CURRENT RESEARCH IN THE PLEISTOCENE

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Contents

From the Editor

Dillehay Breaks the Clovis Barrier!

> There was a demon that lived in the archaeological record.
> The demon lived at 11,500 years B.P. on the radiocarbon meter.
> He lived behind a barrier through which they said
> no man could ever pass.
> They called it the Clovis barrier . . .
>
> (With apologies to the movie *The Right Stuff*)

Earlier this year, Tom Dillehay presented the final report on his work at the Monte Verde site (Dillehay 1997). Donald Grayson is quoted, on the jacket cover of the book, as claiming the report represents "a historic turning point in our understanding of the initial peopling of the New World." David Meltzer says it is "a milestone in American archaeology" (1997:754). Most readers of this journal will appreciate that the sentiments expressed by Grayson and Meltzer are not hyperbolic. Dillehay has done nothing less than demonstrate, once and for all, that people were in this hemisphere at least ten centuries before the Clovis culture appeared in North America.

Even Vance Haynes has publicly accepted the validity of the 12,500-year-old occupation (Gibbons 1997:1257). Thomas Lynch still has his doubts. He is quoted as saying that there won't be a "total consensus" until "the pattern repeats itself at other sites" (quoted in Gibbons 1997:1256). There is an interesting irony in Lynch's stubborn skepticism. Dillehay himself uses the same argument to hedge his bets on the earliest occupation level at Monte Verde.

Dillehay acknowledges that "the combined geological, spatial, and archaeological data are acceptable and, when taken together, meet the criteria for a valid cultural site" (1997:774); but he cannot bring himself to accept the evidence for the 33,000-year-old occupation at Monte Verde. Why not? Because "we have no theory per se that supports an early (pre-15,000 B.P. or pre-20,000 B.P.) entry" (1997:774) and because there is no "suite of strong candidate sites to suggest an earlier human presence" (1997:787).

Meltzer (1989:484) has argued that a suite of sites is unnecessary. One site that meets the criteria for a valid cultural site is sufficient. If Meltzer is right, then our theories must now accommodate a human presence in the Americas not just 12,500 years ago, but more than 30,000 years ago. In the game of science, theories are tested by observations of the facts of nature, not the other way around (e.g., McCain and Segal 1973:99).

Dillehay has finally exorcised one demon from the pandemonium of

American archaeology. It would be a shame if that same demon were now to take up residence at 12,500 B.P.

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ERRATA

Two unfortunate typographical errors appeared in "Comments on Eastern Clovis Lithic Technology at the Carson Conn Short Site (40bn190)" in *CRP* Vol. 13. The numbers in paragraph 3, Page 62, should have read "5 to 30 cm thick." In the following paragraph, the figures should have been "between 4,500 and 5,500 °F minimum temperatures." We apologize to Hugo G. Nami and his co-authors for these errors, which occurred in the editing process.

Also in *CRP* Vol. 13, the table was inadvertently dropped from Daniel S. Amick's paper, "Geochemical Source Analysis of Obsidian Paleoindian Points from the Black Rock Desert, Nevada." That paper appears—with table—in this volume.

Archaeology

Folsom Collections from the La Vega Site in West-Central New Mexico

Daniel S. Amick

This paper discusses a previously unreported Folsom collection from the La Vega site (LA 9075) in west-central New Mexico. Located about 13 km south of Grants, the site was recorded in 1969 by Stewart Peckham (Museum of New Mexico). Victor Brown, a local resident, collected the site during the late 1960s. Brown loaned some broken artifacts to Peckham but retained the complete pieces. When Peckham attempted to return the collection, Brown reportedly had moved to Oklahoma. In this paper I describe the portion of Brown's collection still at the Museum of New Mexico and the history of work at the site. Sullivan (1987) states that John Speth (University of Michigan) also conducted surface collections and test excavations at La Vega. It is possible that Brown's collection was augmented by Speth's later work.

La Vega is situated on the west side of El Malpais, an extensive late-Holocene lava flow covering most of the basin floor south of Grants. The Zuni Mountains lie immediately west, and abundant cherts from the San Andres Formation occur southwest of the site. Folsom activities at La Vega included lithic procurement and fluted-point manufacture from these cherts.

My analysis of the Brown collection produced six Folsom point fragments, four fluted preforms, and 21 channel-flake fragments. Nineteen (61%) of these 31 artifacts are made from local San Andres Formation chert. Remaining raw materials are from various sources in northwestern New Mexico found within 200 km (Banks 1990; Harris et al. 1967). Point fragments include three laterals, one base, one corner, and one tip. All show impact damage. Three points are San Andres chert, one is Cumbres, one Jemez obsidian, and one gray-tan chert (unknown source). Preforms include one overshot base and three corner fragments. Three preforms are San Andres chert and one clear (yellowed) chalcedony. Channel flakes include one proximal, one distal, and 19 medial fragments. Five channel flakes show use modification. The under-representation of proximal fragments may suggest collection bias. Thirteen channel flakes are San Andres chert, two are Chuska, two Zuni, one Chinle, one Cumbres, one gray-tan chert, and one white chalcedony.

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Cherts from the nearby San Andres Formation outcrops are typically white opalescent ("china") or white with black swirls ("fingerprint"). The china variety is lustrous and has low compressive strength, requiring unusually steep beveling on basal margins to reduce platform collapse during fluting. The preform corner fragments resulted from perverse fracture while fluting this relatively soft toolstone. Multiple fluting is evident on two preforms and three channel flakes.

In 1986 and 1988, the Laboratory of Anthropology conducted surface collections and excavations prior to road improvements along Highway 53, which runs through the site (Sullivan 1987; Sullivan and Boyer 1988). A fluted preform base (overshot on first flute) made of San Andres chert was the only Folsom artifact from that work. Archaic, Basketmaker, and Pueblo period artifacts were common. Cultural materials were shallow (less than 10 cm below surface), and numerous pit features were recorded. Radiocarbon samples from two features yielded dates of 6,615 ± 60 (AA-3634) and 8,830 ± 70 (AA-3633). Hydration analysis of 12 Jemez obsidian artifacts produced date estimates ranging from 2,500 to 9,150 B.P. (Montgomery and Bowman 1989). These results demonstrate La Vega is a complex multicomponent site, but the earlier collection of Folsom artifacts by Brown and Speth is notable.

Regional context is difficult to establish for La Vega since little is known about Folsom occupations in this region. Huckell (1982) has reported a few isolated Folsom finds from east-central Arizona. Grants 10 (Airport) and 12, multicomponent dune sites, lie along the Rio San Jose about 15 km north (Agogino 1961; Roosa 1968). Roosa (1968:148–154) reports Grants 12 is a substantial Folsom workshop containing about 150 pitchstone (low-grade obsidian from East Grants Ridge) channel flakes. However, I was unable to confirm these channel flakes or any Folsom artifacts in my examination of this collection (Maxwell Museum, Albuquerque). Furthermore, Folsom use of pitchstone is not recorded elsewhere in New Mexico (Amick 1994a), so I remain skeptical of the Folsom record at Grants 12. On Cebollita Mesa, about 20 km east, 15 Folsom points (fluted and unfluted) were recorded (Broster 1983; Broster and Harrill 1982). But closer examination shows most are isolated artifacts that are fire-damaged and heavily reworked by later cultures (Amick 1994a, 1994b). Numerous Folsom materials have been found in the San Agustin Plains about 80 km south (Amick 1994a; Beckett 1980; Weber 1963). It is possible that similar Folsom evidence remains unreported for the El Malpais and adjacent North Plains region.

Special thanks to Jeff Boyer at the Laboratory of Anthropology (Santa Fe, NM) for providing access to the collection and previous reports and field notes. Conversations with Dennis Stanford (Smithsonian Institution) and Bob Weber (New Mexico Tech) helped confirm my raw material identifications. Thanks also to Kim Trinkaus (Maxwell Museum) for access to the Grants 12 collection and to Bruce Harrill (Bureau of Indian Affairs, Albuquerque) for access to the Cebollita Mesa collection.

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Hawk's Nest: A New Gainey-Clovis Site in Northeastern Illinois

Daniel S. Amick, Thomas J. Loebel, Toby A. Morrow, and Juliet E. Morrow

Repeated surface collections, since 1992, have produced an assemblage of Paleoindian artifacts from a plowed field about 40 km northwest of Chicago. These tools appear to be technologically diagnostic of the Gainey Complex, a fluted-point variant found around the southern Great Lakes (Storck 1991). Few reliable dates currently exist for Gainey, but an age of 11,000–10,500 years B.P. is commonly recommended (Deller and Ellis 1988:255; Simons et al. 1984; Storck and Spiess 1994:125). This site lies on glacial moraine loess formed during the Woodfordian Substage about 12–20,000 years ago (Frye and Willman 1973). Nearby pollen records from Volo Bog indicate open spruce woodlands at 11,000 B.P., which were rapidly replaced by pine, fir, birch, and ash (King 1981). Oak-dominated deciduous forest was present by 10,300 yr B.P. The speed and timing of terminal-Pleistocene environmental change in this area makes it difficult to know what type of environment these Paleoindian occupants were inhabiting.

Existing knowledge about Paleoindian occupations on the southwest side of Lake Michigan is extremely sparse. There are a few dozen fluted-point isolates reported from southeastern Wisconsin (Stoltman and Workman 1969), and several isolated Clovis points are reported from locations in northeastern Illinois (Harrison et al. 1977; Markman 1991). These records suggest a dispersed scatter of fluted projectile points mostly from upland settings.

We refer to this site as Hawk's Nest (11LK344). It is situated next to a small upland depression and is a significant Paleoindian artifact concentration within this region characterized by isolates. Currently, the chipped-stone assemblage contains 130+ waste flakes, 19 end scrapers, 16 fluted-point preforms, 14 side scrapers, 14 utilized flakes, 8 retouched flakes, 7 bifacial blanks or cores, 2 channel flake fragments, 1 fluted-point midsection, and 1 *pièce esquillée*. The site may have been under cultivation for about 60 years; we do not believe previous collection of the site has biased the assemblage, but we continue to investigate this problem. The high proportion of fluted preforms in the Hawk's Nest assemblage is unusual and may suggest weaponry retooling was a key activity. Domination of the tool assemblage by scrapers indicates significant processing and maintenance activities. Settlement function remains to be determined, but we think the site may represent a transitory camp

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along a route of travel associated with the adjacent pond and upland area or some other place.

Toolstone materials include some long-distance sources, but most is locally available. About 55% of the artifacts are local Silurian chert. These poor- to medium-quality stones occur in glacial till deposits and bedrock exposures throughout the region (Willman 1971). Moline chert represents 16% of the assemblage, and sources are located about 200 km west-southwest. Approximately 13% of the assemblage consists of Oneota chert from about 110 km southwest. Another 2% is Shakopee chert from the same area. At least 7% of the artifacts are tentatively identified as Burlington chert. The closest source of Burlington is about 245 km southwest. One end scraper resembles the gray variety of Salem or St. Louis chert also from southwestern Illinois.

Transport from southwest to northeast is indicated by the presence of Moline, Burlington, and Salem. Movement from south to north is indicated by Oneota and Shakopee. These patterns correspond with upstream movement along major river systems, although drainage divides must be crossed to gather these diverse lithic materials. Reduction state of different raw materials reflects distance from source. Large artifacts are made from local (Silurian) materials, while artifacts made of more distant materials (e.g., Moline) are generally smaller and more exhausted. Also there are differences in raw-material frequencies in different tool classes. End scrapers exhibit a diversity of toolstones while 13 of the 16 fluted preforms are made from local (Silurian) cherts.

All stone tools have been piece-plotted using a tape and compass. These Paleoindian artifacts are spatially concentrated in an elliptical area of about 150 by 70 m. Smaller clusters which may represent functionally specific activity areas are identifiable within this scatter. Plowing has damaged many artifacts and may have altered artifact distributions, but we are hopeful that useful spatial information can be recovered and that future subsurface testing will reveal stratigraphic and datable context.

Hawk's Nest may provide valuable information on site distribution and functional variation within the Gainey/Clovis Complex. Clovis land use patterns in the glaciated portion of northern Indiana (Cochran et al. 1990) seem similar to those known from northern Illinois. This record is dominated by isolated projectile points often made from abundant local materials of poor quality. Such patterns may be consistent with generalized foraging.

Thanks to Doug Kullen, Mike Wiant, and Terry Martin for assisting our work on a portion of the 11LK344 collection housed at the Illinois State Museum. Comments on this work by Jack Hofman and Michael Shott have been very helpful.

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A Painted Skull from the Cooper Site: A Folsom Bison Kill in NW Oklahoma

Leland C. Bement, Marian Hyman, Michael E. Zolensky, and Brian J. Carter

An extensively trampled bison skull from the contact between two of the three bone beds at the Folsom-age Cooper site in NW Oklahoma has a red zigzag line 5cm long and 4mm wide painted on its frontal (Figure 1). The line traverses the frontal suture, and paint is deposited on the open suture walls. A second area of paint lies 1.5 cm anterior of the first. Its extent is unknown due to damage from trampling. Taphonomic and site formation analyses suggest the skull was painted just prior to the second kill, after natural decay had cleaned and bleached the skull's surface (Bement 1994). The success of the second kill is amply indicated by the bison skeletons overlying the painted skull and the extensive damage by trampling.

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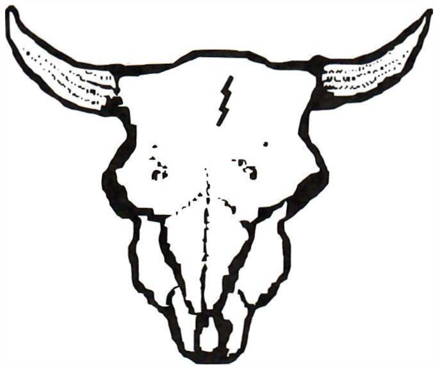

Figure 1. Painted zigzag on trampled bison skull.

Scanning electron microscopy (SEM) and microparticle X-ray diffraction (XRD) were utilized to characterize the pigment. No attempt was made to identify any binder that might have been used to liquefy the paint. SEM analysis was accomplished using a JEOL 35 SEM with EDS. XRD analysis employed a Gandolfi camera. The sample was fastened to the end of a glass fiber and mounted in a rotation device that caused it to rotate simultaneously and at different angular velocities about two axes, yielding essentially a complete powder pattern from an unpowdered sample. A useful diffraction pattern was obtained two days after evacuating the camera to minimize air scattering of the X-rays.

The SEM analysis indicated that a scraping of the pigment included quartz, Ca (probably calcite) and a colloid-like silica mixture containing Si, Al, Mg, K, and Fe. In addition, a crystal of titanium oxide was present along with trace amounts of phosphorus, probably from a bone chip.

XRD analysis revealed the pigment was a mixture of iron oxides and hydroxides including: akaganeite (B-FeOOH), ferrihydrate (Fe_5O_7OH), lepidocrocite (y-FeOOH), maghemite (y-Fe_2O_3), and magnetite (Fe_3O_4), along with rutile (TiO_2), quartz (SiO_2), Manganoan calcite ($Ca,MnCO_3$), gypsum ($CaSO_4$), and orthoclase ($KAlSi_3O_8$). These mineral compounds are common in the Permian bedrock and soils developed from eroded bedrock in this portion of the plains. The pigment was likely selected from nearby soil and rock concentrations.

Many iron oxides and hydroxides are included in the general category of hematite. Hematite has been observed in mortuary and domestic contexts at several New World Paleoindian sites. Mortuary use in the New World includes the Anzick site (Lahren and Bonnichsen 1974) and the Gordon Creek burial site (Anderson 1966). At these sites, hematite covered the bones and associated tools. In a domestic context, hematite has been found at Sheaman (Frison and Stanford 1982), Hanson (Frison and Bradley 1980), Lindenmeier (Wilmsen and Roberts 1978), Stewart's Cattle Guard (Jodry 1987), and Agate Basin (Frison and Stanford 1982) in the form of rubbed hematite nodules, hematite-stained grinding slabs, and hematite dust on possible house floors. Hematite mining was identified at the Powers II site in Wyoming (Stafford

1990). Hematite from this site may have been used in the pre-Folsom level at Hell Gap Locality I (Tankersley et al. 1995).

The Cooper bison skull is the first New World Paleoindian example of art in a non-mortuary ritual context (Roper 1991). A mammoth skull decorated with geometric designs, including zigzags, from Mezhirich and painted post-cranial mammoth bones from Mezin and Mezhirich are upper-Paleolithic counterparts (Soffer 1985).

Other kill-site phenomena indicating non-mortuary ritual include the shaman pole found at Jones-Miller (Stanford 1978) and the possible shaman hut adjacent to the corral at the Archaic-age Ruby site (Frison 1991:208). The bone-filled feature at the Folsom-age Lake Theo site may be another example of ritual associated with bison kills (Harrison and Killen 1978:20,89).

The painted skull at Cooper probably functioned as a talisman or invocation for a successful hunt. Once the kill transpired, the power of the painted piece was spent and its remains abandoned. Only the fickle finger of fate preserved some portion of it for us to discover some 10,000 years later. If this example is part of a culture-wide practice, then perhaps other painted skulls can be found in future explorations of Folsom sites or in existing collections.

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Cody-Complex Artifacts in Oklahoma

Jeannette M. Blackmar and Jack L. Hofman

Few artifacts attributable to the Cody complex had been recognized from Oklahoma by the 1950s (Bell and Baerreis 1951). In 1961, Ray listed only two published articles that documented Scottsbluff points from Washita and McCurtain counties. Since that time the number of published accounts and counties containing Cody-complex artifacts has increased substantially. The 96 Cody artifacts reported in this study occur in 22 counties from the extreme north to south and in the western panhandle to the eastern forest margin of Oklahoma (Figure 1). This distribution, however, is not uniform. The highest frequencies per county occur in Washita (n = 18), Caddo (n = 17), Haskell (n = 9), Blaine (n = 8), and Texas (n = 7). A concentration of Cody artifacts is documented in west-central Oklahoma that accounts for more than a third of the total Oklahoma Cody-complex artifacts (n = 36, 37%). The uneven distribution of Cody artifacts can be partly attributed to limited study of private collections and active collecting of localities with early-Holocene deposits.

Included within the Cody complex are Scottsbluff points, Eden points, and Cody Knives (Wormington 1957, Frison and Todd 1987). This study also

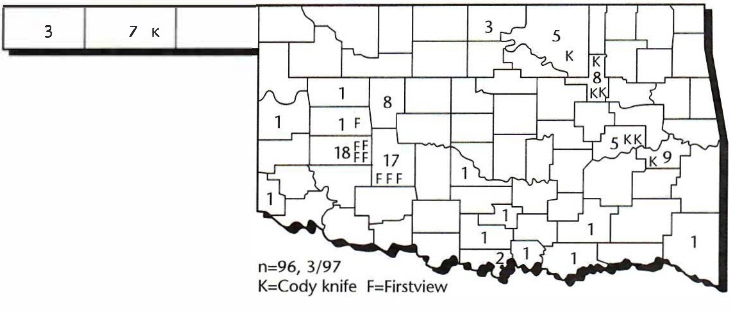

Figure 1. Cody artifact distribution by county.

records Firstview points (Wheat 1972) and Alberta points, but does not include deeply concave base points such as reported from the Johnson-Cline site (Lintz 1978:Fig.2), and sometimes referred to as Scottsbluff (Thurmond 1990:Table 4). The majority of the information was obtained from the Oklahoma Anthropological Society newsletters and bulletins (Bell 1954, 1955,1957; Bullard et al 1985; Duffield 1953; Galm and Hofman 1984;

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McClung 1979; Rhoton 1954; Rhoton and Wyckoff 1986; Thurmond 1991; and White 1981, 1987).

At present we lack detailed information on condition and material for some specimens. The reported artifacts are dominated by Scottsbluff (n = 67, 70%), with smaller but equal representation of Eden (n = 8, 8%), Firstview (n = 8, 8%), and Cody knives (n = 8, 8%), as well as two Alberta points. The remaining three specimens are blade fragments identified as Cody based on distinctive flaking patterns. More than half (53%) of the 90 observed artifacts are complete. The majority of these are Scottsbluff (n = 36, 58%). Both Alberta points are complete in contrast to only two of eight Eden points. Additional Oklahoma Cody artifacts include 11 bases (12%), 10 base and blade fragments (11%), 6 tip and blade segments (7%), 8 blade fragments (9%), and 5 nearly complete artifacts (6%). Eighteen of the artifacts have evidence of reworking. This occurs on the blade (n = 8), tip and blade (n = 5), and tip (n = 3) of Scottsbluff points (n = 12), Cody knives (n = 2), one Firstview point and one Alberta point.

The available dimensions of maximum length, stem length, maximum width and thickness follow. The mean maximum length (mml) for 30 specimens is 6.26 cm (range = 13.2 to 3.02 cm). The Scottsbluff points have a mml of 6.47 cm (n = 25, range = 13.2 to 3.02 cm), and the mml for Firstview points is 5.26 cm (n = 3, range = 6.64 to 3.96). The mean stem length is 1.69 cm (n = 20, range = 2.4 to 1.08 cm) and the Scottsbluff mean stem length is 1.6 cm (n = 17). The mean maximum width of the artifacts is 2.70 cm (n = 56, range = 3.7 to 1.56 cm). The mean thickness is .74 cm (n = 55; range = 1.1 to .49 cm).

A diversity of lithic material is evident in the Oklahoma Cody sample (n = 84). These include unidentified cherts (n = 32, 38%), Alibates (n = 17, 20%), Edwards chert (n = 15, 18%), Boone chert (n = 7, 8.7%), and a variety of material including fossilized wood, quartz, Florence A, chalcedony, obsidian, and Neva each representing three or fewer specimens. Many of the "unidentified cherts" have been reported as originating in the Ozark and Ouachita Mountains (Johnson 1989, Wyckoff 1992). The majority of Scottsbluff points were manufactured from unidentified cherts (n = 3, 37%), followed by Alibates (n = 13, 21%), Edwards chert (n = 11, 17%), and Boone chert (n = 6, 10%). Six of the Cody Knives were made from unidentified cherts (75%), but the remaining two Cody Knives are Alibates. As sample size increases it will be interesting to analyze the distribution of lithic material. Future investigations will compare the distribution of Oklahoma Cody artifacts with Folsom and Clovis point representation.

This study would not have been possible without the input of members of the Oklahoma Anthropological Society and the contributions of Don G. Wyckoff and Robert E. Bell.

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A Radiocarbon Date on a Deeply Buried Stratum Yielding a Plano-Like Projectile Point from the Smith Mountain Site in Virginia

William Childress and Dennis B. Blanton

The Smith Mountain site (44PY152) is a deeply stratified occupation on the south floodplain of the Roanoke River just below the hydroelectric dam at Smith Mountain Gap. Erosion on what is now the upper margin of Leesville Lake has exposed early cultural strata from ca. 1.5 m to over 3.0 m below the modern levee surface. Diagnostic artifacts representing virtually all early horizons known for the region occur on the site including fluted and unfluted Paleoindian lanceolates, Dalton and Hardaway forms (Childress 1993, 1996) (Childress and Vogt 1994).

In 1994 the William and Mary Center for Archaeological Research conducted test excavations at the east end of 44PY152 funded by the Virginia Department of Historic Resources (Blanton et al. 1996). Although excavations yielded no diagnostic artifacts, they identified a buried 3AB "cumulic" cultural horizon (Stratum V) underlying a classic fragipan at a depth of ca. 140–200 cm (Schuldenrein 1996). This stratum, inferred to contain at least the early-Archaic component and perhaps the Paleoindian as well, was AMS dated to 8,810 130 yr B.P. (Beta 77373).

In February 1996, Childress recovered a quartz Plano-like projectile point (Figure 1) embedded in an exposed stratum 3 m below the levee surface at the west end of 44PY152. Auger testing on the sloping profile above the find revealed an early cultural zone of ca. 80 cm corresponding to the cumulic horizon, resting on a cobble lens sloping away from the river. The point, in situ apparently below the lens, was accompanied by a small assemblage of quartz expedient tools. Test Unit 1W excavated in 2.5-cm levels through the Plano stratum yielded large amounts of micro debitage and carbonized wood fragments. A carbon sample recovered approximately 50 cm from the point in the same level returned an AMS date of 10,150 ± 70 yr B.P. (Beta 93017). No fluted points have been recovered at the west end of 44PY152. If they occur in this locus, they may be on a lower stratum which has not yet been exposed. This would suggest greater stratigraphic separation of components than is apparent from the limited excavations at the east end of 44PY152.

The point consists of the proximal portion of a lanceolate which expands slightly to the transverse break. Flaking on the difficult local material is well controlled with opposed lateral removals carrying beyond the mid line to create a cross section grading from lenticular into flattened in the hafting area. Fine pressure retouch maintains straight, even lateral edges. The length

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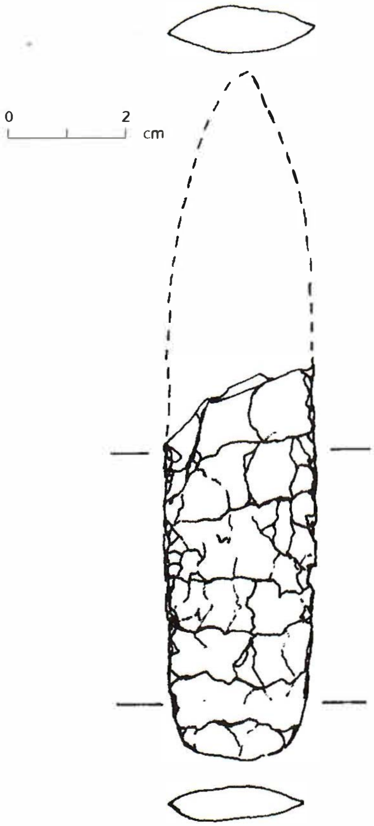

Figure 1. A plano-like projectile point from the Smith Mountain site in Virginia.

is 63 mm (br.), the width is 24 mm, the max. thickness is 7.5 mm. This form resembles the convex base variant of the Agate Basin type (Frison and Stanford 1982).

While Plano-like forms occur in the East, Virginia's early chronologies have not noted them (Gardner 1974:13–17, McAvoy 1992:34–38, 91) and they appear to be absent in the Atlantic seaboard states to the south. Their cultural and temporal relation to western Plano remains uncertain. The only other dated eastern Plano forms occurred at Weirs Beach, N.H., and suggested an early-Archaic assignment at 9,615 ± 225 yr B.P. (GX-4569) (Bolian 1980:124). The date of the Smith Mountain specimen places it within the Paleoindian period and is comparable to Agate Basin dates in the West (Frison 1978:23). In Virginia this is among the earliest dates on a recognized cultural horizon.

The Smith Mountain site may have one of the most complex sequences of deeply stratified Paleoindian components yet discovered in the Eastern U.S. Its potential for contributing to our knowledge of the early settlement of the region merits the allocation of funding for more extensive multidisciplinary work there.

Credit is due to Roanoke Chapter ASV members including Jeanette Cole and Dan and Mary Vogt for their continuing contributions to the investigation of this site. Thanks to Jeanette Cole for the point illustration. Special thanks to Tom Klatka of the VA DHR regional office in Roanoke for the loan of flotation equipment and technical assistance.

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Cody Down South: The Seminole-Rose Site in West Texas

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The Seminole-Rose site is located in Seminole Draw, Gaines County, Texas, and represents a bison (*Bison bison*, cf. *antiquus*) bonebed which has yielded an assemblage of Cody-complex Firstview artifacts. The site was first known through surface collections made beginning in the 1950s. Materials documented in this study were collected since the early 1970s through 1990. An extensive bonebed was present at the site with bone fragments occurring on the surface over an area of 70 m north-south by 50 m east-west.

Test excavations were completed in August 1984 under the direction of Dennis Stanford and Michael Collins. Eight units 2 m square were excavated with recovery controlled by 1-m quads, 10-cm levels, and 6.35-mm-mesh screen. Additional pits were excavated to enable stratigraphic documentation of the deposits. Excavations generally extended about 40 cm below the modern surface with 222 bones mapped in place and 10 chipped-stone artifacts recovered.

Three primary stratigraphic units can be identified which contain the bone and artifacts. Uppermost is Unit 1, which includes the plow zone and eolian tan sand. Displaced bone and artifacts occur in this unit. Unit 2 is a brown eolian sand in some places largely incorporated by the plow zone, but elsewhere as much as 40 cm thick. Bone is most abundant in this unit especially at and near the lower contact with Unit 3. Most complete bones occur at or near the Unit 2/Unit 3 contact which represents an erosional disconformity. The best-preserved bone is embedded within Unit 3 which is a white-tan sandy loam with high carbonate content and increasing silt (and clay?) with depth. The bone bed was apparently first contained within the upper portion of Unit 3. Deflation of Unit 3 exposed the bone to prolonged surface weathering before it was covered by eolian sands of Unit 2. According to local informants, a significant amount of deflation has occurred at the site in recent decades, as much as 0.5 to 1 m in some areas since cultivation began.

The bison bone is in poor condition and exhibits weathering and longitudi

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nal cracking most severely on the upper surfaces. Additional modifications include rodent gnawing, insect boring, and possibly carnivore gnawing. Less dense bones such as vertebrae, ribs, crania, and flat bone are poorly represented. Most of the bone is highly fragmented probably due to natural weathering, but long bone shafts, dense bones, and teeth are relatively well represented. No spiral fractures or cut marks were noted in the field, but burned pieces occur below the plow zone in some test units and are presumed to reflect cultural activity. The MNI is 5 based on right M_3s recovered from the surface. An MNI of 4 is based on left astragali and right metacarpals from the test excavation. Given the large area of the bone deposit, the total number of bison represented is presumed to be much higher.

There is no preferred orientation to the mapped bone pieces, and most were lying flat or nearly horizontal. The mean dip (recorded for 148 of 222 mapped bones) is 8.4 degrees, and 82% of the bone had an inclination of 15 degrees or less. This pattern may have been enhanced by post-depositional erosion which exposed the bone on the surface of Unit 3. Seasonal estimates cannot be made with accuracy, as the few M_3s are mostly in full wear, but at least three age groups are indicated. One M_3 has wear on facets I–IX, but wear on facets VII and VIII and the hypoconulid is light. This may reflect an age since birth of about 4.1 years or late spring to early summer (Todd et al. 1996).

Artifacts from Seminole-Rose are in at least six private collections, with

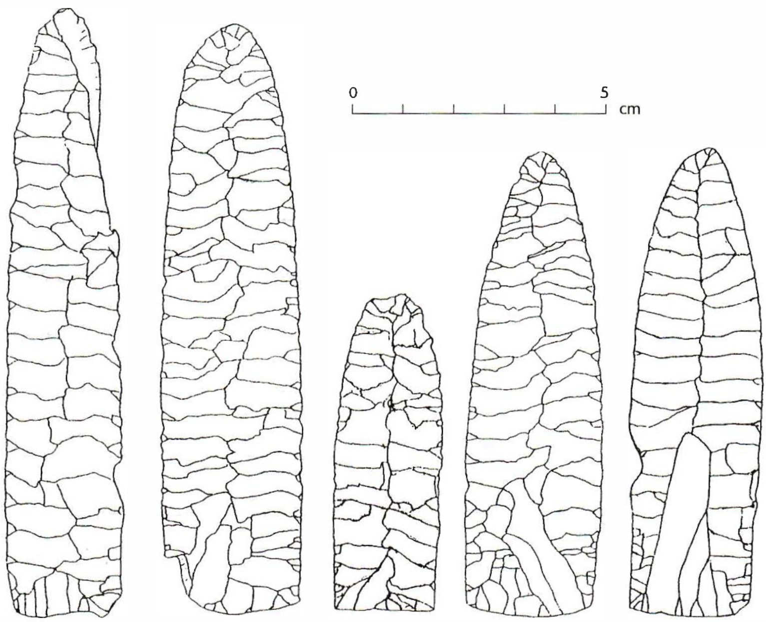

Figure 1. Examples of Cody (Firstview) points from the Seminole-Rose site.

detailed records currently available from three of these. We have documented 46 projectile points and fragments, 9 chipped-stone tools, and 25 flakes. The points include 12 complete or nearly complete pieces, 14 bases or base and blade fragments, 7 midsections, 10 tips, and 3 edge fragments. Lithic materials are dominated by Edwards cherts (n = 36, 78%), with Alibates (n = 2, 4%), jasper (n = 2, 4%), and unidentified or unrecorded pieces (n = 6, 13%). Impact damage is evident on at least 21 of the points, and thermal breaks occur on 5 specimens. Point size is variable, with length ranging from 12.3 to 3.7 cm (x = 8.72, n = 10), maximum width 2.8–1.4 cm (x = 2.3, n = 18), basal width 2.75–1.2 cm (x = 2.16, n = 18), and maximum thickness .52–.94 cm (x = .76, n = 22). Stylistically these points can be referred to the Firstview type (Turner and Hester 1993; Wheat 1972), and are here considered to be part of the Cody complex (Bradley and Stanford 1987; Ebell 1988; Frison and Todd 1987; Hofman 1996; Stanford and Patton 1984; Wheat 1979). The Seminole-Rose points have very slight to no shoulders. The point bases are commonly thinned by removal of several long flakes from the base on each face. Flaking is primarily parallel horizontal and collateral with overlapping flake scars predominant.

Stone tools include four endscrapers, the proximal end of another endscraper, one side scraper, one double side scraper, one graver, and two use-modified flakes. Except for the jasper graver and a chalcedony endscraper, these pieces are all varieties of Edwards chert. The flakes are also dominated by Edwards chert, and one piece found in the 1984 testing may represent impact shatter from a projectile point.

At present no radiometric dates are available. Projectile point cross-dating suggests an approximate age of 8,500 to 9,500 yr B.P. Further analyses of the fauna, lithics, stratigraphy, age, and paleoecology of the site are ongoing.

The 1984 crew included Margaret Jodry, Darrell Creel, Jan Guy, Dan Prikryl, Richard Rose, William Whatley, John Wilson, Craig Coursen and Catherine Collins as well as M. Collins and D. Stanford. Our appreciation is also extended to Billy and Dixie Houston, J. E. "Butch" Ragsdale, Iva Richardson, Richard Powell, Pat Glascock, Jerry Harris, Charles Warren, and Layton and Floyd Oliver.

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Folsom Resource Use and Disposal Behavior: Indian Creek, Montana

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Investigations (1982–1983, 1985–1986) of the deeply stratified, latest-Pleistocene through late-Holocene geological section at the Indian Creek archaeological site (24BW626) in the west-central Montana Rockies revealed 28 hunter-gatherer occupations. Exposed in the basal fine sediments overlying valley boulders were several Paleoindian occupations.

Radiocarbon ages obtained on dispersed bulk charcoal from a traceable carbonaceous stratum (10,980 ± 110 yr B.P. (Beta-4619) in the Downstream Locality and 10,630 ± 280 yr B.P. (Beta-13666) in the Upstream Locality 550 m distant at the Indian Creek site were interpreted as dating the initial Paleoindian occupation at Indian Creek (Davis and Greiser 1992:228). We now believe that this occupation occurred atop the carbonaceous stratum and is therefore slightly younger. A Clovis point recovered from the Occupation I artifact-bearing zone in the Downstream Locality, associated with point basal corners and a basalt channel flake reminiscent of Folsom technology, presented an ambiguous fluted-point affiliation in that locality. The Clovis point is thought to be intrusive, i.e., a Folsom-curated artifact.

A recent AMS collagen dating of unburned *Bison* cf. *antiquus* bone from Upstream Locality, Locus D, Feature LD-28, yielded an age of 10,410 ± 60 yr B.P. (Beta-098679). Channel flakes, a basal corner fragment of a point, and a point preform identify this assemblage as Folsom. The AMS age is stratigraphically consistent and within the Folsom-complex time span (Taylor, Haynes, and Stuiver 1996), from 10,950 to 10,250 yr B.P. Since that computation incorporated the two early ages from Indian Creek, which evidently date a pre-Folsom occupation substrate, the Folsom time span should be shortened, i.e., the early end being 10,890 instead of 10,950 yr B.P.

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Lithic artifacts include bifaces (points, point preforms, point bases, and bifacially worked pieces) and unifaces (end scrapers, side scrapers, and utilized flakes); debitage and worn and broken tools dominated feature residues.

Two rib bone (*Bison* sp.) knapping or polishing tools (Davis and Greiser 1992: Fig. 7.19) and the midsection of a possible bone needle complete the LD-28 artifact assemblage.

The fine-screened detritus from this secondary refuse discard feature was reanalyzed on a finer scale than previously (Davis, Greiser, and Greiser 1987). Lithic artifacts included 7,474 pieces of lithic debitage and 19 stone implements, mostly fragments. Olive-brown chert composed 61% of the pieces, accompanied by small amounts of other utilized cherts, quartzite, basalt, andesite, crystal quartz, and obsidian. Thermal pretreatment and incidental post-manufacture crazing record contact with fire and heat in artifact production and disposal.

The 6,309 bone fragments from LD-28 represented 365 identifiable mammals and four specimens of small birds. Mammalian taxa include *Sylvilagus* sp. (cottontail), *Lepus* sp. (jackrabbit), *Marmota* cf. *flaviventris* (marmot) (MNI = 3), *Spermophilus* sp. (ground squirrel) (MNI = 2), *Microtus* sp. (vole), *Erethizon dorsatum* (porcupine), and *Bison* cf. *antiquus* (bison), with several unidentified artiodactyl tooth fragments. Ten percent of the bones were calcined, including 6.8% of the marmot specimens and 14.7% of the small sciurids (MNI = 3; 1 calcined).

The Downstream artifacts, now attributed to Folsom, are dominated by worn unifacial scraping and cutting implements (Davis, Greiser, and Toth 1985), and the utilized fauna by elements of *Bison* cf. *antiquus*, *Ovis canadensis*, *Marmota flaviventris*, *Sylvilagus* sp., and rodents of two sizes. One burned long bone (*Bison* sp.), green bone spiral breaks, and one bone with cutmarks are possible evidence of butchery by humans.

With respect to the Feature LD-28 bone detritus, the near absence of cutmarks and other indications possibly diagnostic for human handling is not expected because of the small sample size and the predominance of small animals. Lyman (1987), for instance, notes that several ethnoarchaeological studies suggest that cutmarks occur, on average, on only about 20% of the bones in an assemblage. In addition, small animals might have been processed without butchery. The multiple species and number of small mammals and birds and the burning of some bones reflect discard by Folsom peoples camped alongside Indian Creek c. 10,400 yr B.P.

The Indian Creek site investigations were supported by grants from the National Science Foundation (BNS-8508068), the Montana State University research administration, MONTS EPSCoR, the State Historic Preservation Office, Joe and Ruth Cramer (Denver), and the Kokopelli Archaeological Research Fund. We thank Christopher L. Hill and C. Vance Haynes for improving this manuscript.

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The Oldest Habitation Site on the West Coast of the Sea of Japan

Vladimir I. Dyakov

Located 400 km north of Vladivostok by the middle reaches of Zerkalnaya River that flows through the Sikhote-Alin mountain range is an enclave comprising 20 archaeological objects belonging to the Ustinovskaya culture. Some scholars date them from the late Pleistocene (Vasilyevsky and Gladyshev 1989), others from the final Pleistocene/early Holocene (Dyakov 1984, 1986).

Simply because it happened to be the first site to be explored, Ustinovka-I was long perceived by researchers as the Ustinovskaya-type site. (Okladnikov 1966, Petrun 1956, Vasilyevsky and Gladyshev 1989). However, in 1980 the author discovered a site named Ustinovka-IV (Dyakov 1981), which gave evidence of a permanent settlement. The region thus offered the first trustworthy occurrence of dwelling remains left behind by people who knew no pottery.

At present the area excavated at Ustinovka-IV is more than 1,300 m^2. The site is located on an ancient terrace of Zerkalnaya river, raised 17–22 m above the river level. The talus layer incorporated cultural deposits: fragmentary Bronze Age assemblages in its uppermost level, and late-Paleolithic cultural artifacts in the intermediate and lower levels. Dwellings are situated on top of highest flat surface within the locality. They can be recognized by the three subterranean floors each of which slightly differs from others by construction.

Dwelling 1 was found in 1984. Its size is 7.5 by 4.5 m, with an elliptical floor dug 20 cm into the ground. At the center of the floor there is a hearth with an oval pit 1 m in length. The northwestern portion of the floor has a gourd-shaped pit dug into it measuring 1.3 by 1.0 by 0.35 m, filled with lithic deposits and broken tools.

Dwelling 2 was discovered in 1994. Its irregularly shaped subterranean floor is up to 6.0 m long, 2.0 m wide at its northern side, and 3.45 m wide at its southern side. The western wall forms a projection dividing the dwelling in

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two—northern and southern sections. A large pit occupies the northern section almost entirely; its bottom shows traces of high heat and is covered with small pieces of charcoal and ash spots. At the center of the dwelling there is a deep posthole from the main roof support. Two tambour-type house entrances were built through the northern and southern walls. Whole and fragmented tools, more than 20 cores, and thousands of tiny flakes accumulated in central and southern parts of the dwelling need to be mentioned to finish the picture seen on the site.

Dwelling 3 was excavated in 1996. Its floor is almost rectangular (6 x 4 m) with traces of two house entrances. There is only one pit made into a flat floor of the northwestern section of the living space. Almost square in shape (0.7 x 0.6 m), the pit has vertical walls about 0.25 m deep. It was filled with heavy argillaceous soil including artifacts accumulated mostly in its upper half; this pit could have been used as a hearth, but there is no reliable evidence to it.

Dwelling 3 yielded two finds of foremost importance. One is a bifacially chipped stone implement 20 cm long, 10 cm wide and about 2 cm thick, split in two pieces and fashioned as a tool for making microblade cores in a manner very much resembling the yubetsu tradition widespread in the north of Hokkaido. This tool appears to be so far the largest of its kind throughout the continental Far East. Another find is a stone spearhead from a small spear or a javelin. It is unique among spearheads previously found in Ustinovskaya sites in the valley of Zerkalnaya River, and this one must be the Primoriye's oldest stone spearhead.

Distance between dwellings is 10–15 m. This area reveals traces of bonfires and manufacture loci. In addition, there was a group of seven bifacially flaked stones that might have had some special implication. They were found between the Dwellings 1 and 3 lying close to each other making up a figure (0.3 x 0.3 m) at the center of which there was a similar yet bigger stone standing erect.

Several meters east of the Dwelling 2 on a lowered side of the terrace there are numerous traces of ancient mining activity (cherts, ditches) possibly done by the local populace who obtained raw material for tool making from appropriate sedimentary formations.

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Archaeomagnetometry of Paleoindian Alder-Complex Roasting Pits, Barton Gulch, Montana

Jeffrey L. Eighmy and Leslie B. Davis

Dating thermoremanent archaeomagnetic samples requires the development of regional virtual geomagnetic pole (VGP) curves temporally calibrated by reference to a set of independently dated VGPs. VGPs are poles calculated from the magnetic directions preserved in fired features. Curves are not available for the Northern Rockies or the Northern Plains (Eighmy, Taylor, and Klein 1993).

Burned earthovens in situ at the Barton Gulch site, dated to c. 9,400 B.P. and attributed to the Paleoindian Alder complex (cf. Aaberg et al. 1996; Armstrong 1995; Davis 1993; Davis et al. 1989; Davis, Aaberg, and Cummings 1994; and Davis, Aaberg, and Eckerle 1988), are too old to be dated by reference to existing American master curves. The magnetometry of burned, well-dated pit features at Barton Gulch was, however, expected to be useful for establishing the magnetic field direction c. 9,400 B.P. Features of comparable age elsewhere in the Northern Rockies might be dated. Second, inter-feature comparison of the magnetic directions derived for each sampled feature, based on similarity or divergence, might hint at the contemporaneity or noncontemporaneity of those features. Four roasting pits among 19 discrete feature aggregates (VIIA, VIA, XVIIA, and XVIIIA: see floor plan locations in Armstrong 1995) were accordingly sampled by Eighmy (1990).

The optimum demagnetization level, the level at which sample direction appears stable and the sample's directional scatter (the a95 is one of the

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indications of scatter), is small at Barton Gulch. The samples appeared "cleanest" at the 5.0 mT (refers to millitesla, a unit of measurement) step. This is a comparatively low level of demagnetization, but the samples were so weak to begin with that further demagnetization would likely remove the primary signal and thus increase scatter among the remaining magnetic directions. It was necessary to eliminate outliers that deviated so far from the sample cluster and mean direction as to be considered nonrepresentative of the primary magnetization.

That none of the sampled Alder-complex features yielded great archaeomagnetic results is likely an effect of the very low percentage of clay in the enclosing sediments. The ovens had been dug into and below the natural surface; the burned matrixes were soft, but harder than the sandy silt into which they had been dug. When features with a high clay content are burned, they harden and remain hard even when wet. Lacking the requisite cementing clay, the magnetic grains did not remain oriented during the intervening 10,000 years at Barton Gulch.

Radiocarbon-dated composite carbonized seed samples from four specific Barton Gulch roasting pits date the Alder-complex component (Table 1).

Table 1. Barton Gulch Alder-complex uncorrected and calibrated radiocarbon ages.

^{14}C Age Uncorrected	^{14}C Lab No.	Calibrated ^{14}C Age
9,410 ± 140 yr B.P.	Beta-23215	8,088 B.C.
9,340 ± 120 yr B.P.	TX-7565	8,083 B.C.
9,340 ± 120 yr B.P.	TX-7564	8,033 B.C.
9,080 ± 310 yr B.P.	TX-7564	7,495 B.C.

Calibrated by Eighmy, following Stuiver and Reimer (1993), these samples date to the 9th millennium B.C., averaging 8,343 ± 74 B.C. Thus, during the early to mid part of the 9th millennium B.C., the magnetic field in southwestern Montana probably had a declination between 2 degrees west and 9 degrees east and an inclination between 67 degrees and 72 degrees. Therefore, the radiocarbon-dated samples from Barton Gulch do provide a useful glimpse at the geomagnetic field c. 8,340 B.C.

By comparing the relative magnetic directions of these Alder complex ovens, it is feasible to suggest possibilities regarding the relative time when the features might have been in use (Eighmy and Klein 1989). Features VIIA and VIA are interesting in this regard because they have similar magnetic directions. Accordingly, the hypothesis of similar directions for Features VIIA and VIA cannot be rejected at the 95-percent significance level, suggesting that the two features might have been fired at about the same time. In fact, they could have been fired during the same season even though they do not have exactly the same directions; hearths do not record the magnetic field exactly since hearths fired at the same time can have slightly different directions. The magnetic direction of Feature XVIIA, on the other hand, was far from the other two, and the hypothesis of similar directions could be rejected.

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Revised Temporal Assessment of a Proposed Paleoarctic Site in the Sagavanirktok Valley, Northern Alaska

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Renewed excavations and reanalysis at the Gallagher Flint Station, a multicomponent site located in the southern Sagavanirktok Valley north of the Brooks Range, provide new data concerning the proposed late-Pleistocene occupation of this region of northern Alaska. The late-Pleistocene age assessment for the site is based on a single carbon sample recovered in shallow and poorly defined deposits susceptible to a number of taphonomic processes including cryoturbation, solifluction, and bioturbation by burrowing animals. This sample, which produced a date of 10,540 ± 150 yr B.P. (SI-974), is re-

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ported to be associated with a prismatic blade industry in Locality 1 (Dixon 1972, 1975). No definable hearth or hearth-like feature is associated with this sample (Stuckenrath and Mielke 1973).

Results of this reinvestigation suggest that the proposed association of the SI-974 and the Locality 1 assemblage is questionable. First, the origin of the late-Pleistocene carbon sample is problematic. Although SI-974 is reported to have been recovered at a depth of 20–25 cm below surface in unit N12-W60 (Dixon 1972), examination of the field records shows that the two carbon samples collected in this unit came from 1–2.5 cm below surface and 10–15 cm below surface, respectively (Koutsky 1971). There is no mention of a carbon sample being collected at the depth reported for SI-974. Field records also show that only four artifacts were recorded subsequent to the entry describing the latter carbon sample (Koutsky 1971). This sample was never accessioned to the University of Alaska Museum; thus it is unclear as to whether it was the sample submitted for dating. Second, reexamination of the subsurface artifact distribution shows that the bulk of the core-and-blade material from Locality 1 was recovered high in the stratigraphic profile and not at the reported level of the carbon sample dated to the late Pleistocene. Conjoining artifacts from the upper and basal levels of the site in conjunction with the overall artifact distribution suggest that the few artifacts recovered in the lower levels of the site are the result of displacement by post-depositional taphonomic processes.

Renewed excavations failed to produce new carbon samples associated with the proposed late-Pleistocene assemblage. One carbon sample recovered in the northeast quadrant of Locality 1 produced an AMS date of 2,220 ± 50 yr B.P. (Beta-88031); however, no artifacts were found directly associated with this sample. Artifacts recovered from screened matrix surrounding the carbon sample include a mixture of debitage related to both blade/microblade and biface production. Another carbon sample recovered from the same region of the locality during previous excavations is dated 2,620 ± 175 yr B.P. (SI-975) and is reported to be associated with bifacial implements attributed to an intrusive reoccupation of Locality 1 (Dixon 1972). The heterogeneity exhibited in bifacial technology suggests multiple occupations of this locality during the late Holocene.

One carbon sample archived at the University of Alaska Museum also was submitted for AMS dating during this reinvestigation. This sample, recovered from a test pit located approximately 15 m north of Locality 1 and associated with mudstone artifacts technologically identical to the core-and-blade assemblage from Locality 1, produced a date of 6,960 ± 90 yr B.P. (Beta-97211). No other technologically distinct (i.e., intrusive) material was recovered from this excavation unit. In light of the questions concerning SI-975, Beta-97211 currently provides the most reliable age assessment for the mudstone core-and-blade material which characterizes this excavation unit as well as Locality 1.

Refitting of frost-shattered artifact fragments during this reinvestigation also gives a clearer indication of the technological nature of the core-and-blade assemblage of Locality 1. Ninety-four complete or nearly complete flake, blade, and microblade cores are present in the assemblage. These cores exhibit various degrees of reduction with early-stage cores retaining the tabular appearance of the parent raw material (calcareous mudstone) while late-stage cores are typically conical to cylindrical. Internal flaws in the raw material are responsible for many early-stage discards which contributes greatly to observed variability in core morphology. Secondary modification of blade blanks is restricted primarily to marginal and unifacial retouch; only one incompletely worked biface is reported to be associated with the core-and-blade material (Dixon 1976).

The blade/microblade technology represented in the Locality 1 assemblage appears to be more closely related to the Mesolithic Sumnagin industries (10,800–6,200 yr B.P.) of Northeast Asia (Mochanov and Fedoseeva 1984) than to the preceding Dyuktai/Paleoarctic industries to which it is generally ascribed (see Dumond 1987). Core preparation and reduction techniques at Locality 1 exhibit a mixture of traits attributable to both Paleoarctic and regional mid-Holocene blade and microblade industries. Thus, the Locality 1 assemblage appears technologically intermediate between late-Pleistocene and mid-Holocene blade/microblade industries. The mid-Holocene date of Beta-77211 supports the revised temporal assessment for the Locality 1 assemblage.

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Considerations on Radiocarbon and Calibrated Dates from Cerro La China and Cerro El Sombrero, Argentina

Nora Flegenheimer and Marcelo Zárate

Radiocarbon ages of charcoal samples from Cerro La China and Cerro El Sombrero in the Argentine pampas date the Paleoindian occupation to 11,000–10,000 ^{14}C yr. Yet, conventional ^{14}C ages are ambiguous for this interval. Secular variations in geomagnetic intensity (Stuiver et al. 1991) and short-term variations in the production of ^{14}C (Stuiver and Braziunas 1993) produce significant deviations of radiocarbon year from calendar year. Calibrated dates open new alternatives for interpreting early American human records (Taylor et al. 1996).

Applying the calibration program to our data results in two consequences (Table 1). First, the initial occupation occurred about two millennia earlier than was thought (13,000–12,000 cal. years B.P.). Second, the span of these early dates is broadened. Even if the youngest anomalous age at Cerro El Sombrero is dismissed, the remaining dates show a broadened time span. This dispersion may be the result either of dating errors, or of diachronous occupation events that spanned a longer interval than initially thought.

Further uncertainties arise when the prevailing paleoenvironmental conditions are reconstructed. Current interpretations suggest that loess sedimentation was active during Paleoindian occupation and was followed by an interval of soil stability (Zárate and Flegenheimer 1991). This agrees with the subhumid dry climate regionally inferred by pollen analysis prior to circa 12,500 cal. yr B.P. (Prieto 1996). Fluvial sequences indicate that by 10,000 cal. yr B.P. the floodplains stabilized and abruptly changed to ponds and small lakes (Zárate et al. 1996). The Pleistocene/Holocene transition, with drier to more humid conditions, had been interpreted as a relatively rapid change occurring in c. 500 ^{14}C yr. Instead, current calibrated data show a longer interval extending from 12,000 to 10,000 cal. yr B.P., resulting in a different rate of climatic change. It is not yet known if people were still occupying the region when the climate became more humid, since stratigraphic sequences are discontinuous and are modified by pedogenesis.

Modifications produced by calibration must be considered when assessing the rate of human colonization of the continent. Some processes might have occurred during longer intervals than previously thought. For example, the puzzling contemporaneity of several sites yielding assemblages with Fell's Cave Stemmed points (Tagua Tagua, Cueva del Medio, Fell, Tres Arroyos, Alero Piedra Museo, Cerro La China and Cerro El Sombrero) might be only appar-

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Table 1. Radiocarbon and calibrated ages for the early occupations at Cerro La China and Cerro El Sombrero.

Site	Lab. No.	^{14}C age (yr B.P.)	Calibrated ^{14}C age, 1σ [cal yr B.P.]▪
Co. La China-S1▲	I-12741	10,730 ± 150	12,780–12,450[12,620]
Co. La China-S1▲	AA-1327	10,790 ± 120	12,810–12,550[12,680]
Co. La China-S1	AA-8952	10,745 ± 75	12,730–12,540[12,630]
Co. La China-S1	AA-8953	10,804 ± 75	12,780–12,600[12,690]
Co. La China-S1	AA-8954	10,525 ± 75	12,510–12,280[12,400]
Co. La China-S2	AA-8955	11,150 ± 135	13,160–12,880[13,020]
Co. La China-S2	AA-8956	10,560 ± 75	12,550–12,330[12,440]
Co. La China-S3▲	AA-1328	10,610 ± 180	12,690–12,270[12,500]
Co. El Somb.-A1▼	AA-4765	10,725 ± 90	12,720–12,500[12,620]
Co. El Somb.-A1▼	AA-4766	10,270 ± 85	12,210–11,765[12,025]
Co. El Somb.-A1▼	AA-4767	10,675 ± 110	12,690–12,430[12,560]
Co. El Somb.-A1▼	AA-5220	10,480 ± 70	12,460–12,220[12,349]
Co. El Somb.-A1▼	AA-5221	8,060 ± 140	9,140–8,580[8,950]

▪Calibrated according to Stuiver and Reimer (1993). Ages are expressed as ranges at 1-sigma level, followed by the mean age in cal. yr. B.P. in brackets.

▲Flegenheimer 1986/87

▼Flegenheimer et al. 1994

ent and partly due to methodology. Finally, paleoenvironmental and archaeological correlation in regions where dating methods other than ^{14}C or samples other than charcoal are used, merit revision.

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The South American Context of the Pedra Pintada Site in Brazil

Ruth Gruhn

Announcement of the Pedra Pintada rockshelter, a campsite of tropical forest foragers in the lower Amazon valley dated at c. 11,100 yr B.P. (Roosevelt *et al.* 1996), seems to have taken North American archaeologists by surprise. I call attention to a number of published but less publicized sites of comparable age in Brazil and elsewhere in South America, to emphasize the now-solid body of evidence that during Clovis times in North America all major environmental zones of South America were already occupied by populations adapted to local conditions by distinctive non-Clovis technological traditions (see also Dillehay et al. 1992).

For the xerophytic *cerrado* zone of the eastern Brazilian uplands, there are now detailed reports on Lapa do Boquete, a rockshelter in north-central Minas Gerais which has yielded a basal assemblage of unifacial flake tools (including limaces) with four radiocarbon dates on charcoal ranging between 12,070 yr B.P. and 11,000 yr B.P. (Prous 1991, Fogaça and Lima 1991, Prous et al. 1992). In association are abundant charred palm nuts, and remains of freshwater mussels, fish, and small to medium-sized mammals, suggesting a broad-spectrum foraging economy. Wear-pattern analysis of the tools, including the limaces, indicates a woodworking technology. Also reported from Minas Gerais is a date of 11,960 ± 250 yr B.P. on a hearth in the basal zone of the Abrigo de Santana do Riacho (Prous 1981, 1986a, 1986b), in association with exotic quartz flakes and fragments of red ochre. Published long ago were results of excavations at Lapa Vermelha IV, north of Belo Horizonte in Minas Gerais, in which quartz and limestone artifacts were found in the lower levels of solution cavern fill dated at 15,000 ± 400 yr B.P., and in an older cemented sedimentary zone dated at 22,410 yr B.P. and >25,000 yr B.P. (Laming-Emperaire 1979, Laming-Emperaire et al. 1975, Prous 1986a, 1986b). Recently reported although not yet described are stone artifacts and modified wood with radiocarbon dates of 22,500 ± 500 yr B.P. and 23,320 ± 1000 yr B.P. at the rockshelter of Santa Elina in Mato Grosso (Vialou et al. 1995): a preliminary U-Th date obtained on sloth osteoderms associated with ten artifacts at a lower level of this site was 32,000 +5000/-4000 yr B.P. Toca do Boqueirão da Pedra Furada (Guidon 1986, Guidon and Delibrias 1986) is thus not the only archaeological site in Brazil with radiocarbon dates older than 20,000 yr B.P.

For the semi-arid zone of coastal Venezuela, the site of Taima-taima (Bryan et al. 1978, Ochsenius and Gruhn 1979) indicates that people using lanceolate El Jobo points were taking mastodon at waterholes by 13,000 yr B.P. In the forested Bogotá basin of highland Colombia, the open occupation site of Tibitó (Correal 1981, 1986) features an amorphous unifacial flake industry

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(Abriense) in association with remains of horse (most abundant) and mastodon, radiocarbon-dated 11,740 ± 110 yr B.P. In Peru, hunters were pursuing game high on the *puna* in the vicinity of Pachamachay possibly as early as 11,800 ± 930 yr B.P. (Rick 1980); and it appears that there were foragers/fisherfolk on the north Peruvian coast by c. 11,000 yr B.P. (Chauchat et al. 1992; Richardson 1992). For Chile, in the semi-arid coastal zone at Quereo near Los Vilos, people ambushed horse and now-extinct camelid in an arroyo as early as 11,600 ± 190 yr B.P., leaving a simple flake industry and modified bone (Nuñez et al. 1994); and the settlement of foragers at Monte Verde in the temperate rain forest of south-central Chile, dated at c. 13,000 yr B.P., is now well documented (Dillehay 1989). The basal occupation zone (Nivel 11) at Los Toldos, dated at 12,600 ± 600 yr B.P., (Cardich 1978; Cardich et al. 1973) 3, with a distinctive unifacial flake tool industry associated with horse and extinct camelid, suggests that hunters were adapting to the Patagonian grasslands by the close of the Pleistocene, as well.

Archaeological evidence indicates, then, that all major environmental zones of the continent of South America were occupied by distinctive groups at the end of the Pleistocene. The known terminal-Pleistocene sites may appear to be widely scattered in distribution, but it is most reasonable to assume that no human settlement is ever completely isolated, separated by hundreds of kilometers of wilderness from any other human group; the archaeological sites we do know about must indicate that the regions in which they have been found were effectively settled at the time.

It is notable that as in North America, between 11,000 and 10,500 yr B.P., known archaeological sites proliferate markedly on the southern continent. What does this phenomenon represent, in terms of human population dynamics in the settlement of the Americas? For many years a widely accepted model (Martin 1973, Mosiman and Martin 1975) has pictured the late entry of a small number of specialized hunters, with very rapid migration and a tremendous population explosion resulting from the successful exploitation of big game, throughout both American continents. More recently, the phenomenal speed of population growth necessary to populate the Americas by this model has been questioned, and a more realistic rate of population growth proposed (Alsoszatai-Petheo 1992; Whitley and Dorn 1993). It now appears that the sudden proliferation of archaeological sites throughout the Americas around 11,000 years ago represents the upper part of a sigmoid curve of population growth; and the base of the curve, with the initial entry of a small human group into the New World in the Bering Straits area, must lie well back in the late Pleistocene.

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Paleoindian Evidence at the Triple S Ranch Site, Hamilton County, Texas

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Testing and surface collections at the Triple S Ranch site have demonstrated a long sequence of occupation beginning in early Paleoindian times. The site is next to a major spring at the mouth of a box canyon and less than 3 km from the Vista Mountain chert quarry. Although the site's extensive cultural deposits have been disturbed by modern land use and erosion, investigations indicate that some areas, protected by buildings and/or burned rock midden features, have intact deposits with stratified components from Clovis to late Archaic.

The site is on the northeast edge of the Edwards Plateau, at the southwestern edge of the Blackland Prairie. This is an ecologically diverse area at the transition between these distinct geographic zones, within a juniper, oak, and mesquite savanna (Black, 1989). The site is located on a colluvial slope and extends onto an adjacent colluvial fan which is under cultivation. Large portions of the site are covered by the Smith home and several modern barn structures. Backhoe trenches on this fan revealed minimal cultural material. Several other sites, including lithic scatters, have been recognized near the Triple S Ranch site. For example, immediately to the west is a dense lithic scatter on a ridge which extends for 300 m. These lithic workshops reflect use of the Vista Mountain chert quarry located north of the Triple S Ranch. This high-quality material is probably a variety of the Edwards Formation chert, and may have attracted people to the area.

The site has been known for several generations to the land owners who have made extensive collections from it. First recorded by E. B. Sayles, the site became known to Grant Hall of Texas Tech University in 1991 when the landowner showed Hall a collection of artifacts including two Clovis points (Figure 1). Hall initiated testing at the site in 1992 and 1993, and I continued

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those excavations through 1993 and 1994. During the testing, 13 units 1 m square were excavated across the site. Most of these were situated in or near barn structures. Cultural deposits in these units varied from 30 to 130 cm below ground surface.

A total of 41 projectile points were recovered from excavations, ranging from Paleoindian to late Archaic. Seven (17%) of the projectile points are Paleoindian. These include one Plainview, one Plainview-like, three Texas Angostura/Hell Gap, one Golondrina, and one Early Stemmed (Wilson). Of the seven Paleoindian points, six are heavily patinated and identification of the raw material is questionable. The remaining point, the Wilson point, is made from a variety of Edwards chert. Of these points, two are exhausted, the rest are broken and four of these are burinated. Breakage patterns and point reduction indicate retooling.

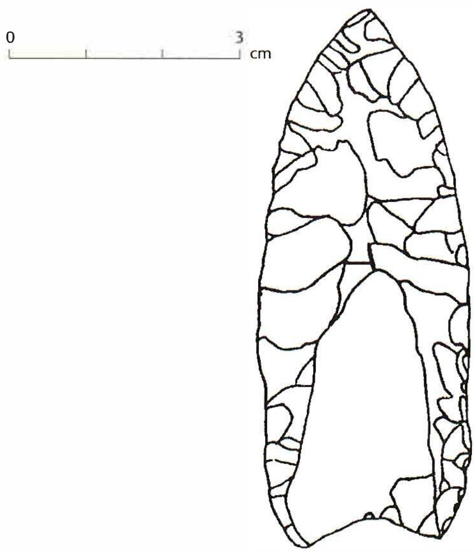

Figure 1. Clovis point from Smith Collection, 41HM11.

As a complement to the excavated sample, research is continuing with Smith's surface collection. At present, 1700 artifacts ranging from Paleoindian to late Prehistoric have been documented. There are 80 Paleoindian points from the surface: 2 Clovis, 27 Plainview, 18 Texas Angostura/Hell Gap, 2 Scottsbluff, 9 Golondrina/Barber, 3 Meserve, 1 San Patrice, 10 Early Stemmed, and 8 unidentified lanceolate points. A wider variety of material is represented in the surface collection, predominantly varieties of Edwards chert, including Fort Hood Yellow and Heiner Lake Tan. In the neighboring counties, Bell and Coryell, 17 different varieties of Edwards chert have been identified (Trierweiler, 1994). Many of these varieties are reflected in the Smith collection.

The diversity of Paleoindian material represented in the surface collection and in the excavation recovery indicates this area was intensively utilized at the end of the Pleistocene. Given the nearby chert resource and the spring, this area provided an ideal camp and retooling site. Research goals are to gain a better idea of how this area of the landscape was used through time. Given the close proximity of the Vista Mountain chert outcropping, I am interested in activities associated with this resource, patterns of discard, retooling, and changes in resource utilization. There is a high percentage of reworked and exhausted tools in the collection which suggests the replacement and retooling of lithic tools and related equipment.

Special thanks to Kenneth Smith for accommodating us, to Del Barnett who has been key in organizing volunteer effort and local support, and to Grant Hall for his leadership and direction. Also thanks are accorded to the numerous volunteers who helped in our endeavors.

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Preliminary Observations on Late-Paleoindian Bison Butchery at the Clary Ranch Site (25GD106), Western Nebraska

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A number of recent studies (M. E. Hill 1996; M. G. Hill 1994; Todd 1987a; Todd et al. 1990) have reaffirmed the notion (Kelly and Todd 1988; Todd 1987b, 1991) that Paleoindian utilization of bison carcasses is often limited to parts of high economic utility (i.e., a gourmet strategy). When bone preservation is good and thorough taphonomic analysis is conducted, evidence of human-inflicted modifications associated with butchery typically consists of several cutmarks and/or impact fractures. Skeletal part equability is also generally high. However, as new sites are discovered and previously excavated assemblages are reevaluated, it is becoming apparent that there is considerable variability in the butchery and processing of bison carcasses by Paleo-

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indians. In these regards, the high incidence of human-inflicted modifications on many of the bison bones from the Clary Ranch site (Myers et al. 1981; this volume) has great potential to increase our understanding of Paleoindian subsistence-related behaviors.

To date, 700 NISP (number of identified specimens) bison appendicular bones have been analyzed in the Clary Ranch collection, which is curated at the University of Nebraska State Museum, Lincoln. Examination of axial elements, scapulae, pelves, and ribs is planned in the future; however, preliminary evaluation suggests that these elements are under-represented in comparison with the appendicular skeleton. At least 17 bison are represented by distal humeri and calcanea.† Other elements that yield high MNI (minimum number of individuals) values include proximal radii (14), proximal metacarpal (13), and distal tibiae (12). All the remaining appendicular elements represent 10 or fewer animals. An MNE (minimum number of elements) of 128 phalanges and 26 sesamoids is also present. Post-depositional taphonomic agents (e.g., density-mediated attrition, subaerial weathering, root etching) do not appear to have significantly influenced element representation or obscured cortical surfaces to a great extent.

Osteometric analysis of the calcanea indicate that at least six cows, four bulls, and six immature bison are represented. Bulls have a mean shaft length of 116.0 mm and mean greatest breadth of 59.3 mm; cows average 101.0 mm and 52.8 mm, respectively. For their respective sex, the calcanea are slightly smaller than those from the Casper and Frasca bonebeds and compare in size with those from the Scottsbluff, Hudson-Meng, and Lodgepole Creek bonebeds (M.G. Hill 1996; M.G. Hill et al. 1995).

Eruption and wear of the teeth in three complete calf mandibles and an isolated M_1 indicate the kill occurred in the late summer to early fall (dental age 0.3–0.5 yrs.). This estimate of the season of death differs slightly from an earlier assessment (Myers et al. 1981) because at that time the sample of ageable dentitions was smaller. Deciduous premolars are erupted and in early stages of wear. M_1 metaconids are about 9 mm above the alveolus and unworn, except for the isolated M_1 that exhibits very light wear on facets I–II (see Frison et al. 1976:38 for facet designations).

Of great interest is the unusually high incidence of cutmarks (total recorded = 1,200) and impact fractures (total recorded = 49). At least one cutmark is present on 80 (NISP) different bones; 41 (NISP) different bones have at least one impact scar. The MNE exhibiting butchery modifications includes: mandible (3); humerus (17); ulna (7); radius (7); carpal (2); metacarpal (5); femur (3); tibia (10); tarsal (5); metatarsal (6); phalange (3). Many of these bones display spiral fractures, as do many lacking macroscopically visible evidence of butchery, suggesting that Paleoindians were at least in part responsible for much of the fragmentation. There are, in fact, no complete tibiae. Only two humeri, one radius, three metacarpals, one femur, and three metatarsals are complete.

Element representation and bone modification data suggest that the exca-

†MNI for calcanea is maximal distinction; estimates for other elements are not.

vated portion (199 m^2) of the Clary Ranch site is a secondary processing area. The bone is scattered and carcasses largely disarticulated. Recorded articulated units include radius-carpal (n = 9, %P [% Potential Articulations, see Todd 1987a:142] = 56.3), carpal-metacarpal (n = 3, %P = 15.8), metacarpal-first phalange (n = 1, %P = 9.1), tibia-tarsal (n = 12, %P = 57.1), and tarsal-metatarsal (n = 2, %P = 14.3). Initial dismemberment is inferred to have occurred at a nearby kill locale, with mostly upper limbs being transported to the site for secondary butchery. Meat stripping may have taken place at the kill site, but extraction of within-bone nutrients almost certainly occurred at Clary Ranch. It has yet to be determined if age and sex of the animal influenced the transport and processing strategies of the hunters. Other appendicular elements, such as carpals, tarsals, and phalanges, although displaying some butchery evidence, were transported as "riders" and not primarily as a food source. Much of the secondary processing seems to have occurred at one of two excavated spatially distinct activity areas, each of which contains fragmentary bones, a variety of tools, and numerous tool resharpening flakes.

Ongoing research with the Clary Ranch bison assemblage has raised questions concerning Paleoindian settlement-subsistence organization. Intensive carcass processing such at that documented at Clary Ranch is atypical, and is more commonly associated with later Holocene kill-butchery sites (Todd 1987b). Cattle Guard (Jodry and Stanford 1992), and arguably Jurgens (Wheat 1979) and Lubbock Lake (Johnson 1987), are possibly the only other Paleoindian sites that compare with Clary Ranch in terms of evidence for segmental butchery and extraction of within-bone nutrients. At present, the underlying causal factors that might help explain why carcass processing is intensive at some Paleoindian sites and not at others are far from clear. However, kill site location, number of animals killed, season, and size of human group among other variables undoubtedly influence butchery and processing and must be considered. This information is crucial to a more thorough understanding of Paleoindian settlement-subsistence dynamics.

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Site Distribution, the Western Pluvial Lakes Tradition, and the Empirical Record

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The Western Pluvial Lakes Tradition (WPLT) characterizes late-Pleistocene/early-Holocene occupants of the Great Basin as reliant on lake/marsh resources (Bedwell 1973, Pettigrew 1984, Willig 1989). The reliance on this specific environment is proposed to be such that participants in this tradition focused on these resources almost exclusively (Bedwell 1973, Bedwell and Cressman 1970, Pettigrew 1984, Price and Johnston 1988, Willig and Aikens 1988) and that they would "never [need to] leave the lacustrine environment" (Bedwell 1973:170). The model thus suggests that most residential locations are in proximity to lakes/marshes (i.e., are near valley bottoms). A corollary to this hypothesis is that the valley bottom "camps" are larger, exhibit a greater number of tools, and are the centers of a logistic foraging pattern (*sensu* Binford 1980).

Recent research conducted in the northwestern Great Basin suggests that the WPLT model does not represent late-Pleistocene/early-Holocene human land use and mobility. Although a dominant explanation of early Great Basin cultures for two decades, this model has yet to be rigorously tested. The

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following summarizes two lines of evidence that do not support the model. Data were (and continue to be) derived from northwestern Nevada. Presently, the database consists of previously recorded sites (80%) and those discovered during fieldwork in 1995–6 (20%).

Table 1 categorizes sites by relative elevational zone and mean number of points and preforms found. Using mean number of projectile points and preforms as a proxy for site size, a clear preference of residence location cannot be seen. Although use of the mean may sometimes hide variation, it does not in this case. Actual counts of points and preforms for sites in the sample range from 2 to 13, resulting in a mean of 4.8 and a median of 5 for all sites. The correspondence of the mean per elevation zone, mean for all sites and median for all sites indicates that the use of mean numbers of points/preforms per elevation zone is valid. This low variance suggests that these people may have been very mobile (Kuhn 1995) Comparison of site distribution and land area distribution (see Table 1) also evinces a pattern counter to that of the WPLT. Chi-square analysis of site and land area distributions establishes that the distributions are similar ($X^2 = 9.46$, $X^{2\text{-crit}} = 12.59$, $a = 0.05$).

Table 1. Relative elevational distributions of available surface area and Stemmed series find locations.

Elevation zone■	% Surface area/zone	No. sites	Mean no. points/site
<70m	25.1	15	4.6
70–140m	23	8	4.9
140–210m	16	2	5
210–280m	12	3	5.6
280–350m	10	3	4
350–420m	7.3	1	7
420–490m	6.7	1	2

■ Relative or within-basin elevation zones across seven drainage basins. Last zone does not represent highest possible relative elevation, but relative elevation zone of highest site.

The WPLT, at the level of settlement distribution, does not seem to be upheld in this analysis. Contrary to the WPLT model, the above and conclusions detailed elsewhere (Hoffman 1996a, 1996b, 1996c) indicate that the late-Pleistocene/early-Holocene inhabitants of the Great Basin were more mobile and less resource-specific. As a result, questions arise of when and where "Archaic" economies in the Great Basin have their roots, as does the consideration of what is "Archaic" in terms of North American Prehistory.

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New Late-Paleoindian Points for South-Central Ontario

Lawrence J. Jackson

The late-Paleoindian period is poorly known in southern Ontario. Two significant sites, Heaman in southwestern (Deller 1976) and Deavitt in south-central Ontario (Dibb 1985), occur along the glacial Lake Algonquin strandline. Regions deeper in the interior appear to have been little used. During the 1980s, intensive survey of an area covering 200 km^2 near Rice Lake in south-central Ontario produced valuable new information on interior settlement systems (Jackson 1994). Part of this survey centered on a stream valley south of Rice Lake between two interlobate moraines.

Only 10 km long and 2 km wide, Plainville Valley has eight late-Palaeoindian points at six separate sites (Figure 1). With 25% of the several-thousand-acre valley floor surveyed, there may be three or four times this number of sites.

A Hi-Lo point base on white Haldimand chert (Figure 1A) has rounded "ears" and basal thinning with short "flute-like" scars on one face and pronounced basal concavity (Fitting 1963). It occurs on a sandy knoll on the south side of Plainville Stream.

Two Holcombe-like lanceolate bases (Fitting et al. 1966) on Onondaga

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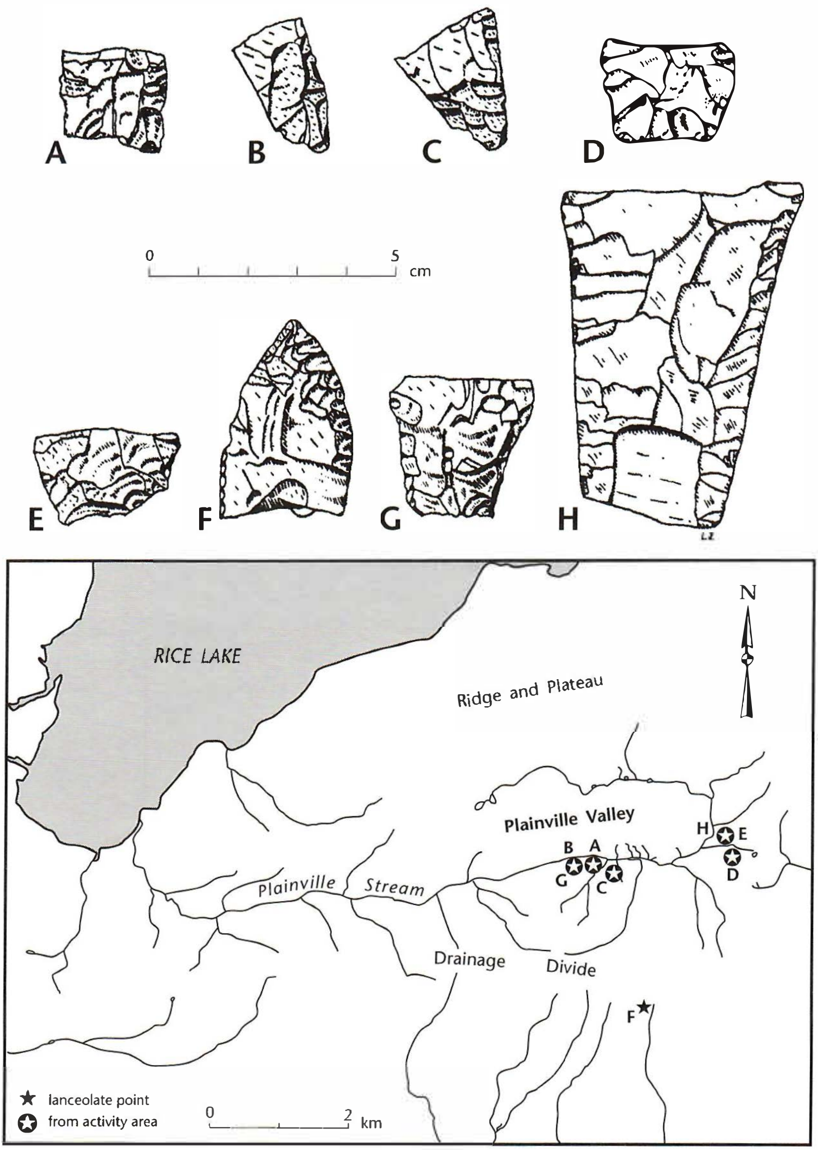

Figure 1. Late Paleo-Indian Projectile Points from Plainville Valley, Rice Lake, Southern Ontario: **A,** Hi-Lo point base, white Haldimand chert; **B,** Holcombe point base, grey Onondaga chert; **C,** Holcombe point base, grey Onondaga chert; **D,** Plainville point base, grey Onondaga chert; **E,** Plainville point base, brown Bayport chert; **F,** Unknown lanceolate, blue Balsam Lake chert; **G,** Hell-Gap mid-section, grey Onondaga chert; **H,** Hell-Gap mid-section, grey Onondaga chert.

chert (Figure 1B and 1C) occur on knolls on the south side of Plainville Stream. Thinning is by multiple short, flute-like removals from bases. Both points are parallel-sided, with moderate basal concavity and "ears."

A finely fashioned lanceolate base on Onondaga chert (Figure 1D) is heat-altered. Thinning and grinding of the straight base and edge expansion just above weak basal "ears" suggest a new type called "Plainville" (Jackson and Lennox 1997). Found on a sandy knoll south of Plainville Stream, this point is similar to lanceolates from the McConnell site in Ohio (Prufer 1963).

A lanceolate base on weathered Bayport chert (Figure 1E) has a ruby-red exterior and brown interior. It is very thin with one poorly executed basal corner, edge grinding, a straight base, and expansion beginning just above basal "ears." Found on a sand ridge beside a spring, this may also be a Plainville type.

A broad-bladed and thick blue-grey lanceolate tip on Balsam Lake chert (Figure 1F) expands below the tip. Balsam Lake chert use is typical of this time period in southern Ontario (Dibb 1985). This find is on a high drainage divide overlooking Plainville Valley to the north and Lake Ontario to the south.

Finally, two Hell Gap mid-sections on Onondaga chert (Figure 1G and 1H) have distinctive proportions and flaking patterns (Deller 1976). The smaller example is from a knoll above Plainville Stream and the larger from a sandy ridge 3 km to the east adjoining a spring and T-stream intersection. Both show widening above mid-point and lateral edge grinding.

These lanceolates most likely post-date the terminal early-Paleoindian–Crowfield phase, ending about 10,300 yr B.P., and predate early-Archaic side-notched types such as St. Charles at about 9,700 yr B.P. (Ellis et al. 1990).

During this estimated 600-year interval there may have been a rapid succession of late-Paleoindian groups. The Plainville Valley data suggest substantial interior occupations. South-central Ontario has now produced Agate Basin, Eden-Scottsbluff-like, Hell-Gap, Hi-Lo, Holcombe, and two new types, Plainville and Medina (Dibb 1985), both diminutive lanceolates. Exact ages and associations remain unknown.

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Carl Schwachheim and the Folsom Site

Lawrence J. Jackson

The 1926 and 1927 excavations of the Folsom site by the Colorado Museum of Natural History are a source of ongoing historical interest. The critical awareness of the excavators and significance of the site to the American Palaeolithic debate are still argued (see Rogers and Martin 1987; Seltzer 1983).

Much has been made of archaeologists "authenticating" the Folsom discoveries of palaeontologists Jesse Figgins and Harold Cook. A divergent view holds that American archaeologists were "slow starters" in late-Pleistocene archaeology due to a long period of criticism by W. H. Holmes and Aleš Hrdlička of the U.S. National Museum and that palaeontologists should be credited with looking for the needed evidence. As late as 1928, Hrdlička referred to Folsom as both recent and misinterpreted (Jackson and Thacker 1992). As palaeontologist Oliver Hay wrote to Jesse Figgins about the Folsom site:

> The anthropologists will insist that it is of comparatively late origin. Unless there is some means of establishing the age of the deposit, either from fossils or from the geology of the region, the specimens will not convince them (DMNH, Dec. 17, 1926).

During the second field season, with exposure of fluted point No. 5 embedded in the ribs of an extinct bison and a subsequent invited visit by Frank Roberts, A. V. Kidder, and others, Folsom was quickly accepted.

As Jesse Figgins wrote to crew member Carl Schwachheim from the Denver Museum, August 31, 1927:

> Letter regarding arrowhead just received. Best congratulations. Cover carefully and securely and await further instructions. Have telegraphed several scientists inviting them to study the point in position. Will keep you posted with their replies (DMNH).

Carl replied:

> Very glad the arrowpoints are causing some excitement as it makes a fellow feel more like he had earned his pay. I hope all the scientists will be satisfied now as they have a chance to study it in place (DMNH).

Carl Schwachheim of Raton, New Mexico, was first involved with Folsom when he and Fred Howarth brought the site to the attention of Jesse Figgins. Carl became principal site excavator under the direction of Harold Cook and Jesse Figgins. During a 1989 visit to Raton, I relocated Carl's field journal—complete with drawings and comments on each of the Folsom site fluted points as they were discovered (Figure 1).

Carl wrote to Jesse Figgins:

> The points we found were not arrow points but long slender lance or spear heads on a long shaft which were hurled from ambush and no doubt antedate the arrowhead by many years. Reasons if they were arrows the shaft would be broken off and the arrow would be whole or broken while the six or seven inch lance head would be broken off even with the end of the shaft thus and the shaft and the rest of the lance

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head would be lost and no doubt never found while if they were arrows and broken the workmanship on the barbs would still be shown the break would not come in the broad part of the head. (DMNH, Dec. 23–26, 1926)

Carl illustrated his letter with an "arrow" and a "lance" complete with hefting accoutrements, probably the first ever depiction of a hefted North American fluted point.

Carl was keenly interested in the technology of the points but also took time to commiserate with Figgins on the failure of his trip East to convince Holmes and Hrdlička about Folsom.

I should have known those eastern men would put enough on you to kill a jack. . . . I am not surprised that the small piece in the block was a fragment of the light point in fact I told Frank to be sure and put that down in his book as being a possible part of No 2 point. . . . The work should not be so hard next season as we have a good bank to start on (DMNH, Dec. 23–26, 1926).

For his part, Jesse Figgins placed great store in Carl's judgment, asking his advice:

It is my opinion we should clear off another piece of ground the same as last year. It is Frank's idea that best results can be had on the north side of the creek, but I would like to have yours and Fred's opinion regarding that. (DMNH, Dec. 16, 1926).

The Folsom excavations succeeded, gained broad acceptance, and were taken over by the American Museum of Natural History in 1928 under palaeontologist Barnum Brown. Less than a decade later, Frank Roberts

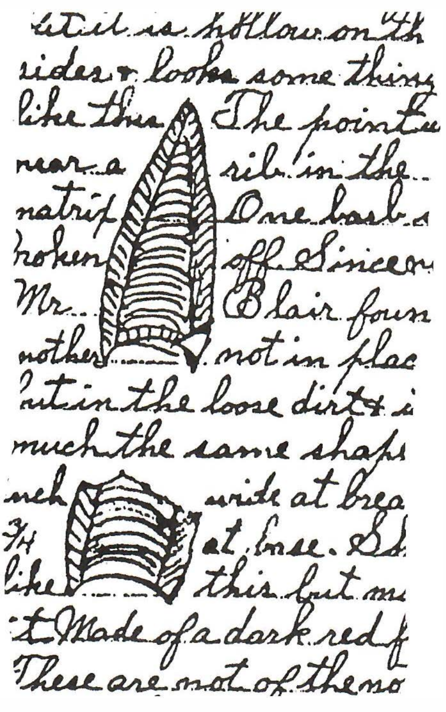

Figure 1. Drawing in field journal of Karl Schwachheim for August 29, 1927, of Fluted Point No. 5 found embedded in ribs of extinct bison at Folsom site (shown about three-fourths actual size).

became the first archaeologist to excavate a Folsom site—Lindenmeier, Colorado. Carl Schwachheim was an amateur archaeologist and naturalist, but his contributions to the Folsom site should not be forgotten. I would like to think that A. V. Kidder's grateful letter of acknowledgment to Jesse Figgins also includes Carl Schwachheim:

> Anthropology owes you a very great debt for having handled this material so carefully and so intelligently, and I think that the researches of yourself and Dr. Cook will go far towards opening a new era in the study of the question of Pleistocene man in the New World. (DMNH, October 13, 1927).

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A Stemmed Bifacial Point from the Serdyak Site, Western Beringia

Maureen L. King and Sergei B. Slobodin

Until recently, stemmed bifacial points were known only from a single locality in western Beringia. In the 1960s Dikov (1968) reported this artifact type from Ushki I level VII in Kamchatka (Figure 1). Approximately 50 stemmed points have been found at Ushki level VII, radiocarbon dated to between 13,000 and 14,000 yr B.P. (Dikov 1977). More than two decades later Kiryak (1989, 1990) reported finding four stemmed points and a lanceolate point at Bolshoi Elgakhchan 1, and a stemmed-point fragment at Bolshoi Elgakhchan 2 in

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western Chukotka. While the Elgakhchan sites are undated, Kiryak (1996:234) believes stemmed bifacial points are a "diagnostic element" of the Ushki level VII complex. A stemmed point classified as the Ushki type has also been reported from Ulkhum on the Chukchi Peninsula (Dikov 1993), as well as two stemmed points from Bolshoi Avlandya in western Chukotka (Vorobei 1993). Here we report a stemmed bifacial point from Serdyak, a site along the northern coast of the Sea of Okhotsk (Priokhotye).

The Serdyak site is on a terrace of the Serdyak River, a tributary of the Ola River. The stemmed point is symmetrical in shape with a sub-triangular blade and a lenticular cross section (Figure 1). The point is made of chalcedony with parallel-oblique flaking on one face and a random flaking pattern on the other. In morphology it is similar to the Ushki level VII stemmed points, as well as to the stemmed points mentioned above. The artifact was found in a surface exposure along with a lanceolate biface. Two test excavations yielded a blade fragment and flake. The specimen from Serdyak provides evidence that stemmed bifacial points had a widespread distribution in western Beringia.

Bifacially chipped-stone projectile points are an uncommon attribute of western Beringian sites. While stemmed points are known from some Neolithic contexts, the points do not resemble those from Ushki level VII. Thus, Dikov (1996) has turned to North America to find analogies for this material comparing the stemmed points to the Stemmed Point Tradition of western North America (Bryan 1980). However, given both the distance involved and the only very general similarities between the points themselves, this interpretation should be viewed cautiously.

In western Beringia, stemmed bifacial points may signal a technological

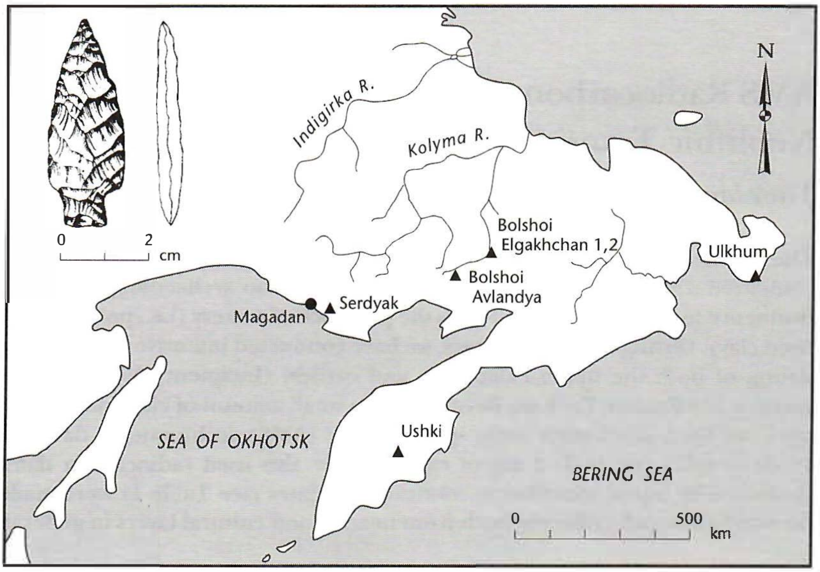

Figure 1. Map showing location of sites in western Beringia with bifacially stemmed projectile points similar to the Ushki level VII points; inset, an illustration of the point from the Serdyak site.

tradition that was present at the close of the Pleistocene. However, a sample of points considerably larger than that currently available, as well as additional specimens from dated contexts, will be essential to evaluate the spatial/temporal relationships of this artifact type.

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AMS Radiocarbon Dating of the Paleolithic-Neolithic Transition in the Russian Far East

Yaroslav V. Kuzmin and A. J. Timothy Jull

The Russian Far East is characterized by a very early beginning of the Neolithic compared with other regions in the world. In Russian archaeology, the most distinctive feature of the Neolithic is the presence of pottery (i.e., pots made of fired clay). During the last few years, we have conducted intensive radiocarbon dating of both the upper-Paleolithic and earliest (Incipient) Neolithic cultures on the Russian Far East. Because of the small amount of charcoal at most sites, we used accelerator mass spectrometry (AMS) technique to date the small samples (up to 1–2 mg of carbon). We also used radiocarbon dates measured by liquid scintillation counting. All dates (see Table 1) were made on wood charcoal, collected both from hearths and cultural layers in general.

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The youngest upper-Paleolithic sites on the southern Russian Far East were radiocarbon dated to c. 14,200–10,100 yr B.P. The oldest Neolithic sites, Gasya and Khummi, were dated to c. 13,200–10,350 yr B.P. (Table 1). Thus we have evidence of the coexistence of two distinct cultural traditions during the interval of c. 13,000–10,000 yr B.P. in the Amur River basin. In Primorye, Maritime Province, the earliest Neolithic cultures previously had radiocarbon dates no older than c. 8,400 yr B.P. (Table 1).

Table 1. Radiocarbon dates.

Region	Site	^{14}C date, yr B.P.	Lab no.	Reference
Upper Paleolithic				
Amur River basin	Malyie Kuruktachi	14,200 ± 130	SOAN-3287■	Kuzmin *et al.*, in press
		13,815 ± 150	AA-13399	This paper
		13,310 ± 105	AA-13398	This paper
		12,485 ± 80	AA-17212	This paper
		11,730 ± 70	AA-17211	This paper
Primorye	Suvorovo 4	15,105 ± 110	AA-9463	Kuzmin *et al.*, 1994
	Ustinovka 6	11,750 ± 620	SOAN-3538■	Kuzmin *et al.*, in press
	Pereval	11,150 ± 100	LE-1565■	Medvedev, pers. comm.
		10,100 ± 100	LE-1566■	This paper
Incipient and Early Neolithic				
Amur River basin	Gasya	12,960 ± 120	LE-1781■	Kuzmin *et al.*, 1996
		10,875 ± 90	AA-13393	This paper
	Khummi	13,260 ± 100	AA-13392	This paper
		10,345 ± 110	AA-13391	This paper
Primorye	Pereval	8,380 ± 60	LE-1565A■	Medvedev, pers. comm.

■Liquid scintillation counting

As for East Asia as a whole, the earliest Neolithic sites have been radiocarbon dated in Japan to c. 12,200–12,700 yr B.P. at the Kamikuroiwa and Fukui sites (Morlan 1967); in southern China to c. 13,700 yr B.P. at the Miaoyan site (Yuan et al. 1995), and probably up to about 14,600 yr B.P. at the Xianrendong site (MacNeish and Libby 1995); and in Transbaikal at c. 11,200 yr B.P. at the Ust-Karenga site. The Paleolithic/Neolithic transition took place in East Asia at various times between c. 14,000 yr B.P. and c. 8,000 yr B.P.; the earliest Neolithic cultures, widely distributed in the region, have radiocarbon dates within the interval c. 14,000–11,000 yr B.P. This may support the model of multi-centered pottery emergence instead of a single-center model with the Incipient Jomon of Japan as "a cradle of pottery-making."

This study was partly supported by grants from both US NSF (# EAR 9508413) and Russian RFFI (#96-06-80688). We would like to thank Dr. Vitaly E. Medvedev for providing the information about the radiocarbon dates on the Pereval site.

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Paleoindian Occupation of the Lower Missouri River Loess Hills: Buried Evidence from DB Ridge, Northeastern Kansas

Brad Logan and William C. Johnson

Three Paleoindian projectile-point fragments (Figure 1) were recovered during excavations at the DB site in northeastern Kansas. DB is a stratified, multicomponent occupation on the summit of a loess-mantled ridge overlooking the Missouri River Valley and that of its tributary, Salt Creek, on the Fort Leavenworth reservation. Excavations were done in 1995 and 1996 to mitigate the impact of construction of a new United States Disciplinary Barracks (Logan 1995a, 1995b, 1997).

Cultural deposits at DB are in soils developed in Pleistocene and Holocene loess. Site stratigraphy consists of: 1) Peoria loess to within c. 1.3 m of the surface; 2) the Brady soil, a Pleistocene-Holocene transition geosol that is discontinuously distributed throughout the Central Plains and dated c. 11,000–9,000 yr B.P. (Johnson 1993, Johnson 1995; Johnson and May 1992); and 3) the modern soil developed in Holocene-age Bignell loess. The A horizon of the Brady soil has been extensively eroded from the ridge.

The most extensive cultural deposits, middle and late Archaic (8000–2500 yr B.P.), are in the Brady B horizon, which is welded to, or incorporated into, the overlying surface soil. The latter contains late Prehistoric deposits (Steed-Kisker phase; c. 1000–600 yr B.P.). The Paleoindian artifacts were in the B horizon of the Brady soil. Their original provenience, given the ages of their associated cultural complexes, was probably the Brady A horizon; stratigraphic association with more extensive evidence of Archaic occupations is attributable to deflation of that soil. The site's proximity to upland springs and woodland resources and the panoramic view it provides of the Salt Creek and Missouri River Valleys appear to have attracted periodic occupation throughout human prehistory in the region.

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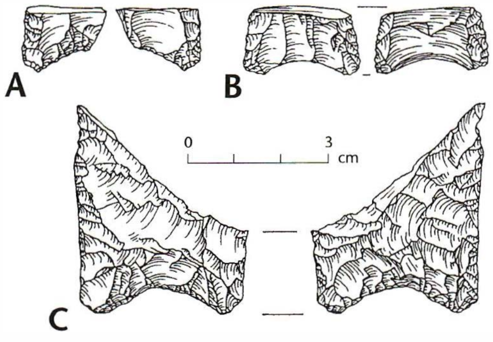

Figure 1. Paleoindian projectile points from the buried Brady soil at the DB site, Fort Leavenworth, Kansas.

Artifact A, the basal fragment of a Folsom point, was found at a depth of 50–60 cm, generally the deepest level of Archaic deposits not extensively disturbed by bioturbation. The point is made of exotic white chert with light gray mottles, possibly from Mississippian outcrops in central Missouri. The base and the one preserved lateral edge have been ground; it exhibits a flute on one face and, on the obverse, traces of two flute scars truncated at the base by retouch scars. Its maximum thickness is 4.1 mm; flute thickness is 3.8 mm.

Artifact B, the base of a Dalton point, is of banded gray Permian chert from the Flint Hills of Kansas c. 100–150 km west of the site. It is from 40–50 cm below surface, is 6.8 mm thick and has a basal width of 25.2 mm. Small flute or basal thinning scars cover all but the lateral edges of both faces, with no evidence of basal and lateral grinding.

Artifact C, the base of a Dalton point, is of local gray fossiliferous (Plattsmouth) chert. It was found at a depth of 60–70 cm, is 8.2 mm thick, and has a basal width of 35.0 mm. It has been extensively ground on all edges and has basal thinning scars on both faces.

The significance of these finds lies in their provenience in a buried soil in the lower Missouri River loess uplands. Previous regional finds of Paleoindian points, including those of Folsom (ca. 10,200–10,800 yr B.P.) and Dalton (ca. 9,700–10,500 yr B.P.) complexes, have been in disturbed contexts, including gravel bars along major streams and on eroded upland surfaces (Brown and Logan 1987; Chapman 1975; Hofman 1994, 1996; Wetherill 1995). The artifacts described here may have been redeposited from the A horizon of the Brady soil, but their buried context and the fact that a portion of the Brady A has been preserved justifies the search for evidence of Paleoindian activity elsewhere in the loess hills of the lower Missouri River Valley. The DB site underscores the potential for shallow burial of Paleoindian and Archaic age sites in upland loess settings that has been recognized recently elsewhere in the Central Great Plains and Midwest (Johnson and Logan 1990:294; Van Nest 1993).

We thank Jack Hofman, Department of Anthropology, University of Kansas, for identification of the Paleoindian projectile points and review of the manuscript and Sarah Moore, who made the drawing. The DB projects were undertaken by the Museum of Anthropology, University of Kansas through a contract to Burns and McDonnell Engineers, Kansas City, Missouri from Fort Leavenworth and the Kansas City District, U.S. Army Corps of Engineers.

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Horace Rivers: A Late-Plainview Component in the Northeastern Texas Panhandle

Robert J. Mallouf and Rolfe D. Mandel

Our general understanding of environmental and cultural mechanisms involved in the transition from Paleoindian to Archaic lifeways remains a problematical research issue in North American archaeology. A remarkable late-

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Paleoindian site investigated in 1992 by the Office of the State Archaeologist, Texas Historical Commission, is yielding data of significance with regard to this and other current research avenues.

The Horace Rivers site is located at the base of the High Plains escarpment in the upper reaches of Morgan Creek, a northern tributary of the Canadian River in the northeastern Texas Panhandle. This small (c. 40 x 40 m) open campsite occupies a remnant of an alluvial terrace (T-2) that generally has not been preserved in other areas of upper Morgan Creek. Cultural deposits are contained in the T-2 fill, which is inset in the Ogallala Formation and protected fortuitously from erosion by a rock-defended terrace scarp. Three major stratigraphic units (Strata I–III) are identified in the upper 5.4 m of the T-2 fill.

The uppermost and youngest stratigraphic unit, Stratum I, is 65 cm thick and consists of loamy overbank deposits. A surface soil with A-Bw-Btk-Bk horizonation is developed in Stratum I. The upper 10 cm of this soil contains campsite features and midden debris, including refuse pits, hearths, arrowpoints, and ceramic sherds, of late-Prehistoric bison hunters (730 ± 70 yr B.P.; AMS, Beta-55906). Stratum I overlies Stratum II on the southern edge of the site. Stratum II is a wedge-shaped unit of loamy alluvium that thins and eventually disappears to the north. Where Stratum II is absent, Stratum III is buried by Stratum I. A thin, culturally sterile paleosol at the top of Stratum II merges with an artifact-bearing paleosol developed at the top of Stratum III. Stratum III, which is over 5 m thick, contains four distinctive substrata of (from top to bottom) overbank, low-energy channel, pond or swale, and high-energy channel deposits. The paleosol at the top of Stratum III is 10–45 cm thick and contains campsite features (basin-shaped pits and hearths) and midden debris attributable to a late Plainview culture occupation. Significantly, the alluvium immediately above and below the Plainview component is culturally sterile, largely eliminating the possibility of more recent or older human contamination.

In the hopes of isolating a living surface within the Plainview paleosol, a block excavation method was utilized employing units 1 m square at 5-cm levels. All excavated material was water screened through fine mesh, resulting in maximum specimen retrieval. Among the recovered lithic artifacts are Plainview points and bifacial point preforms (with refits), unifacial end-scrapers, prismatic blade fragments, a large spokeshave, utilized flakes, and a quantity of tiny alibates agate debitage related to the refurbishing, rather than manufacture, of tools. The Plainview band appears to have depleted their toolstone and might have been traveling toward alibates sources to the west in order to replenish their supply. Stone tools from the Plainview component at Horace Rivers are strikingly similar to those recovered in a Plainview-affiliated bison bonebed at the Lake Theo site (Harrison and Killen 1978) to the south.

Also recovered at Horace Rivers are several thousand specimens of early-Holocene vertebrate fauna, comprising over 50 species (including three extralimital and one extinct species) and consisting of smashed and charred bone fragments. Represented in this Plainview faunal assemblage are bison, antelope, deer, rabbits, muskrats, wolves, badgers, skunks, squirrels, prairie dogs, birds, snakes, turtles, lizards, frogs, fish, mussels, and other species. Bison remains are present but not plentiful. With the major exception of bison bone frequency, strong parallels are noted between the faunal assemblage from Horace Rivers and Plainview/Firstview components at the Lubbock Lake site (Johnson 1988). Attempts to recover pollen from the Plainview paleosol proved unsuccessful.

While definition of a Plainview living surface was not achieved at Horace Rivers, the discovery of four basin-shaped pits, a surface-constructed hearth of caliche nodules, and the refitting of broken stone tools served to narrow the search. Charcoal samples taken from within features and from an approximated living surface in the Plainview component yielded AMS assays of 9,000 ± 70 (Beta-55909), 9,040 ± 70 (Beta-55908), 9,060 ± 90 (Beta-55907), and 9,290 ± 80 (AA-9367) yr B.P., suggesting that site occupation was attendant with the imminent extinction of Plainview culture.

This site provides us with interesting insights into the lifeways of Plainview groups near the end of their cultural existence. Rather than focusing on big-game hunting, this band was dependent on broad-spectrum hunting and gathering for subsistence, much like Archaic peoples who would follow. The scarcity of bison in the faunal assemblage may have special significance with respect to subsistence activities being pursued, particularly if such scarcity was regional rather than localized. Interestingly, there are indications of significant climatic change occurring shortly after Plainview abandonment of the site. The stratum immediately above the Plainview paleosol contains numerous thin charcoal-rich lenses suggestive of repeated grass fires that might be indicative of a rapidly warming and drying environment. Renewed overbank deposition by 7,900 ± 100 yr B.P. (Beta-55904) buried the Plainview component beneath 60–100 cm of alluvium.

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A Preliminary Report on Paso Otero 5, a Late-Pleistocene Site in the Pampean Region of Argentina

Gustavo A. Martínez

Paso Otero 5 is located on the right bank of the Río Quequén Grande River. The site was discovered in 1994 by Pablo Messineo, a student at UNC-Olavarría, and the author. A close examination of the river bank revealed an extensive lens of bones outcropping from fluvial sediments. Subsurface testing later in 1995 and 1996 opened an area of 16 m^2 and confirmed the anthropogenic origin of the bones.

Associated archaeological materials recovered at the site include 32 complete and fragmented bones of extinct megamammals and modern species; several hundred small burnt bones, bone splinters, and fragments; two lithic tools; and a small amount of lithic debris. These materials were found 2.2–2.5 m below the bank surface. This portion of the stratigraphic sequence contains fluvial sediments of the Lujan Formation consisting of two members, the late-Pleistocene Guerrero member and the early- to middle-Holocene Río Salado member (Fidalgo and Tonni 1978; 1981).

The faunal remains consist of a complete left calcaneus of *Megatherium* cf. *M. americanum* (giant ground sloth), a piece of maxilla of *Equus neogeus* (American horse), a fragmented diaphysis of *Toxodon tibia,* and a piece of *Hemiauchenia tibia.* An armor plate and dermal bones also indicate the presence of *Glyptodon* sp. and probably *Scelidotherium* sp. (ground sloth) or *Mylodon* sp. (ground sloth). Two incomplete bones (femur and tibia) of *Lama guanicoe* (guanaco) were recorded in this context. A vertebra and numerous fragments of ribs and long bones of megamammals, some of then burnt, have also been recorded.

Detailed analysis of the most significant tool, either a projectile point or a knife, is still in progress. This tool, made from red chalcedony, has a clear lanceolate form and was not manufactured using bifacial reduction. The shoulders have ground edges suggesting that it was once hafted; the stem and the tip are fractured. One of the edges consists of a series of large retouches, and the other shows only marginal retouch. A section of the margin presents a major regularity which suggests that this portion may have been used as a knife.

The other tool was manufactured from red quartzite and seems to be a compound or multipurpose tool, with a borer-like point, two large notches and a marginally retouched edge. Eight small flakes and nine pieces of debitage (all of them of quartzite) also were found in this context.

The stratigraphy as well as the faunal association suggest an age close to the

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Pleistocene-Holocene boundary. An AMS radiocarbon date from a piece of megamammal bone from this context gave an uncalibrated age of 10,190 ± 120 yr B.P. (AA-19291).

Research at Paso Otero 5 is at an early stage. However, this site has potential to add significant information about problems related to the peopling of South America, the extinction and survival of Pleistocene species into Holocene times, and the relationship between megamammals and Paleoindian people.

A few Paleoindian sites in the Pampas could be related to Paso Otero 5. In the Interserrana area, the earliest component of Arroyo Seco 2 (a base camp) has been dated between 7,300 and 11,500 yr B.P. and contains nine taxa of megamammals, three of which show evidence of been exploited by hunter-gatherers (Politis et al. 1995:195). In the Tandilia area, the El Sombrero and La China sites (open-air sites and caves) represent Paleoindian occupations with uncalibrated radiocarbon ages ranging from 8,000 to 11,000 yr B.P. (see Zárate and Flegenheimer 1997). Significant lithic assemblages consisting of fish-tail projectile points and preforms representing various stages of lithic reduction have been recorded in these sites but no faunal remains were recovered.† Other related sites are Cueva Tixi and Abrigo Los Pinos, where bifacial technology was recognized in levels dated between 10,375 ± 90 and 9,575 ± 120 yr B.P. (Mazzanti 1997). In the first site, one species of extinct mammal, *Eutatus seguini*, was identified, while in the second a fish-tail projectile point was recovered. The distance between Paso Otero 5 and all these sites is about 50 km, which could easily fall within the territory of a single foraging band. Paso Otero 5 is located in a fluvial setting in the river valley bottoms of the Río Quequén Grande (Martínez, in press), and the faunal material from the site is much better represented than that of the Tandilia area sites. This situation makes it possible to compare both geomorphic zones and to clarify the complementary functionality of sites. These comparisons enlarge our understanding of Paleoindian group settlement systems in the critical transition period between the Pleistocene and Holocene.

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The Padre Canyon Paleoindian Locality, Hueco Bolson, Texas

Raymond Mauldin and Jeff D. Leach

Located in far west Texas on the western edge of Hudspeth county, the Padre Canyon Paleoindian locality sits at the southern terminus of the Hueco Mountains. The locality consists of two concentrations of primarily Folsom-age artifacts and is one of a growing list of Folsom sites from the Hueco Bolson/ Tularosa Basin region that add to our understanding of Folsom settlement and mobility (see Amick 1994, 1996). Here we provide a brief description of the assemblage from Padre Canyon and discuss patterns in toolstone use.

The site was originally identified as two concentrations of Paleoindian artifacts with a small quantity of Formative material. Staley and Turnbow (1995) suggest that the Paleoindian artifacts are a secondary sheet-wash deposit. Our work (Mauldin and Leach 1996) documents that the Paleoindian artifacts, while not deposited by sheet wash, have been extensively turbated by badger *(Taxidea taxus)* burrowing. While vertical integrity of the deposits is questionable, some horizontal integrity remains.

Within the Padre Canyon locality, 387 surface artifacts have been collected (Mauldin and Leach 1996; Staley and Turnbow 1995). Subsurface testing in an area of 14 m^2 recovered 401 items (Mauldin and Leach 1996). The collection includes 6 Paleoindian points (4 Folsom, 1 Midland, and 1 Paleoindian base),

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2 snapped Folsom tips, 1 channel flake, 29 steep-angled scrapers, and 9 used projections or spurs. The used projections commonly occur on items with radial breaks (see Frison and Bradley 1980:44).

Chalcedonies and cherts dominate the toolstone, constituting 99% of the assemblage. The predominant material is a grayish-green translucent chalcedony, though other color ranges are present. Chert colors include butterscotch and black, both of which show evidence of heat treatment. While several researchers have identified significant quantities of non-local toolstone (e.g., Edwards Plateau chert) in regional Folsom assemblages (Amick and Stanford 1993; Mauldin and O'Leary 1994), no clear examples are present in the Padre Canyon toolstone. However, many of the chert colors are not common in later period assemblages, suggesting that they may be non-local.

Chalcedonies and cherts have different reduction patterns. Focusing only on the surface items, chert debitage and cores are under-represented, while chert tools are over-represented relative to chalcedony. Over 84% of the 293 chalcedony surface items are unutilized flakes, 7.8% (n = 23) are utilized flakes, 6.5% (n = 19) are formal tools, and 1.4% (n = 4) are cores. The surface patterns for chert artifacts (n = 98) are significantly different, as 50% (n = 49) are unutilized flakes, 12.2% are utilized flakes, and 29.6% (n = 29) are formal tools.

When considered by material, there is little difference in non-cortical unutilized flake percentages for chalcedony (61%) and chert (65%). Similarly, maximum flake lengths for both raw material groups average just over 23 mm. However, using the median length (21.69 mm) of all surface unutilized flakes to partition each material type into two size groups, there are significant differences in chert and chalcedony cortical percentages between size groups. In the small (<21.69 mm) size group, 72% of the chalcedony lack cortex and 4.0% have more than 50% cortex. For the large size group (>21.69 mm), 49.6% lack cortex and 7.4% have more than 50%. Consistent with experimental core reduction (e.g., Tomka 1989:141–142), non-cortical flakes are less common and flakes with more than 50% cortex are more common in the larger size ranges. For the unutilized chert flakes, 68% of the small size group lack cortex, and 4.5% have more than 50% cortex. However, unlike the chalcedony pattern where the percentage of non-cortical flakes drops by 22% in the larger size group, the percentage of large non-cortical chert flakes decreases only slightly to 63%. Chert flakes with more than 50% cortex are actually less common in the larger size group (3.7%). Combined with the low frequency of chert debitage, the lack of cores, and high frequency of tools, these size/cortex patterns suggest that most chert was brought to the location with little cortex, probably in the form of tools. Chert represents 60.4% of all formal tools (29 of 48), even though the material constitutes only 23.3% of the surface collection, while chalcedony, which dominates the surface toolstone (75.7%), represents 40% of the formal tools.

While specific source areas are unknown, the toolstone use suggests that some cherts were brought to the locality as formal tools and flake blanks with little cortex. Chalcedony was the focus of site reduction, and it is probable that the chalcedony tools produced were transported elsewhere. This pattern of staged toolstone use is consistent with Folsom organizational strategies documented in the region (e.g., Amick and Stanford 1993).

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Comments on the East Wenatchee Clovis Site (45DO482), Washington State, As Reported on by Richard M. Gramly

Robert R. Mierendorf

In Vol. 13 of *Current Research in the Pleistocene,* Richard M. Gramly summarized the results of excavations at a uniquely intact Clovis tool cache between 1988 and 1990. Gramly's claim that two ancient pits were present is central to his interpretation of the recovered assemblage. In fact, no such pits were visible and Gramly has offered virtually no empirical evidence demonstrating their existence. As of this date, field efforts by other investigators, myself included, have failed to identify any pits (Mehringer 1988 and 1989; Mehringer and Foit 1990).

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Under authority of a written agreement between the land owner, the State of Washington, and the Colville Confederated Tribes, I served as a professional archeological observer during Gramly's 1990 excavation (I also acquired first-hand knowledge of the site in 1987 when I found the in situ cache and recorded the site). This gave me ample opportunity to note Gramly's alleged discovery of the pits. Having years of experience excavating prehistoric features in this region, including sites from early-Holocene depositional contexts, I was keenly interested in Gramly's field procedures generally, and in his pit hypothesis particularly. Up-close examination of the alleged Feature 1 pit boundary revealed no color, grain-size, or other matrix differences between the claimed pit and non-pit sediments. Unfortunately, Gramly's field procedures did not include wall-shaving or other techniques commonly used to tease out subtle stratigraphic variability in homogeneous deposits; nor did he record wall profiles prior to unit excavation. As a result, by the time the "pit" was recognized, potentially critical stratigraphic information on the unit wall that sectioned the "pit" may have been destroyed by his excavation. In considering Gramly's pit hypothesis, archeologists should be mindful that this same unit wall was initially exposed during Mehringer's 1988 excavation, and it was observed at that time by George Frison, Dennis Stanford, C. Vance Haynes, and other Paleoindian researchers who participated in this first test, yet no pit features were found (Mehringer 1989).

An important consideration regarding the alleged pit relates to Gramly's lack of use of Mehringer's (1989) detailed granulometric study of the site deposits that was available to Gramly while he worked at the site in 1990. In Mehringer's analysis, close-interval sediment samples were removed from two vertical columns and two horizontal rows on the walls of (Mehringer's) excavation unit 9. This unit corresponds with the right-hand of the two full meter-square units depicted on Gramly's foldout (1993:25) entitled "Planview of Feature 1"; one of Mehringer's horizontal sample rows was across the south wall (towards top of the page on Gramly's foldout map), one row and one column each were sampled from the west unit wall (right side of unit on Gramly's figure), and the second vertical column was sampled from the north unit wall (towards bottom of page). In spite of the fact that Mehringer utilized a sensitive measure (½-phi interval) of grain-size variation, he could only detect a slight shift from coarse to fine sand moving upward in the column. No evidence was found for mixing or of sharp discontinuities in the soil (Mehringer 1989:31–40). These results seem to contradict the pit hypothesis, but Gramly does not acknowledge that this analysis bears directly on his hypothesis nor does he attempt to reconcile the differences between his conclusions and Mehringer's results.

The alleged second deeper pit, Feature 2, is just as questionable. His claim is based on the presence of two artifacts recovered c. 2 m from the cache (Gramly 1993:6), but at a slightly greater depth. Again, in the absence of any field evidence, but apparently needing to account for the relative position of the artifacts, Gramly proclaimed the existence in the field of a second pit. Subsequently, he published a diagram of sieved soil samples (Gramly 1993:26) that he claimed reveals the boundaries of pit Feature 2. Two problems are encountered in attempting to use this diagram to support his second pit hypothesis. The first is that as published, there is no way of understanding what sediment variation the analysis has measured. The left-hand axis of the diagram shows the cumulative percentage of an unknown entity. We are left to guess, for example, if it quantifies the full range of particle sizes, or is it just the sand-size fraction, or sand and silt fraction? What do the horizontal lines across the diagram mean and what are the labels A, B, C, etc. between the lines meant to represent? None of these questions are answered in the text; consequently, the reader cannot assess the extent to which the analysis offers evidence in support of Gramly's conclusion. The second problem is that even if the diagram did provide sufficient information, it is plausible that the pit boundaries were created by the excavation of a hole in planting an orchard tree during the last few decades. This is a distinct possibility, since this alleged pit is in line with the existing row of orchard trees and it is known that original orchard trees have been replaced over the years.

The problem confronting archeologists who attempt to utilize Gramly's results to evaluate the site and its significance is that he offers virtually no objective evidence against which they can consider any except Gramly's interpretation. And there is much room for alternative explanations, here. For example, the presence of silica-rich encrustations on some artifacts (Mehringer and Foit 1990), and its complete absence on others, indicates that all artifacts did not share the same post-depositional history. Rather than anthropogenic pits, a more likely explanation, one that accounts for several site characteristics, is that the spatial patterning of the Clovis artifacts and the occurrence of silica-rich encrustations is related to the eolian origin of the site deposits, wherein some artifacts rested on an uneven, wind-deflated surface while others remained buried, and yet others were subjected to both conditions. A good candidate for a deflated surface at the site is what Mehringer called "contact A," a stratigraphic marker detected by most archeologists at the site based on sediment cohesion (Mehringer 1989:40), but nearly undetectable in the granulometric analysis. Although some of the Clovis artifacts rested on contact A, this surface extended well beyond the artifact cache. I have little doubt that Gramly has mistaken contact A for the remains of a pit, even though Mehringer (1989) clearly depicted its relationship to the artifact cache that Gramly later removed.

Given the crucial role of this site in clarifying the nature of western Clovis assemblages, a thorough and careful analysis of Gramly's excavation data is warranted. If such an analysis exists, it has not been made available to the profession, even though Gramly agreed to provide a descriptive scientific report of his results as a condition of the excavation permit granted by the Washington State Historic Preservation Office. If Gramly persists in claiming that two pits existed, it is his professional obligation to present supporting evidence to archeological peers according to a standard that befits one of the most significant Paleoindian archeological sites to be discovered in many years. Those interested in this site and its contribution to Clovis studies should not only read Gramly (1993) and any other documents that he cites regarding the East Wenatchee Clovis site, but should also consult Mehringer's 1989 report submitted to the Washington State Historic Preservation Office. It will become readily apparent that Gramly's inference of the presence of two pits, and certain other conclusions about the site, are purely conjectural.

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Differential Preservation of Lithics on Quaternary River Terraces in Northwest China

Sari Miller-Antonio

This paper discusses the composition of lithic assemblages from six archaeological surface localities on remnant river terraces in the southern Tarim Basin, Xinjiang, China. The late prehistoric in this region is well represented by Gumugou Culture sites which date to c. 4,000 yr B.P. (Chen and Hiebert 1995), but very little is known about the earlier Pleistocene occupation of the region. The vast 500,000-km^2 Tarim Basin has had an arid climate since the Tertiary, but the degree of aridity was variable through pluvial and interpluvial episodes of the Pleistocene (Zhao and Xing 1984). The southern Tarim is rimmed by the lofty Kunlun Mountains, and a gravel-paved plain extends along the base of the Kunlun front range. This broad piedmont is dissected by numerous ephemeral streams and rivers carrying summer meltwaters, a critical resource for this arid region. The degree of weathering and desert pavement formation (gobi) of the gravel plain are important to the chronological interpretation of archaeological remains recovered by ground survey of the river terraces.

Landsat multi-spectral scanner imagery initially identified relict stream and river channels upon which to focus a ground survey. Ancient riverine environments could support riparian communities and provide habitable localities for ancient humans. Archaeological materials were recorded at six river terrace localities. Three of these localities yielded large stone flakes, hammerstones

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and choppers. The other three terrace localities were predominantly microlithic, containing microblades and microblade cores. Two of these microlithic assemblages were associated with a red coarse sand-tempered pottery, and the third was aceramic. In total, there were almost ten times as many microlithic implements recorded as there were larger artifacts.

In the absence of chronometric dates, a typological approach might be used to make generalizations about the relative chronology of materials. For example, the larger flakes and implements could be interpreted as representing earlier populations perhaps dating to the Last Glacial Maximum (about 18,000 yr B.P.), and the microliths would represent a more recent terminal-Pleistocene or Holocene occupation of the region (Huang et al. 1988; Olsen et al. 1989). This reasoning concludes that at least two and possibly three discrete occupations are represented. However, a different interpretation can be made, if the terrace geology, the natural processes which affect desert pavement formation, and raw material differences between stone tools are examined.

A series of five terrace surfaces are distinguishable over the survey region. They are formed on debris that is coarse and poorly sorted, with little apparent progression in pavement formation. No real difference in the size of stones, the degree of rounding or the degree of deposition of secondary minerals or varnish is apparent between the first terrace and the fifth terrace. The terrace sequences reflect both lateral migrations of the river channel and vertical displacements through cut and fill processes that have left remnant erosional surfaces. Therefore, a relative chronology from one river valley to another based on the correlation of terrace surfaces is impossible.

The larger flakes and implements (averaging 94 mm x 80 mm x 22 mm) were almost exclusively made on coarse-grained andesitic porphyrite available as large cobbles and boulders from glacial outwash. This permeable rock, high in calcic plagioclase, is particularly susceptible to the chemical process of salt weathering. In this extreme arid environment, there were many examples of heat shattering and in situ weathering of fan boulders or cobbles naturally fractured, with pieces lying in proximity (Thomas 1989; Zhao and Xing 1984). The microlithic artifacts, mostly microblades (averaging 18 mm x 9 mm x 2 mm) were, by contrast, made of dense cryptocrystalline materials such as chert, jade and very fine-grained quartzite and hornfels. These raw materials are available locally as small nodules and river pebbles and are not as susceptible to the physical and chemical processes discussed above.

Post-depositional processes have clearly affected the composition of these archaeological materials, and any chronological interpretation should consider "depositional sets vs. activity sets vs. recovery sets" (Ebert 1992:222). As several researchers have found, inferences of relative chronology based on the presence or absence of microlithic technology is particularly problematic in the Asian Paleolithic (Aikens and Akazawa 1996; Madsen et al. 1996; Miller-Antonio 1992). It is possible that all these surface localities may represent only one relatively sparse occupation of this region. The association of some of these lithics with ceramics makes it reasonable to place them chronologically within the post-glacial climatic optimum at 7,000–4,000 yr B.P. This occupation was primarily microlithic in nature, but had a component of larger implements under-represented in the archaeological record owing to the natural processes discussed above.

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Bifacial/Unifacial Technology c. 13,000 Years Ago in Southern Patagonia

Laura L. Miotti and Roxana Cattáneo

In southern Patagonia Region the lithic technology associated with the earliest hunter-gatherer occupation, (c. 11-9 ka) has been characterized by bifacial technologies (Lynch 1990). However, some researchers state that the initial technologies in the area were characterized by the manufacture of large flakes, unifacially retouched. Until now, localities exhibiting such technological organization and dating to the late Pleistocene are few: Los Toldos, El Ceibo, and Cerro 3T, where the lowest components are associated with such unifacial assemblages (Cardich 1987; Paunero i.p.).

Information gathered at Piedra Museo locality (PML) in 1995 and 1996

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provides a different insight on the matter. The first occupation of the site AEP1 of PML corresponds to stratum 6 (Miotti 1992; Miotti et al. 1996), where several lithic artifacts and extinct megamammals were recovered. An associated charcoal sample was ^{14}C dated by AMS to 12,890 ± 90 yr B.P. (AA-20125). A corrected $\delta^{13}C_{PDB}$ ($^0/_{00}$, -25.8) and calibrated (Stuiver & Reimer 1993) dates places at 15,194 yr B.P. in mean calendar age. This occupation corresponds to a brief event relating to the butchering of extinct fauna near a paleolake (Miotti et al 1996). Few lithic artifacts (27) were recovered in association with remains of extinct Pleistocene fauna: horse *(Hippidion saldiasi)*, ground sloth *(Mylodon sp.)*, ñandú *(Rhea cf. americana)*, and camelids *(Lama gracilis)* and fauna today inhabit the area, as do guanaco *(Lama guanicoe)* and ñandú *(Pterocnemia pennata)*. One highly polished puncher was the only bone tool recovered (Figure 1). The lithic assemblage includes 3 large bifacial thinning flakes, 5 knives, 11 secondary flakes, and 9 pieces of knapping debris, all produced from high-quality chert and chalcedony. The remaining knives and other bifacial thinning flakes were made out of a translucent chalcedony (Figure 1). The assemblage indicates an internal variability as to technological choices, combining unifacial and bifacial modes of production along an expedient-curated continuum. Use of various types of raw materials independent of functional or technological parameters suggests distinct production strategies.

Overlying strata 4 and 5 document occupations dated at 10,400 ± 80 yr. B.P., mean calendar age 12,298 (Miotti 1992; 1995; 1996). Broken fluted projectile points, Fell's Cave stemmed, or fishtail projectile points (FPP) were found in these layers, as well as unifacial scrapers, endscrapers and knives. Even though this assemblage differs from the one in stratum 6 in terms of technological choices, both are related to the exploitation of extinct faunal resources (Miotti et al 1996). It is therefore probable that southern Patagonia was initially occupied (colonization stage) by forager groups with a broad knowledge of lithic technology. Production of FPPs as well as expedient tools (unifacial scrapers and knives) on a single large flake is functionally efficient for different situational tasks. This new evidence from Patagonia is important because is consistent with data from northeastern Asia and the South Cone of South America (Bradley et al. 1995; Bryan 1995; Mochanov 1993; Politis 1991; Nami 1993–94) and recent bioanthropological models (Neves and Pucciarelli 1991), who propose four distinct migrations into the New World. The first occupation at PML could then be related to the earliest human migration.

In conclusion, in agreement with technological models proposed by Politis (1991:297) and Nami (1993–94), it appears fallacious to consider bifacial and unifacial technologies as opposing technological extremes. Early human occupation at PML, documented in the reliable archaeological record, suggests that the colonization of the extreme southern part of the continent was indeed unique and probably independent from the previous one related to the Clovis phenomenon.

Fieldwork and radiocarbon dating were supported through a Fundación Antorchas Grant, proyecto A-13218/1-000066 and Facultad de Ciencias Naturales y Museo de la Universidad de La Plata Grant. We are specially grateful to Maria Gutiérrez and Luc Litwinionek for their efforts in reading the manuscript and to Gustavo Politis and Patricia Madrid for helpful comments.

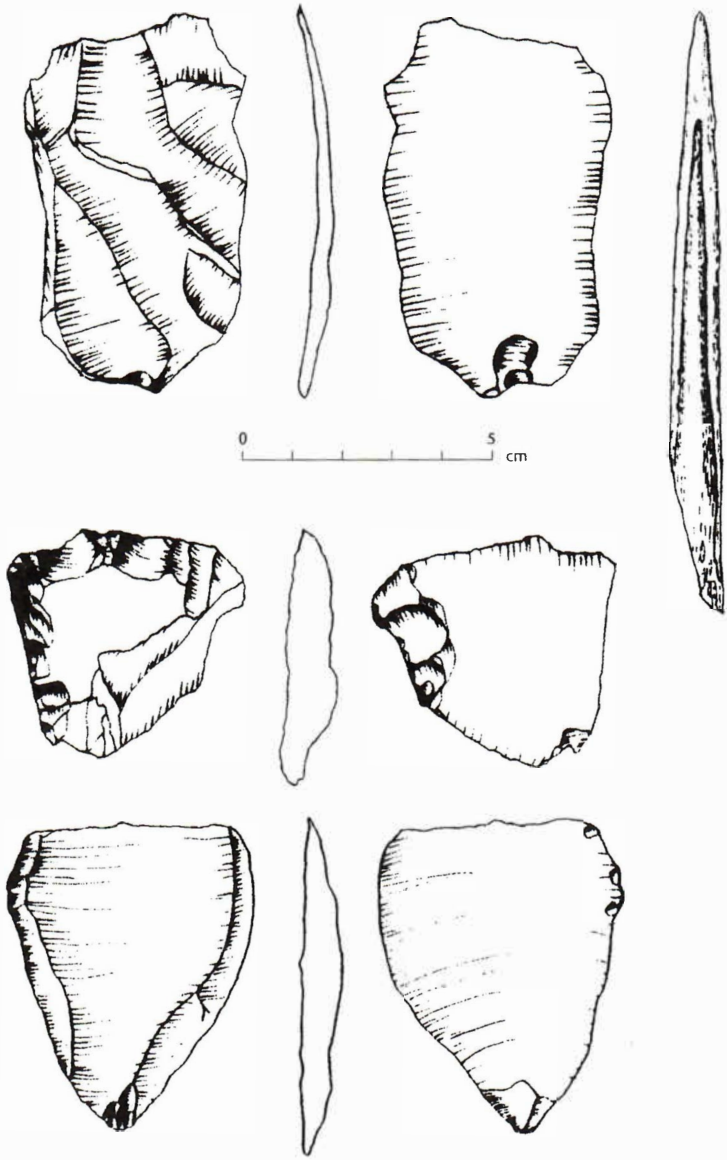

Figure 1. Lithic artifacts of stratum 6, Pleistocene occupation at Piedra Museo Locality.

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Clovis Lithic Technology at the Struttman Eikel Site

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The Struttman-Eikel site is a multicomponent habitation that hosts a Clovis habitation/workshop component. Located on a privately owned tract in the uplands south of the Missouri River near Hermann, Gasconade County, Missouri, the site affords a commanding view of the river valley. With landowner permission, avocational archaeologist Mike Struttman recently surface-

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collected points and bifaces and one uniface fragment from the site. This article provides a preliminary assessment of fluted bifaces collected thus far.

Diagnostic points, point fragments, preforms, and an adze suggest the site was occupied from early Paleoindian through middle Archaic periods. Of the 120 artifacts collected from the site thus far, 9 are confidently assigned to the early-Paleoindian era (c. 11,500–10,800 yr B.P.). These include two finished fluted points of Burlington chert (Figure 1A) and Fern Glen chert (Figure 1B) and seven fluted preforms, all of Burlington chert (Figure 1D–F). Noteworthy is one stage-4 preform with an isolated striking platform prepared for the second flute removal (Figure 1E). In addition to these more diagnostic Clovis artifacts, there are also several stage-4 to -5 biface fragments exhibiting trans-

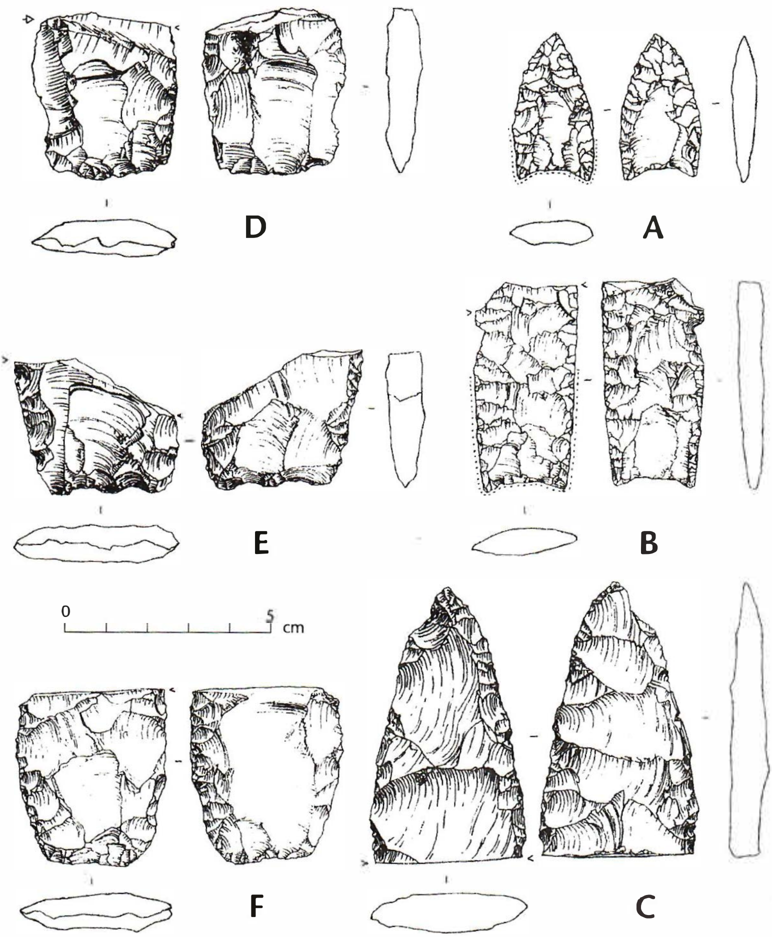

Figure 1. Clovis artifacts from the Struttman-Eikel site, **A–B,** finished fluted points; **C,** stage-4 proximal biface fragment; **D–F,** stage-4 fluted bifaces.

verse percussion (outre passé) flaking distinctive of Clovis biface reduction (Figure 1C) similar to that displayed on Clovis bifaces from the Anzick (Wilke et al. 1991), East-Wenatchee/Richey (Gramly 1993), Fenn (Frison 1991) and Simon (Titmus and Woods 1985) caches. Refitted flakes from the Sheaman site also demonstrate this distinctive flaking pattern (Frison 1982:154). The unifacially flaked artifact in the collection appears to represent the proximal end of an endscraper that may also be associated with the Clovis occupation of the site.

Clovis artifacts from Struttman-Eikel bear a strong technological resemblance to those from the Martens site, 23SL222 (Koldehoff et al. 1996) and the Ready/Lincoln Hills site (Morrow and Morrow 1993, Morrow 1996). A similar reduction trajectory for fluted-point manufacture is represented at all three sites, including the fluting of preforms at a point when they are wider and thicker than the finished point form and the preparation of isolated striking platforms for fluting that are placed in the midline of the biface. Following flute removals, points were further reduced in width and thickness through additional lateral percussion thinning and pressure flaking. In addition, all three sites are located in dissected loess-capped uplands adjacent to major rivers. Future investigations at the Struttman-Eikel site will hopefully advance our understanding of the lifeways of Missouri's earliest culture.

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The Moos Site (41BX1232): A Late-Paleoindian-Component Site in South-Central Texas

David L. Nickels, Steve A. Tomka, Jeff D. Leach and Bruce K. Moses

41BX1232 contains a late-Paleoindian component and is located in northwest Bexar County, south-central Texas, on a low upland and adjoining terrace of spring-fed Leon Creek (Taylor et al. 1991:119). Preliminary surface investigations, suggesting that the site covers an area approximately 9,000 m^2, have revealed bifaces, unifaces, chipped-stone debitage and burned rock scattered over the site. Late-Paleoindian and early-Archaic artifacts (Figure 1) have been observed on the northern two-thirds of the site, while two arrow points were found on the extreme southern end. That the area along Leon Creek has been exploited for several millennia is evidenced by documented sites with diagnostics from the late-Paleoindian through late-Prehistoric periods.

Sixteen artifacts were collected from the northern artifact cluster. The collection includes 10 projectile points and preforms, 3 miscellaneous biface fragments, 2 unifaces, and a large secondary flake. Six of the projectile points are of greatest significance because they indicate the relative age of the materials present in the northern cluster. Four of the six are contracting stem lanceolate points and point fragments. All are similar to "early stemmed lanceolate" late-Paleoindian points identified in other parts of the state (Turner and Hester 1993). Three of the four exhibit heavy stem grinding Figure 1A–C). The fourth specimen is a longitudinally broken proximal fragment of a lanceolate point preform, possibly Barber type (Figure 1D). One of the remaining two points (Figure 1E) is an early-Archaic Gower point (Turner and Hester 1993). It has a slightly expanding stem with ground edges and a concave base. The sixth specimen, an unfinished dart point with steeply alternately beveled stem edges (Figure 1F), is classified as a Nolan preform. In summary, the projectile-point data suggest that the northern portion of 41BX1232 contains two possible components, one late Paleoindian and one early Archaic.

The Moos site is the third late-Paleoindian site recorded within a 2-km section of Leon Creek, yet a paucity of technological, subsistence and settlement data is available compared with information obtained from later-period sites in the region. Surface collection and mapping at the Moos site are ongoing, and subsurface investigations are planned for the near future. The Moos site has significant potential to fill some of the gaps contained in the late-Paleoindian archaeological record along the Balcones Escarpment.

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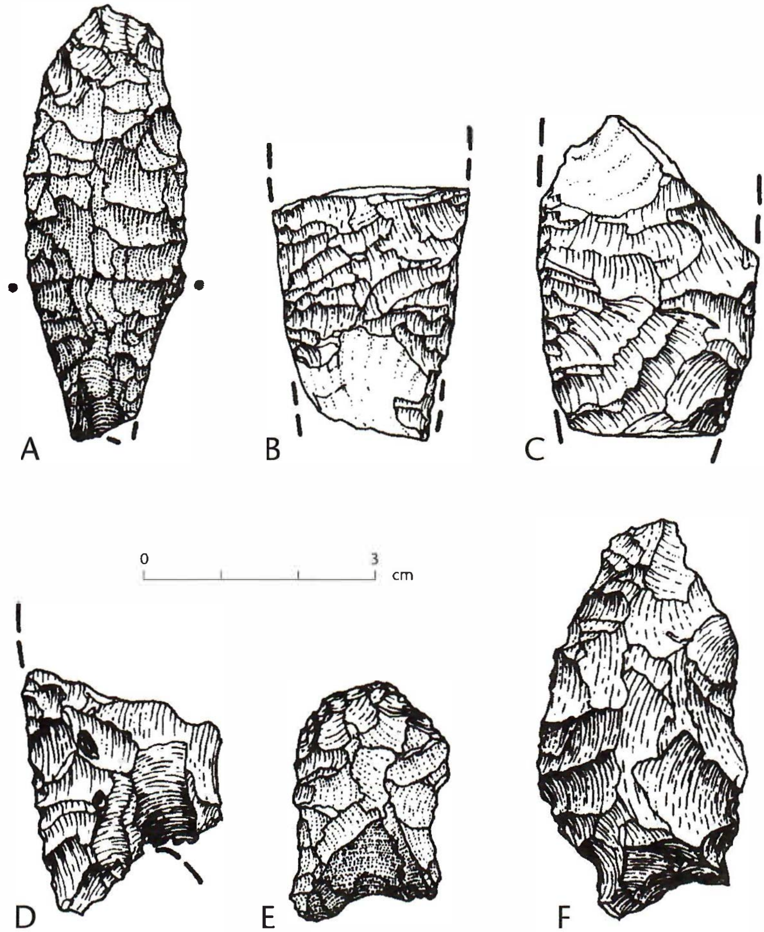

Figure 1. Late-Paleoindian and early-Archaic projectile points and preforms from the Moos site: **A–C,** early stemmed lanceolate points; **D,** early stemmed lanceolate preform; **E,** Gower point; **F,** Nolan preform.

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Additions to a Revised Chronology for Cultural and Non-Cultural Mammoth and Mastodon Fossils in the Southwestern Lake Michigan Basin

David F. Overstreet and Thomas W. Stafford, Jr.

Dallman et al. (1996) reported new AMS radiocarbon dates for mammoth *(Mammuthus primigenius)* and mastodon *(Mammut americanum)* remains from southeastern Wisconsin. Preliminary conclusions drawn from those new dates included: (1) conventional ^{14}C dates from the Great Lakes region on fossil proboscideans were in error in the range of 1,000 to 1,400 years in comparison with AMS ^{14}C measurements on more highly purified chemical fractions, for example, "XAD-purified gelatin hydrolyzate" (Stafford 1990; Stafford et al. 1991); and (2) American mastodon had become extinct in the region by approximately 10,800 yr B.P.

We report seven additional previously unreported ^{14}C measurements (Table 1), five of which are derived from purified bone collagen (AMS). Two samples were taken from the Hebior mammoth and one from the Schaefer mammoth, both of which are intimately associated with chipped-stone tools (Overstreet et al. 1995; Overstreet 1996). Two samples are from the Fenske and Mud Lake Mammoths, whose remains have putative butchery marks (Overstreet et al. 1993). Two dates (Beta 62823, Beta 62824) are conventional ^{14}C measurements from spruce interpreted to have been deposited subsequent to formation of the Schaefer mammoth bone pile. We are confident that the additional AMS dates collectively represent the minimum age (cf. Taylor et al. 1996:522) of the Hebior and Schaefer mammoths and associated stone tools. This contention is supported by identification and analyses of pollen collected from sediments adhering to the Hebior mammoth bones. The Hebior pollen assemblage is indicative of late-Pleistocene rather than early-Holocene vegetation (Fredlund et al. 1996). Finally, the previously reported unpurified bone collagen date for the Schaefer mammoth (Table 1) is shown to be in error by more than 1,300 years.

The current sample of ^{14}C AMS measurements is limited and clearly needs to be expanded with AMS dates on highly purified collagen from additional mammoth and mastodon remains from cultural and non-cultural contexts in the Great Lakes region. Cognizant of current data limitations, we nevertheless propose the following hypotheses to be tested by ongoing and future research: (1) Paleoindian hunting and/or scavenging of mammoths in the southwestern Lake Michigan basin was initiated by at least 12,500 yr B.P.; (2) mammoth and mastodon populations were not contemporaneous in the southwestern Lake Michigan basin, but were sequential inhabitants—mammoths were replaced by mastodons; and (3) extirpation of mammoths in the region, prior to their

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Table 1. ^{14}C assays for southeastern Wisconsin late-Pleistocene megafauna.

Site/specimen	Standard ^{14}C date & lab no.	AMS XAD-Gelatin (KOH collagen), date & lab no.
Schaefer Mammoth (47 Kn 252)	10,960 ± 100B.P. (BETA 62822) Bone collagen	12,310 ± 60B.P. (CAMS 30171)■
	12,220 ± 80B.P. (BETA 62823)■ Spruce sample 4	
	12,480 ± 130B.P. (BETA 62824)■ Spruce sample 8	
Mud Lake Mammoth (47 Kn 246)		13,440 ± 60B.P. (CAMS 36643)■
Fenske Mammoth (47 Kn 240)		13,470 ± 50B.P. (CAMS 36642)■
Hebior Mammoth (47 Kn 265)		12,480 ± 60B.P. (CAMS 28303)■ 12,520 ± 50B.P. (CAMS 24943)■
Lake Mills Mammoth	9,065 ± 90B.P. (WIS-704) Bone collagen	
Deerfield Mastodon 1 UWZP 19580	9,630 ± 110B.P. (WIS-267) Bone collagen	10,780 ± 60B.P. (CAMS 24944)
Deerfield Mastodon 2 UWZP 19581	9,480 ± 100B.P. (WIS-265) Bone collagen	10,910 ± 60B.P. (CAMS 24428)
Deerfield Mastodon 3 UWZP 20500	11,500 (geochronological estimate, bracketed by ^{14}C-dated organics)	11,140 ± 60B.P. (CAMS 24945)

■ previously unreported dates

extinction in the American west and other localities, is more closely associated with rapid and radical alterations of late-Pleistocene and early-Holocene habitats than with human predation or so-called "overkill" (cf. Martin 1984).

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New Evidence for a Nenana-Complex Occupation at the Moose Creek Site, Central Alaska: Preliminary Results of the 1996 Re-excavation

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The Moose Creek site is located on the highest terrace of the Nenana Valley in the northern foothills of the Alaska Range approximately 100 km southwest of Fairbanks. The site overlooks the valley from a point carved out of glacial outwash by the Nenana river and Moose Creek (Wahrhaftig 1958). The site was discovered in 1978 by J. F. Hoffecker and C. F. Waythomas and was partly excavated in 1979 and 1984 (Hoffecker 1985, Powers and Hoffecker 1985). Early investigations revealed the presence of two cultural components. The first contained non-diagnostic tools within and below a level dated between 8,160 yr B.P. and 11,730 yr B.P. (Hoffecker 1985). The second consisted of a dozen flakes and a biface fragment of undetermined Holocene age. Since there were no microblades in the lower component which appeared greater than 11,730 years old, it was tentatively assigned to the Nenana complex (Powers and Hoffecker 1988). However, concerns were raised regarding the validity of the radiocarbon dates obtained from paleosols (Hoffecker 1996:367) and the absence of diagnostic Nenana-complex tools. The objective of the Moose Creek re-excavation was to identify the culture-historical affiliations of the site's components through recognized tool types and to secure radiocarbon dates obtained from wood charcoal.

Moose Creek contains seven distinct stratigraphic units that include two buried soil complexes separated by a layer of sand (Figure 1). Among the significant discoveries of the re-excavation were two Denali-complex occupations associated with these buried soils. The oldest was discovered just below the silver sand unit and is given a tentative age of 10,600 yr B.P. in accordance with data from the Dry Creek site (Bigelow and Powers 1994). The second microblade component was located above the sand and could be as old as 8,500 yr B.P. based on similar material discovered at Panguingue Creek (Goebel and Bigelow 1992, 1996:369).

Another important find was a teardrop-shape Chindadn point located below the lowest Denali occupation (Figure 1). Charcoal from a hearth discovered at this level provided a date of 11,190 ± 60 yr B.P. (Beta-96627, AMS). Associated with this feature were three large cobbles, a biface, a side scraper, a scraper plane, a bipolar flake core, and a sub-triangular point.

This new evidence confirms the existence of a Nenana-complex occupation at Moose Creek. The presence below the sand of material from both the Nenana and Denali complex indicates that the previous assemblage consisted of mixed artifacts. Preliminary results show that the sequence of archaeological components at Moose Creek is similar to that already observed at Dry

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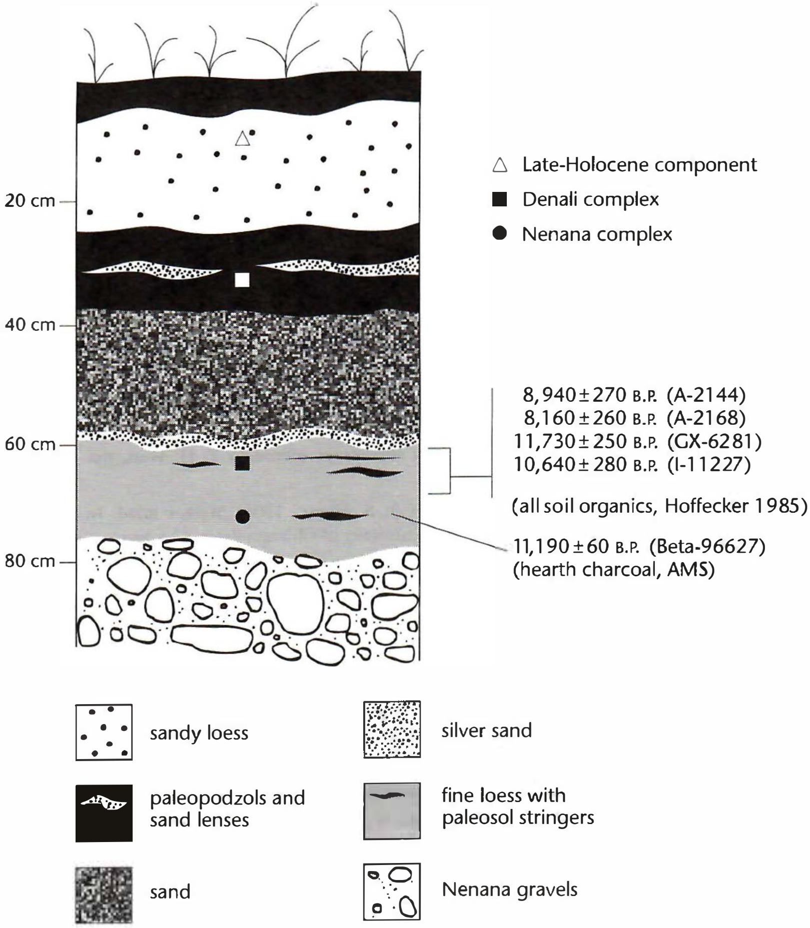
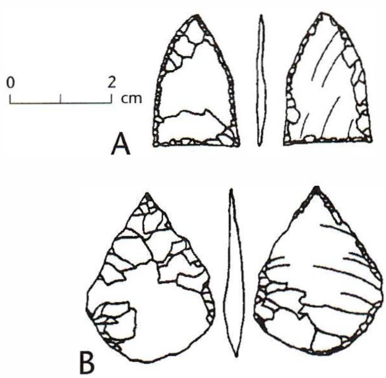


Figure 1. Above, Moose Creek generalized stratigraphic profile and radiocarbon dates. Right, Nenana-complex points: **A**, subtriangular point; **B**, Chindadn point.



Creek (Hoffecker et al. 1996), Walker Road (Goebel et al. 1996, Powers et al. 1990) and Panguingue Creek (Goebel and Bigelow 1996). In addition, statistical tests carried out on Nenana-complex radiocarbon dates from these sites suggest that the Nenana Valley was first occupied c. 11,200 years ago.

The unprecedented logistical challenges of this project were greatly alleviated by the generous help of W. Roger Powers, Robert A. Beckwith, Tom E. Dilley, David R. Yesner, Jacky Hendrix, De Vere Pieschl and Bob Stewart. Many thanks go to the people of Ferry and all who participated. This research was supported by the University of Alaska Fairbanks Summer Sessions and the University of Alaska Museum Geist Fund.

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Further Thoughts on Clovis Old World Origins

Georges A. Pearson

Twenty years ago Müller-Beck proposed a New World peopling scenario based on similarities between Clovis and assemblages recovered at the Kostenki localities (1966, 1967). Müller-Beck suggested that the Americas were colonized by two technologically distinct groups. The first wave of migrants were named "Mousteroid" after their bifacial industries, while the second group

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were termed "Aurignacoid" to describe their use of blades. More recently, Haynes and others echoed a similar hypothesis based on ten technological traits shared between Clovis and the upper-Paleolithic cultures of European Russia (Haynes 1984, 1987, Saunders et al. 1990, 1991). Although the technological similarities pointed out by theses authors are striking, they are still perceived as coincidental or explained by convergence by many archaeologists. This is explained by the fact that material of this kind has yet to be recovered, *as an ensemble*, in the Beringian expanse which joins these Old and New World centers.

In Alaska, the Nenana complex, which is characterized by a conspicuous absence of microblades and the presence of small triangular and teardrop-shaped points, is interpreted to represent a technological antecedent to Clovis (Goebel et al. 1991, Hoffecker et al. 1993). Unfortunately, the Nenana complex remains elusive outside of Alaska and its own origins are unresolved (West 1996). However, what is most interesting is that, similarly to Clovis, the closest link to this Alaskan technology is also found in the Streletskayan assemblages of European Russia. These upper-Paleolithic industries display a persistence of bifacial flaking that may be a technological legacy of the Szeletian of Moravia which contains teardrop-shaped points (Allsworth-Jones 1986; Bordes 1992:352; Demars and Laurent 1992:126; Svoboda et al. 1996). Streletskayan assemblages from the Kostenki localities (Praslov and Rogachev 1982), Sungir (Sukachev et al. 1976), and Biryuchya Balka (Matioukhine 1990) include small triangular points that are typologically and technologically similar to Nenana-complex points (Bradley et al. 1995; Pearson 1997).

The evidence from Alaska adds credence to the notion that a non-Mongoloid population bearing an East European upper-Paleolithic culture expanded north and east prior to the Mongoloid radiation associated with the Dyuktai culture and the American Paleoarctic tradition. Non-Mongoloids may have crossed Beringia further north to avoid the Verkhoyansk mountain range (Figure 1), and this could explain why there is still little evidence of their passage in Siberia. The northward movement of Mongoloids may have created a wedge that bisected the non-Mongoloid population and isolated some of them in eastern Beringia. Hence, two culturally distinct groups inhabited Siberia and Alaska at the end of the Pleistocene. Non-Mongoloids may have

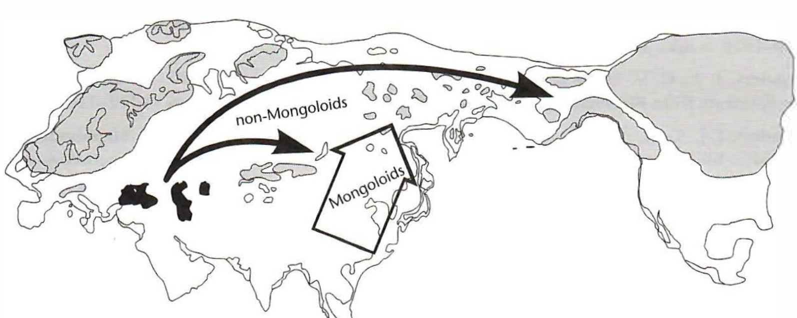

Figure 1. Hypothetical Pleistocene population expansions and Clovis Old World origins.

subsequently been replaced or assimilated as microblade-producing groups pressed northward and then east. However, it is not inconceivable that a relic non-Mongoloid group migrated all the way across the Bering Land Bridge.

If indeed Nenana-complex points are technologically related to Streletskayan projectiles, then the association further supports the idea of an eastward migration of non-Mongoloid groups to the Americas. As such, the Nenana complex represents a technological intermediate bridging part of the gap between Clovis and the upper Paleolithic of European Russia.

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An Early-Holocene Archaeological Site in Oregon's Willamette Valley

Jo Reese and John L. Fagan

In June 1995, during construction of a natural gas pipeline, a deeply buried archaeological component was found (Reese and Fagan 1995). This component, designated the Taylor site, is located at the Linn-Lane county line north of Coburg, Oregon, and is considered to be a part of previously identified site 35LIN453/LA976. A mammoth or mastodon tusk was also found in the pipeline trench 210–240 m to the south of the site.

Artifacts were present in the excavated pipeline trench 234–240 cm below the surface, overlying a soil dominated by undecomposed (peaty) plant materials. The two artifacts found in the pipeline trench wall were 22 cm apart. Artifacts collected from the site include one scraper (Artifact A) from the backdirt pile (the original find), another scraper (Artifact B) from 240 cm below the surface (Figure 1), and a grinding slab or metate fragment from 234 cm below the surface. Fine-mesh (1 mm) water screening of selected samples produced five small pieces of debitage from a sample of the underlying peaty deposit, but none from the stratum where artifacts A and B were found. One small flake was recovered in a sample from about 20–40 cm above the artifacts.

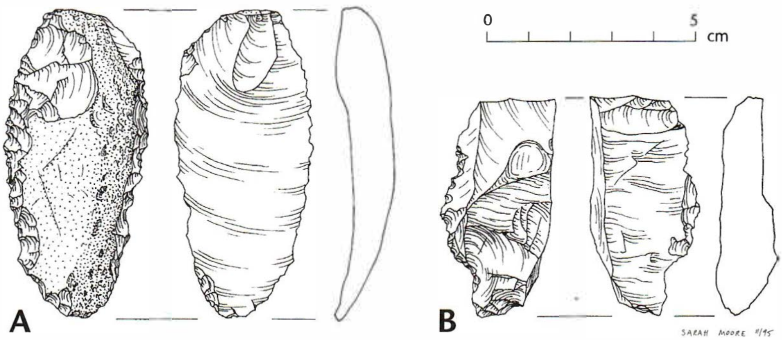

Figure 1. Flaked lithic tools, both scrapers, found at MCN-1. Artifact **A** (Lot 1 Spec. 01) was found in the construction trench backdirt. Artifact **B** (Lot 17 Spec. 01) was found near the base of the east wall of the trench 240 cm below the surface.

Radiocarbon dating of the peaty layer underlying the artifacts provided four dates: 10,080 ± 60 yr B.P. (Beta-86582), 10,040 ± 90 yr B.P. (Beta-86579), 9,850 ± 70 yr B.P. (Beta-86580), and 9,280 ± 70 yr B.P. (Beta-86578). A layer of calcium carbonate nodules, an unusual occurrence in the Willamette Valley, that was 100 cm below the surface and 130 cm above the artifacts, provided a radiocarbon date of 3,080 ± 80 yr B.P. (Beta-86581). Because the artifacts are

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only a few cm above the peaty layer, it is likely that the age of the site is close to 9,000 yr B.P.

The Taylor site component rests on or within the Winkle geomorphic surface, and is early Holocene in age. Pollen, phytoliths, and macrobotanical materials from the Taylor site samples represent an early-Holocene pond or wetland in a *Quercus-Pseudotstuga menziesii* (oak-Douglas fir) woodland setting. The pond or wetland contained diatoms and sponge spicules, and growing around it were sedges, rushes, grasses, and other plants. The wetland had contracted in the area of the Taylor site at about the time the artifacts were deposited. Most of the woody species in the peaty deposit were identified as *Populus,* but the woody species found with the artifacts, while much less abundant, were of *Quercus* and *Salicacea* (willow/poplar family).

Based on the field work and analysis of artifacts and samples from the Taylor site, this deposit is likely to be an early-Holocene archaeological component representing the Paleoindian period. The location is along the remnant of a pond or abandoned stream channel. Habitation or use occurred at a time when the local conditions were changing from a wetland to a meadow-prairie or more forested condition. Two other sites in the southern Willamette Valley (35LA658 and 34LA861) have been dated to this period (Freidel et al. 1989), but neither contains the abundance of preserved plant materials found at the Taylor site.

The authors wish to acknowledge and thank the following who provided specialized analyses of samples and contributed reports to the authors: Patricia F. McDowell, Cathy Whitlock, and Laurie D. Grigg of the University of Oregon; and Linda Scott Cummings and Kathryn Puseman of the Paleo Research Laboratories. Special recognition must go to paleontologist David Taylor, Portland State University, who recognized the archaeological site, and to Northwest Pipeline Corporation and its affiliates who supported and assisted the project.

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Exploring Possible Ecological Factors Underlying Early-Paleoindian Lithic Procurement: The 1996 Red Wing Project, Southern Ontario, Canada

Peter L. Storck

In 1996, a second season of archaeological, geological and paleoecological field work was conducted at the Red Wing site, an early-Paleoindian lithic-procurement site located in the geological source area of Fossil Hill Formation chert on the Blue Mountain/Kolapore uplands in the southern Georgian Bay region of southern Ontario. Fossil Hill chert occurs in situ only in the Blue Mountain/Kolapore uplands but was used in toolkits by Gainey and Parkhill complex peoples over an area of at least 30,000 km^2 in southern Ontario. As noted earlier in this publication series (Storck et al. 1996; Tomenchuk and Storck 1996), one of the primary objectives of the research at Red Wing is to explore possible ecological reasons why some early Paleoindians in Ontario preferred Fossil Hill chert for toolstone. Because of the possible geological setting of the Red Wing site, situated adjacent to a pond in the headwaters of a drainage system flowing into glacial Lake Algonquin in the Huron/Georgian Bay basins, I hypothesized prior to the first season's field work in 1995 that the chert may have been obtained opportunistically while exploiting fish during the spawning season.

The field work in 1995 was concerned with obtaining data that would place the site in an ecological context and identify the cultural affiliation and occupational activities of the early-Paleoindian occupants. Although the identity of these people was still unknown at the end of the season, preliminary geological and paleoecological data indicated that the site was indeed adjacent to a shallow pond in a spruce parkland environment during the late-Pleistocene, from 11,600 ± 100 yr B.P.(TO-5785) to 10,170 ± 90 yr B.P. (TO-5784). However, these same data also indicated that water depths in the pond varied greatly and, further, that the water body may not have supported fish. Because of this, the research focus of the second field season was shifted to investigate other possible organic resources that may have attracted early Paleoindians to the chert source area. In addition, we explored widely for discrete activity areas on the site that would provide culturally diagnostic artifacts. We also obtained several sediment cores from the edge of the site in an effort to date the occupation by correlating strata containing microdebitage with the dated stratigraphic record obtained from the center of the pond basin.

In 1996, widespread test excavations discovered and defined a small area that produced a diverse collection of tools, many of exotic cherts, which suggested activities concerned with re-arming weapons and tool repair. Many of these tools, such as the single- and multiple-spurred gravers, beaked scrap-

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ers, the tip of a fluted point and an unfluted preform are clearly Paleoindian in affiliation. The small size of the point preform suggests a relationship with the Barnes point type rather than with Gainey or Crowfield, thus indicating an occupation by Parkhill-complex peoples (for an overview of the Gainey, Parkhill and Crowfield complexes see Ellis and Deller 1990).

Use-wear analysis of artifacts and debitage in the 1996 sample has identified at least four examples of a tool type not previously reported from Paleoindian complexes in Ontario or the Great Lakes region generally: a chipped-stone adze, apparently used for wood working. The closest analogue is with the late-Paleoindian Dalton adze in the southeastern United States (see, for example, Goodyear 1974; Morse and Goodyear 1973). Unlike Dalton specimens which were shaped in part by grinding, the Red Wing examples were shaped exclusively by knapping. Unfortunately, the cultural affiliation of the Red Wing adzes must remain ambiguous because they were not directly associated with diagnostic Paleoindian tools or found in dated deposits.

Because of the lack of organic preservation at Red Wing, use-wear analysis may provide the only approach for exploring one of the principal research objectives: determining whether early Paleoindians were attracted to Red Wing, and the chert source area generally, by biological resources or solely by the need for toolstone. If the use-wear study leads to the identification of plant species that were harvested at the site, an understanding of the geographic distribution and varying physical properties (by habitat) of those species may indicate whether the Blue Mountain/Kolapore uplands offered regionally specific resources that played a role in the discovery and/or long-term use of Fossil Hill chert as a toolstone.

The multidisciplinary team includes: Robert Barnett (Ontario Ministry of Northern Development and Mines, Pleistocene geologist,), L. Denis Delorme (consultant, paleobiolgist), Stephen Monckton (consultant, paleobiologist), John Tomenchuk (consultant, use-wear analyst) and Peter H. von Bitter (Royal Ontario Museum, Paleozoic geologist). The 1996 field work at Red Wing was funded by research grants to the author from the ROM Foundation, Royal Ontario Museum, and the Social Sciences and Humanities Research Council of Canada.

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Late-Pleistocene Archaeology of Sheriden Cave, Wyandot County, Ohio

Kenneth B. Tankersley, Kenneth M. Ford, Hugh Gregory McDonald, Robert A. Genheimer, and Richard Hendricks

Sheriden (33WY252) is a deeply buried and stratified cave site located in northwestern Wyandot County, Ohio (Bowen 1995). It is part of a cave system which includes Hendricks Cave (33WY1) and Indian Trail Caverns (McKinzie and Prufer 1967). The cave entrance is situated near the crest of a ridge 17 m high of upthrown middle-Silurian Lockport dolomite. The ridge is a resistant fossil reef repeatedly scoured by Pleistocene glaciation and covered by a thin veneer of diamicton (Hansen 1992a:1). While sinkholes and caves are abundant in the area, most are choked with Pleistocene and Holocene sediment.

Historically, the cave entrance appeared as an extensive shallow, circular depression 11 m south of the commercial entrance to Indian Trail Caverns. In July 1990, Richard Hendricks employed a crane operator to excavate the unconsolidated deposits of the sink. As was the case in nearby Hendricks Cave (McKinzie and Prufer 1967:129), the crane encountered alluvium rather than glacial drift. Excavations proceeded to a depth of more than 10 m and exposed a cave passage 4 m by 10 m, partially filled with sediment, on the west side of the sinkhole. A small bulldozer was lowered into the sink to further open the passage. Unlike the bright yellow-colored silt of the sink, layers of dark, greasy, organic-rich deposits were uncovered in the cave. Concentrations of charcoal and bone were visible in the backdirt and along the cave walls. These finds were brought to the attention of Jonathan Bowen (Ohio Historical Society), who notified Gregory McDonald, then curator of vertebrate paleontology of the Cincinnati Museum of Natural History. McDonald directed a paleontological excavation in the cave between 1990 and 1992. The Museum continued the dig through 1995 under the direction of Kenneth Ford.

More than 60 species of large and small vertebrates were recovered from late Pleistocene strata including the extinct or extralimital stagmoose *(Cervalces scotti)*, caribou *(Rangifer tarandus)*, flat-headed peccary *(Platygonus compressus)*, giant beaver *(Castoroides ohioensis)*, short-faced bear *(Arctodus simus)*, masked shrew *(Sorex cinereus)*, pigmy shrew *(Sorex hoyi)*, yellow-cheeked vole *(Microtus xanthognathus)*, northern bog lemming *(Synaptomys borealis)*, redback vole *(Clethrionomys graperi)*, heather vole *(Phenacomys intermedius)*, porcupine *(Erethizon dorsatum)*, ermine *(Mustela erminea)*, pine martin *(Martes americana)*,

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and fisher *(Martes pennanti)* (Ford et al. 1996; Hansen 1992b; McDonald 1992, 1994). A large assemblage of herpetofauna is suggestive of a late-Pleistocene mosaic habitat consisting of a shallow, marshy pond grading into a open woodland with a grassy ecotonal area (Holman 1997).

Kenneth Tankersley initiated an archaeological investigation of the cave in the summer of 1996 under the auspices of Kent State University and the Cleveland Museum of Natural History. A variety of artifacts have been recovered from the fossiliferous late-Pleistocene cave deposits including a plethora of wood charcoal and burned bone; a carved, incised, and beveled osseous point; a flaked-stone side scraper; a fluted-point preform; and chert debitage. The osseous point is comparable to similar objects recovered from Nenana sites in Alaska and Clovis sites in Washington, Wyoming, Arizona, New Mexico, and Florida. The side scraper is manufactured from a large bifacial thinning flake of Wyandotte chert. The source area of this toolstone is located more than 400 km southwest of Sheriden Cave (Tankersley 1984). Other flaked-stone artifacts recovered from the excavations include two flake fragments and shatter manufactured from Wyandotte chert, a broken bifacial preform fabricated from Upper Mercer chert, and three flakes made from Cedarville-Guelph chert. While Cedarville-Guelph is a local chert, Upper Mercer outcrops more than 140 km east of the cave (Stout and Schoenlaub 1945).

Five radiocarbon dates have been obtained from the late-Pleistocene deposits: 11,060 ± 60 yr B.P. (CAMS-10349); 11,480 ± 60 yr B.P. (CAMS-12837); 11,570 ± 70 yr B.P. (CAMS-12839), 11,610 ± 90 yr B.P. (CAMS-12845) (Stoors 1995); and 11,710 ± 220 yr B.P. (PITT-0892) (Holman 1997; McDonald 1992, 1994). Two radiocarbon dates were obtained for the overlying culturally sterile Holocene alluvium: 9,170 ± 60 yr B.P. (CAMS-24126); and 9,190 ± 60 yr B.P. (CAMS-24127) (Merritt 1995). Presently, the exact relationship of the artifacts to the radiocarbon assays, stratigraphy, or late-Pleistocene plant and animal fossils remains unknown. Future archaeological work at Sheriden Cave will provide a temporal and environmental framework for the archaeological record, distinguish between natural sedimentary and biological processes and those that resulted from human behavior, and determine what human behavior left artifacts behind at the site.

Archaeological investigations were possible with the help of Pete Bostrom, Barbara Barrish, Philip Cossentino, Elaine Dowd, Keith and Jean Hendricks, Brian Redmond, Carl Szfranzski, Garry Summers, Jenny Tankersley, Danny Tong, and funding provided by Research and Graduate Studies, Kent State University, and the Lithics Casting Laboratory.

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Final-Pleistocene Environmental History and Prehistoric Man at the Upper Yenisei Area (Siberia)

Sergey A. Vasil'ev, Anatoly F. Yamskikh, Galina Y. Yamskikh, Yuri S. Svezhentsev, and Anatoly K. Kasparov

This paper briefly summarizes the results of a long-term salvage archaeology project carried out in the Upper Yenisei Valley (southern Siberia) in 1980–1991 (Vasil'ev, 1996). On the basis of paleoecological study we can now present the linkage of variations in paleoenvironmental data and artifact assemblages.

Three important multicomponent sites were explored during this campaign. Culture-bearing strata were associated with the third (23–27 m) terrace (Ui I, Western part of Maininskaia) and the second (14–18 m) terrace (Ui II, Eastern part of Maininskaia). Alternate human settlement on different heights above the river could be due to peculiar hydrological conditions caused by drastic rise of water levels during the Sartan Glaciation (Yamskikh, 1993).

The oldest assemblage of this cluster of habitation sites seems to be Layer 2 of Ui I, embedded in cryoturbated fluvial sediments. The faunal assemblage is dominated by Asiatic wild ass, bison, Siberian wild goat, and sheep. It differs from the megafauna of other localities in absence of elk and red deer. An environment with mixed coniferous (pine, Siberian pine) and deciduous

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(birch) forest alternated with steppes could be reconstructed. A series of radiocarbon dates c. 22,000–17,000 yr B.P. places this assemblage in the early Sartan. The lowermost layer (8) of Ui II could be also assigned to this period.

The next phase of prehistoric settlement of the area is represented by a series of cultural horizons associated with laminated alluvial sands, containing layer G in the western part of Maininskaia and layers from 9 to 6 in the eastern part of the site. These layers were deposited in periglacial cold steppe environments. Faunal remains comprise mostly bison, wild sheep, red deer, and Siberian wild goat. This time span corresponds to the Gydansky phase of Sartan.

Certain traces of climatic amelioration could be identified on the levels of layer 5 of Maininskaia and layer 7 of Ui II. Paleosoils were unearthed on the levels of layers B and V of the western part of Maininskaia. Palynological data indicate the dominance of forest (birch, pine, larch, fir) with considerable role of Chenopods *(Chenopodiaceae)*. The faunal assemblage includes remains of bison, Siberian wild goat, red deer, and the first appearance of roe deer. Radiocarbon dates for these layers are c. 16,000–15,000 yr B.P.; thus they could be placed within the early-Sartan (Tiutei) Interstadial.

In the overlaying strata cultural material (layers from 4 to 2 of Maininskaia, and from 6 to 5 for Ui II) was associated with fluvial deposits bearing many traces of frozen-ground wedges on several levels. Some assemblages (layers A-3 and 1 of Maininskaia) were embedded into the bottom of upper loess-like sediments. These strata are characterized by forest-steppe (pine, Siberian pine, birch, dwarf birch, graminoids, wormwood, ferns). The most abundant species were Siberian wild goat, red deer, wild sheep, bison, and elk. In addition to a series of radiocarbon dates for Maininskaia (dates for layers from 4 to 1 lie mostly within c. 14,000 to 12,000 yr B.P.; Vasil'ev, 1992) we could cite a new date run-out on charcoal for layer 6 of Ui II: 14,310 ± 3600 yr. B.P. (LE-3717). These layers can be assigned to the N'iapan phase of the mid-Sartan. The remnants of the cryoturbated buried soil at the levels of layer 5 of Ui II and paleosoil in which layer 0 of Maininskaia was embedded could be correlated with the Kokorevo Interstadial (c. 12,750–12,250 yr B.P.).

The next interstadial phase was marked by the formation of the double cryoturbated paleosoil containing layer 4 of Ui II. The Taimyr (Allerod) age of it has been confirmed by radiocarbon dates on charcoal of 10,760 ± 420 yr B.P. (LE-3713) and 11,970 ± 230 yr B.P. (LE-3609). This warm episode was also marked by buried soils at the level of layer A-2 in the western part of Maininskaia, and up from layer 0 in the eastern part of the site.

The final part of the Pleistocene succession (the Noril'sk cold phase) is represented by the uppermost Paleolithic cultural horizons in the stratigraphic columns of Ui II (Layers 3a, 3, and 2) and Maininskaia, western portion (layer A-1). Unfortunately, the scarcity of pollen hampers the detailed reconstruction of environmental changes in this period. We could only give a general characteristics of the late Sartan. Palynological analysis indicates the alternation of pine-birch forest and birch-larch forest with admixture of fir, silver fir, alder and graminoids *(Poaceae)*, chenopods *(Chenopodiaceae)*, wormwood *(Artemisiae)*, sedges, ferns, mosses, etc. Fauna is dominated by Siberian wild goat, red deer, bison, and roe deer.

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Late-Paleoindian Faunal Remains from Dust Cave, Alabama

Renee Beauchamp Walker

The late-Paleoindian faunal remains from Dust Cave provide a unique opportunity to examine material from a well-preserved, dated, and stratified context. Dust Cave, located in the northwest corner of Alabama along the Tennessee River, was occupied by prehistoric hunter-gatherers from 10,500 yr B.P. until 5,200 yr B.P. (Collins et al. 1994; Goldman-Finn and Driskell 1994). Projectile points from the late-Paleoindian component include Cumberland, Quad and Beaver Lake (Driskell 1994). Associated with these artifacts is a faunal assemblage consisting primarily of small mammals and birds, a finding inconsistent with the assumption that Paleoindian hunters depended primarily on large game (Martin 1984). Thus, one goal of the Dust Cave project is to investigate subsistence strategies of late-Paleoindian hunter-gatherers.

A preliminary sample (1992–1994 field seasons), composed of 2,032 faunal remains weighing 597.2 grams, indicates that prey and habitat selection during the late-Paleoindian period was an intricate process. The most striking characteristic of the faunal remains is the extremely high percentage of bird bones (Figure 1), some having distinct cutmarks. In addition, the presence of certain animal species suggests a variety of habitats were exploited. Evidence for grassland exploitation comes from the presence of prairie chicken remains (Bull and Farrand 1995). Woodland species represent the most diverse group of animals in the assemblage including Eastern box turtle, opossum, rabbits, raccoon, gray squirrel, short-tailed shrew, passenger pigeon, and grackle

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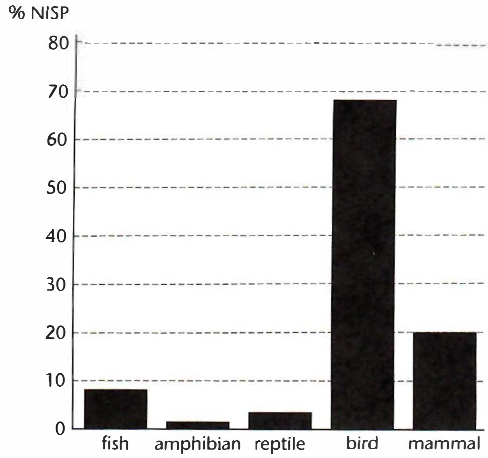

Figure 1. Faunal remains from the late-Paleoindian component at Dust Cave.

(Whitaker 1980). In addition, ecotone species such as the white-tailed deer, turkey, and bobwhite quail were present in both woodland and grassland habitats. Finally, riverine conditions provided habitat for a variety of ducks and geese, as well as fish, aquatic mammals and turtles.

Seasonality is assessed by the presence of passenger pigeon in the assemblage. This now-extinct bird would only have been present in the Southeast during the fall and winter, after which groups would migrate north for nesting (Schorger 1973). Passenger pigeon bone suggests the possible season of occupation for the late-Paleoindian component was fall to early winter.

The Dust Cave faunal remains are integral to understanding late-Paleoindian subsistence strategies. The concept of late-Paleoindians as exclusively big-game hunters is over-emphasized in comparison with their actual subsistence activities (Anderson and Sassaman 1996, Walthall 1980:36). These data from Dust Cave suggest that the common use of small game, a practice often associated with later prehistoric periods, actually began as a way of life by at least 10,500 years ago. Research at Dust Cave continues to provide insight into the adaptations of late-Paleoindian hunter-gatherers in the southeastern United States.

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Evaluation of the Stratigraphy and Age of Diring Yuriakh: A Lower-Paleolithic Site in Central Siberia

Michael R. Waters, Steven L. Forman, and James M. Pierson

Lower-Paleolithic artifacts have been recovered by Mochanov (1992,1993) at Diring Yuriakh, an archaeological site 140 km south of Yakutsk (61° 12′ N latitude; 128° 28′ E longitude) in central Siberia. Here, Mochanov has identified an occupation surface with unifacial choppers and flake debris clustered around large anvils. Mochanov believes that the artifacts from Diring are between 1.8 and 3.2 million years old. Geoarchaeological investigations were undertaken in the summer of 1993 to evaluate the stratigraphy and age of the site (Waters, Forman, and Pierson 1997).

Diring is located on the highest terrace of the Lena River (120 km above the modern river). At the site, unconsolidated Quaternary sediments rest unconformably on Cambrian-age limestone. These sediments are divided into four major units labeled I through IV (from oldest to youngest) and are further subdivided on the basis of lithostratigraphic criteria (Figure 1).

Unit I is composed of gravels (Ia) and sands (Ib) that overlie the limestone. These are fluvial deposits laid down by an ancestral Lena River. Unit I is intruded by wedges filled with well-sorted sand (unit II). Both units I and II are truncated. Resting on top of the eroded surface of unit Ib and the truncated sand wedges (unit II) is a gravel lag. The artifacts from Diring are found on this deflation surface. Overlying the artifact surface is unit III. This unit consists of wind-blown sands (units IIIa and IIIc) and silts (units IIIb, IIId, and IIIe). Toward the front of the terrace, units IIIa-e are completely eroded and the deflation surface is overlain by later eolian sands (unit IV) that form an elongated dune.

Ten thermoluminesce (TL) ages have been obtained so far at Diring (Figure 1); one (OTL507A) is reported here for the first time. Fine-grained polymineralic samples from units IIIa and II that bound the artifact-bearing

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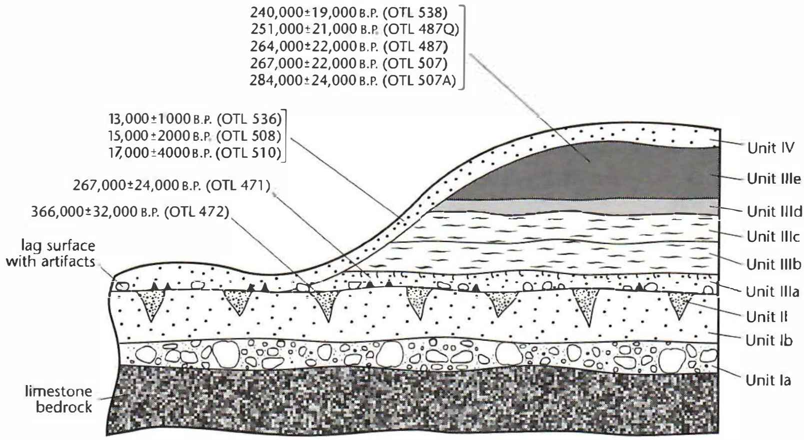

Figure 1. Generalized cross-section of the stratigraphy at Diring Yuriakh and associated TL ages. Solid triangles show the stratigraphic position of artifacts. (Modified from Waters, Forman, and Pierson 1997).

horizon yielded ages of 267 ± 24 (OTL471) and 366 ± 32 ka B.P. (OTL472), respectively. The most securely dated deposit is loess unit IIIe, from which four fine-grained polymineralic samples gave ages of 240 ± 19 (OTL538), 264 ± 22 (OTL487), 267 ± 22 (OTL507), and 284 ± 24 ka B.P. (OTL507A). The quartz extract from sample OTL487 yielded an age of 251 ± 21 ka B.P. (OTL487Q). Three fine-grained polymineralic samples from unit IV yielded TL ages of 13 ± 1 (OTL536), 15 ± 2 (OTL508), and 17 ± 4 ka B.P. (OTL510). TL ages from the loess of unit IIIe that overlies the archaeological material at Diring provide a credible minimum age estimate for the artifact-bearing surface of about 260 ka B.P., while the TL age from unit II underlying the artifact surface provides a maximum age of about 370 ka B.P.

The TL ages confirm that Diring is the oldest archaeological site known in northeast Asia and is an order of magnitude older than previously documented sites (Michael 1984; Mochanov 1978; Yi and Clark 1985). Mochanov (1992, 1993) reports that this early habitation of Siberian is not isolated to Diring, but that other sites in similar stratigraphic positions have been found at 14 other localities along an 800-km segment of the Lena River.

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Current Data on Late-Pleistocene/Early-Holocene Ceramics in Russian Far East

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The history of discoveries of earliest ceramics in Russian Far East began in 1975 on the Gasya site located in the Lower Amur River basin. The most ancient pottery samples accompanying mesolithic stone artifacts in the lower horizon of the site are dated to 12,960 ± 120 yr B.P. (Le-1781) (Derevyanko, Medvedev 1995). In 1989–1996 new sites with early ceramics were discovered in Lower Amur River basin and Primorie region. Their ages vary from late Pleistocene to early Holocene according to absolute and relative datings.

The Khummy site is located in the Lower Amur River basin at some distance from the Gasya site. The lower horizon containing early pottery is dated to 13,260 ± 100 yr B.P. (AA-13392) and 10,345 ± 110 yr B.P. (AA-13391). This pottery is accompanied by mesolithic stone artifacts made in blade and chipped technique (Lapshina 1995).

The Ustinovka-3 site is located in the eastern part of the Primorye region. The lower horizon containing stone artifacts made with a blade technique dates to 9–8 k yr B.P. according to paleobotanical data (Kononenko 1996; Verkhovskaya 1993). The assemblage of early pottery is associated with the lower horizon of the site (Garkovik, Zhushchikhovskaya 1995).

The Almazinka site is located in the northern part of the Primorye region. A cultural layer containing blade-like stone artifacts and fragments of one ceramic vessel is dated to 7,545 ± 80 (AA-9818), 7,430 ± 65 (AA-9817), 7,410 ± 60 (AA-9819) (Lynsha, Zhushchikhovskaya 1996).

The Chernigovka-1 site is located in the western part of the Primorye region (Sapfirov 1989). Blade and microblade stone artifacts and the samples of early pottery belong to the lowest cultural horizon. Its probable date between 12–8 k yr B.P. is based on the resemblance of stone artifacts to the artifacts from the Gorbatka-3 site dated to 13,500 ± 200 yr B.P. (SOAN-1922), site Ilistaya-1 dated to 7,840 ± 60 (Ki-3163) (Kuzmin et al. 1994; Kuznetsov, 1992).

The following paragraphs summarize the technological and morphological features of Far Eastern early pottery.

Two types of ceramic pastes are distinguished, natural clay without artificial temper (Ustinovka-3, Almazinka), and natural clay with artificial plant organic temper (Gasya, Khummy, Chernigovka-1).

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Two forming methods may be recognized, molding (Khummy, Gasya, Ustinovka-3, Chernigovka-1), and coiling (Almazinka). Vessel shapes are simplest, unrestricted. Bottoms are flat (Gasya, Almazinka) or unrecognizable (Khummy, Ustinovka-3, Chernigovka-1).

Special surface treatment is not fixed for most of these early ceramics assemblages. Traces of rough rubbing occur on inner surfaces only of pottery from Ustinovka-3.

The firing temperature was low (500–600 °C) according to analytical data. It is possible to note the following points concerning the general temporal and cultural position of Far Eastern early ceramics assemblages.

1. The technological and morphological characteristics of late-Pleistocene and early-Holocene pottery are more primitive than those of pottery from known Neolithic cultural assemblages of Russian Far East.

2. The technological and morphological characteristics of Far Eastern earliest pottery are similar to those of most ancient pottery from other regions—Eastern Asia, Near East, North and South America (Griffin, 1965; Hoopes, 1994; Vandiver, 1987, 1991; Wang, 1995). This similarity reflects the same level of pottery-making development—its initial stage—independent of chronological and geographical coordinates.

3. The Lower Amur River basin may be considered the region of the earliest appearance of pottery-making in the Russian Far East. Ceramic assemblages discovered here are dated closely to earliest ceramics of Japanese archipelago, between 13–10 k yr B.P. (Kajiwara, 1996; Miyata, 1995; Suda, 1995).

4. The earliest pottery-making of the Russian Far East developed independently from pottery-making of the Japanese archipelago, demonstrated by differences in informing methods: "slab construction" is characteristic of initial Japanese pottery-making (Vandiver, 1991), while molding is the predominant forming technology of Far Eastern earliest ceramics.

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Physical Anthropology

What Did South American Paleoindians Eat?

Walter Neves and Silvia Cornero

The discussion about the subsistence pattern of Paleoindian societies has occupied a large number of pages in the archaeological literature of the Americas, and we agree with Steele and Powell (1993) that the ideas today about this subject can be grouped into two contrasting models. The classic model assumes that the first Americans relied primarily on Pleistocene megafauna for their subsistence. In this model, Paleoindians were big-game hunters for whom small game and plant resources were of little significance. This picture has been strongly supported by extensive evidence of the presence of projectile points in several areas of North America during the initial Holocene, some of them directly associated with bones of extinct animals. For authors that subscribe to this model, later Archaic societies were characterized by the adoption of a wider nutritional basis which incorporated small game and plant resources, accompanied by specialized adaptations to the coastal environment with a concomitant adoption of shellfishing and fishing as the major economic activity (Dincauze, 1981; Kelly & Todd, 1988). This model has been so pervasive in North American archaeological literature that it has inspired some authors to ascribe Pleistocene megafauna mass extinction in the continent to predation pressure exerted by man after his arrival in the Americas (Martin, 1973).

An alternative to the big-hunter model has been elaborated in more recent times (Meltzer and Smith, 1986; Olsen, 1990). Proponents of this model question the "universality" of the big-game hunter profile for the whole of the Americas, and instead suggest that the first Americans had a variety of subsistence patterns that in some places included intensive exploitation of megafauna, and which in other places involved a broader repertoire of food items including small animals, fish and plant resources, much as later Archaic populations did.

If there is no consensus about the Paleoindian subsistence behavior in North America, the situation in South America is still more confused and debated (Dillehay et al., 1992). Remains of different species of megafauna

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have been found in some archaeological sites in the subcontinent (Prous, 1986), but in the great majority of cases there is no clear evidence that the fauna was systematically hunted and eaten (for an exception see Politis, 1989; Politis et al., 1987). The lithic industries associated with these sites also seem to indicate a much more diversified subsistence pattern and appear to be incompatible with specialized hunting of big game (Ardila, 1991; Ardila and Politis, 1989; Politis, 1989; Prous, 1986).

Much about prehistoric subsistence behavior can be generated through osteological analysis of specific markers in skeletal human remains (for a recent review see Larsen, 1987). Unfortunately, analysis has been rare in the case of Paleoindians (for an exception see Steele and Powell, 1993) because few skeletons of these populations are available for analysis, at least where North America is considered (Steele and Powell, 1992; Taylor et al., 1985). Until recently, the situation in South America was not much different. Although many Paleoindian skeletal remains lay in museum shelves in South America (Neves and Pucciarelli, 1991), few came from rigorously excavated sites; and most specimens had been single individuals uncovered from small excavations, a situation which precludes populational inferences.

Santana do Riacho, a rockshelter located at Serra do Cipó, 50 km from the village of Lagoa Santa, State of Minas Gerais, Central Brazil, was systematically excavated by André Prous between 1976 and 1979 (Prous, 1981; 1986; 1991). It yielded 40 individuals of different ages and sexes, which had been disposed in 28 different burials.

The cemetery was continuously used by the same population since 11,960 ± 250 yr B.P. (Gif 5089), but most of the skeletons uncovered are from 8,500 to 9,500 yr B.P. To our knowledge this is the first real population sample of Paleoindian origin available in the Americas; consequently, after being carefully curated, it has been studied in detail by one of us since 1994 (WAN). These studies focus on the biological affinities of this population with their contemporaries in the Americas and elsewhere, and on their life style and quality of life.

Several nutritional disorders have been recently analyzed, and here we report the incidence of dental cavities for the population of Santana do Riacho. Dental caries is an infectious disorder produced by bacterial activities which proliferate under specific oral conditions. Among the factors that influence the development of dental cavities are the composition and texture of food items. A linear relationship has been firmly established between the amount of carbohydrates and sugars ingested and the development of caries (Hilson, 1990). In accordance with Turner II (1979), hunter-gatherer populations exhibit rates of incidence of caries ranging from 0.0 to 5.3%, while rates for horticulturists range from 2.2 to 26.9%. Groups with mixed economies show intermediate rates ranging from 0.44 to 10.3%. Larsen (1987) prefers to attribute to hunter-gatherer economies rates ranging from 0.4 to 7.8%.

Dental cavities in Santana do Riacho were analyzed using standard osteological procedures, visual inspection with the help of a dental metallic explorer. The rate of caries incidence reached 9.0% (8/88) in the group as a whole (including subadults and infants), and 11.0% (4/38) among adults.

(The rate of caries was calculated as the number of carious teeth compared with the total number of teeth observed; no assumption was made about teeth lost ante mortem.) The incidence of tooth decay at Santana do Riacho is high, exceeding rates normally associated with hunter-gatherer economies so far studied. This finding clearly indicates that the diet of Paleoindian populations of central Brazil relied significantly on plant resources, rich in carbohydrates, and seems to reinforce the idea that at least in South America, Paleoindian subsistence economy was not necessarily big-game hunting.

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Lithic Studies

[Editor's Note: The following paper appeared in *Current Research in the Pleistocene* Vol. 13 without its table, so we are reprinting it.]

Geochemical Source Analysis of Obsidian Paleoindian Points from the Black Rock Desert, Nevada

Daniel S. Amick

This paper presents results from X-ray fluorescence source analysis of 50 obsidian Paleoindian projectile points from the Black Rock Desert of northwestern Nevada. Nearly all Paleoindian points from the Black Rock can be assigned to one of three series: Great Basin Stemmed, Great Basin Concave-Base, or Alberta-Cody/Scottsbluff. Typological assignments are based on similarity of technological and morphological attributes. Unfortunately, these artifacts lie exposed on the floor of an ancient lake bed and chronological assignments depend on artifact correlations.

The most common Paleoindian types from the Black Rock are the Great Basin Stemmed series (Pendleton 1979). The age of stemmed points is disputed, but most suggest a range of 8,500–12,000 yr B.P. (Beck and Jones 1990). Projectile points assigned to the Great Basin Concave-Base series are suggested to date 9,000–11,000 yr B.P. (Pendleton 1979). Large numbers of concave-base points are known from the Black Rock (Clewlow 1968); Tulare Lake (Riddell and Olsen 1969); Sunshine Well (Hutchinson 1988); and Big Smoky Valley (Pendleton 1979).

One Black Rock locality (Wallmann and Amick 1991) has produced many artifacts with technological affinities to Alberta/Cody types (including Scottsbluff and Eden) better known from the Great Plains where they date 8,500–10,000 yr B.P. and are associated with bison kills (Frison 1991). Most are stems broken below the shoulders; complete points and distal fragments are rare because tip fragments are commonly recovered and repaired by fixing new stems (Bradley 1991; Bradley and Frison 1987; Huckell 1978).

Current knowledge of lithic procurement and mobility ranges for early Great Basin occupants is limited (Amick 1993, 1995; Beck and Jones 1990;

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Fagan 1990). This paper contributes sourcing results for 50 obsidian projectile points (Richard Hughes, Geochemical Research Laboratory, Letter Report 95-42). Specimens were selected to span the visual diversity of obsidian and include 27 Alberta/Cody, 16 stemmed, and 7 concave-base points. Eleven known sources (Massacre Lake and Guano Valley sources are indistinguishable) are identified for 74% (n = 37) of these artifacts. Most source locations are found 60–150 km northwest or east of the Black Rock, but one point is assigned to Riley (270 km north). See Table 1.

Table 1. Obsidian sources identified in the artifact sample by X-ray fluorescence analysis.

	Alberta/ Cody	Great Basin Stemmed	Concave-Base	Total	Linear Distance and Orientation
Pinto Peak	0	0	1	1	60 km W
Double H Mtns.	5	3	1	9	70 km E
Bordwell Spring	1	0	0	1	80 km W
Paradise Valley	3	1	0	4	85-110 km E
Massacre Lake/ Guano Valley	6	1	2	9	110 km NNW/ 145 km NNW
Hawk's Valley	0	1	3	4	120 km NNW
Buck Mountain	1	0	0	1	140 km NW
Rainbow Mine	3	3	0	6	150 km NW
Beatys Butte	0	1	0	1	150 km NNW
Riley	0	1	0	1	270 km N
Unidentified Sources					
Unknown	0	4	0	4	
Variety A	2	1	0	3	
Variety 1■	5	0	0	5	
Variety 2■	1	0	0	1	
Totals	27	16	7	50	

■ Low-silica rhyolite

This sample is not random so it cannot be used to indicate differences in lithic-procurement patterns for these projectile-point categories. However, the diversity (richness:sample size) of obsidian sources is 0.33 (9:27) for Alberta/ Cody points, 0.56 (9:16) for stemmed points, and 0.57 (4:7) for concave-base points. Distinctive patterns of lithic resource use are also shown among the 13 obsidian artifacts from unidentified sources. For example, six of the Alberta/ Cody points were classified as low-silica rhyolites (unknown source) and many of the Alberta/Cody points from the Black Rock appear to be made from similar stone. Low-silica rhyolites are found throughout central Oregon, northeastern California and northwestern Nevada. Although obsidian occurs in the concave-base assemblage from the Black Rock, chalcedony and chert dominate this type. In contrast, stemmed points from the Black Rock are nearly always obsidian. These differences suggest contrasts in toolstone procurement and landscape mobility patterns of Black Rock Paleoindians.

Thanks to Steve Wallmann and the late Jonathan O. Davis for bringing the Paleoindian archaeology of the Black Rock Desert to my attention. Funding for the obsidian geochemistry source analyses was provided by the Robert and Joy Leland Charitable Trust.

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An Analysis of Resharpening Flakes from the Cooper Site

Scott D. Brosowske and Leland C. Bement

The Cooper site (34HP45) is a Folsom-age bison kill in an ancient arroyo along the northern margin of the Beaver river in northwestern Oklahoma (Bement 1994; Bement and Carter 1995). The site contains the remnants of three late summer/early fall kill episodes. The lithic assemblage from each kill (Folsom projectile points, flake knives, and resharpening flakes) reflects the tasks of bison killing and hide and meat stripping. No tool manufacture debris was found.

A total of 128 pieces of debitage were recovered. Of these, 5 (4%) are frag-

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ments of shattered projectile points, 56 (44%) are flakes with crushed or missing platforms, and 67 (52%) are flakes retaining a platform. Of the 67 flakes with platforms, 61 have single-faceted platforms and 6 have multi-faceted platforms. The high number of single-faceted platforms is consistent with the recovery of unifacial flake knives.

The debitage from the Upper kill is dominated by Alibates agatized dolomite. Of the flakes, 41 (91%) are Alibates and 4 (9%) are Edwards Plateau chert. The middle and lower kills are combined for this analysis, since separation of the kills is slight and transport of material the size of microflakes between the kills by gophers is likely. Of the flakes, 57 (79%) are of Edwards Plateau chert, 13 (18%) are Alibates, and 2 (3%) are an unidentified chert. The Edwards Plateau chert from the combined middle and lower kills includes 24 flakes of a black variety identified as Owl Creek. Additionally, three Alibates, two Edwards Plateau chert (including one Owl Creek variety), and one Ogallala quartzite flakes were recovered from the slump deposits on the river floodplain.

Based on evidence from intact platforms, soft hammer percussion or pressure flaking were the methods used for edge rejuvenation. Ring cracks and salient bulbs of percussion, characteristics associated with hard hammer percussion, are absent. Although it is possible that flakes removed by hard hammer percussion are not equally preserved in the assemblage, the lack of evidence for this technique on complete flakes suggests that soft hammer or percussion was most likely used.

Using distinguishing characteristics such as color, degree of translucency, and texture, the presence of six Alibates, five Edwards (one Owl Creek), one unidentified chert, and one Ogallala quartzite tool is indicated by resharpening flakes. Resharpened tools actually recovered from the combined kills include one each of Edwards, Day Creek, and Alibates, and three of Owl Creek. An additional Edwards and two Alibates tools that were not reworked were also recovered. The resharpening flakes indicate five Alibates, four Edwards, one unidentified chert, and one Ogallala quartzite tool were not contained in the deposits. Attempts to fit the resharpening flakes onto the recovered tools failed to produce a single refit. The failure for refits is attributed to the small size of the flakes, the broken condition of many of the flakes, the extreme extent of wear on tool edges, and the high number of tools indicated but not recovered.

Microscopic examination of the edge remnants on the flake platforms indicates the tool edges were extremely worn at the time of resharpening. Wear characteristics include rounding, pitting and polishing. The extent of wear indicated by the edge remnants on the flake platforms mirrors the wear on the edges of the discarded or lost tools. Erratic removal of flat scalar microflakes from both the ventral and dorsal surfaces on recovered tools indicates that much of their use was the cutting action of a knife. The mixture of rounding, pitting, and polishing supports the contextual indication that these tools were used to cut fresh hide and muscle (Frison 1979; Keeley 1980; Odell and Odell-Vereecken 1980; Vaughan 1985). In experimental butchering of bison, Frison (1979) learned that the first cuts to open the hide quickly dulled the tool's edge and that resharpening was necessary to continue with these initial cuts. Subsequent tasks of skinning and meat stripping could be performed with a tool dulled slicing the hide. Meat cutting further dulled the edge until resharpening was needed for continued use. The edge remnants on resharpening flake platforms and the edges of abandoned or lost tools display the extensive dulling from hide and meat cutting.

Analysis of microdebitage from three kills at the Cooper site indicate that more tools were used to butcher these animals than were recovered during excavation, that tool edges were extremely dull at the time of resharpening, and that the tools were employed in hide removal and muscle stripping.

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Provenance Analysis of Obsidian Paleoindian Projectile Points from Yellowstone National Park, Wyoming

Kenneth P. Cannon and Richard E. Hughes

Four years age we reported the results of the geochemical characterization of seven Paleoindian-style projectile points from surface contexts in Yellowstone National Park (Cannon and Hughes 1993). Since then, another 25 points believed to date to this time period have been analyzed using non-destructive X-ray fluorescence (see Hughes 1988, 1994a for discussion of analytical methods; raw data appear in Hughes 1989, 1991, 1992, 1994b).

Compared with the relatively restricted number of sources documented in

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projectile-point collections from later time periods, the points assigned herein to the terminal Pleistocene-early Holocene (Figure 1) represent at least 10 distinct geochemical types (Cannon and Hughes 1995).

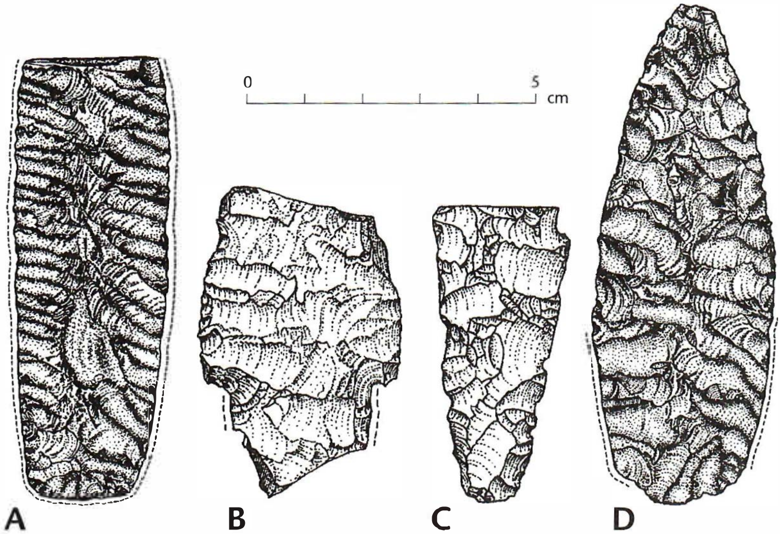

Figure 1. Selected obsidian Paleoindian-style projectile points from Yellowstone National Park, Wyoming: **A,** FS15642 is from West Thumb and sourced to Bear Gulch; **B,** FS6123 is from West Thumb and has a trace element composition most similar to ash flow tuff obsidians from the Pack Saddle Creek area, eastern Idaho; **C,** FS7048 is from Arnica Creek and sourced to Obsidian Cliff; **D,** FS4990 was found on the trail to Mt. Chittenden and sourced to Bear Gulch.

The three major sources utilized during this time are Obsidian Cliff (n = 17; 53.13%), Bear Gulch (n = 5; 15.63%), and Teton Pass Variety 2 (n = 3; 9.38%). In straight-line distance, Bear Gulch is about 90 km west and Teton Pass is about 125 km south of Yellowstone. Other sources (e.g., American Falls, Idaho), over 280 km distant, are also represented in the assemblage (Cannon and Hughes 1993:55). Distant source-use during Paleoindian times also has been documented elsewhere in the Far West (e.g., Jones and Beck 1990:76).

Conveyance distance and diversity of material types may provide some clue to the territorial scale of Paleoindian groups utilizing the Yellowstone Plateau, although it is unclear at this time whether the use of non-local obsidians indicates shifting access to sources, changes in the scale of residential mobility, or a subtle combination of both. Recent research shows, however, that at the end of the Pleistocene, conditions cooler and moister than those of present existed in Yellowstone (Whitlock 1993), reducing time when high altitudes could be occupied and effectively restricting access to Yellowstone Plateau sources to the warm season. At about 9500 yr B.P., warmer, drier conditions prevailed, accompanied by evidence for increased fire frequency (Whitlock and Millspaugh 1994). Modern fire ecology studies document improved for-age for ungulates in post-fire settings (e.g., Hobbs and Spowart 1984), and with a corresponding florescence in the resource base, one might expect that hunter-gatherer mobility would decrease (Cannon 1996a). Archaeologically, this may be reflected by a greater abundance of local Yellowstone obsidian (e.g., Obsidian Cliff and Cougar Creek) by peoples using late-Paleoindian lanceolate and stemmed points.

Despite intensive investigations (Cannon 1996b; Cannon et al. 1994, 1996, 1997), knowledge of Paleoindian occupation of Yellowstone is still known only from surface-recovered artifacts, and the number of obsidian samples so far attributable to this period is regrettably small. Nonetheless, judged on the basis of obsidian used to fashion projectile points, Paleoindian peoples appear to have used a greater number of geologic sources than subsequent populations in the greater Yellowstone vicinity.

Funding for this research has been provided over the years by a number of sources: the National Park Service, the Federal Highways Administration, and AGS Specialists. We would also like to thank Dr. Ralph Hartely for his support.

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The Greenbelt Core: A Polyhedral Blade Core from San Antonio, Texas

Brett A. Houk, Steve Tomka, Britt Bousman, C. K. Chandler, Bruce Moses, Marcie Renner, and Mike Lyons

In February 1997, Marcie Renner showed Brett Houk a heavily patinated blade fragment (Figure 1A) that Mike Lyons found on the surface of his neighborhood greenbelt. Houk visited the location and noted abundant artifacts on the surface A short time later, Lyons found a heavily patinated blade core (Figure 1B) near the location of the blade discovery. The core was partially buried in topsoil. Following discovery of the core, Lyons, Houk, Renner, Bousman, and Tomka returned for a more detailed assessment of the site. No other cores or blades were located during this visit.

The polyhedral core is 143 mm long and weighs 650.5 g. The striking platform varies from 53 to 61 mm in diameter (Figure 1C). The surface of the core has 14 blade scars. Eight scars originate from the subrectangular multifaceted striking platform at the proximal end of the core. Six blades were removed from the pointed distal end of the core. Only one blade scar, 31 mm wide, extends the full length of the core. It was removed from the distal end of the core. Most blade scars, removed from either end, tend to overlap near the center of the core. Judging from the morphology of the core's margins, most of the blades were nearly straight or slightly curved along their longitudinal axis. The core is entirely decorticate. A coarse-grained segment in the parent mate-

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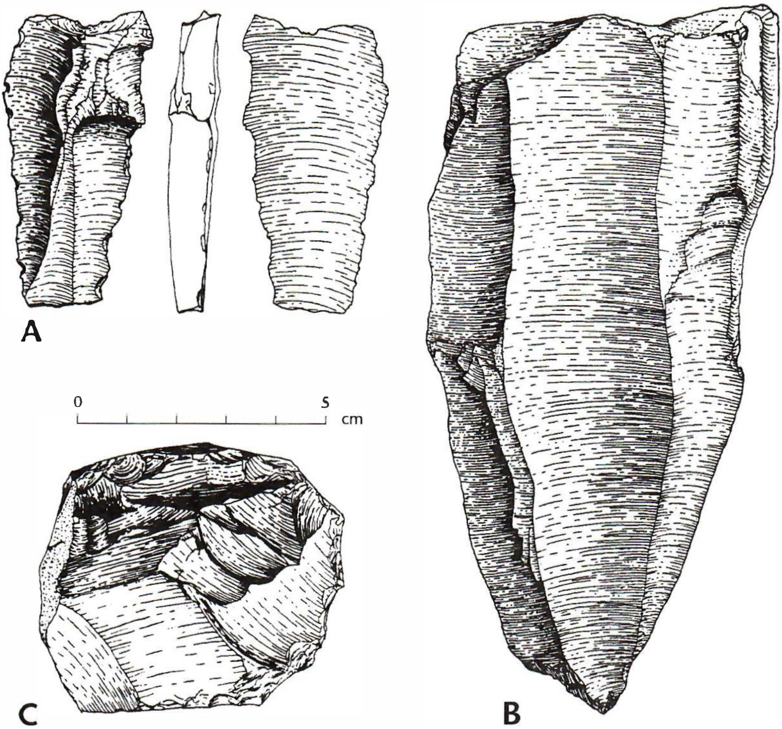

Figure 1. Paleoindian blade and polyhedral blade core from the Greenbelt site: **A,** blade; **B,** polyhedral blade core; **C,** faceted striking platform on blade core.

rial, below the striking platform, may have prevented blade removal from this portion of the core. Except for two or three recent flake scars that reveal light gray, fine-grained chert, a heavy white patina covers the surface of the core.

Similar cores from the Southern Plains and Texas have been attributed to a Clovis affiliation (Chandler 1992; Collins 1990; Collins and Headrick 1992; Collins et al. 1992; Goode and Mallouf 1991; Green 1963; Hammatt 1970; Kelly 1992; Young and Collins 1989). Clovis blade cores have at least eight characteristics: polyhedral cross section; faceted platform with multiple deep negative scars; some platform scars terminating with a hinge; the platform plane oriented perpendicular to the core's long axis; blade lengths ranging from 75 mm to 150 mm; smooth, low-amplitude ripple marks on blade scars; high-quality chert; and heavy patination. The Greenbelt core and blade together display all of these characteristics and are probably of Clovis age, although they lack any clear cultural or geological context.

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The Distribution of Alibates Silicified Dolomite Clasts Along the Canadian River

Kenneth C. Kraft

The bedrock location of Alibates silicified dolomite along the Canadian River in Potter County, Texas, is well known to contemporary geologists and archaeologists (Banks 1984, 1990; Bowers 1975; Bowers and Reaser 1974, 1996; Bryan 1950; Carroll 1941; Gould 1907; Green and Keeley 1960; Holliday and Welty 1981; Patton 1923; Roth 1955; Shaeffer 1958; Totten 1956; Wyckoff 1989, 1993). This material was also well known to hundreds of generations of Pleistocene and Holocene nomads to late-Holocene pre-contact villagers (Banks 1990:91; Wyckoff 1993:37). More often than not the location of Alibates and the acquisition of the material for stone tool manufacture was thought to be restricted to its bedrock source. Previous reports drew attention to the occurrence and abundance of Alibates clasts in gravel deposits along the Canadian River in western Oklahoma (Bryan 1950; Shaeffer 1958; Wyckoff 1993). The present report expands on that research.

Wyckoff (1993:37) notes that the location of Alibates-bearing gravels downstream of the bedrock source are not well known or documented. In response, a survey of three transects across the Canadian River valley in western Oklahoma was undertaken which revealed the persistent, but minor, presence of Alibates clasts in gravel deposits. The clasts were recovered from 39 exposures ranging from 100 to 172 miles east of the bedrock source (Figure 1). A total of 1,365 clasts were recovered from various terraces along the river with each

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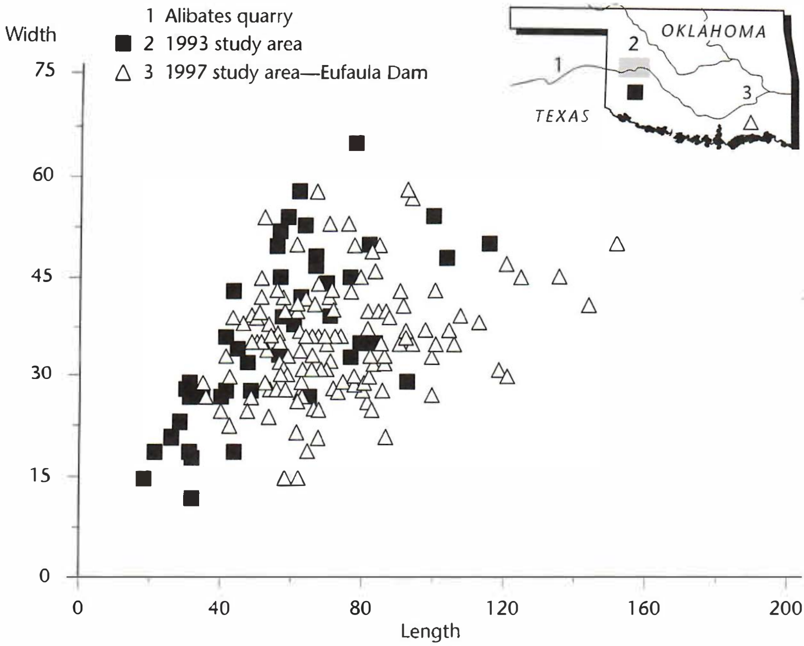

Figure 1. Scattergram of Alibates clasts from western and eastern Oklahoma.

location being cataloged according to UTM coordinates. Wyckoff's (1993:51) research demonstrated that clast size varied regardless of distance from the bedrock source or age of the terrace. Among other important data gleaned from the research, his results showed that Alibates was available for prehistoric exploitation in western Oklahoma's Canadian River basin (Wyckoff 1993:52–53). To this exemplar study the following results may be added.

The present report draws attention to 135 clasts collected by avocational archaeologists along the Canadian River in Haskell County, Oklahoma. The collection locale is 210 miles from the easternmost collection made in 1993, a total of 382 river miles downstream from the bedrock source. Although Wyckoff's 1993 study was able to plot each gravel deposit to a first, second, or third terrace setting, these new finds come from the present river bed. The collection was made below Eufaula Dam (Figure 1), and most likely represents displaced materials from various settings along the river's course. Each of the 135 clasts was measured. These data were entered into a statistical computer program along with comparable measurements from Wyckoff's westernmost and easternmost collection areas. The results are presented in Figure 1. It is easy to see the variation in size of the clasts from Haskell County. Future studies from this part of the river with close regard to provenience may clarify trends in clast distribution.

The data presented in Figure 1 demonstrate the availability of Alibates cobbles in eastern Oklahoma to prehistoric occupants of the area without the need for long-distance travel or trade. Interpretation of the archaeological record concerning smaller Holocene projectile points and tools is obvious; however, the maximum length of many of the clasts (151–100 mm) does fit well within the length range for late-Pleistocene spear points recovered from the area. Clearly, Alibates clasts of knappable size could be obtained long distances from the bedrock source, the Haskell County locality being the furthest east at present.

In sum, this report illustrates the need for ongoing research concerning the presence of Alibates clasts in the Canadian River's eastern reaches. The present level of research can only draw attention to the fact that Alibates clasts are readily available in local river gravels and available in sufficient lengths to manufacture typical Pleistocene points. Discerning whether Alibates artifacts were manufactured from material from the distant quarries or nearby gravels is considered to be a major hindrance to archaeologist's theories about prehistoric mobility and commerce. This report hopes to draw attention to the need for a reconsideration of mobility and acquisition patterns of Pleistocene-age groups in the vicinity.

The author greatly appreciates the interest of avocational archaeologists Billy Ross, John Carter, John and Ann Coffman, and Jay Maulsby. This report benefited from comments from Dr. Don Wyckoff and Jesse A. M. Ballenger who also assisted in graphic design. 2

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Reduction Sequence at the Clary Ranch Site

Thomas P. Myers

The Clary Ranch site is a late-Paleoindian bison-kill site in western Nebraska, about 130 km west of the forks of the Platte River (Myers, Corner and Tanner 1981). It is located about 5.5 km from the mouth of Ash Hollow Creek, one of the principal intermittent streams that cross-cut the Cheyenne Table south of the North Platte River. Ash Hollow Cave, a long-time campsite, refitting area and lookout site in use since Paleoindian times, is nearby (Champe 1946). In the immediate vicinity of the site, the land is relatively flat with few abrupt breaks in the topography. Prairie turnips, chokecherries and other potential food resources of the high plains still grow close to the site.

The site was discovered eroding from the bank of Ash Hollow Creek by ranch owner Orin Clary and brought to the writer's attention by Dennis Shimmin, Superintendent of Ash Hollow State Park. During the excavations from 1979 to 1982, the badly broken remains of 17 bison (Hill, this volume) were recovered along with projectile points and a variety of small stone tools. The site was buried by fine-grained alluvium indicating a slow flow of water that would have been unlikely to move the remains far from where they had been discarded. A concentration of tiny flakes indicates where a knapper sharpened a number of stone tools.

Clary Points are crudely diagonally flaked lanceolate points with a concave base and the following dimensions:

length	65.0–28.1 mm
width	26.1–16.0mm
thickness	7.0–4.5 mm
basal concavity	5.0–0.0 mm

Thirteen points and point fragments define the reduction sequence: an alternate beveling process that produced an end product classifiable as a Meserve Point (Myers and Lambert 1983). (Figure 1.) Raw materials used for the points include Smoky Hill jasper, Hartville Uplift chalcedonies and White River Group chalcedonies. The range of people making Clary points extended at least from the Hartville Uplift to the eastern Sand Hills, 400 miles to the east (Myers 1995).

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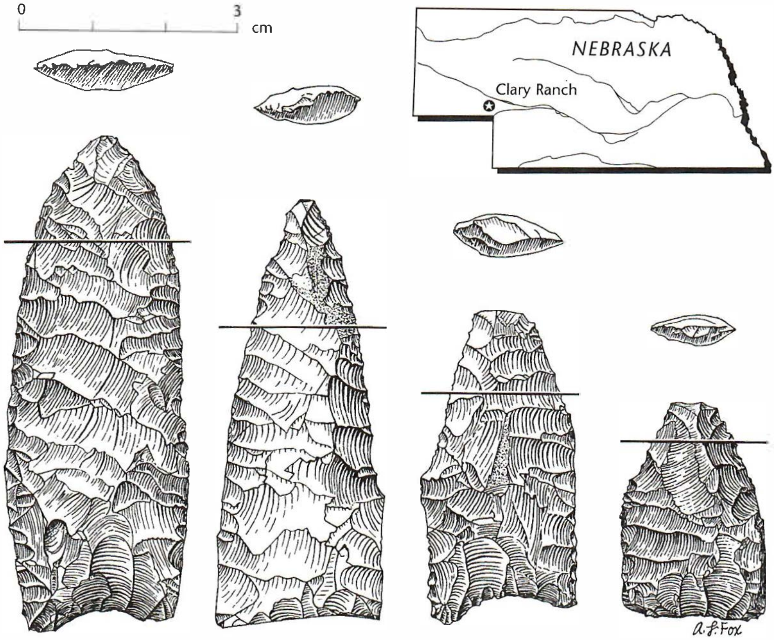

Figure 1. Reduction sequence of Clary points.

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Lake Ilo Ultrathin Bifaces and Folsom Points: Separate Production Sequences

Jerry D. William, Matthew J. Root, and Lisa K. Shifrin

Three Folsom sites along Spring Creek in western North Dakota (32DU955A, 955C, 955D) contain specialized bifacial knives that we call ultrathin bifaces. These are characterized by extremely thin, biconcave cross sections, and ovoid and pointed outline forms (Root et al. 1997). Tools are 1–2 mm thinner in the middle than along edges and have average width:thickness ratios of 15:1 (with a maximum of 20:1). Thicknesses indicate that all but the earliest stage ultrathin preforms are thinner than fluted-point preforms, indicating that these tools represent a reduction technology distinct from fluted-point manufacture. Finished ultrathins are too thin to have been recycled into fluted-point production, but they may have been recycled into unfluted Midland points.

A bivariate plot of tool widths and thicknesses illustrates the distinction between fluted-point preforms and ultrathins (Figure 1; only specimens with both width and thickness are plotted). The point preforms have at least one channel flake removed. To reconstruct the original thickness of the preforms prior to fluting, we added the average channel flake thickness to the thickness between the flutes of points and preforms (the Ts measure of Wilmsen and Roberts [1978:106]). The 200 channel flakes from the sites averaged 2.0 mm thick; we added 2 or 4 mm depending on whether channel flakes were removed from one or two faces. We measured ultrathin thickness at the thinnest point near the intersection of the length and width axes (cf. Callahan 1979:170). Ultrathins average 4.0 ± 0.8 mm thick (range 2.9–5.8 mm, n = 18). Stage 6 and later Folsom preforms (Frison and Bradley 1980:45–52) with added channel flake thicknesses average 7.1 ± 1.0 mm thick (range 4.9–9.3 mm, n = 44). A t-test indicates that ultrathins are significantly thinner than Folsom preforms (t = -13.28, significant at .01). Three unfluted Folsom points are similar in thickness to finished ultrathins. Thus the manufacture of such points is possible by recycling broken ultrathin bifaces (e.g., Amick 1995; Hofman 1991).

Folsom lithic technologies included staged reduction and transport of large multipurpose bifacial tools/cores (Boldurian and Hubinsky 1994; Ingbar 1992). People often carried large bifaces from quarries that served as cores, knives, and fluted-point preforms in a staged sequence. Evidence presented here indicates that ultrathin bifaces could not have been reused in such a fluted-point manufacturing sequence, though they could be recycled into unfluted points.

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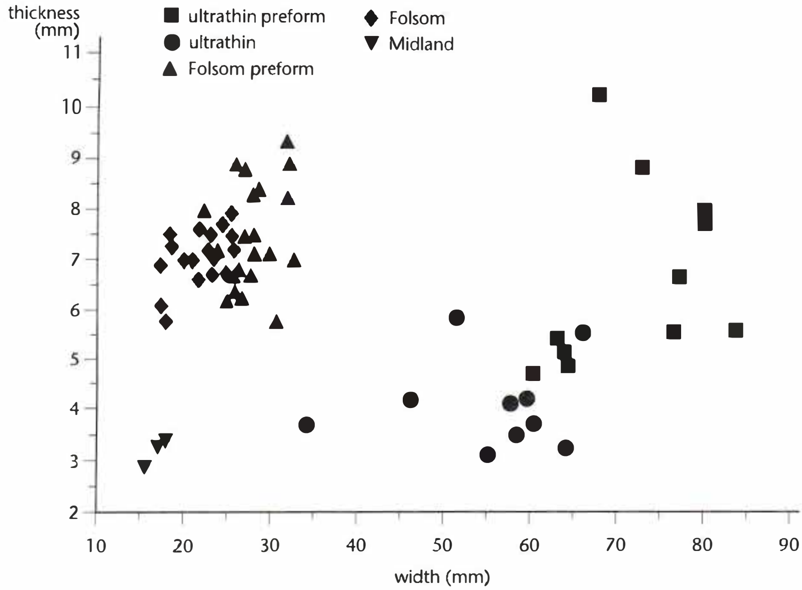

Figure 1. Plot of widths and thicknesses of ultrathin bifaces and preforms (stages 3–5) and Folsom points and preforms (stages 6–11). An original preform thickness for fluted points is calculated by adding average channel flake thickness(es) to preform thickness between flutes.

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Taphonomy—Bone Modification

Effects of Collector Bias on Pleistocene Bone Breakage Frequencies from Old Crow, Northern Yukon Territory

T. Max Friesen

Since its initial definition by Efremov (1940), the study of taphonomy has grown rapidly, but unevenly (e.g., Lyman 1994). For example, while some "sullegic" or collection-related taphonomic factors (Clark and Kietzke 1967:118), such as the effects of mesh size on recovery rates of small vertebrate taxa, are becoming well known (e.g., Shaffer and Sanchez 1994, and references therein), few attempts have been made to quantify the effects of differing research strategies on selective collection of bone assemblages.

This report presents quantified data which reveal biases in frequencies of bone breakage types introduced by selective collection at Locality 11A in the Old Crow Basin, northern Yukon Territory, Canada. Locality 11A is one of several elongated point-bar deposits of complex origin located along the Old Crow River which have yielded large quantities of Pleistocene vertebrate fossils (Bonnichsen 1979; Harington 1987; Irving and Beebe 1984). Only bones identified to order Proboscidea are included in this analysis, over 95% of which are from mammoths, genus *Mammuthus,* while the remainder represent American mastodon *(Mammut americanum)* (Neill n.d.). Teeth (including tusks) were excluded from this study because they are known to break differently from bones.

Crucial to the study of collector bias is the fact that during different field seasons, bones from Locality 11A were collected by several researchers addressing very different research questions (Irving and Beebe 1984). In 1971 (n = 15) and 1973 (n = 66), samples were collected by paleontologist C. R. Harington primarily for use in taxonomic studies. Therefore, a bias toward complete bones is expected. The 1970 (n = 247) and 1976 (n = 726) samples were selected by a number of individuals, including archaeologist W. N. Irving, for specimens useful in both archaeological and paleontological research. Because "spiral fracture," or fresh breakage of bone, had been recognized as possible evidence

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for human activity at Old Crow since 1966 (Irving and Harington 1973), selection for bones exhibiting this feature is expected. Finally, in 1975 (n = 1,322) an attempt was made to collect all bones and bone fragments from designated areas on the surface of the point bar in order to determine the nature of unbiased frequencies from the site. While these 1975 frequencies may be marginally affected by previous collection of the site between 1970 and 1973, Harington (1987) has observed that annual reworking is extensive, with many new bones deposited on the surface of Locality 11A each new collecting season. Therefore, the 1975 collections can be considered relatively unbiased, and for present purposes provide a useful comparison for collections from other years. All samples were surface-collected between 1970 and 1975, while in 1976 both excavation and surface collection techniques were employed.

Bones were divided into three breakage categories. Category 1 contained bones broken while fresh ("spiral fracture"), and included only those broken bones which exhibited a smooth and curvilinear fracture facet, with an angle between the fracture facet and the exterior cortical surface of less than or greater than 90 degrees (Bonnichsen 1979; Irving and Harington 1973; Morlan 1980, 1983). Category 2 included all broken bones which did not exhibit characteristics diagnostic of fresh fracture. Category 3, "intact," contained only complete bones, without significant breakage.

Results provide strong confirmation of expected biases introduced by different collecting methods. Intact bones, which are expected to be selected for paleontological reasons because they retain features which allow taxonomic and functional anatomical analysis, represent only 2.0% (27/1,322) of the "unbiased" 1975 sample. However, samples selected for both archaeological and paleontological purposes (1970 and 1976) contain 6.5% (16/247) and 11.6% (84/726) intact bones, respectively, while samples selected exclusively for paleontological purposes (1971 and 1973) contain even higher (33.3%, 5/15 and 54.5%, 36/66) frequencies of intact bones, respectively. Bones fractured while fresh, expected to be selected by archaeologists interested in cultural bone modification, vary from 0.0% in both "paleontological" samples, to 4.1% (54/1,322) in the "unbiased" 1975 sample, to much higher (17.8%, 129/726 and 19.0%, 47/247) frequencies in the "archaeological/paleontological" collections of 1976 and 1970, respectively.

These results are significant because they illustrate biases produced by different collection methods at a *single* locality. They serve to indicate that in cases where complete samples are not collected in the field due to logistical or financial constraints, different investigators can produce samples with significantly dissimilar attribute frequencies. Unless sullegic taphonomic factors such as collection methods are considered, very different interpretations of the taphonomic history of a site may be produced. As such, this cautionary tale is instructive for any researcher who performs taphonomic or archaeological analyses on existing museum collections.

I thank the late Dr. W. N. Irving, principal investigator of the Northern Yukon Research Programme, for his support, encouragement, and insights into the Old Crow bones. In addition, I thank Drs. C. S. Churcher, C. R. Harington, M. R. Kleindienst, and H. G. Savage for information and help during various stages of this research.

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Taphonomy of the 1953 Bison Bonebed at the Milnesand Site

Matthew E. Hill, Jr. and Jack L. Hofman

The Milnesand site is a Paleoindian bison bonebed located on the southern edge of Sulphur Draw in Roosevelt County, New Mexico (Johnson et al. 1986; Sellards 1955; Warnica and Williamson 1968). First identified by Ted Williamson, the site was excavated in 1953 by E. H. Sellards. Through the efforts of Sellards and later work by James Warnica and Ted Williamson, a small collection of bison remains and a large assemblage of lithic artifacts including over 103 projectile points have been recovered from the site. This paper outlines the results of a recent taphonomic analysis of the bison remains

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to complement the recent fieldwork at the site by the Texas Tech Museum (Buchanan et al. 1996) and to increase what is known about the faunal assemblage from Milnesand (Drake 1994; Hill et al. 1994).

The faunal assemblage was analyzed at the Balcones Research Lab in Austin, Texas, in September of 1993. The collection consists of 180 bison bones collected during the 1953 excavations at the site (Sellards 1955). Seasonality estimates, based on three loose M_3, suggest an early-winter to spring mortality (0.7–1.1 years). Two M_3 have light wear on facets I-II, comparable to group 3 specimens from the Hawken site (Frison et al. 1976). A third M_3 has full wear across facets I-VIII, but only light wear on the hypoconulid. This is similar to group-5 material from the Garnsey (Wilson 1980) and Mill Iron sites (Todd et al. 1996). Multiple mortality events are possible; however, the small sample of teeth precludes testing this possibility.

Based on right astragali, at least 33 animals are represented in the collection. Other skeletal parts, however, are not equally represented. Well-represented elements include metacarpals (MNI = 6), calcanei (MNI = 6), humeri (MNI = 4); radii (MNI = 4), first phalanges (MNI = 4), and mandibles (MNI = 4). All other elements represent less than two animals.

Drake (1994) suggested that the skeletal inequality was the result of high-utility carcass parts being transported from a nearby kill. The present research suggests other possible explanations. A strong positive correlation ($r^s = 0.6$, $p = 0.004$, $n = 21$) between Kreutzer's (1992) volume density for bison bones and %MAU values suggests that density-mediated destruction was at least partially responsible for skeletal element frequency. Also, discussion with one the 1953 crew members (Holmes Semken, pers. comm. 1994) indicates that only large, identifiable bones were collected, while most fragmented bones were ignored. The high frequency of astragali probably relates both to Sellards's (1955:538) interest in the utilizing astragali for identifying bison species and to the density of this element.

Pupation chambers probably produced by the larvae of dermestid beetles (Martin and West 1995) were observed at or near the articular surfaces of 28 limb bones in the collection. Because dermestid larvae are extremely sensitive to light and require specific temperature and moisture conditions to survive, their presence has some important implications on site formation. First, dermestids generally occupy carrion exposed on the surface during warm weather which have been dead for one to two weeks. Second, to avoid direct exposure to sunlight, the larvae construct the pupation chambers in protected areas, such as those covered by hide or horn sheaths. To provide the necessary conditions for larval development, at least some of the Milnesand carcasses could not have been intensively butchered or otherwise disarticulated. Also, they had to remain in this largely intact state for approximately 42 days with average daily temperatures above 10 °C. This temperature range suggests that either the kill occurred during the later part of our seasonality estimate or the carcasses remained frozen through the winter and the dermestid activity occurred soon after they thawed in the spring.

Subaerial weathering data indicate that the bones did not remain exposed on the surface very long. Of the bones coded for maximum weathering, 97%

(n = 59) show evidence of limited weathering (i.e., Todd's [1987] Stage 1 and 2). Limited subaerial weathering, while not surprising given the selective recovery of only identifiable bones, does indicate that at least part of the bonebed was quickly buried and not exposed by later erosion (see Johnson et al. 1986).

The high number of usable projectile points recovered from the site suggests that something inhibited the hunters from recovering their weaponry following the kill. It is possible that dense packing of unused carcasses or the sandy substrate resulted in the high loss of points. Considering the biased collection techniques, the density-mediated attrition of faunal remains, and the large area (ca. 72 m^2) of exposed bones identified by Sellards,the actual number of animals killed at Milnesand was likely much higher than 33. Also, the presence of dermestid pupation chambers suggests that some of the carcasses remained articulated following abandonment.

Special thanks to Ernest Lundelius and Melissa C. Winsas and the staffs of the Texas Memorial Museum and Texas Archaeological Research Laboratory (Austin) for access to the Milnesand material. This research was supported by the Carroll D. Clark Fund of the Department of Anthropology at the University of Kansas. Thanks to Margaret Beck for her comments on this paper.

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Methods

Hunter-Gatherer Mating Distance and Early Paleoindian Social Mobility

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Given very low population densities, migrating early-Paleoindian hunter-gatherers had limited accessibility to eligible mates. In order to adapt to low-density mate distribution, two alternatives have been suggested: 1) band endogamy and consanguineous spousal relations (e.g., incest), with high mobility associated with residential and logistic travel (Hofman 1994; Kelly and Todd 1988; Meltzer 1995; Rogers and Rogers 1987:45-46); and 2) band exogamy and high levels of mate searching, social mobility and kin tie maintenance (Bamforth 1991; Hayden 1982; Hester and Grady 1977).

In order to test the hypothesis that long-distance travel by early Paleoindians was for social reasons, I compiled data on contemporary hunter-gatherers regarding distances between birthplaces of spouses, a measure of mating distance (Hewlett et al. 1982; Yellen and Harpending 1972). I hypothesize that as population density decreases, rather than turning to endogamous relations, hunter-gatherers seek exogamous ties, expand social networks, and increase mating distances (Jochim 1981:203). Specifically, I predict the following relationship: the lower the population density of a group, the larger the mating distance (Hewlett et al. 1986). Thus, the null hypothesis is that there is a low, fall-off point in population density, at which people must turn to endogamy. If no fall-off is observed among hunter-gatherers facing low population densities, we may infer that early-Paleoindian populations relied on exogamy to adapt to mate distribution.

Preliminary results support the original and reject the null hypothesis. As Figure 1 shows, as population density decreases, mean mating distance (an average of individual mating distances in a given population) increases at a disproportionate rate (as suggested by E. A. Smith, pers. comm. 1997). On a logarithmic scale, the correlation is very strong (r2 = 0.92). With population densities as low as .006/km2 (Gregg 1985), early Paleoindians would be on the upper left end of this figure.

Given these limited data, we can tentatively support the original hypothesis,

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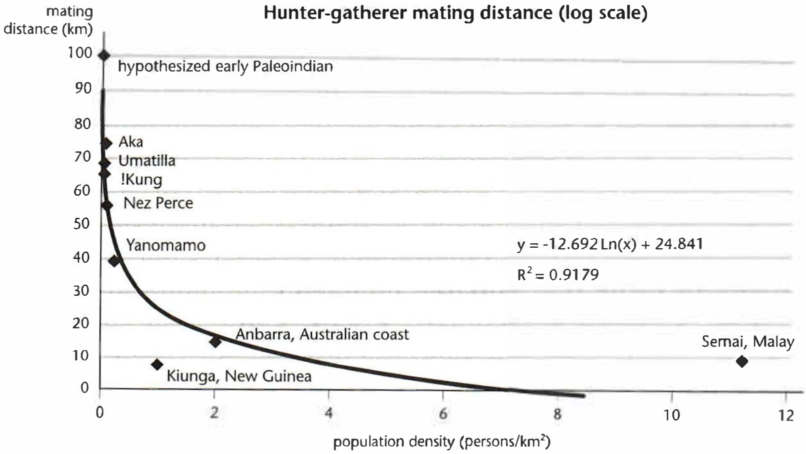

Figure 1. Relationship between hunter-gatherer mating distance and population density, with hypothesized early-Paleoindian values.

that, as a solution to mate distribution, early Paleoindians were exogamous and traveled extreme distances to find eligible mates. During such social mobility, early Paleoindians acquired exotic toolstones which they discarded at locations some 500–2,000 km from their geologic sources (Amick 1996; Tankersley 1991). Thus, social mobility is an important piece in the puzzle to explain long-distance movements of early Paleoindians in the Americas. For archaeologists, the challenge now is to identify criteria to distinguish between different types of mobility, whether it be residential, logistic or social.

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Paleoenvironments: Plants

New Evidence on the Environments Encountered by Paleoindians in Central and Eastern Beringia

Scott A. Elias

The reconstruction of Paleoindian lifeways in Beringia requires knowledge of the environmental setting in which they operated. In recent years, I have been piecing together paleoenvironmental reconstructions for various regions of central and eastern Beringia, using the results of fossil insect, pollen, and plant macrofossil studies conducted at the Institute of Arctic and Alpine Research, University of Colorado (INSTAAR). I am now in a position to summarize the paleoenvironmental reconstructions that my research team has compiled from these regions. The following summaries represent more than a decade of work by a number of researchers, as noted in the acknowledgments.

Bering Land Bridge Late-Wisconsin plant macrofossils, pollen, and insect fossils were sampled from cores taken from late-Pleistocene sediments on the Bering and Chukchi shelves (the central and northern sectors of the land bridge). These fossil data indicate that mesic shrub tundra environments were widespread on the land bridge, even during the last glacial maximum (Elias et al., 1996a). On the whole, the landscapes of the land bridge may have resembled the modern North Slope region of Alaska, dominated in many regions by shrub tundra vegetation. Contrary to previous hypotheses, we found no evidence of steppe tundra on the land bridge. The land bridge may have formed a band of more mesic shrub tundra in the center of Beringia, bounded by more arid, grassy, steppe-tundra regions in Siberia and Alaska. Megafaunal mammals (and presumably human hunters) used the land bridge to cross from Siberian to Alaska, but grazing on the land bridge itself may have been poor (Elias et al., 1997).

Our new accelerator mass spectrometer (AMS) ^{14}C dates on plant macrofossils show that much of the land bridge was above sea level and thus available for human and animal migration until after 11,000 yr B.P. This revised age of inundation of the land bridge is considerably younger than the previous estimate of 14,400 yr B.P. (McManus and Creager, 1984). Mutual climatic

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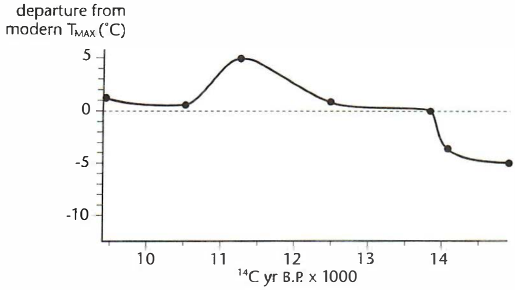

Figure 1. Calibrated mean July temperatures for eastern Beringia during the late glacial interval, derived from Mutual Climatic Range estimates from fossil beetle assemblages. To standardize for regional climatic differences, temperatures are shown as departures from modern mean July temperatures at study sites.

range (MCR) analysis of insect fossil assemblages from the youngest land bridge horizons indicates that mean July temperatures about 11,000 yr B.P. were substantially warmer than present (Elias et al., 1996a). According to the MCR results, mean July temperatures on the Bering shelf were 13 °C, compared with 10.8 °C modern mean July temperature at Nome (NOAA, 1982). On the Chukchi shelf, fossil insect assemblages between 11,300 and 11,000 yr B.P. yielded an estimated mean July temperature of 11 °C. The modern mean July temperature at Barrow, the nearest modern meteorological station, is only 4 °C. The interval of maximum postglacial insolation in the arctic region centered upon 11,000 yr B.P. (Berger, 1978).

The Paleoindians that first entered the New World lived in a time of rapidly changing environments that brought about ecological upheavals such as have not been seen again. Throughout western and northern Alaska, MCR estimates based on fossil insect assemblages indicate that mean summer temperatures reached modern levels as early as 13,750 yr B.P., then became warmer than modern until at least 9,700 yr B.P. (Figure 1). The exact timing of climatic changes within the late glacial interval remains unresolved for now, but the initial postglacial warming to modern levels may have taken place in only a few decades, as has been documented by fossil insect data from other parts of the Northern Hemisphere (Coope and Lemdahl, 1996; Elias et al., 1996b).

Despite the insect evidence for strong amelioration of summer temperatures in early postglacial times, coniferous forests were slow to spread across Eastern Beringia. Deciduous shrubs and small trees (first birch, then alder) spread relatively rapidly across broad regions, and groves of balsam poplar expanded on the North Slope (Nelson and Carter, 1987). Coniferous forests did not reach their modern range limits in western and southwestern Alaska until the mid-Holocene (Lamb and Edwards, 1988; Short et al., 1992). Hence, treeless landscapes dominated much of Eastern Beringia for thousands of years after deglaciation.

Much of the palynological data summarized in this paper is the work of Susan Short. Hilary Birks identified plant macrofossils from the Bering Land Bridge. Geologists Peter Lea (Bowdoin College) and Chris Waythomas (U. S. Geological Survey, Anchorage) collaborated on paleoenvironmental research in southwestern Alaska. Geologists Hans Nelson and Larry Phillips (U. S. Geological Survey, Menlo Park) collaborated on paleoenvironmental research on the Bering Land Bridge. Financial support for my Beringian research has come from grants from the National Science Foundation, DPP-8619310, DPP-8921807, and OPP-9223654.

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Paleoecological Inferences from Pollen, Algae, and Chrysophycophata in Pleistocene Sediments from Centennial Valley, Montana

James K. Huber and Christopher L. Hill

Strata on the west side of Centennial Valley in southwest Montana contain Pleistocene fossils (Dundas et al. 1996; Hill and Albanese 1996; Hill et al. 1995). Here we describe and provide a preliminary interpretation of microbiotics recovered from the Unit A-B-C stratigraphic sequence (cf. Albanese et al. 1995). In the exposure sampled for microbiotic materials, Unit A is a deposit c. 2 m thick of mostly light brownish gray muddy sand overlain by Unit B, a deposit 0.3–1.2 m thick of mostly dark silt containing higher amounts of organics. A mammoth tooth was recovered along the interface between Unit A and Unit B. Unit B is overlain by a sub-unit of Unit C consisting of massive

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light-gray silt c. 1.0–1.24 m thick with higher carbonate than Units A or B and lower organics than Unit B.

An estimate of the minimum age for this sequence is based on radiocarbon dates of collagen from bones incorporated into a debris flow which overlies these deposits. The bones in the debris flow date from about 25,000–19,000 yr B.P. (Hill and Albanese 1996). Several attempts have been made to directly date fossils recovered from Units A and B. Isolated bones of mammoth were recovered in 1996 from Unit A but have not been analyzed. Bones recovered in the uppermost part of Unit A or along the interface of Unit A and B apparently contain no dateable collagen based on analyses by Beta Analytic. There are two infinite dates on organics from Unit B and a finite date of about 36,500 yr B.P. (Hill and Albanese 1996). Thus it seems the sequence is relatively well constrained in terms of a minimum age but could in fact be too old to date using radiocarbon techniques.

Each of these stratigraphic units was analyzed for microbiotic paleoenvironmental indicators. In terms of pollen, quantity is very low, but the sequence shows a decreasing trend in the amount of trees along with an increase in the amount of herbs. If this trend is a potential signal indicating that the sequence reflects either a glacial-to-interglacial transition interval or an interglacial-to-glacial transition, it may be used to speculate on how long it took for at least the accumulation of sediments from the top of Unit A to the lower part of Unit C (perhaps 10,000 years?). This trend appears to be primarily a result of high amounts of *Pinus* (pine) in Unit A and high amounts of *Artemisia* (sagebrush, wormwood), *Tubuliflorae* (subfamily of *Compositae* [*Asteraceae*]), and *Ambrosia*-type (ragweed) in Unit C. The shrub *Salix* (willow) was found only in Unit C. There is also a general decrease in the percentage of indeterminable degraded pollen grains. This could be related to changing sedimentological conditions and may be a taphonomic indicator reflecting possible redeposition of some microbotanical remains.

There were no aquatics found in the Unit A sediments. *Isoetes macrospora* (quillwort), *Polygonum lapathifolium*-type (knotweed) and *Sagittaria* (arrowhead) were recovered from organic-rich Unit B sediments. *Potamogeton* (pondweed) was the only aquatic found in Unit C.

There are several trends within the algae. As with tree pollen, there is a general decline in *Zygnema*-type (spore). There are relatively higher amounts of species of *Pediastrum* in Unit C.

Chrysophytes are present in extreme abundance throughout the sequence. They are slightly higher in Unit B, which also contains the fungus *Gaeumannomyces* cf. *caricis*. This deposit also contains several unique aquatics and algae. Aquatics found in Unit B are *Isoetes macrospora*, *Polygonum lapathifolium*-type, and *Sagittaria*. In terms of algae, *Mougeotia* (zygospore), and *Scenedesmus* are found only in Unit B. The only pollen unique to Unit B is *Rosaceae* (Rose family).

Some preliminary paleoecologic inferences can be proposed, although the likelihood that taphonomic circumstances have prevailed which may have introduced pre-Quaternary materials into the assemblages needs to be kept in mind. An open conifer parkland may be indicated by the presence of *Picea* (spruce), *Pinus* and *Cupressaceae* (cedar) and the open ground plants *Artemisia, Tubuliflorae, Ambrosia*-type, *Cyperaceae* (sedge), *Graminae* (grass), *Pteridium*-type (bracken fern), and *Dryopteris*-type (shield fern). The presence of the fungal hypodia of *Gaeumannomyces* cf. *caricis* may be an indication for a local origin of sedge in Unit B. Van Geel (1986) has reported a correlation between the presence of this fungi and the local appearance of *Cyperaceae* in peat, which would mean that the *Cyperaceae* pollen is probably from a local source. Within the algae, the presence of *Zygnema* in all three units and *Mougeotia* in Unit B is indicative of shallow and more or less mesotrophic habitats (Van Geel 1978). Decreasing relative frequencies of these algae along with an increase in *Pediastrum Boryanum* (an indicator of lake eutrophication) may suggest an increase in nutrient influx within the basin through time. The decrease in *Chrysophytes* may be related to changing depositional environments reflected in the relatively higher carbonate content of Unit C. These paleobiotic indicators, along with chronologic, stratigraphic, and vertebrate studies, contribute to an understanding of pre-Last Glacial Maximum environments in Centennial Valley.

Fieldwork in Centennial Valley between 1994 and 1996 was conducted by the Museum of the Rockies' Ice Age Research Program partially with funds provided by the United States Bureau of Land Management, the Kokopelli Archaeological Research Fund (Museum of the Rockies, Montana State University, L. B. Davis, director), and a MONTS-EPSCoR grant (to Hill). Interpretation of the Centennial Valley biostratigraphy has benefited from discussions or communication with Mark Sant, Robert Bump, John Albanese, David Batten, Robert Dundas, Cathy Whitlock, and Eric Grimm.

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The Environmental Changes of Gorny Altai (Western Siberia) during the Mousterian/ Late-Paleolithic Transition: Data from Kara-Bom Site Section

S. A. Laukhin

The Kara-Bom site is located in western Siberia about 3,200 km east-southeast from Moscow (85° 20′ E 50° 40′ N). The site is situated in the intermountain depression of a mid-level elevation of mountains in the Ursul River basin at the junction of the Semisaret and Kaierlyk rivers. The depression bottom at 1,000–1,200 m AMSL is at present covered by steppe vegetation. Upslope, on surrounding mountains, Siberian cedar and trees with leaves that are shed every year (deciduous forests) extend to 1,900 m AMSL. Above this level, alpine meadows are found.

The Kara-Bom section is on a deluvial-proluvial apron. The description of the section, including analysis of radiocarbon-dated artifacts, is published in Derevianko et al. (1990, 1993). While investigating the section the author collected samples for palynological analysis from layers 5–9, which include the cultural levels from Mousterian (in layer 9) to late Paleolithic (in layer 5). The cultural level in layer 5 is dated to 38,080 ± 910 and 30,990 ± 460 yr B.P. by ^{14}C, and to 33 Ka by USR. The most realistic estimate of the age of layer 5 (late Paleolithic) is 33–34 Ka, corresponding to the Malokheting warming (Kind 1974) of the middle Wurm (Wisconsin). According to Derevianko et al. (1993, p. 7), the transition Mousterian to late Paleolithic occurred c. 43 Ka during layer-6 sedimentation (43,200 ± 1,500, 43,300 ± 1,600 yr B.P.). Therefore the layers analyzed for pollen include the Mousterian, the transition from Mousterian to late Paleolithic, and the beginning of the late Paleolithic.

Pollen analysis of 52 samples was completed by E. M. Malaeva; pollen and spore counts ranged from 400 to 800 grains/sample. Since space limitations prevent publication of the full diagram, we here use a condensed version (Figure 1) showing only the basic changes in vegetation and climate that can be reconstructed from this diagram.

The 52 spectra are characteristic of steppe vegetation of the region. Even if the *Chicoriaceae* (frequently more than 50% in each spectrum) are excluded from the pollen sum, pollen of trees and shrubs compose usually less than 30%; only in the deepest part of the section do they reach 50–60%. At that time, the forests covered the mountain slopes and spread along the valley of the Paleo-Semisaret River.

The palynozones are grouped from bottom to top in zones P1–P14. The change in composition of trees and shrubs offers significant information. There are stable frequencies of *Pinus sibirica,* which is not presently found in

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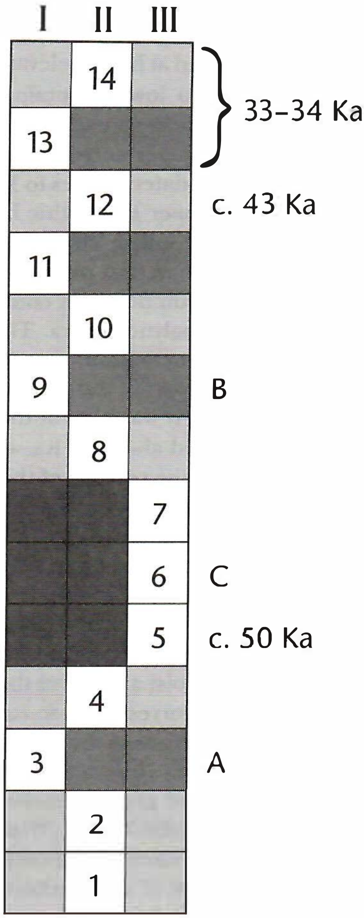

Figure 1. Changes in moisture in time of layers 9–4 accumulation of Kara-Bom section. Stages: **I,** relatively moist; **II,** transitional; **III,** relatively dry. Optimums: **A, B,** moist; **C,** warming. 1–14: numbers of palynozones.

this depression or on the slopes of the surrounding mountains, but which is well known in the low elevations of the Altaian mountains to the north. Other paleo-dendroflora include taxa located in areas removed from central Altai or even Siberia: *Tilia* cf. *sibirica, Corylus* cf. *avellana, Ulmus* cf. *laevis, Acer* sp., *Alnus* cf. *glutinosa, Betula sect. Costatae, Juglans* cf. *manshurica, Picea* sp. (exot.), *Betula* sp. (exot.), *Corylus* sp. (exot.). Upwards in the section, some taxa disappear: *Picea* sp. (exot.) and *Juglans* cf. *manshurica* in P4, *Betula* sp. (exot.) in P7, and finally, *Corylus* sp. (exot.) and *Betula* sect. *Costatae* in P12.

The distribution of pollen in palynozones shows paleoclimatic rhythms (Figure 1), alternating primarily between zones with conifer tree taxa and zone dominate *Betula* sect. *Albae.* P6, an apparent exception, contains the most complete conifer tree assemblage including *Picea, Pinus sibirica,* and *Abies.* None of P3 zone taxa is present in zones P1, P2, P4, P8, P12, and P14. The vegetation was changing in response to the influence of humidity and warming. The biggest increase in moisture was at level P3; the smallest at level P9; and weak impulses of moisture occurred at levels P11 and P13. At times of moisture increase, dark coniferous taiga expanded at higher elevations. Mixed forests with added broad-leaved taxa moved to low mountain slopes and foothills. In times of declining moisture, birch forests spread and broad-leaved taxa migrated to mid-mountain elevations. Dry stages were mostly warm.

The upper part of the diagram, according ^{14}C dates, relates to Malokhetian warming. The transition from Mousterian to upper Paleolithic happened at the very beginning of this warming. The cooling that preceded the Malokhetian warming may correspond to P9, the wettest period in the upper part of the section. The remainder of the diagram does not contain cooling traces but characterizes successive changes in palynospectra. This does not allow us to suppose a long interruption in sedimentation, corresponding to the early Wurm (Wisconsin). Probably the lower part of the section, which has been analyzed by palynology, is related to the early warming of the beginning of middle Wurm. In that case, layer 9 was formed about 50 Ka, and the USR date of 62.2 Ka in layer 9 does not correspond to the real age of the sediments. A. P. Derevianko et al. (1993, p.6) also relate layers 9–4 to interglacial about 50–25 Ka, concurring that the USR date is older than reality. They consider that early-Wurmian cooling corresponds only to the lower part of layer 10. The palynospectra of periglacial vegetation are already studied there and in layer 11, where there is a USR date of 72.2 Ka (Derevianko et al. 1993).

Therefore the transition from Mousterian to upper Paleolithic in Gorny Altai came true in conditions of climate more moist and warm than now. It is interesting that the middle-Wurmian optimum corresponds to early warming of one (c. 50 Ka) in the middle mountains of Altai, as in the extreme north of western Siberia (Arkhipov 1990), in middle Siberia (Isaeva et al. 1986), and in northeastern Asia (Laukhin 1993). The stage of greatest moisture at Altai preceded the warm optimum. Probably the middle Wurm (Wisconsin) produced different climates in different parts of the Northern Hemisphere: in the Arcto-Pacific region (including the northernmost of the southern mountains of western Siberia) climate was interglacial, and in the Atlantic region (including most parts of western Siberia) it was interstadial.

The author thanks Academician A. P. Derevianko for making available facilities during Kara-Bom section field investigation, and Dr. Linda C. K. Shane for detailed discussions and helpful comments on this paper; he also thanks Dr. E. M. Malaeva for conducting palynological analysis of author's samples and for discussing the results of these analyses.

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Did the Argentine Pampean Ecosystem Exist in the Pleistocene?

Eduardo P. Tonni and Alberto L. Cione

The Pampa is an extended prairie lowland with a southern highland area in central eastern Argentina. The climate is temperate and wet (c_f in Köppen's climatic regions). The Pampean grassland encompasses the phenetic Zoogeographic Pampasic Dominion (Figure 1A; Ringuelet 1961). Remarkably, this dominion is almost characterized by negative evidence because there are no specific endemic species and only a few subspecies are endemic to the area. Most mammal and bird species (and all the fishes) are subtropical (Tonni 1990). The boundaries include an ecotone with the Central and Patagonian Dominions (drier and colder).

Current research in Pleistocene and Holocene rocks is providing valuable geological and paleontological information for understanding the dramatic environmental and faunistic changes in the area.

The climate was more arid than today during almost all the Pleistocene. The terrestrial fauna of the Pampean Pleistocene includes abundant and diverse large extinct mammals, many of them weighing over a ton, including species of the toxodont (*Toxodon*) and the ground sloth (*Megatherium*), and a variety of living and extinct species including the tuco tuco (*Ctenomys* spp.) and the saber-toothed tiger (*Smilodon populator*).

During the early Pleistocene (most of the Ensenadan) the climate was for the most part warmer than today (Tonni and Cione 1995). Several intertropical, not necessarily wetland, mammals inhabited the area. They included *Tapirus*, the echimid *Clyomys*, extinct procyonids, and some Patagonian taxa. Such associations with no modern analogues have also been documented in North America but only during the late Pleistocene (see Graham et al. 1996).

The prevailing weather was mostly colder than today and much more arid during the late Pleistocene (latest Ensenadan and Lujanian). Extensive sand fields and dry steppe developed in the area. We have good vertebrate record for the Last Glacial Maximum (c. 20,000 years ago). Until the beginning of the Holocene, the large ungulates and edentates and wide-ranging species shared the ecospace mostly with Patagonian and Central extant mammal and bird

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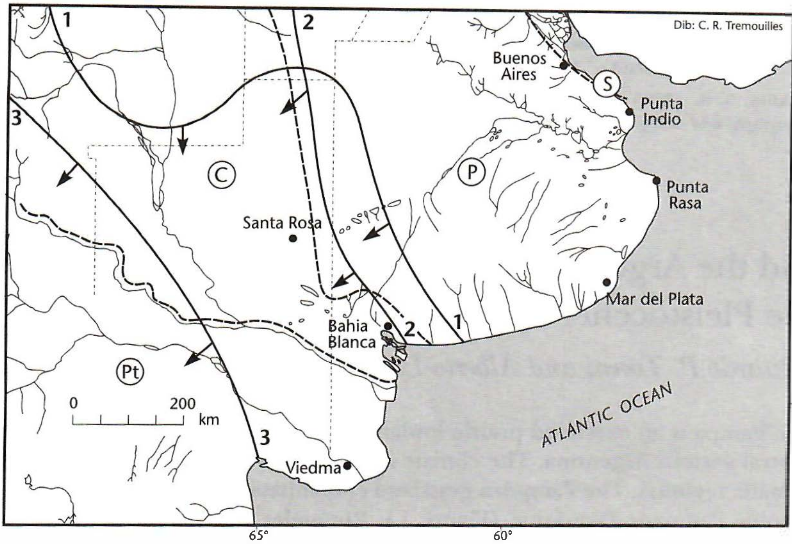
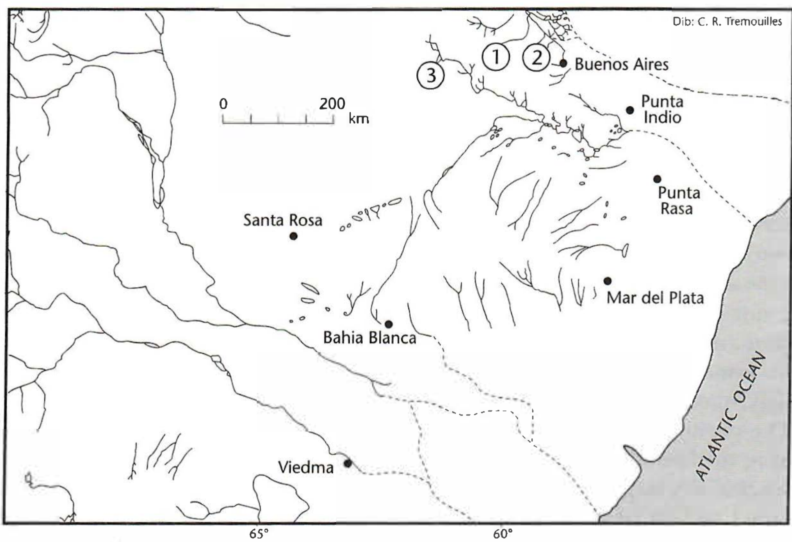


Figure 1. Maps depicting central eastern Argentina. **A,** present day. Zoogeographic Dominions (Ringuelet 1961): **S,** Subtropical; **P,** Pampean; **C,** Central; **Pt,** Patagonian. Northeastern boundaries of distribution of **1,** *Zaedyus;* **2,** *Microcavia;* **3,** *Lestodelphys.* **B,** during the Last Glacial Maximum. The coast was defined at 120 m below present sea level. The river courses under sea level are highly speculative. Note the occurrences of *Zaedyus, Microcavia,* and *Lestodelphys* outside the present range (Tonni and Cione 1995).



species. No subtropical mammal is known for the late Pleistocene, and the fauna was similar to that of present-day northern Patagonia, with the addition of the extinct mammals.

In summary, during the Pleistocene, the present Pampean ecosystem did not exist in the area or elsewhere. The modern climate of the Pampa appears to have been established very recently, probably c. 1,000 yr B.P. This would explain the low endemism in the area. The differences observed between the late Pleistocene and present biocenoses are the result of migrations provoked by climatic changes, of megamammal extinction in the latest Pleistocene-early Holocene, and of recent human activities.

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Paleoenvironments: Vertebrates

A Record of Late-Pleistocene Stout-legged Llama, *Palaeolama Mirifica* Simpson, in Tennessee

Emanuel Breitburg and John B. Broster

In 1965, the Donelson Site (40Dv183) was excavated by Philbrick Crouch, the Director of the Nashville Children's Museum. Located 0.4 miles south of the Stones River in the eastern part of Davidson County, the site contained commingled mastodon (*Mammut americanum*), horse (*Equus* spp.), Key deer (*Odocoileus virginianus* cf. *clavium*), and camelid skeletons. Although the excavators left a scant record of investigation, the bone deposit clearly represents a late-Pleistocene faunal assemblage. The partial camelid skeleton is of particular interest. The specimen was initially identified to the llama-like genus *Camelops*. However, Webb's (1974:207) study of Florida *Palaeolama* concluded the genus did not range to eastern North America and found all claims of *Camelops* to be *Palaeolama*. Since then, *Camelops* has been reported to occur in the Central Basin of the Interior Low Plateau (cf. Corgan and Breitburg 1996:43). Indeed, Webb (1981) eventually made a positive identification of Camelops on a left maxillary third molar taken from Jaguar Cave, Fentress County, Tennessee (Robbins et al. 1981:377). To wit, the range of Camelops east of the Mississippi River, and Palaeolama north of Florida and west-central Alabama (Muto and Gunn 1985), remains puzzling. In this study we evaluate the Donelson-site camelid by examining dental and postcranial element size using multivariate and bivariate statistical procedures.

Our analysis of principal components includes assessment of the length and breadth of the mandibular first, second, and third molars. The same dental measures are compared with the following species of two *Camelinae* tribes: *Camelopini, Camelops hesternus* and *Megatylopus matthewi* (Webb 1965:43,50); and Lamini, Bolivian *Palaeolama weddelli* and sympatric Florida *P. mirifica* and *Hemiauchenia macrocephala* (Webb 1974:180, 187, 190). Figure 1 shows odontometric affinity between the Tennessee camelid and Florida *P. mirifica*, slightly less affinity with *P. weddelli,* and no affinity with *C. hesternus, M. matthewi*, and *H. macrocephala*. A bivariate plot of metatarsal log length and distal width fits well within the range of Palaeolama from Peru, Bolivia,

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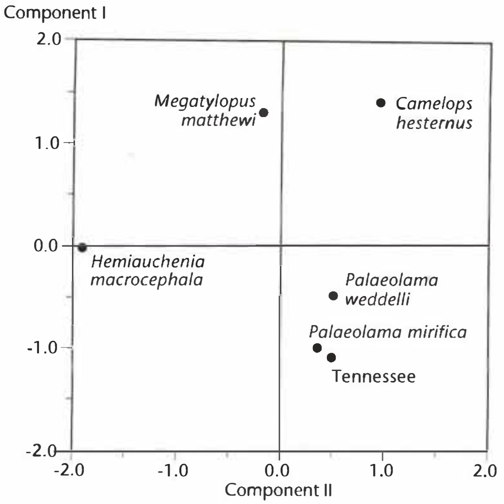

Figure 1. Principal components plot of mandibular molar dimensions for the Tennessee camelid, *Camelopini* and *Lamini*.

Ecuador, and Florida. Consequently, statistical results favor the identification of the Tennessee specimen as *P. mirifica*.

The presence of stout-legged llama in Tennessee extends the range of the species further north and east than has been known previously. Along with the first record of *P. mirifica* from the midcontinent in southern Missouri (Graham 1990; 1992), further discoveries should provide greater insight into the range, timing and nature of North American late-Pleistocene *Palaeolama* radiation.

The Nashville Children's Museum evolved to become the Cumberland Museum and Science Center where the Donelson Site specimens are housed today. In 1979, Dr. Clayton E. Ray, Smithsonian Institution, identified the Key deer remains for Mary Thieme, then Curator of Collections.

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New Record for the Flamingo (*Phoenicopterus* cf. *P. Ruber* Linnaeus) from Pleistocene-Holocene Transition Sediments in México

Eduardo Corona-M. and Joaquín Arroyo-Cabrales

In August 1996, scientific excavations were conducted in the town of Tocuila, Municipality of Texcoco, State of México, by personnel of the Universidad Autónoma de Chapingo and the Instituto Nacional de Antropología e Historia (INAH), directed by archaeologist Luis Morett and Joaquín Arroyo. Excavations were undertaken in conjunction with discovery of a mammoth skull found while digging a septic pit. More than 700 bones were obtained, most pertaining to several mammoth individuals (*Mammuthus columbi*). Two bones were identified by this senior author as pertaining to flamingo, *Phoenicopterus* cf. *P. ruber.*

These identified bones are a humerus fragment and a proximal portion of a scapula; their size is similar to those elements from skeletons of recent animals deposited in the comparative osteological collection of the Paleozoology Lab, INAH. The cranial breadth of the scapula is 16.5 mm; the greatest length is 76.2 mm (incomplete). The breadth of the proximal end of the humerus is 36.6 mm; the smallest breadth of the corpus is 12.7 mm; the greatest length is 151.9 mm (incomplete). (All measurements after Von den Driesch, 1976.)

The importance of this record is the availability of dates for stratigraphically associated sediments, since both bones were obtained in strata overlying those where mammoth bones were found, which were recently dated c. 11,300 yr B.P. using conventional ^{14}C radiocarbon techniques (De los Ríos-Paredes, 1997). This evidence supports the hypothesis that the flamingo was a species present, perhaps in the process of extinction, in central México at the beginning of the Holocene.

The flamingo is a bird species with few previous fossil records from México. Four locality records are available:

Taxon	*Phoenicopterus stocki* Miller
Locality	Valle del Río Papigochic, Chihuahua.
Date	Middle Pliocene (Hemphillian)
Author	Miller, 1944. Holotype in Los Angeles County Museum of Natural History.

Taxon	*Phoenicopterus copei* Shufeldt
Locality	Chimalhuacán, State of México.
Date	Late Pleistocene
Author	Brodkorb and Phillips, 1973. Specimen on deposit at the Paleozoology Lab, INAH.

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Taxon	*Phoenicopterus* cf. *P. ruber* Linneaeus
Locality	2 km north of Chapala, Jalisco.
Date	Late Pliocene–early Pleistocene (Blancan)
Author	Howard, 1969; specimen on deposit at Los Angeles County Museum of Natural History.

Taxon	*Phoenicopterus* sp. Linnaeus
Locality	Laguna de San Marcos deposits, Jalisco.
Date	Late Pleistocene
Author	Howard, 1969; specimen on deposit at Los Angeles County Museum of Natural History.

The above list shows the diversity of names assigned in the genus, but not the phylogenetic relationships among the different taxa. For this reason, we prefer to make a tentative identification and await future comparative studies of the fossil specimens of the genus *Phoenicopterus* here reported.

This study concludes that the genus *Phoenicopterus* was present in central México from the Pliocene to the Pleistocene-Holocene transition. Review of names and descriptions is necessary to clarify the phylogenetic and biogeographical relationships of these different taxa.

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Preliminary Zooarchaeological Results at Agua de la Cueva–Sector Sur Shelter

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Late-Pleistocene/early-Holocene human occupations have been identified at Agua de la Cueva–Sector Sur site (69° 09′ 49″ W 32° 37′ 01″ S; 2,900 m.a.s.l) (García 1992, 1996). These archaeological remains have been recovered in stratum 2b (c. 11,000–9,000 yr B.P.) and stratum 2c (c. 9,000–7,500 yr B.P.) (García 1996). In this paper we describe the archaeofaunal assemblages of these strata.

The zooarchaeological sample analyzed is composed of 2,034 specimens of archaeofaunistic evidence recovered from both strata. The specimens are highly fragmented and moderately weathered. Table 1 lists the taxonomy and quantity of the specimens.

Table 1. Specimens from Agua de la Cueva–Sector Sur Shelter. Abundance in NISP; x = present.

Specimen	Stratum 2b	Stratum 2c
unidentifiable	215	40
large Aves (indet.)	–	1
Rheidae (indet.)	1	–
mammal (indet.)	106	8
large mammal (indet.)	608	35
Artiodactyla (indet.)	50	–
Lama sp. (indet.)	626	53
Lama (*Vicugna* sp.)	16	–
Lama guanicoe	250	10
Chaetophractus vellerosus	2	–
Lagidium sp.	13	–
Rodentia	x	x

The results indicate a predominance of camelids. The presence of taxa such as *rheidae, rodentia, Lagidium* sp. and *Chaetophractus vellerosus* is much lower by comparison. *Lama* sp., *Lama guanicoe* and *Lama* (*Vicugna* sp.) are the most abundant, but the latter is remarkably less common and restricted to stratum 2b. The subgenus *Lama* (*Vicugna*) includes the species *Lama* (*Vicugna gracilis*) and *Lama* (*Vicugna vicugna*) (Menegaz et al. 1989). According to the present information, *Lama* (*Vicugna gracilis*) became extinct during the early Holocene, as evidenced in the archaeological sites of Pampa and Patagonia (Menegáz et al. 1989; Menegáz et al. 1995). By contrast, *Lama* (*Vicugna vicugna*) is currently distributed all through the Andean highlands up to San

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Juan province, north of Agua de La Cueva site. The studied remains, corresponding to this subgenus, could not be determined at the specific level (Neme and Gil 1996).

Although the zooarchaeological records in both strata are similar, there are two clear differences: the presence of *Lama* (*Vicugna*) exclusively in stratum 2b, and the difference in the relative quantities of specimens in the two strata. Stratum 2b contains more specimens than stratum 2c, even though both represent approximately similar time periods (Table 1).

It can be inferred that around 11,000 years ago the inhabitants of the site depended primarily on fauna that are still extant, though *Lama* (*Vicugna gracilis*) could be an exception). This dependence is particularly clear in occupations of the highest Precordilleran level (2,500–3,000 m.a.s.l). The exploitation of other taxa in addition to *Lama* sp. was of very low intensity; for example, *Lagidium* sp. was not exploited on a regular basis, although it was an abundant and highly predictable resource. This fact distinguishes this site from other South American occupations found at the same elevation (Mengoni 1986). A similar situation is observed for *Chaetophractus vellerosus*. Finally, birds were occasionally exploited but were not a significant food source for the people who inhabited the area.

We would like to thank CONICET and CIUNC for financial support; Laura Miotti, José Luis Prado and Adriana Menegáz, who contributed to the identification of *Lama* (*Vicugna*); and Rossi, who helped with rodent and *Chaetophractus vellerosus* identification. This paper was improved by critical readings and suggestions from Gustavo Politis, Humberto Lagiglia, Laura Miotti and Marcelo Zárate. Miguel Giardina helped with the curation of the collection. And finally, we would like to thank María Gutierrez and Nora Fleghenheimer for the English version of this paper.

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Late-Pleistocene Camel (*Camelops hesternus*) from Central Nevada

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Fossil remains of Yesterday's camel, *Camelops hesternus* (Leidy, 1873), have been recovered from nearly two dozen late-Pleistocene localities in the Great Basin (summarized in Grayson 1993: Table 7-1, Figure 7-1; see also Currey and James 1982:35–36; Dansie et al. 1988; Graham and Lundelius 1994:436–437, 638; Grayson 1982, 1985:154; James 1981: Table 6; Kurten and Anderson 1980:305–306, Figure 15.4). A good proportion of these Rancholabrean camelids are from localities around the margins of what was once Pleistocene Lake Lahontan and Bonneville in the western and eastern Great Basin, respectively. Further, many of the specimens have been found within the past few decades, for even in the mid-1980s Grayson (1985:154) could state that he had reported the fifth published record of camel from Nevada. Although large-headed llama (*Hemiauchenia* sp.) was mentioned from a late-Pleistocene context in Mineral Hill Cave, central Nevada (McGuire 1980) and a brief account of camel (*C.* cf. *hesternus*) from eastern Nevada was recently published (Jones et al. 1996), it appears that no specimens from the central portion of the state have been described.

The author recovered several *Camelops hesternus* elements at the north end of Grass Valley in Lander County, central Nevada, during two brief visits to the area in 1983 (designated as locality 26P-LA9 in the Nevada State Museum [NSM] paleontological numbering system). The bone fragments were eroding from sediments of Pleistocene Lake Gilbert in a badlands area at 5,660 feet elevation about 400 m northwest of the existing playa. A deposit of Mazama ash (J. O. Davis Locality No. 181), a chronostratigraphic marker in the Great Basin dating around 7,000 yr B.P., was observed in an exposure about 150 m northeast of the fossil locality. Based on the stratigraphic position of the fossils, which were a few meters lower relative to the volcanic ash layer, the camel is estimated to date between 12,000 and 20,000 years ago.

With regard to taphonomy, although bone preservation was good, the Grass Valley camel remains that had been exposed were fragmented into numerous small pieces 2–3 cm in length. All the fragmentation was the result of post-depositional breakage due to disintegration as the camel elements were exposed on the ground surface. Refitting of seven fragments resulted in only one identifiable element, a left astragalus. Thirty-three other small articular surfaces and diaphysis fragments were refit, but none could be identified to element, with the exception of a possible ectocuneiform. Based on the refit fragments, a single immature camel appears to be represented. No butchering marks were observed on the fragments. Root etching was visible on various specimens. Two small fragments of articular surfaces exhibited punctures and pitting representative of carnivore gnawing.

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Identification of the left astragalus as *C. hesternus* was based on comparison with a specimen from Rye Patch Reservoir, Nevada (26P-Pe22; right astragalus, NSM Occ 64), as well as comparisons with published data for specimens from Rancho La Brea in Los Angeles, California (Webb 1965:Table 12). Measurements of the Grass Valley astragalus are as follows: lateral length incomplete; medial length 77.9 mm; minimum length 63.7 mm; proximal width 57.9 mm; distal width incomplete. These measurements compared favorably with the Rye Patch specimen (author's measurements) and the range of specimens from Rancho La Brea (Webb 1965:Table 12).

Although some researchers have suggested the procurement of *Camelops* by Paleoindians in North America (e.g., Frison et al. 1978), most such evidence points to non-cultural processes (Haynes 1988; Haynes and Stanford 1984). No artifacts or cultural features were observed in or near the Grass Valley camel. Given the taphonomic observations noted above, this camelid appears to have been an immature animal that died of natural causes at the margins of Pleistocene Lake Gilbert. Carnivores could either have preyed on this immature animal or scavenged the carcass.

I thank Kathy Pedrick and Evy Seelinger for assisting with the test excavation; Bob Elston for use of equipment and facilities at the Gund Ranch; Don Tuohy and Amy Dansie for access to the Nevada State Museum comparative specimens; and the late Jonathan Davis and the late Keith Katzer for geomorphological observations.

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Pleistocene Giant Beaver (*Castoroides ohioensis*) from the Hiscock Site, Western New York State

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Remains of the North American giant beaver *(Castoroides ohioensis)* occur in Blancan to Rancholabrean deposits from Alaska south to Florida, and from Nebraska to the East Coast. The greatest concentration of material is in Illinois and Indiana (Kurten and Anderson 1980).

In New York, Hartnagel and Bishop (1922) report *Castoroides* at Clyde in Wayne Co., midway between Rochester and Syracuse; and at Lenox in Madison Co., between Syracuse and Utica. A third occurrence is at the Dutchess Quarry Caves in Orange County, in the southeast corner of the state, from which a molar was dated to 11,670 ± 70 yr B.P. (Funk and Steadman 1994).

A new western New York occurrence of *Castoroides* has recently come to light with the recognition of an upper right incisor in the collection of the Buffalo Museum of Science (catalogue no. E27100). In 1996, one of the authors (RSL) noticed the specimen in an unlabeled box with the tip of a premaxillary proboscidean tusk. Both specimens appear similar to Pleistocene fossils from the Hiscock Site in northeastern Genesee Co., New York (Laub et al., 1988). This site was first probed in 1959 by the Buffalo Museum of Science, and a large assemblage of Pleistocene and Holocene bones was brought to that institution for conservation and study. Because no agreement was reached to transfer title of the material to the museum, it was returned to the landowner. The specimens remained in his possession until 1982, when he agreed to donate them to the museum and granted permission for the site to be excavated.

At the time of the 1959 reconnaissance, the late Carol A. Heubusch was curator of geology at the Buffalo Museum of Science. Several years after the museum began excavation of the Hiscock Site, she mentioned to RSL that a

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tooth of the giant beaver had been found during that initial survey. A search of the material returned to the museum failed, however, to produce this specimen.

When the *Castoroides* tooth was found in the museum collection, it was suspected of being the item described by Heubusch. This suspicion was strengthened when the tusk tip found with it was recognized in a photograph taken at the 1959 reconnaissance. Another photograph showed what may have been the tooth, but the resolution was too poor to be certain.

To test the hypothesis that the tooth came from the Hiscock Site, sediment was removed from the pulp cavity and analyzed for pollen by one of the authors (JHM). The prominent components were *Picea, Pinus, Cyperaceae, Gramineae,* long-spine *Compositae,* and *Rosaceae.* The pollen profile matches that for the Pleistocene horizon of the Hiscock Site as developed by Miller (1988), and is unlike that of any other known Pleistocene assemblage known to JHM. It is therefore concluded that this specimen is from the Hiscock Site.

The specimen's mesio-distal and bucco-lingual diameters are both 2.5 cm. The pulp cavity is 4 cm deep, with an internal diameter of 1.6 cm at its aperture. Although the crown end of the incisor is broken off and the root end worn, the tooth's axial length (14 cm) and the fact that it curves through nearly 90 degrees of arc suggest that very little is missing. A striated enamel band is well preserved.

This *Castoroides* specimen is from an extensively (but by no means exhaustively) explored site. During the late Pleistocene, Hiscock was a depression containing a number of spring-fed pools whose water level fluctuated. Postglacial lake Tcakowageh and/or its wetlands lay within two miles of the site (Muller and Calkin 1988). The Pleistocene component of the Hiscock basin includes bones predominantly of American mastodon, with much smaller contributions from caribou, stag-moose and California condor. Many of the bones appear to have been heavily gnawed, but despite a report of Missouri mastodon teeth possibly chewed by *Castoroides* (Saunders 1977), no evidence of such activity by this species has been recognized yet at Hiscock. There is ample documentation that humans frequented the site at this time, and that they manipulated some of the bones deposited here (Laub 1994; Laub, Tomenchuk and Storck 1996; Tomenchuk and Laub 1995). The possibility that the *Castoroides* tooth owes its presence at Hiscock to human agencies rather than the animal's habitat preferences must be considered.

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Climate and Muskrats at Lubbock Lake

Patrick Lewis and Eileen Johnson

Lubbock Lake Landmark is a well-stratified late-Quaternary site in Yellowhouse Draw on the Southern High Plains of Texas. Muskrats (*Ondatra zibethicus*) were prevalent at Lubbock Lake in the late Pleistocene and early Holocene, but declined as the paleoenvironment became warmer and drier and surface water became less available. By 9,000 yr B.P., muskrats were no longer present; they do not inhabit the Southern High Plains today (Davis and Schmidly 1994; Johnson 1987).

Four muskrat populations are found in four substrata; 1B, dating to approximately 11,100 B.P.; 2A, 10,800–10,200 yr B.P.; 2B cienega, c. 10,000 yr B.P.; and upper 2B, c. 9,500–8,600 yr B.P. (Johnson and Holiday 1989). Stratum 1 represents a cool and humid climate in which a meandering stream dominated the environment. As the climate warmed and dried, the stream gave way to a marsh environment. In substrata 2A and 2B, the climate continued to become warmer and drier, and the freshwater marsh became shallower and eventually turned brackish (Johnson 1987).

Research is underway to study possible microevolution in the muskrats due to climatic and environmental changes. This research focuses on adaptation of the lower first molar in response to changes in temperature and precipitation (Nelson and Semken 1970). The adaptation can be quantified in the length:width ratio of the lower first molar. Muskrats from northern climates

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exhibit a larger ratio than do those in southern climates (Nelson and Semken 1970; Semken 1966). This pattern is found in both recent and fossil populations as they adapted to the warming environment.

Initial findings with the Lubbock Lake populations agree with what the model predicts (Nelson and Semken 1970). The ratio for the oldest population of muskrats, those living in the cool climate, is significantly higher than for populations from subsequent substrata. Successive substrata show this movement toward a smaller, warmer ratio. The ratio of the substratum 1B muskrats appears intermediate to those of fossil muskrat populations of the Wisconsin period and modern muskrats from Michigan (Figure 1). The substratum 2A ratio is near the ratio found in recent muskrat populations from Michigan. This trend continues, with both of the 2B populations bearing a close correlation to recent muskrats from Alabama and central Texas. (Nelson and Semken 1970).

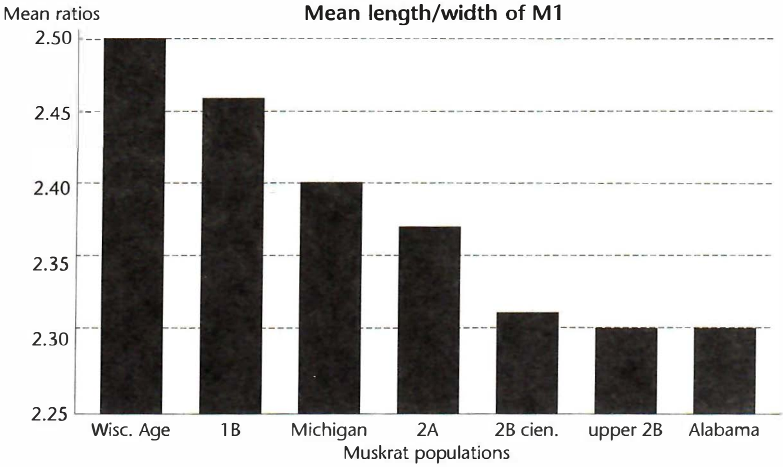

Figure 1. M_1 ratios of muskrat populations from the Wisconsin period, modern Michigan and Alabama, and the four Lubbock Lake populations.

These initial results from the study of the Lubbock Lake muskrat populations provide independent paleoclimatic data that support previous interpretations (Johnson 1987). To increase the database and further test this working hypothesis, finer measurements of the M_1, more sophisticated statistical analyses, and further comparisons with modern subspecies are underway. This continued research should determine the relatedness of the Lubbock Lake populations to each other and to modern subspecies, and establish more conclusively their adaptive response to the changing climate of the late Pleistocene and early Holocene.

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Prehistoric Dental Abnormalities in *Microtus* cf. *pennsylvanicus* of Eastern Washington

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Evolution of the dentition of voles of the genus *Microtus* is an important topic in Quaternary science (e.g., Barnosky 1990 and references therein). Distinguishing instances of selection-driven change from instances of drift and individual anomalies is critical in such endeavors. Part of the procedure for making such distinctions consists of placing fossil specimens in their proper time—space contexts and describing critical dental attributes (e.g., Guilday 1982). In this paper I describe a specimen of the meadow vole (*Microtus* cf. *pennsylvanicus)* recovered from Holocene sediments in eastern Washington state that displays unique dental attributes.

Lamona Rockshelter (45LI150) is 24 m wide and 13 m deep and is located on top of a bluff above Crab Creek in the Channeled Scablands of eastern Washington (Figure 1). It was excavated by geographers and archaeologists from Eastern Washington University in the 1970s. Excavations attained a maximum depth of 3 m in the unconsolidated rock, volcanic ash, and aeolian silts that constitute the deposits. These sediments may extend to a depth exceeding 10 m. Volcanic ash lenses and radiocarbon dates from sediments adjacent to the rockshelter suggest basal sediments within the rockshelter may date to the late Pleistocene (c. 12,000–10,000 yr B.P.). The few diagnostic artifacts and radiocarbon dates on textiles recovered from excavations within the shelter, however, suggest materials there date to the last 3,000 years or so. If excavations continue into deeper and older deposits, the evolutionary significance of the dental abnormalities reported here can be determined.

Abundant faunal and floral remains are included in the deposits within the rockshelter, and many of the latter—including prehistoric textiles—seem to have been accumulated by pack rats building nests in the shelter (most likely the bushy-tailed woodrat, *Neotoma cinerea,* the remains of which are quite numerous in the deposits). Taphonomic analysis of the faunal remains indicates that raptors and owls deposited many faunal remains in site sediments,

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and carnivores also contributed to the accumulation (Lyman 1993). Humans seem to have been responsible for the deposition of very few faunal remains. Over 6,500 bones and teeth of mammals have been identified to at least the genus level (the large collection of bird remains has not yet been studied). Among the species identified are several that have significant implications for the mammalian biogeographic history of eastern Washington, including the pygmy rabbit (*Brachylagus idahoensis)*, red fox (*Vulpes vulpes)*, meadow vole, and possibly ermine (*Mustela erminea)*. None of these taxa is found in the area today.

The remains of microtine rodents recovered from Lamona Rockshelter include 57 specimens of *Microtus* sp., 5 specimens of *M. montanus* (montane vole), 18 specimens of *M. pennsylvanicus,* and 143 specimens of *Lagurus curtatus* (sagebrush vole). An additional specimen is assigned to *M.* cf. *pennsylvanicus.* This specimen consists of joined left and right maxillae in which are seated both the left and right M_1s and M_2s. Assignment to species is based on the presence of the button-shaped loop posterior to the third closed triangle of the M_2 that is diagnostic of this species. This identification is tentative, however, because neither the M_2 nor the M_1 is typical of this species. The M_1 has an accessory salient angle medio-anteriorly that almost completely divides the third triangle into two separate islands of dentin (Figure 1). The M_1 also has an extra loop posterior to the fourth triangle. Neither feature is found in typical M_1s of *M. pennsylvanicus.* In addition, the second triangle on the M_2 possesses a hint of an accessory salient angle located antero-medially, as well as the button loop posterior to the fourth salient angle. None of the abnormal features are evident among the other five M_2s and three M_1s assigned to this species; the majority of the 18 specimens so assigned were identified on the basis of the shape of the incisive foramena (Ingles 1965:272; Maser and Storm 1970).

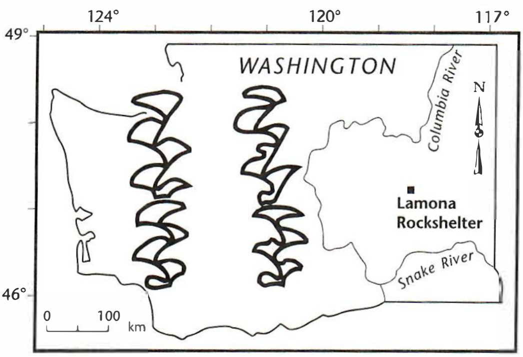

Figure 1. Map of Washington state showing location of Lamona Rockshelter and occlusal views of a normal left M1 and M2 (left) and the abnormal specimen (right) from this site.

The M_1s and M_2s of the abnormal specimen are bilaterally symmetrical—have identical occlusal surface features—suggesting the unique features of these teeth may not be mere dental anomalies, but rather are congenital. Many unusual dental features among mammals and archaeological remains of mammals that have been categorized as anomalies are found on only one or the other side of the upper or lower tooth rows. That the features described in the preceding paragraph are found on both sides of the upper tooth rows suggests they are genetically determined. What, then, might the evolutionary significance of such anatomical features be? No temporal sequence or historical documentation of the traits is yet available from Lamona Rockshelter, and reports of similar features could not be found in the extensive literature on meadow vole dentition. Mammalian surveys undertaken in the early twentieth century did not recover *M. pennsylvanicus* from areas within 40 km of Lamona Rockshelter (Booth 1947:429; Dalquest 1948:346). Given that this is beyond the foraging radius of the raptors and owls that likely deposited the abnormal specimen, perhaps the anatomical traits described here are the result of genetic drift within a small, isolated, relictual population of meadow voles that was soon to be extirpated. The range of this species included areas far to the south of its modern range during the late Pleistocene (FAUNMAP Working Group 1994:548–549), and it has been suggested that modern populations nearest to Lamona Rockshelter are Pleistocene relicts (Martin 1968).

The reason for the postulated extirpation of a population of meadow voles once resident in the immediate vicinity of Lamona Rockshelter is of potential interest, since it may involve environmental change. The reason for the isolation of the population from which the abnormal specimen derived is of potential interest for the same reason. If the relictual status of the population was the result of climatic change, and if that population became inbred as a result of isolation, dental abnormalities like those described here (and perhaps others) should increase in frequency from the time of isolation. Further study of the paleoecological record in conjunction with analysis of more ancient samples of *M. pennsylvanicus* remains from this portion of eastern Washington will test this possibility.

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A New Glyptodont from Mexico

Oscar J. Polaco, Ana Fabiola Guzmán and Eduardo Corona-M.

The edentates known as glyptodonts are unmistakable animals in paleontological sites. Gillette and Ray (1981) placed all North American glyptodonts in a single genus, *Glyptotherium,* with four well-defined species, *G. texanum, G. arizonae, G. cylindricum* and *G. floridanum,* plus the nominal species *G. mexicanum.* They described the skeleton of *G. texanum,* and compared the other species with it, improving morphological knowledge of this genus.

In December 1996, remains of a glyptodont were recovered in a Cuauchichinola village near Puente de Ixtla, in the Mexican state of Morelos (GPS 180 39′ 57.1″ N, 990 21′ 22.28″ W). The glyptodont was found in lacustrine deposits on the west slope of Cerro del Cañón at a depth of 2.16 m. It was the only animal found in the site and probably dates to the late Pleistocene.

The bone inventory includes the left half of the carapace, some isolated scutes from the right side, the nearly complete pelvis, numerous dermal ossicles, some scutes of the cephalic shield, the atlas, a chevron bone, the entire mandible with a full set of teeth, and a complete skull with almost a complete set of teeth. Its preservation is very good.

This finding represents the only record of a complete skull and associated mandible from Mexico and southern United States. The characteristics exhibited by the skull could clarify relationships within the genus *Glyptotherium.*

The cranial sutures are strongly united and indiscernible, indicating an adult animal. A mixture of characteristics in the skull distinguish it from the other species known (the following description and measurements follow Gillette and Ray, 1981). The skull shows the prezygomatic region complete. The premaxillary bones are clearly visible and have incisive foramina of elliptical shape. The narial aperture is formed by the lower and lateral edges of the premaxilla, and the dorsal one probably by a small pair of tapering nasals. The palatal region is mainly smooth, with the left palatine foramen in front of the groove, between the anterior and medium lobes of N5, and the right palatine foramen in front of the anterior lobe of N5. The palatine furrow is shallow. There is a distinct glenoid foramen in the upper border of the mandibular fossa. The basioccipital-basisphenoid contact is nearly contiguous and lies in the plane of the posterior nares. The squamus occipital bears a median longitudinal ridge from the apex of the nuchal crest to the foramen magnum. Nl is ovoid, elongated in the anteroposterior direction, with a sigmoid profile; the osteodentine core shows a pair of short branches posteriorly.

The mandible also shows some interesting characteristics. The lower margin is broadly rounded; its maximum depth occurs in the vertical plane passing

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through N6. A postdental canal that is a lateral open groove starts in the posterior border of N8. The mental foramen is anteriorly and ventrally placed to the N1, and thus in lateral view is not visible. N1 is molariform, trilobate, with its inner surface strikingly convex; in its external surface, the anterior lobe has a medial expansion, the middle lobe is well defined and the posterior lobe is obliquely oriented, extending posteroexternally into an elongated lobe. The anteromedial and anterolateral faces of the teeth are slightly convex, and the anterior apex is blunt in the occlusal pattern.

The measurements (mm) for the skull are: transverse inner margins of infraorbital foramina, 115; vertical length of right descending zygomatic process, 103.5; anteroposterior diameter from anterior margin of base descending right zygomatic process to posterior extremity, occipital condyle, 243.3; anteroposterior diameter, mandibular facet to infraorbital canal, lower anterior margin, left, 153, right, 153. Left mandibular measurements are: height of ascending ramus measured from condyle through posterior lobe of N7 to lower margin of horizontal ramus, 190.9; maximum transverse diameter, articular condyle, 42.4; anteroposterior diameter, articular condyle, 13.9; transverse diameter, horizontal ramus below N5, 33.1; transverse diameter, ascending ramus opposite N7, 19.5; vertical depth, horizontal ramus at N5, including tooth, 99.4; g-axis, 187.1; h-axis, 169.5; i-axis, 87.4; j-axis, 74.4.

The glyptodont from Cuauchichinola could represent an undescribed species; nevertheless, it is necessary to compare it with *Glyptotherium mexicanum,* since it shares some features with this species.

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The Conaway Collection: A Quaternary Vertebrate Record of the Yazoo River Basin

M. W. Ruddell, R. C. Brister, J. M. Conaway, C. Davenport, P. A. Delcourt, and R. T. Saucier

A significant sample of Quaternary fossils have been collected by John Conaway and others from gravel bars of the Mississippi River in the Yazoo Basin over the past two decades. This collection potentially represents salient

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paleoenvironmental information for this region and has many multidisciplinary research applications. Because of the nature of how the collection was acquired and where it was found, a great deal of taphonomic problems exist. The actions of the Mississippi River have created a complicated taphonomic history. The collection represents a taphocoenose and allochthonous assemblage. There is an apparent taxonomic bias in the composition of the fossils collected. Although the fauna is presumably from a riverine area, aquatic species are only sparsely represented in the collection. The vast majority of the fossils represent medium to large herbivores. The only significant Pleistocene carnivore identified was the American lion (*Panthera leo atrox*). The preservation in general was excellent. A quick burial after death is likely because of the lack of weathering and carnivore damage. E. Manning (unpublished ms.) has suggested that the quick burial and lack of aquatic species may indicate that the animals were covered by loess in the Crowley's Ridge region of northeastern Arkansas. However, recent paleontological and ethological studies of modern large herbivores suggest that animals in distress tend to die near water sources (Barnosky 1985; Haynes 1991). Further taphonomic analysis is required to answer where and how the animals found in this collection died and where their remains were deposited.

Ascertaining the chronology of the channel bar deposits is highly problematic (Behrensmeyer 1984). Although the vast majority of the fauna appear to represent late-Pleistocene representatives, mixing of more recent and ancient faunas has occurred. Recent species include pig (*Sus scrofa*), and cow (*Bos taurus*). Early Eocene taxa (whale, shark, and invertebrates) have also been excavated by the actions of the Mississippi River and deposited on channel bars (E. Manning unpublished ms.). Based upon the presence of bison, a Rancholabrean Land Mammal Age is the most precise chronological statement that can be made about the majority of the assemblage. Tests on the fossil bone preclude use of AMS dating owing to the lack of preserved collagen. A possible alternative dating method may be ESR because of the abundance of large herbivore cheek teeth found in the collection. The presence of a potential chronocline of bison (*B. latifrons, B. b. antiquus, B. b. occidentalis* and *B. b. bison*) may provide a relative means for dating the fauna (Wilson 1980).

Paleoecologically, the assemblage is represented by a mixture of forest-adapted and grassland grazers. The former category includes mastodon (*Mammut americanum*), tapir (*Tapirus haysii*), Jefferson's ground sloth (*Megalonx jeffersonii*), cervids, and black bear (*Ursus americanus*). The latter category includes bison (*Bison spp.*), horse (*Equus* sp.), Harlan's ground sloth (*Paramylodon harlanii*), musk ox (*Bootherium bombifrons*), mammoth (*Mammuthus* sp.), and giant tortoise (*Geochelone crassiscutata*). The most abundant occurring taxa are cervids, bison and horse. The presence of *G. crassiscutata* has classically been used as an indicator of equable climate.

Some of the fauna identified in the collection may represent first recorded occurrences of several taxa (*Dasypus bellas, Megalonyx jeffersonii, Paramylodon harlani, Panthera leo atrox, Arctodus simus, Mammuthus, Equus* sp., *Myohylus nasutus, Cervalces scotti, Odocoileus hemionus, Bison, Bootherium bombifrons,* and

Castoroides ohioensis) based upon FAUNMAP (FAUNMAP Working Group 1994). However, it must be noted that the FAUNMAP project delineates only fauna that are Woodfordian or more recent in age; it is possible that portions of this collection may be late Sangamonian or earlier (R. Graham pers. comm.).

Another potential avenue of research for this assemblage lies in the archaeology of the region. The Paleoindian archaeology of the area has been extensively mapped (Gillam 1995). Considering the lack of classic kill sites in the Southeast, our knowledge would benefit from the paleoenvironmental information offered by the vertebrates in the assemblage. In conclusion, the Conaway Collection represents a potentially significant contribution to the paleoenvironmental record of this region of the Mississippi River Valley.

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Acari Remains from Pleniglacial Sediments of the Venezuelan Andes and Their Paleolimnological Significance

Valentí Rull and Teresa Vegas-Vilarrúbia

Palynological analyses of pleniglacial lake sediments from the Venezuelan Andes reveal the El Caballo stadial (16.5 ka B.P.), which represents a late glacial readvance after the Last Glacial Maximum (Rull and Vegas-Vilarrúbia, 1996). A lowering of the snow line by 1,200 m and decrease in temperature to 7 °C below present are inferred. The same sediments produced a relatively high number of algae and unknown types. Among them, small fragments of acari legs (tarsi) are abundant and well preserved. Most are consistent with the

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genus *Hydrozetes (Acari:Oribatida:Hydrozetidae)* (R. Norton, pers. comm.), a cosmopolitan genus of aquatic species that yields abundant remains in lake sediments (Erickson, 1995). They live in the littoral zone and the shelf. Intimately associated with aquatic vegetation, this genus is opportunistic in its feeding requirements, consuming filamentous algae, wood fibers, detritus, bacterial slime, and decaying plant and animal material (Erickson 1988).

In the section studied, three assemblages were obtained by means of cluster analysis on identified aquatic remains (Figure 1): littoral *(Hydrozetes, Spirogyra-3, Spirogyra-2)*, pelagic (*Bulbochaete, Dinoflagellate* cysts, *Botryococcus)*, and bogs (*Isoëtes, Spirogyra*-1). The dominance of the first two indicate that a lake with well-developed littoral communities existed between pollen zones MC-1 and MC-3. Most types were strongly reduced or disappeared with the onset of a cold oscillation (El Caballo stadial), and only *Botryococcus* remained in significant numbers. This suggestion that the aquatic biota was notably reduced and that only the most cold-tolerant elements survived is supported by modern Andean sediments, in which *Zygnemataceae* spores have an upper altitudinal limit notably lower than *Botryococcus* (Salgado-Labouriau, 1979). Therefore, a temperature control on acari populations is suggested. On the other hand, the correlation between *Spirogyra*-3 (*Zygnemataceae)* spores and mite remains ($r = 0.819$; $p < 0.001$) suggests some association between this filamentous alga and living mites. If this is true, the absence of acari in higher strata might also

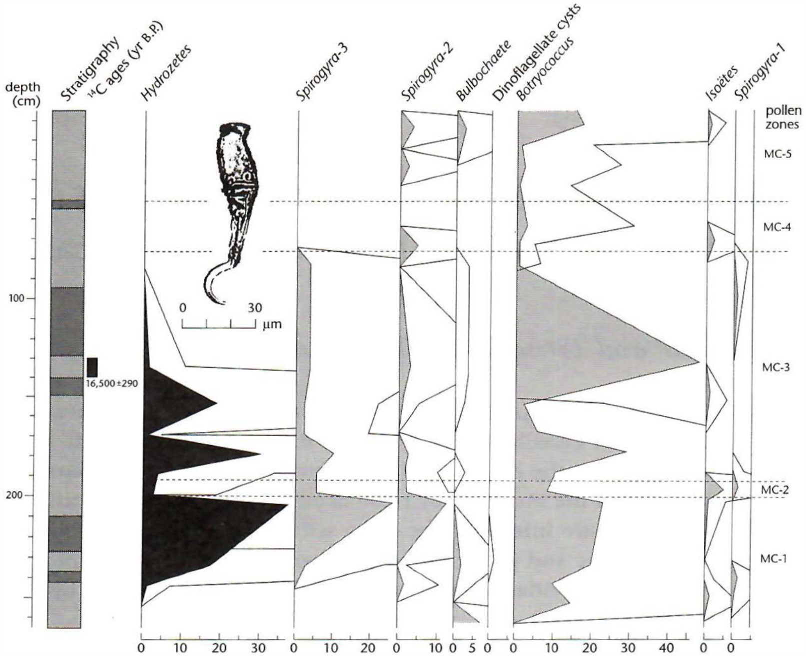

Figure 1. Stratigraphical distribution of mite tarsi found (example, inset) compared with algae remains and the spores of aquatic pteridophyte *Isoëtes*. Stratigraphy, dating details and pollen zones in Rull and Vegas Vilarrúbia (1996).

be related to intense habitat modification; this theory is supported by the inability of both acari and alga populations to recover after the stadial.

It is interesting that only tarsi and a few claws were encountered in the analyzed sediments, whereas these elements are usually missing from fossil oribatids (Erickson, personal communication). A satisfactory explanation is not yet available, but tarsi are the terminal segments of mite legs, having attachment elements such as hooks (Figure 1), and it is probable that the tarsi found are those that remained fixed to filamentous algae after detaching from the mite.

The assumed temperature control and the characteristic habitat of these oribatid mites make their fossils promising paleoecological tools, but more studies, especially involving surface samples, are needed for a complete understanding.

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Timing the Post-glacial Arrival of Black Bears (*Ursus americanus*) in Southeast Alaska and Eastern Beringia

Robert A. Sattler and E. James Dixon

Early-Holocene bear remains in southeastern Alaskan and eastern Beringian caves document the post-glacial dispersal of black bear (*Ursus americanus*) in northwest North America. Kurtén and Anderson (1980:183) report that black bears are the most common ursid found during the late Pleistocene of North America. Radiocarbon ages on black bear remains from coastal regions of southeastern Alaska and from unglaciated regions in northern and western Alaska suggest that black bears dispersed northward along the Cordillera during the Pleistocene-Holocene transition and radiated throughout eastern Beringia by modern times.

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The earliest dated remains of a black bear in northwestern North America are from a cave located in the southern portion of the Alexander Archipelago in southeastern Alaska. Heaton et al. (1996) reported an infinite ^{14}C age of 41,600 ± 1,500 yr B.P. (AA-16831) on a small tibia of black bear. However, a finite date on a different black bear from the same cave yielded an age of 28,700 ± 360 (AA-21569) yr B.P. (T. Heaton, pers. comm., 1997). Presuming these radiocarbon ages are reliable, this discovery places black bears on the west side of the Cordillera and north of the Queen Charlotte Islands during the last interstade (isotope stage 3). Moreover, growing evidence from the Alexander Archipelago indicates that the region may have been a glacial refugium from which terrestrial mammals could possibly have dispersed onto the mainland (Heaton et al. 1996).

It is not known whether black bears survived the full-glacial period in southeastern Alaska, or if they returned to the region in post-glacial times, but numerous skeletal remains date to the Pleistocene-Holocene transition. In southeastern Alaska, radiocarbon ages are reported on seven black bear skeletal elements that range from 11,715 ± 120 yr B.P. (AA-15226) to 6,415 ± 130 yr B.P. (AA-10447) (Baichtal 1995; Heaton et al. 1996). Some of these individuals died in overwintering hibernaculi. Some remains consist of complete or nearly complete unravaged skeletons in near-surface sediments on cave floors; others have been disarticulated and chewed by carnivores.

In eastern Beringia, the evidence of *U. americanus* includes remarkable series of deciduous teeth in Holocene cave fills along with rare skeletal elements in the Porcupine River and Trail Creek caves (Dixon et al. 1985; Dixon and Smith 1986). In one of the Porcupine River caves in northeastern Alaska, an assemblage of black bear skeletal parts consists of ravaged limb bones and ribs that are associated with cultural remains and two radiocarbon ages of c. 3,500 yr B.P. (Sattler, in press). The deciduous teeth (n = 24) of bear were stratigraphically above and below the cultural occupation, and two radiocarbon ages of c. 6,400 yr B.P. provide a minimum limiting age for the oldest teeth. Similarly, the skeletal remains of black bear in an adjacent cave are stratigraphically below limiting ages of 7,830 ± 100 yr B.P. (DIC-1854) and 7,965 ± 155 yr B.P. (Beta-1868).

In northern and western Alaska, bears seem to have consistently survived winter denning throughout the Holocene, and ontogenically young individuals shed their canine milk teeth before emerging from winter dens. Though some of the larger deciduous teeth may represent brown bear, the post-cranial elements in small caves are black bear and most deciduous teeth are smaller than modern brown bear canines (Dixon et al. 1985; Dixon and Smith 1986). Presuming that the deciduous teeth are *U. americanus* based on comparative analysis, the limiting ages indicate that black bears were hibernating in small caves around 8,000 yr B.P. in northeastern Alaska. Currently, black bears in this region spend more than half the year in overwinter dens (Smith et al. 1994).

These data indicate that bears repeatedly used small caves as winter dens in northern and western Alaska beginning in the early Holocene. The radiocarbon ages of naturally shed bear teeth and skeletal parts found in cave sediments suggest that black bears arrived in northeastern Alaska during the early-Holocene thermal maximum (cf. Ritchie et al. 1983). The provisional model on post-glacial migration indicates that black bears appeared in southeastern Alaska around 12,000 yr B.P., and in northeastern Alaska before 8,000 yr B.P. The geochronology of fossil black bears demonstrates a northward migration along the Cordillera after deglaciation as conifer forests recolonized formerly glaciated and unglaciated regions (cf. Mann and Hamilton 1995).

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Paleoenvironments: Geosciences

Geomorphic Relationships and Paleoenvironmental Context of Glaciers, Fluvial Deposits, and Glacial Lake Great Falls, Montana

Christopher L. Hill and Seppo H. Valppu

Glacial Lake Great Falls formed as Laurentide ice obstructed the Missouri River near present-day Great Falls, Montana (Alden 1932; Calhoun 1906). The sedimentologic dynamics associated with this geomorphic context can be interpreted based on studies by the United States Geological Survey (USGS) and, since 1995, the Museum of the Rockies Ice Age Research Program. Meltwaters from two alpine glaciers flowed into the lake. Till, glacio-fluvial, delta, and lacustrine deposits are present along the Sun River and Dearborn River drainages. These sediments record the geomorphic response connected with glaciation, fluvial aggradation and downcutting, and local base-level changes related to the lake.

Moraines within the Dearborn drainage grade to outwash terraces. Terraces are present along tributaries of the South Fork of the Dearborn (e.g., Cave Creek, Rogers Pass quadrangle). Colluvium and alluvium appear to have buried a Pleistocene entrance to Blacktail Cave. Age relationships can be determined based on travertine within Blacktail Cave. Buried cave fill contains fossils dating to about 10,270 B.P. (Hill 1996). Outside the cave, the colluvial and alluvial deposits form part of the geomorphic framework connected with the glacial, fluvial, and lake deposits of the Dearborn drainage. At least four Pleistocene terraces are present along the lower South Fork, and two higher benches exist within the Comb Rock quadrangle (Schmidt 1966).

There are parallels between the Dearborn moraine-terrace-lake geomorphology and the Sun River system to the north. They are connected by the timing of glaciation and changes in lake levels. In the Vaughn quadrangle, terraces grade to erratics interpreted as drift from grounded icebergs, indicating three shorelines between about 3,880 and 3,700 feet. Kame-delta sediments are found along the 3,800-foot lake margin. Lake sediments below

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about 3,716 feet are at about the elevation of a prominent delta. It grades laterally into outwash and lake deposits. Outwash-terrace gravels are traceable to moraines west of Augusta. The Sun River terrace grades downstream to delta sediments of the 3,480-foot lake level (Maughn 1961). Deposits of the lowest lake level are around 3,360 feet. Alluvium overlying Pinedale outwash contains Glacial Peak ash (Lemke et al. 1975).

Shorelines, lake, and terrace deposits are exposed along the Missouri River. At 3,900 feet the lake would have extended from the ice barrier near Great Falls into the Townsend Valley (Montagne 1979). At exposures along Holter Lake laminated calcareous (ca. 13–16% carbonate) silts and muds contain ostracods (*Candona* sp. tentatively identified as cf. *C. acuminata* or cf. *C. Acuta,* the specimens are juvenile and rather difficult to identify to species level) as well as diatoms (order Centrales diatoms, tentative identification *Stephanodiscus* sp. and some in the order Pennales diatoms, tentative identification *Navicula* sp.). Five bench surfaces of the "Old Terrace Gravels" and four bench surfaces of the "Younger Terrace Gravels" constrain the age of the lake deposits (Schmidt 1972). Shorelines in the Helena quadrangle at 3,900 feet (Stickney 1987) were being destroyed by development around the Helena airport in 1996. Within the Hauser Lake quadrangle, shore features are present at slightly lower than 3,800 to possibly as high as 4,000 feet. Lake rhythmites are exposed along the northeast shoreline of Lake Hauser and along the Missouri River at elevations of less than 3,800 feet (Schmidt 1986).

Based on ice sheet dynamics it seems likely glacial lakes existed around Great Falls during the middle and late Pleistocene (during deposition of the Havre, Herring Park and Fort Asssiniboin tills, cf. Fullerton and Colton 1986; Schmidt 1986; Stickney 1987; Vuke et al. 1995). The laminated lake sands and silts may provide absolute ages for these lakes using TL and OSL measurements, while chemical and isotopic studies of the ostracods could contribute detailed paleoenvironmental data. Other paleobiotic indicators are useful for inferring Pleistocene environments connected with the sedimentologic, stratigraphic and geomorphic records. Silty clay glacial lake sediment from near Cascade (Lemke et al. 1975: H23-H26) contained *Pinus* (pine), *Juniperus* (juniper), *Pseudotsuga taxifolia* (Douglas fir), *Artemisia* (sagebrush, wormwood), and *Compositae* (Composite family) (Leopold 1958b; pers. comm. to CLH 1997). Lake clays from below 3,360 ft (in the Benton Lake basin, USGS Paleobot Loc. No. D1241) reflect a coniferous assemblage dominated by pine but also containing forbs and grass. These assemblages suggest a forest landscape similar to what is now present at middle to low elevations in the region (Leopold 1958a; pers. comm. to CLH 1997). Extinct fauna from the Dearborn drainage include *Arctodus simus* (giant short-faced bear), *Lepus arcticus* (Arctic hare), *Equus* cf. *conversidens* (horse), *Bootherium bombifrons* (musk ox) and *Microtus* cf. *paroperarius* (Hibbard's tundra vole) (Davis et al. 1996), while mammoth remains have been found along the Sun River. These geologic and paleobiotic records provide an opportunity to develop detailed paleoecologic and paleoclimatologic inferences of the Rocky Mountains and northern Great Plains during the Pleistocene.

Thanks to John Montagne for drawing Hill's attention to the Holter Lake exposures and Estella

Leopold for permission to include pollen data. Thanks to Carol Edwards at the USGS Field Records Library, Sharon Van Loenen, and discussions with Dave Fullerton, all at USGS, Denver. Valppu identified the ostracods and diatoms and provided the grain size analyses of the Holter Lake samples. Thanks to Cheryl Hill for field assistance. J. K. Huber (University of Minnesota Archaeometry Laboratory) provided the carbonate content on the Holter Lake samples based on loss-on-ignition measurements. Funds partially provided to the MOR Ice Age Research Program from the Kokopelli Archaeological Research Fund (L. B. Davis, director) and an MSU-Bozeman MONTS-EPSCoR grant to Hill.

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Further Excavations and Paleoenvironmental Data at the Sunshine Locality, Eastern Nevada

Gary Huckleberry, Charlotte Beck, George T. Jones, and Amy Holmes

The Sunshine Locality is a buried Paleoindian site in Long Valley, Nevada. Previous surveys and test excavations revealed a suite of lacustrine, alluvial, and eolian deposits containing Paleoindian artifacts in association with extinct fauna (Beck et al., 1994; Jones et al., 1996). Most of the artifacts and faunal remains are fluvially reworked but with limited fluvial abrasion. We resumed archaeological and geological test excavations in 1995 and 1996 with the purpose of defining deposit architecture and obtaining further chronological and paleoenvironmental information.

Geological skip trenches placed in the center and margins of the modern channel of Sunshine Wash over a 600-m reach provided further stratigraphic control. These new exposures confirm the interpretation of a buried paleochannel inset into late-Pleistocene lake sediments. Although horizontal facies exist, the overall stratigraphy is relatively consistent along the study reach. Basal alluvium consists of channel and bar deposits that grade upwards from gravel- to sand-dominant lithologies (Strata F/G, D, and E; Figure 1). The gravely alluvium contains Paleoindian artifacts and extinct fauna, and seven ^{14}C dates on charred material bracket the age of this deposit at 9,800–10,400 yr B.P. Above this lie an organic (cienega) paleosol and discontinuous marl ("Stratum" C) where six ^{14}C dates on charred material and sediment indicate an age of 9,000–9,800 yr B.P. The cienega paleosol and marl correlate to other "black mats" in the region that cluster in age at the Pleistocene-Holocene transition and that represent a time of increased spring activity (Jay Quade, 1995, written communication). The cienega paleosol and marl are overlain by eolian sands that interfinger with lenses of fine textured alluvium near the channel axis (Strata A/B). The eolian sands contain a calcareous paleosol (Stage I–II carbonate morphology) along the margins of the channel well above groundwater influences. Based on regional soil chronosequences, this soil is mid-Holocene in age and probably no younger than 3,000 yr B.P. The calcic paleosol is overlain by more eolian sand and a cambic soil at the surface.

A cessation of deep lake activity, decreasing stream competence, increased eolian activity, and a shift from wet-meadow to well-drained, calcic pedogenesis at the Sunshine Locality record the general xerification through time from the terminal Pleistocene into the Holocene. It is not clear, however, whether the zenith of aridity corresponds to the mid-Holocene and the corresponding calcic paleosol or to subsequent renewed dune activity during

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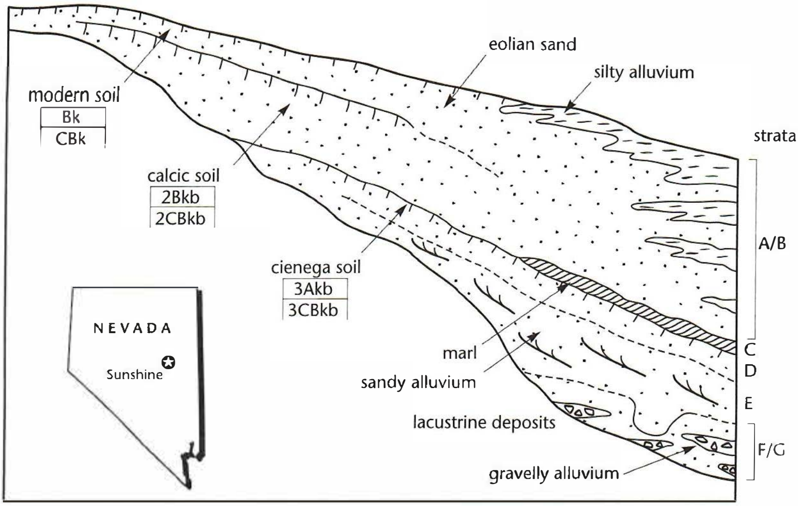

Figure 1. Schematic profile of stratigraphy and soils at the Sunshine Locality.

the late Holocene. The sequence does support a relatively stable climate during the last 3,000 years.

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Late-Pleistocene and Holocene Environments on Fort Riley, Kansas

William C. Johnson, Kyeong Park, John S. Isaacson, and Donald L. Johnson

A multi-year effort, funded by the U.S. Army Corps of Engineers, is underway to develop a geoarchaeological model of the Fort Riley military installation in

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Kansas. Integral to the study is determining the potential for buried Paleoindian sites, particularly on the loess-mantled uplands. The loess stratigraphy consists of the last-interglacial Sangamon soil, middle-Wisconsinan Gilman Canyon loess and soil, late-Wisconsinan Peoria loess, late-Pleistocene/early-Holocene Brady soil, and the Holocene Bignell loess capped by the modern surface soil. Because of possible cultural associations, our focus has been on the uppermost Peoria loess, Brady soil, and Bignell loess. In addition to radiocarbon-dating the units and mapping the distribution of the sediments, we are attempting to reconstruct late-Pleistocene and Holocene environments by using such proxies as rock magnetic parameters, carbon isotopes ($\delta^{13}C$), and opal phytoliths.

A loess sequence on a strath, or bedrock-defended river terrace, situated on the valley wall in Pumphouse Canyon at its confluence with the Kansas River valley, illustrates the late-Pleistocene and Holocene stratigraphy and proxy data (Figure 1). Two rock magnetic parameters, susceptibility, and frequency dependence of susceptibility, are measures of the bulk concentration of magnetic minerals (e.g., maghemite, magnetite) and the percent of that occurring as 'superparamagnetic,' or extremely fine material (18–20 nm: very fine clay), respectively (Clark 1990); in loess deposits of the region, increases in these rock magnetic parameters usually signify pedogenic weathering. The near-surface, high magnetic values indicate the surface soil, whereas the drop extending to below the 5,810 ± 160 yr B.P. (ISGS-3165) level characterizes the relatively unweathered Bignell loess. The prominent 'spike' or increase in magnetic response, most notable in the susceptibility curve, probably reflects incipient soil development during the middle Holocene. The relatively well developed Brady soil, dated regionally at about 10,500 to 9,000 yr B.P. (Johnson 1993), is reflected by both parameter curves; the offset between the two curves is due to frequency dependence detecting the fine magnetic material of the lower B horizon. The reappearance of high values near

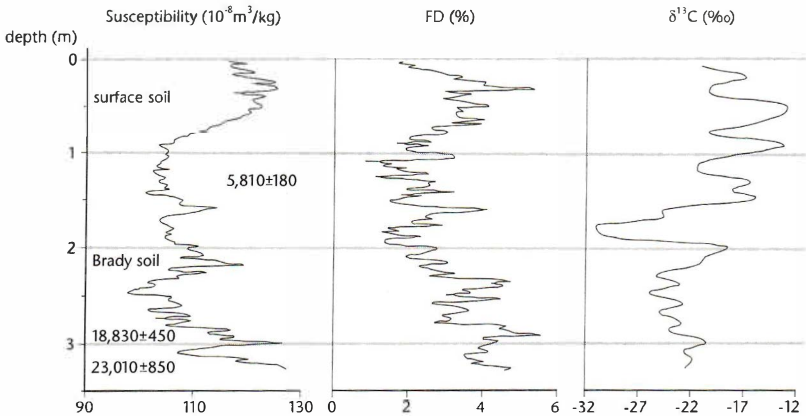

Figure 1. Magnetic susceptibility, frequency dependence of susceptibility, ^{14}C, and ^{13}C data from the loess-mantled strath in Pumphouse Canyon at Fort Riley. Total humates were used to determine the ^{14}C ages, and ages given are corrected for the effects of isotopic fractionation.

18,830 ± 450 yr B.P. (ISGS-3167) and 23,010 ± 850 yr B.P. (ISGS-3166) signals the upper part of the Gilman Canyon soil, dating regionally from about 36,000 yr B.P. to 19,500 yr B.P. (Johnson 1993).

Isotopic assays from organic carbon (total humates) in the soils and sediments provide an indication of the relative importance of C_3 (cool season; moist) versus C_4 (warm season; dry) plants (primarily grasses in this environment), i.e., less negative isotopic values indicate a dominantly C_4 environment, whereas more negative values denote increasingly C_3 conditions (e.g., Deines 1980; Krishnamurthy et al. 1982). The data exhibit a series of oscillations in the upper 1.5 m which may reflect fluctuations in late-Holocene climate. Similarly, opal phytolith data, obtainable from only the upper 1.5 m at this locality, indicate four reversals in the C_3–C_4 grass record prior to 5,810 yr B.P. which correspond temporally and botanically to those of the ^{13}C curve. The dramatic drop immediately above the Brady soil has no equivalent in our other isotopic records and therefore apparently reflects local conditions at that time. The overall pattern of more negative values during the late Pleistocene (cool, moist C_3 environment) and less negative values during the Holocene (warm, dry C_4 environment) is consistent with the regional climatic model (COHMAP 1988; Kutzbach et al. 1993). The time of climatic transition and Brady soil development, as expressed in these data, is crucial because of its association with the Paleoindian cultures.

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East Sayan: Glacial Episodes in the Pleistocene

Vladimir G. Nemchinov, Rinchin Ts. Budaev, Iridii N. Rezanov and Valentina V. Savinova

The region of East Sayan is situated in southeast Siberia, practically in the central part of Asia continent. This mountain system consists of differently oriented orographic elements and consists of a continuous belt of mountains stretching more than 750 km from the south part of Lake Baikal to the Enisey River.

The authors' investigation in the thinly populated and relatively poorly studied southeast part of East Sayan has offered opportunities for studying and dating palinological features of late-Cenozoic sediments from three independent glacial episodes in the Pleistocene. Traces of the middle-Pleistocene glaciation are preserved only in limited areas. Glacial features indicate that glaciation in this period was not significant. Elevation of year-round snow was lowered to 2,650 m. The general extent of glaciers was 25–30 km, but their depth in the region of the snow line was 350 m. This glaciation is attributed to the Riss, according to an Alpine chrono-stratigraphic nomenclature. Initiation of mountain glaciation in East Sayan could coincide with the development of middle-Pleistocene glaciation of West Siberia at the time of tectonic activity. This local tectonism included a forebulge downwarping of the plain at the north foot of the Munku-Sardik ridge and synchronous uplifting of its leading escarpment. Total vertical displacement was 150–200 m, occurring at a rate of 1.3 mm a year. Vertical tectonic movement maintained its intensity at the beginning of late-Pleistocene time. This was accompanied by the intensive erosive activity and shaping of the river valleys, many of which served either to encourage or constrain valley glaciers during the following Zyryansk episode. The most ancient deposits from this time are gravelly beds discovered in the Kitoy River Valley.

By RTL methods the deposits date to 105,000 ± 4,000 yr B.P., corresponding to the end of the Kazantsevo Interglacial (Riss-Wurm). Pebble beds are overlain by clumpy rock debris. At the end of Kazantsevo time there are widespread *Pinus-Betula* communities with a touch of *Picea, Pinus sibirica, Tsuga,* and rarely *Larix, Salix* and *Alnaster,* suggesting quite warm and damp climate.

The largest-scale glaciation in East Sayan occurred in the late Pleistocene, which is divided into two separate intervals: Zyryansk glaciation, which corresponds to lower Wurm; and Sartansk glaciation, upper Wurm. The first of these was a time of maximum buildup and spread of montaine glaciers. The main centers of Zyryansk glaciation in East Sayan were the ridges of Kropotkin, Munku-Sardik, Bolshoy Sayan, Kitoy and Tunka. At the time of maximum development of glaciers, the elevation of the snow line on the

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slopes of the Munku-Sardik ridge was 2,300 m. Maximum thickness of the ice sheet near Khore and Oka reached 700 m. We established also that glacier movement was laminar, with an average velocity of 20 m per year and extending 20 km from valley heads. The largest glacier of Zyryansk time was the Tissa Glacier, which arose in the area of Topographers Pic on the Bolshoy Sayan Ridge and extended eastward 80 km to the Oka River. Its maximum area exceeded 1,300 km^2, and it was 700 m thick.

Warming climate during the Karginsk Interglacial (the middle Wurm) is reflected in palynological complexes of this period, including fragments of broad-leaved flora such as *Quercus mongolica, Ulmus,* and *Corylus.* Lake-bed strata typically yielded marsh facies with woody debris, whose absolute ^{14}C age is 47,500 ± 1,500 yr B.P. The second late-Pleistocene (Sartansk) glaciation of East Sayan was localized in axial areas of high ridges and consisted of a collection of cirque glaciers, small drift of which occurred mostly on slopes with north exposure where the snow line reached 2,700 m. Along broad, main valleys in the final stage of glaciation, sandy lacustrine strata formed, quite often filling separate fragments of Zyryan marginal channels. In the valley of the Oka River, such deposits have been RTL-dated at 15,600 ± 3,900 yr B.P.

In East Sayan during the Pleistocene there were three independent glaciations separated by interglacials during which glaciers may have disappeared altogether: the middle-Pleistocene glaciation was much smaller than the first late-Pleistocene episode (Zyryansk); the Zyryansk glaciation was the largest and retreated with several oscillations; the second (Sartansk) late-Pleistocene cirque glaciation was independent in that it was separated from the Zyryansk glaciation by a long-lasting warm Karginsk Interglacial.

Our thanks to Zoya Rusyaeva, who checked the English.

Preliminary Report on Geoarchaeological Investigations at the Cremer Site (24SW264), South-Central Montana

Dustin White, Marvin T. Beatty, and Robson Bonnichsen

Few paleoenvironmental studies spanning the late-Quaternary period have been reported from central Montana (Barnosky 1989; Davis 1984; Lahren 1976). Recent geoarchaeological investigations at the Cremer site (24SW264), northeastern Sweet Grass Co., Montana (elev. 1,490 m), have provided important new information regarding late-Pleistocene and Holocene environmental changes in this sparsely studied region.

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The site locality is situated in a transitional position between the northern High Plains and the Rocky Mountain Front. The archaeological site itself is exposed along a terrace escarpment of a small tributary of the Musselshell River. Nowatzyk (1983) conducted test excavations in 1979 and 1980 that revealed a sequence of at least five occupation surfaces. She interpreted the site as a stratified multicomponent, open campsite with cultural affiliations spanning the late-Prehistoric to mid-/early- Plains Archaic periods (Nowatzyk 1983).

In 1995 and 1996, we carried out a detailed study of the stratigraphy and pedology of the Cremer site locality utilizing three backhoe trenches totaling 122 m. Soil profiles from selected locations along two of the trenches are presented in Figure 1.

Figure 1a shows the pedologic horizons within the footslope component of Trench 1. Five prominent soils (A or Ab horizons) are separated by deposits emplaced during discrete episodes of accelerated colluviation. These deposits reflect changing climatic/environmental conditions (landscape instability) that interrupted intervals of landscape stability and pedogenesis. Corrected radiocarbon dates shown in Figure 1a are from bone (5,920 ± 80 yr B.P., Beta-88601; 3,730 ± 110 yr B.P., Beta-100154) and charcoal (5,100 ± 70 yr B.P., Beta-88602), respectively.

Figure 1b shows the pedologic horizons from a trench on a stable colluvial landform approximately 150 m south of Trench 1. The upper 1.25 m of this profile contains four discrete soils. Two other soils were identified stratigraphically below this upper soil sequence. Radiocarbon ages associated with these lower soils are from bone (7,490 ± 100 yr B.P., Beta-100155) and charcoal (10,090 ± 130 yr B.P., Beta-100153), respectively (Figure 1b). Bone fragments recovered from the horizon overlying the soil dating to c. 7,500 yr B.P. were ^{14}C dated at 8,200 ± 80 yr B.P. (Beta-103886). The apparent anomaly in age is best explained by the latter horizon's content of redeposited older slopewash.

The Cremer site locality is important to paleoenvironmental reconstructions of central Montana because it consists of well-stratified soil sequences that span the last 10,000 years. This record of pedogenesis is particularly significant for understanding regional climatic/environmental changes during the early- to middle-Holecene periods. Detailed archaeological study of the earliest dated soils will be necessary to determine their association with cultural materials.

We thank George and Helen Cremer for site access, funding, and material and logistical support. CSFA crews and Earthwatch volunteers were of significant assistance as well. A complete report on recent investigations at the Cremer site is currently in preparation as a master's thesis by Dustin White.

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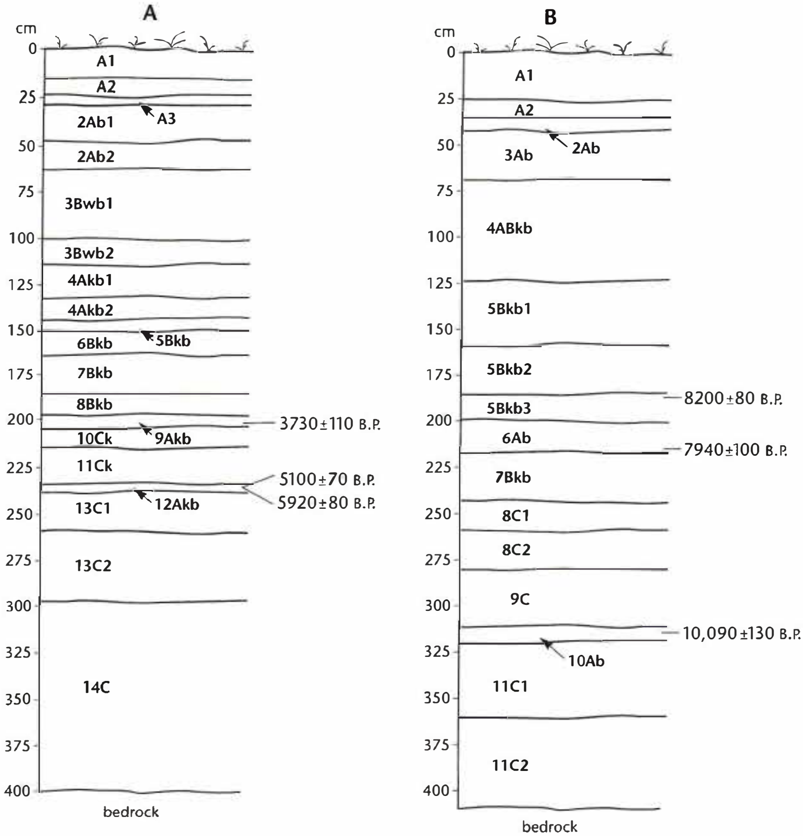

Figure 1. Soil profiles and 14C chronology from the Cremer site locality (24SW264), Montana. (Pedologic nomenclature follows Soil Survey Staff 1993.)

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Information for Contributors

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The following are some preferred abbreviations, words and spellings: Paleoindian (or Paleoamerican), archaeology, ca. (circa), yr B.P. (years before present), early-, mid-, late- (i.e., early-Holocene), ^{14}C (radiocarbon 14; ^{16}C, etc.), in situ, et al., pers. comm., CRM (cultural resource management), and AMS or TAMS (accelerator mass spectrometer technique of radiocarbon dating). Metric units should be used and abbreviated throughout: mm, cm, m, km, ha, m^2, etc.

Numbers should be written out when they start a sentence and when they are numbers one through nine (exception: ". . . researchers recovered 20 choppers, 10 burins, and 2 knives"). Numbers greater than nine should be written as numerals. All numbers greater than 999, including radiocarbon ages, should use a comma (22,000 ± 1,210 yr B.P.; 1,000 years ago; 12,000 mollusks).

Radiocarbon dates should be expressed in ^{14}C years before present (yr B.P.) and should include the standard error and the laboratory number, i.e., 11,000 ± 250 yr B.P. (A-1026).

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