CURRENT RESEARCH IN THE PLEISTOCENE

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A Peopling of the Americas Publication

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From the Editor

This is the twentieth issue of *Current Research in the Pleistocene* and the first to be published by the Center for the Study of the First Americans from our new home at Texas A&M University. With the move to Texas A&M, the Center was able to reorganize and hire a new office manger—Laurie Lind. Through her organizational skills and hard-working nature, we have been able to get *CRP* back on a predictable timetable for publication.

With the next issue of *Current Research in the Pleistocene,* we would like to increase the subscription base for *CRP*. *Current Research in the Pleistocene* is currently sold like a book that comes out once a year. However, *CRP* is a journal and as such we would like to have it on a subscription basis. In the back of this volume you will find a subscription form. I encourage you to fill it out and send it to us for your advance subscription to volume 21, which should be available in December 2004. This will help the Center to determine how many copies of *CRP* to print, and you will receive volume 21 at a discounted price as soon as it is available.

Volume 20 also represents my first and last appearance as editor of *CRP*. I basically saw myself as editor-in-transition to keep *CRP* on track for 2003 while we organized the Center and before we could find a new editor to shepherd *CRP* into the future. Ted Goebel, a well-known First Americans researcher at the University of Nevada, Reno, and Executive Director of the Sundance Archaeological Research Fund, has agreed to take over the editorship of *CRP*. Under his guidance, I am sure *CRP* will continue to grow and prosper.

Good luck to all in your research endeavors and send us your manuscripts.

Michael R. Waters

Archaeology

Late-Plano Occupation at the St. Louis Site (FfNk-7), Central Saskatchewan

Leslie J. Amundson and David Meyer

The St. Louis site is located in central Saskatchewan, in the valley of the South Saskatchewan River. It was found by Amundson in July 2002 during a CRM study (sponsored by Saskatchewan Highways and Transportation) related to the planned construction of a new bridge. The bridge approach crosses a narrow terrace within the river valley. Amundson dug eight deep tests in this terrace, encountering bison bones and debitage to a depth of over 2 m. Some deeply buried bone was radiocarbon-dated to 7960 ± 60 RCYBP (Beta-168388), suggesting that late-Plano materials had been encountered. A detailed site evaluation found that the terrace consists of silty floodplain deposits, each capped by a thin, dark organic horizon, several of which contain cultural materials. Intact components approaching 8000 yr B.P. are unknown in central Saskatchewan, leading to the decision to conduct mitigative excavations.

Amundson directed the excavation of a 67-m^2 block with some crew members provided by Meyer through the multi-year collaborative SCAPE project (Web site **http://scape.brandonu.ca**), which is funded by the Social Sciences and Humanities Research Council of Canada. This exposed Layer VII, 129–141 cm below the surface, a thin paleosol that contains a scatter of faunal remains, fire-cracked stones, and debitage associated with a small hearth. As well, we recovered the basal half of a lanceolate projectile point (Figure 1). One margin of this point is damaged, probably as a result of use impact; the intact opposite margin is heavily ground. Bone collagen (bison) from Layer VII has been dated to 7810 ± 70 RCYBP (Beta-173609). Layer VIII, 18–28 cm deeper, dated to 8400 ± 70 RCYBP (Beta-173610), again on bison bone collagen, and produced a small amount of debitage and bison bones, as well as the remains of fish, grouse, and rabbit. Layer IX, 17–22 cm below VIII, dated to 9150 ± 40 RCYBP (Beta-173611) (bison bone collagen), may not be cultural.

Excavations have also revealed four bison skulls in the size range of extinct species. Although late-Plano points have been collected from field surfaces in

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Figure 1. Lanceolate point base recovered from Layer VII.

this region (Meyer 1970, Meyer and Pettipas 1977), the St. Louis site is significant because it has in situ components with the potential to provide much information on late-Plano times in central Saskatchewan.

We especially thank Jorges Antunes, Senior Supervisor and Geotechnical Engineer, Saskatchewan Highways and Transportation, who supported this project by providing necessary infrastructure including an access road and reservoirs for water screening. Nathan Friesen of Stantec Consulting Ltd. provided the projectile point image, and we also extend our gratitude to our enthusiastic excavation crew.

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Revisiting the Late-Pleistocene/Early-Holocene Archaeology of Pleistocene Lake China and the CRBR Locality

Mark E. Basgall

Pleistocene Lake China (PLC) preserves an exceptionally rich record of late-Pleistocene/early-Holocene archaeology and paleontology, having yielded many hundreds of diagnostic artifacts and numerous exposures of Rancholabrean fauna. Current descriptions of the locality emerge primarily from the work of Emma Lou Davis, who, working on shoestring budgets with untrained volunteers, still achieved fairly exacting spatial controls and consistent levels of interdisciplinary cooperation (cf. Davis 1974, 1975, 1978). Despite the great potential demonstrated by the original PLC research, the controversial positions that Davis took and idiosyncracies of her reporting style have made it difficult to compare data from PLC with those from other regional contexts. Based on targeted reconnaissance and close consultation with local avocationals, Davis identified two site localities for concerted study. Much of the work was done at a series of benches associated with the 2175-ft contour, where surface collections were made across 16 discontinuous, irregular-shaped grid units (designated Stakes 1-27, hereafter termed the "Lakebed" locality). A second location, "Charlie Range Basalt Ridge" (CRBR), received less attention owing to access restrictions, although Davis rightly believed it had greater integrity than the lakebed exposures.

This paper outlines ongoing efforts to place past work at PLC within a more current empirical and theoretical framework, a research program that has three basic components: (1) reassessing existing archaeological data using contemporary approaches; (2) continuing work at previously identified localities to resolve still outstanding issues; and (3) initiating new work at other PLC locations that can provide further insight into early cultural adaptations. A brief summary of recent work at CRBR follows.

The PLC Research Program

Reassessing past efforts has necessitated a careful inventory of existing documentation and physical collections, portions of which are housed at several locations. Most materials are curated at the Maturango Museum in Ridgecrest, California; some paperwork is stored at the Naval Air Weapons Station at China Lake, and most paleontological samples are kept at the Los Angeles County Museum. Field notebooks, mapping data, personal letters, and manuscript fragments have been located and are being annotated by location and topic; many of these contain information never before available. Artifact collections at the Maturango Museum were borrowed, reclassified into standardized groups, and entered into electronic format that allows effective

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sorting by grid location, tool class, material group, and artifact condition. Many items originally identified as tools proved to be chipping debris, while catalogued debitage frequently comprised broken implements such as projectile points, bifaces, or scrapers; artifact counts in the original publications have little utility. Samples from these collections are being subjected to chronometric and compositional analyses, and faculty and student projects will offer full technological assessments of both assemblages.

A second component of the PLC research program is intended to clarify spatial relationships and acquire contextual information overlooked during the first efforts. Earlier work was performed without benefit of the refined geospatial technologies available today, based on limited transit shots, triangulation, and a fair amount of gross estimation. Fortunately, Davis marked grid datums and corners with rebar stakes that are still mostly in place; resurvey of the two main localities relocated sufficient markers to reconstruct the size and configuration of most collection units. Documentation found at the Maturango Museum will ultimately permit fine-grained plotting of individual bone and artifact positions. Central to the third component of the PLC program is a probabilistic survey of the lake basin, geared toward shoreline features, old surfaces adjacent to the playa, and the outflow channel. It is fully expected that locations with better chronostratigraphic integrity are preserved in the area. Finally, continuing the Davis tradition, interdisciplinary studies will refine reconstructions of regional environmental and landscape history.

Research at the CRBR Locality

The original Davis (1978) CRBR effort focused on the playa surface where fossil mammoth remains were discovered; the primary archaeological deposit lies some distance away, within a small embayment rimmed by a basalt flow that has buffered the extreme deflation common along the north shoreline. Surface artifacts are largely unweathered, having been buried until relatively recent times. Recent research involved the use of 34 5.0-by-5.0-m grid units to characterize surface content; 22 0.5-by-1.0-m test units used to assess the internal structure of site sediments indicate that buried cultural material was restricted to the shoulder of the ridge formation and adjacent to two areas of organic staining. Larger exposures in these areas disclosed a spring-related peat radiometrically dated to 9870 ± 50 RCYBP (Beta-170210) and 10,010 ± 110 RCYBP (Beta-170208), and an artifact-bearing paleosol dated to ca. 8390 ± 130 RCYBP (Beta-170209).

Diagnostic artifacts were differentially distributed across the site area: fluted points (n = 9) primarily at lower elevations near the embayment mouth; Great Basin stemmed points (n = 40) and crescents (n = 11) clustered near the spring/paleosol deposits; and Pinto points (n = 11) dispersed across the wider site area. Combined with earlier collections (made by Davis and two local collectors, Richard and William Fagnant), the CRBR assemblage now includes 219 projectile points, 45 crescents, 286 bifaces, 556 scrapers, 26 cores/core tools, 5 milling tools, and 11 battered cobbles in addition to abundant debitage and faunal material. None of the fossil bone appears related directly to the human occupation.

The PLC research program has been made possible by funding from the Naval Air Weapons Station at China Lake, the past and continuing support of Carolyn Shepherd, Russell Kaldenberg, Jan Lawson, and William Eckhardt, Elva Younkin and the Maturango Museum, and the efforts of CSUS graduate students who have braved the Mojave Desert in summer on multiple occasions.

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Clovis Bison Hunting at the Jake Bluff Site, NW Oklahoma

Leland C. Bement and Brian J. Carter

Recent investigation of the Jake Bluff site (34HP60) in NW Oklahoma uncovered a Clovis bison kill in an arroyo. The six-week-long 2002 excavation opened three trenches (2 by 6 m) perpendicular to the long axis of the buried arroyo. Lateral extensions of these trenches brought the total excavated area to 40 m^2, including a total of 8 m^2 along the arroyo floor.

The excavations identified a 20-m-long, 2-m-wide gully with the appearance of an eroded animal trail incised into soft sandstone bedrock. A pile of bison bones on the west side of the gully included the butchered legs of at least three animals. The eastern side of the gully yielded bone fragments, resharpening flakes, hammerstones, a flake knife, and a possible anvil stone indicative of additional processing activity. The deposits in the arroyo contained resharpening flakes, additional hammerstones, bones of at least 12 animals, and two Clovis projectile points. The bison remains in the arroyo brought the overall site minimum number of individuals (MNI) to 15 animals. Preliminary analysis suggests the herd consisted of cows, calves, and juveniles.

Both Clovis projectile points are made of Alibates agatized dolomite and display a single flute on each face (Figure 1). One has been reworked from a much larger point (now L = 5.13 cm, W = 2.59, T = 0.74); the other is similar to the Clovis type II defined by Hester (1972) at Blackwater Draw and is rather diminutive (L = 4.25 cm, W = 1.75, T = 0.57).

Workmanship on both specimens is similar to other Southern Plains Clovis

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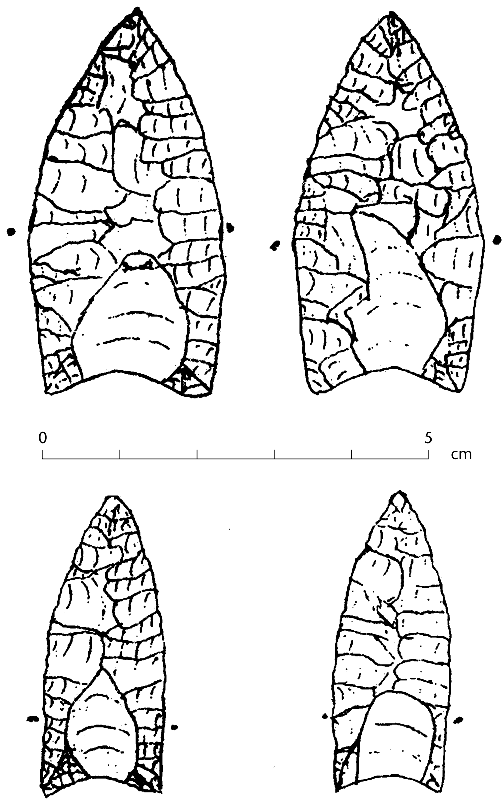

Figure 1. Two Clovis-style projectile points discovered in a bone pile on the gully floor.

(Hofman and Wyckoff 1991). Fine pressure retouch on the larger point is reminiscent of the workmanship on the Clovis points from the Domebo mammoth kill in central Oklahoma (Leonhardy 1966). Basal characteristics place both points in the middle of the range of Western Clovis points discussed by Morrow and Morrow (2002).

Three radiocarbon dates on XAD-purified collagen, 10,750 ± 40 RCYBP (CAMS 79940), 10,840 ± 45 RCYBP (CAMS 90968), and 10,700 ± 45 RCYBP (CAMS 90969), averaging 10,754 ± 83 RCYBP, suggest Jake Bluff postdates the extinction of mammoths. It is logical that Clovis hunters would turn to bison hunting as mammoth and other megafauna became scarce. Clovis hunters may have developed mass kill techniques such as arroyo traps to replace meat quantities lost by the extinction of mammoth. The addition of larger arroyo-style bison kills to a repertoire of smaller kills around watering areas foretells a pattern seen during the Folsom period (Bement 1999).

Continued work at the Jake Bluff site includes the analysis of lithic technology, butchering technology, landscape evolution, and seasonality, and the search for a nearby camp.

This project was funded in part by the National Geographic Society, the University of Oklahoma,

Oklahoma Archeological Survey, Oklahoma State University, Oklahoma Anthropological Society, and private donations.

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Clovis-age Artifacts from Rocky Mountain National Park and Vicinity, North Central Colorado

Robert H. Brunswig

The University of Northern Colorado (UNC), under contract to the National Park Service, recently completed a five-year archaeological survey and testing program (1998–2002) in Rocky Mountain National Park, Colorado. Surveys covering 29,739 acres from lower montane forests and valleys to alpine tundra documented or reinvestigated more than 400 prehistoric sites and isolated artifact finds. Among those prehistoric resources are 35 sites or isolated projectile-point finds from all known southern Rocky Mountain Paleoindian periods (Brunswig 2001, 2003), including eight known or suspected projectile points from the region's earliest Clovis complex (Figure 1).

Only one artifact, a Clovis base collected from alpine tundra on Trail Ridge (Figure 1A), has been previously reported (Husted 1965:496). A second Clovis base (Figure 1B, site 5LR90) was recently identified among artifacts previously collected in the course of a 1961 M.A. thesis survey by Wil Husted (1962). Subsequent UNC reinvestigation of the site found it to be an extensive multicomponent lithic scatter and quarry locality in alpine tundra overlooking Milner Pass, southwest of Trail Ridge. In 2000, UNC surveys recovered a complete but slightly unusual Clovis point (Figure 1C) in La Poudre Pass on a multicomponent lithic scatter site (5LR10242) in the subalpine forest-meadow zone on a grass-covered glacial kame knoll. The point has only minimal evidence of basal fluting, but its lower third thinned by edge flaking

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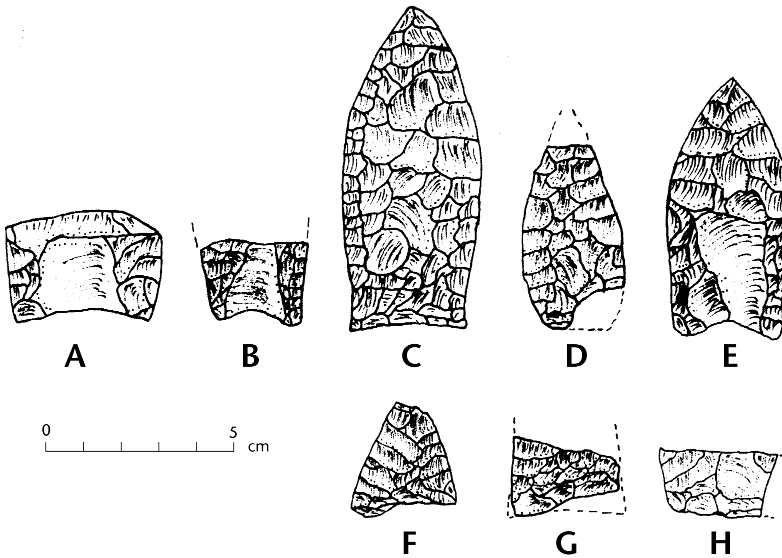

Figure 1. Clovis artifacts from Rocky Mountain National Park and vicinity.

and its overall form and flaking pattern conform to common Clovis traits. Furthermore, basal flutes are often limited in size or even nearly lacking in many Clovis points (Howard 1990:258). Sediment core studies of an adjacent fen established the formerly glaciated pass as largely ice-free by the time of Clovis occupations, a condition confirmed by the nearby Clovis component (Doerner and Brunswig in prep). Another isolated projectile point (Figure 1D), resembling Clovis variants at the Wyoming Colby Mammoth site (Frison 1986: Figure 3.2) and with a hint of modest fluting on its broken base, was recovered from a steep mountain slope immediately above the Ute Trail in lower montane (ponderosa pine) forest. A final complete Clovis projectile point (Figure 1E, 5BL5811, redrawn from its isolated find form illustration), was recovered in 1990 by a Kansas summer resident of the Rocky Mountain National Park area less than a mile from the southeastern boundary of the Park (Wood and Dobbs 1990). Three remaining fragmentary artifacts, which have physical traits that broadly fit Clovis form and flaking patterns but are not definitively Clovis in origin, are a large, finely flaked projectile point tip (Figure 1F, 5GA2518) and a heavily battered base fragment (Figure 1H, 5LR9842) from multicomponent lithic scatter sites in the alpine tundra of the Park, and a partial base (Figure 1G) from a lithic scatter (5LR611) on a lower montane (lodgepole pine) stream terrace site. It is important to note five of the above artifacts were recovered from modern alpine tundra (Trail Ridge, 5GA2518, 5LR90, 5LR9842) or upper subalpine forest/meadow (5LR10242) ecosystems, suggesting effective deglaciation and permanent snowfield clearance by late Clovis times. Their material sources suggest initiation of an indigenous mountain interior adaptation and familiarity with local lithic sources: three artifacts (Trail Ridge, 5GA2518, 5BL5811) are made of Kremmling chert from Middle Park (immediately west of the Continental Divide), and two others (5LR611, 5LR7074) are made of Table Mountain jasper from the same mountain valley. Remaining artifacts are made of non-local materials; at least two cases, 5LR90 (petrified wood) and 5LR10242 (oolitic chert), are from suspected sources in central and southwest Wyoming.

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Early-Holocene Lithic Technology of the Peruvian Coast: The Tres Piedras Quarry

Elmo León Canales

The Paiján complex occupied a large portion of the Peruvian Coast between the Younger Dryas and the middle Holocene (e.g., Chauchat et al. 1992; Canales 2001a). The Paiján complex is characterized by a sophisticated *chaîne opératoire* resulting in a stemmed projectile point (e.g., Pelegrin and Chauchat 1993). Production of these distinctive points involved at least three stages: Stage 1, oval bifacial preforms (cf. Crabtree 1972:85) knapped with pebbles known as *Chivateros* preforms (e.g., Bonavia 1982) (Figure 1A); Stage 2, bifacial leaf-shaped pieces manufactured with the use of a hardwood hammer

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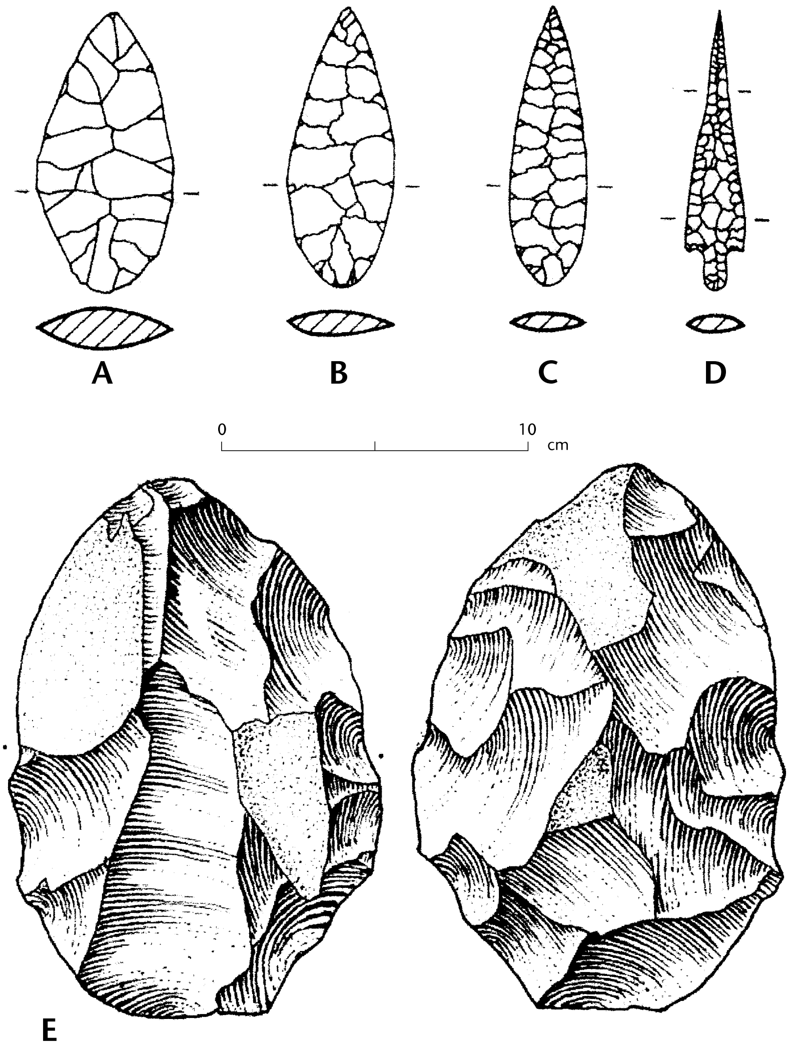

Figure 1. A–D, the technological stages of bifacial reduction of Paiján lithic technology (from Chauchat et al. n/d); **E,** a bifacial preform from the *Tres Piedras* quarry site.

(Figure 1B, C); and Stage 3, finished stemmed, triangular-shaped Paiján points that are pressure flaked (Figure 1D). Although these three technological stages are frequently reported from quarries and workshops along the Peruvian coast, few quarries belonging to this Paiján complex have been found and reported (Chauchat et al. 1992).

This paper reports new findings related to the first lithic technological stage coming from the quarry Tres Piedras, located in the Huarmey Valley (Canales 2001b). Since no charcoal was found at this site, direct dating by the radiocarbon technique was not possible. However, the presence of diagnostic Paiján points indicates that the site dates between approximately 8000 and 6200 CALYBP (Chauchat 1988:59; Canales 2001:130–133). All lithic debris from the surface of the site was collected (Bonavia 1982), and 237 artifacts were analyzed (Canales 2002). This assemblage includes 10 bifacial roughouts, a crude version of a preform or blank slightly modified (cf. Crabtree 1972:23; Inizan et al. 1995:180) (4.22 percent); 22 bifacial *Chivateros* preforms (9.28 percent); 14 primary cortical flakes removed by hard hammer percussion (5.91 percent); 165 thick secondary flakes with ridges detached by a stone hammer (5.91 percent); 25 elongated flakes removed by soft woody hammers (10.55 percent); and a cobble used as a hammer (0.34 percent). The distinction between cortical and thick flakes is based on experimental studies replicating the Paiján lithic technology. These studies found that flakes removed by stone hammers are thicker and shorter than those obtained by a wood hammer (e.g., Pelegrin and Chauchat 1993). All pieces are of metavolcanic andesite.

The initial stage blanks are about 10–13 cm long and 5–6 cm thick. Their weight ranges between 300 and 600 g. The bifacial roughouts often have large cortical surfaces. They usually have between 3 and 16 scars that indicate the first stage of bifacial shaping (Canales 2000:87).

The *Chivateros* preforms exhibit more flake scars, have relatively regular oval and spear-like shapes, and fewer cortical surfaces. These preforms are 3–3.6 cm thick as a result of bifacial thinning (Canales 2002).

Cortical and thick flakes, often produced by stone hammers, are believed to be the result of bifacial trimming (Chauchat et al. 1992). Thick flakes have fanlike shapes, platform angles of 75°–80°, slightly convex sections, and typical parallel dorsal ridges.

Other quarry sites, such as PV35-2 (Bonavia 1982), PV22-12 104 (Chauchat et al. 1992), site 9, Sta. Cristina (Uceda 1986), and Cerro Chivateros (Lanning and Patterson 1967), yielded similar debitage. These sites and the Tres Piedras quarry are all part of the north coast and north central Paiján complex. Much more remains to be learned about the Paiján lithic technology. Large areas of the Peruvian central coast that remain unexplored may contain Pleistocene and early-Holocene sites.

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The End of the Pleistocene in Central Chile: Evidence of Economic and Cultural Diversity

Luis E. Cornejo B. and Miguel Saavedra V.

Until the early 1990s, there was little evidence of the first inhabitants of central Chile, which led to a relatively simple interpretation of prehistory. In one case there was evidence from Taguatagua (34° 30′ S, 71° 10′ W) of classical Paleoamerican hunters of extinct fauna dated around 11,000 yr B.P. (Montané 1968). In another case we had early-Holocene evidence from Cuchipuy (34° 29′ S, 71° 07′ W) (Kaltwasser et al. 1980) and Punta Curaumilla (33° 06′ S, 71° 44′ W) (Ramírez et al. 1993) dated about 2500 years later.

However, information recovered by us from the Andean rockshelter of El Manzano 1 (33° 34′ S, 70° 23′ W) excavated in the late 1980s (Saavedra et al. 1991), its recent reevaluation (Cornejo et al. 1998; Cornejo and Saavedra 2001), and a restudy of the Taguatagua locality (Núñez et al. 1994) now lead us to propose another view of central Chilean archaeology. This understanding is more complex; it stresses the diversity in life styles and settlement patterns that seems to characterize the Pleistocene-Holocene transition.

El Manzano 1 is located on El Manzano stream, in the mountainous basin of

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the Maipo River at an elevation of 1150 masl. Its lowermost levels reveal occupations dated to the Pleistocene-Holocene transition. A sample of charcoal from stratum 6 returned an age of 9870 ± 250 RCYBP (Beta 70120), or 12,365–10,570 CALYBP ($p = 0.95$). Artifacts from this horizon are characterized by a low number of formal tools and an emphasis on expedient technology. Although we recovered evidence in the site of the last stages of lithic reduction on non-local fine-grained raw materials, none of the artifacts thus made was discarded there. All the tools recovered from this early horizon are endscrapers and planes simply made on coarse-grained local stones and discarded soon after use. Although the faunal assemblage is small and heavily deteriorated, it reveals a clear dominance of guanaco (*Lama guanicoe*). Other species identified include the vizcacha (*Lagidium viscacia*), a large rodent, and unidentified canids, possibly foxes.

Recent studies on Taguatagua (Núñez et al. 1994) reveal a component slightly later than the one previously reported by Montané (1968). This component, labeled Taguatagua 2, is dated to 10,190 ± 130 RCYBP, 9900 ± 100 RCYBP, and 9700 ± 90 RCYBP (Núñez et al. 1994:516–517; Núñez et al. 2001 table 1). It is characterized by specialized hunting technology (Fell pattern or "fishtail" points) in association with extinct fauna. This occupation has been interpreted (Núñez et al. 1994) as a Paleoamerican kill site within the relic Pleistocene environment of the Taguatagua basin.

Because the lower component of El Manzano 1 is contemporaneous with the Taguatagua 2 occupation and the assemblage and faunal associations are different at the two sites, we believe two economic patterns were present in central Chile between 10,000 and 9000 RCYBP. One is associated with the hunting of relic megafauna (Taguatagua 2); the other is associated with the hunting of modern species, especially guanaco (*Lama guanicoe*), far away from lacustrine basins (El Manzano 1). Another site of the same age as El Manzano 1 is located in the mountain basin of the Aconcagua River, north of the Maipo; Stehberg (1997, pers. comm.) is studying the Piuquenes Cave (32° 16′ S, 70° 16′ W), whose lower layers are dated to around 10,000 RCYBP with a modern fauna.

At present, it is unclear whether the two economic patterns discussed here correspond to different and coexistent cultural systems, or whether they result from the movement of the same cultural group between different ecological zones, such as the central valley and the mountain valleys. Because it is not possible to establish a relationship among these sites (e.g., by raw material circulation), we believe that the evidence currently available is more consistent with the coexistence of two different cultural systems (for an alternative interpretation see García and Labarca 2001; Núñez 2001).

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Eagles, Abalones, and Pre-Clovis Shell Middens on California's Channel Islands

Jon Erlandson, Torben Rick, Paul Collins, and Don Morris

In 1968, Phil Orr presented his case for pre-Clovis occupation of California's Northern Channel Islands. His evidence included fire areas and burned mammoth bones, some purportedly associated with stone tools, and several undated shell middens found in possible Pleistocene soils. Most scholars have been skeptical about Orr's "associations" of humans and mammoths, and ^{14}C dating of basal middens at SRI-1, -3, -5, -6, and -26 demonstrates that all date between about 7500 and 9300 CALYBP (e.g., Erlandson 1994; Erlandson and

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Rick 1999; Erlandson et al. 1999). What remains of Orr's claims for pre-Clovis occupation is vaguely described and undated inland localities on Santa Rosa Island where abalone shells were found in possible Pleistocene sediments. Orr (1968:55) argued that only humans could have transported such abalone shells and stated that, in all his years on the island, "I have investigated every eagle nest found and have never seen an abalone shell." Nonetheless, bald eagles, condors, and other birds native to the Channel Islands transport marine shellfish to nests or roosts away from the coast (Collins et al. 2000; Erlandson and Moss 2001).

In this paper we report on faunal remains collected from a bald eagle nest and midden located near Ferrelo Point, San Miguel Island, about 90 m above sea level on a rock outcrop about 150 m from the sea. Faunal remains were concentrated in the nest area and also widely scattered on the slope below. In 2000, we surface collected the entire area and excavated the nest, handpicking faunal remains and screening samples through 1/16-inch mesh. We recovered numerous shellfish fragments (including several whole abalone shells) and thousands of well-preserved bones from marine fish, sea birds, terrestrial mammals, and sea mammals. Although our analysis is ongoing, we provide a preliminary description of the shellfish and other faunal remains and discuss their implications for Orr's argument about the origin of abalone shells in Pleistocene deposits on the islands.

We recovered 185 shellfish specimens weighing 640.2 g. At least 25 shellfish taxa are represented. Abalones contribute over 93 percent of the shell weight, most of it from four large (13–14 cm long) black abalone shells. Also present are three species of mussel (2.5 percent), several limpets (2.0 percent), barnacle (0.5 percent), two sea urchins (0.5 percent), small gastropods (0.4 percent), chitons (0.3 percent), crab (0.2 percent), small clams (0.1 percent), and gooseneck barnacle (0.1 percent). Most of the shellfish, including the most abundant types, are common in Channel Island archaeological sites. Many of the smaller shells may be from the stomachs of fish or sea birds, but the large abalone shells clearly were transported to the nest by eagles, refuting Orr's statements to the contrary.

We also recovered over 1500 fish bones, primarily from rocky shore and kelp-bed species such as California sheephead, rockfish, cabezon, perch, and prickleback. These too are common in Channel Islands archaeological sites spanning the Holocene (Rick et al. 2001). The fish bones are extremely well preserved, with little evidence of eagle damage (i.e., puncture marks), suggesting that differentiating fish bones deposited by eagles and humans may sometimes be difficult. The most abundant faunal remains in the midden are from birds. In the first of 14 samples of avian remains analyzed, 540 bones and 31 marine species were identified, with cormorants, scoters, sooty shearwater, and rhinoceros auklet most common. Domestic sheep dominate the mammal remains, but a few California sea lion and elephant seal bones are also present.

Our study of the Cape Ferrelo eagle nest suggests that bald eagles transported large abalone shells, along with a variety of other marine faunal remains, from Channel Island coastlines to inland locations. This raises serious questions about Orr's (1968) assertion that only humans could have been responsible for abalone shells found in ancient terrestrial sediments on the islands. Our work also suggests that bald eagles can create middens that mimic those produced by humans in some important ways.

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Earliest-Holocene Tool Assemblages from Northern Florida with Stratigraphically Controlled Radiocarbon Estimates (Sites 8LE2105 and 8JE591)

Michael K. Faught, Michael B. Hornum, R. Christopher Goodwin, Brinnen Carter, and S. David Webb

Two sites in northern Florida have produced reliable radiocarbon determinations indicating earliest-Holocene ages for both side- and corner-notched projectile points and associated formal chipped-stone tools. Site 8LE2105 is a

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stratified site in Leon County, northwestern Florida, reported by R. Christopher Goodwin & Associates, Inc. as part of a CRM phase III mitigation project (Hornum et al. 1996). In addition to abundant debitage, the excavations produced 12 Bolen points (7 corner-notched and 5 side-notched), 4 Hendrix (side) scrapers, 4 unifacial adzes, and 2 fluted biface preforms in a single stratigraphic unit (Component III). The project was completed in 1995 and published as a limited distribution report in 1996. The artifacts are curated at the Department of Anthropology, Florida State University. Three radiocarbon ages average 9870 ± 40 RCYBP for this occupation (Table 1).

Table 1. Radiocarbon ages and pooled mean averages for 8LE2105 and 8JE591. Ages were first tested for chi-square contemporaneity, then averaged.

Site	Age (RCYBP) and sample number	Pooled Mean Average (RCYBP)
8LE2105, Component III	9,850 ± 50 (Beta 81467)	Average of 3: 9870 ± 40
	9,900 ± 60 (Beta 81468)	
	10,090 ± 70 (Beta 81469)	
8JE591, Page/Ladson Bolen Surface	9,930 ± 60 (Beta 58858), log above surface	Average of 4: 9958 ± 40
	9,950 ± 70 (Beta 103888), hickory nut in surface	
	10,000 ± 120 (Beta 21750), charred wood	
	10,000 ± 80 (Beta 058857), wood stake in surface	
	10,280 ± 110 (Beta 21752), "desiccated wood"	

Another site with earliest-Holocene age estimates for both side- and corner-notched points is the Page/Ladson site (8JE591) in the Aucilla River (Carter 2003; Dunbar et al. 1988, 1989). The submerged sediment bank at Page/Ladson is one of the deepest stratigraphic sections in the Southeast and includes both late-Pleistocene and early-Holocene sediments (Ellis et al. 1998). The stratigraphy at Page/Ladson contains a sealed occupational surface with Bolen notched points (both side- and corner-notched specimens), broken unifacial adzes, probable manuported rocks, and carved wooden stakes. Radiocarbon ages averaging 9958 ± 40 RCYBP for this occupation are shown in Table 1. A full report on early-Paleoindian evidence for this site is forthcoming (Webb pers. comm.); we draw attention here only to the earliest-Holocene age and co-occurrence of side- and corner-notched projectile points in a single stratum.

The fact that both side- and corner-notched points occur together in two stratigraphically secure and well-dated sites in Florida counters any previous assumptions of a sequential relationship between these varieties (i.e., side notching before corner notching). Similar radiocarbon ages for side-notched projectile points at Dust Cave in Alabama confirm the very early Holocene age of notched points in the Southeast (Driskell 1996). Given this evidence, to our knowledge notched points in the southeastern United States represent the earliest such artifacts anywhere in the New World.

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Below Folsom at Two Moon: Paleoamericans and Rockshelters in Wyoming's Bighorn Mountains

Judson B. Finley, Chris C. Finley, Marcel Kornfeld, and George C. Frison

In 2003 we reported a fragmented Folsom projectile point and an associated 10,000-year-old radiocarbon date from Two Moon Shelter, a rockshelter located in northwestern Wyoming's Bighorn Mountains (Finley et al. 2003). Such finds are rare in Paleoamerican research, but a handful of western North American rockshelters yield early artifacts or contemporaneous age estimates. This note supplements recent findings at Two Moon Shelter by reporting new information regarding a cultural level positioned stratigraphically below that bearing the Folsom artifact.

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Test excavations at Bighorn Mountain rockshelters utilize a detailed methodology designed to maximize information on both natural and cultural formation processes. In dense cultural deposits such excavation becomes a time-consuming endeavor, requiring at sites like Two Moon nearly 10 years to excavate completely a 1-by-2-m unit less than 1 m deep. The reward comes, however, in resolving issues where potentially important discoveries are found in stratigraphically complex situations.

Deposits in the 1-by-2-m unit at Two Moon have returned more than 32,000 pieces of Phosporia chert debitage, nearly 4,000 of which are plotted in situ. Owing to the sheer density of artifacts, distinguishing cultural levels during excavation is sometimes difficult. Approximately 1 to 2 cm of culturally sterile sediment separates the lowest component from the overlying Folsom level (Figure 1). Figure 1 demonstrates the relationship between the 10,060 ± 60 RCYBP date (Beta 164002), the Folsom projectile point fragment, and the lowest component. Whereas debitage from the Folsom level represents mid-stage bifacial reduction (few cortex-bearing flakes present and minimal bifacial thinning), the lower level bears a full range of debris from initial core reduction to biface finishing. Present are *outre passé* flakes, intentionally prepared to remove the margin opposite the striking platform, as well as possible blades.

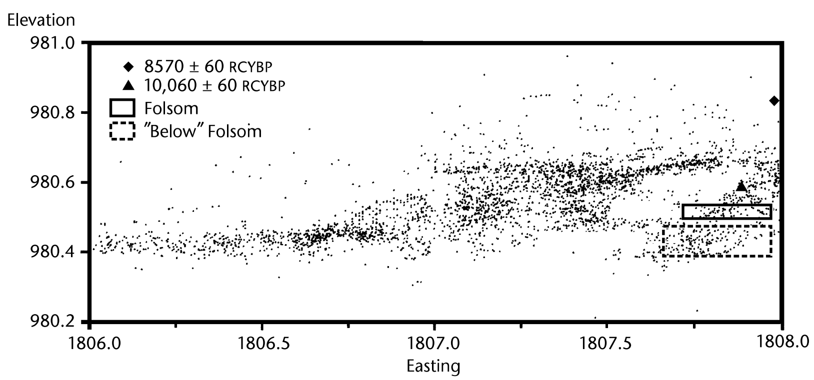

Figure 1. A two-dimensional artifact backplot demonstrating the association between the Two Moon Shelter 10,060 ± 60 RCYBP date (Beta 164002), the Folsom artifact, and the lowest cultural level.

Currently we cannot secure an age estimate for this lowest level, only to say that it is "below Folsom." A fragmented deer-size mandible is directly associated with artifacts, but as yet no age estimate is available. Until this becomes known, we are reluctant to assign cultural affiliation to Two Moon's lowest component. Although *outre passé* flakes are characteristic of Clovis manufacturing techniques, their presence alone is not enough to make this association since they may just as likely represent an older Folsom component. Most importantly, however, Two Moon represents an important addition to our understanding of Paleoamerican landscape utilization through repeated use of rockshelters for the express purpose of procuring toolstone.

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Late-Pleistocene Humans at Bonneville Estates Rockshelter, Eastern Nevada

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Bonneville Estates Rockshelter is located in eastern Elko County, Nevada, about 30 km south of Danger Cave and the city of Wendover, Utah. The rockshelter is approximately 25 m wide at its mouth, 15 m deep, and as much as 10 m high. Bedrock is Permian-aged limestone (Coats 1987). At an elevation of 1585 m, the rockshelter is associated with the high shoreline complex of Pleistocene Lake Bonneville, which last filled to this level around 15,000 RCYBP (Oviatt 1997). At 14,500 RCYBP, Lake Bonneville catastrophically downcut its outlet at Red Rock Pass and lake level dropped nearly 108 m. By 11,000–10,000 RCYBP the lake had receded to the 1300-m Gilbert Shoreline, so that it was at least 7 km from Bonneville Estates Rockshelter. Modern vegetation near the rockshelter is scrub desert dominated by shadscale and Mormon tea. Packrat middens from the area document the presence of a low-elevation limber pine–sagebrush parkland from 13,000 to 11,000 RCYBP, followed by a sagebrush-shadscale scrub 10,000–8000 RCYBP (Rhode 2000a, 2000b; Rhode and Madsen 1995). These data suggest that climate during the latest Pleistocene and early Holocene steadily became warmer and drier, but was cooler and more mesic than today.

T. Murphy and S. Dondero of the Bureau of Land Management's Elko Field Office discovered Bonneville Estates Rockshelter in 1986. In 1988 P-III Associates, Inc., conducted test excavations to evaluate the integrity of the rockshelter's cultural deposits. They exposed a well-stratified sequence spanning the last 6000 RCYBP (Schroedl and Coulam 1989). In 2000 we renewed excavations at Bonneville Estates; a major objective of our research has been

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to discern whether late-Pleistocene cultural deposits are preserved in the shelter's sediments. During the summers of 2001–2002 we exposed a sealed cultural component with diagnostic lithic artifacts, associated faunal remains, and a hearth ^{14}C-dated to about 10,100 RCYBP.

The latest-Pleistocene cultural component (Stratum A18) at Bonneville Estates Rockshelter occurs at a depth of about 140 cm below the modern surface. So far, an area less than 4 m^2 has been excavated of this component. Stratum A18 is an organic-rich band of silt with pebble-sized angular rock inclusions. Vegetable matter is not well preserved in this stratum, but small fragments of unburned shadscale are scattered throughout its matrix. A 30-cm-thick stratum of angular rubble (rockfall from the shelter's ceiling) seals the component and separates it from a series of well-stratified and well-preserved Holocene cultural components that span from about 7500 to 1000 RCYBP (Graf et al. 2002).

Lithic artifacts so far recovered from stratum A18 include 78 debitage pieces and 4 tools. Lithic raw materials are primarily obsidian; however, several basalt and microcrystalline quartz (i.e., chert) artifacts also occur. Biface thinning flakes dominate the debitage assemblage. The four tools include a large quartzite-cobble hammerstone, an obsidian biface fragment, and two obsidian stemmed-point fragments. The biface fragment appears to have the upper portion of a shoulder on one of its lower corners, suggesting that it may represent the blade of a large stemmed point. The two stemmed-point fragments include a basal fragment and midsection; both have heavily edge-ground margins. These stemmed-point fragments are similar in morphology and size to those that Bryan (1979) described for nearby Smith Creek Cave; we ascribe them to the Parman stemmed-point type (after Layton 1970).

Approximately 750 remains of fauna have been recovered from stratum A18. Many of these are from rodents (e.g., pocket gophers, packrats, mice), but a significant number are from leporids, medium- to large-sized mammals (some of which are burned), and birds. A total of 74 have been preliminarily identified into rough categories; these include 28 cottontail rabbit (*Sylvilagus* sp.), 1 hare (*Lepus* sp.), 11 leporid (cottontail or hare), 3 small ungulate, a large ungulate, 13 small bird, 11 large bird, and 6 bat. Many of the cottontail bones are from relatively young individuals, suggesting they were deposited during the early spring season, and the large bird bones appear to represent waterfowl. Further analysis of these remains is underway.

The stemmed-point fragments, lithic debitage, and faunal remains described above were found in association with an unlined hearth filled with charcoal and ash (Figure 1). The hearth was about 80 cm in diameter and as much as 15 cm thick. Sediment underlying the hearth was fire-reddened. Wood charcoal from the hearth has been identified as pine and sagebrush. Three samples of this charcoal yielded AMS ^{14}C ages of 10,040 ± 70 (Beta-170443), 10,080 ± 50 (Beta-164229), and 10,100 ± 60 (Beta-170444) RCYBP. These data indicate that the cultural occupation represented by stratum A18 at Bonneville Estates Rockshelter occurred at the end of the Younger Dryas, when lakes or marshes covered many of the valley floors of the Great Basin (Madsen 2002).

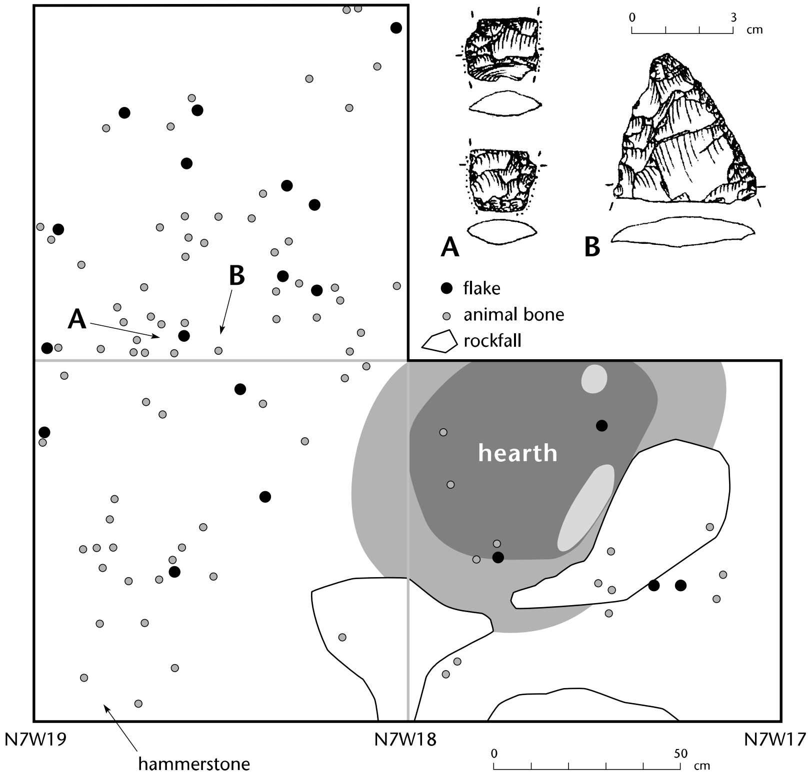

Figure 1. Floor of stratum A18 in Bonneville Estates Rockshelter, showing location of hearth and distribution of lithic artifacts and animal bones.

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Evidence of a Clovis Occupation at the Topper Site, 38AL23, Allendale County, South Carolina

Albert C. Goodyear and Kenn Steffy

The Topper site is a multicomponent prehistoric chert quarry and quarry-related habitation site located on a terrace-hillside of the Savannah River in South Carolina. It has been known to be a chert quarry since 1981, when a local resident named David Topper showed A. C. Goodyear and T. Charles the site (Goodyear and Charles 1984). In 1985 it was included as part of a suite of chert quarries mapped and tested for Allendale County and nominated to the National Register of Historic Places. At that time it was considered a probable Paleoindian site along with at least two other known Paleoindian quarries (Goodyear et al. 1985). Chert can been seen today eroding from the hillside overlooking the terrace as well as in a small creek bed. The chert is essentially all of one type as described in petrologic studies by Upchurch (1984), who has defined it as a member of the Allendale chert quarry cluster.

Test excavations conducted in 1984, 1985, and 1986 documented the stratigraphy and occupational history and explicitly searched for Paleoindian lithic materials. Work resumed there in 1998 as part of the Allendale Paleoindian Expedition. New discoveries in South America and Virginia between 1986 and 1998 prompted excavations in 1998 at Topper below what was thought to be the Clovis-age level. This resulted in the discovery of an unusual lithic assemblage located as much as a meter below the Clovis level associated with what is now known to be a Pleistocene floodplain (T2)

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(Goodyear 2001a, 2001b; Waters 2002). The upper meter of sediments, which contains a complete cultural sequence from Clovis to Mississippian, is colluvial in origin resulting from slopewash down the hillside (Foss 2002; Waters 2002). Based on OSL dating, this slopewash began to form about 15.2 ka yrs.; above that, in the base of the colluvium, an OSL date of 13.5 ka yrs was obtained (Forman 2002), which is Clovis in age.

Evidence of Clovis at Topper has been based primarily on the recognition of the typical transversely flaked and end-thinned biface preforms (Figure 1, A–F). The characteristic expanding blade margins are present even at an early production stage, yielding what Morrow (1995) has referred to as the "row-boat"-shaped preform. End thinning resulting in reverse hinge fractures is present; other preforms were ruined by *outre passé* errors. Until the 2002 season, these bifaces were found lightly distributed over the excavation area, making it difficult to recognize a spatially concentrated Clovis occupation. In

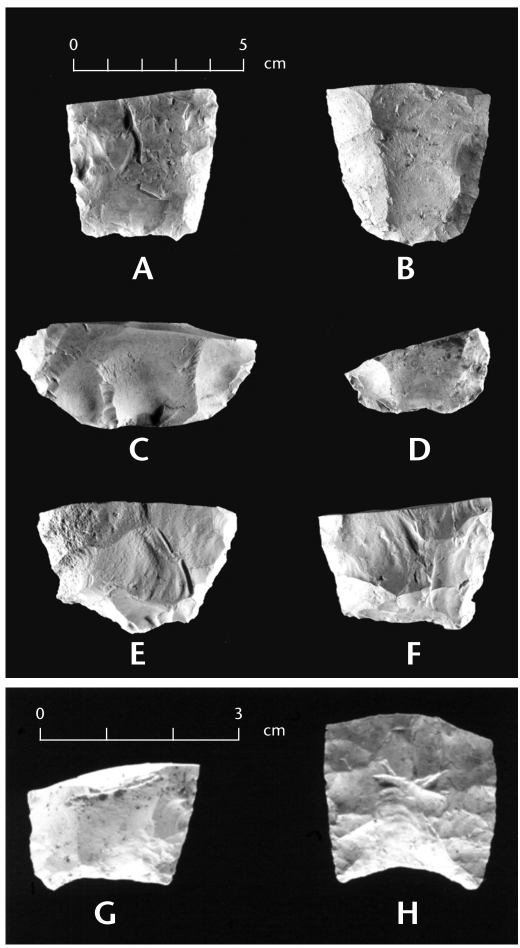

Figure 1. A–F, Clovis preforms in various stages; **G,** Clovis base; **H,** lanceolate point base. Photo by SCIAA-Daryl Miller.

2002, two different operations on the northern end of the site encountered dense cultural layers of obvious Clovis lithic technology (Goodyear 2002/2003), including the base of a Clovis point (Figure 1G). A second lanceolate base, found on the southern end in the 2002 block excavation, appears to be a basally thinned Paleoindian point (Figure 1H). It was found in what is normally the early-Archaic level; however, there appears to be some stratigraphic mixing between Clovis and early Archaic. No diagnostic post-Clovis Paleoindian points or even Dalton points have been found in 344 m^2 of excavation. It may be that early-Archaic Taylor people were walking on the previous Clovis land surface. This suggests that the sedimentation rate on the hillside was heavily influenced by quarrying and human foot traffic.

Clovis lithics recovered in 2002 from the northern end of the site are dominated by normal core reduction debris and also include numerous prismatic blades representing the initial production of blades and blade cores including bladelets (Goodyear 2002/2003). The presence of flake tools including unifaces indicates that other manufacturing activities were carried out in addition to flintworking. Excavation efforts in the 2003 season will concentrate on recovering more Clovis lithic technology from this dense zone.

We thank the Clariant Corporation, owners of the Topper site, for their interest and support in field investigations. The members of the Allendale Paleoindian Excavation who have helped gather this data are acknowledged, as well as several colleagues who have reviewed the Topper lithics, especially Julie Morrow, Dennis Stanford, and Mike Waters.

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Recent Application of Optically Stimulated Luminescent (OSL) Dating at the Nipper Creek Site (38RD18), South Carolina

Albert C. Goodyear, Steven L. Forman, and John E. Foss

The Nipper Creek site (38RD18) is a stratified, multicomponent prehistoric site with artifacts ranging in age from Paleoindian to Mississippian (Goodyear et al. 1986; Wetmore and Goodyear 1986). The site is located 15km northwest of Columbia, South Carolina, near the junction of Nipper Creek and the Broad River. Situated in the Carolina Slate Belt of the Piedmont Province, the site is unusual in that it was formed by mass wastage of sands from a granite pluton that invaded the Slate Belt rocks. A clear case of colluvial fan development can be recognized as the sand mantle thins going upslope (Colquhoun 1986).

Archaeological, geological, and pedological investigations from 1985 to 1988 revealed an intricate record of human occupation and landscape change contained within the upper 200 cm. In 2002, the site was revisited and sampled to evaluate the applicability of OSL dating in the predominantly sandy sediments and to determine the age of the basal sediments and their rates of deposition.

Archaeological data from a 1985 2-by-4-m unit (Wetmore and Goodyear 1986) and an adjacent 1986 3-by-4-m unit revealed well-stratified archaeological horizons. From ground surface to 30 cm, only occasional 18th-century artifacts and lithic flakes were found, indicating rapid sedimentation from historic plowing and erosion. At about 45 cm, a prominent late-Archaic midden (4500–4000 RCYBP) was present, grading into a late-middle-Archaic Guilford horizon (6000–5000 RCYBP) ending at about 62 cm. A stratigraphically discrete middle-Archaic Morrow Mountain horizon (7500–6000 RCYBP) was located between 60 and 70 cm. Between 80 and 90 cm, several early-Archaic corner- and side-notched points (10,000–8500 RCYBP) were found along with numerous well-made unifacial tools. Two Dalton points (10,500–10,000 RCYBP) were also found in this zone. From 90 to 100 cm, in the presumed Paleoindian level, occasional flakes of cryptocrystalline lithic material and unifaces were found. Excavations did not go below 100 cm because artifacts ceased to occur at this depth. No Paleoindian points have been excavated, although the base of a fluted point was found in the adjacent field, which was mined for sand. While charcoal fragments are present from 40 to 90 cm except for the late-Archaic level, ^{14}C dates were progressively too late by

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depth owing to natural and human disturbances from above (Goodyear et al. 1986:6).

As part of the original 1985 geology study, a 200-cm-deep soil peel was taken from an excavation wall (Colquhoun 1986). Lithologically, the entire profile is dominated by fine to medium sands. For soil morphology, there appears to be two phases of pedogensis: B horizons from 162 to 203 cm, separated by approximately 60 cm of unmodified sands, followed by a series of B horizons that began forming during the Paleoindian period (Table 1). Because of the archaeological sequence, the pre-Paleoindian sediments (below 100 cm) are suspected to be of unknown Pleistocene age.

Given pre-Clovis-age sites in South America and the eastern United States (Goodyear 2003), it is important to prospect for and identify landscapes containing sediment packages that date from 13 ka to 25 ka yrs ago. Thus the approximate lower half of the 2-m profile of Nipper Creek (which is not influenced by pedogenesis) was dated using an OSL method (Figure 1).

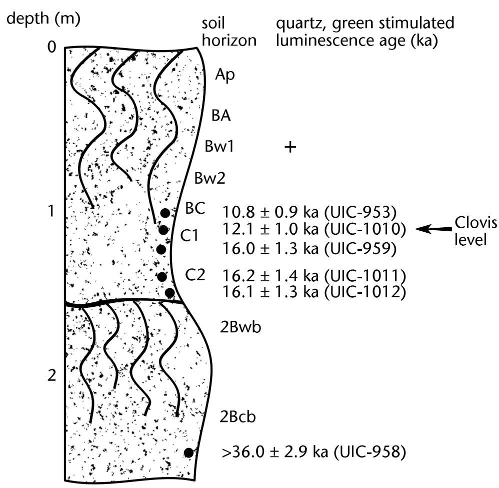

Figure 1. Stratigraphy at Nipper Creek site showing OSL dates listed in Table 1.

Specifically, 150- to 200-micron quartz grains were isolated for OSL dating by green light stimulation (GSL) using a multiple-aliquot approach (Forman and Pierson, 2002). Table 1 shows Forman's results. The GSL ages of 10,800 ± 900 yr B.P. (UIC953) and 12,100 ± 1030 yr B.P. (UIC1010) are close to the ages of artifacts known for those depths. The 12.1 ka date is a little below the suspected Clovis level but within one sigma of the accepted Clovis time of 13.1 ka. Moreover, there may be a 5- to 10-cm uncertainty in the vertical placement of the OSL sample in reference to the artifact-bearing horizons identified in 1986. OSL age increases to 15,980 ± 1340 yr B.P. (UIC959) from about 110 to 125 cm, with sediments yielding similar ages to 155 cm. Approximately 50 cm of sand that accumulated around 16.1 ka probably indicates a significant instability in the Nipper Creek hillside. A minimum limiting GSL age date of >35,700 ± 2900 yr B.P. (UIC958) was obtained below the lowest paleosol at 250 cm.

The Nipper Creek OSL dates are relevant to late-Quaternary studies and

Table 1. Multiple-aliquot regeneration ages under green (514 ± 10 nm) stimulated luminescence (GSL) for 100- to 150-μm quartz grains from colluvial sediments, Nipper Creek site, South Carolina.

Field number	Laboratory number	Equivalent Dose (Gy)	U (ppm)■	Th (ppm)■	K_20 (%)▲	Dose rate (Gy/ky)◗	GSL age (yr)
NP02-07	UIC953	35.07 ± 0.18	2.5 ± 0.4	6.4 ± 1. 0	2.76 ± 0.02	3.24 ± 0.16	10,800 ± 900
NP02-01	UIC958	98.73 ± 1.56	2.3 ± 0.4	8.6 ± 1. 0	2.24 ± 0.02	2.83 ± 0.14	>35,700 ± 2900
NP02-04	UIC959	53.52 ± 0.94	2.4 ± 0.4	5.0 ± 0.8	3.00 ± 0.02	3.35 ± 0.16	15,980 ± 1340
NP02-06	UIC1010	36.28 ± 0.42	1.8 ± 0.2	2.5 ± 0.5.	2.94 ± 0.02	3.00 ± 0.15	12,100 ± 1030
NP02-03	UIC1011	44.73 ± 0.62	1.8 ± 0.2	4.9 ± 0.7	2.46 ± 0.02	2.76 ± 0.13	16,190 ± 1350
NP02-02	UIC1012	44.12 ± 0.20	1.8 ± 0.2	4.2 ± 0.6	2.64 ± 0.02	2.75 ± 0.13	16,100 ± 1300

■ U and Th ppm levels calculated from alpha count rate, assuming secular equilibrium. Similar U and Th values.

▲ Percent potassium determined by ICP-MS on a homogenized 50-g aliquot by Activation Laboratories LTD, Ontario, Canada.

◗ Dose rate value includes a contribution from cosmic radiation of 0.16 ± 0.01 Gy/ka (Prescott and Hutton, 1994) and assuming a moisture content of 10 ± 3%. All errors are at 1σ. Analysis by the Luminescence Dating Research Laboratory, Univ. of Illinois-Chicago.

archaeology because they show plausible ages for early-Holocene archaeological records and can potentially be used as an alternative to ^{14}C dating when suitable organics are absent. In many sandy early-Holocene and late-Pleistocene deposits in the Southeast (cf. Ivester et al., 2001), OSL may be the only dating method possible; and a major late-Pleistocene erosional event has been identified at about 16.0 ka. A pollen study done 30 km northeast of Nipper Creek at White Pond (Watts 1980) showed that at 15,000–15,500 CALYBP the cold, dry, jack pine–dominated flora rapidly gave way to a mesic hardwood forest, implying greater precipitation. At Clear Pond located 175 km east, this same floral shift was dated at about 16,000–17,000 CALYBP (Hussey 1993). These changes coincide approximately with the 16.1 ka time of the erosional event at Nipper Creek.

We thank Chris Judge of S.C. Department of Natural Resources for arranging the backhoe work at the site. Funds for OSL dating were made available from the Elizabeth Stringfellow Endowment of the University of South Carolina.

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A Fluted Projectile Point Base from Yucca Mountain, Southern Nevada

William T. Hartwell and Kerry Varley

In October 2000, the Desert Research Institute (DRI) conducted archaeological monitoring of a previously recorded site on the Nevada Test Site (NTS) near Yucca Mountain in southern Nevada. This activity resulted in recovery of the basal section of a fluted point (Figure 1) from the center of a two-track dirt road. The site from which the point base was collected is a very dispersed

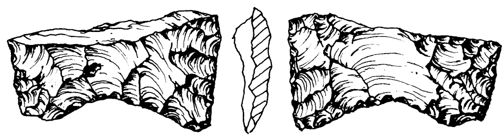

Figure 1. Fluted point base from Yucca Mountain in southern Nevada.

surface scatter of seven pieces of debitage located on a small saddle about 2½ miles east of the crest of Yucca Mountain. Lithic raw materials include a decortication flake and two core reduction flakes of tan chert and chalcedony, and four biface thinning flakes of a material known locally as "phenocrystic chert" (Buck et al. 1994:19). Artifacts are located within and adjacent to the road, and some exhibit edge damage attributable to vehicular traffic (cf. Gifford-Gonzales et al. 1985:815).

One face of the point is fluted while the other has several smaller basal thinning removals; an end-shock fracture occurs approximately 29.50 mm from the proximal end. The point fragment is 37.25 mm wide, although the lateral edges, which have been ground, gently expand and indicate greater width. Thickness at the point of breakage is 6.20 mm. Flake removals along the fracture are likely a result of damage from vehicular traffic. Although the point is made from tan chalcedony, it is of a different color and texture than the debitage present at the site.

Fluted points are rare on the NTS; only three others have been previously reported (Jones and Edwards 1994; Reno 1985; Worman 1969). Although the other fluted points occur in sites that contain significant Paleoarchaic point components representative of the Western Stemmed Tradition (Bryan 1980; Willig and Aikens 1989), their actual relationship, if any, to these assemblages remains unclear. However, differential material selection between the two technologies used to produce the points is apparent. Studies examining differential material use by Paleoarchaic and Paleoamerican traditions in the Great Basin (Amick 1993, 1995) show preference for obsidian in manufacturing stemmed forms, something especially true at the NTS, where nearly 90 percent are made from obsidian (Hartwell et al. 1996) in spite of the relative abundance

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of other potential toolstone resources. Fluted points reported for the NTS and southern Great Basin, however, are manufactured from cherts and chalcedonies, implying selection based on durability rather than sharpness.

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Clovis Projectile Points and Preforms in Nebraska: Distribution and Lithic Sources

Steven R. Holen

Myers (1987:67–68) reported on the distribution of fluted points in Nebraska, including 45 Folsom points and 19 Clovis points, although 20 Clovis points are shown on the accompanying map. Two later reports (Hofman et al. 1999 and

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Holen 2001) recorded 78 and 81 Clovis points and preforms, respectively. This study documents 79 Clovis points and 7 preforms from Nebraska, for a total of 86 artifacts. Most of the artifacts were recorded from private collections; about 20 percent of the sample were recorded from museum collections. Clovis points and preforms have been found in 34 of the 93 Nebraska counties (Figure 1). Significant gaps in the Clovis artifact distribution exist in northeast, north-central, and central Nebraska, and the southwest corner of the Panhandle. This uneven distribution pattern partially reflects intensive research with private collections in the southern part of the state. However, preliminary data suggest the density of Clovis artifacts in northern Nebraska is actually lower than in the southern region, a suggestion supported by the low density of Clovis points recorded in South Dakota (Hofman et al. 1999).

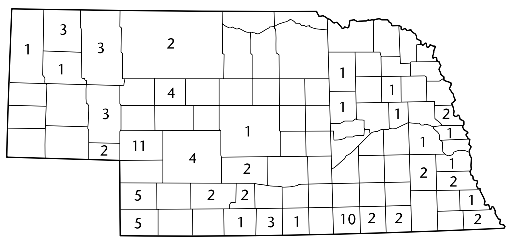

Figure 1. Distribution of Clovis projectile points and preforms in Nebraska.

White River Group chalcedony (WRGC), the most common lithic material, is represented by 16 points, or 18.6 percent of the sample. Flattop Butte in northeast Colorado, the nearest source of WRGC for most Nebraska artifacts, is also the primary source, as confirmed by neutron activation analysis of the Eckles Clovis assemblage of WRGC from north-central Kansas (Hoard et al. 1992, 1993). Smoky Hill jasper, outcropping primarily in south-central Nebraska in the Republican River drainage, is the second most abundant material with 12 artifacts (14.9 percent). Hartville chert from outcrops in east-central Wyoming, the third most abundant lithic material, accounts for 10 artifacts (11.6 percent). Pennsylvanian and Permian chert outcropping in eastern and southeastern Nebraska are tied for the fourth most common material, each represented by nine artifacts or 10.5 percent of the sample. Knife River flint from North Dakota (5 artifacts, 5.8 percent), and Alibates flint (4 artifacts, 4.7 percent) and Edwards chert (3 artifacts, 3.5 percent) from Texas are the most exotic lithic materials identified.

Eleven artifacts (12.8 percent) had been moved more than 600 km from the primary source area, and 27 artifacts (31.4 percent) had been moved more than 400 km. Myers's (1987) preliminary interpretation of Clovis adaptations based on lithic procurement data suggests low mobility for Clovis populations. A larger sample and more precise lithic identifications in this study suggest instead that high mobility was an important adaptation for Clovis populations on the central Great Plains, with lithic materials moving hundreds of kilometers in all directions (Holen 2001).

I would like to thank the many people in Nebraska who shared Clovis information from their collections and made this research possible. I would also like to thank Jack Hofman, who assisted in collecting this data on two long trips to western Nebraska and eastern Colorado.

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2002 Investigations at the Boca Negra Wash Folsom Site, North-central New Mexico

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For the second consecutive year, the University of New Mexico Southwestern Archaeological Field School was held at the Boca Negra Wash site, a small Folsom camp situated on the Llano de Albuquerque a short distance east of the Albuquerque Volcanoes. As described previously (Huckell and Kilby 2000; Huckell et al. 2001), this site consists of two spatially discrete loci—defined by surface and shallowly buried artifact concentrations—at the southern and southeastern margins of a playa. The 15 field school students excavated 45 1-m^2 units in Locus A. This completed a 5 percent random sample of a 600-m^2 section of the locus as well as 20 nonrandomly chosen squares to further investigate areas adjacent to particularly productive random sample units. An additional 26 units were excavated in Locus B, 7 as part of a nonrandom, patterned sampling program and 19 that were judgmentally placed. One new backhoe trench was excavated in the playa, and results of paleoenvironmental and chronometric age assessments of previously collected samples of playa sediments were obtained.

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The most notable result of work in Locus A was the discovery of what appears to be a specialized work area near the southeastern end of the locus. From an area measuring approximately 6 by 3 m came a complete endscraper, a multi-spurred graver, approximately half of a large, thin unifacially retouched flake, and 159 flakes. The bulk of the flakes (86, or 54 percent) were recovered from three contiguous 1-m units near the center of the excavated area; all are small and appear to be derived from uniface and biface retouching. The three tools were recovered in units 1–2 m from this debitage concentration.

Locus B continued to be productive. Surface exposure of Folsom artifacts, due in part to the drought of the past two years, suggests the size of this locus is greater—at least 80 m by 20 m—than previously appreciated. Two 1-by-2-m test units were dug in the vicinity of separate occurrences of Folsom point fragments up to 50 m west of the main area of excavations; both tests produced buried artifacts. The most important discovery, however, was the recovery of over 40 small pieces of tooth enamel, none larger than 10 mm in maximum dimension. A few represent lingual or buccal portions of cheek teeth, morphologically consistent with bison; the thickness of all fragments is also in the bison size range. With regard to their vertical distribution within excavated units, the enamel fragments mirror exactly the vertical distribution of the artifacts, suggesting they are potentially associated. We hypothesize that the enamel fragments represent the last vestiges of bison that were killed and processed around the southern edge of playa by the Folsom occupants of Locus B. Similar enamel fragments have been recovered from Locus A, although in smaller numbers. Locus B, and possibly also Locus A, may therefore represent short-term camps established after one or two successful kill events.

Two sediment samples collected in 2000 from the lower one-third of the playa fill were analyzed for phytolith and pollen preservation by Steven Bozarth. He found phytoliths to be abundant and well-preserved, and pollen present in low concentrations. An AMS ^{14}C date of 9540 ± 580 RCYBP (AA-46155) was obtained on bulk organics from a 2.5-cm-thick sample taken from the upper portion of a clay unit approximately 50 cm above the base of the playa: . This same unit is one of two shown to contain phytoliths and pollen. A second AMS radiocarbon date of 562 ± 34 RCYBP (AA-46156) was obtained on carbonized grass stem fragments picked out of an eolian sand deposit 1.5 m above the base of the playa and 0.4 m below the present ground surface. In addition, an OSL (optically stimulated luminescence) age of approximately 14,000 ka (UIC 914; 14,010 ± 2000 ka single-aliquot regeneration; 14,050 ± 900 ka multiple-aliquot regeneration) was obtained by Steve Forman from a sample of eolian sand immediately beneath the lacustrine muds. These assays demonstrate that lacustrine sediments began to accumulate in this particular basin a millennium or so prior to Folsom (roughly 12,300–12,900 CALYBP at 1σ; Taylor et al. 1996: Fig. 7) and that deposition continued at a slow but consistent pace until approximately 600 yr B.P. Together, these results show that this small playa can help to reconstruct the latest-Pleistocene and Holocene climatic and vegetative history of north-central New Mexico.

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Late-Pleistocene Human Occupations on the Semiarid Coast of Chile: A Comment

Donald Jackson S., César Méndez M. and Roxana Seguel Q.

Several locations in the semiarid territory in Chile have yielded the remains of extinct fauna, mainly the genera *Palaeolama* and *Lama* (Camelidae), *Cuvieronius* (Proboscidae), *Hippidion* and *Equus* (*Amerhippus*) (Equidae), *Antifer* and *Hippocamelus* (Cervidae), *Macrauchenia* (Macraucheniidae), and the orders Felidae and Canidae (Alberdi and Frassinetti 2000; Casamiquela 1969–70; Frassinetti and Alberdi 2000; Moreno et al. 1994; Tamayo and Frassinetti 1980). Even though these remains are not associated with artifacts, their existence suggests that systematic research is needed to find this kind of context. Theoretically, such evidence is predictable on the edges of Pleistocene pond formations and ancient river basins (especially at their confluences) and even under rockshelters.

The Los Vilos district (Choapa Province, ca. 31° S) is unique in Chile because it has an uninterrupted archaeological record from the late Pleistocene to historic times (Jackson et al. 1995, Méndez 2002). To date, the only accepted Paleoindian site in this semiarid region is Quereo (Montané and Bahamondes 1973; Núñez 1977, 1983; Núñez et al. 1983, 1994), located just a few kilometers south of Los Vilos, the main town in the district. The Quereo site was defined as a hunting and butchering location, and stratigraphic excavations identified a Paleoindian occupation with two segregated levels. In the lower level, several possibly contaminated wood samples yielded dates of 11,600 ± 190 RCYBP (N-2965), 11,400 ± 145 RCYBP (N-2966), 10,925 ± 85 RCYBP (SI-3391), 11,400 ± 155 RCYBP (N-2964), 11,100 ± 150 RCYBP (N-2963).

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These samples are associated with evidence of bone fractures and are considered suspect (Núñez et al. 1994). The second level, dated to 11,000 ± 150 RCYBP (N-2962), yielded evidence of native horse, mastodon, deer, extinct camelids, ground sloth, and other species associated with lithic artifacts and bones exhibiting a few cultural marks (impacts, cuts, and fractures) as a result of ephemeral processing activities (Núñez et al. 1994). Moreover, bone concentrations in the upper level suggest human behavioral patterns. Since climatic conditions were arid during both events, the Quereo ravine became an "oasis"- type ecological refugee (Núñez et al. 1983).

Recent research has investigated other possible nearby Paleoindian settlements. Particularly along the Los Vilos coast, a total of 14 sites including Quereo that have yielded extinct fauna have been mapped. At least four of these sites (El Membrillo, El Avistadero, Valle de los Caballos, and Lazareto ravine) exhibit surface associations between faunal remains and lithic tools. Another site, Las Monedas, presents two stratigraphic events with extinct fauna that are quite similar to those in Quereo.

Until recently, most archaeological research has been conducted at El Membrillo. In this surface context, two *Mylodon* sp. loci were identified, one of which is associated with a core and its flakes (refitted). Bones with fractures and at least one butchering mark were observed. A bone sample with enough collagen was radiocarbon-dated at 13,500 ± 65 RCYBP (NSRL-11081, Jackson 2002). A third locus, in a more disperse surface context, indicates another, yet undated event; items recovered include remains of *Palaeolama* sp. and native horse, clearly flaked bones, and lithic artifacts, such as a marginal sidescraper (Jackson 2002). Strong local wind deflation makes this context difficult to evaluate, especially associations with artifacts.

The semiarid coastal environment of Chile seems to have attracted human groups during the late Pleistocene. Even if the sites of Quereo and El Membrillo represent the first human activity in the area, the relationship between these initial populations and early-Holocene human adaptations that followed remains unclear. Current research at Los Vilos and other non-coastal nearby locations (FONDECYT project 1030585) holds promise of obtaining new information that will enhance our understanding of colonizing Paleoindian occupations like Quereo, later human adaptations, and their relation to paleoclimatic changes.

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The Eden Projectile Point Manufacturing Sequence at Hell Gap, Locality V, Wyoming

Edward J. Knell

Hell Gap Locality V contains a Cody-complex campsite where projectile point manufacture was an important component of the site activities (Knell 1999, 2004; Knell et al. 2002). The chipped-stone assemblage has a large sample of Eden projectile point preforms (n = 26) that provide insights into the Eden point manufacturing sequence (Figure 1), which I briefly describe here.

I assigned each preform a manufacturing stage based on technological variables and width:thickness ratios using Bradley and Stanford's (1987) seven-stage experimental Eden point manufacturing sequence as a guide. The experimental stages characterize the Locality V reduction sequence, although some variation occurs.

Stage 1 (n = 0) represents a tabular flake or flake blank, although no unmodified blanks suitable for manufacturing Eden points were recovered at Locality V.

Stage 2 (n = 5) represents initial thinning and shaping to create a parallel-sided biface free of major humps and ridges (Figure 1A). Knappers at Locality V selectively removed transmedial flakes with large, shallow flake scars and bending initiations, indicating a soft hammer (baton) was used to thin the

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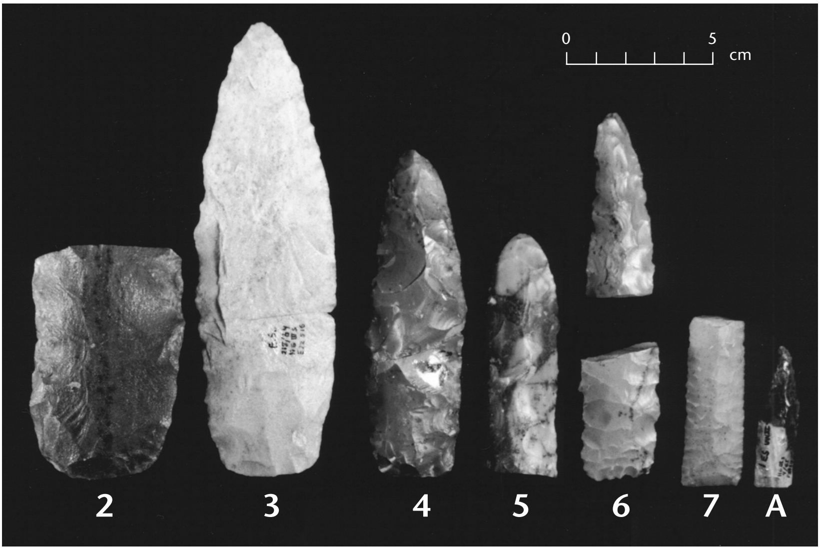

Figure 1. Composite of Eden projectile point preforms by sequential manufacture stage **2–7; A,** technologically complete, reworked Eden point.

preforms. The flake blank platform and bulb were removed by non-serial percussion flaking. One tip fragment was thinned by selective, transmedial percussion flaking and has a triangular plan view.

Stage 3 (n = 9) includes shaping preforms by selective percussion flaking (Figure 1B). Some tip segments at Locality V have transmedial percussion flake scars that thin and selective pressure flakes that shape the preform, with most flake scars approaching the midline. The basal segments, thinned and shaped by longitudinal and lateral percussion flakes, are rounded rather than square.

Stage 4 (n = 5) represents both serial percussion and pressure flaking (Figure 1C). The tip segment has the earliest evidence of serial comedial pressure flaking in the reduction sequence. The midsection and basal segments have serial percussion and pressure flake scars that approach the midline. The basal portions are thinned and shaped by longitudinal and lateral pressure flakes. The stem is square, but not refined like finished Eden points.

Stage 5 (n = 3) preforms depict a second sequence of serial comedial pressure flaking resulting in a centered ridgeline and parallel margins (Figure 1D). The emphasis was on shaping the preform outline.

Stage 6 (n = 2) represents a third sequence of serial comedial pressure flaking resulting in parallel margins and smaller, more evenly spaced flake scars along the entire preform (Figure 1E). The base is square and thinned by a series of short longitudinal pressure flakes.

Stage 7 (n = 2) represents a fourth sequence of serial comedial pressure flaking resulting in nearly finished Eden points (Figure 1F). Both Locality V specimens broke prior to receiving final touches such as ground stem margins and stem indentations. Locality V knappers possibly executed an additional sequence of comedial pressure flaking that accounts for the very fine pressure flake removals that occur between Stage 6 and 7, although direct evidence is lacking.

The Hell Gap Locality V preforms (1) represent the entire—or nearly entire—Eden point manufacturing sequence; (2) constitute one of only a few large collections of preforms from Cody-complex sites; and (3) demonstrate that the experimental sequence developed by Bradley and Stanford is a good model for archaeological assemblages.

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New AMS ^{14}C Data on the Paleolithic-Neolithic Transition in the Amur River Basin, Russian Far East: Late-Glacial Coexistence

Yaroslav V. Kuzmin, G. S. Burr, and A. J. Timothy Jull

Extensive geoarchaeological research was conducted in the Russian Far East during the last few years. Significant progress in ^{14}C dating of principal Stone Age cultural complexes in the Amur River basin and Primorye (Maritime) Region, compared with a previous study (Kuzmin and Jull 1997), has enabled

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us to establish more precisely the ages of sites belonging to the late upper Paleolithic (i.e., pre-pottery assemblages) and the initial and early Neolithic (i.e., pottery-containing complexes). Currently we have more than 30 solid ^{14}C values run predominantly on charcoal, using the AMS technique in most cases (Lab codes AA, GEO, and LLNL) (see Table 1).

Late-upper-Paleolithic complexes in the middle and lower streams of the

Table 1. Radiocarbon dates (material dated is wood charcoal).

Region	Site	Age (RCYBP)	Lab no.	Reference
Upper Paleolithic				
Amur River basin	Malyie Kuruktachi	14,200 ± 130	SOAN-3287	Kuzmin and Jull 1997
		13,815 ± 150	AA-13399	Kuzmin and Jull 1997
		13,310 ± 105	AA-13398	Kuzmin and Jull 1997
		12,485 ± 80	AA-17212	Kuzmin and Jull 1997
		12,010 ± 75	AA-23128	Jull et al. 2001
		11,730 ± 70	AA-17211	Kuzmin and Jull 1997
		11,355 ± 370	SOAN-3591	Jull et al. 2001
		10,520 ± 95	SOAN-3590	Jull et al. 2001
	Goly Mys 4	12,925 ± 65	AA-36277	Jull et al. 2001
		12,680 ± 65	AA-36278	Jull et al. 2001
		12,610 ± 60	AA-36279	Jull et al. 2001
		12,360 ± 60	AA-36281	Jull et al. 2001
		10,340 ± 50	AA-36280	Jull et al. 2001
Primorye	Suvorovo 4	15,900 ± 120	AA-36626	Jull et al. 2000
		15,340 ± 90	AA-36625	Jull et al. 2000
		15,300 ± 140	Ki-3502	Kuzmin et al. 1994
		15,105 ± 100	AA-9463	Kuzmin and Jull 1997
	Ustinovka 6	11,750 ± 620	SOAN-3538	Kuzmin and Jull 1997
		11,550 ± 240	GEO-1412	Kuzmin 1998
Initial and Early Neolithic				
Amur River basin	Gasya	12,960 ± 120	LE-1781	Kuzmin and Jull 1997
		11,340 ± 60	GEO-1413	Kuzmin 1998
		10,875 ± 90	AA-13391	Kuzmin and Jull 1997
	Khummi	13,260 ± 100	AA-13392	Kuzmin and Jull 1997
		12,425 ± 850	SOAN-3583	Kuzmin 1998
		12,150 ± 110	SOAN-3826	Lapshina 2002
		10,345 ± 110	AA-13391	Kuzmin and Jull 1997
	Goncharka	12,500 ± 60	LLNL-102169	Jull et al. 2001
		12,055 ± 75	AA-25437	Jull et al. 2001
		10,590 ± 60	LLNL-102168	Jull et al. 2001
		10,280 ± 70	AA-25438	Jull et al. 2001
		10,280 ± 70	AA-25439	Jull et al. 2001
		9,890 ± 230	GaK-18981	Jull et al. 2001
	Gromatukha	12,340 ± 60	AA-36079	Jull et al. 2001
		9,895 ± 50	AA-36447	Jull et al. 2001
Primorye	Chernigovka	10,770 ± 75	AA-20936■	O'Malley et al. 1999
	Ustinovka 3	9,300 ± 30	KSU-?	Garkovik 2000
	Pereval	8,360 ± 60	LE-1565A	Kuzmin and Jull 1997

■Date obtained on pottery temper

Amur River basin have existed since ca. 19,400 yr B.P. (Kuzmin et al. 1998), and the majority of sites, such as Malyie Kuruktachi and Goly Mys 4, correspond to the late glacial, ca. 14,200–10,300 yr B.P. (Table 1). In today's Primorye, the Ustinovka complex (Suvorovo 4 and Ustinovka 6 sites) dates between ca. 15,900 and 11,600 yr B.P. Initial-Neolithic complexes in the Amur River basin, such as Osipovka (Gasya, Khummi, and Goncharka sites) and Gromatukha, existed between ca. 13,000 and 9900 yr B.P. In Primorye, the earliest Neolithic complexes are significantly younger. The tentative age estimate of the plant fiber–tempered pottery from the Chernigovka site is ca. 10,800 yr B.P. Charcoal ^{14}C dates for the early-Neolithic sites of Ustinovka 3 and Pereval are ca. 9300–8400 yr B.P.

The wide variation in the earliest-Neolithic date series, up to 2000–3000 ^{14}C years (Table 1), may be explained by multiple site occupation episodes throughout millennia; charcoal dates show a broad range of ages. The earliest dates obtained from the lower part of the site profiles reflect the initial site occupation.

The Amur River basin currently has the largest collection of ^{14}C data available for studying the timing of the Paleolithic-Neolithic transition in the Russian Far East. In this area we have temporal coexistence of both late-upper-Paleolithic and initial-Neolithic complexes, with ^{14}C ages that overlap over the time interval ca. 13,000–10,300 yr B.P. (see Table 1). This period corresponds to the transition from upper-Paleolithic microblade technology to pottery manufacture (Kuzmin and Orlova 1998, 2000), with continuing use of microblades in the initial Neolithic (Derevianko and Petrin 1995). At this time, forest tundra and light larch-birch forests in the Amur River basin were gradually replaced by dark coniferous forests with an admixture of broad-leaved species (oak, elm, and linden). In Primorye, we observe a supplanting of the upper-Paleolithic Ustinovka culture bearers (ca. 11,000–10,000 yr B.P.) by the early-Neolithic population, rather than coexistence.

Thus the Amur River basin is an area that records the earliest Paleolithic-Neolithic transition in East Asia and in the entire Old World, along with Japan and southern China (Nakamura et al. 2001; Taniguchi 1999; Zhao and Wu 2000).

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Paleoindian/Archaic Transition Rock Feature

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Features are uncommon in the archaeological record for the early Holocene of North America. At the Skyrocket site (CA-Cal-629/630), located 40 miles east of Stockton, California, in the first tier of the Sierran foothills, we exposed a large concentration of stones measuring approximately 10 by 10 by 0.5 m, consisting of spent milling slabs, field stones, artifacts, and a large quantity of chipping waste. This feature was discovered approximately 200 cm below surface in a sealed deposit and was connected to a "finger" of bedrock that extended into an ancient marsh (Figure 1). Radiocarbon dates

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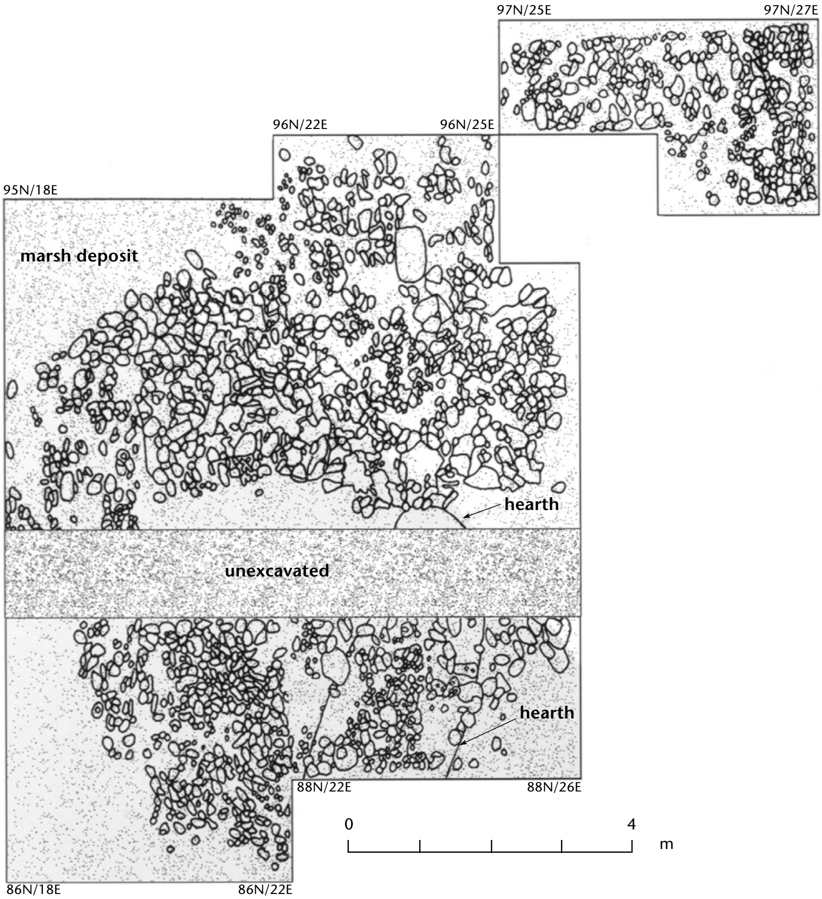

Figure 1. Skyrocket stone platform.

associated with this rock concentration range from 7000 ± 70 RCYBP (WSU 4616) on its surface to 9410 ± 250 RCYBP (WSU 4929) at its base. Stratigraphically sandwiched in the middle of the platform was a hearth dating to 8550 ± 150 RCYBP (WSU 4614). We have found no other references in the literature describing features of this size and complexity for the Paleoindian/Archaic Transition, which we believe raises some questions about hunter-gatherer mobility at that time.

The strata around the feature contained very few artifacts, whereas within this rock concentration there were 51 bifaces, with a density of 2.7/m^3, 114 hand stones (6.1/m^3), 408 milling slab fragments (21.9/m^3), 14,002 flakes (499/m^3), and 92 unifaces (5.0/m^3). The high concentration of chipping waste strongly suggests stone tool manufacture and reprovisioning took place there; the large accumulation of spent milling slabs suggests plant materials were also processed. The presence of a significantly large hearth (see Figure 1) argues *against* the feature simply being a refuse dump; moreover, it was used for a considerable length of time, two or more millennia. Throughout this period, this area appears to have been the focus of human activity, possibly representing a "favored location," and its level surface and circular shape argue that some effort was made to maintain it. The feature appears to have been intentionally built on a bedrock finger, which extended into a marsh fed by an artesian spring. It appears that the initial focus of activity was the bedrock finger, but over time the surface area was significantly expanded, possibly the result of the concentration of activities taking place there.

The properties of this feature suggest it was consistently used by a group of hunter-gatherers whose behavior better fits the model of "central based foragers" than of "wanderers" (Binford 1980).

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The Influence of Pleistocene Biogenic Excavations on Holocene Hydrology at the Hiscock Site (Western New York State)

Richard S. Laub

The late-Pleistocene horizon of the Hiscock site (Laub et al. 1988) contains a number of excavations in the surface of the underlying till and lake deposits that were subsequently filled in with fossiliferous Pleistocene gravel (the fibrous gravelly clay). The top of the Pleistocene layer is horizontal, and no Holocene material is found in the excavations, confirming that they are pre-Holocene in age.

These features (Laub 1998, Figs. 1, 2; Laub and Haynes 1998) have been attributed to the activities of mastodons (*Mammut americanum)*, whose remains are abundant at the site. On the other hand, Tomenchuk (in press) has suggested that Paleoindians excavated at least some of these hollows, expecting that fresh exposures of the mineral-rich water (McAndrews, in press; Ponomarenko and Telka, in press; Tankersley et al., 1998) would attract prey animals such as caribou (whose remains occur here) to the location.

An interesting aspect of these excavations is that they appear to have influenced site hydrology when Holocene springs were remobilized subsequent to a post-Pleistocene dry period. In excavation pit I5NE, a pod of spring sand about 40 cm in diameter was found in the basal 8 cm of the woody layer

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(a Holocene peat) (Figure 1). Holocene fossils occurred within this pod. Immediately below the pod lay the fibrous gravelly clay, a fossiliferous Pleistocene gravel. This unit proved to be much thicker below the sand pod than elsewhere in the pit. Once excavation was completed, it became clear that the stratigraphic basement on which the FGC lay had been dug out to a depth of about 55 cm below the immediately surrounding area. The hollow was roughly circular, about 200 cm in diameter, with a central steep-sided area 90 cm across and more gradual slopes beyond. Two parallel holes about 40 cm apart penetrated the steepest wall. Thus the Holocene spring sand pod lay directly above the Pleistocene excavation. Furthermore, within the fibrous gravelly clay filling the hollow, there was a downwardly narrowing cone of spring sand extending from near the top of the unit to near its base.

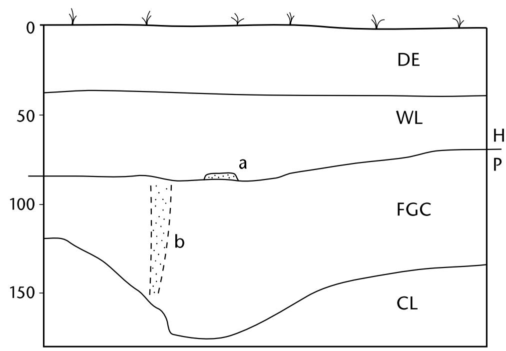

Figure 1. Vertical section parallel to the east-west gridline, showing the stratigraphy of the area described. Left half is in excavation unit I5NE, east half is in I6NW. Units represented are the Holocene (H) dark earth (DE) and woody layer (WL), both of which are peats, and the Pleistocene (P) fibrous gravelly clay (FGC) and cobble layer (CL). **A,** pod of spring sand; **B,** vertical cone of spring sand. Scale in cm, with no vertical exaggeration. The cobble layer consists of glacial till and lake deposits, the base on which the fossiliferous units were deposited. The hollow lies in the cobble layer, directly below the pod of spring sand (**A**).

The hollow lay within a channel-like feature in the basement surface. This suggests that someone or something made the excavation in a low area where water might be expected to lie beneath the surface during a dry period. The bioturbated and recycled nature of the fibrous gravelly clay (Laub in press) has obscured the surface from which the hole was dug. Later in the Pleistocene, the hollow filled in. The disturbed basement sediment subsequently provided a relatively permeable vent for a Holocene spring. The same phenomenon was connected with a second hollow at the site (Laub 1998, Figs. 1, 2).

Earlier, it was reported how a Holocene tree-fall at Hiscock affected the Pleistocene record (Laub 1996). It is interesting that the present case is the inverse of the other: a Pleistocene event affecting the Holocene record.

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Stratigraphic, Chronometric, and Lithic Technological Evidence of Late-Pleistocene and Early-Holocene Occupations in the Middle Magdalena River, Colombia, South America

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The Magdalena River is the most prominent corridor through the Andean mountains in northern South America. Surveys conducted along its middle sector revealed preceramic occupations in stratified contexts. Initially a dozen sites were located during CRM projects (ICAN-ODC 1994, López et al. 1998). Lithic assemblages from surface collections and test excavations are characterized by both bifacial and unifacial technology. Radiocarbon dates on

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associated charcoal place the earliest occupation in the 11th millennium B.P. (López 1998).

Six open-air campsites, situated in scattered Pleistocene/early-Holocene terrace remnants of an old alluvial floodplain (ca. 150 masl) or in small tributary valleys of the Magdalena system, were tested with small excavations. Early cultural materials are found buried in alluvial terraces in the Bt horizon from ca. 40 cm to 80 cm below the present ground surface (López et al. 1993). A tightly clustered series of radiocarbon dates place the earliest occupations in the region in the late Pleistocene. At present the older dates come from the lower cultural layers of the sites of La Palestina (05YON002)—10,400 ± 90 RCYBP (Beta-40855), 10,230 ± 90 RCYBP (Beta-40854), 10,260 ± 70 RCYBP (Beta-123565), and 10,300 ± 70 RCYBP (Beta-123566); San Juan de Bedout (05PBE014)—10,350 ± 90 RCYBP (Beta-40852); and Nare (05PNA005)—10,350 ± 60 RCYBP (Beta-70040) and 10,400 ± 40 RCYBP (AMS Beta-146798).

Raw material is abundant, particularly chert and milky quartz cobbles. Thousands of waste flakes, many the product of bipolar flaking, were recovered as well as a number of expedient tools made on flakes. Other tools were fashioned from large flakes by unifacial and bifacial retouch. Bifacially flaked points vary considerably in size (4–16 cm long) and shape, although triangular contracting stemmed forms are the most common (Figure 1). Biface edges were reduced using controlled percussion and, in the very final stage, pressure retouch. In all, 100 plano-convex scrapers have been recovered that are remarkably uniform in size and shape (López 1998, 1999; López et al. 1998, 2001).

Geoarchaeological evidence suggests that early inhabitants camped around beaches and islands and near streams and swamps. Lithic workshops supported hunting activities and faunal preparation. At present there are no megafaunal findings. They probably speared aquatic mammals (manatee), riverine fauna (fish, caiman, turtle), and middle-sized terrestrial mammals (López et al. 2001, Otero et al. 2002). With a number of stratified early sites already identified, further research in the middle Magdalena region can be expected to make a significant contribution to the study of early human adaptations to lowlands tropical environments (Cooke 1998; Dillehay 2000; López 1998).

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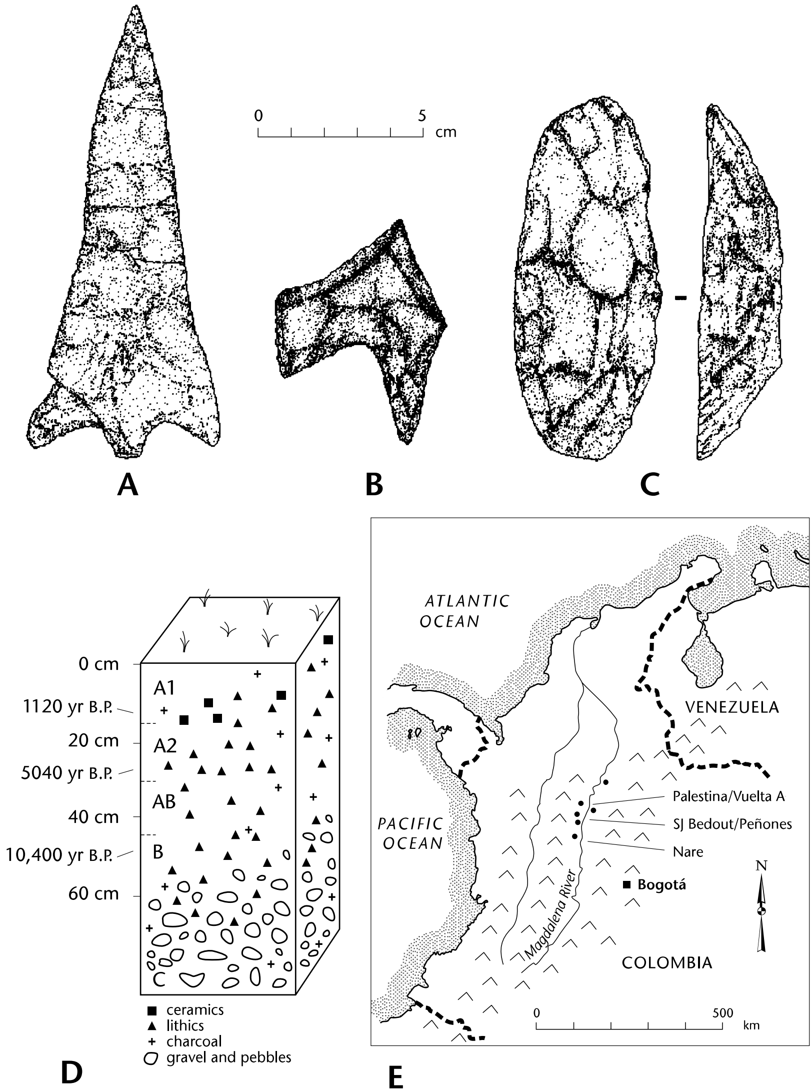

Figure 1. **A,** stemmed point (surface); **B,** excavated basal fragment from Peñones site; **C,** scraper from Nare site; **D,** stratigraphy, Nare site; **E,** main middle Magdalena early sites.

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Ontolo (8JE1577): Another Early-Prehistoric Site Submerged on the Continental Shelf of NW Florida

Brian S. Marks and Michael K. Faught

Ontolo (8JE1577) is one of 39 submerged prehistoric sites now known on the continental shelf of NW Florida (Faught 1996; Faught et al. 1992; Faught n.d.; Marks 2002). The site is located approximately 9 km from the mouth of the modern Aucilla River, in approximately 5 m of seawater, along the western margins of the paleo-channel of the Aucilla River (*PaleoAucilla*). Based on the number of artifacts observed during initial surveys, it is one of the densest submerged prehistoric human occupation sites encountered offshore so far (Marks 2002; Tabón and Pendleton 2002). The collections include artifacts diagnostic of late-Paleoindian (Figure 1A and B) and middle-Archaic age (Figure 1C–J), suggesting at least two different occupation periods.

The extent of the artifact array is more than 120 m east-west and over 110 m north-south. The area is covered with marine biota and biogenic (shelly) sand. Patches of very low relief rocks (<5 cm) are frequent. The natural margins of the site are defined on three sides by sea grass and a sandy plain on the west side. Subbottom profiler remote sensing has revealed several areas near the site where karst depressions with preserved sediment beds may exist, and survey operations have indicated other large artifact clusters nearby.

Initial surface collections at Ontolo produced several diagnostic artifacts (Figure 1). Of the artifacts collected, 20 percent are tools (n = 103), including 38 bifacially flaked tools and 36 unifacial tools (Marks 2002). Expedient tools are also frequent (n = 21); these include flakes with side and end use wear, notches, and spurs. Eight cores make up 7 percent of all tools. Cortex coverage on the artifacts is very low, indicating materials were transported to the site from elsewhere (Marks 2002).

Ontolo is a surface array of chipped-stone artifacts that has been untouched by humans for thousands of years, essentially since the site was completely submerged sometime after 5,000 years ago (Faught and Donoghue 1997).

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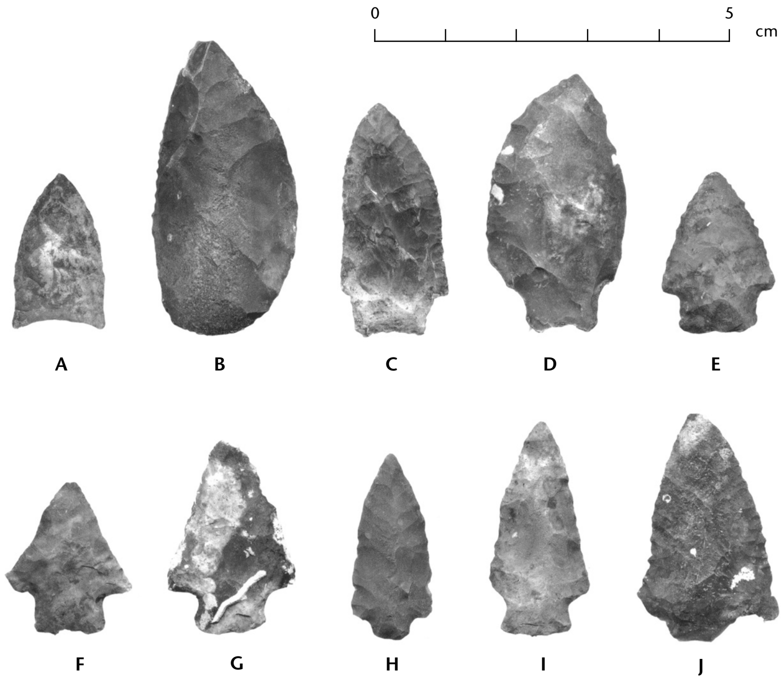

Figure 1. Diagnostic chipped-stone tools found at Ontolo 8JE1577; **B** is unifacial.

Additional work is planned at Ontolo to determine the depth and character of any preserved sedimentary deposits at the site.

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Buried Dalton Occupation in the Upper Alabama River Valley, Autauga County, Alabama

Scott C. Meeks, Sarah C. Sherwood, and Kandace D. Detwiler

The Pearson site (1Au397) lies in the upper Coastal Plain approximately 25 km west of Montgomery in south-central Autauga County, Alabama (Figure 1). The site was initially recorded and evaluated during compliance work by the University of Alabama, Office of Archaeological Research (OAR) (Meeks 2001). Subsequent archaeological mitigation involving a .62-ha portion of the 1.8-ha Pearson site by OAR resulted in excavating 604 m^2 of deposits, producing evidence of 12,000 years of human occupation at the site (Meeks et al. 2003). The earliest deposits include a relatively discrete Dalton occupation directly overlying Pleistocene gravels. Such a multicomponent site with Pleistocene/Holocene transition archaeological materials had yet to be reported for this region. The investigation included detailed lithic, archaeobotanical, and geoarchaeological analyses.

The Pearson site, located on the north bank of the Alabama River, is situated along the backside of a dissected Pleistocene terrace overlooking a backwater swamp associated with Bear Creek, a major tributary of the Alabama River. Today the local Pleistocene terraces are discontinuous and segmented, with the local soils mapped as Quartzsipsamments formed in Pleistocene overbank deposits reworked by eolian processes. Sites in these sand-rich depositional environments are often dismissed as mixed, with poor context. While geoarchaeological analyses identified wind-sorted sediments throughout the stratigraphic sequence, geochemical and artifact spatial and size data all suggest nominal vertical mixing of the cultural components.

The deepest archaeological deposit at the site contains Dalton points and uniface tools in a 20- to 30-cm-thick yellowish brown mixed sand, ca. 60–90 cm below ground surface. Directly underlying the Dalton zone is a zone of concentrated rounded gravel most likely related to the late-Pleistocene formation of the terrace sequence (Szabo 1973). Significant increases in total phosphorus and organic carbon in the Dalton zone suggest a buried surface that most likely formed as the terrace stabilized during the Pleistocene/Holocene transition. Although there are no radiocarbon results yet, the timing of the Dalton occupation above the gravel deposit indicates deposition of these gravels probably occurred no later than ca. 10,500 RCYBP. By this time the Alabama River was entrenched at an elevation of 12–

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14 m below the site and was no longer contributing overbank deposits to the terraces on the north side of the river. Subsequent eolian reworking of the Pleistocene alluvium, along with limited overbank deposition from Bear Creek, buried the Dalton artifacts and subsequent cultural components.

The Dalton occupation contains an impressive assemblage of 259 chipped-stone tools including 12 Dalton points, 180 bifaces, 23 formal unifaces (scrapers and blades), 33 expedient flaked tools, and 21 cores (Figure 1). The co-occurrence of the formal unifaces with Dalton points at the site is consistent with other reported late-Paleoindian and Dalton sites in the Southeast and Midwest (Daniel and Wisenbaker 1989; DeJarnette et al. 1962; Goodyear 1974; Meeks 1994; Morse 1997). Most of these tools were produced on locally available material including quartzite (83 percent) and Knox chert (3 percent). Nonlocal raw materials include Tallahatta quartzite (5 percent) from south-central and western Alabama and Coastal Plain chert (5 percent) from southeastern Alabama. The remaining nonlocal materials (4 percent) consist of Bangor chert, Conasauga chert, and Ft. Payne chert from northern Alabama. Raw material frequencies for the debitage follow similar patterns displayed by the stone tools, although quartzite exhibits a slightly higher frequency (93 percent, n = 54,874), and the total of nonlocal materials drops to a combined 5 percent.

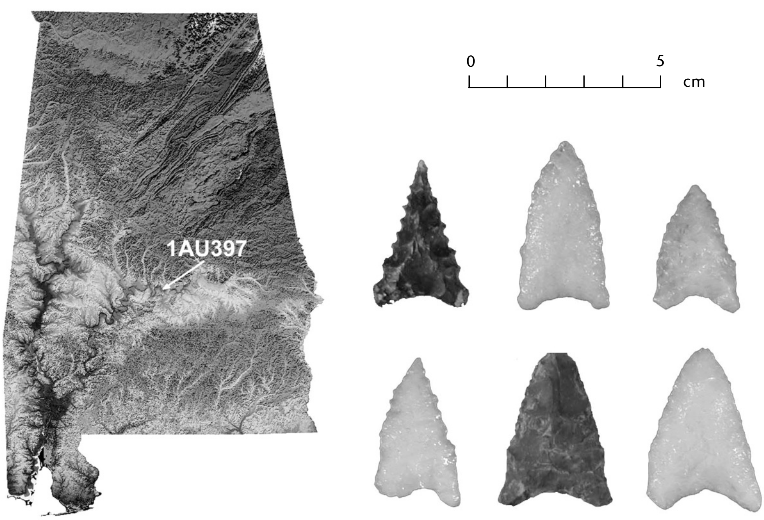

Figure 1. Location of the Pearson Site (1Au397) in the upper Coastal Plain of Alabama and selected Dalton points from the excavations.

In addition to the stone tool assemblage, two rock clusters (hearths) composed of heat-altered quartzite cobbles are associated with the Dalton occupation. Botanical analysis shows that the samples are dominated by nutshell, primarily hickory (n = 265, 2.49 g), with one fragment of acorn shell and cap. If one assumes that the inhabitants of the site did not employ storage strategies, then the botanical data support late-summer and autumn occupation of the site. The evidence of nut exploitation at the Pearson site supports the view that late-Paleoindian subsistence economies in the Eastern Woodlands were more generalized and similar to traditional Archaic patterns (Kuehn 1998; Meltzer and Smith 1986; Walker et al. 2001).

In sum, the archaeological investigations at the Pearson site demonstrate the presence of relatively intact, buried archaeological deposits in the Upper Alabama River Valley dating to the Pleistocene/Holocene transition. The excavations highlight the presence of a stratified site containing a Dalton component in unconsolidated sandy soil. The absence of other intact early sites reported in similar depositional environments in the region suggests that these sites are overlooked or prematurely dismissed for reasons of poor context.

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Reassessing Archaeology of the Lakebed Locality, Pleistocene Lake China, California

Steven Moore, Denise Jurich, and Mark E. Basgall

This brief paper outlines ongoing research at the "Lakebed" locality first investigated between 1969 and 1974 by Emma Lou Davis. This work is summarized in her monograph (1978) on the archaeology and paleontology of Pleistocene Lake China (PLC). Surface collections, stratigraphic trenches, and occasional excavations were made at 16 irregular-shaped grids ("Stakes") positioned at the 2175-ft elevation of the basin; grids were positioned where materials were most dense rather than with an intent to explore more intact geomorphic contexts. Observing differential levels of artifact weathering and seeing evident spatial correspondences among old landform features, artifacts, and fossil bone, Davis concluded that occupants of these locations exploited Pleistocene animals including mammoth, horse, and camel as much as 45,000 years ago. Many archaeologists were skeptical of some of these claims and thereby unfortunately contributed to a research hiatus of more than 25 years. The PLC record was assumed to be strictly surficial, with no potential for building resolved assemblages or harboring buried deposits.

Intended as one part of a broader reassessment of the early prehistory of PLC (see Basgall, this volume), work at the Lakebed locality has so far had two primary goals: (1) to establish precise geospatial controls for the grid locations and stratigraphic trenches worked by Davis a quarter century ago; and (2) to reclassify and further analyze archaeological and paleontological materials recovered during the earlier investigations. These are seen as essential to any further excavation at the Lakebed locality itself and to any complete understanding of late-Pleistocene/early-Holocene land use in the general region.

Remapping efforts at the Lakebed locality have been facilitated by the fact that Davis marked most grid datum and corner locations with rebar sections or large steel stakes; smaller nails denote the location of specific artifact or feature exposures. These markers have largely survived intact, and a systematic reconnaissance program was able to relocate the exact positioning of most collection grids or stake areas. Modern GPS technologies have been used in conjunction with laser-assisted mapping stations to fix the vertical and horizontal position of all identified collection and backhoe trenching locations. Concurrent efforts made to map the distribution of paleosol exposures across the grids, what Davis termed "flaggy sandstone," seems to show correlation with the dispersion of both artifact and fossil remains. These offer a basis for predicting where intact sediment profiles may exist.

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As outlined in the companion piece (Basgall, this volume), sleuthing has shown that documentation, artifacts, and paleontological remains generated by Davis reside at several facilities and institutions. To date, emphasis has been on organizing field notes and recataloguing the artifacts in an electronic format according to standardized analytical classes. Idiosyncracies in typological treatment, raw material designations, and general descriptive procedures have made it impossible to determine precisely which archaeological implements came from specific grid/stake areas. Artifact counts provided in the original publications (Davis 1974, 1975, 1978) are of limited utility because classification procedures were unstandardized and many tools remained unrecognized in associated debitage samples.

Table 1 lists artifact totals from the recataloguing effort according to grid location; the ARC (Archaeological Research Center) row reflects isolated artifacts encountered across the broader Lakebed locality in the course of the recent remapping program. Space limitations preclude discussion of these data, but several issues warrant comment. Projectile points in this sample include 45 Great Basin concave-base (cf. fluted) forms, 59 Great Basin stemmed, six Pinto, and two late-prehistoric Rose Spring–series variants. Bone counts are extremely underrepresented, since paleontological specimens are housed at a separate institution and have yet to be consolidated. Finally, Davis identified many items labeled “cobbles” as artifacts, possibly tools used for processing plants; inspection of the items shows them to be highly weathered, lacking obvious modification, but occurring in an extralocal geological context. Some number likely represent tools of uncertain use.

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Table 1. Composition of Recatalogued Collections from the Lakebed Locality.

	PRO	CRC	BIF	FFT	SFT	COR	CTL	DEB	HND	BST	COB	BON■	Total
Stake 1	15	-	12	10	10	-	-	401	-	1	-	-	449
Stake 7	1	-	3	20	2	1	-	90	-	-	1	-	118
Stake 8	6	2	17	22	13	1	1	397	-	1	-	-	460
Stake 8NE	2	-	2	4	2	-	-	266	-	-	-	10	286
Stake 9	6	1	23	32	5	7	-	427	1	2	5	2	511
Stake 10	7	3	15	22	4	3	-	500	-	-	2	-	556
Stake 13	3	11	19	42	8	3	-	499	-	1	3	-	589
Stake 19	6	6	11	13	4	2	1	309	-	-	2	1	355
Stake 19SW	1	2	3	9	-	2	-	247	1	-	25	-	290
Stake 22	2	1	12	23	7	4	1	368	-	1	7	-	426
Stake 24	24	5	58	54	25	7	-	1541	-	-	-	-	1714
Stake 25	12	3	25	32	6	-	-	479	-	1	10	-	568
Stake 25NW	9	4	28	29	6	1	-	825	-	3	36	2	943
Stake 25U	-	2	10	14	5	3	-	356	-	-	7	511	908
Stake 26	-	-	2	5	-	1	-	41	-	-	-	-	49
Stake 27	-	1	2	3	-	-	-	13	-	-	-	3	22
ARC	28	11	3	-	-	-	1	-	-	-	-	29	72
Total	122	52	245	334	97	35	4	6759	2	10	98	558	8316

PRO projectile point
CRC crescent
BIF biface
FFT formed flake tool (scraper)
SFT simple flake tool (edge-modified flake)
COR core
CTL core tool
DEB debitage
HND handstone
BST battered stone (cobble tool)
COB cobble
BON bone
■ counts reflect only that bone in the Maturango Museum collections; much more material is housed at Los Angeles Museum of Natural History
ARC materials collected by the Archaeological Research Center, California State University, Sacramento.

Solving Lund's Dilemma: New AMS Dates Confirm That Humans and Megafauna Coexisted at Lagoa Santa

Walter A. Neves and Luís B. Piló

In September 1843, following 10 years of intensive explorations in hundreds of caves in the Lagoa Santa karst, central Brazil, the Danish naturalist Peter W. Lund undertook extensive paleontological excavations in one chamber of Sumidouro Cave. Based on his findings at Sumidouro (human bones associated with bones of extinct mammals), Lund posed a daring hypothesis for his time: man was present in the Americas since the terminal Pleistocene and coexisted with the now-extinct megafauna (Lund 1844).

Trained under Cuvier's catastrophist school of thought, Lund himself paid a high personal price for having reached, reluctantly, the conclusion that man and extinct animals once lived together in the savannas of central Brazil: he never explored any additional caves after his diggings at Sumidouro, and he suddenly stopped his frenetic written scientific production (Neves 1997).

Few scientists supported Lund's hypothesis during his life (Quatrefages 1880; Reinhardt 1888). The main criticisms raised against his "coexistence" thesis derived from the fact that Sumidouro Cave is periodically flooded by the water of an adjacent Doline Lake through a very active swallet. This frequent water inflow could have disturbed the original sediments and redeposited animal and human bones originally accumulated at very different times (Hansen 1888; Hrdlička 1912; Kate 1885; Lacerda and Peixoto 1876; Lütken 1883; Rivet 1908). Lund also posited that the similar degree of fossilization of the animal and the human bones found at Sumidouro lent support to the idea that both assemblages were accumulated at similar times. However, since recently deposited animal bones in the cave also presented a high degree of fossilization, this evidence was also criticized by his contemporaries and immediately after his death in 1880 (Hrdlička 1912; Lacerda and Peixoto 1876).

All archaeological or paleontological research carried out in Lagoa Santa after Lund's death was oriented to solve the "coexistence" hypothesis, including the professional excavations that have been undertaken in the region since the 1950s. So far, only questionable pieces of evidence supporting Lund's original hypothesis have been found. Walter et al. (1937) found, between 1933 and 1935, a human skeleton (Confins Man) associated with remains of *Equus neogeus* and *Haplomastodon waringi* 2 m below a stalagmite layer at Lapa Mortuária de Confins. Since no reliable stratigraphic control was adopted in this pioneer operation, most specialists have not accepted this evidence as confirmation of Lund's hypothesis (Prous 2002). In Lapa

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Vermelha, another important archaeological site located in the Lagoa Santa Karst, Laming-Emperaire (1979) found bones and dung of a ground sloth (*Catonyx cuvieri*) in deposits dated by associated charcoal to 9580 ± 200 RCYBP (GIF-3208). The human occupation at this site seems to extend back to the terminal Pleistocene (Prous 2002).

The finding of the now famous "Luzia" skeleton (whose bones do not contain enough collagen to be directly dated) at levels estimated between 11,000 and 11,500 RCYBP (Laming-Emperaire 1979; Prous and Laming-Emperaire in press) is considered the best indirect evidence to support the "coexistence" hypothesis in Lagoa Santa. However, the diggers failed so far to establish a clear association between the extinct animal remains and the hearths and lithics found at the same site (Laming-Emperaire et al. 1975; Prous 2002). A *Haplomastodon waringi* iliac bone claimed to exhibit cut marks was identified by A. Bryan in the 1970s amidst the Harold Walter paleontological collection housed at the Natural History Museum of Federal University of Minas Gerais. Bryan suggested that a fragment had been removed from this bone for use as raw material to produce tools (Prous 2002), but independent analysis undertaken on the same material has questioned the human nature of these "cut marks" (Prous 2002).

In order to solve Lund's dilemma, we collected more than 50 samples of extinct megafauna bones from several different Lagoa Santa sites explored by Lund (material housed at the Zoological Museum of the University of Copenhagen–ZMUC) and by other specialists (material housed at the Natural History Museum of the Federal University of Minas Gerais–MHN). Seven of these samples were submitted for AMS dating and collagen dated (Table 1). Two of these samples (Beta-165398 and Beta-174722) produced early-Holocene dates compatible with the antiquity of human presence in Lagoa Santa. A human bone collected by Lund at Lapa do Braga (Beta-174736), which was also recently dated by us (Table 1), and the terminal Pleistocene date we generated for the first human occupational level at Lapa das Boleiras (Beta-168451) strongly suggest that humans and megafauna coexisted at Lagoa Santa, as Peter Lund originally proposed in 1844.

The relationship between the first humans to arrive in Central Brazil and the extinct megafauna is still a pending matter. After almost 150 years of intensive excavations at Lagoa Santa and elsewhere in Brazil, no evidence has been generated that Paleoindians used the megafauna as food or as source of raw materials (Kipnis 1998; Roosevelt et al. 2002). It is now clear, at least at Lagoa Santa, that these large animals were still available for exploitation by the local Paleoindians if desired. Their absence in the local early food and raw material repertoires was not a matter of unavailability but of cultural choice.

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Table 1. Recent obtained dates for extinct megafauna and human cultural and biological remains from Lagoa Santa.

Site	Sample	Lab. no.	Species/material	Measured ^{14}C age (RCYBP)	$^{13}C/^{12}C$ Ratio (‰)	Conventional ^{14}C age (RCYBP)	2σ calibration (CALYBP)
Escrivânia 5	ZMUC-12555	Beta-174711	*Equus neogeus*/tooth collagen	16,620 ± 70	-8.2	16,900 ± 70	20,610–19,660
Escrivânia 5	ZMUC-7548	Beta-174718	*Equinae* (sp. indet.)/bone collagen	16,550 ± 60	-9.1	16,810 ± 60	20,480–19,580
Escrivânia 5	ZMUC-7550	Beta-174712	*Equus neogeus*/bone collagen	16,250 ± 60	-8.6	16,520 ± 60	20,140–19,250
Escrivânia 5	ZMUC-8821	Beta-174713	*Equus neogeus*/bone collagen	16,180 ± 70	-8.5	16,450 ± 70	20,080–19,150
Tatus	ZMUC-2273	Beta-174688	*Catonyx cuvieri*/bone collagen	14,030 ± 50	-21.6	14,090 ± 50	17,240–16,530
Tatus	ZMUC-3166	Beta-174689	*Catonyx cuvieri*/bone collagen	13,920 ± 50	-21.6	13,980 ± 50	17,110–16,410
Cuvieri	MHN-SN	Beta-165398	*Catonyx cuvieri*/bone collagen	9960 ± 40	-23.1	9990 ± 40	11,570–11,250
Escrivânia 5	ZMUC- 11454	Beta-174722	*Smilodon populator*/bone collagen	9130 ± 150	-17.0	9260 ± 150	11,050–10,960 and 10,770–10,170
Braga	ZMUC-4725	Beta-174736	*Homo sapiens*/bone collagen	9680 ± 70	-19.2	9780 ± 70	11,260–11,110
Boleiras	BL-K12-N1	Beta-168451	charcoal	10,150 ±130	-25.0	10,150 ±130	12,620–12,480 and 12,380–11,240

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New Excavations in Valsequillo, Puebla, México

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One of the most controversial localities in México in regard to the issue of early man in the Americas is Valsequillo, Puebla. The area is located in central Mexico in the middle of the Mexican Volcanic Belt on a small lake, which is subject to seasonal changes in water level amplified by the effects of a dam.

Since the early 20th century, there have been several references to the discovery of extinct fauna in possible association with human artifacts, including some bones with evidence of human-related modifications (Armenta 1959); however, it was not until the early 1960s that controlled archaeological excavations were undertaken (Irwin-Williams 1967). The initial results from the excavations gave promising data, including some dates associated with human presence of around 26,000 yr B.P., that warranted further investigations, including a field season by Mexican archaeologists under the direction of Professor José Luis Lorenzo. However, a controversy at the time (Lorenzo 1967 vs. Irwin-Williams 1969) hindered detailed research. In the mid-1960s, German researchers explored the area again and obtained some data, but did not resolve the main question of association of extinct fauna and human presence (Guenther 1973). In the 1970s, Steen-McIntyre et al. (1981) were able to excavate again to study the stratigraphy at Hueyatlaco; furthermore, new dates assayed by different methods suggested that the early artifacts were around 200,000 years old. More recently, Pichardo (1997, 1999) tried to synthesize the published information on Hueyatlaco; however, problems with the past investigations have been passed on to these papers without critical evaluation.

A new project was initiated in 2000 to try to resolve the ambiguities surrounding this important site. The project goal is to find new evidence of the association of extinct fauna and human artifacts, as well as to reconstruct the stratigraphy and paleolandscape, which has proven quite difficult. In the first excavation season, past excavation trenches were precisely located, including those dug by Lorenzo's field party. In fact, Lorenzo's trenches were found around 70 cm above those excavated by Irwin-Williams, precluding any contemporaneous findings by the Mexican field party and those made by the U.S. team. Moreover, one of the recent trenches found the upper contact of what Pichardo (1997) mentioned as Faunal Stage II, dated around 22,000 yr B.P.; however, further excavations were hindered by the fast-rising water level of the dam.

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The trenches were cut into a series of volcaniclastic, lake, and stream deposits. The upper part of the section underlies the Tetela brown mudflow. The Hueyatlaco ash, which forms the top part of the section, is underlain by several clay and sandy beds that grade into gravelly sands. Under these sediments another ash horizon and stream gravels were found. A basaltic ash under these deposits was cored at the beginning of the season, although most of the trenches were unable to get down to this level because of the rising water level.

The excavation confirmed the presence of extinct animals, including camel (*Camelops* sp.), horse (*Equus* sp.), dwarf pronghorn (*Capromeryx mexicana*), and mammoth (*Mammuthus columbi*). Among the approximately 400 collected bones, none showed human-related modification. Just one small debitage piece is indisputably of human origin; it was found at the same level as extinct animal bones, but was not associated with them (i.e., the artifact was not in actual contact with the bones). These samples were located in one of the silty clay deposits that underlie the Hueyatlaco ash (Figure 1).

It must be noted that for the most part excavations were undertaken above the trenches that Irwin-Williams dug, since the dammed water level at the

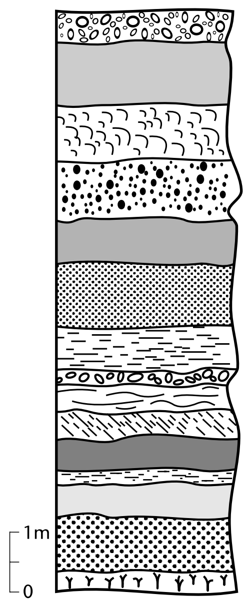

Figure 1. Lake sediments dominate in the stratigraphic column. The Tetela mudflow and the Toluquilla ash mark the upper and lower limits of the section. Two other silicic ashfall deposits were found, the Hueyatlaco ash and the Valsequillo ash, which overlie the fossiliferous gravel lenses.

edge of the site was high (this is an ongoing problem in investigating the locality). Ongoing research in the area will focus on extending the trenches to obtain and date new samples.

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Update on Paleoindian Research on the Isthmus of Panama

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Since our initial survey of Lake La Yeguada in 1999 (Pearson 2000), continued investigations on the Isthmus of Panama have located additional Paleoindian sites. These include new finds around the eroding shore of Lake La Yeguada, as well as a quarry/workshop, and a cave site on the Azuero Peninsula.

Lake La Yeguada is located 650 masl in Veraguas Province on the Pacific side of the Continental Divide (Bush et al. 1992) (Figure 1). A foot survey, carried out along its exposed shore in May 2001 (when the lake was at its lowest level), discovered a lithic scatter of bifacial thinning flakes and the distal half of a point preform (Figure 1).

Since bifacial reduction of cryptocrystalline stone was apparently abandoned on the Isthmus after 7000 RCYBP (Ranere and Cooke 1995, 1996,

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2002), we can surmise that the manufacturing debris was left behind by some of Panama's earliest occupants. It is significant that some of these bifacial thinning flakes terminated as overshots and were "set up" to remove flat or square edges on the opposite margins of performs. Another was struck to eliminate a large hinge fracture scar left by an end-thinning removal (see Bradley 1991:373, 1993:254).

Several interesting technological observations can also be made on the preform fragment. First, it displays the scar of a large flute-like end thinning removal, suggesting that early-stage fluting may have been a strategy employed by its maker. Second, the piece snapped as the result of a strong blow to the base, which may represent a second fluting attempt. Third, it appears to have been made on a thin flake, considering its width:thickness ratio (5.4) and the shape of its cross section (Callahan 2000). Finally, it shows what seems to be a failed overshooting attempt possibly intended to remove a remnant flat or square edge on the opposite margin. Overall, this new point recalls broad-blade fishtail specimens from Central America (Bird and Cooke 1978; MacNeish et al. 1980; Pearson and Bostrom 1998; Ranere and Cooke 1991; Snarskis 1979).

The Nieto quarry/workshop is located on the Azuero Peninsula (124 masl) approximately 10 km northwest of the town of Pesé (Figure 1). The site consists of a large open-air workshop surrounding an exposed vein of gray-white, translucent cryptocrystalline quartz that juts from the summit of a small hill. This outcrop forms a pillar-like wall that is flanked on both sides by steep colluvial slopes containing a large amount of cultural and natural lithic debris. Diagnostic tools found at the quarry include several Clovis-like point performs, a channel flake, gravers with multiple spurs, and large scraper planes (Pearson 2002). It is interesting to note that, although sources of better-quality cherts and jaspers are present near Nieto, Paleoindians appear to have been attracted by the esthetic qualities of this translucent quartz.

Cueva de Los Vampiros is located approximately 3 km inland from Parita Bay (Figure 1). The cave was discovered in 1982 during the *Proyecto Santa Maria* survey (Cooke and Ranere 1984). Initial test pits revealed the presence of a bifacial industry associated with a date of 8560 ± 160 RCYBP (Beta-5101).

New test excavations in 2002 uncovered an occupation resting above an 11,550 ± 140 RCYBP (Beta-167520, bulk soil organics) surface (Pearson 2002). Artifacts from this level include the distal end of a fluted point, a spurred endscraper, a sidescraper, a possible blade, two point tips, and several bifacial thinning overshots. Interestingly, both Clovis-like and fishtail-point industries appear to be present at Vampiros based on the stylistic and technological characteristics of its lithic assemblage.

A second phase of investigation is now underway at Vampiros that will (1) expand the original test pit to expose a large section of the Paleoindian living floor; (2) excavate test pits deep within the cave where burials may be located; and (3) test a second cave entrance near Vampiros.

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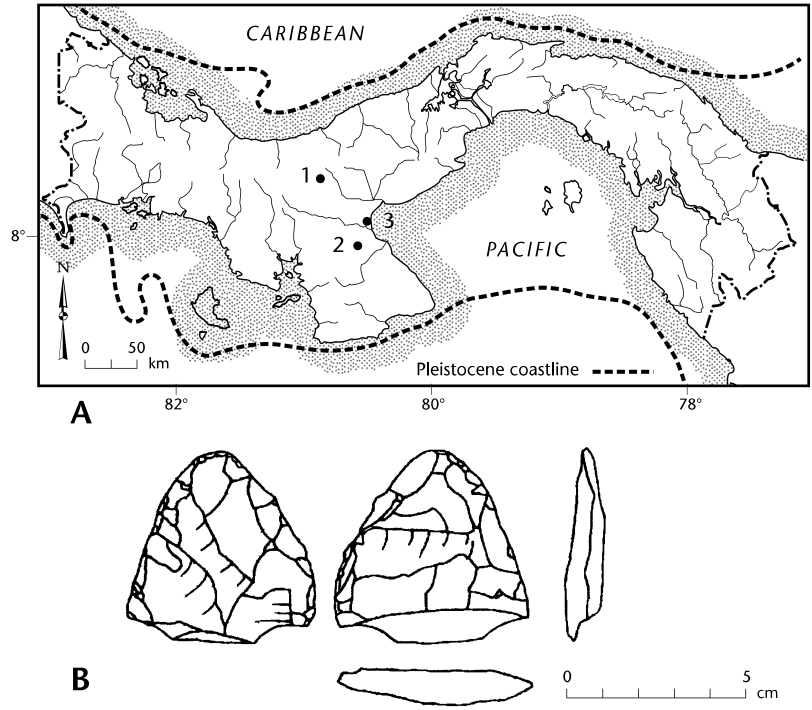

Figure 1. **A,** map of Panama showing principal sites (**1,** Lake La Yeguada; **2,** Nieto quarry/workshop; **3,** Cueva de Los Vampiros); **B,** point preform from Lake La Yeguada.

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Finding Late-Pleistocene Sites in Coastal River Valleys: Geoarchaeological Insights from the Southern Oregon Coast

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Recent renewed interest in a coastal migration hypothesis of initial entry into the New World has inspired archaeological studies with the goal of locating late-Pleistocene sites on the Northwest coast (Davis et al. 2003; Fedje and Christensen 1999; Fedje and Josenhans 2000). Models of coastal migration often include an element of inland mobility via coastal rivers following initial colonization of coastal areas (Dixon 2001; Mandryk et al. 2001). To date, no archaeological evidence of late-Pleistocene human occupation of the Northwest coast has been discovered in coastal river valleys. The absence of early coastal river sites is surely due, in part, to the dynamic geomorphic forces active on the Northwest coast during and after the late Pleistocene. Although the process of how landscape change during rising sea level affects the

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distribution of coastal sites is generally understood (e.g., Waters 1992:268–269), the specific effects and timing of postglacial alluvial adjustment along the Northwest coast are less clear. Addressing this problem, our paper reports the results of subsurface sediment coring at a locality ca. 2 km from the Pacific Ocean on the Sixes River in southern Oregon and its implications for discovering early sites in coastal river valleys.

In September 2002, the senior author recovered a 29-m-long continuous sediment core from an abandoned meander on the lower Sixes River, which is located immediately north of Cape Blanco and about 35 km south of Bandon, Oregon. A charcoal sample from the base of this core (Core 4) dated to 10,190 ± 60 RCYBP (Beta-173811). Prior to this work, Kelsey et al. (2002) conducted sediment coring at the same abandoned meander locality. Their efforts produced stratigraphic sediment columns 7 m deep, which represent ca. 6000 ^{14}C years of depositional history. Based on preliminary analysis of Core 4 sediments and comparison with previous investigations (Kelsey et al. 2002), 23 m of fine- to coarse-grained sediments were deposited between 10,190 and 6000 RCYBP. Since 6000 RCYBP the Sixes River added nearly 7 m of fine-grained, organic-rich sediments (Kelsey et al. 2002). In total, the Sixes River aggraded almost 30 m since the terminal Pleistocene.

There is little doubt that late-Pleistocene inhabitants of the Northwest coast would have used river valleys. However, based on the data presented above, late-Pleistocene deposits are deeply buried in some river valleys, thereby hindering efforts to find early coastal sites. This situation promises to make archaeological discovery of early coastal riverine sites a difficult task and must be considered an inherent aspect of testing the coastal entry hypothesis. Alternatively, in some areas tectonism will promote near-surface access to late-Pleistocene deposits (L. G. Davis et al. unpublished data) that may retain early sites; however, these locations must be identified on a case-by-case basis.

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Human Occupation in the Beringian "Mammoth Steppe": Starved for Fuel, or Dung-Burner's Paradise?

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Several researchers suggest that western Beringia went unoccupied before and during the Full Glacial because of a lack of woody fuel (Elias 2002; Goebel 1999; Guthrie 1990; Hoffecker and Elias 2003; Hoffecker et al. 1993), limiting when people could enter the Americas. If abundant large herbivores grazed this "mammoth steppe," (Guthrie 1990; MacPhee et al. 2002), dung should have been plentiful. People rely on dung for fuel in many high-latitude and high-altitude grassland and tundra environments where wood is scarce or absent (e.g., Winterhalder et al. 1974; Wright 1992). Herbivores transform grass and browse into concentrated lignins and other undigested residue that is easily collected, dried, stored, and burned. Understanding the availability and burning properties of herbivore dung and the energetics of collecting and processing is necessary to evaluate the proposition that human occupation prior to ca. 14,000 yr B.P. in Beringia was fuel-limited.

The Tibetan Plateau of central Asia is an appropriate analog to the western Beringian subarctic, since it is similarly devoid of woody plants and temperature and precipitation regimes are similar. Modern Tibetan pastoralists burn *argols* (Mongolian for animal droppings) for nearly all heating and cooking needs (Goldstein and Beall 1990). Dung from different herbivores varies in fuel properties (see Huc 1852:104–5 for an interesting early account of Tibetan "argology"); yak dung is preferred for its sustained even, moderate heat. Dried yak dung yields about 3306 kcal/kg or 893 kcal/liter of gross energy, similar to cattle and bison dung. We initiated an ethnoarchaeological evaluation of dung use in the northern Tibetan Plateau, Qinghai Province, China in 2001, and preliminary observations suggest that a single family, living in a 10-m^2 canvas or hair tent with an earthen firebox, requires about 100–150

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liters of dung chips per day in summer and about double that in winter, amounting to roughly 70,000–80,000 liters of dung consumed annually.

Collecting and processing dung is a significant part of a woman's daily routine. Men and children also collect, often on special foraging trips. One group of dung foragers that we observed had collected 1000 liters per person in 4 hours in a pasture where yak patties were spaced 3–4 paces apart. Dung for a year's needs thus requires about 320 person-hours (less than an hour a day) for collecting and additional time to dry it. Collecting time is not limited here unless previous collecting has scoured the landscape, but drying and processing might limit daily fuel production in the wet season (Goldstein and Beall 1990).

The upper-Paleolithic peopling of the Tibetan Plateau (Brantingham et al. 2001; Brantingham et al. 2003) undoubtedly depended for fuel on dung from wild rather than domesticated herds. Nineteenth-century explorers in Tibet reported astonishing numbers of large herbivores (Schaller 1998). For example, Rockhill (1894:199–205, 381) writes,

> We saw a great many antelopes (ling yang and huang yang) near the foot of the pass, and on the way up I noticed six yaks feeding on the side-hills. The ground was everywhere covered with their dung, so I fancy they are quite numerous in these hills. . . . Bunches of yaks were on every hill, and that readily accounted for the shortness of the grass in the neighborhood. It is wonderful what huge quantities of grass these animals eat, a herd of a hundred would, I believe, find barely enough on a good, rich meadow three miles square. Fortunately their droppings supplied us with an abundance of much needed fuel . . . [the grasslands were] alive with game of every description, and the ground was so thickly covered with yak and wild ass dropping that it looked like a vast barnyard.

But Rockhill also mentions dismal camps where dung was either lacking or too wet to burn. Patchiness of dung distribution is an important factor, along with the time needed to dry it and the ability of foragers to transport dung or store it, that figures into whether sustained occupation of Tibet was fuel-limited. The distribution and density of ruminants may also be a factor, given the apparent human preference for their dung.

Our initial results suggest that dung of large herbivores was a suitable and available fuel source in glacial-age western Beringia, and that lack of fuel was likely not a hindrance to the human occupation of the region. We will continue to pursue this issue by investigating modern-day dung availability, collection, and use from both domestic and wild stocks and developing archaeological signatures of dung fuel use in the colonization of the Tibetan Plateau, and hopefully Beringia as well.

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Early Cave Occupations on San Miguel Island, California

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Caves and rockshelters around the world have been important for the study of early humans (Bonsall and Tolen-Smith 1997). On California's Channel Islands, which contain some of the earliest evidence of coastal occupation in North America, a number of rockshelters and caves have yielded early cultural deposits. Our recent work on San Miguel Island has documented as many as 15 shell middens dated between about 11,800 and 8000 CALYBP. Three of these are located in caves or rockshelters, which provide shelter from the island's pervasive winds and winter storms.

The most recent addition to the inventory of early cave occupations on San Miguel Island is a small rockshelter (Seal Cave) located near the tip of Harris

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Point on the north-central coast. This site, perched on a sheer cliff overlooking the sea in an area of steep bathymetry, is roughly 3 by 5 m wide and about 2 m high. Shell midden deposits blanket the floor of the cave, where a shell fishhook fragment found on the surface suggests that a late-Holocene occupation (<3000 CALYBP) took place. A 15-by-20-cm probe excavated near the center of the cave floor detected cultural deposits approximately 25 cm thick. Two well-preserved California mussel shells from near the top and base of this deposit were dated to 9030 ± 100 RCYBP (Beta-171120, ca. 9250 CALYBP) and 9440 ± 50 RCYBP (OS-34804, ca. 9830 CALYBP), providing further evidence of early human cave occupation on the Channel Islands. Currently used by a variety of birds, Seal Cave contains chipped-stone artifacts, an *Olivella* spire-lopped bead, abundant shellfish remains, and fish, rodent, and bird bones. Test excavations planned for this eroding shell midden in 2003 will help document the chronology and contents of this important site.

Two early caves with remarkable preservation are located on the northeast coast of San Miguel. At Daisy Cave (CA-SMI-261), where deposits span much of the terminal Pleistocene and Holocene, the earliest well-documented occupation is a low-density shell midden containing charcoal and chipped-stone artifacts dated to about 10,600 RCYBP (11,800 CALYBP). Much more extensive occupation took place between about 9600 and 8000 RCYBP (10,000–8400 CALYBP); evidence includes shell beads, bone gorges, stone tools, cordage, woven artifacts, and the remains of a variety of marine fishes, rocky intertidal shellfish, sea birds, and sea mammals (Connolly et al. 1995; Erlandson et al. 1996; Rick et al. 2001).

Located near Daisy Cave, Cave of the Chimneys (CA-SMI-603) has also produced a remarkable record of human occupation spanning much of the Holocene (Vellanoweth et al. 2000). The earliest deposits have been dated to roughly 8100 to 7300 RCYBP (8400–7500 CALYBP) and contain woven sea grass, *Olivella* spire-ground beads, a bone gorge, and rocky intertidal shellfish and fishes (Vellanoweth et al. 2003). ^{14}C dates from Daisy Cave and Cave of the Chimneys suggest an alternating pattern of occupation, with one cave being used while the other was not.

Several other San Miguel shelters contain cultural deposits, including two small rockshelters (CA-SMI-516 and CA-SMI-573) on the southwest coast, another cave on Harris Point (CA-SMI-264), and Otter Cave on the northwest coast. Otter Cave appears to have been used for a relatively short time around 6400 RCYBP (6600 CALYBP) and yielded a diverse assemblage of marine shellfish and *Dentalium pretiosum* shell artifacts (Erlandson et al. 2001). CA-SMI-264, -516, and -573 have produced late-Holocene dates, but exposures at CA-SMI-264 and -516 contain deeper deposits not yet dated.

Investigation of these caves and rockshelters adds to the growing body of data on early human land use on the Channel Islands. In coastal regions—where rising sea levels during the Holocene submerged many early sites—caves and rockshelters often provide invaluable data on early technology and subsistence. The shelter they offered attracted people from now-submerged shorelines and fostered the preservation of archaeological materials, including perishable items rarely recovered in open sites. Future research at Seal

Cave and other Channel Islands shelters should provide exciting information on the nature and scale of early human occupation of coastal regions.

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Clovis Points from the Missouri River Valley, North Dakota

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Regional studies on distributions of early-Paleoamerican artifacts provide insights into land-use, mobility, and migration patterns (e.g., Amick 1994; Anderson and Faught 1998; Anderson and Gillam 2000; Bamforth 2002:84–85). Because the development of regional databases provides an important tool for such studies, we describe seven surface-collected Clovis points from the Missouri River valley. These points were collected ca. 130 km east of the North Dakota–Montana border along a possible late-Pleistocene migration route (e.g., Anderson and Gillam 2000).

Clovis points are well documented in nearby areas of the Canadian Plains

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(e.g., Buchner and Pettipas 1990) and eastern Montana (Davis et al. 1989), and Clovis sites are well known in the Northwestern Plains (e.g., Frison 1991). Though Folsom points are plentiful in North Dakota (Root 2000; Root et al. 1999; Schneider 1982; William 2000), only five possible Clovis points are previously reported from the state (Schneider 1982). Reevaluation of these points, however, indicates that only one is a Clovis point (from uncertain provenience in Morton County). One is a Folsom preform, one is a basally thinned biface, and the other two are of uncertain typology (F. E. Schneider, pers. comm. 2003).

We describe three complete Clovis points and three basal fragments from Mountrail County and one complete point from McLean County, North Dakota; all are technologically finished points (Figure 1). Six are Knife River flint and one basal fragment is porcellanite, which are local toolstones. Blank types are indeterminate, and none exhibit evidence of heat treatment. Five

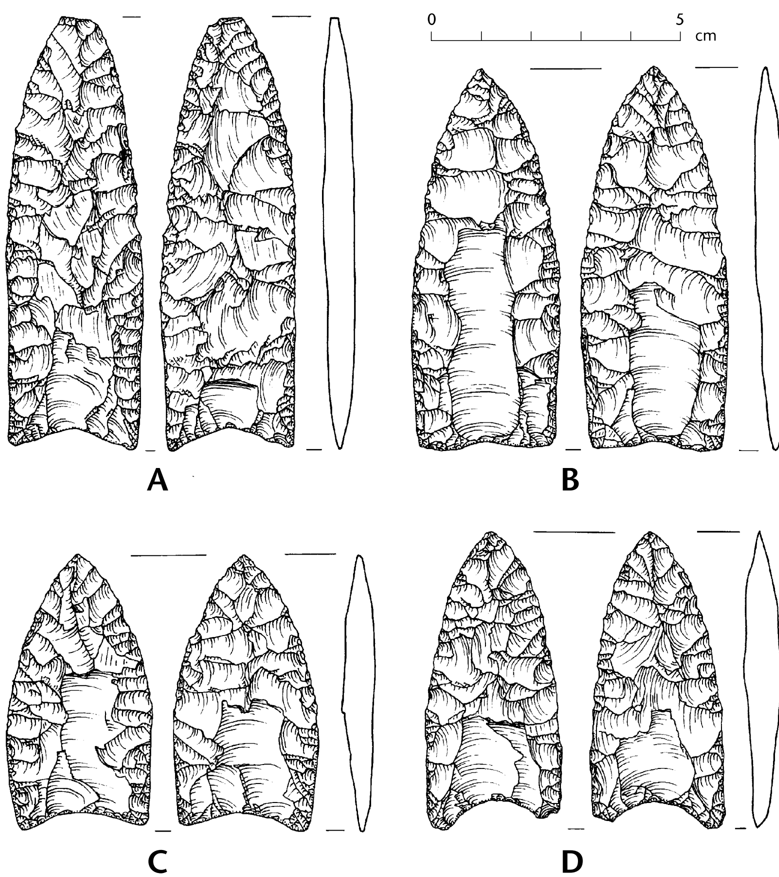

Figure 1. Clovis Points from the Missouri River valley, North Dakota; **A, C, D,** Mountrail County; **B,** Shell Village Island, Mclean County.

points have remnants of percussion thinning scars on the blades, and one retains an overshot thinning flake termination (Figure 1D). Prior to fluting, knappers usually shaped the points by selective marginal pressure flaking, and occasionally by invasive pressure flaking.

Channel flake scars range from 9.8 to 44.4 mm long and 11.9 to 17.8 mm wide, with the longest flutes usually on the side fluted first. Eight flutes are simple, five are multiple, and one is composite (definitions from Morrow 1995:176). Channel flake terminations on six points include two feather, seven step, and three removed by subsequent retouch. The remaining point is broken proximal to the channel flake terminations. All basal and lateral haft elements are moderately to heavily ground or polished, with the length of grinding ranging from 24.4 to 40.1 mm. Basal concavities range from 1.6 to 5.7 mm; basal concavity to maximum width ratios fall in the range of other Western Clovis points (Morrow and Morrow 2002:Figure 8). Postfluting lateral retouch invades the channel flakes on only three specimens; retouch is generally limited to minor marginal pressure flaking. Points range from 55.6 to 87.7 mm long and 27.1 to 30.9 mm wide.

The Missouri River points are similar in size, shape, and production technology to other Western Clovis points. Bradley (1991:373) considers removal of channel flake step terminations diagnostic of High Plains Clovis point production, though this occurs on only two of the Missouri River specimens. Documentation of these weapons is the first direct evidence of Clovis exploitation of the Missouri River valley in North Dakota.

We thank Mike McGonigal for bringing the Clovis points together and for kindly allowing us to study them. We thank Sarah Moore for her excellent illustrations and Ed Knell for his helpful comments. We extend our gratitude to Fred Schneider for his assistance and for sharing his data on North Dakota fluted points.

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A Note on the Functions of Folsom Ultrathin Bifaces

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In a recent paper, Root et al. (1999) describe an assemblage of ultrathin bifaces from the Lake Ilo Folsom sites. Ultrathins are distinguished by their extreme width:thickness ratio, generally exceeding 10:1, often exhibiting a biconcave latitudinal cross section. They hypothesize that ultrathins functioned both as cores in early stages of reduction and as highly curated cutting tools. Eleven ultrathins were fractured radially; based on microwear analyses, some were recycled and used as burins and planes (Root et al. 1999:161). Similarly, Jodry (1998, 1999:204-212) suggests that ultrathin bifaces may have functioned primarily as specialized butchery tools used to remove thin sheets of meat for drying. In this paper, we describe a refit sequence from Locality B of the Barger Gulch site (Middle Park, Colorado) that further demonstrates the versatility of these distinctive artifacts.

During the 2001 field season, we recovered an end fragment of a Folsom ultrathin biface that conjoined to a failed Folsom preform on a flat bend break facet on the distal margin of the preform (Figure 1). The artifacts are made on an orange dendritic chert, believed to be Trout Creek jasper from South Park or the Arkansas Valley. The small biface fragment has a maximum width:thickness ratio of 8.4:1, suggesting the original biface would have easily exceeded 10:1. The preform, which was fluted twice from the base and once from the tip, broke when the channel from the tip overpassed in the center of

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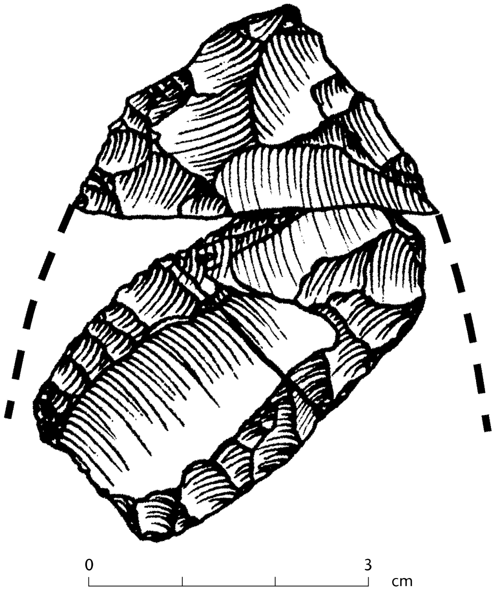

Figure 1. Refitted Folsom ultrathin biface fragment and preform. The refit indicates the recycling of a biface by segmentation for projectile point production. The preform was discarded when a channel flake taken from the tip overshot and broke the piece in half.

the piece. Also recovered were a channel flake and a number of marginal pressure flakes that refit to the preform. All the artifacts were separated by less than 1.05 m and were located in an isolated concentration of Trout Creek debitage. Two additional channel flakes were found in the same area but do not refit to the preform, suggesting that at least one further projectile point of this material was manufactured, possibly from the same biface.

Therefore, we suggest that Folsom ultrathins, in addition to being used as long use-life cutting tools, served as cores for Folsom point production—not in the traditional sense of point production through percussion flaking, but by intentionally segmenting bifaces through bend breaks and possibly radial fracture. Wilke et al. (1991) suggested a similar strategy for Clovis point production, based on bend breaks present on the margins of bifaces and preforms from the Anzick cache. This reduction sequence would have eliminated preform failure during early-stage reduction, since an ultrathin fragment is essentially ready for fluting after only minimal shaping.

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Results of a Great Basin Fluted-Point Survey

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This paper presents the findings of a systematic survey of fluted points from the Great Basin. Most literature on Great Basin fluted points exists in the form of reports on isolated finds or individual sites. To study this technology in broader context across the entire region, I collected data from various published and unpublished sources, from the collections of the Nevada State Museum in Carson City, from private collections, and from information provided by archaeologists in government agencies. The survey was completed in 2001–2002 and identified a sample of 179 points.

The first goal of the survey was to gather data on Great Basin fluted point morphology. Variables measured are shown in Figure 1, and the resulting data are summarized in Table 1. These data demonstrate the variety in form in Great Basin fluted points. The greatest variation occurs in front angle (49°–104°) and maximum length (3.14–12.30 cm). These two variables, however, are sensitive to resharpening. The attribute that is least likely to be affected by resharpening is basal concavity, for which variation is the smallest (0.000–0.346 cm).

Table 1. Morphological characteristics of Great Basin fluted points.

	n	minimum	maximum	mean	std. dev.
max. width (cm)	85	1.780	6.700	2.914	0.695
max. length (cm)	30	3.140	12.300	6.340	2.246
thickness (cm)	151	0.300	1.400	0.674	0.172
basal width (cm)	117	1.450	5.200	2.623	0.606
front angle (degrees)	32	49.000	104.000	69.875	14.731
basal concavity (basal indentation: basal width)	106	0.000	0.346	0.141	0.075

The survey also identified patterns in choice of raw material. Of the 124 fluted points for which information on material type was available, 72 (58.1 percent) are made from chert, 49 (39.5 percent) are made from obsidian, 2 (1.6 percent) are made from fine-grained volcanics, and one (<1 percent) is

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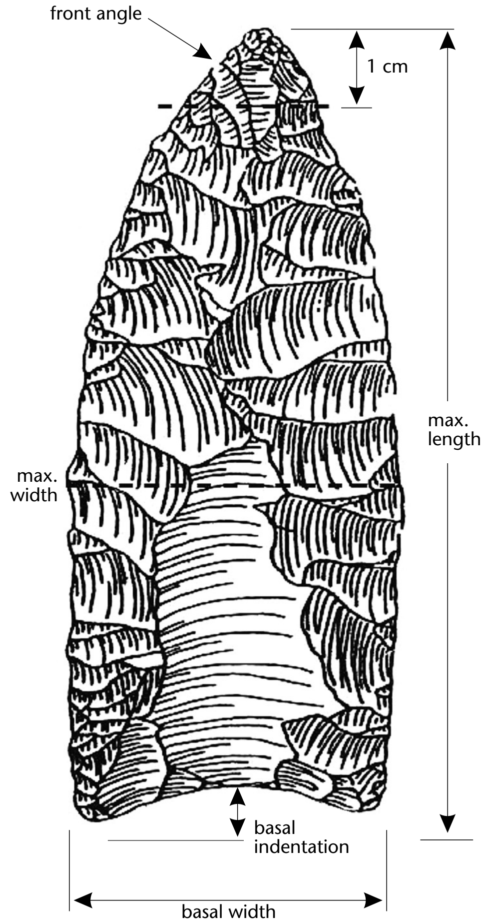

Figure 1. Methods for measuring various attributes of fluted points (modified from Grayson 1993:236).

made from quartz. This pattern is consistent with observations drawn in previous analyses (see Beck and Jones 1997:200).

Finally, my study tested the accuracy of the perceived notion that Great Basin fluted-point sites are limited to lowland environments (Grayson 1993). Of the 164 points for which information on topographic setting was available (recovered from 47 separate sites), 148 (90.2 percent) come from valley bottoms. Of the 47 sites, 33 (70.2 percent) occur in valley bottoms. Five fluted-point sites (6 points) occur on alluvial fans, and 9 sites (9 points) have been found in upland settings.

This study is a starting point for future efforts both to build a Great Basin fluted-point database and to investigate variability in the morphology and distribution of fluted points from this region. The addition of such information to the North American fluted-point database, which is currently lacking in data on the Intermontane West (e.g., Anderson and Faught 1999), may help researchers better understand the first migrations through the New World.

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Reduction Sequence of a "Fishtail" Projectile Point at the Los Pinos Shelter Site, Pampean Region, Argentina

Federico Valverde

The Los Pinos Shelter is a rockshelter located in the eastern sector of the Tandilia Range System in the Argentine Pampean region (Figure 1A). It presents evidence of human settlement during the Pleistocene-Holocene transition that is dated between 9570 ± 150 RCYBP (LP-630, charcoal) and 10,465 ± 65 RCYBP (AA-24045, charcoal) (Mazzanti 2003). The abundant and diverse recovered assemblage of lithic artifacts reveals different stages of tools production: 13 cores, 47 bipolar cores, 20 core fragments, 3 hammers, 91 tools (projectile points, endscrapers, scrapers, notches, and perforators, among others), 1,515 flakes, and 1,780 bits of microdebris.

The stratigraphic integrity of this site made it possible to refit flakes to individual artifacts. For example, 16 flakes were refitted onto one core.

Most of the cores and debris are made from medium-grain quartzite of local origin; a fine-grain orthoquartzite from a geological outcrop of the Sierras Bayas group, 70 km from the site, was selected for manufacturing many of the artifacts.

At this site a fishtail projectile point (FPP) (Figure 1C) was found close to a preform of projectile point (Figure 1B) and three small bifacial thinning flakes (Figure 1D). All these materials are associated with vegetable charcoal dated 10,415 ± 70 RCYBP (AA24046) and ± 10,465 ± 65 RCYBP (AA-24045). Moreover, all these artifacts were made from a fine white orthoquartzite that, in the case of the point and the preform, possesses similar yellow veins. The bifacial thinning flakes are of a size similar to the flake scars of the preform.

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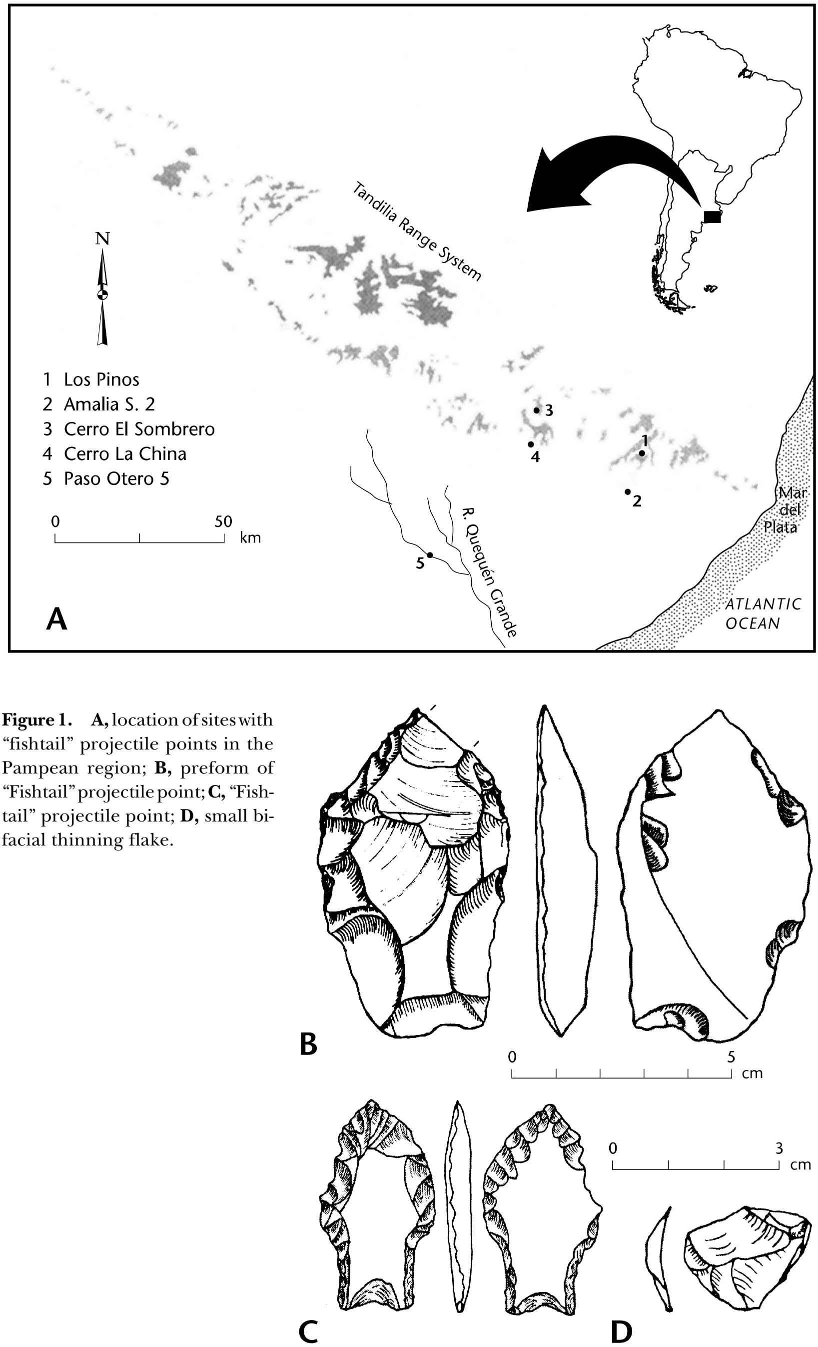

Figure 1. **A,** location of sites with "fishtail" projectile points in the Pampean region; **B,** preform of "Fishtail" projectile point; **C,** "Fishtail" projectile point; **D,** small bifacial thinning flake.

The blank of this preform is a large flake (7.5 cm long, 4.4 cm maximum width, and 1.4 cm maximum thickness), which was unifacially retouched on both edges and probably utilized as a scraper. Only a few flake scars occur on the ventral face, and it has a fracture on its distal edge, which could be the cause for its having been recycled as a scraper. Another possibility is that it was first intended to be used as a scraper, but was later transformed into an FPP. The FPP recovered at the site is 3.9 cm long, 2.2 cm wide, and 0.5 cm thick. Furthermore, this FPP shows a lateral fracture that was recycled in the form of a notch, which is consistent with the long use life of these artifacts (Flegenheimer 1991).

The information reported here underscores the importance of this lithic assemblage in our understanding the way in which FPPs were manufactured. It confirms and augments relevant descriptions reported by others (Bird 1969; Flegenheimer 1991; Nami 1997).

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Druchak Microblade Industry of Northeast Asia

Igor Vorobei

At our present stage of knowledge of the archaeology of Northeast Asia, satisfying progress in regional Paleolithic studies is being made in research into microblade industries of the terminal Pleistocene. One of the sites representing this type of industry is Druchak-V (63° 01′ N, 160° 00′ E), discovered in 1988. In 1989–1992 an area of ca. 80 m^2 was excavated. The collection from the site includes about 25,000 artifacts.

The site is located in the Gizhiga River basin, 140 km from the Okhotsk Sea (northern Priokhotye), on the southern side of the Okhotsk-Kolyma watershed. It is situated upon a 23-m terrace. Cultural remains were recovered from cryogenically deformed loamy sands 0.1–1.6 m thick. Dates obtained from

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wood charcoal dispersed in the upper layer, 5120 ± 180 RCYBP (Le-4712) and 7790 ± 250 RCYBP (Le-4711), reflect post-genetic disturbances of the deposits containing the cultural remains.

The Druchak-V lithic industry is morphologically diverse and not yet completely analyzed. Raw materials are dominated by low-quality corneous rocks. Large cores (including Levallois-like cores) with convex and flat surfaces were used to manufacture blade-like spalls. The spalls produced from flattened core surfaces sometime exceed 19 cm, with a length:thickness ratio reaching 20:1. The microblade industry is characterized by wedge-shaped microcores mostly produced by the Yubetsu technology.

The tool kit (Figure 1) includes bifacial points, burins (including the characteristic "Verkholensk" transverse burins made on long biface thinning flakes), gravers, scrapers (including side-notched and pointed ones), *skreblos,* perforators, retouched segments, an ax, an adze, a pebble tool, notched tools, and retouched flakes and blades. Specific technological elements include flat

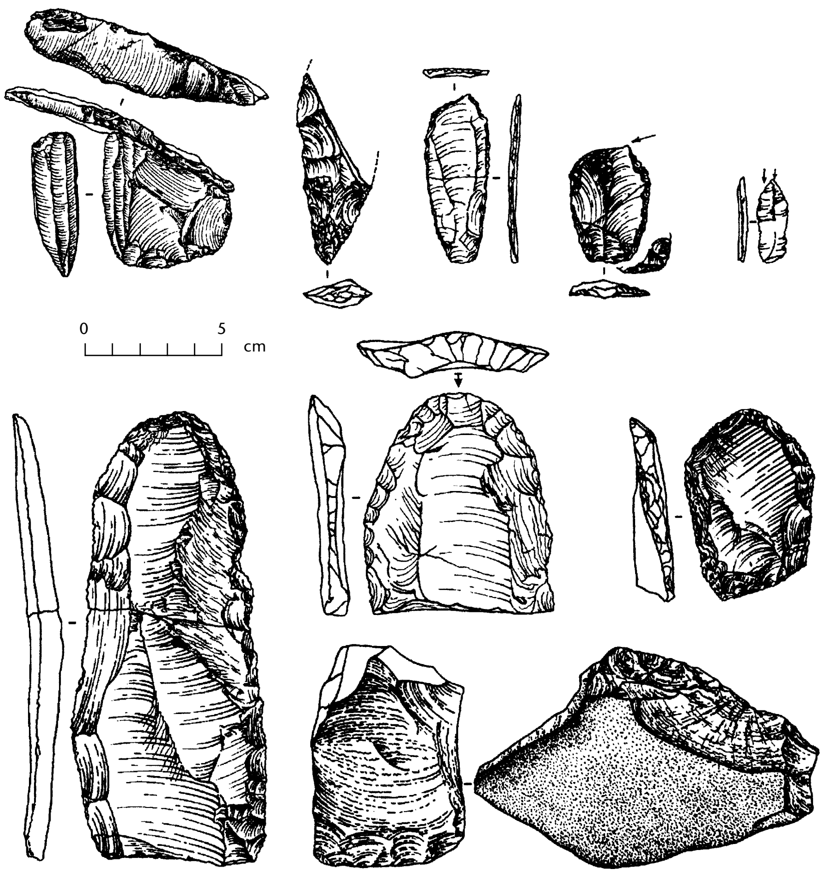

Figure 1. Druchak-V stone artifacts.

burination, ventral thinning, macroscrapers to 16 cm long, scrapers with rounded edges on the proximal ends of long spalls, and a pointed microblade formed with flat ventral burin spalls.

The author originally supported the hypothesis of early-Holocene age of the Druchak complex and of its ties with the series of pre-ceramic sites in the Far East. These days another interpretation can be supported. The initial penetration of the Druchak-type industry into northern Priokhotye occurred before the spread of "classic" Dyuktai complexes, genetically linked to the Selemdga late-Paleolithic culture, into Yakutia, i.e., no later than 13,000–14,000 yr B.P. The upper age limit of the industry is fixed by industrial elements (i.e., tools on mesoblades) of the late Paleolithic of the southern Far East appearing in the northeast no later than the Pleistocene-Holocene boundary. Morphologically, some tool classes of the Druchak industry can be compared with a wide range of mid-late-Paleolithic "Mesolithic" industries of Siberia, the Far East, and Alaska. However, the Druchak complex as a whole cannot be considered a subset of any of those. The genetic ties between the Druchak industry and the final-Paleolithic industries of the Baikal area (15,000–11,000 yr B.P.) are clear.

The Preliminary View of a Late-Pleistocene Lithic Assemblage at Indian Sands (35CU67C) on the Southern Oregon Coast

Samuel C. Willis

Investigations at Indian Sands (35CU67C) on the southern Northwest Coast in Curry Co., Oregon recovered a lithic assemblage from a paleosol dated 10,430 ± 150 RCYBP (Beta-173811, charcoal) (Davis et. al. 2002). This discovery places Indian Sands as one of the oldest sites on the Northwest coast. Notwithstanding an acknowledged small sample size (only a 1-by-2-m test unit was excavated), 136 pieces of lithic debitage were subjected to multiple analyses in an attempt to understand 1) the lithic reduction strategy and nature of tool production, 2) site function, and 3) mobility among late-Pleistocene coastal peoples.

The lithic reduction strategy was assessed using a freestanding typology (Sullivan and Rozen 1985), a triple-cortex typology (Mauldin and Amick 1989), an aggregate analysis (Ahler 1989), and a technological typology (Andrefsky 1998). The freestanding typology reported that flake fragments constitute 60 percent of the debitage; the triple-cortex approach reported that interior flakes constitute 89 percent of the debitage population. The size-

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aggregate analysis reported that 85 percent of debitage is less than 2 cm, and the weight-aggregate analysis showed 78 percent of the assemblage falls between 0.1 and 0.2 g. Particularly interesting, technological analysis located a number of bifacial thinning flakes. All analyses suggest a late-stage lithic reduction strategy in producing or maintaining formal tools at Indian Sands ca. 10,430 ± 150 RCYBP.

Two non-debitage lithic artifacts were recovered as well. One chert flake tool appears to be expedient with no evidence of hafting. This tool retains a steep distal edge and exhibits polish and micro-fracture. The complex multi-directional scar pattern observed on the dorsal side of a chert core reduction flake suggests multidirectional core technology was used.

One of the more interesting aspects of the Indian Sands site is the availability and acquisition of lithic raw material, which has implications in our understanding early coastal site use and mobility (Andrefsky 1994). Because a chert source exists at Indian Sands, the site may have been used as a quarry. Although sourcing has not been completed, the fact that 91.9 percent of chert debitage is similar to locally available chert suggests quarrying took place at the site. X-ray fluorescence shows that obsidian, which accounts for 5.9 percent of the late-Pleistocene lithic assemblage, originated at Spodue Mountain in interior southern Oregon and the Medicine Lake basin of northern California. Whether obsidian was acquired from an established trade network or simply imported, its presence suggests inhabitants had a thorough knowledge of Northwest lithic sources by 10,430 ± 150 RCYBP.

In summary, the late-Pleistocene lithic assemblage appears to be evidence of formal and expedient tool production using multidirectional core technology and the manufacture or maintenance of bifacial tools. Clearly, interpreting site function becomes awkward because of the absence of early-stage reduction patterns normally expected in proximity to a chert source. As stated above, this discrepancy could be due to a sampling error. Future archaeological investigations at Indian Sands may clarify this issue. Lastly, the late-Pleistocene lithic assemblage at Indian Sands suggests coastal hunter-gatherers used upland lithic toolstone sources and that additional contemporaneous sites may be found by investigating known lithic raw material sources on the Northwest coast.

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Physical Anthropology

Craniometric Relationships of Paleoamericans and Archaic Indians

Deborah L. Cunningham and Richard L. Jantz

Do Paleoamerican or Archaic Indian crania resemble those of Amerindians? If not, can we determine when modern Amerindian cranial morphology appeared? How similar are Paleoamerican and Archaic crania?

We analyzed six Paleoamerican crania: Wet Gravel Female and Male (10,550–12,550 CALYBP; Key 1983), Lime Creek (extremely tentative date of 11,524 ± 450 RCYBP; Key 1983), Spirit Cave (9415 ± 25 RCYBP; Tuohy and Dansie 1997), Wizards Beach (9225 ± 60 RCYBP; Tuohy and Dansie 1997), and Browns Valley (8790–9049 ± 82/110 RCYBP; Myster and O'Connell 1997). We also included 14 Archaic Indian crania. Two are from the early period: Pelican Rapids (7840 ± 70 RCYBP; Myster and O'Connell 1997) and Prospect (7000 CALYBP; Cressman 1940). Four are middle Archaic: Turin (4720 ± 25 RCYBP; Crane and Griffin 1960 in Fisher et al., 1985), SI94-03 (3720 ± 80 RCYBP), and two Dry Lake crania (3250 ± 750 CALYBP; Key 1983). The remaining specimens are late Archaic: NSM 871 (2480 ± 120 RCYBP), two Gering crania (2000 ± 500 CLYBP; Key 1983), and five Bahm crania (1920 ± 140 RCYBP; Williams 1994).

We compared these specimens with a geographically diverse sample of 2,400 crania that includes 7 prehistoric and historic Amerindian groups (Howells 1973, 1989; unpublished data). We used 32 measurements and employed 2 multivariate statistical methods. Mahalanobis D^2 determines which modern populations each cranium resembles, while associated typicality probabilities evaluate whether the specimen is a typical or atypical member of the modern group. A second method determines the distance of the fossil crania from each other (Defrise-Gussenhoven 1967). This figure is compared with an expected distance derived from the modern groups. See Van Vark (1995) and Jantz and Owsley (2001) for support of using a modern covariance matrix to evaluate fossils, and Howells (1973, 1989) for internal checks on the reference samples.

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We found the Lime Creek, Spirit Cave, and Browns Valley Paleoamericans significantly atypical compared with any population. The Wet Gravel Female shows affiliation with the Bronze Age Anyang from southern Asia as well as with modern Pacific Rim and Polynesian groups (Hainan $D^2 = 25.5$; Anyang $D^2 = 29.9$, Mokapu $D^2 = 32.3$), while the Wet Gravel Male (Blackfoot $D^2 = 22.6$, Prehistoric Arikara $D^2 = 27.8$, Pawnee $D^2 = 29.9$) and Wizards Beach (Blackfoot $D^2 = 29.4$, Norse $D^2 = 31.9$, Peru $D^2 = 33.8$) show Amerindian and European association.

The early Archaics also show a mosaic pattern of affiliation and typicality. Pelican Rapids is an outlier to modern groups. The Prospect cranium has a varied affiliation with Amerindian and European populations with reasonable typicality probabilities. All the middle-Archaic specimens show some association with modern Amerindians. Turin exhibits typical European and Amerindian affiliation, while SI94-03 is typical of Amerindian and Polynesian groups. Both Dry Lake crania exhibit a pattern of typical Amerindian morphology. The late-Archaic NSM 871 is typical of European and Amerindian groups, and two of the Bahm crania show typical associations with Amerindian and European populations. The Gering crania and the other three Bahm specimens are atypical relative to modern groups.

As we move through time, significant differences between the Paleoamerican and Archaic Indian morphology increase. There is only one statistically significant difference between an early Archaic and a Paleoamerican cranium (Pelican Rapids: Browns Valley). Each middle-Archaic specimen is significantly different from between one and three Paleoamericans. The late-Archaic crania are extremely varied, differing significantly from between one and six Paleoamericans.

In conclusion, three of the six Paleoamericans are atypical of any modern group. Of the remaining three, two exhibit affiliation with the Blackfoot Amerindian group based on high typicality probabilities. The Wet Gravel Male, however, has an uncertain date. The two Wet Gravel specimens were pumped out of a gravel pit and exhibit different patterns of staining and fossilization, with the female being more similar to the other Pleistocene fauna from the pit. The male could be more recent, but determining an exact date is impossible short of dating the bone itself.

When the Archaic specimens are divided into early, middle, and late, some patterns emerge. While both early-Archaic crania have Amerindian groups as nearest neighbors, only Prospect would be typical. It is in the middle-Archaic period, especially the late middle Archaic, that the most consistent pattern of affiliation with modern Amerindian groups appears. The late-Archaic specimens show a mixed pattern of affiliation and typicality that may be partly due to problems with the Bahm assemblage. These skeletons may be older than 1,900 years, and they may not represent a spatially and temporally constrained group (J. A. Williams pers. comm. 1999). Modern Amerindian cranial morphology first consistently appeared in the late–middle Archaic period, and it is difficult to discern whether this occurred gradually in situ or was the result of later migrations.

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Paleoamerican Remains from the East Texas Gulf Coast

Robert P. d'Aigle and Nataliya V. Hryshechko

An AMS radiocarbon date of 10,740 ± 760 RCYBP (AA45910) was obtained on human remains recovered from the BZT-1 site on the San Bernard Wildlife in Brazoria County, Texas. The date places the remains firmly in the Paleoamerican period. These are the oldest human remains from Texas and among the oldest in North America.

The find consists of bones from the skull, including right and left parietals,

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right and left temporals, the frontal, the occipital, a maxillary fragment with left M2, M1, P2 and P1, a fragment of the mandible, cervical vertebrae 1 and 2, and a clavicle fragment. (Steele 2002). An additional 166 unidentified bone fragments that were recovered reveal considerable in situ fragmentation post mortem. The skull was oriented in a westerly direction. Bone fragments and teeth from the lower face and jaw were recovered directly beneath the skull, including a lateral maxillary incisor that displays extreme shoveling. The individual is tentatively identified as female based on small skull size, moderately prominent muscle markings, and slight brow ridge development. The unfused or slightly fused state of the sutures uniting the superior portion of the braincase indicates the woman was in late adolescence or early adulthood. No lesions were observed in the bone, nor were dental caries or hypoplasia observed. Although DNA could not be recovered from bone, intact tooth samples were sent to the Armed Forces DNA Identification Laboratory (Schmerer 2002). No artifacts were recovered.

The site is located on the Brazos River floodplain. The site stratigraphy consists of two layers of alluvial sediments (Moya 2002). The contact between the two occurs at approximately 1.35 m below the surface; the top of the skull was located approximately 10 cm below this contact in the lower deposit. Soil development is visible in both deposits. The soil developed in the lower alluvial deposit consists of a buried B horizon, which is dark gray (10YR 4/1) in color, high in organics, and has a prismatic structure. The underlying alluvial C horizon is yellowish red (5YR 5/6) sand and silt, massive, with pockets of very fine sand and rounded gravels.

The stratigraphy around the skull revealed no visible evidence of a burial shaft. Sediment samples adjacent to the outside of the skull were indistinguishable mineralogically from sediment in the same stratum 2 m from the skull (Drees 2002). In June 2001, PaleoResearch Laboratories discovered human protein in three sediment samples adjacent to the skull exterior (Puseman 2002). This protein indicates that the muscle and skin tissues surrounding the skull decomposed in situ (d'Aigle and Hryshechko 2002; Tuller 2002). The skull, mandible, vertebrae, and a fragment of the clavicle were arranged in anatomical position, suggesting that the torso and limbs of this individual probably remain at BZT-1. The bones show no evidence of cremation.

Two bone samples were dated at the University of Arizona lab (d'Aigle and Hryshechko 2002). The 10,740 ± 760 RCYBP (AA45910) date was returned on a portion of a petrosal with a total carbon mass of 40 μg. A date of 8700 ± 2300 RCYBP (AA45909) was returned on 5 μg of carbon extracted from an intact tooth. Stafford Research Laboratories, Inc. returned an AMS date of 5135 ± 40 RCYBP (CAMS-87685) on humic acids from a sediment sample inside the skull; humic acids from a sediment sample outside the skull were dated to 4870 ± 40 RCYBP (CAMS-87686). Contamination of the sediment samples with modern humic acid is considered likely (Stafford 2002). Recently, Stafford has reported pockets of intact collagen in a portion of a petrosal from the BZT-1 skeleton (T. Stafford, pers. comm. 2002).

Stable isotope analyses of a tooth enamel sample were performed by Robert Tykot (University of Florida). A $\delta^{13}C$ value of –10.5 ‰ was measured on the sample indicating a diet in adolescence composed of C4 plants and marine resources consistent with occupation of the Texas Gulf coast (Tykot 2002). A $\delta^{13}C$ value of –26.5 ‰ measured on the organic fraction of the petrosal bone dated by the University of Arizona seems anomalously large. Although this value has been observed in the bones of groups living in the tropics and therefore might suggest that this individual spent the years prior to her death mainly in a tropical forest environment, the value is unusual in Texas skeletal samples and needs corroboration (Tykot 2002).

The results reported here are preliminary in nature. CRC International Archaeology and Ecology LLC returned to the BZT-1 site in Spring 2003, in collaboration with researchers from Texas A&M University, to conduct additional excavations at the site under an ARPA permit.

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Paleoenvironments: Invertebrates

Eastward Paleorange Extension of the Freshwater Bivalve *Anodonta beringiana* to Bell Basin, Yukon

C. R. Harington and Donald Frost

We describe and provide measurements and a radiocarbon date for several *Anodonta beringiana* shells collected by the second author in September 2001. The shells were exposed on the surface of a gravel bar 6.5 km downstream (66° 59.2′ N, 137° 36.0′ W) from "Porcupine Lake" (a widening of Porcupine River). This is the second documented locality for the species in the Yukon and extends its paleorange eastward more than 160 km to Bell Basin from Old Crow Basin.

The sample examined consists of three nearly complete specimens (two relatively large with separated paired valves and a smaller one with both valves intact). The specimens are readily identifiable because of their large size (e.g., the length, height, and breadth in mm of Porcupine Lake shell CR-02-A are 112.5, 63.2, and 41.7, compared with Old Crow Basin means of 110.6, 63.4 and 42.2); elliptical shape (broadly rounded anteriorly and narrowly rounded posteriorly); dark periostracum (dark brown to yellowish brown); inflated umbo—projecting above the hinge line; and a few straightish bars that parallel the hinge line (Clarke 1981; Warren and Harington 1998).

The Yukon floater (*Anodonta beringiana,* Middendorf 1851) is the most widespread, abundant, and well-preserved freshwater mussel in Old Crow Basin deposits (nearly 460 valves from 40 localities collected by field workers under the direction of the first author, plus 49 previously unreported specimens collected by fieldworkers under the direction of the late Dr. W. N. Irving in the Canadian Museum of Nature's Quaternary Zoology Collection). Historically, this species has been reported from eastern Russia and in various Arctic, Pacific, and Bering Sea drainages in Alaska. Radiocarbon-dated shells from Old Crow Basin indicate that it lived there between 11,500 and 9000 yr B.P., during a period of rapid environmental change (Birch Interval), when climatic and hydrologic regimes differed from those of the preceding cold period (Duvanny Yar Interval) and of today's warmth and moistness. Such

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conditions may have favored the dispersal of *Anodonta beringiana* from a glacial refugium in eastern Russia via its salmonid and gasterosteid host fishes up the Yukon and Porcupine rivers. Fish hosts carry the parasitic glochidial-larvae of the mussels. The chinook salmon (*Oncorhynchus tshawytscha* [Walbaum]), rarely reported from Old Crow River today, is the only known fish host for *Anodonta beringiana* in the upper Yukon system (Warren and Harington 1998).

At present *Anodonta beringiana* is a convenient geochronological indicator of late-glacial downcutting in Old Crow Basin ("*Anodonta* phase"; Harington 1977: 141).

D. W. Taylor, after reviewing the extensive mollusk collections at the United States National Museum, concluded that the species "does not occur in America outside of Alaska" (McCulloch, et al. 1965:449). Based on his observations and interviews with local residents, the first author concluded that *Anodonta beringiana* does not occur today in Old Crow Basin (Clarke and Harington 1978). Other records were based on misidentifications or errors, including Clarke's (1981:293) map showing the modern presence of *Anodonta beringiana* in the headwaters of the Porcupine River and Yukon River systems in the Yukon Territory (Warren and Harington 1988:258).

Although the shells from Bell Basin were originally thought to be of similar age to those from Old Crow Basin, a valve yielded an AMS radiocarbon date of 1,150 ± 40 yr B.P. (Beta-166216). This indicates that *Anodonta beringiana* occupied Bell Basin in the late-Holocene, some 9000 years later than the Old Crow Basin population. Whether they had reached Bell Basin earlier is not known.

We acknowledge the financial support of the Canadian Museum of Nature for the radiocarbon date.

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Paleoecological Inferences Based on Pollen and Stable Isotopes for Mammoth-bearing Deposits of the Oahe Formation (Aggie Brown Member), Eastern Montana

James K. Huber and Christopher L. Hill

Late-Wisconsinan eolian sediments assigned to the Aggie Brown Member of the Oahe formation were first described in North Dakota (Clayton and Moran 1979; Clayton et al. 1976; Clayton et al. 1980) and have been recognized in eastern Montana (Hill 2001; Hill and Davis 1998). The upland stratigraphy within the drainage of the South Fork of Deer Creek consists of eolian silts with several buried soils (paleosols) (Hill and Davis 1998). At one locality, a buried soil correlated with the Leonard Paleosol overlies eolian silts containing the remains of *Mammuthus columbi* (Davis and Wilson 1985; Hill and Davis 1998). There are several radiocarbon ages for these remains, including 11,500 ± 80 RCYBP (Beta-102031) derived from collagen (pretreatment with HCl and NaOH) and 12,330 ± 50 RCYBP (SR-5576) based on XAD-gelatin (KOH-collagen). Thus, radiocarbon dates on a Rancholabrean taxon indicate that deposits of the Aggie Brown Member underlying a buried soil correlated with the Leonard Paleosol are late Wisconsinan. Pollen from these deposits can be used to help evaluate late-glacial ecological contexts on the northern Plains.

Samples were collected from the mammoth-bearing upland silts within the Deer Creek drainage. The samples contained fragments of mollusks and gastropods, small bones, charcoal, and pollen. Three silt samples were analyzed for their pollen content. The samples were treated with a modified Faegri and Iverson (1975) technique (addition of KOH, HCl, HF, and acetolysis), sieved through 7-μm Nitex screens (Cwynar, Burden, and McAndrews 1979), stained with safranin and stored in silicone oil for counting. In addition, one standard *Eucalyptus* tablet was added to the sample in order to estimate pollen concentration values (Maher 1972).

The South Fork of Deer Creek Aggie Brown Member pollen spectra is relatively high in nonarboreal pollen (NAP). NAP ranges from 50 percent to 62 percent. The most abundant NAP types are Cyperaceae (sedge, 5–19 percent), Poaceae (grass, 8–10 percent), *Pteridium*-type (bracken fern, 4–8 percent), *Dryopteris*-type (shield fern, 13 percent), and Campanulaceae (bellflower, 2–6 percent). *Artemisia* (sage/wormwood, 2–3 percent), Tubuliflorae (subfamily of Compositae, 2–3 percent), *Ambrosia*-type (ragweed, 2–3 percent), Chenopodiaceae/Amaranthaceae (goosefoot/amaranth, 1–2 per-

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cent), and *Lycopodium* (clubmoss, 1 percent) are also prominent. Trace amounts of *Selaginella rupestris* (spikemoss) occur in two of the samples.

Arboreal pollen (AP) is characterized by a dominance of *Pinus* (pine, 9–16 percent), *Betula* (birch, 3–7 percent), *Salix* (willow, 12–15 percent), and *Alnus* (alder, 1–4 percent). *Picea* (spruce, 2–5 percent), *Pseudotsuga/Larix* (Douglas fir/tamarack, 1–4 percent), *Quercus* (oak, 5–7 percent), and *Populus* (aspen, 1–3 percent) occur in two of the three samples.

The dominance of *Pinus*, *Betula*, and *Salix* and open-ground herbaceous plants in the South Fork Deer Creek drainage suggest the presence of an open conifer/deciduous parkland. The spectra are similar to that recovered from mammoth-bearing deposits in Centennial Valley, Montana (Huber and Hill 1997). However, more *Picea* (spruce) is present in the Centennial Valley pollen spectra (Huber 1995). The landscape context inferred from the pollen assemblages recovered from the South Fork Deer Creek upland silts can be compared with $^{13}C/^{12}C$ ratios from mammoth fossils imbedded within these deposits (Hill and Davis 1998). Stable isotope measurements of collagen from mammoth bones are within the range associated with C3 plant photosynthetic pathway, indicating a vegetational landscape potentially associated with cool late-glacial climates. The presence of *Picea* in the Aggie Brown Member samples, although low in value (2–5 percent), may indicate cool moist climatic conditions.

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New Late-Pleistocene Mollusk Records from the Mammoth Site of Hot Springs, South Dakota

Christopher N. Jass

The Mammoth site is a 26,000-year-old paleontological locality situated in the southern Black Hills of western South Dakota (Agenbroad and Mead 1994; Agenbroad et al. 1990). Annual excavations at the site began in 1974 and continue to the present. Despite many years of excavation, the potential for recovery of additional microfaunal specimens is high. Recent efforts to pick and sort a portion of the large backlog of sieved sediments resulted in a summary of molluscan remains recovered from the Mammoth site (Jass et al. 2002). Subsequent to that analysis, additional mollusk fossils were identified after further sorting of sieved sediments. Here I report two additional molluscan taxa from the Mammoth site.

Molluscan fossils from the Mammoth site were primarily recovered by wet-sieving excavated sediments through 1-mm mesh screens. The use of a 1-mm mesh screen potentially biases the Mammoth site malacofauna by reducing the number of small taxa recovered (Jass et al. 2002), and the use of smaller screen sizes for attempts to recover mollusks is recommended. The identification of the fossil mollusks reported here is based on phenetic similarity to modern comparative specimens and characters outlined by Pilsbry (1948). An ocular micrometer was used to measure shells. These specimens are curated at the Mammoth Site Laboratory (MSL).

Single shells of *Columella columella alticola* and *Discus* sp. represent new taxonomic records for the Mammoth site. The specimen of *C. c. alticola* (MSL 1885) is cylindrical in shape and contains 6.5 whorls. The aperture lacks teeth and the lip is thin. The specimen is 2.65 mm high and 1.3 mm wide. *Columella columella alticola* is not known to occur in the Black Hills today, but was recently reported from a nearby late-Pleistocene locality, the Nelson-Wittenberg site (Jass et al. 2002).

Another form of *Columella* (*C. simplex edentula*) was previously reported from the Mammoth site (Mead et al. 1994). However, I found only one

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Columella specimen (MSL 1887) in the collection, and I now consider the record of *C. s. edentula* to be invalid. The combination of height (2.7 mm), width (1.6 mm), and number of whorls (4.5) of this specimen is not consistent with published data on extant forms of *Columella* (see Burch 1962; Pilsbry 1948). The structure of the lip suggests that the specimen is a juvenile and more likely represents an additional record of *Pupilla*, based on comparisons with extant pupillids. The single specimen of *C. c. alticola* reported here represents the only known occurrence of *Columella* at the Mammoth site and the second record of this species from Pleistocene deposits in the Black Hills.

A single, incomplete specimen of *Discus* sp. (MSL 1886) closely resembles modern specimens of *Discus* in size, form, and the presence of strong ribbing. Three specimens of *Discus* sp. were reported from the Nelson-Wittenberg site (Jass et al. 2002). *Discus whitneyi* occurs in the Black Hills today (Frest and Johannes 1993) and was reported from late-Holocene sediments from Graveyard Cave in the southern Black Hills (Jass et al. 2002).

Recovery and identification of *Columella columella alticola* and *Discus* sp. from the Mammoth site increases the minimum number of known species of mollusks from 13 to 14 (taking into account the revised identification of the specimen previously identified as *C. simplex edentula*). Of these, seven are terrestrial gastropods, all of which were also recovered from sediments from the Nelson-Wittenberg site. The taxonomic similarity between these two localities suggests a pattern of faunal stability from 37,900 to 26,000 yr B.P. in the Black Hills, although much additional work is needed to confirm this. Evaluating new localities (e.g., Morrison 2000), refining screenwashing methods (i.e., using smaller screen sizes), reevaluating the criteria used to identify fossil mollusks (i.e., what role does geography play in the identification of fossil mollusks?), and further sampling extant mollusks in the region will provide more robust data for testing short- and long-term stability hypotheses. The addition of *Discus* sp. and *C. c. alticola* to the fossil record of the Mammoth Site does not alter previous interpretations of local paleoenvironmental conditions (see Jass et al. 2002; Mead et al. 1994).

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Paleoenvironments: Vertebrates

An Insect-eating Bat (Mammalia: Chiroptera) from the Pleistocene of Argentina

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Compared with other mammals, the fossil record for bats (Mammalia: Chiroptera) is sparse. Among the reasons proposed for this are lack of fossilization, poor preservation of bat bones, and bias introduced by collecting techniques (Arroyo-Cabrales 1992). However, an enhanced bat record has recently been produced by implementing archaeological excavation methodology in paleontological sites. In fact, the first well-documented Chiropteran occurrence in Argentina (Pardiñas and Tonni 2000) was recently published. Another fossil specimen from the Argentinean Pleistocene is documented here.

The studied specimen comes from the archaeological site Epullán Grande Cave (Neuquén, Argentina), with an associated radiocarbon date of 7550 ± 70 yr B.P. (Beta-47401; stratigraphic provenience level 7, roof). Epullán Grande Cave, 40° 23′ 21″ S, 70° 11′ 40″ W, is located ca. 40 km southwest of Piedra del Aguila, Department of Collón Curá, Province of Neuquén, Argentina. It was excavated and studied by Crivelli Montero et al. (1996a). The archaeological sequence covers the early Holocene to the post-Hispanic late Holocene. The remains of small mammals are very abundant, especially toward the middle levels.

Epullán Grande Cave is centered in the western district of the Patagonian steppe, 80 km directly west of the first forests of *Nothofagus* and equidistant from both the Monte and the Central phytogeographical districts (Cabrera 1971). A herbaceous steppe is dominated by *Stipa*, with an important shrubby component of *Mulinum*, *Larrea*, and *Schinus*, and a small "cortaderal" (*Cortaderia*) that flanks both; a cañadón and temporary mallín occur within 5 km of the deposit.

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This cave is a good opportunity to examine the environmental evolution of the last 10 ka in the north of the Patagonian steppe. Stratigraphy is complex. For example, level 7 is a sequence of sands that represents the first 3,000 years of cave fill. Segment 10-7 ka (represented by level 7) possibly indicates a condensation of events. Globally, it reflects severe (although not extreme) environmental conditions, with limited water availability and dominant westerly winds. The low incidence of the sigmodontine rodent *Eligmodontia* sp. at that stage suggests a shrubby steppe less developed than the current one and possibly lower mean temperature (Pardiñas 1999). Additionally, palynological data suggest the development of a herbaceous steppe (Prieto and Stutz 1996).

The specimen MLP 96-V-23-1 is a left mandibular ramus lacking all but the m3. The specimen is almost complete; there is damage to the anterior portion and a pitted coronoid process. Based on the present alveoli, it apparently had the dental formula i /?, c /1, pm /2, m /3. The morphology of the m3 is that of Vespertilioninae m3 type B of Menu (1985). This determination precludes its assignment within the genus *Lasiurus*, which has South American species within the size range of the fossil specimen. *Lasiurus* is considered m3 type C. Furthermore, the fossil mandible is quite gracile, different from the more robust *Lasiurus* mandibles. The tooth is very similar in morphology to that of several species of *Histiotus*. It is provisionally referred to the genus pending a complete review of diagnostic characters of the species within the genus.

This fossil specimen from the Pleistocene of northwestern Patagonia is the first Argentinean fossil record of a bat of the genus *Histiotus* (Vespertilionidae). The presence of such a bat in a lowland locality is surprising. The big-eared brown bat genus *Histiotus* is known from four recent species in Argentina and at least two others within South America (Bárquez et al. 1999; Handley 1996). Among the four species documented for Argentina, the fossil remains suggest an individual whose size and shape fall between the extant species *H. montanus* and *H. macrotus*. Specimens from these two species are rare occurrences in forests, open dry areas, and at high elevations in the mountains. These two species are not known within fossiliferous deposits in Argentina, and the only fossil record for the genus is from Lagoa Santa, Brazil (Paula Couto 1946).

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Size Variation in Southern Plains *Bison Antiquus* from Lubbock Lake and Cooper

Patrick Lewis, Briggs Buchanan, Eileen Johnson, Leland Bement, and Laura Gruss

While bison are integral to the study of late-Pleistocene environments and cultures, research on the populations from the Southern Plains (SP) has been limited (Wyckoff et al. 1994). The large samples of bison metatarsals from the SP sites of Lubbock Lake and Cooper, however, invite questions related to biogeographic variation. *Bison antiquus* metatarsals dating to the late Pleistocene from Lubbock Lake (n = 59) and Cooper (n = 34) were analyzed for differences in size. Lubbock Lake (41LU1) is a well-stratified archaeological site located in a meander of Yellowhouse Draw on the Southern High Plains of northwestern Texas (Holliday and Allen 1987; Johnson 1987b, 1987c). *Bison antiquus* remains are found in the lowermost deposits stratum 1 (S1) and stratum 2 (S2). Stratum 1 dates to 11,000 years ago; deposition of S2 began about 11,000 years ago, with aggradation ending around 8500 years ago (Holliday et al., 1983, 1985). Cooper (34HP45) is located on the floodplain margin of the Beaver River in northwestern Oklahoma (Bement, 1999).

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Three Folsom-age kills occurred within the confines of a narrow arroyo. The Cooper bison sample dates after the Lubbock Lake S1 population and is contemporary with the lower S2 (substratum 2A) population.

To test whether bison populations from the late Pleistocene to early Holocene varied in size, metatarsal lengths were compared and tested for significant differences using analysis of variance (ANOVA). Female samples sizes were S1 = 6, Cooper = 23, S2 = 16. Male sample sizes were S1 = 2, Cooper = 11, S2 = 35. Results of the ANOVA show significant variation between the populations of female bison metatarsals ($p = 0.007$). A post hoc Bonferroni/Dunn test found that the significant result was due to the difference between the S2 and Cooper specimens ($p = 0.03$). No significant differences, however, were found among the male metatarsals (Figure 1).

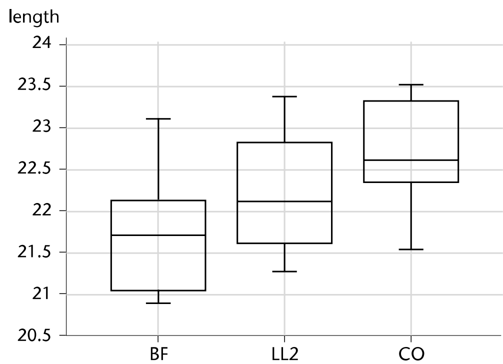

Figure 1. Male metacarpal lengths (cm) for the three ancient bison populations studied, with median, 75th percentiles, and 90th percentiles depicted. **BF,** Bonfire Shelter; **LL2,** Lubbock Lake stratum 2; **CO,** Cooper.

While the Southern High Plains plateau separates it from the rest of the Southern Plains and gives it a distinctive environment, the plateau likely did not limit gene flow between bison herds. These results suggest rather the possibility of a large-scale north/south morphocline or the adaptation of slightly smaller size in the bison on the Southern High Plains. Further work utilizing multiple measurements and both metapodials is under way to address further the evolution of Southern Plains bison through the late Pleistocene and Holocene.

This study is part of the ongoing Lubbock Lake Landmark regional research program into late-Quaternary climatic and environmental change on the Southern Plains.

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Pleistocene Proboscideans from Lago de Chapala, Jalisco, Mexico

Spencer G. Lucas

Located in Jalisco, Mexico, about 60 km south of Guadalajara, the Chapala graben is in the western terminus of the Mexican volcanic belt (Allan 1986). Extension began in the Chapala graben during the late Miocene, and a large lake had developed by Pliocene time. The extant lake is the remnant of that much larger lake, which has been called "Lake Jalisco" (Clements 1963; Mitchell 1965). Plio-Pleistocene lacustrine deposits of "Lake Jalisco" are the Chapala Formation (Clements 1959).

Pleistocene fossil vertebrates from the Chapala Formation are derived from the floor of the lake basin during times of low water level (Downs 1956, 1958a, b; Rufolo 1998). Large collections are housed in the Museo Regional de Guadalajara (MRG), Museo de Paleontologia de Guadalajara (MPG) and the Natural History Museum of Los Angeles County (LACM).

Rufolo (1998) described the LACM collection and documented a diverse Pleistocene assemblage of glyptodonts, ground sloths, canids, felids, capybaras, horses, tapirs, peccaries, cervids, antilocaprids, and bison, as well as a small assemblage of proboscidean fossils he assigned to *Cuvieronius* sp. and *Mammuthus* cf. *M. columbi.* I have studied the much larger proboscidean collections from the Chapala Formation at MRG and visited selected localities. Here, dental measurements are in mm, l indicates maximum crown length, w indicates maximum crown width, m (lower case) indicates a lower molar, and M (upper case) an upper molar.

Three genera of proboscideans are known from the Chapala Formation, the gomphotheres *Stegomastodon* and *Cuvieronius* and the elephantid *Mammuthus.* The *Stegomastodon* record newly reported here is the first from Jalisco.

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It is a single articulated, nearly complete skeleton collected at Santa Cruz de la Soledad in gray calcareous shale of the lake bottom (UTM zone 13, 692479E, 2245494N, datum NAD 27). The skull includes two nearly straight tusks with no enamel present. The lower jaw lacks tusks and has a left m3 with relatively simple trefoils and five lophids; m3 l = 200, w = 88. This is a relatively primitive specimen of *Stegomastodon*, best assigned to *S. rexroadensis* (Lucas and Oakes 1986; Woodburne 1961).

Cuvieronius is represented by many upper and lower jaw fragments and isolated molars, isolated upper tusks (with spiral enamel bands), and postcrania. Mean values (in mm) of selected dental measurements of 14 specimens are m2, l = 126; m2, w = 71; m3, l = 194; m3, w = 85; M2, l = 116; M2, w = 76; M3, l = 179; M3, w = 86. I assign the Chapala specimens to *C. tropicus,* which they most resemble (Lucas et al. 1999; Montellano-Ballestros 2002; Webb and Dudley 1995)

Mammuthus is the most common Pleistocene proboscidean in the Chapala collections, and numerous dental and postcranial remains are available for study. Means (in mm) of selected dental measurements (see Madden 1981 for measuring protocol) of 25 specimens are M3, l = 260+; w = 115; height = 200; number of plates = 14+; plate ratio = 6–8; plate thickness = 11; and enamel thickness = 3.4. For m3, l = 245+; w = 95; height = 175; number of plates = 15+; plate ratio = 7–8; plate thickness = 9; and enamel thickness = 3.2. Rufolo (1998) stressed uncertainties about the species-level taxonomy of *Mammuthus* and only tentatively assigned the LACM specimens to *M.* cf. *M. columbi.* However, his metrics and mine are within the range of values of *M. imperator,* and the enamel thickness values and plate thicknesses of the Chapala mammoths are outside the range of *M. columbi* (Dutrow 1980, Madden 1981, 1995, Agenbroad 1994). Thus, given their relatively thick enamel and plates, I assign the Chapala mammoths to *M. imperator.*

Chapala joins the short list of North American localities where *Stegomastodon*, *Cuvieronius,* and *Mammuthus* apparently co-occur. I am certain that *Cuvieronius* and *Mammuthus* co-occur at Chapala—numerous specimens of both genera were collected together and show the same black manganese preservation characteristic of many of the Chapala fossils (Downs 1958b). However, the Chapala *Stegomastodon* does not have this type of preservation. Furthermore, *Stegomastodon rexroadensis* is a Blancan taxon in the USA, and where *Stegomastodon* co-occurs with *Cuvieronius* and *Mammuthus,* a much more advanced morphology of *Stegomastodon* is present than observed in the Chapala specimen (Hibbard and Dalquest 1966, Lucas et al. 1999). Indeed, these occurrences of advanced *Stegomastodon* with *Cuvieronius* and *Mammuthus* are of Irvingtonian age, and the association of *Cuvieronius* and *Mammuthus* at Lago de Chapala is probably also Irvingtonian. The presence of *Bison* in the Lago de Chapala collections suggests a Rancholabrean age (Rufolo 1998). Therefore, Blancan, Irvingtonian and Rancholabrean mammals appear to be mixed in the Lago de Chapala collections; among the proboscideans, only *Cuvieronius* and *Mammuthus* are directly associated.

I thank the staff of the MRG and MPG for assistance, INAH for financial support, and Gary Morgan and an anonymous reviewer for comments.

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American Mastodont (*Mammut americanum*) and Associated Mollusks from a Pleistocene Alluvial Deposit on the Southern Colorado Plateau in Northwestern New Mexico

Gary S. Morgan, Spencer G. Lucas, and Mark E. Gordon

Pleistocene vertebrate faunas are uncommon on the southern Colorado Plateau in northwestern New Mexico. Two of the most important Pleistocene sites in this region, Black Rock and Trapped Rock Draw, are located on the Zuni Pueblo in McKinley County. Black Rock was one of the first Pleistocene vertebrate faunas described from New Mexico (Gidley 1906), but was not studied in detail until recently (Lucas and Morgan in press). The Black Rock fauna includes *Castor canadensis* (beaver), *Equus* (horse), camelid, *Bootherium bombifrons* (woodland musk ox), *Bison*, and *Mammuthus columbi* (Columbian mammoth). *Bison* and *Bootherium* indicate a late-Pleistocene (Rancholabrean) age for the Black Rock fauna, as does an Ar/Ar date of 164 ± 35 ka on the underlying Black Rock basalt flow (Laughlin et al. 1993).

The Trapped Rock Draw fauna consists of *Mammut americanum* (American mastodont) and associated terrestrial and freshwater mollusks. The site is 2.5 km south of Zuni, McKinley County, New Mexico (35° 03′ N, 108° 51′ W) at an elevation of 1950 m. A mandible of *Mammut americanum* was found in the western cutbank of Trapped Rock Draw in trough-crossbedded gravels of a coarse alluvium about 12 m below the ground surface. The fossil and its depth in the alluvium suggest a late-Pleistocene age, but a more precise date is not available. Today Trapped Rock Draw is a dry wash, but in the Pleistocene it was probably a tributary of the nearby Zuni River.

The right dentary with m2–m3 of *Mammut americanum* from Trapped Rock Draw remains in the field, but we were able to examine the left dentary of this same individual, which includes a partial m2 and complete m3. This left dentary is currently housed in the collections of the Zuni Cultural Resource Enterprise in Black Rock, New Mexico. Measurements (in mm) of the teeth are m2 width, 82; m3 length, 178; m3 width, 93; depth of ramus under m2/m3, 165. The well-worn m3 has four lophids and a talonid and ptychodont enamel. Each lophid on m3 consists of two cuspids separated by a median sulcus. There are no median pillars and no pretrite or posttrite cuspids, and the talonid is a small transverse lophid. The jaws from Trapped Rock Draw are very similar to other specimens of *M. americanum* from New Mexico, especially a left dentary with m2–m3 (NMMNH 25098) from a gravel pit near Lemitar in Socorro County (Lucas and Morgan 1997). *M. americanum* is rare in New Mexico compared with the numerous records of mammoth (Lucas and

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Effinger 1991; Lucas and Morgan 1997). There are five other records of American mastodont from New Mexico (Lucas and Morgan 1997), two from the Sandia Mountains (Sandia Cave and Tree Spring), two in the middle Rio Grande Valley (Los Lunas and Lemitar), and an unpublished record (left m3) from near Piñon in Otero County in the southeastern part of the state. Trapped Rock Draw is the first record of *M. americanum* from northwestern New Mexico.

Small sediment samples (less than 1 kg) from four superposed stratigraphic units at the Trapped Rock Draw site yielded 13 species of terrestrial gastropods, one freshwater gastropod, and one bivalve. Two landsnails (*Vertigo* cf. *V. modesta, Oxyloma* sp.) and a freshwater bivalve (*Pisidium casertanum*) occur in the same layer as the mastodont jaw. Strata immediately below and above the mastodont yielded more diverse molluscan assemblages of nine and seven species, respectively, mostly landsnails, but also including the freshwater snail *Stagnicola caperata*. All molluscan taxa appear to be extant species. Habitat preferences of the mollusks (Metcalf and Smartt 1998; Gordon, personal observations) reflect generally cooler, more mesic environments relative to present climatic conditions. The mollusks from just above and below the mastodont indicate a mixed riparian corridor of grass and deciduous forest surrounded by open stands of mixed conifer. The presence of *Pisidium* and *Oxyloma* in the mastodont layer suggests deposition during a cooler and wetter period with localized marshy conditions. The American mastodont inhabited coniferous forests and riparian habitats (Kurtén and Anderson 1980), supporting the paleoecological conditions suggested by the molluscan fauna. The ancestral Zuni River and its tributaries, such as Trapped Rock Draw, apparently supported a diverse riparian forest in the late Pleistocene, with nearby mixed coniferous and deciduous forests.

Diane Howell and representatives of the Zuni Pueblo allowed us to visit localities on the Zuni Pueblo and study the Trapped Rock Draw mastodont jaw. Paul Drakos and Steve Reneau collected the mollusk samples. Robert Purdy and Robert Emry made it possible for us to examine the Black Rock fauna in the National Museum of Natural History, Smithsonian Institution.

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Dating and Preliminary Observations of an American Mastodon from Northeast Ohio

Brian G. Redmond and Cheryl P. Mattevi

On 28 July 2001, the partial skeleton of an American mastodon (*Mammut americanum*) was discovered during commercial excavation within a late-Pleistocene kettle lake remnant in Columbiana County, Ohio. A salvage excavation of the undisturbed mastodon remains was arranged by the junior author on 31 July, followed by collection of additional remains from spoil piles throughout the month of August. The remains are currently curated in the Department of Archaeology at the Cleveland Museum of Natural History (Accession No. 2001-35).

The Hartley Mastodon site is about 14 km north of the southern terminus of the Kent Moraine of the late-Wisconsinan (about 16,000 yr B.P.) Grand River Lobe described by White and Totten (1985). Topography is gently rolling, with well-drained hilltops adjacent to small, wet depressions. Mastodon remains were found at a depth of about 140 cm at the contact between a lower gray organic marl and higher muck deposits (Mattevi and Munro-Stasiuk 2002). The marl is extremely fossiliferous, with abundant molluscs including *Sphaerium* sp. and *Helisoma* sp. as well as aquatic vegetation fibers, seeds including *Nymphaea* and *Scirpus,* twigs, and spruce (*Picea* sp.) cones. Abundant beaver-chewed wood fragments were closely associated with the remains. Above the mastodon the sediments change abruptly to extremely organic muck deposits, containing abundant vegetation including *Sphagnum* and hemlock *(Tsuga)* cones and twigs. Fossils indicate that during the time the mastodon lived, this was a diverse environment, with a shallow eutrophic lake very rich in aquatic vegetation surrounded by a mixed boreal forest dominated by spruce.

The mastodon remains consist of two tusks and 95 complete or nearly complete bones, which include an intact cranium, mandible, stylohyoid, innominates, sacrum, 36 ribs, 29 vertebrae, and 20 foot bones. The cranium, mandible, pelvic assembly, eight ribs, and nine posterior vertebrae were removed by the contractor prior to systematic excavation. Upon excavation, the remaining vertebral section (C2 through T9) was found articulated and apparently in situ. Found in immediate proximity to the vertebral section were the right tusk, 17 ribs, and 4 bones from the right fore foot. The ribs were not articulated with the vertebrae, and the left tusk was found about 2 m south of the main cluster. Significantly, no long bone elements, scapulae, or sternum were found despite a thorough excavation of spoil piles and adjacent areas.

The bones of the Hartley Mastodon are non-mineralized and in an excellent state of preservation. The dental age of the specimen (following Saunders

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1977:30) is 30 to 35 years based on the presence of the second and third molars and their relative degree of wear. The reconstructed left tusk measures 110 cm in maximum length and 8 cm in diameter at the proximal end. The circumference of the tusk is 24.2 cm, which falls well below the documented range for adult male proboscideans as reported by Haynes (1993:43). The width of the iliac shaft (16 cm) and the diagonal height of the pelvic aperture (42 cm) yield a height:width ratio of 2.63, which falls within the range for female mammoths with independent evidence of gender (Lister 1996:255–258).

Carnivore tooth punctures and gnawing abrasions were detected on bones from all four feet and on the distal ends of several ribs. Human-made cut marks are absent; however, two adjacent fractures on the vertebral bodies of T9 and T10 may be evidence of the deliberate disarticulation of the spinal column using stone or bone tools. This damage somewhat resembles butchering trauma identified by Fisher (1984:343–347) on mastodon remains from Michigan.

Two samples of rib bone submitted for standard radiocarbon assay produced conventional ages of 10,950 ± 40 RCYBP (Beta-165219) and 10,880 ± 50 RCYBP (Beta-165220). These results place the specimen contemporary with the earliest documented presence of humans in northern Ohio (Brose 1994:64–66; Tankersley and Redmond 1999:76–77; Tankersley et al. 2001:62–64). Evidence of Paleoamerican presence in the immediate vicinity of the Hartley Mastodon site is presently limited to surface occurrences of lithic fragments. A small knoll situated only 50 m west of the site has yielded a possible channel flake from a fluted biface. A fluted-point base of Flint Ridge chalcedony was recovered from a hilltop approximately 700 m to the northeast. Continued investigations should help clarify the true relationship, if any, between ancient humans and the Hartley Mastodon.

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A New Record of *Sylvilagus Palustrellus* from the Rancholabrean (Late Pleistocene) of Florida

Dennis R. Ruez, Jr.

The north-central Florida Ichetucknee River fauna contains a diverse assemblage of Rancholabrean (late-Pleistocene) fossil vertebrates from both forest and open-terrain ecosystems (Lambert and Holling 1998; Webb 1974). This assemblage, housed at the Florida Museum of Natural History (UF), contains two species of lagomorphs, *Sylvilagus palustris* and *Sylvilagus palustrellus.* The extant marsh rabbit, *S. palustris,* is abundant in many fossil and modern faunas of Florida and is represented in the Ichetucknee River fauna by at least 22 lower third premolars (p3), the most diagnostic element of fossil rabbits. A single p3 (UF 48448) is referable to the extinct dwarf marsh rabbit, *S. palustrellus.*

The *Sylvilagus palustrellus* specimen (Figure 1) has an anteroposterior length of 2.65 mm and width of 1.92 mm. The posterior enamel wall in the PER (abbreviations in figure caption) is crenulate labially. The anterior wall of the PER is simple, with only slight, broad folding. The AER enamel has only slight folding, and the single AR is broad. There is also a sharp fold of the thick enamel anterolingually. In lateral view UF 48448 has parallel sides, indicating that the tooth belonged to an adult (White 1987, 1991).

The *Sylvilagus palustrellus* p3 may be distinguished from *Sylvilagus palustris*

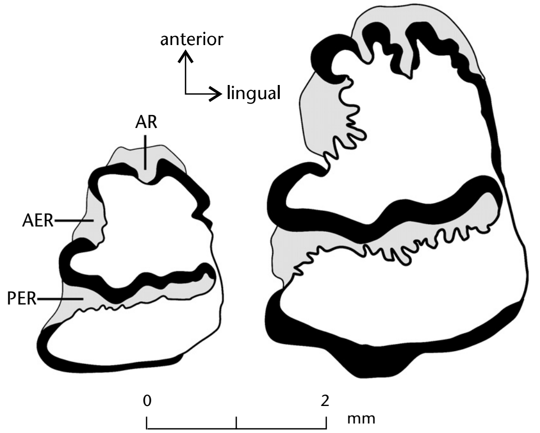

Figure 1. Occlusal view of two left lower third premolars from the specimen of *Sylvilagus palustrellus,* UF 48448. UF 48444 is average in size, degree of folding, and number of reentrants for *Sylvilagus palustris* from the Ichetucknee River fauna. **AR,** anterior reentrant; **AER,** anteroexternal reentrant; **PER,** posteroexternal reentrant. Enamel is shown in black, dentine is white, and cementum is stippled.

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by the small size, anteroposterior elongation, comparatively simple folding in the AER, and single AR of UF 48448. The same characteristics also distinguish *S. palustrellus* from the swamp rabbit, *Sylvilagus aquaticus.* The other abundant late-Pleistocene and modern rabbit in the eastern U.S. is the Eastern cottontail, *Sylvilagus floridanus.* Tooth size of the Eastern cottontail, while averaging significantly larger, may approach that of *S. palustrellus.* The p3 of *S. floridanus* also typically has a single AR; however, it is narrow. Additionally, the AER of *S. floridanus* usually has no folding; folding in the thin enamel of the PER (when present) is usually restricted to the lingual portion, and folding of the thick enamel is likewise lingual and may be extremely crenulate. The p3 is more equidimensional (and may even have a greater width than length).

Sylvilagus palustrellus was previously recorded at Melbourne (Gazin 1950) and Vero (Hulbert 2001; Webb 1974). The specimen reported here adds the inland Ichetucknee River fauna to the known biogeographic distribution, which remains restricted to the state of Florida.

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First Records of Pleistocene Fauna for an Archaeological Context in Uruguay: Evidence from Pay Paso Locality, Site 1

Rafael Suárez

During the years 2000 and 2002, I resumed field research at the Pay Paso locality located in northwestern Uruguay (on the Brazilian frontier) along the Cuareim River. Site 1 was discovered by a local resident, Mr. Lucho Conti, in

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the 1960s. A. Austral investigated the site in the 1980s and published one ^{14}C date of 9890 ± 75 RCYBP on charcoal for the site (Austral 1995:213).

The current field work discovered six new archaeological and paleontological sites in an area extending 10 km along the Cuareim River. Pay Paso 0, 1, and 3 are stratified archaeological sites, Pay Paso 2 and 4 are stratified paleontological sites, and Pay Paso 5 and 6 are surface archaeological sites. Scutes of *Glyptodon* sp. were found in Pay Paso 2, and in 1995 local resident Mr. Roberto Moreira recovered several bones of a young S*tegomastodon* sp. from Pay Paso 4. From the surface 30 m from the *Stegomastodon* sp. bones Mr. Moreira recovered three large specialized bifaces with Paleoindian technological features (platform isolation, basal fluting, and overshot flanking) recently described by Suárez (2001:57, 2002:318 Figure 3 a–b).

This report presents preliminary data of current research at Pay Paso site 1 (30° 16′ S, 57° 27′ W). To date, 59 m^2 has been excavated in the lower level of site 1, where we have identified at least three cultural components with projectile points dating to the Pleistocene-Holocene transition (ca. 10,000–8600 RCYBP), one of which is reported here.

Recently, ^{14}C dates of 9120 ± 40 RCYBP (Beta-56973; AMS on charcoal), 9280 ± 200 RCYBP (Uru-248), and 8570 ± 150 RCYBP (Uru-246) were obtained from Pay Paso site 1. The first two dates, which average about 9100 RCYBP, come from a cultural component where red ocher, bifaces in early and final stages of reduction (n = 4), and more than a thousand pieces of debitage were recovered. The tool assemblage includes projectile points (n = 5), end- and sidescrapers (n = 16), blade tools (n = 2), retouched bifacial tools (n = 1), bifacial thinning flakes with use wear (n = 6), cores (n = 5), multiple tools (n = 3), choppers (n = 3), and others (n = 3). In this cultural component, we found late-Pleistocene fauna in direct context and stratigraphic association with unifacial tools, red ocher, and fragments of plant charcoal (used to obtain the ^{14}C dates). Faunal remains recovered in this cultural component include a *Glyptodon* sp. scute, several tooth fragments (not yet identified), and bones in an initial stage of fossilization. The projectile points are unknown in regional stratified contexts, but recently two have been identified by typological and design features as Pay Paso–type points (Figure 1B) belonging to latest-Paleoindian times in Uruguay ca. 9500–9100 RCYBP (Suárez 2003). In this locality, local collectors have found on the surface 14 Pay Paso–type points similar to those recovered from stratigraphic context.

On the surface of Pay Paso site 1, only 10 m from where we excavated, was discovered an extraordinarily well made large variant of a Fishtail fluted spear point, manufactured on highly silicified sandstone of the Arapey formation (Figure 1A). This artifact is asymmetrical with very pronounced shoulders; the tip and the stem corner were damaged, probably during use in prehistoric times. It exhibits very good knapping technique with large percussion flake scars, excellent basal fluting on one side of the stem, and abrasion/polish on both edges of the stem. It is 109 mm long, 56.8 mm wide, and 9 mm thick; the fluted channel is 26.5 mm long and 12.7 mm wide. It is one of the largest complete Paleoindian fluted points discovered in Uruguay and South America. I wish to emphasize the remarkable size of this fluted point.

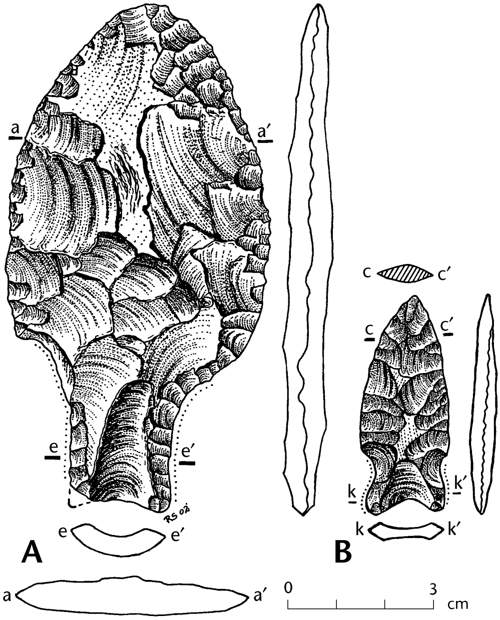

Figure 1. Paleoindian points of Uruguay from Pay Paso site 1, both manufactured on highly silicified sandstone. **A,** large fluted Fishtail spear point (note very pronounced shoulders); **B,** Pay Paso–type point (C2LPVI # 2332), recovered in archaeological excavation (ca. 9500–9100 RCYBP) (note the basal thinning on both faces of the stem).

Another recently discovered Fishtail point is 107 mm long (Suárez and López 2003:73 Figure 5). Both points are in the range of length of 16 large Clovis fluted points present in the Fenn cache (Frison and Bradley 1999:107 Table 1: plate numbers 2 to 7, 10 to 15, 17–18, 24 and 25). These two Fishtail points are also comparable in size to other large fluted and unfluted Paleoindian points in North American Paleoindian assemblages (e.g., Frison 1999:271 Figure 5 a–b; Stanford 1999:294–328 Figure 7 b,c,f and g; Figure 24 b–i; Figure 29 a–e).

In conclusion, new archaeological data obtained from Pay Paso site 1 are encouraging because:

- they identify the first occurrence of late-Pleistocene fauna associated in situ with archaeological material for Uruguay and confirm that late-Pleistocene fauna survived at 30° S latitude, 57° W longitude until the early Holocene, as in other regions of the Southern Cone;
- a new cultural component for Paleoindian times has been discovered. Tentatively called the Pay Paso component, it is characterized by formal tools including Pay Paso–type points, bifacial and blade tools, and end- and sidescrapers. It is dated ca. 9500–9100 RCYBP. Evidence of Paleo-indians in southeastern South America and Uruguay has been previously unknown for this period;
- the Paleoindian period in this geographic region of South America has more variation in cultural and chronological aspects than previously documented.

Future field work in the lower level of the Pay Paso site 1 will focus on resolving problems related to microstratigraphy, producing new ^{14}C data, and generating baseline data on the environment of the Pleistocene-Holocene transition.

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Preliminary Comments on Faunal Material from the Gault Site, Central Texas

Cinda L. Timperley, Pamela R. Owen, and Ernest L. Lundelius, Jr.

The Gault Site is located on the Edwards Plateau in Bell County, Texas. Its close proximity to the Blackland Prairie accounts for the region's rich biodiversity today. Rich biotic resources, presumed to have been in place from the terminal Pleistocene, combined with readily available high-quality tool stone, probably accounted for its appeal for habitation (Collins 2002; Collins et al. 2002).

Gault is a multicomponent site with cultural units ranging from Clovis (ca. 11,200 RCYBP) to historic. Stratigraphic nomenclature used here is our working terminology and applies to the lithology as it occurs generally across the site. Basal flash-flood gravels occur widely in the site and yield moderately permineralized bone that is broken, heavily abraded, and largely taxonomically unidentifiable. Skeletal remains appear to be from mammals deer-sized and larger. Dental remains are preserved more completely and identifiable to *Bison* (bison), *Equus* (horse), and *Mammuthus* (mammoth). No cultural material has been identified from this stratum.

An internally stratified yellow clay overlies the gravels and contains, chronologically, a thick Clovis component, Folsom, and late-Paleoindian components. Taxonomically identifiable vertebrate specimens from the yellow clay as a whole are rare at this stage in analysis, but fossils are plentiful and often found in close proximity to diagnostic artifacts. In addition to thousands of indeterminate isolated fragments catalogued, nearly 100 field jackets await preparation and many specimens will be identifiable to at least family level once prepared. Currently most identifiable elements belong to *Mammuthus*, *Equus*, *Bison*, *Sylvilagus* (cottontail rabbit), Neornithes (bird), Squamata (snake), and Testudines (turtle).

The Clovis component can be split into two horizons. The lower portion is a yellow clay horizon that overlies or interfingers with the gravels. Bone from this horizon is deeply cracked with step-fracture patterns and exfoliated cortex. This weathering is often overprinted with post-burial solution pitting from groundwater activity and root/insect etching. Dental material, occurring as isolated whole and splintered teeth, is identifiable to *Bison* and *Equus*. Burned and unburned bone commonly occur in the same levels in no discernible pattern. Specimens recovered include an *Equus* petrosal and scapula;

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Bison astragali and radius; an antilocaprid molar; and indeterminate large-mammal bone fragments. Nearby Wilson-Leonard and Kincaid sites also yielded horse associated with Clovis-age cultural material (Baker 1998; Baker et al. 2002; Collins et al. 1989). A mandible with erupted m2s and an ulna of a young adult *Mammuthus* possibly represent the same individual. One canid (*Canis* sp.) proximal phalanx co-occurred with the mammoth mandible.

The upper horizon, a gritty yellow clay, has yielded copious indeterminate large-mammal long bone fragments and occasional identifiable elements such as *Bison* teeth and astragali. Seventy percent of field-jacketed specimens were collected from this cultural stratum. Some fragments of large long bones exhibit combinations of spiral breaks, impact fractures, and cut marks. We also recovered small-vertebrate remains, some burned, of snake, turtle, bird, and canid. The bone appears to have experienced little subaerial exposure or fluvial transport. The smooth cortical surfaces do not generally exhibit exfoliation or longitudinal cracks typical of weathered bone. Several specimens in unmistakable Clovis context occurred within 25 cm of broken bifaces and in dense flake clusters containing blades and biface fragments. A single flake cluster yielded two *Sylvilagus* R P2/s and several burned turtle shell fragments.

While *Mammuthus* and *Equus* occur only in the lower horizon of the Clovis component, *Bison* persists through the entire Clovis section and up into the Folsom component. *Odocoileus* (deer) appears in the extreme upper part of the Clovis section. At present, little change has been observed in Clovis tool forms despite change in the megafaunal composition. The Folsom component is sparse; *Bison* is among the few remains.

The late-Paleoindian component occurs in the top of the yellow clay, and in an overlying red clay where present. This component yielded slightly more specimens than did the Folsom. Only *Odocoileus* and *Bison* have been identified.

The overlying Archaic-Holocene black clay/midden stratum yielded numerous vertebrate specimens, primarily *Odocoileus* and small vertebrates including snake, bird, *Didelphis* (opossum), and canid.

While all cultural/geologic strata were sampled at Gault, the focus of study is the Clovis/pre-Clovis deposits, which may ultimately skew species richness or specimen abundance toward these strata. Currently, paleogeographic interpretations are limited. Horse, bison, and mammoth are extinct, and the antilocaprid is extirpated if not extinct. The remaining fauna, to the extent identified, occur in or near the site area. This synopsis covers only preliminary analysis of material collected by UT staff, visiting avocational groups, and volunteers. Results from analyses conducted at Texas A&M and Brigham Young universities are forthcoming and will increase overall information.

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Paleoenvironments: Geosciences

Pleistocene Stratigraphy, Geomorphology, and Geochronology within the Lower Yellowstone River Basin, Montana

Christopher L. Hill

Stratigraphic sequences and geomorphic features provide a record of the middle and late Pleistocene in the lower Yellowstone drainage of eastern Montana. Upland settings contain eolian deposits and paleosols, some associated with Rancholabrean fauna (Hill 2001; Hill and Davis 1998). Within the Yellowstone Valley are several distinct terraces composed principally of fluvial sands and gravels. These fluvial deposits occasionally contain vertebrate remains (Hill 2001). Besides alluvium, stratigraphic sequences in the Yellowstone Valley and its tributaries contain tephra and secondary carbonates. Uranium-series, K-Ar, and radiocarbon dating of materials within the stratigraphic sequences assist in evaluating middle- and late Pleistocene landscape dynamics in this region of the Northern Plains.

Middle-Pleistocene or possibly Sangamonian-age gravels and sands form high terraces around the Yellowstone River valley (Wilson and Hill 2000). Some of these deposits contain fossil vertebrates. For instance, the Doeden gravels north of Miles City, Montana, contain a Illinoian/Sangamonian(?) local fauna that includes ground sloths, mammoth, mastodon, horses, an antilocaprid, a cervid, musk ox, and giant short-faced bear (Hill 2003; Wilson and Hill 2000). The base of these gravels is about 63 m above the present level of the Yellowstone River. Silts overlie the gravels at elevations of about 82 m above the Yellowstone. Dates on tephra and calcrete from within the Yellowstone River and Tongue River valleys indicate that these terraces were formed in the middle Pleistocene or early late Pleistocene (Bergantino 1991; Hinrichs 1988; Izett and Wilcox 1982).

There are also a series of lower, younger terraces within the Yellowstone Valley and its tributaries. Radiocarbon dates on vertebrate remains constrain the minimum age of these deposits. For example, terrace gravels overlain by silts form the 12- to 15-m terrace at Glendive, Montana. Collagen from mammoth (*Mammuthus*) recovered from these gravels dates to 20,470 ± 80

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RCYBP (Beta-155642). Gravels deposited along Beaver Creek, near Wibaux, Montana, also contain proboscidean remains (Hill 2001). Tusk fragments from these gravels have been dated to 26,000 ± 120 RCYBP (XAD-gelatin, KOH-collagen, SR-6086, CAMS-84539). Thus the lower terraces appear to have been formed during the late Wisconsinan, perhaps slightly before and during the Last Glacial Maximum.

The uplands within the lower Yellowstone drainage contain stratigraphic sequences associated with the last glacial-interglacial transition (Hill 2002). These settings indicate that late-glacial environments were associated with intervals of eolian deposition interrupted by periods of increased landscape stability and soil formation. Some pedogenic features are secondary carbonates possibly associated with arid climates; other buried soils are characterized by well-developed A-horizons that possibly developed during wetter or cooler climates. Two stratigraphic sequences illustrate this pattern. The South Fork of Deer Creek flows into the Yellowstone Valley from the north. Upland silts overlie bedrock and contain buried A horizons and secondary carbonates (Hill and Davis 1988). The silts contain the remains of a mammoth (*Mammuthus columbi*). There are two ages based on collagen from this mammoth, 12,330 ± 50 RCYBP (XAD-gelatin, KOH-collagen, SR-5576, CAMS-72348) and 11,500 ± 80 RCYBP (HCl and NaOH, Beta-102031) (Hill 2001; Hill and Davis 1998). Stratigraphic sequences south of the Yellowstone River also contain eolian silts and buried soils. For example, buried A horizons developed within eolian silts present at OTL ridge (south of Glendive, Montana) have a humic-acid age of 11,415 ± 35 RCYBP (SR-6089, CAMS-84533) and total organic carbon (treatment with HCl but not NaOH) ages of 9540 ± 90 RCYBP (Beta-155709) and 9330 ± 80 RCYBP (Beta-155708). These upland lithostratigraphic sequences can be correlated with the Aggie Brown Member of the Oahe formation (Artz 1995; Clayton and Moran 1979; Clayton et al. 1976; Clayton et al. 1980) and other regional late-Pleistocene deposits (Rawling et al. 2003).

The drainage of the lower Yellowstone Valley contains several sets of fluvial gravels that form middle- and late-Pleistocene-age terraces. Direct dating of vertebrate fossils recovered from deposits forming the lower terraces indicates these were likely formed between 26,000 and 20,000 RCYBP. Deposition of upland silts had been initiated by about 12,000 RCYBP. Soil-forming episodes occurred close to the Pleistocene-Holocene transition, generally within the interval 11,000–9000 RCYBP, and can be correlated with the Leonard Paleosol.

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An OSL Evaluation of the Depositional Chronology of the Cow Creek Floodplain, Payne County, Oklahoma

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Fluvial sediments, particularly overbank floodplain deposits transported at high turbidities, have traditionally been a challenge for luminescence dating. However, in recent years advances in experimental and analytical methods have expanded the applications of luminescence dating for Quaternary research.

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Tributaries of the major rivers in central Oklahoma have experienced floods throughout the Holocene. The flooding history of Black Bear Creek, a tributary of the Arkansas River in north central Oklahoma, has been examined by McQueen and others (1993). They reported evidence of distinct flooding events after 1150 yr B.P. and 3600 yr B.P. based on ^{14}C dating of buried soils. Similarly, studies by Carter (1990) of soil cores from the Deer Creek and Bluff Creek floodplains, tributaries of the Cimarron River in central Oklahoma, suggest that significant depositional events occurred after 1100 and 4000 yr B.P., which are consistent with the observations of McQueen et al. (1993).

Cow Creek is a tributary of the Cimarron River that lies between the two study areas cited above. At the Oklahoma State University agricultural research farm (36° 07′ 12.28″ N, 97° 05′ 59.62″ W) a permanent artificially exposed soil profile for teaching purposes provides an opportunity to study similar flood deposits. The floodplain soil profile (Ashport series; fine-silty mixed thermic fluentic Haplustoll) exposes a 1.9-m section of sandy fluvial deposits overlaying a buried soil horizon (Figure 1). The deposits above the buried soil have been interpreted as the result of a single late-Holocene flood; variations in texture are attributed to eddies in the flood waters. However, the variations in color and texture as well as distinct stratification could instead be the signature of depositional units resulting from more than one event.

The objective of this study was to use the latest experimental and analytical advances in OSL (optically stimulated luminescence) dating to evaluate the number and timing of depositional events recorded in the fluvial sediments at the Cow Creek study site.

Samples for OSL dating (Figure 1) were collected from the C horizon at 121, 140, and 162 cm below the modern surface, with particular attention placed on an exceptionally distinct layer at ca. 130–150 cm. This stratigraphic layer (OSL #2) was composed of strongly cross-bedded light tan, fine to medium sands. The layers above and below (OSL #1 and #3) were less strongly cross-bedded and composed of reddish brown to reddish tan fine sands and silts.

OSL dating was conducted in the Optically and Thermally Stimulated Phenomena Laboratory at Oklahoma State University following laboratory procedures described in Lepper et al. (2000) and Lepper (2001). Experimental methods included single-aliquot regeneration (SAR) data collection (adapted from Murray and Wintle 2000) and objective dose distribution analysis (Lepper and McKeever 2002). These methods make it possible to determine hundreds of age estimations per sample and to select a representative age for the deposit based on the shape of the data distribution. Dosimetric data were obtained via gamma-ray spectroscopy (Nextep Technologies, Stillwater OK). Two ^{14}C dates were available from the buried soil (conventional bulk SOM), 1210 ± 60 RCYBP (Beta-31826; 230–260 cm depth) and 1610 ± 70 RCYBP (Beta-33924; 267–333 cm depth).

The OSL ages obtained were 1225 ± 430 (OSL #1), 1690 ± 910 (OSL #2), and 3750 ± 1200 (OSL #3) yr B.P. Seemingly large uncertainties reflect properties of the data distribution rather than simply computational errors (Lepper

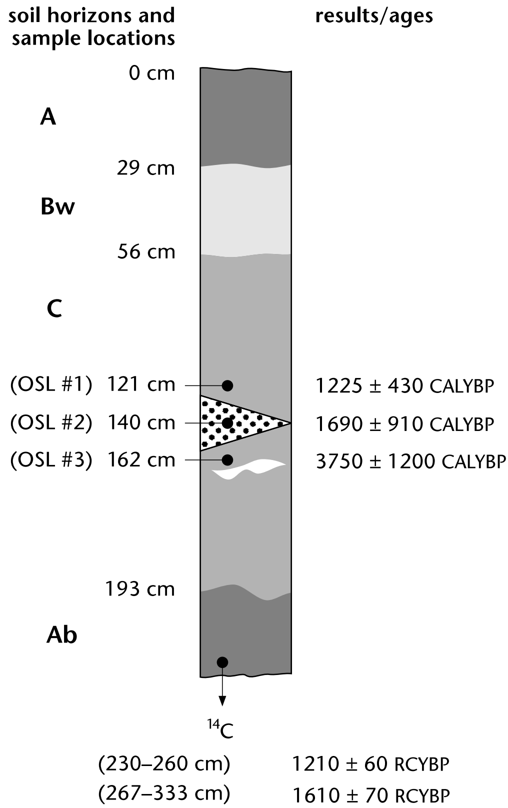

Figure 1. Stratigraphic representation of the Soil Science Teaching profile in the Cow Creek floodplain, showing OSL sample locations and dating results.

2001) and should not be considered a weakness of the analytical method. The OSL ages for samples #1 and #3 correlate extremely well with local flooding events documented in watersheds less than 50 miles to the north and south of Cow Creek (Carter 1990; McQueen et al. 1993). Based on its textural and stratigraphic distinctness, which includes a higher degree of sorting and exceptionally strong cross-bedding, the unit containing OSL #2 could be interpreted as a channel feature rather than a floodplain deposit. The OSL depositional chronology for Cow Creek is also consistent with an established general paleoclimatic history for the Osage Plains, documenting a regional period of stream aggradation between ca. 1000 and ca. 5000 yr B.P. (Hall, 1988). Although the OSL ages are stratigraphically consistent with each other, they are not so with the ^{14}C ages (evaluated in greater detail in Lepper, 2001).

Based on OSL ages obtained in this investigation, the upper 1.9 m of floodplain deposits exposed in the Cow Creek soil profile can be interpreted as the result of as many as three Holocene depositional events that are consistent with local paleoflood histories and the regional response to paleoclimatic influences. The OSL methods used here should have equal utility for studies of similar Pleistocene deposits.

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Paleoclimate under the Microscope: Sediment Micromorphological Analysis at the Gault Site, a Paleoamerican Site in Central Texas

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The Gault site is an open-air Paleoamerican site located along a mesic valley floor near the source of Buttermilk Creek, a first-order stream in central Texas. The site was buried within an alluvial-colluvial matrix overlying limestone bedrock and appears to have been occupied intermittently for 11,000 years. During excavation, attempts to collect paleoenvironmental data (e.g., pollen) yielded no results; therefore it was necessary to consider other sources of data for paleoenvironmental reconstruction. As part of the broader geoarchaeological investigation, sediment micromorphological analysis was conducted on sediment samples collected from three locations across the site. Sediment samples from each of the nine main stratigraphic units containing artifacts were used for 44 thin sections. Field analysis identified pedogenic features including soil structure, redoximorphic features, and precipitation of calcium carbonate. However, some features were not fully understood until they were subjected to micromorphological analysis. For example, the origin of calcium carbonate features found throughout the Gault site was unclear from normal field observations. Micromorphological analysis clarified the carbonate genesis and the extent of pedogenesis linked to local paleoclimatic trends.

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Calcium carbonate can become dissolved and redeposited (precipitated) as the result of variations in soil pH, carbon dioxide concentration, temperature, and biological activity (Birkeland 1999; Drever 1997; Krauskopf and Bird 1995; McFadden et al. 1991; Wright and Tucker 1991). Such deposits or accumulations are known as pedogenic calcium carbonates. Micromorphological evidence from the Gault site suggests that although some lithogenic calcium carbonate clasts (fossil fragments and limestone clasts) were alluvial or colluvial, most features are pedogenic (filaments, pore coatings, and nodules), based on the guidelines set forth by West et al. 1988. Furthermore, these features do not exhibit the morphology common to groundwater calcium carbonates, which tend to be coarse-grained and predominantly found in voids (Birkeland 1999). Nonetheless, samples for stable C isotope analysis from the Gault site are currently being processed, although preliminary observations suggest they are pedogenic.

Micromorphological analysis and particle-size analysis (including analysis on a carbonate-free basis) suggest that pedogenesis occurred as the precipitation of calcium carbonate. In the unit overlying bedrock and containing Clovis artifacts (Unit 3a), calcium carbonate concentration is very low (3.4 percent $CaCO_3$ Eq.) compared with overlying Units 3b (42 percent $CaCO_3$ Eq.), 4b (47 percent $CaCO_3$ Eq.), and 4c (33 percent $CaCO_3$ Eq.) containing Clovis and late-Paleoamerican artifacts. More specifically, calcium carbonate originally deposited in Unit 3a (Clovis) was likely leached prior to burial of this unit. Unit 3b (Clovis) contains a high concentration of calcium carbonate and a low concentration of redoximorphic features, which suggests that pedogenesis was moderate compared with Unit 3a. Within Units 4b and 4c, the significant increase in calcium carbonate in Unit 4b was likely caused by leaching from overlying Unit 4c. However, each of these units consists of alluvial sediment originating from a common source (Buttermilk Creek drainage area), which contains similar concentrations of calcium carbonate upon deposition. Therefore, contrasts in calcium carbonate accumulation are most likely linked to variation in pedogenesis.

Climate is one of the major factors that control pedogenesis (Birkeland 1999). Therefore variation in climate will cause variation in pedogenic features between stratigraphic units, reflecting contrasts in the local climate regimes in which they formed. Pedogenic calcium carbonate features in each stratigraphic unit were identified through micromorphological analysis, and variations of these features between stratigraphic units infer climatic trends such as temperature and precipitation. Furthermore, these climatic trends correlate with regional paleoenvironmental models for Texas and Arizona.

Evidence from the Gault site most closely correlates with the paleoenvironmental model for central Texas (Nordt et al. 1994) based on stable C isotope analysis. According to this model, Units 3a and 3b (Clovis) formed during a relatively dry period compared with overlying units. Stratigraphic and geomorphic evidence in southeastern Arizona indicates that water table levels dropped significantly around 10,900 yr B.P. (Haynes 1991, 1993). This correlates with the oxygen isotope record (decrease in $\delta^{18}O$ levels) during the colder and drier Younger Dryas period that occurred in northern Europe ca.

10,750 yr B.P. At the Aubrey site in northern Texas, geochemical, botanical, and faunal data imply that the environment was cool and dry from the end of the Pleistocene until the Clovis period and possibly later (Humphrey and Ferring 2001).

Micromorphological analysis of pedogenic features influenced by climate can be useful in interpreting paleoenvironmental trends between stratigraphic units, particularly when additional paleoenvironmental data have not survived in the archaeological record. This is especially significant when these trends can be compared with independent models from the same region.

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Errata

The following corrections apply to “Beyond 12 Mile Creek: Other Paleoamerican Evidence From Logan And Wallace Counties, Kansas,” by Janice A. McLean, which appeared in last year’s issue of *Current Research in the Pleistocene* (Vol. 19, 2001), pp. 64–57.

1. On 12/7/2002, 14LO16, discussed on p. 66, became 14WC17. The site is located on the Wallace/Logan border and was mistakenly assigned to Logan County during the writing of this article.
2. The Clovis perform (Figure 1A), temporarily assigned database identification 14WCTEMP-133, received real site number 14WC76 on 1/6/2003.

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