Cultural Records Office (WYCRO) database revealed that site 48FR6264 is the highest recorded Folsom locality in Wyoming and the only Folsom site recorded in the Wind River Range. Wyoming has several deeply stratified, well-preserved Folsom sites, such as Carter/Kerr-McGee, the Agate Basin Folsom localities, Hanson, and Hell Gap (Frison 1991), located in topographic basins and usually associated with bison procurement. This association has contributed to a unidimensional view of the Folsom cultural complex. However, Folsom groups were certainly capable of exploiting different environmental and ecological settings (Amick 2000). There is now a growing body of evidence from Wyoming and Colorado that Folsom groups were also exploiting the high county. In Colorado, Jodry (1999) notes at least four Folsom sites above 3048 m (10,000 feet). In Wyoming, the majority of Folsom sites and isolates occur within geologic basins; however, more than 31 percent occur in range, uplift, or overthrust areas. Jodry (1999:54) suggests that high-altitude sites may have been used as seasonal hunting camps. Greater knowledge of high-altitude Folsom sites is certain to increase our understanding of the full range of the Folsom adaptation.

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Paleoenvironments: Plants

A Late-Glacial Algae Sequence from Wild Rice Lake Reservoir, St. Louis County, Minnesota

James K. Huber

A phycological investigation of green algae (Chlorophycophyta) from late-glacial sediments recovered from Wild Rice Lake Reservoir, St. Louis County, Minnesota, indicates a period of hypertrophism or high nutrient influx during the late-glacial *Betula-Picea* assemblage zone [10,500 to 10,200 RCYBP (Huber 2001b)]. Wild Rice Lake Reservoir is located approximately 15 km northwest of Duluth, Minnesota (UTM Zone 15: 562272, 5193200). In the 1920s Wild Rice Lake was modified when a dam was built at the north end of the lake creating what is now known as Wild Rice Lake Reservoir (Rapp 1995).

The upper 75 cm of sediment of the 200-cm-long core recovered from Wild Rice Lake Reservoir is gyttja. Below 75 cm, the sediment is minerogenic. An abrupt sediment change at 75 cm in the core indicates that a major hiatus occurs, probably the result of the shallow Wild Rice Lake drying up during the Hypsithermal (Huber 2001b). Pollen and algae are poorly preserved between 75 and 190 cm. Although algae are present, statistically valid counts cannot be undertaken as a result of low abundance and poor preservation.

The most abundant green algae are *Scenedesmus*, *Pediastrum Boryanum*, and *Tetraedron* (mostly *Tetraedron minimum*). *Tetraedron minimum* is a true free-floating plankton commonly found in both deep open water and among vegetation in shallow water near shore (Prescott 1962). *Pediastrum Boryanum* var. *longicorne*, *P. integrum* var. *scutum*, *P. integrum* var. *priva*, *P. Kawraiskyi*, and *Botryococcus* are also common (Figure 1). Other green algae present in the sequence include: *Pediastrum araneosum*, *P. araneosum* var. *rugulosum*, *P. duplex*, *P. duplex* var. *rugulosum*, *P. Boryanum* var. *undulatum*, *P. obtusum*, *P. simplex*, *P. integrum*, *Spirogyra*-type (resting spore), *Zygnema*-type (resting spore), and *Coelastrum*. *Gloeotrichia*-type, a blue-green alga (Cyanochloronta), is also present.

At the beginning of the sequence a thriving algal community had already become established, indicating that initial colonization had taken place prior to the deposition of the sediment recovered at the time of coring. This is indicated by the lack of the underlying Compositae-Cyperaceae pollen assemblage zone commonly found in northeast Minnesota (Huber 2001b). It is

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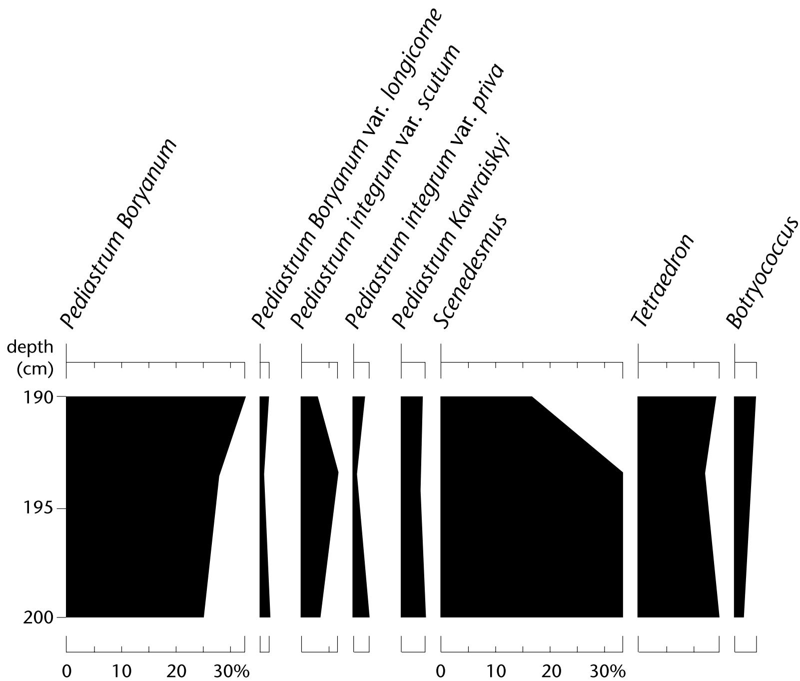

Figure 1. Percentage diagram of selected freshwater algae, Wild Rice Lake Reservoir, St. Louis County, Minnesota. Approximate age of sequence is 10,500 to 10,200 RCYBP based on pollen correlation to dated sites.

possible that either the lake sediments of this age were not recovered during coring or that the lake may not have existed prior to this time. At Big Rice, Gegoka, and Shannon lakes in northeast Minnesota initial alga abundances are much lower in the basal sediments indicating a gradual alga colonization (Huber 2001a). The abundance of both *Pediastrum Boryanum*, an indicator of lake eutrophication (Cronberg 1982), and *Scenedesmus*, an indicator of elevated nutrient levels (Cronberg 1982), indicates that Wild Rice Lake Reservoir underwent a period of hypertrophism or high nutrient influx during the late-glacial *Betula-Picea* assemblage zone between 10,500 to 10,200 RCYBP. A similar period of hypertrophism is seen at Gegoka Lake (Huber 1996) and other lakes in northeast Minnesota (Crisman 1978; Huber 2001a). The period of hypertrophism may be the result of an increase in erosion caused by fire or a change in residence time of water in the lake (Huber 1996). The continued use of nonsiliceous algae microfossils in paleoecological investigations and reconstructions will provide valuable information that will aid in the interpretation of changing paleoenvironmental conditions.

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Paleoenvironments: Vertebrates and Invertebrates

Paleontological Investigations at the Pratum-Rutschman/Qualey Mammoth Site, Marion County, Oregon

Bax R. Barton and Stacie J. Cearley

Mammoth remains were first reported from the Willamette Valley of western Oregon in the 1800s. In 1927 Hay catalogued eight finds of Columbian mammoths and three of indeterminate species from the area. The earliest of these was an upper molar mentioned by Dr. Joseph Leidy in 1869 "as having been found in the Willamette Valley" (Hay 1927). No current catalog exists for these finds, but based on museum collections and newspaper accounts it is clear that mammoth finds from the valley have been common throughout the past century and now probably exceed many dozens of finds and sites. A recent literature search on mammoths in the valley failed to locate any modern paleontological analysis of mammoth remains or any AMS-dated mammoth finds. These data, if they exist, are probably deeply buried in archaeological CRM "gray literature." To begin to address this research void, and to establish a research baseline for the study of mammoths in the region, we are analyzing in detail the mammoth find from Pratum in the lower Willamette Valley (Barton and Cearley 2008; Cearley 2008; Cearley and Barton 2007).

The Pratum-Rutschman/Qualey mammoth was discovered in 1967 during backhoe excavations to create a farm pond in a frequently flooded swale on the property of Roy Rutschman. Excavations by Rutschman and equipment operator Norm Qualey recovered two molars, a femur, tusk fragments, and a fragmentary pelvis (Silverton Appeal 1967). The pond is located on Howell Prairie in the northern Willamette valley of western Oregon, approximately 9.7 km northeast of Salem. The site is in northeast Marion County, in section 6 of township/range T7S, R1W. The nearest town is Pratum, situated roughly halfway between the cities of Salem and Silverton. The area, which is mapped on the USGS Stayton NE 7.5° quadrangle, is located at 44° 58.576′ N and

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122° 50.582′ W. The site is in the Pudding River watershed at a surface elevation of approximately 64 ± 3 m.a.s.l.

Morphometric analysis identifies the genus and species of the molars (McDaniel and Jefferson 2006; Saunders 1970, 1999). Their angle of plate presentation to the occlusal surface and the convex curvature of those surfaces indicate that the Pratum molars are upper molars. The curvature of the root cavities and the occlusal wear patterns differentiate these teeth as left and right molars. The distal plates on the Pratum molars exhibit compression-produced curvatures that exclude their being 6th molars. The height of these molars (165 mm and 140 mm) eliminates the possibility that they may be 1st–4th molars. This suggests that the molars are 5th molars in the dental sequence. Based on the geographic location and ^{14}C age of the find, two mammoth species (*M. columbi* and *M. primigenius*) are candidate species for this mammoth. Our measurements of width and enamel thickness of the Pratum molars exceed similar measurements for *M. primigenius* 5th molars, while the lamellar frequency of these molars fails to meet minimal expectations for this species. Finally, the height of the Pratum molars exceeds expected values for all species except *M. columbi*. The Pratum molars are therefore identified as left and right upper 5th molars (LM^5 and RM^5) from a Columbian mammoth (*Mammuthus columbi*), with roughly 80 percent of their plates in wear (= Laws's group XV) (Laws 1966). By analogy with African elephant years (AEY), this suggests that the Pratum mammoth was 24.5 ± 3 AEY at death (or perhaps slightly younger, at 18 AEY, using Craig's scale [Haynes 1991]). Applying age and social group criteria reported by Sikes (1971) places the Pratum mammoth in the "early prime adult" social group at the time of death.

Sample dentine from the right molar was submitted to the University of Waikato Radiocarbon Dating Laboratory for collagen analysis. The sample was decalcified, gelatinized, and ultrafiltered, and yielded an AMS ^{14}C date of 12,023 ± 77 RCYBP (WK-21807) with a $\delta^{13}C$ value of –21.2 ± 0.2‰ and percent N value of 17.0 percent. This AMS ^{14}C date equals a calibrated age range of 13,730–14,050 CALYBP at 95.4 percent probability (Cearley 2008).

The Pratum femur, a complete left femur with fully fused epiphyses, has a total length of 1117 mm and articular length of 1046 mm. The midshaft transverse diameter is 143 mm; the distal-end maximum width is 237 mm. Since the ratio of femur length to humerus length in mammoths is predictable, the femur length of 1117 mm suggests a shoulder height for the Pratum mammoth of roughly 2823 mm (*contra* Barton and Cearley 2008). Additional studies are underway on stable isotopes ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$, and $^{87}Sr/^{86}Sr$) from the tusk and molars.

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First Lamine Camel (cf. *Palaeolama*) Reported from the Tunica Hills of Louisiana

Grant S. Boardman

Hundreds of Hemphilian and Rancholabrean terrestrial vertebrate fossils have been collected from the Tunica Hills of West Feliciana Parish in east-central Louisiana. Despite their abundance, however, few have garnered much attention in the literature (Manning and MacFadden 1989; Schiebout et al. 2006). On a collecting trip in August of 2005, a fragmentary camel jaw was collected as float on a side creek (30° 58′ 41″ N, 91° 30′ 7″ W) of the Tunica Bayou, which has yielded both Hemphilian taxa (*Nannippus minor*, *Cormohipparion emsliei*, and *Teleoceras* sp.) and the standard assemblage of Rancholabrean taxa (e.g., *Mammut americanum*, *Equus* sp., *Megalonyx jeffersonii*, *Smilodon* sp., *Tapirus* sp., and *Bison bison*). LSUMG V19069 is a fragmentary right mandible of a juvenile lamine camel containing the posterior lobe of the p4 and a complete m1, m2 and un-erupted m3. The dentary itself extends from the posterior lobe of the p4 to just past the m3 (Figure 1). In medial view the crown and roots of m3 are exposed and are clearly demarcated (Figure 1B).

The jaw fragment is referred to *Palaeolama* based on several characteristics:

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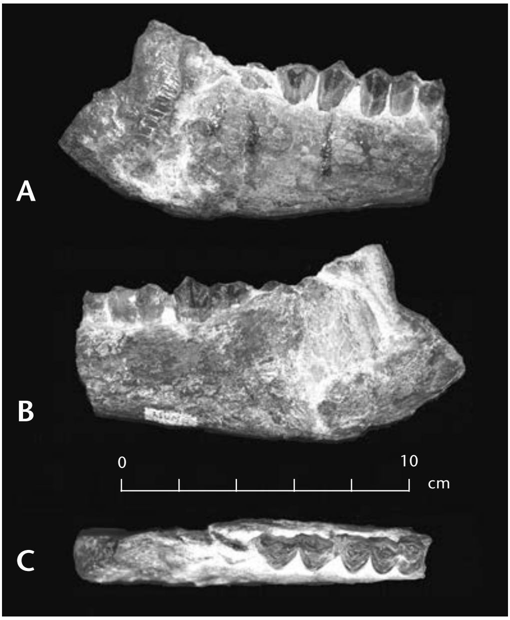

Figure 1. LSUMG V19069, lamine camel, cf. *Palaeolama*, fragmentary right mandible. **A,** lateral view; **B,** medial view with exposed root on m3; **C,** occlusal view.

(1) the shape of the posterior lobe of the p4 suggests a bilobate shape for the fragmented tooth, a shape generally exhibited by *Palaeolama mirifica* and unlike the generally subtriangular p4 of *Hemiauchenia* (Webb 1974); (2) cervid-style crenulations are noted on the lateral surface of the molars; (3) p4 conforms with Webb's (1974) diagnosis for *P. mirifica*; (4) in occlusal view the labial lophids are V-shaped, as opposed to the generally U-shaped labial lophids seen in *Hemiauchenia* (Scherer et al. 2007). Also, although the molars are damaged it appears that this specimen has weak parastylids and protostylids, a condition linking it to *Palaeolama mirifica* (Ruez 2005).

Placing this specimen stratigraphically is problematic, considering the amount of reworking noted in the area (Manning and MacFadden 1989). The limestone concretion encasing the jaw is perhaps the best evidence that it is Rancholabrean in age. Note that none of the Hemphilian fossils found in the area have been found covered in limestone concretion, whereas many of the Rancholabrean specimens have (Wilbur H. Lee, pers. comm. 2008). Although less plausible, this does not eliminate the possibility of the specimen's being older than Rancholabrean.

I would like to thank Dr. Judith Schiebout for allowing me to publish on this specimen from the LSU Museum of Geosciences collection and Wilbur H. "Bill" Lee for his knowledge of collections from the Tunica Hills. My thanks also to Dr. Blaine W. Schubert and Dr. Steven C. Wallace for helping with photographing and figuring the specimen.

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Ontogenetic Stages in *Paramylodon harlani* Owen from Tlalnepantla, Mexico

Alejandro Cristín-Ponciano and Marisol Montellano-Ballesteros

Mylodonts are a quite well known group of mammals that lived during the Pleistocene in North America. Numerous detailed descriptions have been published, but only Stock (1925) and McDonald (2000) provided any information on morphological changes observed between consecutive ontogenetic stages.

In 2003, an important late-Pleistocene fossiliferous outcrop from Tlalnepantla, Estado de Mexico, was reported by Cristín (2003). More than 300 bones of *Paramylodon harlani* Owen were collected. The elements recovered included skulls, jaws, teeth, cervical, thoracic, lumbar and caudal vertebrae, scapulae, humeri, ulnae, radii, scaphoids, lunars, unciforms, metacarpals, phalanges of the *manus* and *pes,* ribs, "synsacra" (Stock used this term to refer to the fusion of the sacral elements and the last lumbar vertebra), pelvic girdles, femora, tibiae, naviculars, and ectocuneiforms.

The size of the sample offers the opportunity to conduct morphometric analyses. Based on size and morphological features, three ontogenetic stages were identified: juvenile (JS), subadult (SAS), and adult (AS) stages (Figure 1). The JS group includes two upper M5s, a lower m2, two scapulae (one of them lacks the metacoracoid, suggesting it was not ossified), four humeri, one scaphoid, and one synsacrum. The molariforms and the rest of the elements are 40 percent smaller than the specimens reported by Stock (1925) and those that complete the assemblage from Tlalnepantla.

The SAS group is mainly formed by specimens that, although the size of an

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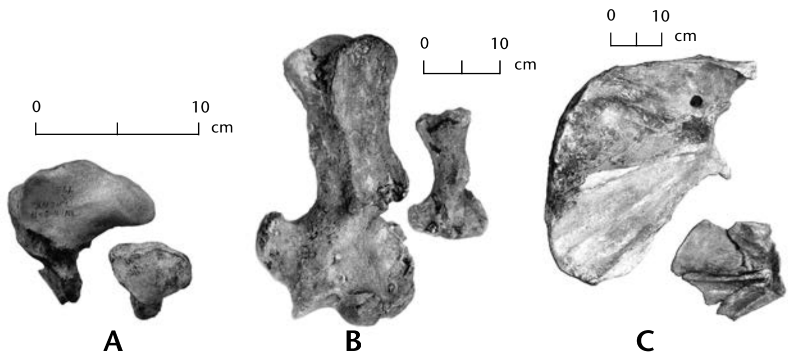

Figure 1. Examples of elements of adult and juvenile individuals of *Paramylodon harlani* Owen from Tlalnepantla. **A,** scaphoids; **B,** humeri; **C,** scapulae.

adult, have sutures that are unossified or only partially ossified. In this suite of elements, one skull shows visible sutures in the dorsal and ventral regions; two ulnae lack the distal epiphysis; one femur shows marked sutures between the diaphysis and epiphyses, and a second femur is represented only by a distal epiphysis; and a synsacrum shows visible sutures between the intervertebral disks and the centra.

The AS group includes all the remaining elements (nearly 300 specimens) and is therefore the most abundant group. The bones are completely ossified and are the largest of the sample. Some of them are slightly larger than those found at Rancho La Brea (Cristín and Montellano 2003).

Besides resolving ontogenetic stages, we observed modifications in some elements, independent of the size of the element. For example, in the ulnae, three variants in the articular facet for the humerus were recognized: (1) a semicircular facet with a foramen; (2) a wide articular facet bearing a foramen; and (3) an articular facet lacking the foramen, with a thick ossification plate on its place and the foramen placed laterally.

In mammals the unossified epiphysis and sutures are in relation with ontogenetic development, so it is possible to identify which elements belong to a juvenile, subadult, or adult.

In a graph plotting the measurements of the material (cranial and postcranial elements) from Tlalnepantla and from specimens cited by Brown (1903), Stock (1925), Monés (1971), Dundas and Cunningham (1993) and McDonald et al. (2004), the separation of elements considered to belong to the JS group is clear.

If we consider that in an adult group the size of bones does not differ significantly, and that except for some *adult* cranial features (e.g., shape and angle of the occipital bone and wearing on the upper M1, McDonald 2006), there is no additional morphological evidence of sexual dimorphism, then the strong differences observed in the size of bones suggest they are due to ontogenetic differences and not to sexual dimorphism.

Three ontogenetic stages were recognized in the sample from Tlalnepantla; at least 16 specimens are juvenile and subadult individuals, and the rest are adults. This death assemblage is interesting from the point of view of demography because the number of adults exceeds the number of juveniles. Further studies should look for an explanation.

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Vertebrate Fossils from the San Pedro Valley of Sonora, Mexico

Edmund P. Gaines

The portion of the San Pedro Valley located in southern Arizona has long been known for its rich Quaternary fossil record (Gazin 1942; Gidley 1922, 1926; Gray 1965, 1967; Haury 1953; Haynes 2007; Lindsay 1984; Lindsay et al. 1990). Over one-third of the valley, however, is situated south of the international border in Sonora, Mexico. Despite more than 80 years of paleontological research in the valley in Arizona, little is known of the Sonoran portions of the basin. The purpose of this paper is to report two new Pleistocene fossil localities in the Mexican reaches of the valley discovered as a result of collaborative field investigations undertaken by the University of Arizona and *Instituto Nacional de Antropología e Historia* (INAH). These two sites stand as the first

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reported occurrences of Quaternary fossils from the San Pedro Valley of Sonora, Mexico.

Site AZ:EE:12:5 (INAH) is situated 500 m south of the border near the town of Naco, Sonora. The author discovered the fossils while prospecting for potential Paleoamerican sites in a southern tributary arroyo of Greenbush Draw—the location of the Naco Clovis-mammoth site (Haury 1953). In situ fossil bone is exposed in the steep arroyo wall 1.5 to 1.65 m below the surface. Additional fragments of heavily mineralized bone litter the arroyo floor for a distance of roughly 30 m downstream. Identifiable remains consist of fragmentary rib and vertebral elements belonging to the order Proboscidea. The fossil-bearing deposit is reddish (2.5YR 3/6) silty clay that is heavily weathered, exhibiting strong carbonate, iron, and manganese translocation.

The in situ fossils at the site remain unexcavated; however, field observations provide reliable age estimates. Given the high degree of bone mineralization and heavy weathering exhibited by the fossil-bearing stratum, the deposit and associated fossils date to at least the Last Glacial Maxim (C. V. Haynes, pers. comm. 2006). The stratigraphic occurrence of the remains indicates that the fossil-bearing deposit can be correlated with either the Milville (Qmi) Formation known from Curry Draw (Haynes 2007) or the upper members of the St. David Formation (Gray 1965, 1967).

Site AZ:FF:13:7 (INAH) is located in the southeastern portion of the valley roughly 15 km south of Sierra San José. A local landowner identified the site and contacted the author when he observed fossil bone eroding out of a gully on his property. The site consists of several loci of fossil material diffusely scattered over an area of roughly 600 m^2. Dental remains observable at the surface represent at least three individuals of three different genera—*Mammuthus* (mammoth), *Equus* (horse), and *Camelops* (camel). The primary locus has several large bone fragments exposed on the floor of a shallow, gently sloping gully. One of the fragments is identifiable as the left portion of a *Mammuthus* mandible that contains an intact $M_{1.}$ The fossil-bearing stratum is light brown (7.5YR 6/4) clay containing ca. 20–30 percent poorly sorted angular pebbles and gravels. This deposit is exposed by sheet erosion over much of the ground surface in the vicinity. Concentrations of fragmentary fossil material occur in many of these eroded areas and include pieces of *Equus* and *Camelops* teeth. The lithology of the deposit and fragmentary character of the remains indicate that they occur in a redeposited, secondary context.

Field analysis of the *Mammuthus* M_1 documented the following attributes: 12 ridge plates; 137.3 mm anterior/posterior (missing at least one lamella); 77.4 mm lingual/bucchal; 3.13 mm enamel thickness at midline; and 6 ridge plates per 100 mm. The ratio of 6 ridge plates/100mm is on the low end for *Mammuthus columbi* and on the high end for the more primitive *Mammuthus imperator* (Saunders 1970; Maglio 1973). The enamel thickness is outside the range of variation for all specimens of *Mammuthus columbi* reported from Arizona (Saunders 1970) but is consistent with enamel thickness reported for *Mammuthus imperator* (Maglio 1973).

While the fossil-bearing deposits at both locations are unlikely to contain associated archaeological material, these two paleontological sites are significant because they represent the first documented occurrence of Pleistocene fossils in the reach of the San Pedro Valley located in Mexico. Their presence demonstrates the preservation and exposure of Pleistocene strata in the valley south of the border and allows for biostratigraphic correlations throughout the entire basin on both sides of the international boundary. Given the abundance of Quaternary fossils known from the valley in Arizona, it seems certain that future investigations will recover further evidence of extinct Pleistocene fauna from the San Pedro Valley of Mexico.

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New Record of Proboscidean Fossil Tracks in the Pleistocene of Central México

José Rubén Guzmán-Gutiérrez, Felisa J. Aguilar, Rubén A. Rodríguez-de la Rosa, and Oscar J. Polaco

The fossil record of vertebrate tracks in México is still too meager; however, it preserves a great diversity of forms ranging in age from middle Jurassic to Pleistocene (Rodriguez-de la Rosa et al. 2004). The first and more ancient record corresponds to a locality close to the town of San Juan de los Lagos, Jalisco, in central México. The evidence was first recorded in the late 19th century (Bárcena 1885, 1892; Dugès 1894), but remained relatively unknown for more than 100 years. Bárcena (1885, 1892) and Dugès (1894) recorded two different animal fossil tracks belonging to birds and felids present in two small slabs that were studied at the time they were collected at Rancho La Verdolaga. The track site, which was relocated recently, consists of a series of quarries in the surroundings of La Verdolaga. In one of the sites (21° 21′ 11″ N, 102° 23′ 35″ W) there is an exposed surface of 3.6 m by 27 m with thousands of bird and artiodactyl tracks in situ; also, collected from other quarries, are slabs with tracks of several different animals. Remarkable among them those of a proboscidean.

The proboscidean tracks, contained on a single slab, consist of two closely associated ichnites, preserved as convex hyporeliefs subcircular in shape, representing both manus and pes impressions (Figure 1). The measurements of the incomplete manus impression are: anteroposterior length, 226 mm; transversal length, 203 mm. For the pes the measurements are 255 and 273 mm, respectively. The track exhibits three, possibly four digit impressions. Owing to its close association and measurements it is thought to represent the manus-pes set of a single individual. The size of the tracks corresponds to an immature individual of age group I (*sensu* McNeil et al. 2005). At present the ichnofauna also includes four bird morphotypes, artiodactyls (camelids), and felids. The deposit age presumably is middle or late Pleistocene, suggested by the presence in neighboring layers of bison fossil remains, which were recorded by Dugès (1894); they include *Bison latifrons*, from which a vertebra is housed in the Museum of Natural History "Alfredo Dugès" in the city of Guanajuato.

Previous notices of proboscidean tracks from México came only from

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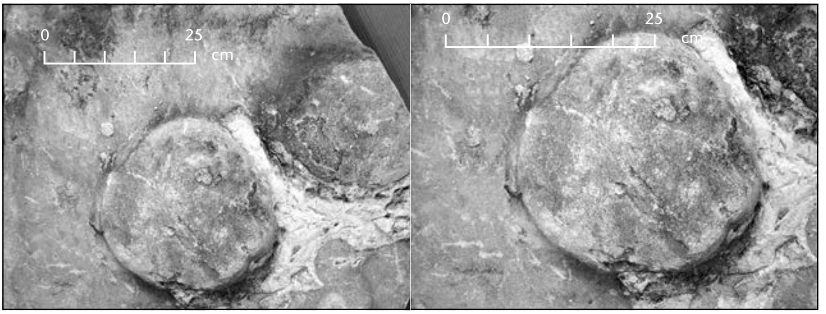

Figure 1. Convex hyporelief of proboscidean tracks. The slab consists of a tuffaceous rock with feldspar crystals. The main track layer is composed of a consolidated white marl. The image on the right side is a close-up of the complete ichnite.

Tepexi de Rodríguez, Puebla (Cabral-Perdomo 1995, 2000); therefore the tracks from San Juan de los Lagos are the only confirmed record of proboscidean ichnites for the Pleistocene of México.

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Associations of Freshwater Mollusks and Extinct Fauna in Kamac Mayu Site during the Late Pleistocene in the Arid North of Chile

Donald Jackson S. and Patricio López M.

Reports on extinct faunal remains from the arid north of Chile are scarce (Bonn and García 2002; Casamiquela 1969–1970, 1999; López et al. 2005; Salinas et al. 1991), as is information about the conditions and environments of deposition. Nevertheless, recent extinct fauna findings in the sites of Kamac Mayu and Betecsa 1 in the arid north of Chile (Alberdi et al. 2007; López et al. 2007) have generated a more complete environmental scene owing to the presence of fauna not previously described for the area, macrobotanical remains, and the identification of associated freshwater mollusks.

Kamac Mayu site is located in the city of Calama (68° 542′ 403″ W, 22° 262′ 203″ S), in the arid north of Chile. Stratigraphic excavations 1.80 m deep in a 32-m^2 area allowed the identification of sedimentation in four stages of deposition (Chong and Jensen 2004): 1) a lacustrine stage; 2) stage of karstic erosion; 3) fluvial stage; 4) stage of calcareous cementation. The first stage consists of pulverized marl and diatomites from the Chiu-Chiu Formation dated to the Plio-Pleistocene. During the second stage an erosional surface was formed by dissolution cavities, followed by a fluvial system of clastic sediment. The third stage (fluvial) consists of sandy gravel and sand deposits that filled a series of channels of the karstic formation; the deposition process predates the present Loa River and the period in which the extinct faunal remains would have been deposited (López and Labarca 2005).

The fossil fauna includes remains of at least one juvenile and one adult *Hippidion saldiasi,* five *Macrauchenia* sp. adults, a juvenile Edentata of undetermined genus and species, and camelid remains without assignment to genus, but with affinities with *Lama gracilis* (López et al. 2007). This faunal assemblage is the result of the natural death of the animals in lacustrine situations, suggesting that they were redeposited downstream from the original place of death (López and Labarca 2005). Nevertheless, the presence of *Macrauchenia* crania that could have "anchored" more easily than other bones reveals the probable place of death and the fluvial transport of the remaining bones.

The record of a lacustrine and humid environment at the moment of death and deposition of the faunal remains is also revealed by the presence of five species of freshwater mollusks and one species of micro-mollusk. Among the freshwater mollusks, two species from the Planorbidae family were found, with only one genus in Chile represented by *Biomphalaria,* with a total of seven

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species (Valdovinos 2006), of which only *Biomphalaria costata, Biomphalaria thermali,* and *Biomphalaria aymara* are from the Andean highlands of northern Chile (Valdovinos and Stuardo 1991). Other mollusks correspond to the Hydrobiidae family, represented by at least two undetermined species of the *Littoridina* genus, for which 21 species are known in Chile (Valdovinos 2006), with six species distributed currently in the arid north of Chile (15°–25° S) (Valdovinos 1999).

Likewise, a species of freshwater bivalve from the Sphaeriidae family was found. Although the genus and species were not determined, it could correspond to *Pisidium meierbrooki, Sphaerium lauricochae,* or *Sphaerium forbesi*, the only genera and species of this family from the Andean highlands of Chile, Perú and Bolivia (Parada and Peredo 2006).

The highest frequency for mollusks is represented by a micro-gastropod from the Endodontidae family, of unidentified genera and species. In Chile this type of mollusk is represented by at least seven genera and 30 species (Valdovinos 1999), none of which is currently found in the arid north of Chile (15°–25° S). This may indicate their paleodistribution and later regional extinction.

The different genera and species of the Planorbidae, Hydrobiidae, and Sphaeriidae families identified in the context associated with the extinct fauna correspond to freshwater mollusks that are currently found in lake and river environments from the north-center and south of Chile. The species of the Endodontidae family are micro-gastropods usually found under the foliage of humid environment vegetation.

This evidence indicates that the mammals associated with the Kamac Mayu site in the late Pleistocene (López et al. 2007) lived in a lacustrine environment, probably small lakes and marshes, with oasis vegetation and small bushes, as observed in the Chiu-Chiu micro-basin today. Probably the advent of arid conditions was related to the death of these mammals and the associated mollusks. A similar situation can be suggested for nearby sites with extinct fauna, such as Betecsa 1 (Alberdi et al. 2007) and Ojos de Apache (López et al. 2005), both located in the great basin of Calama in the arid north of Chile.

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The Eastern Beringian Radiocarbon Record and Late-Pleistocene/Early-Holocene Extinctions

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Humans and megafauna coexisted in eastern Beringia in the late Pleistocene, but it is still unknown whether their interactions or the effects of climate changes mainly influenced extinctions. On the surface, these events appear coeval. Explanations have largely been restricted to two competing theories—climate change and over-hunting by humans (Guthrie 2004; Martin 1966, 1984). Assessing the circumstances surrounding the extinction process depends on precise species chronology. Evaluating the reliability of the ^{14}C record can increase our confidence in archaeological, paleontological, and ecological interpretations. Eastern Beringia, the geographic crossroads for human entry into the Americas, is central to understanding the unique and selective extinctions of the late Pleistocene.

The limitations of ^{14}C dating (Hedges and Van Klinken 1992; Stafford et al. 1991), and the value of interpreting large numbers of dates (Surovell and

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Brantingham 2007) have long been recognized. Pettitt et al. (2003) and Mead and Meltzer (1984) have called for rigorous evaluation of ^{14}C data. Recent efforts have been made to assess the reliability of existing ^{14}C databases to address both the climatic role in megafauna extinction (Buck and Bard 2007) and human colonization events of empty landscapes (Graf 2006).

In some studies, ^{14}C frequencies have served as a proxy for population-size fluctuations (Buck and Bard 2007). In the study reported here, over 600 dates on *Equus, Mammuthus, Bison,* and archaeological components from Alaska and Yukon were compiled from the literature (Guthrie 2003, 2006; Harington 2003) and the Canadian Archaeological Radiocarbon Database. Archaeological ^{14}C dates were compiled from sites dating between 13,000 and 5000 CALYBP, with special attention to those dating to the late Pleistocene. Sites with multiple dates were averaged for each component (excluding all non-overlapping dates at $>2\sigma$) using Long and Rippeteau's (1974) weighted-averaging method. Most known megafaunal specimens were collected from localities in the Dawson area of Yukon and the Fairbanks, Alaska, mining district. Few specimens were collected in situ; sampling bias exists, since collecting efforts were centered on surface and placer-mining discoveries. Thus, Pleistocene fauna are largely unknown from coastal regions.

These data were evaluated by employing a quantified approach in which individual ^{14}C dates were assigned values indicative of their reliability. A standardized set of criteria was utilized to account for the degree of association with the event or specimen and for geologic context, material dated, pretreatment methods, and date precision. After evaluation, the remaining 136 reliable ^{14}C dates were then compared for their temporal distribution with each other, and with climate proxy records.

Bone is an important part of this project, as most proboscidean and *Equus* ages are derived from directly dated bone collagen or apatite. Although it is generally acknowledged that ^{14}C ages derived from bone produce anomalously old dates when contaminated or yield very little dateable carbon (Pettitt et al. 2003), bone may yield a clearer association than wood charcoal between the event age and ^{14}C age. Also, the preservation of Beringian bone is favorable, as specimens are frequently recovered from frozen muck deposits with sustained low mean temperatures since the LGM.

Two proxy climate records, ice accumulation from the GRIP core and $\delta^{18}O$ from the GISP2 core, were used as temperature proxies (Johnsen et al. 1995; Langley et al. 1985). Calibrated ^{14}C ages were derived from the Cologne Radiocarbon Calibration and Paleoclimate Research Package (Weninger et al. 2005).

While no simple correlation between climatic fluctuations, human colonization, and Pleistocene extinctions can be made, several trends are noted. First, *Mammuthus* populations survived the Bølling-Allerød warm period and the initial human colonization of Beringia (approximately 14,000 CALYBP). Population levels dropped significantly around 12,000 CALYBP with evidence for increasing human population sizes. Holocene *Mammuthus* populations survived only on island refugia uninhabited by people until the historic period. Second, *Equus* dates are consistently less reliable than those on *Mammuthus, Bison,* and archaeological components. In agreement with Buck and Bard's (2007) analysis, *Equus* also survived the warmest period of the late Pleistocene and became extinct approximately 14,000 CALYBP, broadly contemporaneous with the first human arrival. Third, general trends in population decline are not significantly different between the set of most reliable dates and the set of all dates, which may indicate collagen dates are not particularly problematic for Beringian Pleistocene fauna. Finally, the distribution of fauna does not fully depict LGM distributions because of preservation and collection bias.

Continued dating and evaluation programs are useful tools which will strengthen the ability to discern Pleistocene megafauna dynamics and interaction with humans during the initial colonization of North America.

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Temporal Patterns of Existence and Extinction for Woolly Mammoth (*Mammuthus primigenius* Blum.) in Northern Asia: The 2007 State of the Art

Yaroslav V. Kuzmin

Significant progress has been achieved in the last few decades in terms of radiocarbon (^{14}C) dating of late-Pleistocene megafauna. It is assumed that the number of ^{14}C dates run directly on animal remains is somehow related to the size of its populations (Guthrie 2006; Kuzmin et al. 2008; Sulerzhitsky and Romanenko 1999; Ugan and Byers 2007). Based on the Siberian ^{14}C mammoth database (Orlova et al. 2007), the latest developments in this field are presented here.

Of about 760 ^{14}C values available for Siberia and adjacent northern Asia, after deleting multiple dates for the same individual and infinite-age determinations (i.e., greater than 45,000 RCYBP) we have in late 2007 about 550 finite ^{14}C dates. The average standard deviation (one sigma) for these dates is 530 ^{14}C years. It is noted that more than 100 Holocene mammoth ^{14}C values from Wrangel Island, ca. 9000–3700 RCYBP (Vartanyan 2007; Vartanyan et al. 2008), are deliberately excluded from our dataset because the Wrangel population was isolated from the mainland; the distribution of ^{14}C dates for this population therefore most likely reflects regional and not global environmental changes (Vartanyan 2007:122).

The distribution histogram for uncalibrated mammoth ^{14}C dates, created for the territory of Siberia within ca. 9000–51,000 RCYBP (Figure 1), shows that until ca. 41,000 RCYBP the size of the population was probably low. This, however, may be related to insufficient information currently available. Since ca. 41,000 RCYBP, mammoths were abundant in Siberia until ca. 10,000 RCYBP. More specifically, several declines in ^{14}C values, with the most pronounced ones at ca. 40,000–37,000, 28,000–23,000, 20,000–15,000, and 12,000–9000 RCYBP, can be detected. The largest numbers of ^{14}C dates correspond to intervals of ca. 29,000–28,000, 21,000–20,000, and 13,000–12,000 RCYBP (Figure 1). These deviations probably reflect changes in population size; however, more studies on a regional scale (e.g., specific regions of the Siberian subcontinent; see Nikolsky and Sulerzhitsky 2007) are necessary to connect them with environmental changes. Also, it is impossible at this stage to correlate falls and peaks in mammoth ^{14}C values distribution (Figure 1) with particular cold or warm periods of the general paleoclimatic records in Northern Hemisphere (Kuzmin et al. 2008).

Extensive ^{14}C dating of mammoth finds reveals several “pockets” (perhaps isolated from each other) of late-glacial mammoths, dated to ca. 12,000–10,200 RCYBP, especially in central Western Siberia and Trans-Urals. This contradicts the “retreat to the north” model of mammoth extinction by Sher (1997), which was valid until the early 2000s and should be revised now.

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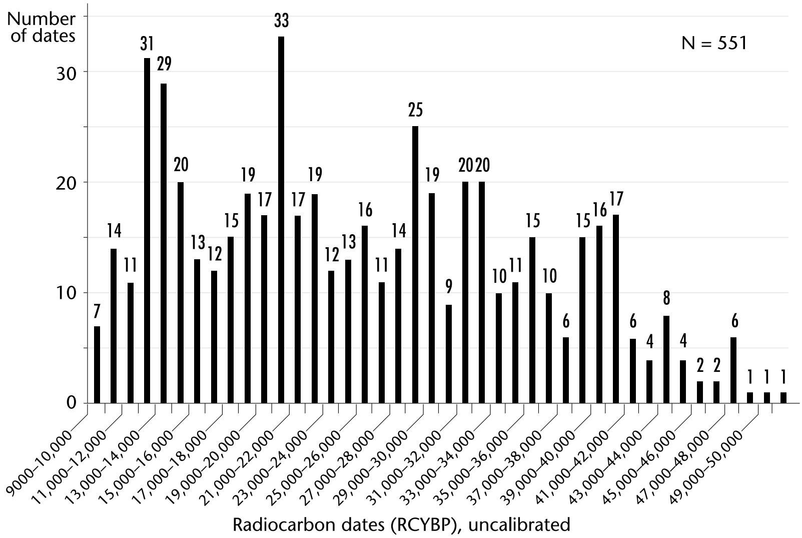

Figure 1. Frequency distribution of ^{14}C-dated mammoth remains from Siberia and adjacent northern Asia.

Until 2005 the "youngest" mammoths in Eurasia, except for Wrangel Island, were found in two regions of mainland Siberian Arctic: Taymyr Peninsula (ca. 9670 RCYBP; Sulerzhitsky and Romanenko 1999); and Novaya Sibir Island (ca. 9650–9450 RCYBP; P. A. Nikolsky, pers. comm. 2007) in the modern Laptev Sea, which was not an island but part of the mainland before ca. 7000 RCYBP. The most recent discovery of Holocene mammoths in the extreme northeast Siberian mainland, the Kyttyk [*Karchyk* in The Times Atlas 1995:39, grid H2] Peninsula of western Chukotka, with ^{14}C dates of ca. 9000–8700 RCYBP (Vartanyan et al. 2005), raises the issue of multiple Holocene mammoth refugia.

There are now three places in the Northern Hemisphere where woolly mammoths survived well into the Holocene: Wrangel Island, St. Paul Island, and Kyttyk Peninsula (Guthrie 2006; Sulerzhitsky and Romanenko 1999; Vartanyan et al. 2005; Veltre et al. 2008). As was recently pointed out, despite the fact that the natural environment of Wrangel Island in the Holocene was similar to that of the surrounding mainland (Vartanyan 2007), mammoths went extinct in continental Siberia at ca. 8700 RCYBP (to the best of our knowledge) but continued to exist on Wrangel Island until ca. 3700 RCYBP. This shows that the process of final mammoth extinction was quite "nonlinear" in relation to environmental conditions, and more work is needed to clarify this phenomenon.

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Reevaluation of the Pleistocene Fauna of the Hiscock Site Based on Evidence of Intrusion

Richard S. Laub

The Pleistocene fauna of the Hiscock site in western New York State is reported to consist of eight species: *Mammut americanum* (American mastodon), *Rangifer tarandus* (caribou), *Cervalces scotti* (stag-moose), *Castoroides ohioensis* (giant beaver), *Mylohyus* sp. (peccary), *Gymnogyps californianus* (California condor), *Lepus* sp. cf. *L. americanus* (hare), and *Ectopistes migratorius* (passenger pigeon) (Laub 2003a). All were attributed to the Pleistocene on the basis of their stratigraphic occurrence, in most cases supported by a common association with Ice Age faunas of the Northeast.

In the 2004 field season, a half-mandible of a small rodent, field number I3NW-38, was found 70 cm below ground level. It was well embedded in the

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Fibrous Gravelly Clay, the fossiliferous Pleistocene unit at the site (Laub 2003b), and its color was identical to that of other bones found in this unit. Consequently, it was accepted as being of late-Pleistocene age, and as an addition to the Ice Age bestiary of the Hiscock Site.

Subsequently, the specimen was identified as belonging to *Glaucomys volans* (southern flying squirrel), a species previously reported from the Holocene component of the site (Steadman 1988:98, 106). Although it is known from the North American Pleistocene (FAUNMAP Working Group 1994; Kurtén and Anderson 1980), this coincidence engendered doubt as to the true age of the specimen. Instances where specimens had been intruded into older strata are known from Hiscock (e.g., Laub 1998:198), and it was determined that a ^{14}C date was required to resolve the issue. In early 2007, AMS dating of the specimen yielded an age of 445 ± 25 RCYBP (UCIAMS-35587), indicating that the mandible had, indeed, been intruded. It also showed that color is not a reliable indicator of age at Hiscock.

This result calls for a re-evaluation of the Hiscock Pleistocene fauna. The American mastodon, caribou, stag-moose, and giant beaver are well-established elements of the Ice Age in the Northeast. Caution was recently advised about interpreting the single *Mylohyus* tooth as evidence that this species lived at Hiscock (Laub 2007), but not about its age, which is well established as exclusively Pleistocene (FAUNMAP Working Group 1994; Kurtén and Anderson 1980).

The California condor is represented by three bones. While one of them, a partial humerus, lay close to a Holocene spring vent that penetrated the Fibrous Gravelly Clay, the other two bones, a coracoid and ungual, clearly lay in the Pleistocene deposits, some distance from the spring vent. This species has a significant and widespread Pleistocene record (Steadman and Miller 1987), so its inclusion in the Hiscock Ice Age fauna seems reasonable.

The presence of hare is primarily based upon a single metatarsal fragment. This specimen was found in situ, deep within the Fibrous Gravelly Clay. In addition, a complete tibia of *Lepus americanus* (snowshoe hare) was found within the same unit, 7 cm from its top. The latter dated to 9940 ± 40 RCYBP (CAMS-77488), rather young for this unit (Laub 2003a, b). Yet, while it may have been intruded from above, its date is similar to that of a spruce frond from Hiscock (9090 ± 40 RCYBP, Beta-199770; Laub 2006), suggesting that the environment in which the hare lived remained the spruce-pine forest that prevailed earlier in the region (e.g., Miller 1973, 1988). This, and the presence of hare in Ice Age deposits elsewhere in the Northeast (Laub 2003a), support its contemporary presence at Hiscock.

The issue of passenger pigeon in the Hiscock Pleistocene horizon presents a problem similar to the flying squirrel jaw. While this species is extremely abundant in the Holocene deposits (Steadman 1988), it is represented here by only a single bone in the Pleistocene. It is unclear if *E. migratorius* was present in New York during the Pleistocene. At the Dutchess Quarry Caves in southeastern New York (Funk and Steadman 1994), *E. migratorius* occurs in strata that are either probable Holocene (Cave 1, Stratum 1; Cave 8, Stratum 3), or mixed Holocene and Pleistocene (Cave 1, Stratum 2; Cave 8, Stratum 4). The

Carnegie Museum of Natural History database has no Pleistocene specimens from Pennsylvania—only from bordering states to the south (Amy Henrici, pers. comm.). Nor does the New York State Museum have unequivocal passenger pigeon remains from the New York Pleistocene (Robert S. Feranec, pers. comm.). Hence, it seems prudent to view the presence of this species in the Hiscock Pleistocene as questionable pending the discovery of more material.

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Mastodons and Paleocamelids from Mid-Latitude Chile: Archaeological, Paleontological and Paleoenvironmental Implications from Aguas de Ramón 1 Site (Metropolitan Region)

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Excavations performed at Aguas de Ramón-1 site (913 m.a.s.l., 6299640 m S, 359746 m E, Datum 69), located on the southern fringe of the middle course of Aguas de Ramón ravine (Las Condes, Metropolitan Region, Chile), revealed appendicular and axial skeletal remains of Gomphotheriidae and a Camelidae (genus and species indet.) specimen. These finds were made at a depth of 5.37 m in a lithostratigraphic sequence of three depositional units. The basal unit is an ancient glacial moraine ascribed to the final advance of glaciers known for the area, which occurred ca. 18,000 RCYBP (Lamy et al. 1999). The second unit, associated with the deposition of the mastodon and camelid remains, is a series of highly oxidized lime, clay, and sand deposits correlated to a phase of higher humidity during the late Pleistocene, which allowed the concentration of different water currents in a riverine and lacustrine environment. Lastly, the early Holocene to present is represented by the subsequent pebbly and lime colluvial stratum without fossil evidence.

Taphonomic analyses suggest that the mastodon remains were redeposited by water current inside an ancient basin that drained into the present-day ravine. The presence of a proximal femur fragment and highly eroded rib fragments with drag-marks point precisely to a dynamic alteration process due to ancient fluvial currents. Gomphoteriidae remains were recovered from Stratum 10, a sand and pebble deposit which altered original bone composition through diagenetic processes, making the bone unsuitable for dating by ^{14}C procedures owing to insufficient collagen. The Camelidae record consists of a metatarsal fragment intermediate in size between the extinct *Palaeolama* and contemporary guanaco (*Lama guanicoe).* Despite the impossibility of precise taxonomic identification, these antecedents should be taken into

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account for future studies regarding possible size changes in certain species related to the Pleistocene/Holocene transition.

According to existing bibliography on mastodon finds in Chilean territory, the distribution of gomphotheriids extends from the northernmost border of Chile to the latitude of Puerto Montt and Chiloe Island (Frassinetti and Alberdi 2000, 2005). In mid-latitude Chile, mastodon remains are distributed through continental hinterlands, the Coastal Range and coastal zones (Casamiquela 1999; Frassinetti and Alberdi 2005), found in late-Pleistocene and early-Holocene deposits (Dillehay 1992; Núñez et al. 1994a, 1994b; Paskoff 1971). The importance of these species to the first settlers of continental Chile is evidenced in archaeological sites such as Quereo (IV Region), Taguatagua (VI Region), and Monte Verde (X Region), where exploitation by hunting and possibly scavenging is represented (Dillehay 1992; López et al. 2004; Núñez et al. 1994a).

Taxonomically two genera of Gomphotheriidae have been suggested for Chilean territory, *Cuvieronius* and *Stegomastodon.* Migration routes for the former have been proposed from the Desaguadero River to Ulloma and then northern Chile; or from Ecuador through the Andes, following the *Equus (Amerhippus) andium* migratory route (Frassinetti and Alberdi 2000). On the other hand, the presence of *Stegamastodon* suggests a possible entrance route from Argentina (Frassinetti and Alberdi 2005), although this hypothesis is based on taxonomic affinities and not on contextual evidence.

The discovery of Gomphoteriidae remains at Aguas de Ramon-1 site, located at an elevation higher than 900 m.a.s.l. in the middle course of a ravine in the Andean foothills, constitutes evidence relevant to the study of mastodon migration routes through paths from present Argentinean territory. Furthermore, knowledge of mastodon migration routes can contribute to the study of glacial advance and retreat events during the last ca. 20,000 years, as well as to more accurate environmental reconstructions during the final Pleistocene in the mid-latitude Chilean foothills.

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Quantitative Differentiation of Mexican Pleistocene Horses

María del Pilar Melgarejo-Damián and Marisol Montellano-Ballesteros

It has always been difficult to describe and classify North American Pleistocene horses to the level of species, chiefly because of the scarcity of fossil remains, almost invariably fragmentary. Since complete skeletons are hardly ever found, most descriptions have been made based on cranial and mandibular fragments and isolated teeth and limb bones (Schafer and Dalquest 1991).

Consequently, during the 19th century and a great part of the 20th, most Mexican Pleistocene equids were identified by qualitative characteristics of cheek teeth, such as the shape of the protocone in the upper molars and that of the linguaflexid and ectoflexid in the lower molars. Slight differences in these shapes prompted the creation of new species, sometimes delimited by very strict boundaries. On this basis, up to 24 species of equids have been named from Mexican fossil material. Unfortunately, such characteristics have been found to be sensitive to ontogenetic variations (MacFadden 1989) and are therefore of little help in distinguishing species. These arbitrary criteria were responsible for a gross overestimation of the number of species present in Mexican localities.

Since the second half of the 20th century, however, an effort has been made to establish more objective classifications. Greater importance has been placed on quantitative characteristics rather than qualitative ones. Refinements have also been made at the molecular level (Weinstock et al. 2005). As a result, the number of species recognized in Mexican Pleistocene localities is far fewer today (Alberdi et al. 2003; Reynoso-Rosales and Montellano-

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Ballesteros 1994; Winans 1989). The scientific community is even weighing the suggestion that a single species of Pleistocene equids could manifest the breadth of intraspecific or geographic variations to encompass all previously defined species (Weinstock et al. 2005).

The objective of this report is to describe a quantitative study to determine the number of Pleistocene species present in several localities of 14 Mexican states. The study focused on the localities El Cedazo (Aguascalientes), El Cedral (San Luis Potosí), and Valle de Tequixquiac (México), owing to their abundance of fossil material. Dental material of two extant equids (*Equus asinus* and *E. caballus*) was included in the study to function as a control group.

Specimens analyzed in the study include 200 upper molars and 196 lower molars belonging to the extant species; and 665 upper molars, 696 lower molars, and 342 postcranial elements belonging to the fossil material. The cheek teeth were separately reclassified according to their position in the dental series and measured according to Winans (1985). The postcranial elements reclassified were the calcaneum, astragalus, phalanges I and II, metatarsal, metacarpal, and tibia; they were measured according to Eisenmann et al. (1988) and Winans (1989).

Three different sizes of equids (large, medium, and small) were found at the El Cedral locality, whereas in the El Cedazo and Valle de Tequixquiac localities, two different sizes of equids (large and medium) were obtained, along with a few representatives of a possible third, and smaller, group. Material from the rest of the Mexican localities was successfully placed in one of these three size categories.

The measurements obtained were processed and analyzed using several statistical methods. Principal component analysis and discriminant function analysis were deemed the most appropriate methods for their ability to weigh the effect of several variables at the same time.

Our analysis produced these conclusions:

- no sexual dimorphism in the cheek teeth dimensions was observed in either of the extant species;
- both species were easily distinguished from one another with the methods herein employed;
- the results obtained from the fossil material are similar to those of the extant species when confronted.

Consequently we consider that the differences in size observed in the Mexican Pleistocene material correspond to three different species. These three species are tentatively given the names of *Equus mexicanus* for the large taxon, *Equus conversidens* for the medium-sized one, and *Equus tau* for the small one. We believe that studying fossil material with quantitative criteria results in classification more objective and less arbitrary than would be obtained with purely qualitative criteria.

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Small Mammals and Paleoenvironments around the Pleistocene-Holocene Boundary in Patagonia

Ulyses F. J. Pardiñas and Pablo Teta

Patagonian micromammal fossil assemblages have been little used for paleoenvironmental reconstructions (e.g., Pardiñas 1998; Pearson and Pearson 1993; Teta et al. 2005), despite their high value in drylands (>80% of the territory), due to the scarcity of other traditional paleoclimatic archives. Here we briefly comment on the environmental significance of seven archaeological micromammal assemblages ranging from ca. 40° to 52° S with chronologies between 13,000 and 7000 RCYBP.

The studied or discussed (reference indicated) samples (in Figure 1 arranged by increasing latitude S) came from the lower levels of Cueva Epullán Grande (LL, 40° 23′ S, 70° 11′ W, Neuquén, Argentina), Cueva Traful I (CTI, 40° 43′ S, 71° 7′ W, Neuquén, Argentina), El Trébol (ET, 41° 04′ S, 71° 29′ W, Río Negro, Argentina) (Hajduk et al. 2004), Los Toldos Cueva 13 (LT, 47° 22′ S; 68° 58′ W, Santa Cruz, Argentina), Piedra Museo 1 (PM1, 47° 53′ S, 67° 52′ W, Santa Cruz, Argentina), Cueva del Milodón (CM, 51° 36′ S,

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72° 36′ W, Magallanes, Chile) (Simonetti and Rau 1989), and Tres Arroyos 1 (TA1, 53° 23′ S, 68° 47′ W, Tierra del Fuego, Chile) (Figure 1). The assemblages—mainly products of owl-pellet deposition (Pardiñas 1999)—were largely composed of sigmodontine and caviomorph rodent remains; paleoenvironmental reconstruction was based on comparisons between archaeological and modern micromammal assemblages produced by owl predation near each site (Pardiñas 1999; Figure 1).

In northeastern Patagonia, the LL assemblages suggest lower moisture than at present and a local landscape dominated by open rocky areas with sparse shrubby vegetation. Samples from CTI are characterized by lower specific diversity and an absence of primary-*Nothofagus* forest sigmodontines (e.g., *Irenomys*, *Geoxus*). Both situations are indicative of drier and colder conditions, with a greater influence of westerlies around the Pleistocene-Holocene bound-

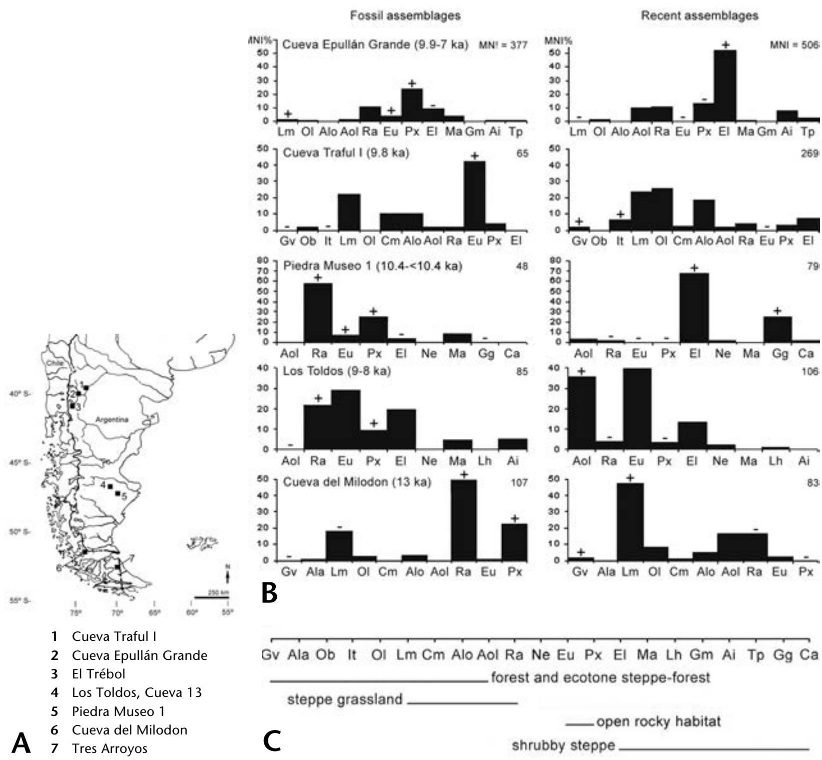

Figure 1. **A,** Austral portion of South America showing the location of studied archaeological sites; **B**, approximated habitat requirements of small mammals reported in the studied samples; **C**, pair-comparisons between selected micromammal fossil (*left*) and recent (*right*) assemblages (+ and – symbols on histogram columns highlight the main paired differences). **Ai,** *Akodon iniscatus*; **Aa,** *Abrothrix lanosus*; **Al,** *A. longipilis*; **Ao,** *A. olivaceus*; **Ca,** *Calomys*; **Cm,** *Chelemys macronyx*; **El,** *Eligmodontia*; **Eu,** *Euneomys*; **Gg,** *Graomys griseoflavus*; **Gm,** *Galea musteloides*; **Gv,** *Geoxus valdivianus*; **It,** *Irenomys tarsalis*; **Lh,** *Lestodelphys halli*; **Lm,** *Loxodontomys micropus*; **Ma,** *Microcavia australis*; **Ne,** *Notiomys edwardsii*; **Ob,** *Octodon*; **Ol,** *Oligoryzomys longicaudatus*; **Px,** *Phyllotis xanthopygus*; **Ra,** *Reithrodon auritus*; **Tp,** *Thylamys pallidior*; **ka** = RCYBP.

ary and early Holocene. The assemblage of ET is in line with LL and CTI, showing the presence of sigmodontines from open grassy areas (*Reithrodon*) and dominance of a typical shrubland form (*Loxodontomys*), suggesting poor development of *Nothofagus* forest near the end of the Pleistocene. In southern Patagonia, the assemblages recovered in PM1 and LT suggest a terminal Pleistocene/early Holocene expansion of grassy steppes under cold climatic conditions and higher effective moisture than at present. The absence of *Graomys griseoflavus* and the lower frequencies of *Eligmodontia* spp. in the fossil samples indicate poor development of the shrubby steppe dominant the area today. In the southern extreme, and reflecting terminal-Pleistocene conditions (and possible Younger Dryas impact), samples from CM and TA1 are indicative of open areas under very cold and windy conditions, with large rocky outcrops (revealed by *Phyllotis* occurrence) and minimal *Nothofagus* expression in CM and an extremely hostile landscape—probably in the process of recolonization after ice—around TA1 (suggested by very low species richness).

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Paleohistological Study of Pleistocene Mammoth (*Mammuthus*) Bone

Margaret Streeter, Sean Prall, and Christopher Hill

Paleohistological analysis has been applied to nonhuman bone to provide information on the biological age of animals as well as processes of diagenesis or fossilization (Cook et al. 1962; Sander and Andrassy 2006; Enlow and Brown 1956). Here we report on the histological analysis of two specimens of Pleistocene proboscideans from the western interior of North America. These specimens retain elements of the bone microstructure and are from distinct depositional and taphonomic contexts. The comparison of osteon size and density provides information on the biological age at death of these individuals and has the potential to address questions regarding the rate of growth and development of Pleistocene megafauna. This research illustrates the utility of even small fragments of ancient bone for estimating the lifespan and physiological characteristics of Pleistocene fauna as well as for evaluating post-depositional processes (Hedges 2002; Jans et al. 2002).

The materials analyzed are fragments of cortical bone from two proboscideans. The geologically oldest sample is a fragment of rib recovered from a gravel pit at Miles City, Montana (Hill 2006). It is likely a fragment of *Mammuthus columbi*. However, the presence of mastodon (*Mammut americanum*) in the deposit means that the identification of the specimen as either mammoth or mastodon has not been determined with absolute certainty. The geologic context indicates this specimen is pre-Wisconsin (Illinoian?) in age (younger than the Lava Creek B tephra dated to around 600,000 years ago and possibly older than calcretes dated to at least 124,000 years ago). The geologically younger sample is part of a limb bone from a single, nearly complete *Mammuthus columbi* collected from upland silts in the Deer Creek drainage in eastern Montana. The specimen was found in eolian silts underlying a buried soil and has a collagen (XAD-gelatin) age of about 12,330 RCYBP (Hill 2006). A femur from this mammoth has been reported to contain fibrous collagen but no visible osteocytes or vessels (Schweitzer et al. 2007).

A set of microscopic slides was prepared for each specimen using standard histological procedures (Stout and Paine 1992). Laboratory methods consisted of embedding undecalcified fragments of bone in epoxy resin, cutting the specimen to 100 μm, and hand-grinding the thin section to a thickness of approximately 80 μm (Frost 1958). The slides were examined on a microscope using transmitted and polarized light at 40X, 100X, and 200X magnifications as needed. Measurement of osteon size was accomplished using the point count method at 200X.

The results of these studies provide information on the age, growth and

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development and the post-depositional factors that affected the Proboscidean bone. The thin sections show the preservation of the osteon structure, including concentric lamellae that surround the Haversian canals, which extend longitudinally through the bone and provide a passage for small blood vessels. Cortical surfaces were strongly dominated by closely packed osteons (Haversian systems), and osteocytic lacunae were observed. The cortex comprised several generations of secondary osteons (evidence of bone remodeling), whose accumulation has been shown to correlate strongly with age in some mammals (cf. Kerley and Ubelaker 1978). The density of Haversian systems, the fact that no primary lamellar, plexiform bone, or interstitial lamellae were visible indicates that these individuals were mature adults. Mean osteon size and osteon density, which can also be used to evaluate the relative age of individuals, are compared here with a previous study on an adult mastodon (Wu et al. 1970) (Table 1).

Table 1. Histological parameters of Proboscidean bone.

Sample	Mean Osteon Area (mm^2)	Osteon Number ($/mm^2$)
Deer Creek	.090	5.2
Miles City	.064	7.7
Mastodon (Wu et al. 1970)		9.6[1]

[1] Includes osteon fragments.

The thin sections also provide information on the effects of diagenetic alteration (Schultz 2001, Turner-Walker and Jans 2008). The bone of the pre-Wisconsin (Miles City) proboscidean, recovered from terrace gravels, has an amber color reflecting incipient mineralization, most likely related to Fe-enrichment from groundwater. In contrast, the late-Pleistocene (Deer Creek) mammoth bone, recovered from upland eolian silts, is more friable and has very little color, indicating essentially no mineral enrichment. This supports the interpretation that different hydrologic conditions have affected the bones. No evidence of calcite or silica crystal formation or evidence of fungal, algal, or bacterial invasion was observed in either bone.

These data can be compared with other histological studies of fossil bone. Like specimens of *Mammuthus* from Alaska (Eschscholtz Bay) and California (Irvington and Rancho la Brea) (Cook et al. 1962), and from late-Pleistocene northern Europe (Sander and Andrassy 2006), the Montana samples exhibit the persistence of the Haversian systems (secondary bone formation). All the specimens have features that are similar to those found in present-day elephant bone (Cook et al. 1962). Thus, histological studies appear to provide a way to compare the physiology and growth patterns of extinct and extant proboscideans.

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Paleoenvironments: Geosciences

A Younger Dryas Signature on the Southern Plains

Leland C. Bement and Brian J. Carter

The Younger Dryas oscillation event is defined as a late-Pleistocene return to glacial conditions following a significant warming of the Northern Hemisphere. This Younger Dryas event is seen in the Greenland ice-core isotopes (Alley 2000). Similar climate changes in continental areas have been observed as the re-advancement of mountain glaciers and in proxy datasets, including shifts in floral communities. Stable carbon isotope analysis ($\delta^{13}C$) of ancient soil A horizons within the Beaver River drainage of the Oklahoma panhandle define a similar pattern (Figure 1).

The core of this dataset is found at the Bull Creek site soil profile. The deep soil profile containing eight buried A horizons that range in age from ca.

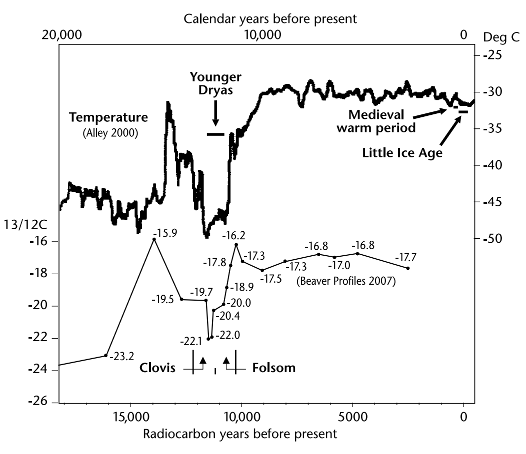

Figure 1. Comparison of the temperature curve obtained from the Greenland ice cores (GISP-2) (Alley 2000) and the stable carbon isotope ratios obtained from dated soil A-horizons within the Beaver River drainage, Southern Plains.

11,000 to 6200 RCYBP provide a broad time frame (Bement et al. 2007a). Changes in deposition and vegetation for the Bull Creek site are observed in the analyses of 10 stable carbon isotope, 34 pollen, 10 phytolith, and 52 sediment samples (Bement et al. 2007a). Recent survey in the area has identified additional locations within the same low-order drainage, similar small

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stream systems, and the larger Beaver River basin that contribute supporting isotope, pollen, phytolith, and particle-size evidence (Bement et al. 2007b). This evidence extends the proxy climate record both forward and back in time (Bement et al. 2007b) and supports the time-temperature relationship recorded in Figure 1 by an additional eight data points. All radiocarbon dates and corresponding δ^{13}C ratios from buried A-horizons are published elsewhere (Bement et al. 2007a, b). The Greenland ice-core trend is positioned above the Beaver River trend for comparison purposes (Figure 1). The Beaver River trend is presented in ^{14}C years because conversion equations between the two continue to be refined (Waters and Stafford 2007).

Although δ^{13}C ratios are generally employed to segregate plants according to photosynthetic pathways, recent work on the plains of North America has identified temperature gradients that correlate to these ratios (Fredlund and Tieszen 1997). The magnitude of temperature change represented in Figure 1 can be obtained by converting soil δ^{13}C ratios to temperature following the equations of Fredlund and Tieszen (1997) and Johnson and Willey (2000) derived from modern soil isotope ratios, phytoliths, and temperature gradients. The isotopes describe an 8°C difference between the initial Younger Dryas maximum cold snap and subsequent warm rebound. This supports other studies that describe a 5°–10°C shift during the Younger Dryas event (Alley 2000; Fredlund and Tieszen 1997). Few Younger Dryas indicators are derived from Plains datasets. And fewer studies provide multiple supporting pollen, phytolith, and particle-size distribution data. Work continues along the Beaver River drainage to bolster the record of terminal Pleistocene environs.

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Databases and Meetings

2008 Paleoamerican Origins Workshop: A Brief Report

Michael B. Collins, Michael R. Waters, Albert C. Goodyear, Dennis J. Stanford, Tom Pertierra, and Ted Goebel

Science advances when evidence and interpretations are verified or rejected according to the epistemology of the particular discipline engaged in the research. In the case of archaeology, the rules of evidence are largely subjective, each body of evidence is unique, and interpretations tend to be influenced to a significant degree by the idiosyncrasies of the investigator(s). These very real circumstances foster disagreements that are not easily resolved, and there is no formal mechanism for arbitrating the disagreements beyond peer review of funding proposals and publications, neither of which is flawless. This can lead to divisiveness and polarization in regard to many controversial interpretations.

Nowhere within the discipline of archaeology have these unfortunate characteristics of our science been more apparent than in the debate over the archaeological evidence for the peopling of the Americas. Scholarly disagreement, debate, and promulgation of competing interpretations are beneficial to the discipline, but divisiveness and polarization are not.

For the purpose of furthering reasonable, professional, constructive, and civil dialogue toward improving our research methods, standards, and results, the Center for the Study of the First Americans, Texas Archeological Research Laboratory, Southeastern Paleoamerican Survey, and Smithsonian Institution organized the Paleoamerican Origins Workshop. Scholars bearing a wide spectrum of views on the question of the peopling of the Americas gathered at

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the University of Texas at Austin, February 14–16, 2008. The format was semi-formal and consisted of presentations followed by considerable discussion.

Twenty-eight speakers detailed site-specific evidence as well as discussed broad substantive issues and regional syntheses. Of particular value were the more than eleven hours of discussion, more than two hours of perusing and discussing specimens from several key sites, and time for discussion at three conference meals. A common thread in the papers, discussions, and conversations was the issue of what constitutes solid archaeological grounds for interpretation.

A strong sense of enthusiasm and excitement permeated the workshop, which clearly reflects this subfield at this moment. There was hearty but collegial exchange of ideas among participants holding a wide spectrum of views, and we feel that large steps were taken toward improving professional exchange and lessening the tendency toward a polemic.

A number of sites dating in the 1,000 to 2,000 years before Clovis were thoroughly discussed, concerns were addressed, and possible misconceptions were clarified. To most participants, the aggregate evidence from these sites was robust and undeniable, leading to the conclusion that the Americas were certainly occupied during the interval of 15,500 to 13,500 CALYBP. Although each participant's list of the discussed North American sites with acceptable evidence would vary, some mix of Shaefer, Hebior, Mud Lake, Manis, Paisley Cave, Page-Ladson, Gault, and Buttermilk Creek sites would be included by many of those attending, even though investigations continue at some and final reports are not available for others. To a minority of participants, site-specific issues still prevented unconditional acceptance of this case for a late "pre-Clovis" period of human prehistory.

Evidence is emerging for an even earlier human entry into the Americas, prior to 15,500 CALYBP. Presentations and discussions concerning Miles Point and similar localities on the Delmarva Peninsula, Cactus Hill, La Sena, Lovewell, Burnham, Topper, Monte Verde I, and others suggesting the possibility of a human presence in the Americas before the Last Glacial Maximum is increasingly intriguing and may develop rapidly in the near future.

The case for a late entry of humans into the Americas ("Clovis First") did not achieve consensus in this workshop.

Several conceptual and methodological topics addressed by the workshop may hold more significant and lasting importance than the consideration of specific sites. These include the following:

1. Geoarchaeology plays a critical role in the study of early sites in terms of stratigraphy and geochronology, site formation, and site prediction and prospection models.
2. Prehistorians interested in the early archaeological record of the Americas must work to inform cultural resource managers at the local, state, and federal levels; state historic preservation officers; and archaeological consultants about the issues of early site visibility, contexts, and significance. These do not fit the usual bureaucratic criteria for site survey, assessment, and importance.
3. The long-standing criteria of reliable dating, good stratigraphic context,

unequivocal human artifacts, or human remains still hold and must be met fully for all early sites.

4. Any model of the peopling of the Americas must consider the genetic data as well as the physical anthropological evidence. These must be reconciled with the archaeological evidence.
5. The peopling of the Americas involves the entire hemisphere, and models must consider the extensive South American and emerging Central American evidence for early sites.
6. Substantive, collegial debate among professionals with differing opinions is essential to improving the quality of our evidence, interpretations, and models.

Finally, an important outcome of this workshop is redoubled effort by its sponsors to organize and host a more comprehensive conference on the early archaeological record of the Western Hemisphere with a much larger number of participants and open to the general public. The conference will cover a greater array of topics, formal exhibits, and flintknapping sessions, and a date will be set soon.

The Far East Archaeological Database (FEAD): A Maximum 1-Minute-Resolution Dataset for Exploring the Big Picture

J. Christopher Gillam, Andrei V. Tabarev, Masami Izuho, Yuichi Nakazawa, Chen Quanjia, Batmunkh Tsogtbaatar, and Yongwook Yoo

The Far East Archaeological Database (FEAD) is being developed from site location data in the published literature and through individual and institu-

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tional collaborations to provide a maximum 1-minute latitude/longitude resolution (2 km or less) archaeological site dataset for exploring patterns of settlement, migration, interaction, and exchange at regional and greater scales of analysis. The prehistoric technology and cultural chronology of the Far East are well understood, and research interest in settlement, migration, interaction, and exchange networks of the region remains strong (Izuho and Sato 2007; Jull et al. 1994; Krupianko and Tabarev 2001; Kuzmin 2001; Kuzmin et al. 2002; Kuznetsov 1996; Nakazawa et al. 2007; Uchiyama 2006; Vasil'ev et al. 2002). Site coordinates in the database are provided in latitude/longitude format for ease of integration with any geographic information system (GIS) analytical environment.

There are a variety of free, on-line, global-scale, GIS data sources that aid the modeling goals of the project. Of particular interest are the Shuttle Radar Topography Mission (SRTM) 90-m DEM (Rabus et al. 2003), the GLOBE (Hastings et al. 1999) 1-km resolution DEM, and the ETOPO2 4-km resolution DEM data (ETOPO2 includes sea-floor bathymetry [NGDC 2006]). The use of GIS with FEAD can go far beyond mapping of site distributions. Combined with global-scale environmental data, GIS analyses offer great potential for exploring fundamental problems in the archaeology of the Far East, neighboring regions, and worldwide.

For example, multivariate statistics and GIS have been used for eco-cultural niche modeling (ECNM) using archaeological distributions from FEAD with the HYDRO1K (USGS 2003) and CLIMAP (1994) environmental datasets (e.g., Banks et al. 2006; Gillam et al. 2007). For Siberia and the Russian Far East, a sample of Paleolithic sites (n = 108) has been used to predict the potential range of populations during interstadial periods of the Pleistocene (Figure 1) (Gillam and Tabarev 2006). Likewise, we have examined possible exchange networks of obsidian raw materials in Primorye by linking known

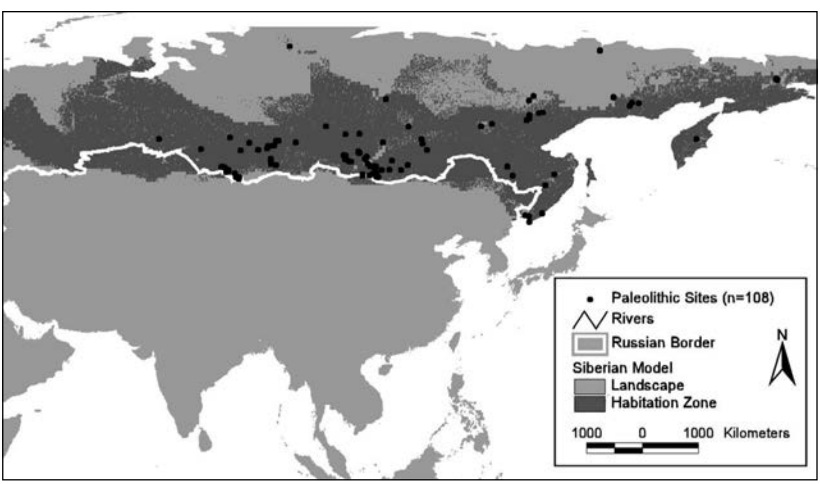

Figure 1. Paleolithic predictive model illustrating the potential range of cultural groups during interstadial periods in Siberia and the Russian Far East (Gillam and Tabarev 2006).

quarry locations with habitation sites throughout the region (Gillam and Tabarev 2004).

The ultimate goal is to promote innovative analyses of site location through institutional and international collaboration, resulting in a growth in knowledge of large-scale cultural processes applicable to the Far East and beyond. The dataset has its roots in the research interests of the authors and currently includes Paleolithic and Neolithic site location data from Siberia, the Russian Far East, and Japanese Archipelago. However, the database is by design intended to be inclusive, not exclusive to a given time or culture, and will grow with support and collaboration from fellow scholars. We are particularly interested in developing new collaborative partnerships with colleagues and institutions in China, Japan, Mongolia, North Korea, South Korea, and Russia, as well as others with active research programs in the region.

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The Paleoindian Database of Uruguay: Collections Survey and GIS Data Development

Rafael Suárez and J. Christopher Gillam

In the past decade, the archaeology of the late Pleistocene and early Holocene in Uruguay has witnessed many new discoveries of early hunter-gatherers that parallel findings throughout the Americas. This transitional period is characterized by two early point types, Fishtail and Pay Paso. Fishtail, or Fell's Cave, points occur with and without fluting and are widely distributed in Uruguay (Figure 1A) (Bosh et. al 1974; Suárez 2006). Pay Paso points from northwest and central Uruguay are a more recent type, have a triangular blade, well-defined stem with concave base, and bilateral basal thinning (Figure 1B) (Suárez 2003).

A collections survey to further document site location and component information throughout the region is underway. To date, 46 sites with Fishtail or Pay Paso points, quarries of agate, silicified sandstone, silicified limestone, and rhyolite, and ^{14}C-dated site locations have been recorded (Figure 1). These new sites supplement the 15 previously known early sites from the region.

A total of 56 Fishtail and 20 Pay Paso points have been recorded from private and public collections, within 12 of 19 departamentos (counties). Approximately 70 percent of the Fishtail points (n = 39) were manufactured on

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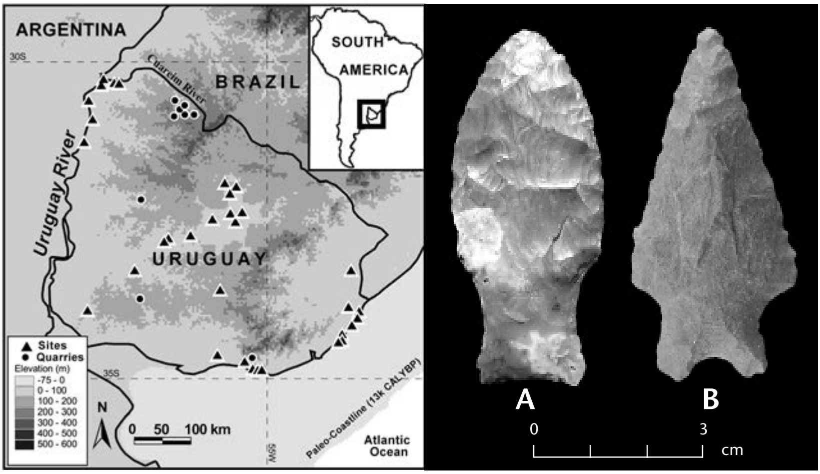

Figure 1. Map of late-Pleistocene and early-Holocene sites in Uruguay on the reconstructed paleo-landscape (13,000 CALYBP) and the two Paleoindian point types recorded from Uruguay. **A,** Fishtail design, from middle Negro River, manufactured on silicified limestone (Museo Histórico Casa de Rivera, Durazno). **B,** Pay Paso design, from Arroyo Carpintería site (middle Negro River), manufactured on silicified sandstone (W. "Chito" Aizpún, private collection).

silicified limestone, 11 percent (n = 6) on jasper, 8 percent (n = 4) on opal, and only 4 percent on silicified sandstone (n = 2). The raw materials preferred for making Pay Paso points is remarkably different, with a greater frequency of silicified sandstone points (45 percent, n = 9), and less frequent, but still significant, use of silicified limestone (35 percent, n = 7). The remaining Fishtail (n = 5) and Pay Paso (n = 4) points in the sample are made from expedient materials, including quartz, rhyolite, chalcedony, and cuarcite.

Pay Paso points are apparently absent from sites along the modern southeast Atlantic Coast; these sites were located on interior lands during the Pleistocene, the paleo-shoreline being up to 120 km out to sea (Figure 1). Pay Paso points are most frequent in northwestern and central Uruguay, suggesting a more restricted distribution than the preceding Fishtail type.

Statistical analysis and cartographic modeling are being used to examine the settlement systems and ecological niches of these early hunter-gatherers, and to explore potential interaction and exchange networks throughout the region (e.g., Anderson and Gillam 2000; Banks et al. 2006; Harris 2000; Hunt 1992). Least-cost paths analyses are being used to examine potential trail networks within and between drainages and to and from key resources, such as stone quarries. Results of the collections survey will provide a statistically valid sample of sites that will be used for predictive modeling of site location and for identifying ecological niches exploited by early hunter-gatherers. This research is yielding new insights into early hunter-gatherer adaptations of the region and will be used to direct future field research in Uruguay and neighboring regions.

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Trust and Paleolithic Research Fund, University of South Carolina Educational Foundation. Thanks to Lic. Oscar Padrón Favre, Director of Museo Histórico Casa de Rivera (I.M. Durazno), and Maestro Walter D. Suárez, Director of Museo del Indio y la Megafauna (Cerros Azules, Maldonado), for allowing study of the museum's collections. Aizpún and S. Bálsamo opened the doors of his family's home for study of their important archaeological collection. National Geographic Society and The Wenner-Gren Foundation support the investigations of R. Suárez on early human occupation in Uruguay.

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Dissertation or thesis: Phippen, P. G. 1988 Archaeology at Owl Ridge: A Pleistocene-Holocene Boundary Age Site in Central Alaska. Unpublished M.A. thesis, Department of Anthropology, University of Alaska, Fairbanks.

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