CURRENT RESEARCH IN THE PLEISTOCENE

Volume 27 2010

A Peopling of the Americas Publication

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College Station, Texas

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Current Research in the Pleistocene is published annually by the Center for the Study of the First Americans. ISSN 8755-898X.

Typesetting and camera-ready preparation by C&C Wordsmiths, Lenoir, North Carolina

Printed by Tops Printing, Bryan, Texas

Contents

Archaeology: North America

Geosciences

Paleobotany

Paleontology

Archaeology: Latin America

Late-Pleistocene/Early-Holocene Tropical Foragers of Chiapas, Mexico: Recent Studies

Guillermo Acosta Ochoa

➤ **Keywords:** Southern Mexico, tropical environments, early foragers

Here we present the first results of an archaeological field study, which began in 2004, to define the early occupations of the tropical and subtropical zones of southeastern Mexico. Excavations from 2005 to 2009 have focused on three caves in Chiapas with pre-pottery occupations: Santa Marta, La Encañada, and Los Grifos (Figure 1A). The last two show similarities with fluted-point sites such as Los Tapiales in Guatemala. Particularly at Los Grifos two fluted points

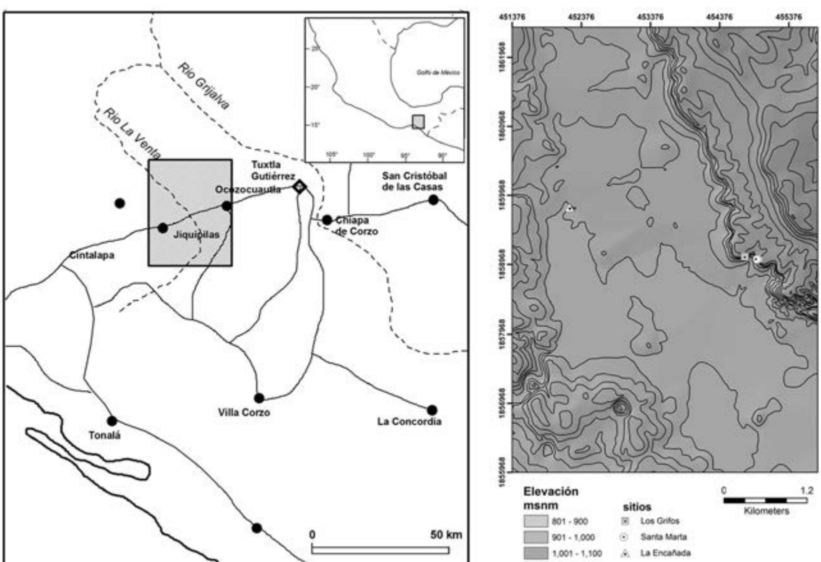

Figure 1A. Study area.

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have been identified, a Clovis (or clovisoid) and a fishtail, which make the site the first with such characteristics in Middle America. Santa Marta, on the other hand, not only exhibits lithic material of expedient technology but also milling stones and botanical samples, which indicate incipient horticulture starting at the end of the Pleistocene.

Previous dates for Los Grifos of 9540 ± 150 (I-10762), 9460 ± 150 (I-10761) and 8930 ± 150 (I-10760) RCYBP (García-Bárcena 1980; Santamaría 1981) suggest its fluted-point occupation occurred during the earliest Holocene. However, the earliest occupations of the area do not correspond to fluted point sites, but with caves like Santa Marta with expedient lithic artifacts and elements of broad-spectrum subsistence. The initial levels at this rockshelter are Pleistocene in age (XVII stratum), with dates around 10,460 ± 50 RCYBP (Beta-233470), and 10,055 ± 90 RCYBP (UNAM 07-22). The upper levels of stratum XVI are dated to the Pleistocene-Holocene transition, between 9950 ± 60 (Beta-233475) and 9800 ± 50 RCYBP (Beta-233476) (Table 1).

Table 1. Late-Pleistocene/Early-Holocene dates of Santa Marta and Los Grifos, Chiapas, Mexico.

Cave	Lab. number	Material	Context	^{14}C Date	CALYBP (2σ)■	Reference
Santa Marta	Beta-233470 AMS	*Celtis* seed	Capa XVII Nivel 1	10,460 ± 50	12,680–12,110	Present study
Santa Marta	UNAM-07-22	charcoal	Contacto Capas XVI-XVII	10,055 ± 90	11,266–11,840	Acosta 2008
Santa Marta	Beta-233476 AMS	charcoal	Capa XVI, nivel 6	9950 ± 60	11,690–11,230	Present study
Santa Marta	Beta-233475 AMS		Capa XVI, nivel 1	9800 ± 50	11,260–11,170	Present study
Santa Marta	I-9260	charcoal	Capa XVI	9330 ± 290	10,511–10,574	García-Bárcena y Santamaría 1982
Santa Marta	I-9259	charcoal	Capa XVI	9280 ± 290	9672–11,241	García-Bárcena y Santamaría 1982
Santa Marta	Beta-233470 AMS	charcoal	Capa XI, nivel 1	8740 ± 50	9910–9950	Present study
Santa Marta	I-8955	charcoal	Capa XV	8785 ± 425	8773–10,889	García-Bárcena y Santamaría 1982
Los Grifos	I-10762	charcoal	Below fishtail occupation	9540 ± 150	10,485–11,233	Santamaría 1981
Los Grifos	I-10761	charcoal	Below fishtai occupation	9460 ± 150	10,299–11,182	Santamaría 1981
Los Grifos	-	Obsidian hydratation	Below fishtail occupation	9330		Santamaría y García-Bárcena
1989						
Los Grifos	I-10760	charcoal	Over fishtail occupation	8930 ± 150	9555–10,378	Santamaría 1981

■Calibrated with Calib 6.0.1

The lithics of Santa Marta are manufactured on local flint, mainly on flakes with marginal retouch (Figure 1B). Starch grains and microscopic signs of use-wear on stone tools indicate they were used to work plant fiber, principally woods of mesophiles and the tropical rainforest.

Faunal remains indicate that the collection of freshwater jute-snails (*Pachychilus* sp.) was an important subsistence activity. Small and medium-sized animals like deer (*Odocoileus* and *Mazama*), peccary (*Dicotyles*), and rabbit (*Silvylagus*), as well as snakes (*Crotalus*), iguanas (*Iguana*), and tortoises

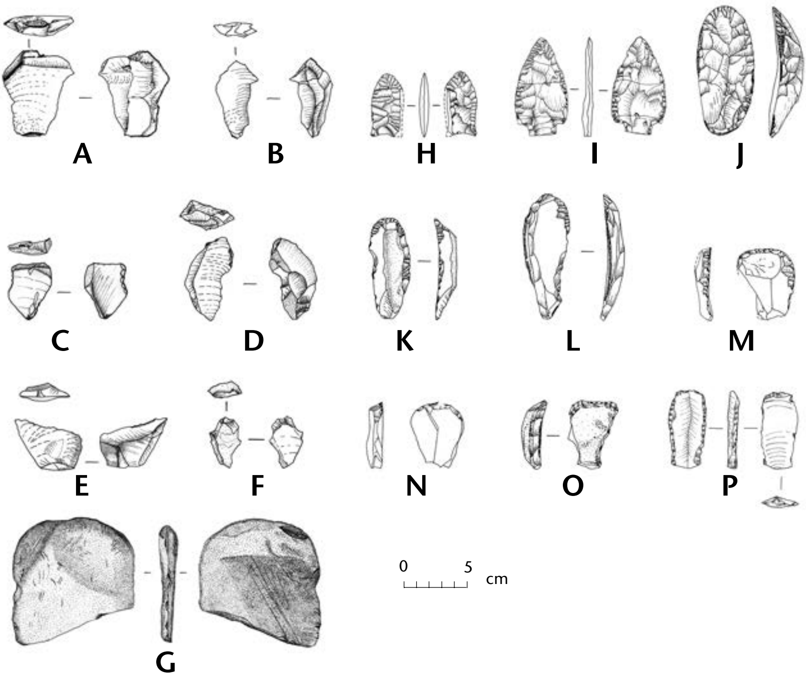

Figure 1B. Lithics.

(*Kinosternon*) were the most important hunting prey. Megafaunal remains were not found.

Santa Marta's paleoethnobotanical results (Acosta 2008) provide evidence of the presence of milling stones with microfossil remains (starch grains) of *Zea* in levels around 9800 RCYBP, while *Zea* pollen (introduced teosinte is suspected) is present in the sedimentary record starting with Pleistocene levels (between 10,460 ± 50 and 10,050 ± 90 RCYBP), along with cocoa pollen (*Theobroma* sp.), green tomato seeds (*Physalis* sp.), nance seeds (*Byrsonima crassifolia),* and figs (*Ficus cooki*). Pollen analysis in association with macrobotanical flotation results suggests that, along with species inhabiting perturbed areas, there are several groups of forest species, including mesophile (*Alnus*), tropical rainforest (*Theobroma*), and deciduous forest (*Ficus, Byrsonima*). These results suggest the possibility that specific tropical areas were altered as scattered orchards, where wild and semidomesticated species could spread out (horticulture). This process has now been detected in other tropical areas in Colombia (Gnecco and Aceituno 2004) and Ecuador (Piperno et al. 2000). Nevertheless, Santa Marta appears to precede both of them by at least half a millennium, but further investigation is required.

This study has been possible thanks to the support of Programa de Apoyo a Proyectos de Investigación e Innovación Tecnológica (PAPIIT-UNAM), a Ph.D. grant from Consejo Nacional de Ciencia y Tecnología (CONACyT), and donations from the Foundation for The Advancement of Mesoamerican Studies (FAMSI).

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Pleistocene-Holocene Transition in Northern Patagonia: Evidence from Huenul Cave (Neuquén, Argentina)

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➤ **Keywords:** Northern Patagonia, late Pleistocene-early Holocene, human-megafauna interactions

Northern Neuquén (Patagonia, Argentina) constitutes a void in our current knowledge of the early human peopling of South America (Borrero 2008). This report stems from a regional survey project recently started in northern Neuquén that was intended to bridge this gap. In particular, new research being conducted at the Cueva Huenul 1 site (CH1) provides stratified se-

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quences of archaeological and paleontological remains spanning the late-Pleistocene/early-Holocene period (Figure 1). Although never published in any depth, this cave site was known to have excellent preservation conditions and a long temporal sequence, with a date of 11,150 ± 230 RCYBP (AC-0010) on a sediment sample whose stratigraphic context is unknown (Cordero et al. 2002).

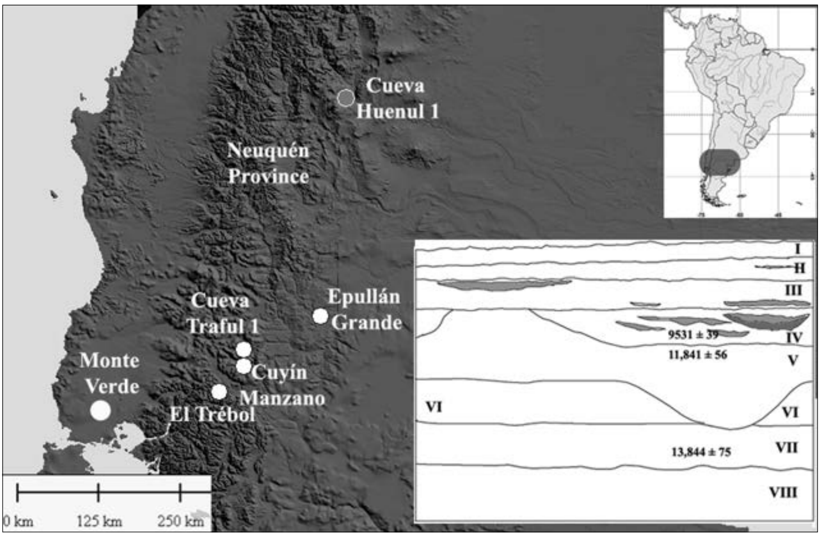

Figure 1. Location of CH1 and stratigraphic profile; other sites mentioned in the text. References: Cueva Traful I (Crivelli M. et al. 1993), Epullán Grande (Crivelli M. et al. 1996), Cuyín Manzano (Ceballos 1982), El Trébol (Hajduk et al. 2006), Monte Verde (Dillehay 1997).

Recent excavations conducted by us in CH1 provided a 1.4-m sequence composed of two main sets of litho-stratigraphic units separated by an erosive unconformity (Figure 1). These units differ in terms of sedimentological and chemical properties: The basal units VIII-V have a high content of organic matter (up to 5%) and nearly bimodal granulometric distributions, indicating mixed depositional agents. Macroscopically, they appear to be composed mainly of dung remains. A large amount of very well preserved coprolites was recovered whose size and morphology indicate they belong to megafaunal species, tentatively assigned to extinct ground sloth. No bones were recorded in these deposits; a set of small lithic flakes was recovered, although the

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existence of rodent and anthropic disturbances on the top of these layers makes it likely that they migrated downwards, thus preventing an interpretation of temporal association. A sharp and well-defined erosive unconformity separates this basal set of units from the second stratigraphic set, composed of units IV–I. These units have lower organic matter percentages (between 0.4% and 1.1%) and very similar unimodal granulometric profiles that indicate a predominantly eolian sedimentary deposition.

Two dates were obtained on dung samples from the basal strata: The lower sample comes from the 100- to 110-cm level and provides a date of 13,844 ± 75 RCYBP (AA-85722, $\delta^{13}C$= -21.1‰) constituting the oldest age for the CH1 deposits; a second date of 11,841 ± 56 RCYBP (AA-85720, $\delta^{13}C$= -17.6‰) was obtained for the top of the dung layers (55–60 cm). Two well-defined lenticular hearths were recorded directly above the unconformity (55–57 cm), providing the oldest clearly unimpeachable human occupation on the site. A charcoal sample from hearth #2 was dated to 9531 ± 39 RCYBP (AA-85718, $\delta^{13}C$= -22.7‰), constituting the oldest date for human occupations in CH1. The lithic assemblage associated with this date is very small. It is composed of flakes, microflakes, and debris produced by edge-shaping activities. No tools were recorded. The raw materials are local and include the so-called Huenul obsidian (Barberena et al. 2010), basalt, and chalcedony. This evidence indicates a very brief human use of the cave.

The stratigraphic and chronological information illuminates a number of interesting issues: 1) the dung deposits (units VIII–V) are late Pleistocene in age and do not show an unambiguous anthropic contribution; 2) the level containing the hearths (unit IV), firm evidence of human presence, is early Holocene in age and yields scarce lithic artifacts and bones; 3) the erosive unconformity separating these two segments of the sequence can be bracketed between the dates of 11,841 ± 56 and 9531 ± 39 RCYBP.

Putting this information on a supra-regional scale, the CH1 site constitutes another case along the south-central Andes where gaps of varying length are recorded between megafaunal remains and the earliest human occupations (Crivelli M. et al. 1993; Diéguez and Neme 2003; Martínez et al. 2007). This is consistent with previous suggestions that indicate that “in many regions of northern Patagonia, especially near the Andean range, the Pleistocene fauna were already gone when the first humans arrived” (Borrero 2008:72), although not all cases fit this pattern, as recorded at El Trébol forest rockshelter (Hajduk et al. 2006). The information collected contributes to an emerging evaluation of the variability in timing and pattern of human-megafauna interaction in southern South America (Barnosky and Lindsey 2010; Borrero 2009).

The earliest date for human presence in CH1 is consistent with data available for northern Patagonia east of the Andes, clustering right after 10,000 RCYBP. The dataset shows a brief temporal pulse during which human occupations are first recorded at a number of distant places. This is best explained as human radiation to ecologically marginal regions from areas that were colonized earlier. At a regional scale it appears that steppe (CH1, Epullán Grande, Arroyo Malo 3) and forest-steppe ecotone (Cueva Traful 1, Cuyín Manzano) settings display earlier ages than forest ecosystems east of the Andes (Borrero

2008). On the other hand, at a supra-regional scale, available evidence for western settings (i.e., Monte Verde site) suggest initial human occupations occurring later than in forested regions west of the Andes (Dillehay 1997).

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El Abrevadero, Chihuahua: A Site with Remains of Pleistocene Fauna and Artifacts of Early Humans in Northwestern México

Enrique Chacón-Soria and Felisa J. Aguilar

➤ **Keywords**: Late Pleistocene, megafauna–early human relationships, Paleoindian

Studies on early humans in Chihuahua have been incidental and occasional. The evidence recovered from various parts of the state to date consists of projectile points of the Clovis, Folsom, Plainview, and Golondrina types among others, thus indicating a Paleoindian occupation ranging from 11,000 to 8000 RCYBP (Aveleyra Arroyo de Anda 1961; Di Peso 1965, Kelley et al. 2001; Phelps 1990a, 1990b, 1998, Turner and Hester 1999). Regarding sites with late-Pleistocene megafauna in the state, 23 localities have been recorded so far (Arroyo-Cabrales et al. 2002), with representatives of the orders Proboscidea (*Mammuthus* sp., *Mammut americanum*, *Cuvieronius* sp., and *Stegomastodon* sp.), Carnivora (Canidae, Felidae, and Ursidae), Artiodactyla, Perissodactyla, Chiroptera, Lagomorpha, and Rodentia (Arroyo-Cabrales et al. 2002). At these localities, unlike elsewhere in Mexico, it has not been possible to establish association of extinct fauna with early human settlers. In particular, at only six localities have mammoth bones been found associated with artifacts (Arroyo-Cabrales et al. 2006).

Recently a claim about the fortuitous discovery of fossils in a spring in the town of Ahumada, Chihuahua, 80 km south of Ciudad Juarez, was reported to the National Institute of Anthropology and History (INAH) (Aguilar y Chacón 2008). In October 2009 the staff of INAH visited the site, called El Abrevadero (30° 34′ 50″ N, 106° 50′ 30″ W, 1236 masl), and performed initial fieldwork there, leading to the recovery of the fossil material described here.

The fossils were located in the northern wall of the waterhole, in a matrix of sandstone, silt, and clay. The fossil remains recovered consist of teeth, auditory bullae, and postcranial skeletal elements (vertebrae, long bones, phalanges, etc.) belonging to horse (*Equus conversidens*), mammoth (*Mammuthus columbi*), camel (*Camelops* sp.), bison (cf. *Bison* sp.), deer (cf. *Odocoileus* sp.), mylodont ground sloth (Mylodontidae) as well as carapace plates of freshwater turtle (*Kinosternon* sp.).

In some of the bones recovered, mainly on fragments of long bones of mammoth, marks were observed suggesting modification (cutmarks and manufacture traces) due to human activity, which indicates the possibility that

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these bones could have been butchered and modified by humans. This interpretation, though, is preliminary and must be confirmed by a detailed taphonomic analysis of the materials to rule out the possibility of modification by natural agents (e.g., water, gnawing by carnivores or rodents).

As part of the research, additional prospecting was conducted in the area of the main site. About 150 m south of the waterhole, a projectile point of the Clovis type was found, and about 1000 m south a point of the Plainview type was found. These lithic materials were collected on the surface, with no direct association with the fossil remains of the Pleistocene megafauna, but they reinforce the hypothesis of an early presence of humans in this region of Chihuahua, as suggested previously by Comandurán et al. (1992) and Le Tourneau (1995).

We thank the students of archaeology of the ENAH, Claudia Jaramillo and Samuel Mateo, for their support during fieldwork; Jose Ruben Guzman-Gutierrez for translating the text to English, and an anonymous reviewer provided helpful suggestions to improve its content.

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Early-Holocene Human Skeletal Remains from the Argentinean Pampas

Nora Flegenheimer, Cristina Bayón, Clara Scabuzzo, Natalia Mazzia, Rodrigo Vecchi, Celeste Weitzel, Romina Frontini, and Mariano Colombo

➤ **Keywords**: Human remains, early Holocene, Argentinean Pampas

Since the late 19th century the Argentinean pampas have been an important setting for discussions of the antiquity of the peopling of South America (Podgorny 2009; Politis et al. 2010). Currently two sites containing bones of megafauna and humans, sites 1 and 2 at El Guanaco locality (38° 41′ S; 59° 39′ W), are being excavated in the Pampean plains. They are about 500 m distant from one another, towards the north and east of a shallow lake. Both sites exhibit early-Holocene occupations, dated ca. 10,000 RCYBP. Site 1 is multicomponent and includes extinct megafauna in its lower levels, and site 2 has recently yielded early human skeletal remains. We here present AMS radiocarbon dates for both sites.

Site 1 profile has three stratigraphic units (Bayón et al. 2004), the lowest being a calcium carbonate layer, which was the floor during the first human occupations. Unit 2 corresponds to a loess deposit with weak pedologic modification. This unit is truncated in some areas by a burial pit of late-Holocene age. A radiocarbon date has placed the upper levels of unit 2 in middle-Holocene times (Zárate et al. 2009). The lowest levels of unit 2 include faunal remains of *Lama guanicoe, Lagostomus maximus, Lycalopex* sp.*, Lutreolina crassicaudata, Ctenomys* sp., cavids, and two extinct species, *Equus* sp. and *Macrauchenia patachonica.* These last do not show evidence of anthropic modifications. Eggshells of *Rheidae* are also abundant. These remains are associated

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with lithic artifacts. A humerus of *Lama guanicoe* from these levels exhibiting helical fracturing has been dated at 9250 ± 40 RCYBP (SR-6381).

Site 2 is in a sandy eolian deposit corresponding to a dune environment formed by deflation of the neighboring lake. At this site the sedimentation rate was greater and the calcium carbonate layer is overlain by an archaeologically sterile deposit including extinct fauna; this level was the ground surface for the first human inhabitants. In the overlying levels early- and middle-Holocene occupations have been recorded (Zárate et al. 2009). Three faunal remains yielded early-Holocene ages; a tibia-tarsal of *Rhea americana* was dated 9140 ± 120 RCYBP (AA-82713), corroborated by a second date of 9048 ± 69 RCYBP (AA-82713) on the same sample. Also, a distal end of a metapodial of *Lama guanicoe* was dated 8507 ± 84 RCYBP (AA-82712), and a humerus of *Lama guanicoe* was dated 8411 ± 80 RCYBP (AA-71658). This last sample was spatially associated with a grinding stone that provided evidence that organic resources were processed at the site; these were first considered as vegetal and marine resources (Babot et al. 2007), but later reinterpreted as seeds (Mazzia 2010). The context also includes scarce flaked lithic artifacts. The early occupations are interpreted as representing a residential camp where also *Rhea americana*, *Lama guanicoe*, and *Ozotecerus bezoarticus* were processed and consumed (Frontini 2008). No extinct fauna was found in association.

In the lowermost levels of this site, remains were excavated of two human individuals, an infant and an adult. The sediment has high calcium carbonate content and the bones are characterized by calcium carbonate, manganese oxide, root marks, and poor preservation. The infant was better preserved than the adult and corresponds to a primary burial in a right lateral position with flexed legs. Portions of both the axial and appendicular skeleton were recovered; they include the cranium, portions of the vertebral column and some rib fragments, both humeri, part of the coxae, and a femur. The posture of the adult individual cannot be inferred as only cranial fragments were recovered. A rib from the infant was dated 8123 ± 82 RCYBP (AA-82710), and a maxilla of the adult was dated 8433 ± 84 RCYBP (AA-82705). These dates place the burials at El Guanaco site 2 among the earliest human bones recovered in the region.

Discoveries in Argentina follow the general tendency observed for the Americas, which is that early human burials are infrequently found. This scarcity has been explained in different ways, such as cultural practices that did not favor preservation, taphonomic biases, or sampling problems (Barrientos 2002; Dillehay 1997). Although currently 17 sites with dates between 12,000 and 8000 RCYBP have been published for the pampean region, only one is known to include early human remains (Politis et al. 2010). In this context, the information at El Guanaco is relevant to discussions of several issues concerning the early inhabitants, namely burial practices and their relation to domestic environments, diet, and cooking practices, and the relationships between humans and megafauna.

Special thanks to the owners and staff at Estancia El Guanaco and Mr. V. Bustillo and staff from Proagro. Research was supported by grants SEPCyT- PICT 26040, SEPCyT-PICT 717, CONICET-PIP 112-

200801-02979, SECyT-UNS 24/I154. As usual, we are indebted to our North American colleagues at the University of Arizona facilities, especially to Tim Jull for help with radiocarbon dates, and to Tom Stafford for preparing sample SR-6381.

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Early Human Occupation in the Southern Part of the Deseado Massif (Patagonia, Argentina)

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➤ **Keywords**: Pleistocene-Holocene transition, Patagonia, hunter-gatherers

Human occupation sites dating to the Pleistocene-Holocene transition have been identified in the Deseado Massif, Patagonia (e.g., Cardich et al. 1973; Miotti et al. 1999; Miotti and Salemme 2003, 2004; Paunero 2000a, 2000b, 2009; Paunero et al. 2007). However, south of the Massif, the earliest evidence of human occupation dates to the early Holocene, ca. 8900 RCYBP at El Verano (Durán et al. 2003) and ca. 8050 RCYBP at La Martita Cave 4 (Aguerre 2003).

There has been no previous systematic archaeological research in the Deseado Massif south of El Verano and La Martita Cave 4 sites. However, this area is crucial to our understanding of the initial peopling of southern Patagonia because, although the Massif contains numerous caves as well as excellent rocks for flintknapping (*sensu* Aragón and Franco 1997; Callahan 1979), similar resources are scarce to the south (e.g., Echeveste 2005; Franco and Cirigliano 2009; Franco et al. 2009; Panza and Franchi 2002; Panza and Haller 2002; Panza and Marin 1998; Russo and Flores 1972; Russo et al. 1980). Research in nearby areas indicates that variations in these resources from one area to another, as well as differences in the availability of water, had a significant impact on early human populations (e.g., Borrero and Franco 2000; Goñi et al. 2000–2002; Franco et al. 2007).

The area of La Gruta is in the southern part of the Deseado Massif just north of the Chico River, which flows from northwest to southeast. Borrero (1989–90, 1994–95) has suggested that rivers may have been important routes during the peopling of Patagonia, and it is thus very possible that early hunter-gatherers may have followed the Chico River. Today the area is dominated by closed depressions in volcanic rocks that may contain seasonal lagoons and occasional permanent bodies of water. Studies are currently underway in the

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south of the Massif to determine how water levels in the lagoons varied during the late Pleistocene and Holocene to assess the possible importance of the lagoons in the initial occupation of the area. Primary and secondary sources of lithic raw material were identified in the southern part of the Deseado Massif and in spaces located south of it by conducting systematic surveys. Although the findings are exploratory, the comparison with results obtained by other researchers suggests a greater availability of high-quality raw materials north of the La Gruta area (Franco et al. 2009).

A small cave (La Gruta, lagoon 2, cave 1) was discovered in the cliff wall of one closed depression that contains a seasonal lagoon. A small test pit in the floor of the shelter did not reach bedrock but exposed deposits dating back to 10,656 ± 54 RCYBP (AA-76792, Franco and Cattaneo 2009). Later, a 1-by-1-m test pit excavated to bedrock exposed a series of small hearths in the oldest deposits of brownish red sandy silt (Franco et al. 2010). Additional dates of 10,840 ± 62 (AA-84223), 10,845 ± 61 (AA-84224) and 10,477 ± 56 RCYBP (AA-84225) indicate early human utilization of the area. Artifacts associated with the hearths are small flakes (89% are < 20 mm long) mostly of chalcedony and siliceous rocks. Some of the chalcedony may have been imported, since it was not identified in the immediate vicinity (*sensu* Meltzer 1989). Black and gray obsidians were also recovered; based on geochemical data they probably came from 158 km to the north in the Pampa del Asador (Stern 1999, 2000). The presence of obsidian in deposits dating to the Pleistocene-Holocene transition supports the suggestion of Civalero and Franco (2003) and Franco (2002, 2004) that early human populations knew of the sources and included obsidian in their toolkits.

These preliminary findings indicate that the southern part of the Deseado Massif was being utilized by human populations at least by 10,845 ± 61 RCYBP or 12,890–12,600 CALYBP, calibrated using CALIB 6.0 (Stuiver and Reimer 1993) and INTCAL09 (Reimer et al. 2009)). La Gruta rockshelter would have provided protection from the wind and given an excellent view of the nearby area. The size of the site and hearths, as well as artifact characteristics, suggest that during the Pleistocene-Holocene transition the cave was used repeatedly for short periods of time by a few to several people. These people probably used the cave for shelter during hunting trips and to sight prey. Pollen analysis of cave sediments indicates that when the shelter was used the vegetation was grass steppe, suggesting semiarid conditions.

Research was funded by projects PIP 5209 (CONICET), PICT 19-26040 (ANPCyT) and UBACyT F119 (University of Buenos Aires). Triton S.A. Mining Company and AMS Laboratory, University of Arizona, gave support for radiocarbon dates. We wish to thank Dirección de Cultura, Gobernador Gregores, Dra. A. Aguerre, Dr. T. Jull and Mag. C. Baetti.

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New Evidence of Fishtail Occupation in Northern Perú

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➤ **Keywords**: Colonization, late Pleistocene, Andean South America

The Fishtail complex is best known from numerous sites identified in the Southern Cone of South America (Chile, Argentina, and Uruguay) (Borerro 2006; Nami 2007; Suárez and López 2003). Within the Central Andes, however, few sites yielding Fishtail projectile points have been documented. Among these sites are El Inga in Ecuador (Bell 2000; Mayer-Oakes 1986), LaCumbre (Ossa 1976), Laguna Negra (León C. et al. 2004), and two sites in the Chicama Valley in Perú (Briceño 2004). An isolated find in the Piura Alta area of Northern Perú has also been reported (Chauchat and Zevallos 1979). Recent survey of the Quebrada del Batán (Q. Batán) in the lower Jequetepeque Valley of northern Perú (7° 03′ 49″ S, 79° 24′ 53″ W) identified four additional sites, Je 979 (7° 03′ 20″, 79° 24′ 13″), Je 996 (7° 03′ 28″, 79° 23′ 50″), Je 1002 (7° 03′ 32″, 79° 24′ 25″), and Je 1010 (7° 04′ 20″, 79° 25′ 12″), yielding Fishtail points and point fragments (Maggard 2010).

The four Q. Batán sites are open-air settings situated on alluvial terraces bordering *quebradas* (large canyon-like drainages) that provide commanding views of large expanses of the drainage floor, intersecting drainages, and the nearby coastal plain. Like the sites in the Chicama and Moche valleys, each of the Q. Batán Fishtail sites also contained projectile points from the contemporary or overlapping Paiján complex (Briceño 2004; Ossa 1976). Both the Paiján and Fishtail points were recovered from mixed surface contexts. However, limited excavations at these sites provided data that identify some materials and strata associated with each complex.

Among the four Q. Batán Fishtail points, two (from sites Je 996 and 1010) display sharply contracting stems that flare outward at the stem base (concavo-convex), resulting in the classic "fishtail" appearance. The stems are relatively narrow, and the stem base is flat to concave. Lateral edges and stem bases are heavily ground. The other two points (from sites Je 979 and 1002) have broad contracting stems with flat stem bases and ground lateral margins. Only one point, the contracting stem example from site Je 1002, displays fluting on a single face.

Raw materials used in the manufacture of the Q. Batán Fishtail points include quartz crystal (n = 2), chalcedony (n = 1), and a mottled blue-gray chert (n = 1) (Maggard 2010). Outcrops of quartz crystal occur in the Q. Batán region and likely represent sources of locally acquired materials. The other raw materials (chalcedony and chert) are non-local in origin. The specific sources of these materials are unknown, but most likely are located in the Andean highlands

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some 35–45 km to the east. A similar pattern of raw material use (local quartz crystal and non-local fine-grained silicates) was also reported for Fishtail points recovered elsewhere in northern Perú (Briceño 2004; León C. et al. 2004). In contrast, Paiján points found on these sites are manufactured entirely from locally available fine-grained quartz, quartzite, and rhyolite.

All the documented Fishtail points from northern Perú (Q. Batán, Q. Santa Maria, La Cumbre, Piura Alta, and Laguna Negra) are similar in size (approximately 5–6 cm long). This average length is similar to that of points from sites in Argentina, Uruguay, and Ecuador, whose length averages 4–7 cm (Bell 2000; Nami 2007; Politis 1991, Table 2; Suárez and López 2003). In spite of the similarities in size, there is a relatively wide range of morphological variability among Fishtail points within and across different regions. As the points from the Q. Batán demonstrate, this appears to be equally true in northern Perú.

Fishtail points from western South America generally date to ca. 11,200–10,100 RCYBP (Borerro 2006; Dillehay 2000; Nami 2007). AMS dates from intact deposits at two of the sites in the Q. Batán (Je 996 and 1002) suggest a somewhat more restricted time frame of regional occupation (ca. 11,100–10,600 RCYBP). Site Je 1002 yielded an AMS date of 11,014 ± 64 RCYBP (AA57942); site Je 996 yielded a date of 10,650 ± 50 RCYBP (Beta 185074) (Maggard 2010). Both dates are from wood charcoal samples from buried strata containing lithic debitage and tools of the same non-local raw materials (chalcedony and chert) used in the manufacture of the Q. Batán Fishtail points. These raw materials are different from those used in Paiján lithic manufacture and are considered to represent the Fishtail occupations at these sites. Other artifacts collected from Fishtail contexts included a variety of lithic tools (unifaces, bifaces, and retouched flakes) and limited faunal remains including South American fox (*Psuedalopex* sp.), peccary (Tayassuidae), and crab (Decapoda).

Because so few Fishtail sites in northern Perú have been documented, much less excavated, our understanding of Fishtail occupation in the Central Andes is severely limited. However, data from the Q. Batán sites are refining the regional temporal framework of Fishtail occupation, which appears to have been more restricted than in other parts of South America. Data from these sites are also providing important new insights regarding the technological, economic, and mobility patterns of Fishtail groups outside of the more thoroughly studied areas in the southern cone of South America.

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Early High-quality Lithic Procurement in the Semiarid North of Chile

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➤ **Keywords**: lithic procurement, quartz crystal, fishtail projectile points

The identification of high-quality quartz crystal as one of the main lithic resources used at the Quebrada Santa Julia campsite (Jackson et al. 2007; Méndez et al. 2007) motivated a regional search for potential procurement areas and functionally related sites. At Santa Julia, excavations uncovered a 13,100 CALYBP short-term occupation, where quartz crystal was observed to constitute ~40% of the chipping debris and fragments and was the material of two marginally retouched knives (of a total of eight retouched tools) and two

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other bifacial artifacts. Of the latter, one is a fragment of a preform of a fluted projectile point that refits to bifacial-reduction flakes from the same occupation floor. The exceptional quality of this rock, its evident association with megafauna at Santa Julia, and its presence at several other late-Pleistocene and early-Holocene sites across a wide region emphasized the importance of locating its source.

Within the Semiarid North of Chile, Rivano and Sepulveda (1996) previously mapped the regional occurrence of quartz in the inland localities of Caimanes (31° 56′ S) and Tilama (32° 05′ S), both ~35 km from the coast. Our research team designed and conducted systematic surface surveys along an area linking these two localities, 35 and 40 km from Santa Julia, respectively. Surveys assessed the quality and availability of potential lithic resources and performed archaeological surface sampling.

As for lithic resource occurrence, we sampled 11 localities, identifying mainly white non-translucent quartz rocks. In only two localities did we also observe translucent quartz crystal. This rock is observed mainly as concentrated outcrops (n = 7) and only rarely as stratified veins (n = 3). Most of the occurrences were of average or below-average chipping quality and were unsuitable for bifacial flaking. Among the places sampled we only observed six cases of modern small-scale mining exploitation and three cases of prehistoric quarrying.

Along the 17 km Caimanes/Tilama transect, surface surveys recorded 24 archaeological sites, primarily concentrated towards the southern area. Among these, at least 11 were identified as late-Holocene settlements on the basis of surface pot sherds as the main material component, and 9 were classified as indeterminable lithic concentrations. Among the other four aceramic sites, we selected Valiente site (CT14) for a preliminary 3-m^2 test excavation.

The site is located on an exposed profile (714 m.a.s.l.) immediately adjacent (~30 m) to a small intermittent ravine (Quebrada Naranjo) and next to one of the most significant currently exploited quartz concentrations. The deposit is composed mainly of clay and sand sediments with conspicuous quartz fragments. The excavations uncovered a ~70-cm deposit with a significant lithic assemblage comprising mainly bifacial debitage and preform fragments on quartz crystal of the highest quality locally available. Within the sample were found two Fishtail projectile-point stems, one of which refitted to a projectile-point preform mid-fragment (Figure 1) located ~150 cm away. Small charcoal particles and unidentifiable charred fragments of mammal bones are present but infrequent in the excavated deposit.

Despite the fact we do not yet have radiometric assays, we expect an early date for the Valiente site, at least contemporaneous with Taguatagua 2 (12,400–10,900 CALYBP), the only site within the wider region of Central and Semiarid North Chile with stratigraphic evidence of quartz crystal Fishtail projectile points (Núñez et al. 1994). Because of its location Valiente is therefore critically important for understanding early lithic procurement in the Semiarid North of Chile. Since Valiente lies 37.4 km away from the terminal-Pleistocene site of Santa Julia, it provides a minimum procurement distance for high-quality toolstone, and informs us about the possible mobility ranges for the earliest hunter-gatherers in the region. Jackson (1998) and

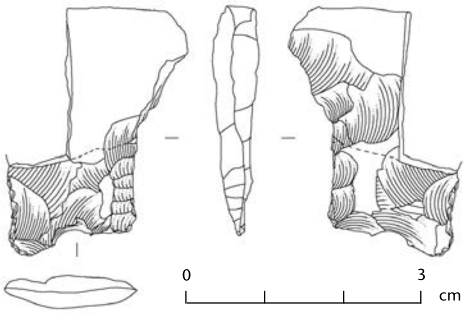

Figure 1. Refitted fragments of a Fishtail projectile-point preform in quartz crystal from CT14 (upper fragment #304, lower fragment #305).

Galarce (2005) have also recorded quartz crystal at early-Holocene coastal sites with lanceolate projectile points and noted the importance of inland localities for later well-established lithic-procurement strategies in the region.

Nami (2009) has recently noted the recurrence of glasslike crystal quartz in several Fishtail projectile points in localities in Uruguay and other areas of South America, attributing its use to both economic and cultural considerations. Nevertheless, the association of quartz crystal Fishtail and Paiján projectile points in Santa María, Perú (Briceño 1999, Dillehay 2000), suggests wider typological variability in the early use of quartz crystal. A similar scenario can be supported for Semiarid North and Central Chile, where the localities mentioned above show both Fishtail and other fluted variations manufactured on this rock, as does the one from Quebrada Santa Julia.

Research funded by FONDECYT 1090044 grant.

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Fishtail Points, First Evidence of Late-Pleistocene Hunter-Gatherers in Somuncurá Plateau (Rio Negro Province, Argentina)

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➤ **Keywords**: Fishtail points, Pleistocene/Holocene, north Patagonia

North and central Patagonia, eastward to Los Andes, shows an archaeological gap regarding early human occupation (Miotti and Salemme 2004). However, little evidence about Pleistocene archaeological sites from the cordillera and foothills at similar latitudes has been reported (Ceballos 1982; Dillehay 1997; Hajduk et al. 2004). In this paper, we present new evidence about this topic from Somuncurá Plateau.

Somuncurá is a basaltic plateau 10,000 km^2 in area at 1000 m.a.s.l. surrounded by ranges of hills. Volcanoes and other volcanic features are common. The plateau is cut by numerous canyons and "bajos" with streams or shallow lagoons. Land and aquatic fauna is rich and diverse, and freshwater springs are abundant. Archaeological variability is great, showing sites related to hunting, burials, quarries and workshops, furniture, domestic activities, and rock art. An important landform in the area is a pair of high mesas called Cerro Amigo Oeste (AW) and Cerro Amigo Este (AE). Evidence about the earliest human occupations is from the Los Dos Amigos locality (LDA), located on the top and uppermost slope of AW, as well as another site on a nearby low plain (LDA-5). There are no radiocarbon dates for the locality yet (Figure 1A).

LDA-5, which expands at the bottom of the mesas, is cut by a gully flowing and emptying into the Las Vacas lagoon. In this site two Fishtail projectile points made from chalcedony were associated with other lithic artifacts.

The most relevant site in the region is AW, located 1350 m from LDA-5. At the amazing archaeological locality situated on the top of the mesa were discovered 116 Fishtail points (similar to stemmed Fell points) and bifaces, knives, large flakes with marginal retouch, discoidal stones (n = 4), and one polished ocher sphere 22.8 mm in diameter. Most artifacts are broken. Of the Fishtail points, only 10 are complete; 100 are stems or stems with the proximal part of the blade. In contrast, on the eastern mesa (AE) there was no archaeological material.

Local chalcedony (n = 85) is the main raw material for the Fishtail points;

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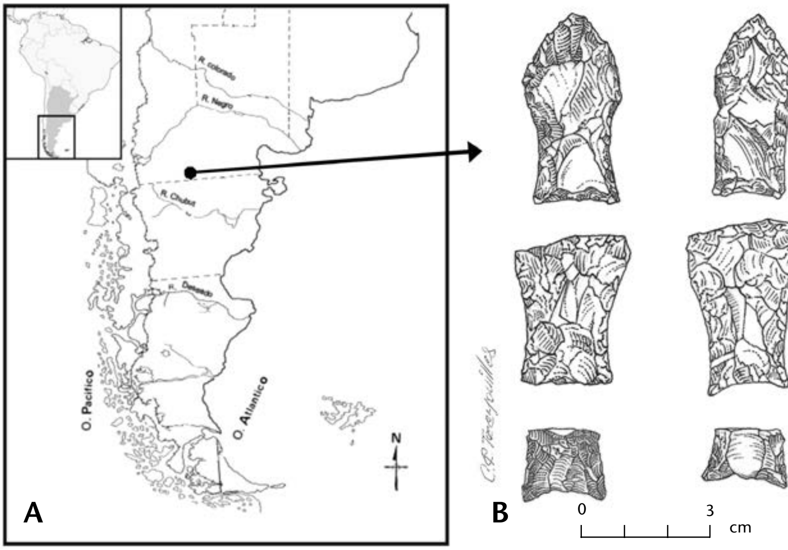

Figure 1. **A**, map; **B**, Fishtail points from AW hilltop.

however, obsidian (n = 8), red jasper (12), crystal quartz (5), and colored flints (6) were found (Figure 1B). This high variability of raw materials at AW implies human mobility within 15 km, the distance to an Aneken chalcedony quarry. Recent XRF geochemical analyses characterize the raw material of the points (Miotti et al. 2010) and thus identify its geographical source. These preliminary data, in conjunction with other technological information, indicate that the local obsidian most widely represented in the archaeological context was obtained from various local sources. However, one extra-regional source appears to be represented in the sample, possibly the Cerro Castillo obsidian source, which lies more than 80 km distant. These geochemical results contribute to our understanding of the spatial organization of early human societies inhabiting Patagonia.

Fishtail points at the locality spatially are distributed heterogeneously. They appear to be concentrated at the top of the mesa (AW), and are very scarce and dispersed on the plain below (LDA-5). The Fishtail points in both zones were broken, and at AW mesa-top they were frequently preformed, revived, and recycled. In some cases they appear broken and abandoned. Although the mesa-top is a basaltic crown surface without sedimentary deposits, there are deposits of loess at the bottom of the hill that may contain archaeological material. The markers invite us to infer that AW functioned as a lithic workshop, like Cerro El Sombrero (Flegenheimer 2003) and Cerro de los Burros (Meneghin 2004), and that the plain may have been used as a hunting field.

LDA is important because, like Cerro La China, Cerro El Sombrero, and Cerro de Los Burros, it is a hilltop enclave yielding more than 100 Fishtail points. On the other hand, Cerro Amigo Oeste is the first context in Patagonia whose occupation during the Pleistocene/Holocene transition appears to be related to the manufacture of Fishtail points. LDA is the first reliable evidence of human occupation during the Pleistocene/Holocene transition (13,000–8500 RCYBP) in the North Patagonia plateau and therefore represents a new point of interest on the map of the First Americans.

Not only was the locality the site where lithic technology was practiced, it was also a vantage point that commanded the surrounding plain. The differential use of space by the first hunter-gatherers suggests they were keenly aware of their surroundings and adept at creating new dialogs between the landscape and themselves. Similar evidence is found in other island promontories of Pampa and Patagonia, such as Cerro El Sombrero and Cerro de Los Burros, that people exploring and colonizing the empty regions of Patagonia needed to reinforce social communication. Archaeological evidence from these sites rewards us with insight into their thriving lithics industry (Miotti and Terranova 2010).

Agencia de Promoción científica y tecnológica, Argentina (ANPCyT) (grant 12687) and CONICET (grant 5885) support investigations on early human occupation in Patagonia. CODEMA Río Negro province and El Caín neighbors kindly welcomed us and accommodated us during our successful field seasons. Liliana Kugel helped with the English translation.

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New Paleoindian Finds and Microwear Analysis at the Arroyo Cacique Site, Tacuarembó Department, Uruguay

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➤ **Keywords**: Fishtail points, microwear, Uruguay

The Middle Negro River basin in the central part of Uruguay has produced an unusual archaeological record. Over the years Paleo South American remains were recovered as isolated finds or in archaeological sites. One of these sites, Arroyo Cacique (AC, Tacurembó Department; 32° 41′ 54.30″ S, 56° 11′ 30.66″ W), yielded diverse terminal-Pleistocene/Holocene projectile points and unifacial tools. Among them were unequivocal Paleo Southamerican Fishtail points, systematically dated in the Southern Cone at ca. 11–10 kya (Nami 2007). AC is currently submerged beneath the Rincón del Bonete Lake. When the water level falls, however, a small island about 200 by 800 m with archaeological remains emerges. Paleoindian finds were reported previously (Nami 2007: Figure 4), and several recent visits have produced additional artifacts (Figure 1A–E) consisting of Fishtail points (AC1–3), unifacial tools (AC4–5) and a bladelike flake (AC6).

A brief description of each piece follows, with dimensions (length, width, and thickness in mm) in parentheses. AC1 (Figure 1A) (17.0 x 21.9 x 6.2) is a red chert Fishtail stemmed point fluted on both faces and probably broken by use. AC2 (Figure 1B) (27.5 x 18.8 x 7.8), made from crystal quartz, shows a flake starting at the tip and ending at a step fracture, possibly produced by impact, that eliminates a great part of the blade. The blade does not have enough mass to bear continued resharpening, and for this reason it was probably discarded. AC3 (42.1 x 19.0 x 8.6, Figure 1C), made on dark brown silicified sandstone, has a fracture on the tip, and a step and burin-like fracture located on one border and the opposite edge. As usual on Fishtail points, the margins of the stem are highly abraded. These points show signs of resharpening and fractures from use, a common condition seen on other Fishtail points from South America (Nami 1998, 2000).

The state of the projectile points suggests that they were probably brought to the site on foreshafts and that repair of weapons was one of the activities performed there. AC2 reaffirms that Fishtail-producing hunter-gatherers preferred crystal quartz as raw material (Nami 2009). The similarity of AC3 to a

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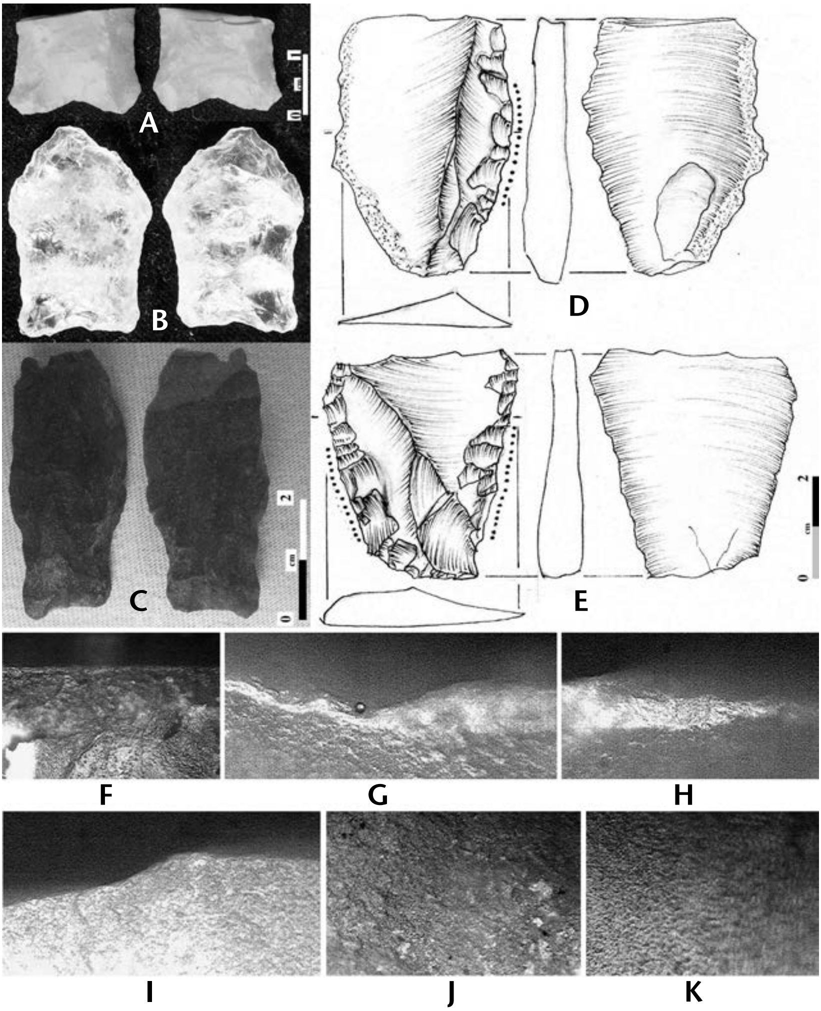

Figure 1. **A–E,** Paleoindian artifacts recovered at Arroyo Cacique site. **A,** Fishtail fluted stem; **B–C,** Fishtail points; **D–E,** unifacial tools showing microwear location along the edges; **F–J,** photomicrographs of the damage observed during microwear analysis; **F,** functional edge of AC4 used to scrape an undetermined hard substance; **G–H,** micro lunar flakes and micropolish that might be attributed to bone observed on AC5; **I–J,** natural edge and surface of AC6 showing generalized luster; **K,** experimental fresh fracture, which lacks the luster shown in previous images.

Fishtail point found at Cueva del Medio in southern Chile is remarkable (Nami 1985-86: Figure 6, 1987: Figure 16a).

Three pieces that might be considered part of the Paleoindian lithic assemblage by virtue of striking technological and typological similarities were also recovered (Nami 2007). Two are unifacial tools, AC4 (Figure 1D) (53.2 x 25.8 x 8.9) and AC5 (Figure 1E) (46.3 x 39.5 x 8.2); AC6 (52.2 x 32.8 x 9.7) is a nonretouched distal part of a bladelike flake made on red chert, a stone commonly used by early hunter-gatherers in this part of the continent. Flake blanks of these tools show careful platform preparation and diffuse bulbs and lips, suggesting use of some kind of strategy for preparing the core and detaching flakes using a variation of soft percussion flaking (Nami 2006).

Use-wear analysis on these pieces was done using the “high power” approach following Keeley’s (1976, 1980) methodology. Polishing intensity and striations were analyzed with a UNION metallographic microscope with magnification between 100x and 300x. Despite the fact that AC artifacts came from an underwater site, their edges and ridges do not show water alterations (rounding by water abrasion, salt deposit, or an opaque patina) such have been observed in the late Pleistocene/early-Holocene artifacts from the flowed zone of Los Toldos cave 2 (Cardich et al. 1993–94). The generalized luster, however, suggests some wind polishing with sand. AC4 shows non-intensive generalized luster on the entire surface and small striae with perpendicular orientation to the functional edges, indicating that it was used to scrape an unidentified hard substance (Figure 1F). Both edges of AC5 have polishing striations and a few semilunar flakes that suggest the tool was used with a longitudinal action for cutting a hard substance, probably bone (Figure 1G–H). Finally, specimen AC6 shows no functional wear, but has generalized luster and abrasion on the natural edges and entire surface (Figure 1I–J). This modification did not occur on a fresh fracture experimentally produced in a piece of the same raw material (Figure 1K).

In summary, the new finds from the AC site provide additional details on the lithic technology employed by Paleo South American hunter-gatherers living in the eastern part of the Southern Cone during the terminal Pleistocene. They also further our understanding of stone tool function and technological organization, a topic not very well known in this part of the South America.

We are indebted to the University of Buenos Aires and CONICET (PIP-114-200801-00344) for their continuous support; Museo Nacional de Historia Natural y Antropología de Uruguay for having sponsored the archaeological research in Uruguay; A. Toscano, Director of the museum, for his support; A. Florines for his constant support, help, and counsel in different aspects of this research; S. Bálsamo and V. Carbalho for their help in the study their collections; M. Meneghin for help with the figure; and Betty Meggers especially for editing an earlier draft of this paper.

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Extinct Fauna, Palimpsest and Scavenging in the Semiarid North Coast of Chile

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➤**Keywords**: Extinct fauna, palimpsest, scavenging, Chile

As part of a Pleistocene peopling interdisciplinary research program (FONDECYT 1090044) we have been studying surface and stratigraphic sites with possible associations between extinct fauna and cultural evidence in the Semiarid North of Chile (Jackson et al. 2003; Méndez and Jackson 2006; Méndez et al. 2004). One of these sites, El Avistadero (LV.100; ~32° S) is located on a coastal marine terrace (40 m.a.s.l.) with overlying dune fields (Figure 1). Southwest wind deflation has exposed a red clay deposit corresponding to the upper part of the terrace (Varela 1981) along with extinct faunal remains and lithic tools.

To assess cultural associations at the site, we conducted surface samplings (40 m^2) and stratigraphic excavations (16 m^2) immediately to the north and south of the dune system circumscribing the main deflation area. The stratigraphy of the excavation showed an 80-cm clean sand paleodune deposit with sandy clay sediments towards the base. In the basal deposit we recovered volcanic tuff cores and lithic debitage (obtained from an adjacent rock out-

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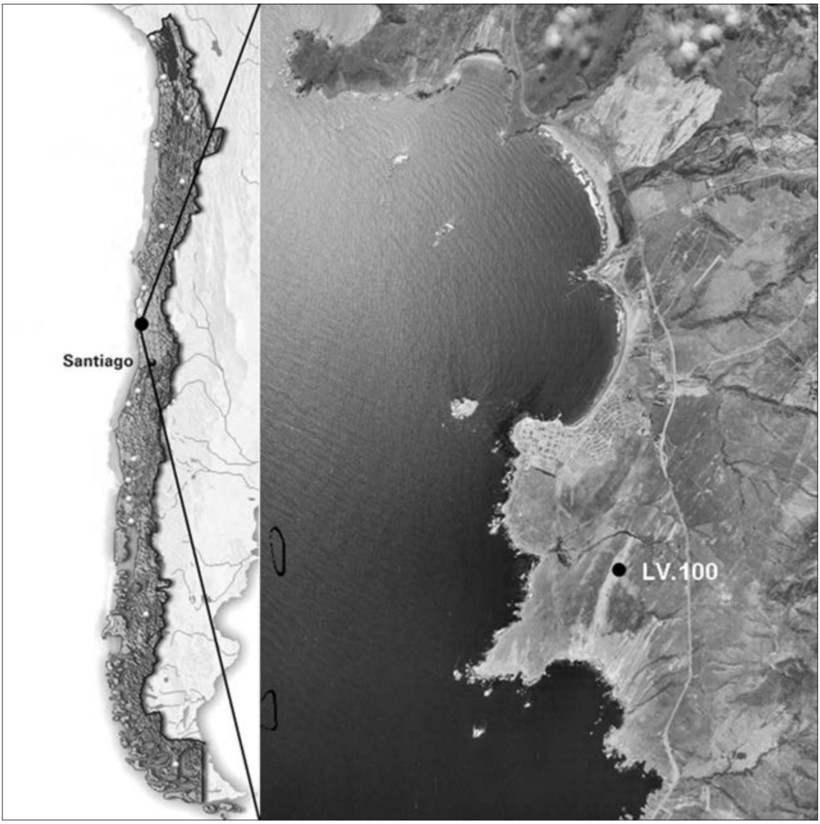

Figure 1. Location of the study area and El Avistadero site.

crop) associated with isolated charcoal pieces. One of these charcoal samples yielded an age of 240 ± 50 RCYBP (Beta-188336) suggesting undetected historic stratigraphic perturbations. A thermoluminescence date on a rock exposed to fire yielded a result of 7500 ± 500 CALYBP (UCTL-1576), an age consistent with lithic evidence expected at a middle-Holocene hunter-gatherer procurement and biface-thinning location.

In the surface sample from south of the deflated area we collected cores, bifacial thinning flakes, and one triangular projectile point manufactured on tuff from the nearby outcrop, along with small unidentified bone fragments with fire marks and extinct faunal remains, some embedded in the clayish matrix. In the north surface sample we only recorded dispersed extinct faunal remains within the sandy clay deposit. The extinct fauna includes *Equus* (*Amerhippus*) sp., represented by remains of the appendicular skeleton (humerus, femora, carpals, and teeth), *Palaeolama* sp., represented by several reassembled fragments of a basioccipital, and Mylodontidae, one claw and 81 osteoderms, the latter concentrated in just 1 m^2. Modern faunal remains include fox (*Pseudalopex griseus*) and rodents (*Octodon* sp.). The *Equus*

(*Amerhippus* sp.) femur exhibits dental carnivore marks consistent with gnawing by a small canid (López 2007). Some of the Mylodontidae osteoderms show digestive acid alterations, and their spatial concentration suggests a carnivore's fecal deposition (López and Jackson 2004), like the well-preserved *Panthera onca mesembrina*'s feces containing *Mylodon darwinii*'s hair and osteoderms recorded in Patagonia (Borrero 2001).

An *Equus* (*Amerhippus* sp.) sample yielded no collagen, thus precluding precise ^{14}C age determination. Nevertheless, the sample's position between the clay stratum and the sandy clay interphase is identical to a Mylodontidae vertebra dated to 13,500 ± 65 RCYBP in the nearby site of El Membrillo (Jackson 2003), thus suggesting a similar age for El Avistadero. This age also indicates the beginning of this and other analogous dune systems along the coast of the study area (Ortega 2006). Based on our contextual assessment, the association between extinct faunal and lithic remains at El Avistadero may be interpreted as juxtaposition resulting from the current intense eolian deflation. The middle-Holocene lithic evidence resulted from a hunter-gatherer occupation superposed on extinct faunal remains deposited several millennia earlier, near the end of the Pleistocene.

The evidence of extinct fauna deposited over the upper part of the marine terrace and during the beginning of the dune deposition is interpreted as a product of several carnivore scavenging events on the basis of the dispersion of remains, the few anatomical elements represented for each taxa, and the evidence of punctures and digestive acids. Carnivores carried and accumulated prey parts gathered at nearby sites, like Quereo's ravine, where a diverse but incomplete megafaunal assemblage has been observed (Núñez et al. 1994). The thorough study of contexts such as the one in El Avistadero has a twofold aim; it opens a window into the complex site-formation processes in sites of terminal-Pleistocene age, and it informs us about extinct carnivore/prey dynamics. In this sense, it helps to reconstruct the complex palaeoecological scenario that the first human immigrants faced in the region.

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Tres Árboles Site (RN2-2b), a Buried Late-Pleistocene Fishtail Site in Alluvium, Central Uruguay

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➤ **Keywords**: Fishtail, alluvium, Uruguay

The Tres Árboles site (RN2-2b) is located in central Uruguay (32° 44′ 29.7″ S 56° 44′ 10.7″ W) along arroyo Tres Árboles, where during a visit in May 2009 the authors verified the context of artifacts in alluvial sediments of probable terminal-Pleistocene to early-Holocene age. The site location was referred to us by Mr. S. Bálsamo, a local collector, who had obtained from this site a Fishtail point made from chert of the Queguay Formation. This Fishtail point (Figure 1B) is 65.7 mm long and 36.9 mm wide, with a 22.4-mm stem and a thickness of 8.4 mm. It exhibits basal thinning by long overlapping parallel retouches. The point is red and black with white spots. During the visit, two diagnostic artifacts were found in situ at a depth of about 250–280 cm below the surface of an alluvial terrace tread within the eroding terrace scarp, including: (1) a biface in the initial stage of reduction manufactured from chalcedony (Figure 1A), which was thinned from a rounded pebble and exhibits one face totally with flake scars, whereas the opposite face exhibits about 40% cortex; and (2) a blade tool of silicified limestone (Figure 2C). Other artifacts, which were out of context and had been washed out onto the sloping ground surface, include endscrapers, sidescrapers, and informal tools from flakes.

The terrace scarp exposes basalt bedrock at a depth of 300 cm, which is overlain at 280–300 cm by a Ck horizon of dark yellowish-brown (10YR 4/4) gravelly silty clay loam that is calcareous, with many 0.5- to 1.0-cm-diameter

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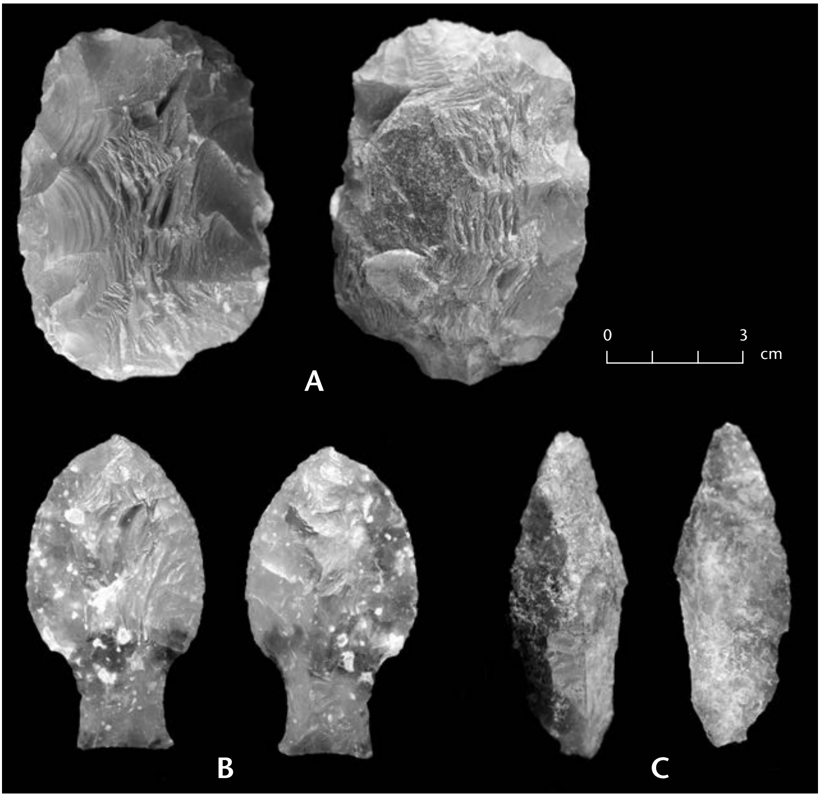

Figure 1. Diagnostic Paleoamerican tools from the Tres Árboles site: **A,** biface of chalcedony; **B,** Fishtail point of chert; **C,** blade tool of silicified limestone.

secondary carbonate concretions. The Fishtail artifacts occur immediately above the gravelly Ck horizon at 250–280 cm in the basal part of a dark brown (10YR 3/3) clay to silty clay loam that constitutes a Bkb horizon, which also contains secondary carbonate concretions. This Bkb horizon is about 1 m thick (180–280 cm). The Bkb horizon is overlain by a leached Bb horizon that is a very dark brown (10YR 3/2) clay loam at a depth of 104–180 cm. The Bb horizon is capped by a cumulic buried A horizon (Ab) of very dark grey (10YR 3/1) loam that grades upward into silty clay loam at a depth of 70–104 cm. The buried A horizon is capped by very dark brown (10YR 3/2) silty clay loam that exhibits faint thin (< 2 cm) planar beds and a few stringers of granules and fine pebbles. This stratigraphy indicates that the Fishtail artifacts occupy the basal vertical accretion deposits of a 2.8-m-thick sequence of overbank deposits that probably span the terminal Pleistocene and Holocene. It suggests the people of the Fishtail culture occupied a riverside/floodplain campsite that was subject to flooding.

The Tres Árboles site (RN2-2b) is a potentially important site that will contribute to better understanding of the Fishtail adaptations ca. 11,000–10,400

RCYBP (13,000–12,200 CALYBP) (Suárez 2010) in central Uruguay. Indeed, the buried context of this site is rare, and it should further resolve regional Fishtail stylistic chronologies. Future research will focus on obtaining archaeological and chronological data through extensive excavation of the site.

Thanks to Mr. S. Bálsamo for allowing study and photography of his archaeological collection.

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Archaeology: Northeast Asia

Hunter-Fisher-Gatherer Settlement Dynamics in Toyama Prefecture, Honshu, Japan

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➤ **Keywords**: Hunter-fisher-gatherers, Pleistocene-Holocene, Japan

The Pleistocene-Holocene transition of Japan was a time of significant cultural and environmental change as it was in other parts of east Asia and worldwide. Toyama Prefecture (hereafter, Toyama) represents a 4250-km^2 region surrounded by mountains on three sides and Toyama Bay along the Sea of Japan in west-central Honshu. In Toyama, the late Paleolithic Period spans 30,000–16,500 RCYBP (Anbiru 1986). The development of pottery ca. 16,500 RCYBP marked the end of the late Paleolithic Period and beginning of the Jomon Period that continued into the late Holocene (16,500–2400 RCYBP). Although pottery became a hallmark of the Jomon culture over the millennia, the Jomon people remained primarily hunter-fisher-gatherers (Koyama 1978), peaking during the middle Jomon sub-period at 5500–4400 RCYBP during the Holocene climatic optimum. Many scholars argue that Japanese hunter-fisher-gatherers were increasingly sedentary over time with food processing (drying, salting, etc.), food storage, semidomesticated plants and animals, and exchange systems offsetting the need for frequent group movement (Kobayashi 2004; Uchiyama 2006, 2008). If this is the case, one might expect a broader distribution of site clusters as dependence on localized resources diminished, a pattern that is evidenced in the analyses that follow.

Analyses of sites in Toyama dating to the late Paleolithic (n = 170) and Jomon (n = 1142) period are yielding valuable insights into the long-term cultural trajectories of these hunter-fisher-gatherers. Toyama consists of three basic physiographic zones: mountains, hills, and plains (Figure 1). Occupation of the mountains was restricted to lower altitudes along major valleys and appears continuous through time owing to topographic restrictions on settle-

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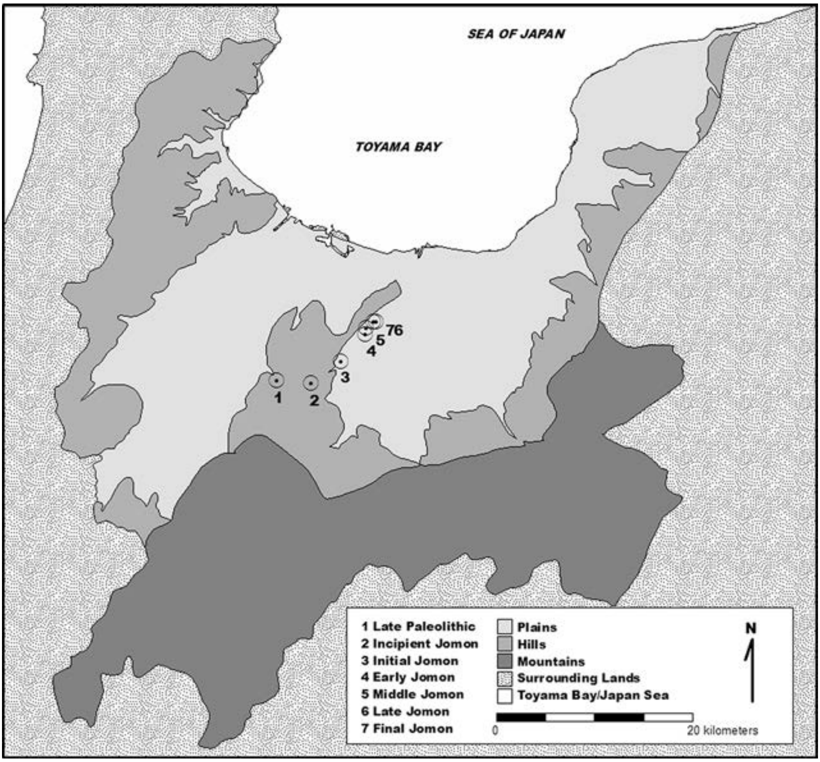

Figure 1. The geographic mean of site locations through time traces the northeastern migration of hunter-fisher-gatherers from the interior hills to the alluvial and coastal plains of Toyama Prefecture, Japan.

ment. However, occupation of the neighboring hills and plains was significantly more complex.

Average nearest-neighbor-distance (ESRI 2009) of the geographic distribution of archaeological sites indicates that they are significantly clustered for each sub-period (0.01 confidence level). Further, Moran's I index of spatial autocorrelation (Moran 1950) of the time-sliced series of sites by sub-period indicates that the locations of site clusters also vary significantly over time (0.05 confidence level). Likewise, there is a gradual shift in land-use from the diverse edge environs of the hills along the mountains-plains interface, to the plains of Toyama over time, suggesting less dependence on localized resources and a wider distribution of settlement. By calculating the geographic mean of site locations for the late Paleolithic and six Jomon sub-periods, a northeasterly shift in settlement toward the plains is evident (Figure 1).

Chi-square tests (X^2) of observed versus expected frequencies of sites within the hills and plains environmental zones further reveal shifts in settlement patterns over the millennia. During the late Paleolithic period (30,000–16,500 RCYBP), sites are significantly associated with the hills environmental zone. It is hypothesized that this zone was the most ecologically diverse, representing a major edge environment that was more stable than the fluctuating coastline of the time. During the Pleistocene, this was a cool deciduous broadleaf forest environment lying between the mountains and Toyama Plain. The nearby plain was likely occupied by large herbivores (e.g., Yabe's giant deer/elk, *Sinomegaceros yabei*, and Naumann's elephant, *Palaeoloxodon naumanni*) suitable for episodic subsistence hunting by Paleolithic people of the region (Keally 1991). Research on the timing of Pleistocene extinctions in Japan suggests that it does not correlate with the arrival of humans, but rather occurred gradually over many millennia (ca. 30,000–10,000 RCYBP; Hudson 2007; Kawamura 1985; Keally 1991; Norton et al. 2010), indicating big-game hunting was simply a part of a more diverse subsistence strategy. Populations from terminal late Paleolithic through initial Jomon (ca. 20,000–7000 RCYBP) likely hunted modern species as well, such as wild boar (*Sus scrofa)* and Sika deer (*Cervus nippon*), as did later Jomon groups during the middle to late Holocene (ca. 7000–2400 RCYBP).

During the terminal Pleistocene through early Holocene (incipient-early Jomon, 16,500–5500 RCYBP), sites are not significantly associated with either physiographic zone. This may reflect the development of a settlement system and foraging adaptation that is geographically dispersed and based on food storage and secondary processing, following the forestation of open lands on the plains and increased occurrence of nut-bearing trees throughout the region. The warm temperate broadleaf deciduous and evergreen forests of the time were also an excellent setting for the wild boar and Sika deer that appear in the archaeological record (Inaba 1983). The exploitation of riverine and near-shore maritime resources likely increased during this time as well, further spreading population clusters as sea levels rose and river systems stabilized. Future analyses will shed further light on cultural landscape changes by exploring site function/hierarchy, territories, and exchange networks of the region.

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Origin and Evolution of the Late Paleolithic Microindustry in Northern Mongolia

Sergei Gladyshev, Andrei Tabarev, and John W. Olsen

Keywords: Mongolia, Paleolithic, microblade technology

In 2009, a tripartite Russian-American-Mongolian team continued investigating the stratified Tolbor-15 site in the Khangai Mountains of northern Mongolia (Gladyshev and Tabarev 2009). Newly recovered data are very encouraging with respect to the quest for the origin and development of the *pressure* microblade technique in northeast Asia.

The earliest example of microblade technology at Tolbor-15 was identified in Horizon 5 (Figure 1A), a boat-shaped microcore fashioned on a trihedral blank (Figure 1, *12*). All microcores except this one were produced by percussion, and the percentage of microblades in the horizon overall is very low. The single associated radiocarbon date from this horizon (28,460 ± 310 RCYBP; AA-84137, ostrich egg shell fragment) could signal one of the earliest manifestations of the microblade technique in northeast Asia (Kuzmin et al. 2007:120).

The subsequent development of this technology is manifest in Horizons 3 and 4 at Tolbor-15, which contains two types of microcores; those produced on thin flakes with retouched bases and a narrow blade-removal surface (Figure 1, *8–10*), and a second type made on bifacial preforms with platforms prepared by the sequential removal of ski-spalls (Figure 1, *11*). The number of microblades in both Horizons 3 and 4 is dramatically increased over earlier strata, while the associated radiocarbon dates clearly indicate the later chro-

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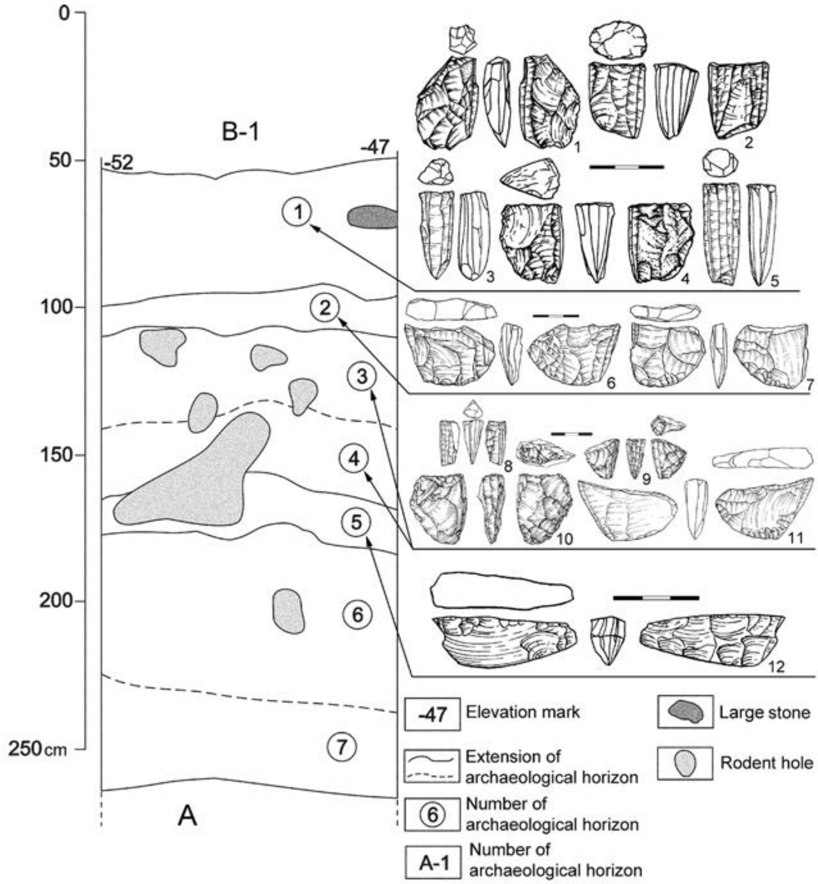

Figure 1. **A,** Tolbor-15, southern profile; ***1, 2, 4,*** microcores with narrow flake-removal surfaces (Horizon 1); ***3, 5,*** conical microcores (Horizon 1); ***6, 7,*** wedge-shaped microcores (Horizon 2); ***8–10*** **,** microcores with narrow flake-removal surfaces (Horizons 3–4); ***11,*** wedge-shaped microcore (Horizon 4); ***12*** **,** boat-shaped microcore (Horizon 5).

nology of these assemblages: 14,056 ± 81 RCYBP (AA-84136) and 14,930 ± 70 RCYBP (Beta-263742) for Horizon 3; 14,680 ± 70 RCYBP (Beta-263744) and 14,820 ± 70 RCYBP (Beta-263745) for Horizon 4.

The same conditions of preparing and exploiting microcores characterize Tolbor-15, Horizon 2, in which microblades dominate the total number of removals. Horizon 1 yielded two varieties of microcores, those with narrow blade-removal surfaces on flakes (Figure 1, *1, 2, 4*) and microconical cores (Figure 1, *3, 5*). The production of this type was possible only by using a fixed, though presumably portable, vise. Typically, such cores cease to be reduced owing to the failure to maintain a proper angle between the platform and flake-removal surface. While the optimal angle is about 65°–70°, this reduction strategy approaches 90°, leading to deformation of the core's flake-removal surface. An alternative device would have been required for reducing microconical cores because of the necessity of constantly rotating the core. Microcore reduction yielded microblades, which, with additional ventral retouch, were employed as lithic insets in composite tools.

A wide range of analogous microcores, similar to those excavated from Horizons 1 and 2 at Tolbor-15, are known in Mongolia and adjacent territories of Central and Eastern Eurasia.

Evidence of pressure-based—rather than percussion-based—microblade technology at Tolbor-15 clearly demonstrates for the first time in this region the evolution of later-Pleistocene lithic industries down to the Pleistocene-Holocene boundary, providing a better basis for elucidating chronological and cultural frameworks for the Paleolithic-Neolithic transition in northern Mongolia.

Our research was supported by grants # 09-06-00006a and # 10-06-93160 Mong-a from the Russian Foundation for Basic Research and the Je Tsongkhapa Endowment for Central and Inner Asian Archaeology at the University of Arizona.

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Use-Wear Analysis of Burins and Burin Blanks of the Sugikubo Blade Industry in Central Japan

Akira Iwase

Keywords: Use-wear analysis, burin, burin blank, projectile point, Sugikubo blade industry, Japanese Archipelago

Investigation of the archaeological record of northeast Asia around the last glacial maximum (LGM) is crucial for understanding the peopling of the Americas (e.g., Goebel 1999; Goebel et al. 2008; Graf 2009; Madsen 2004). Graf (2009) suggested that after the LGM the re-colonization of Siberia originated in maritime eastern Asia, including Japan. Therefore, understanding human technological adaptation to the temperate forests of the Japanese Archipelago, which differed from the cold and arid environments of higher latitudes in Asia, may contribute to understanding the repopulation of Siberia and, in turn, the peopling of the New World.

To address the issue of adaptive technology, I have presented the use-wear

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analysis of Sugikubo-type points (Iwase 2009) and Kamiyama-type burins (Iwase and Morisaki 2008) from Late Upper Paleolithic sites in central Japan. Building upon previous analyses, this study reports the results of an additional use-wear analysis of Sugikubo-type points recovered from the second excavation locality of Uenohara site, Nagano Prefecture, central Japan (36° 482′ 463″ N, 138° 112′ 573″ E). Iwase (2009) demonstrated that Sugikubo-type points (Figure 1A) were multifunctional projectiles and knives. Broken or unusable Sugikubo-type points were also frequently recycled into burins (Figure 1B) and burin blanks (Figure 1C). The proximal end of a broken point was usually modified. Techno-morphologically, a burin blank has typical scraper edge-like retouches on the distal end (Figure 1C), from which burin spalls would be removed (Sawada 1996). Transformation of points into burins and burin blanks is inferred to be one of the characteristics of the Sugikubo blade industry (Morisaki 2004), which dates to roughly 20,000–18,000 RCYBP in north-central Japan (Iwase and Morisaki 2008).

Use-wear analysis employed the high-power approach (Keeley 1980) and followed procedures described elsewhere (Iwase 2009; Iwase and Morisaki 2008). Five recycled Sugikubo-type points were analyzed; three are burins, and two are burin blanks. Two specimens (Figure 1B, C) showed traces of use. Specimen F3-5 (Figure 1B) is made from hard shale; it has a rough and pitted polish accompanied by well-developed abrasion and diffuse shallow striations oriented parallel to the right lateral edge (Figure 1D, E) on the ventral and dorsal faces. These use indicators suggest that this tool was used to cut dry hide (Kajiwara and Akoshima 1981). In contrast, the burin-facet edge is unused (Figure 1F); a burin blow to the specimen probably eliminated or rejuvenated the used lateral edge (Vaughan 1985). Specimen E4-104 is an obsidian burin blank (Figure 1B). Bright, smooth, and rounded polish is located on the margin of the scraper-like edge (Figure 1G). This polish resembles fresh hide polish (Midoshima 1986). The faint striations run obliquely to the bit edge, implying use as a scraper. On the ventral face of left lateral edge, faint striations are perpendicular to the working edge (Figure 1H). This lateral margin also is abraded (Figure 1I). Although polish was not observed, fine shallow striations and marked abrasion on the margin suggest that this edge was used to scrape a relatively soft material like hide. These results indicate that the burin blank itself was also used without burin blow.

The use-wear traces on the burin and burin blank suggest that they were used to work hide, while use indicators on the Sugikubo-type point infer hunting and cutting meat or other soft materials (Iwase 2009). These results indicate that Sugikubo-type point was used in animal resource processing works after being modified into a burin and burin blank. The paucity of evidence for tool use on hard animal materials like bone and antler (Iwase and Morisaki 2008; Iwase 2009; this paper) implies that hunter-gatherers adapted to the temperate forests of central Japan had not fully developed the lithic technologies to shape bone or antler weapons (e.g., microblade slotted points). This technology probably differed from those of higher latitudes in Asia and is macroscopically correlated with the richer timber resources of temperate forests in central Japan. Given that the re-colonization into Siberia

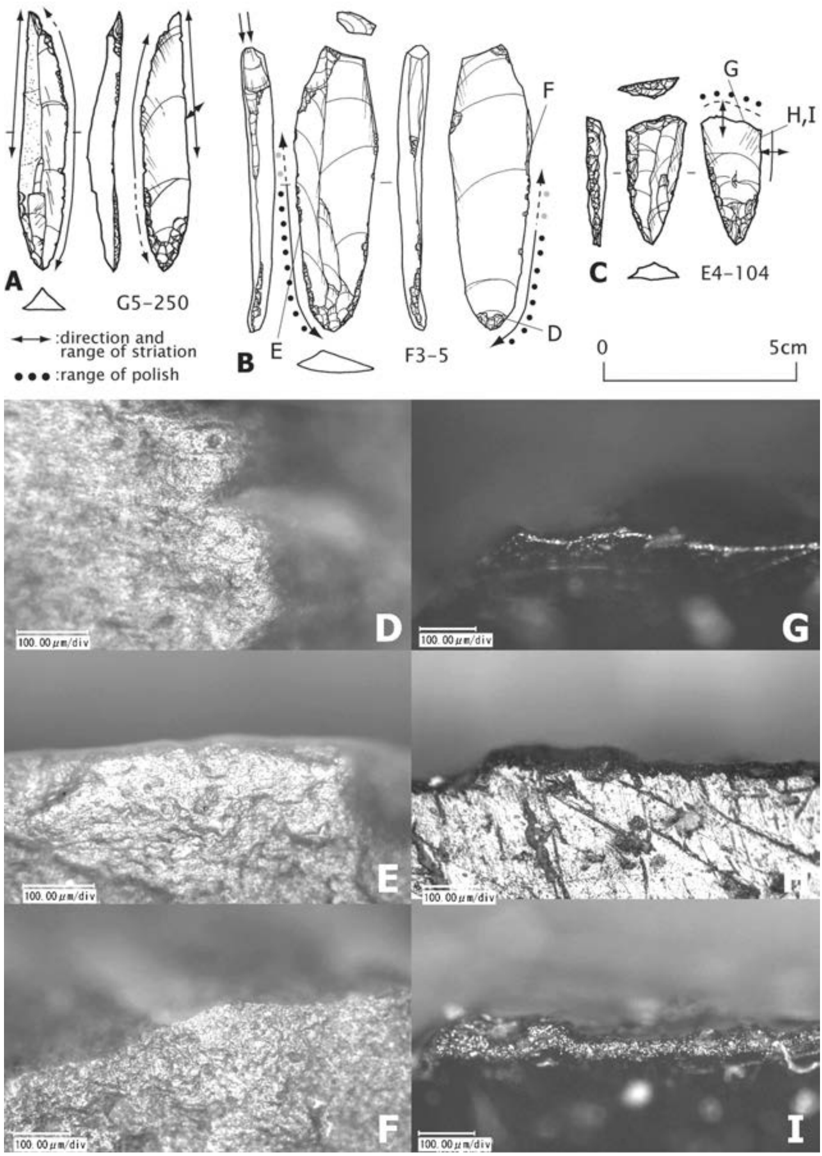

Figure1. **A,** Sugikubo-type point; **B-C,** a burin and burin blank recycled from a Sugikubo-type point; **D–I,** microscopic use-wear traces on the burin and burin blank. The letters in the upper illustrations (**B–C**) correspond to the lower photographs.

originated from the Japanese Archipelago, the possible region of origin was the northern provinces, where there were fewer timber resources and where the toolkit and technology to utilize the bone and antler as weapon materials had highly developed. In Japan it is extremely rare to recover organic materials from archaeological sites. The use-wear analysis will contribute to the inquiry into the technology to make the osseous implements.

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Radiocarbon Age of the Paleolithic Layers at Ushki 1 Site, Kamchatka (Northeastern Siberia): New Dates from the N. N. Dikov Excavation in 1989

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Keywords: Ushki 1, Upper Paleolithic, Kamchatka Peninsula, Northeastern Siberia

The Ushki site cluster on the Kamchatka Peninsula is well known for its role in the discussions of peopling the New World. For a long time, the Kamchatka Peninsula was seen as possible "jumping-off point" from northeastern Siberia (or western Beringia) to the east, to Alaska, and farther into the New World (e.g., Dikov 1996:250). The first ^{14}C dates measured in the 1960s and 1970s were ca. 14,300–13,600 RCYBP from the lowermost component of the Ushki 1 site (layer 7); and ca. 10,800–10,400 RCYBP (e.g., Dikov 1996) from the overlying layer 6. Consequently, layer 7 of the Ushki cluster could have a direct relationship to the initial peopling of the northwestern North America (e.g., Dikov 2004:32–37) because at present the earliest sites in Alaska are dated to ca. 12,000 RCYBP (e.g., Hoffecker and Elias 2007:108).

Excavations in 2000 and subsequent ^{14}C dating of Ushki 1 and 5 sites challenge the initial age determination for the Ushki cluster (Goebel et al. 2003). According to new ^{14}C dates from eastern and central profiles at the Ushki 1 site, layer 7 dates ca. 11,300–10,700 RCYBP, while layer 6 dates ca. 11,100–10,000 RCYBP (Goebel et al. 2003); in this case, layer 7 of Ushki sites do not have direct relationship to the initial peopling of North America (Goebel et al. 2003:504). However, samples for ^{14}C dating in 2000 were collected away from the grave pit in layer 7 (T. Goebel, pers. comm. 2007), where N. N. Dikov obtained charcoal in the 1960s which was dated to ca. 14,300–13,600 RCYBP (see Dikov 2003:41).

In September 2005, two charcoal samples from the 1989 excavation campaign of the Ushki 1 site were obtained from the Northeastern Multidisciplinary Research Institute (Magadan) facilities. These samples were originally collected and recorded by the late Prof. N. N. Dikov (see Dikov 1993:11–22). Charcoal from layer 7 was taken from grids m-7 and m-8 in Dwelling 10 (Dikov 1993:12–13), and charcoal of layer 6 was obtained from grids d-17, d-18, e-17, and e-18 (Dikov 1993:20–21, inset). Dwelling 10 is located 20 m south of the grave pit (Dikov 1993:12–13) where ^{14}C dates of ca. 14,300–13,600 RCYBP were obtained.

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AMS ^{14}C dating of these samples was performed at the Arizona Laboratory in March 2006. From layer 7, the age is 11,070 ± 60 RCYBP (AA-69057; $d^{13}C$ = -26.6‰) (calendar age with ± 2 sigma is 12,890–13,100 CALYBP); and from layer 6 the age is 10,170 ± 60 RCYBP (AA-69055; $\delta^{13}C$ = -25.5‰) (11,420–12,080 CALYBP). These values are concordant with data received by Goebel et al. (2003) and the latest dating results of other N. N. Dikov's samples (Goebel et al. 2010).

Given the phenomenon of wide variation of ^{14}C dates at the Paleolithic sites in Siberia and elsewhere (e.g., Fiedel and Kuzmin 2007; Kuzmin and Keates 2005), it is still not possible to reject completely the previous age of layer 7 at the Ushki 1 site (e.g., Dikov 1996, 2003). In our opinion, this may be possible if additional excavation and sampling occur at the part of site near the grave pit where the first samples were collected in the 1960s.

This research was partly funded by the Russian RFFI (06-06-80258) and U.S. NSF (EAR 06-22305). We are grateful to Dr. T. Goebel (Texas A & M University, College Station, TX, USA) for providing details of the 2000 excavation campaign at the Ushki sites.

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On the Spatial Distribution of Hearths in the Last Glacial Maximum Occupation of Kawanishi C, Hokkaido

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➤ **Keywords**: hearths, Last Glacial Maximum, Hokkaido

In this paper we report on the Last Glacial Maximum (LGM) human occupation at the Kawanishi C site and propose two alternative hypotheses to explain space use based on arrangement of the evident hearth features. Kawanishi C is an open-air site located on the Tokachi Plain, southeastern Hokkaido (Japan) (42° 52′ 50″ N, 143° 11′ 00″ E, ca. 70 m.a.s.l.) (Obihiro Board of Education 1998). The site is situated on the middle "Kamisatsunai I" terrace on the left bank of the Urikai River, a confluence of the Satsunai River, which is part of the Tokachi Plain drainage to the north. To mitigate the impact of housing construction and an associated road, 3090 m^2 was excavated in 1996 and 1997, directed by M. Kitazawa, the principal archaeologist of the Obihiro Board of Education. Although a small assemblage with microblades (n = 172) was discovered in a loam deposit above the En-a tephra (dated to ca. 17,000–15,000 RCYBP), the majority of lithic artifacts and pigments consisting of red (hematite) and black (magnetite) (n ≈ 18,000) were in separate beds between the En-a tephra and the Spfa-1 tephra (ca. 45–40 ka). AMS dates on charcoal from H-1 and H-4 were 21,420 ± 190 RCYBP (Beta-107731) and 21,800 ± 90 RCYBP (Beta-106506), respectively, corresponding to the LGM. Since the highly acid Pleistocene loam sediments decompose organic remains, the assemblage mainly consists of blade tools (i.e., scrapers and burins) and flakes from their edge resharpening. No projectiles were found. Among the clusters, the heavy-duty tools (i.e., choppers, anvils) are almost equally found, while light processing tools (i.e., endscrapers, sidescrapers, burins, and perforators) and blades occur more frequently in Cluster 4 (n = 58) than the others.

Four hearths (labeled H1 to H4 in Figure 1 from west to east), identified as burnt sediments, were located within five lithic concentrations (labeled 1 to 5 in Figure 1) at an elevation of 70.2 m.a.s.l. The nearest neighbor index (NNI), applied to the distribution of hearths on the surface, does not show complete spatial randomness (NNI = 2.7188, z = 6.5765, $p < 0.0001$). Since the NNI is >1, the hearth locations are regularly distributed. This nonrandom spatial patterning provides two alternative hypotheses to explain formation processes at the site: First, the LGM foragers at Kawanishi C kept regular distances between the

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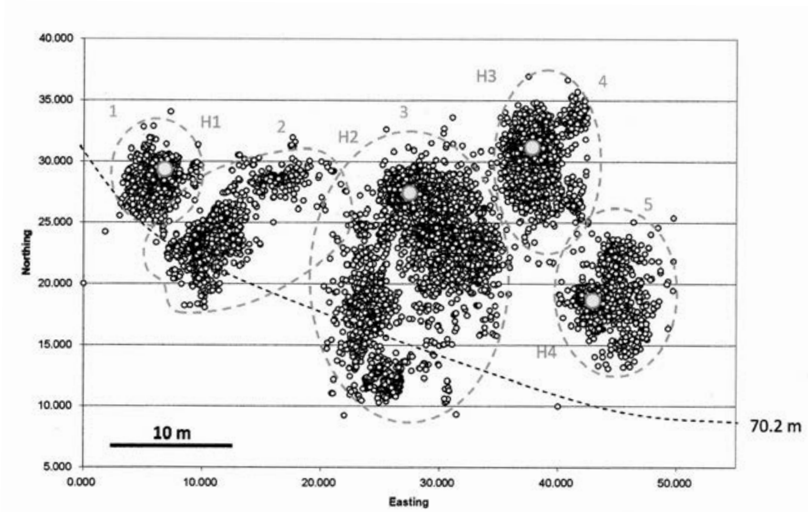

Figure 1. Clusters of artifacts with locations of hearths at Kawanishi C.

major activity areas around the hearths. Second, each hearth was left during a separate occupation event. If the former is the case, it was likely an aggregation site (e.g., Conkey 1980; Hofman 1994; Robinson et al. 2009; Wills and Windes 1989). If the latter is the case, the site was a palimpsest and the evenly spaced hearths were merely a contingent product of different occupations; foraging parties built hearths during different occupations, avoiding visible cultural remains of previous inhabitants. To evaluate which of these scenarios is the case, it is necessary to perform a more thorough investigation of formation processes of the artifact concentrations at Kawanishi C. While hearths are evenly spaced, most of the hearths (H1, H2, and H4) are not located at the centers of artifact clusters. This may imply that activities were performed both around and away from hearths or that the extent of natural disturbances varied. An examination of the relationships among the clusters with and without hearths will further illuminate the alternative scenarios of occupation history. An elucidation of human occupation history at LGM sites in Hokkaido will provide insights into the kinds of adaptive strategies (e.g., fission-fusion, mobility, stone tool reductions) and social structures (e.g., group size, division of labor) of Upper Paleolithic foragers who could have been a founding Asian population of the first Americans.

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The Mal'ta Ivory Plate: A Paleolithic Mnemonic of Leather Technology?*

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Keywords: Mnemonic technology, Siberian Paleolithic, Mal'ta

Mal'ta is a well-known Upper Paleolithic site located on the left bank of the Belaia River of southeast Siberia. The site, presumably a seasonal reindeer hunting camp dating to about 23,000 CALYBP (Medvedev 1998b), is well known for being the source of some of the finest and richest Upper Paleolithic art in the region, including 30 ivory carvings of human figurines.

One of the most intriguing pieces of Mal'ta art is an ivory plate discovered in 1929 by the expedition led by the Russian archaeologist M. M. Gerasimov. The plate, which measures 13.8 x 8.1 cm, has a small perforated hole in its center and engravings on its two sides; one side is engraved with dotted spirals, the other side with snakelike figures (Figure 1) (Abramova 1962). These engravings have puzzled specialists ever since the piece was discovered, and numerous hypotheses have been put forth about what the engravings represent. It has been proposed that they represent genealogical information (Medvedev 1998a), that the plate is a cosmological shamanistic object (Schlesier 2001), a calendar-astronomical device (Frolov 1978; Larichev et al. 1990; Renfrew and Bahn 1991), and a stylized map of the Mal'ta settlement (Medvedev 1998a).

Here we propose that the spiral engravings instead are a schematic representation of a widely documented technique for producing thongs or straps from hides. Using this technique, thongs can be produced by cutting a hide in a continuous spiral. This can be achieved by piercing a hole in the center of the hide and then cutting a continuous strip in an eccentric-spiral way until the hide's outer edge is reached. Following the reverse direction, that is, starting at the edge of the hide and then cutting inwards, in a concentric way, until reaching the center, also produces a leather strap (Murdoch 1892).

Although the exact antiquity of this technique is currently unknown, leatherworking is hypothesized to have existed since the Middle Paleolithic in

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*A longer version of this article has been published in Russian (Prieto and Cárdenas 2009).

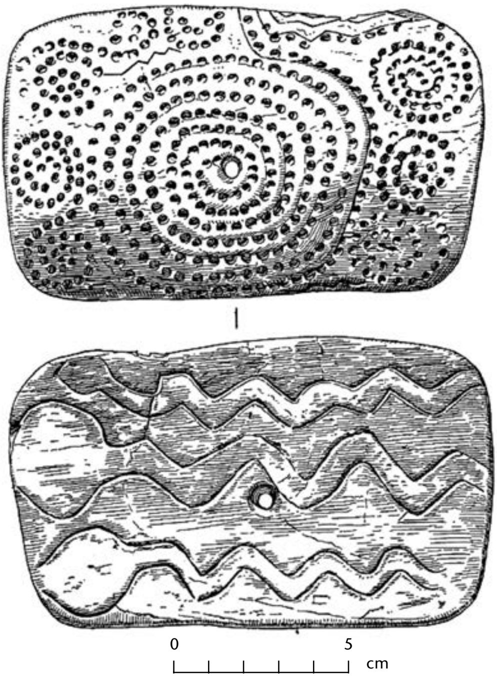

Figure 1. The Mal'ta plate (from Abramova 1962).

Europe (D'Iatchenko and David 2002), and rope manufacturing is conjectured to have existed since the Upper Paleolithic (Gilbert 1956).

Perhaps one of the clearest archaeological depictions of thong manufacturing using the described technique is in the wall paintings of the tomb of Rekhmire (Dynasty XVIII), from the Valley of the Nobles in ancient Thebes. A scene shows how rope makers cut hides to extract thongs that were subsequently twisted to produce rope (Gilbert 1956).

This ancient technique today survives among modern hunter-gatherers (D'Iatchenko and David 2002) and has been copiously documented by modern ethnologists. For instance, hunter-gatherers of Tierra del Fuego used this technique to produce long straps from hides of guanacos (*Lama guanicoe*) and pinnipeds (*Arctocephalus* and *Otaria*) (Gusinde 1982), Chipewyan extracted thongs from caribou skin (Birket-Smith 1930), Inuits from sealskin (Jenness 1946; Pryde 1971), Blackfoot from buffalo bull (Ewers 1955), and Siberian Dolgans from reindeer skin (Popov 1964).

The technique is also well known to modern artisans (Christopher 1952). Patagonian sheep farmers also use the technique today to produce thongs from cowhide for manufacturing their horse-riding equipment.

The popularity of this technique lies in the fact that long and sturdy continuous pieces of leather can be extracted from a single hide; that is, the thong can be longer than the hide itself.

We suggest that the spirals depicted in the plate are a schematic representation of this efficient technique for extracting thongs from hides. Accordingly, the biggest spiral depicted in the plate's center describes how the hide is cut until its outer edges are reached so as to produce the longest possible continuous leather strip from the hide. The smaller spirals illustrate the method of extracting smaller thongs from leftover areas. According to this interpretation, dots would have no other function than to direct the engraving of the spiral designs, which can be difficult to reproduce accurately on an ivory surface using a straight line. Although we do not have an interpretation for the snakelike designs engraved in the back of the plate, they are certainly reminiscent of the shape that thongs take when stretched after being cut from the hide.

Numerous artifacts from the Mal'ta inventory, such as ivory needles, scrapers, and "grooved" bones, are suggestive of the existence of leatherworking in the Mal'ta cultural repertoire. The presence of a leather industry in Mal'ta is also suggested by some of the female figurines found in Mal'ta and Buret' (a Siberian archaeological site that is culturally similar to Mal'ta) that show what appears to be fur clothing (Abramova 1962; Medvedev 1998a).

The greatest difficulty in interpreting the engravings is that about a quarter of the original plate is missing and has been reconstructed with wax (Marshack 1991). Thus, the interpretation that the plate is a lunar calendar (Frolov 1978), based on the number of dots engraved in it, is undermined by the fact that an accurate count of the number of dots cannot be made. In contrast, the missing portion does not affect our interpretation given that most of the main spiral has been preserved (the missing portion being mostly the smaller spirals) (Marshack 1991).

The plate may therefore be the oldest blueprint of a technique developed to enhance the productivity of hides, a technique that is perhaps the best solution for such a purpose. Similar devices with engravings of patterns for enhancing the productivity of hides are well documented in many cultures (Prieto 1997). If our conjecture is correct, the plate could represent the earliest representation of a technique used in manufacturing thongs in the Siberian Upper Paleolithic and therefore would be an early example of a mnemonic device.

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The First Ushki-type Stemmed Point from Upper Kolyma (Western Beringia)

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➤ **Keywords**: Ushki-type stemmed points, Western Beringia, Paleolithic North-East Asia, crystal quartz point

Recently the first Ushki-type stemmed point has been found in the Upper Kolyma at the Omchik II site. Significantly, this find expands the Early Ushki Paleolithic Culture area to the Upper Kolyma region.

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The Omchik II point (Figure 1) was found on the surface of a broad gentle pass, disturbed by road construction, between the Kolyma tributaries, the Omchik and Podumai rivers. The find coordinates are 61° 14′ 04.6″ N and 149° 10′ 40.4″ E, at an elevation of 876 m. There is a panoramic view of both river valleys from the pass; therefore, in view of the small number of finds, the site can be considered a hunting lookout. About 300 m from the point, the locality of wedge-shaped cores was found, which confirms the possibility of finding Paleolithic materials there.

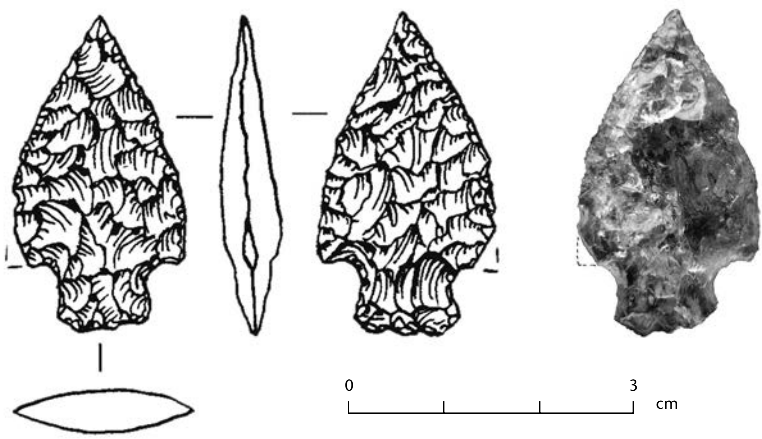

Figure 1. Ushki-type stemmed point from Omchik II site (Upper Kolyma).

The point is made from crystal quartz, carefully worked by random flaking on both surfaces. It has a flattened lenticular cross section, a triangular blade, a stem dilating down, and clearly exposed shoulders, one of which is damaged. According to the typological classification of tools in northeast Asia, it might belong to the Ushki-type stemmed point. The point is 3.4 cm long, 1.9 cm wide, and 0.6 cm thick. Beside the point, only flakes, including fine crystal ones, were found, which implies that it might have been resharpened on the spot.

The geographic origin and extent of the Upper Paleolithic Early Ushki Culture of western Beringia (from Level 7, the oldest at the Ushki site, discovered by Dikov [1996] in Kamchatka in 1964) are still obscure. The age of this culture, earlier dated to 14,000–13,000 RCYBP, has been revised to 11,300–11,200 RCYBP (Goebel et al. 2003). In Beringia, this culture is referred to as a non-microblade industry (Goebel 2004; Slobodin 2001) and is compared to the Nenana complex (Goebel 2004). The hallmark of the Early Ushki culture is the bifacial stemmed point, about 50 of which have been found at the Ushki site. Their stems vary from straight to convergent to dilative (button-shaped). The points are 2–6 cm long and 1.2–2.3 cm wide, 0.25–0.8 cm thick, mostly with lenticular cross sections, though there are two specimens with subtriangular cross sections. In early complexes of eastern Beringia, this point form has not been found; it appeared there later, about 7000 RCYBP (Laughlin 1980).

At the Ushki site, this culture preceded the Upper Paleolithic Late Ushki Culture (from Level 6), containing wedge-shaped cores, microblades, and bifaces, and dated to about 10,800 RCYBP. The Late Ushki Upper Paleolithic Culture spread to other parts of Beringia a few millennia earlier. No succession between the two cultures has been traced (Slobodin 2001).

Outside Kamchatka, the Late Paleolithic Early Ushki Culture with stemmed points has been found at just a few sites: Bol'shoi Elgakhchan, Bol'shaia Avlondia on the Omolon River (right tributary of the Kolyma River) and Serdiak on the north coast of Okhotsk Sea (Slobodin 2001, 2002).

The appearance of these points permits us to clearly distinguish them from all other points, including other types of stemmed points, represented in the prehistory of northeast Asia. They are not known from the rest of Siberia either. This allows us to distinguish them as a separate Ushki point type in the Northeast Asia tool classification (Slobodin 2001, 2002).

Dikov (1996) noted the similarity of Ushki stemmed points to stemmed points in America (e.g., Marmes Rockshelter) and called them "Americanoid." Goebel (2004) notes that some Ushki points rather resemble the Elko corner-notched or Gatecliff contracting-stemmed type of the Great Basin. For now the Ushki Level 7 stemmed points can be compared with some of the oldest specimens in North America, from the Lind Coulee site from the Columbia Plateau, dated at 12,000–11,000 RCYBP (Davis and Sisson 1998).

The Omchik II point invites us to assume that the Early Ushki Upper Paleolithic Culture existed not only in Kamchatka and Chukotka but also in the Kolyma region.

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Archaeology: North America

Employing High-Resolution Bathymetric Data to Infer Possible Migration Routes of Pleistocene Populations

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➤ **Keywords**: bathymetric data, Beringia, Beringian standstill, Caribbean, ETOPO1 dataset, GIS, sea-level data

Using high-resolution mapping data, it is feasible to evaluate possible movement patterns of human groups over the landscape, including over terrain now submerged to appreciable depths by rising sea level. Earlier analyses typically made use of modern physiographic features, that is, land above modern sea level, or used shorelines extrapolated from sea-level curves and bathymetric data similar to the ETOPO1 data presented here (e.g., Anderson and Gillam 2000; Gillam et al. 2006; Lambeck et al. 2002). The ETOPO1 database provides elevation and bathymetric data resampled to form a 1-minute grid for much of the planet, with cells nominally 1.85 km on a side, and vertical resolution nominally on the order of a meter (effective horizontal resolution is typically 4 km for bathymetry and 2 km for terrain; vertical accuracy is highly variable for shallow water, depths less than 200 m, owing to errors in sea-surface satellite altimetry measurements; Amante and Eakins 2009). In the Arctic, isostatic impacts are also a concern, but this is primarily a problem adjacent to massive glaciers (e.g., the mountainous area of southwestern Alaska and the Canadian coastline, south of our study area) and less impact is expected for the largely unglaciated Beringia landmass and corresponding shoreline. Despite these caveats, when coupled with data detailing ice sheet and periglacial lake locations that may have served as barriers to movement (e.g., Dyke 2004), such landscape reconstructions can offer in-

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sights into possible migration pathways taken by human groups exploring and colonizing new lands (e.g., Anderson and Gillam 2000; Gillam et al. 2007).

The ETOPO1 data format employed was the ASCII Grid (.asc), a raster grid that has an attribute in the table that equates to elevation in meters where the value zero represents the current sea level. The elevation dataset was processed with the ESRI ArcGIS® software to perform all transformations and displays. To produce the paleocoastlines the selected depth from zero is added to the elevation raster set (e.g., Gillam et al. 2006). Therefore a -120-m paleocoastline is derived by adding 120 to the elevation attribute.

These datasets offer insight into patterns of human colonization and movement in many areas. Examining the northern Pacific ocean floor, for example, reveals the existence of chains of archipelagoes along the southern coast of Beringia at the Last Glacial Maximum and for thousands of years afterwards until well into the Holocene (Anderson 2010; Brigham-Grette et al. 2004:37–39; Erlandson et al. 2007, 2008; Fedje et al. 2004; Manley 2002) (Figure 1a). These same maps suggest that the Aleutians would have been far easier to colonize moving westward from the Alaska Peninsula than eastward from Kamchatka, because even with greatly lowered sea level wide open water gaps (>100 km) were still present, particularly in the western part of the chain. Southern Beringia, in contrast, was flanked by dozens of small islands and a highly irregular and indented coastline, an environment encouraging if not mandating both water travel and maritime subsistence (Brigham-Grette et al. 2004; Erlandson et al. 2007, 2008). By the time early human populations passing through these archipelagoes reached and rounded the Alaska Peninsula and headed south along the Pacific Northwest coast, they would likely have been thoroughly adapted to a maritime way of life (e.g., Dixon 1999). Local populations may have existed in such areas in isolation from earlier Asian progenitors, a "standstill" suggested by both genetic and linguistic data (e.g., Nichols 1990, 2002, 2008; Tamm et al. 2007; see also Anderson 2010)

Merging terrestrial and bathymetric elevation data can also suggest how the settlement of other regions may have proceeded during periods of lowered sea level. In the northern Caribbean, for example, the greatly enlarged Bahamian shelf would have facilitated movement from Florida to Cuba and on to Hispaniola, with only comparatively minor open water gaps (Figure 1B). Movement into the northern Caribbean and Cuba from Central America would have also been facilitated by lowered sea levels, via the greatly enlarged Yucatan Peninsula and the peninsula formed to the northeast of Honduras and Nicaragua, the latter making Cuba within fairly easy reach via a series of islands to Jamaica. Large portions of the Caribbean may well have been settled in the late Pleistocene, even though little artifactual evidence for such a possibility currently exists. Likewise, if people were crossing the north Atlantic or south Pacific during the height of the last ice age, scenarios proposed by some scholars (e.g., Bradley and Stanford 2004; Stanford and Bradley 2002; Wyatt 2004), the distances would have been somewhat lessened by the existence of now-submerged islands. Similar approaches have been used to map hominin dispersals in the Old World (Field et al. 2006), another example of the wide array of possible applications.

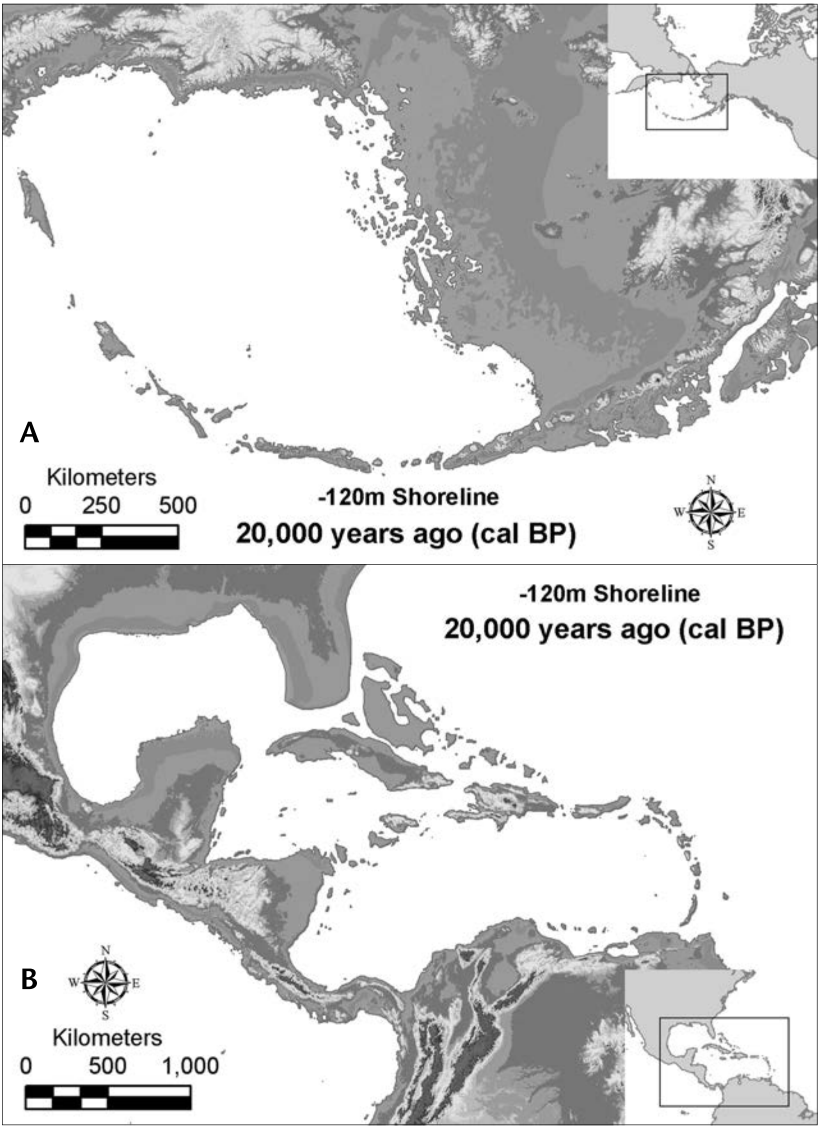

Figure 1. **A,** the island archipelago of southern Beringia and the Aleutians ca. 20,000 CALYBP, based on sea-level data in Manley (2002) and Lambeck et al. (2002), elevation/bathymetric data from Amante and Eakins (2009), and a mapping approach adapted from Manley (2002) and Brigham-Grette et al. (2004-38.); **B,** the Caribbean and Gulf of Mexico ca. 20,000 CALYBP, based on bathymetric and elevation data in Lambeck et al. (2002), and elevation/bathymetric data from Amante and Eakins (2009).

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Paleoindians in Southwestern New York: Preliminary Results from Collector Surveys

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➤ **Keywords**: Paleoindians, survey, eastern Great Lakes

The eastern Great Lakes region has been a focus of Paleoindian research for decades (e.g., Deller and Ellis 1992; Fogelman and Lantz 2006), but relatively little is known about the late-Pleistocene occupation of New York State. Ritchie (1965) produced the first map of fluted-point distributions for the state, and Wellman (1982) provided updated point counts by county, but analyses of regional or national point distribution maps (e.g., Anderson et al. 2010) shows that a dearth of information exists from New York compared with surrounding states. Paleontological and paleoenvironmental data indicate that the western portion of the state was deglaciated by approximately 12,500 RCYBP (e.g., Laub et al. 1988; Shuman et al. 2002), and archaeological evidence from sites like Arc (Vanderlaan 1986), Divers Lake (Prisch 1976), Emanon Pond (Tankersley 1995), and Hiscock (Laub 2003), indicate that early-Paleoindian groups (i.e., Gainey/Clovis) were utilizing, and possibly permanently occupying, the region. Consequently, the current lack of documented fluted points is problematic. To address this issue, exploratory research was conducted in Chautauqua and Cattaraugus counties, western New York, during the summer of 2009. A series of examinations of private collections resulted in the identification of at least 10 previously undocumented fluted points and one multicomponent site.

The first collection includes two fluted points and one probable fluted preform that were collected as isolated surface finds between the towns of Akeley, PA, and Frewsburg, NY, as well as numerous early- and middle-Archaic points. Although the majority of the collection is currently in storage, high-quality photographs in the possession of the collector show that both fluted points were heavily resharpened, making it impossible to assign them to a specific point type. Material identification is tentative, but one of the resharpened points appears to be Onondaga chert, which outcrops over 100 km to the north.

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The second assemblage, from an undocumented site locally known as the Cold Springs site, comes largely from a field outside the town of Steamburg, NY. It was surface collected over a period of about 30 years and includes at least two fluted points as well as over 200 other tools and more recent point types. The base of a resharpened Crowfield-like point made of fine-grained brown chert measures 29 mm wide, 25 mm long at the break and about 4 mm thick (Figure 1A). The primary flute on each face would have extended past the break, and small secondary flutes on each surface are about 19 mm long. The base of a Gainey point made of dark grey chert measures 27 mm wide, 52 mm long at the break, and 5 mm thick (Figure 1B). The single flutes on each side of the point are wide (up to 19 mm) and extend to the break, and basal grinding extends approximately 16 mm.

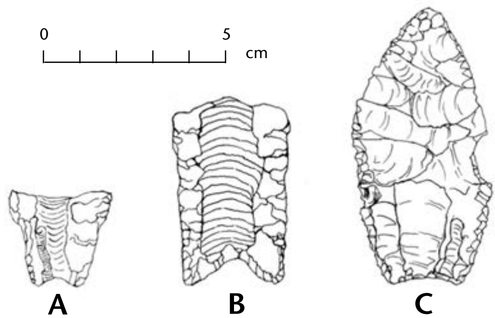

Figure 1. Projectile points described in text.

The final collection consists of thousands of projectile points and tools acquired by Orry B. Heath over the course of his lifetime, which have since been donated to the Chautauqua County Historical Society. Most of the materials were collected in and around the town of Ellery, NY, from about 1900 to 1940. At the time of my visit, the artifacts were behind glass and wired into the original display frames that he had constructed. Therefore precise measurements and detailed examination of the collection were not possible. However, a minimum of six fluted points were identified, and volunteers have begun the process of removing the points and reorganizing them based on the locations where they were found, which will allow for more thorough observations in future visits. Four of the six points are made from Onondaga chert, and two are of unknown material. The only point that can be given a typological designation is a complete Crowfield point, which is 86 mm long and 39 mm wide at the shoulders, although a large flake was removed from one edge of the finished point that reduces its maximum width (Figure 1C). One face has four fluting scars, the longest of which measures 43 mm and is mostly obliterated by the final flute, which is 32 mm long. The opposite face has at least three flute scars, the longest extending 30 mm. Although it is a mixed assemblage, the collection also includes utilized blade tools, the largest of which is 104 mm long and 33 mm wide, and bifacial tools exhibiting overshot flaking and overshot flakes themselves, which are found in fluted-point contexts throughout the Northeast (Tankersley 1998:10).

Although the Paleoindian period in New York is not well represented in the literature, the preliminary survey of collections presented here for the western part of the state clearly illustrates that much information is potentially available. The recent implementation of a statewide fluted-point survey[1] (Lothrop 2009), combined with continued collector interviews and testing of sites, will help to answer some lingering questions about Paleoindian groups in the eastern Great Lakes region.

The William Shirley Fulton Scholarship from the University of Arizona provided funding for travel and documentation of collections. Many thanks to Bill Engelbrecht, Jon Lothrop, Richard Laub, and David G. Anderson for their encouragement and advice, and to Jack Ericson, John Haskins, Jack Angove, and "Lefty" Olson for access to collections, notes, maps, and for taking time out of their schedules to talk with me. Molly Zuckerman, D. Shane Miller, and two reviewers provided comments and feedback on this paper. Molly Zuckerman also provided artifact illustrations.

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[1]All data, photographs, and line drawings of the artifacts described have been submitted to the NYPID and PIDBA projects.

Prospecting for Deeply Buried Paleoindian Sites in the Yellowhouse System, Southern High Plains

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➤ **Keywords**: Paleoindian, deep trench excavation, Southern High Plains

An interdisciplinary program of research is underway along a significant stretch of Yellowhouse Draw on the Southern High Plains in western Texas. A research goal of this investigation is the quantitative evaluation of the archaeological footprint for Paleoindian populations, which is of critical interest in evaluating sample biases in the current late-Pleistocene dataset (cf. Surovell and Waguespack, 2008). The archaeological record of the deeply buried and well-stratified Paleoindian-age sediments (strata 1 and 2 in the regional stratigraphy; Holliday 1995) contained within the draw systems of the Southern High Plains has played a significant role in the history of Paleoindian research and North American archaeology (Holliday 1997). Importantly, the spectacular archaeological and paleontological records at the most regionally significant sites (Lubbock Lake [Johnson 1987]; Blackwater Draw #1 [Hester 1972]) initially were identified by large earth-moving projects rather than sought out directly by archaeological prospecting (Holliday 1997). Predictions as to the relative density of expected cultural material within the extant draw systems are largely based on the results of these two key sites (e.g., Stafford 1981). The current research program attempts to assess quantitatively these predictions and refine Paleoindian subsistence models in order to situate them within a broader landscape context.

In the Yellowhouse system downstream from Lubbock Lake, access to Paleoindian-age deposits is constrained by three factors: 1) thickness of the late Quaternary valley fill; 2) elevation of the watertable above the targeted deposits; and 3) inability to target locations within the valley system with a high potential for cultural material. Potential depths to Paleoindian-age deposits increase with distance downstream (Stafford 1981). To date, no methods of geophysical investigation have been developed for targeting the archaeological signature of hunter-gatherer sites within this site setting.

Recent research at the Paul site (41LU136) within Yellowhouse Draw just north of the confluence with Blackwater Draw resulted in an excellent opportunity to test the potential for sampling the Paleoindian-age deposits and thereby provide an independent assessment of the research potential for the draw system (Johnson 2010). The site setting near the confluence of two major

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draw systems suggested a high potential that this area was a significant crossroads for human and herd movement across the surface of the High Plains.

The results of geoarchaeological investigations indicate that the valley fill is over 5 m thick along the valley axis and typical of the stratigraphic sequence in the Yellowhouse system (Holliday 1995). The Paleoindian-age stratigraphic record is quite uniform, with strata 1 and 2 encountered in the deepest cores and trenches. The radiocarbon dating of stratum 2 has produced results generally similar to dates from Lubbock Lake and other exposures of the unit (Holliday 1985, 1995). These strata, however, are well below the watertable.

Underwater testing necessitated employing an adaptive sampling framework and the use of a trackhoe. The initial process involved cutting trenches below the watertable with a 1.5-m-wide toothed bucket. This blind operation did not allow viewing the sediments or context prior to removal. Excavation in ca. 10-cm arbitrary levels within recognized stratigraphic units was the objective. To record the depth of each trackhoe bite, the beginning and ending elevation of each level was calculated by measuring down vertically from a control point placed at the surface of the trench and recorded on a trench form. Elevation readings occasionally were erratic owing to trench infilling or trackhoe operator error. A surprising degree of precision nevertheless was achieved, and levels largely were within the parameters set out in the methodology.

The sampling strategy focused on a rigorously systematic recovery program that included geoarchaeological, paleoenvironmental, artifactual, and chronometric components. Sample-size strategy for Paleoindian-age strata was to water process all recovered sediments by provenience through fine-mesh screens.

Despite the methodological difficulties, all below-watertable trenches yielded sediments that were consistent stratigraphically with well-established Paleoindian contexts identified elsewhere in the draw system (Holliday 1985, 1995). Water screening of the recovered sediments yielded a very large biological assemblage of more than a quarter million specimens and a small artifact assemblage (n = 332). Cultural material associated with Paleoindian contexts consisted of a limited quantity of culturally modified bone, hearthstones, lithic debitage, and a broken bifacial tool. Organic materials in stratum 2 appeared to be exceptionally well preserved.

Estimates of the total volume of sediment explored indicate that ca. 34 tons of sediment was excavated and water processed from stratum 2, and ca. 29 tons from stratum 1. Relative richness indicates a low artifact yield of less than one artifact (0.94) for every ton of sediment processed. This statistic is of sobering note to researchers attempting to locate deeply buried Paleoindian sites within the draw systems of the Southern High Plains. Nevertheless, the ability to encounter and systematically sample the deeply buried deposits highlights the potential of the utilized research methodology in prospecting for well buried sites. In particular, the proactive ability to examine Paleoindian contexts and thereby independently assess the archaeological record of the Yellowhouse system is significant as a research approach.

Research at the Paul site was funded by the Museum of Texas Tech University and the City of Lubbock, and conducted under Texas Historical Commission Antiquities permit #2625. The Paul

Site Collection is a state-associated collection housed at the Museum of Texas Tech University, held in trust for the people and State of Texas. This paper represents part of the ongoing Lubbock Lake Landmark regional research into grasslands hunter-gatherers and adaptation to ecological change on the Southern Plains.

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Development of a Model to Predict the Location of Early-Holocene Habitation Sites along the Western Coast of Prince of Wales Island and the Outer Islands, Southeast Alaska

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➤ **Keywords**: Paleoshoreline, sea-level curve, Prince of Wales Island, southeast Alaska

Understanding the position of paleoshorelines is key to locating early-Holocene habitation sites. A recently compiled dataset of over 400 shell-bearing raised deposits throughout southeast Alaska (Carlson 2007), updated in 2009, gives insight on the timing and complexity of isostatic crustal adjustments that

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resulted from glaciation and deglaciation, eustatic sea level change, forebulge development, and subsequent tectonic uplift.

In 2009 we sampled, dated, and measured the elevation of over 20 shell-bearing raised deposits (Figure 1). To estimate paleo high-tide elevation , only sediments containing in situ butter clams (*Saxidomus giganteus*) were considered. It was assumed that as today, paleo butter clams existed in the littoral

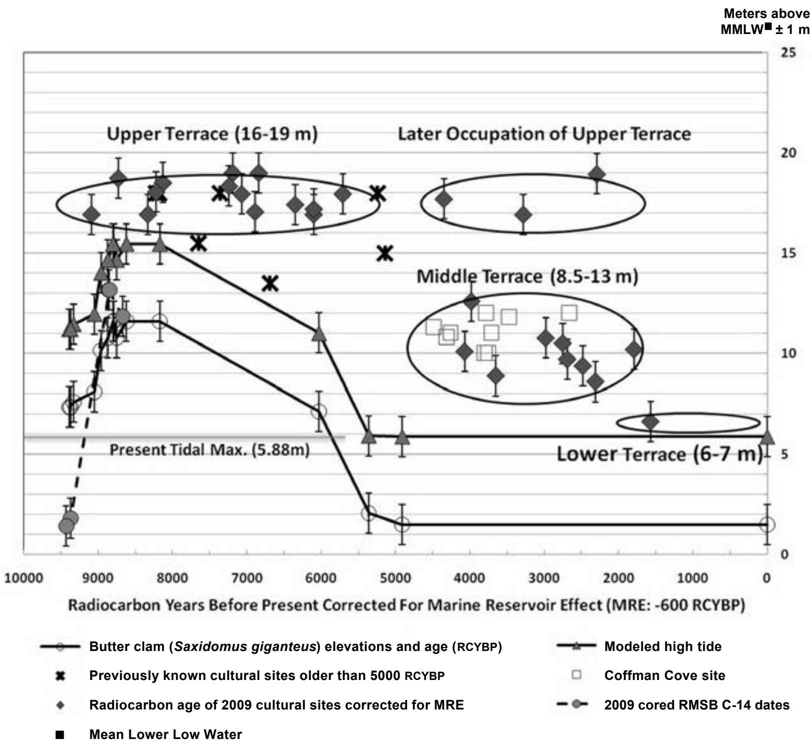

Figure 1. Preliminary sea-level curve for Prince of Wales and surrounding Islands, southeast Alaska. Cultural sites inventoried in 2009 plotted with previously known sites define three terraces at 16–19 m, 8.5–13 m, and 6–7 m above MLLW that correlate well with modeled paleo high-tide levels derived from dates and elevations on butter clams recovered from raised marine shell bed (RMSB) deposits, augmented by dates from cored RMSB. Sites older than 5000 RCYBP represent Chuck Lake on Heceta Island (8220 ± 125 (WSU 3241), 8180 ± 130 (WSU 3243), 7360 ± 270 (WSU 3242), 5240 ± 90 (WSU 3244), 5140 ± 90 (WSU 3245) RCYBP (Ackerman et al. (1985)), the Thorne River site (7650 ± 160 (WSU 3618) RCYBP (Holmes et al., 1989)), and the Elliott site (6,690 ± 50 (Beta 214406) RCYBP) on Prince of Wales Island (POWI). Data for the Coffman Cove site on POWI was provided by Moss et al. (2008). A marine reservoir correction of -600 RCYBP was applied as discussed in Josenhans et al. (1997) and Southon and Fedje (2003).

zone from between – 1 m and +2 m elevation relative to Mean Lower Low Water (MLLW). It was assumed that the average high tide of +5.88 m above MLLW had been constant through time. If butter clams can be found to an elevation of +2 m above MLLW, then the paleo high-tide elevation should be approximately +3.88 m above the occurrence of in situ butter clams. The resultant paleoshoreline model suggested that the paleo high tide should have been 15.5 ± 1 m above MLLW between 7600 and 9200 RCYBP. Assuming that early inhabitants would have camped 1–3 m above the paleoshoreline, early-Holocene sites should be located 16–19 m above MLLW today. A similar sea-level curve is reported from the Haida Gwaii, British Columbia, Canada (Josenhans et al. 1997; Fedje and Christensen 1999). GIS spatial modeling utilizing LiDAR generated Digital Elevation Models (DEM) and available 20-m DEM's were used to predict the paleoshoreline (9200 RCYBP) based on the sea-level curve. Several test localities were selected based on terrace elevation, protected former shorelines and embayments, and the abundance of marine resources, i.e., salmon streams and intertidal and estuary habitat (Carlson and Baichtal 2009).

Our survey confirmed four early- to middle-Holocene habitation sites on terraces developed at 16–19 m above MLLW yielding basal dates of 9090 ± 50 (Beta 264554), 8730 ± 50 (Beta 254082), 8220 ± 50 (Beta 268998), and 6890 ± 40 RCYBP (Beta 269000). Three distinct terraces were identified that record a marine regression beginning about 8200 RCYBP. These terraces are found from 16 to 19 m, 8.5 to 13 m, and at 6–7 m above MLLW (Baichtal and Carlson 2009). It appears that the upper terrace became available for habitation at about 9200 RCYBP, the middle terrace at about 5000 RCYBP, and the lower terrace at about 2000 RCYBP.

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An Early Occurrence of Plainview in the Oklahoma Panhandle

Leland C. Bement and Brian J. Carter

➤ **Keywords**: Southern Plains, Plainview, early Paleoindian.

The examination of a deeply buried cultural layer within stratified deposits at the Bull Creek site (34BV176) in the Oklahoma Panhandle (Bement et al. 2007a,b) yielded two unfluted lanceolate projectile points (Figure 1) that fit the technological and morphological description of Plainview (Knudson 1973). Projectile point A was found on the debris slope beneath the high-bank

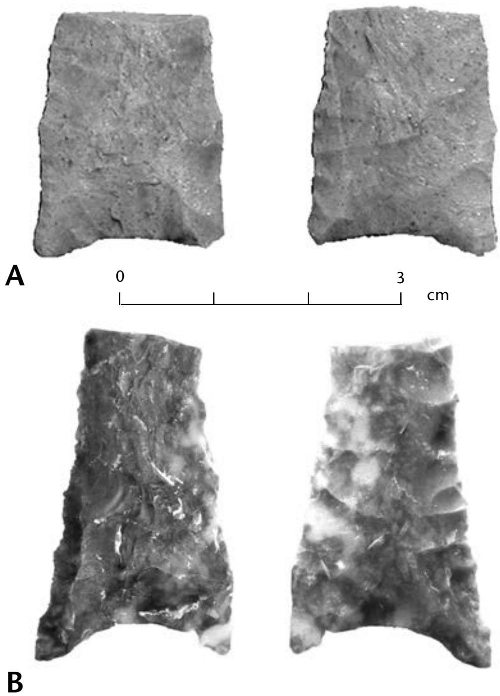

Figure 1. Plainview projectile points from the Bull Creek site, 34BV176. **A,** tan quartzite point from slump; **B,** red Alibates agatized dolomite point from excavation. Extent of reworking on both specimens leaves distinct shoulders.

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exposure, while projectile point B was found at a depth of 2.7 m below the surface during the excavation of 54 m^3. Projectile point B was excavated from the base of a zone containing camp debris that included debitage from tool manufacture/maintenance and the broken and scattered bones of *Bison antiquus, Antilocapra americana, Canis* cf. *dirus, Sylvilagus* sp., turtle, and freshwater mussel. Projectile point B was 20 cm below and 2 m south of a deflated, unlined hearth containing burned bone fragments and charred earth.

Both projectile points had been reworked and their tips broken prior to discard. Projectile point A is made of tan quartzite and is currently 27.0 mm long (distal 1/3 missing), 20.9 mm wide, 5.6 mm thick, and basally indented 2.2 mm, with ground edges and base. Projectile point B is made of red Alibates agatized dolomite and is 35.7 mm long (distal ¼ missing), 21.9 mm wide, 5.1 mm thick, and basally indented 3.4 mm, with ground edges and base. Both specimens have been basally thinned by removing multiple flakes on each surface. These flakes invade previous flake scars, identifying the last act in the reduction sequence (Bradley 2009:261; Bradley and Frison 1996; Krieger 1947; Stanford 1999:306).

The age of the culture-bearing unit is placed at 10,685 ± 50 RCYBP based on the average (Calib 5.1; Reimer et al. 2004) of four bulk soil dates from the artifact-bearing strata (Beta-262538 10,750 ± 70 RCYBP; Beta-262539 10,640 ± 70 RCYBP; Beta-184853 10,350 ± 210 RCYBP; Beta-180546 10,850 ± 210 RCYBP) that are statistically the same at 95% confidence level (test statistic T = 4.437528, X^2 (.05) = 7.81, degree of freedom = 3). This culture-bearing unit is bracketed by a culturally sterile lower soil providing a maximum age of 10,985 ± 45 RCYBP (average of Beta-184854 11,070 ± 60 RCYBP, Beta-262540 10, 870 ± 70 RCYBP) and by a culturally sterile higher soil providing a minimum age of 10,407 ± 60 RCYBP (average of Beta-184852 10,400 ± 120 RCYBP, Beta-262537 10,410 ± 70 RCYBP).

The recent work at Bull Creek suggests Plainview on the Southern Plains may be coeval with Folsom (Holliday et al. 1999) and may correlate with the early occurrence of Plainview/Goshen on the Northern Plains at Mill Iron, although predating its occurrence at the Jim Pitts site (Sellet et al. 2009).

This work is a continuation of explorations in Beaver County, Oklahoma sponsored by grants from various private donors, including Courson Oil Company, and interested landowners. In particular we thank Carolyn Leavengood, Mr. and Mrs. Brauer, and Mr. John Seaman for their continuing interest in this project.

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The Large Rockshelter: A Crowfield Fluted-Point Site in Coshocton County, Ohio

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➤ **Keywords**: Fluted point, rockshelter, Ohio

The Large Rockshelter lies along the edge of a steep wooded ravine in the headwaters of Wolf Creek in northwestern Coshocton County, Ohio. This small sandstone shelter faces to the northwest and has 9 m^2 of floor space. The shelter was chosen for excavation because several potsherds had originally been found on the surface of the site. In the fall of 2009, two 2-by-2-m units were initially excavated beneath this shelter and more pottery sherds, a small amount of flint debitage, and a few projectile points from the late-Prehistoric, Woodland, and late-Archaic periods were recovered. Artifacts and midden soil were largely confined to the upper 30 cm of the units. However, excavation

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was continued into the underlying yellow sand because of the presence of a few small flint chips and charcoal fragments.

At a depth of 77 cm the base of a Crowfield fluted point (Figure 1) was found in situ in the southeast wall of Unit A-1. The base of this broken point measures

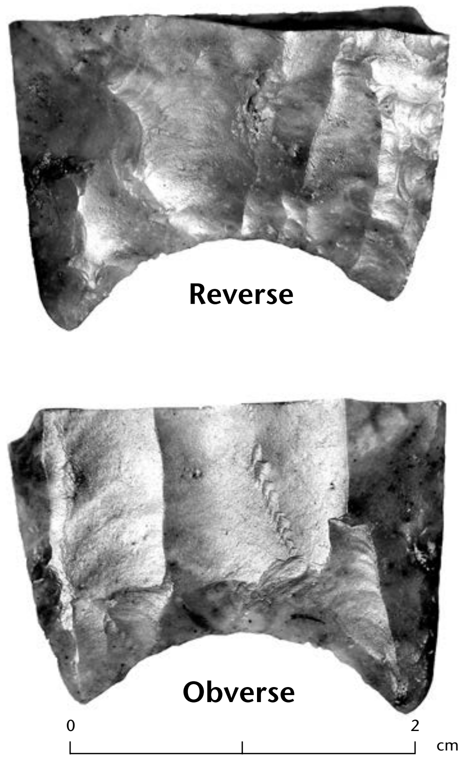

Figure 1. The Crowfield fluted point from Large Rockshelter, Ohio.

21.7 mm from ear to ear; multiple flakes have been removed to form the flutes on either face, the sides of the point exhibit lateral grinding, and the concave base is slightly ground. No other artifacts were found in association with this base although small flint flakes and charcoal fragments continued to a depth of 140 cm, at which point excavation was terminated. Rodent burrows were ubiquitous throughout these sandy soils. Although no disturbance was evident in the immediate vicinity of the Crowfield point, an Archaic point was subsequently recovered at a depth of 93 cm (near a rodent burrow). Two charcoal samples from the unit were submitted for ^{14}C AMS dating: sample #1 from a depth of 78–80 cm dated at 4600 ± 40 RCYBP (Beta-272116); sample #2 at a depth of 129.5 cm dated at 4540 ± 40 RCYBP (Beta-272117). It is apparent that the original stratigraphy of this unit has been significantly compromised by bioturbation.

Sandstone rockshelters and limestone caves were frequently utilized by Native Americans living in eastern North America during the Archaic, Woodland, and late-Prehistoric periods. However, Paleoindian fluted points are rarely found at these sites (Kelly and Todd 1988:237; Prufer and Spurlock 2006:2; Walthall 1998:223–24). Only two other fluted points have been recorded from caves or rockshelters in Ohio: a "heavily reworked" Clovis point from Sheriden Cave in Wyandot County (Tankersley and Redmond 2000:45; Waters et al. 2009), and a "reworked" Gainey fluted point from Fallsburg Rockshelter in Licking County (Carskadden 2004:10). In the Northeast, a "reworked" fluted point was recovered from the basal level of Binette Rockshelter in Connecticut (Thompson 1969; Wiegand 1983:159) and four Cumberland fluted points were found at Duchess Quarry Caves in New York (Funk et al. 1994; Kopper et al. 1980; Steadman and Funk 1987). In the Southeast, a "heavily reworked" Cumberland fluted point was excavated from the basal level of Dust Cave in Alabama (Sherwood et al. 2004:535).

Farther west, several sites in Missouri have produced fluted points, including a Clovis point in the bottom level at Rogers Shelter (Chapman 1975:73–75, 100) and Graham Cave fluted points from the basal levels at Graham Cave and Arnold Research Cave (Chapman 1975:105–07). However, all these points have subsequently been reclassified as variants of Dalton points (Morse and Morse 1983:64; O'Brien and Wood 1998:58, 76). It is only with the appearance of late-Paleoindian/early-Archaic point types such as Dalton, Quad, and Beaver Lake (O'Brien and Wood 1998:97) that Native Americans began to make "significant use" of caves and rockshelters (Goodyear 1982:384; Walthall 1998:227, 234).

The scarcity of fluted points in caves and rockshelters of eastern North America is rather surprising since one would expect that these sites would be particularly valuable to peoples living during the waning stages of the Wisconsin Glaciation. In Europe, humans made extensive use of such sites throughout the Pleistocene. Moreover, since caves and rockshelters provided protection for artifacts as well as for people, older occupations should be preserved more frequently beneath shelters than in open-air environments. This is certainly true across the Old World, where much of the evidence for the initial colonization of Europe and Asia is derived from caves and rockshelters. One of the theories that have been advanced to explain this anomaly in eastern North America is that, owing to their focus on migratory animals and the development of a highly mobile lifestyle, Paleoindians had little knowledge or interest in caves and rockshelters (Kelly and Todd 1988:237; Walthall 1998:231-232). The recovery of a single broken Crowfield base at Large Rockshelter, as well as the isolated heavily resharpened points found at Sheriden Cave, Fallsburg Rockshelter, Binette Rockshelter, and Dust Cave, all suggest a very transient use of these sites—in many cases, just long enough to remove and discard a broken or worn-out point and replace it with a newer, sharper projectile.

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Recent Research Results from the Water Canyon Site, a Clovis and Late-Paleoindian Locale in West-Central New Mexico

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➤ **Keywords**: Bison, Clovis, late Paleoindian, paleoenvironment

The Water Canyon site (Dello-Russo 2001) is located in the La Jencia Basin west of Socorro, New Mexico, in a juniper savannah setting. As defined today, it

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covers ca. 7.0 hectares and comprises four surface lithic-artifact concentrations or loci. Based on the presence of Clovis (Locus 3) and Scottsbluff (Loci 1 and 4) projectile-point fragments, the site was occupied during the early- and late-Paleoindian periods (ca. 11,300–10,900 and 9400–8300 RCYBP, respectively) (Holliday 2005; Pitblado 2003:82–83). A narrow, steep-sided arroyo through Locus 1 has exposed a horizontally extensive and continuous layer of organic-rich mud about 1.5 to > 3.0 m below the surface that is interpreted as a prehistoric wet meadow deposit. From additional exposures throughout the small tributary basin in which the site is located, and from a series of mechanical sediment cores, we estimate this deposit covers at least 4.8 hectares.

During fieldwork in 2008, 2009, and 2010, we recovered and subsequently dated charcoal and sediment samples from the deposit. The initial reported radiocarbon dates (Table 1) indicate that the wet meadow deposit was extant from the late-Pleistocene to the early-Holocene epoch. They also parallel the timing of site occupation based on diagnostic artifacts and, consequently, suggest that the wet meadow may have served as a focal point on the landscape for Paleoindian foragers.

Table 1. Radiometric dates from the buried wet meadow deposit at the Water Canyon site.

Sample no. or location	Material dated	Depth below ground surface (cm)	Date (RCYBP)	Date (CALYBP)
Top of cienega deposit	—	150	—	—
A-15021	Bulk sediments	179	9285 ± 85	ca. 10,690–10,230
Bone in situ	—	182–187	—	—
A-15022	Bulk sediments	201	7820 ± 220	ca. 9350–8150
AA-83855	Charcoal	202–210	9750 ± 50	ca. 11,240–11,070
AA-83854	Bulk sediments	216	11,030 ± 60	ca. 13,200–12,850

Radiocarbon dating done at University of Arizona Isotope Geochemistry Laboratory (A-#s) and the NSF-Arizona Accelerator Mass Spectrometry (AMS) Laboratory (AA#s).

Testing efforts in 2009 and 2010 resulted in the recovery of over 100 lithic artifacts in association with bones (calcaneum, sesamoid, rib, distal femur, vertebra), pieces of tooth enamel and ca. 80 additional bone fragments from the wet meadow deposit on both sides of the arroyo and at levels between 1 m and 2 m below the ground surface. These bones and enamel represent the remains of at least one *Bison antiquus occidentalis* individual (G. Morgan, pers. comm. 2009; McDonald 1981). Some of the bone fragments are burned, suggesting the possibility of a nearby thermal feature. While additional mammal bone was also encountered in mechanical cores at 3.45–3.65 m below the surface in the northern portion of Locus 1, the species from which these bones derive is currently unknown.

Associated lithic artifacts from both sides of the arroyo include debitage and a middle stage rhyolite biface fragment exhibiting an *outre passé* flake scar. X-ray fluorescence analysis has matched one obsidian thinning flake to the Mule Creek source in southwest New Mexico, an air distance of about 190 km from the Water Canyon site (Shackley 2010) . No diagnostic lithic artifacts have yet been recovered from the wet meadow deposit.

Finally, initial studies of pollen from sediments recovered through mechanical coring of the wet meadow deposit suggest that the site environment during the late Pleistocene/early Holocene consisted of a sagebrush steppe with a gallery forest of birch and maple along the Water Canyon drainage and its tributaries (S. Smith, pers. comm. 2009). The presence of the sagebrush steppe at that time is consistent with findings from other regional pollen and woodrat midden studies (Hall and Riskind 2010).

The Water Canyon site is the first buried, intact Paleoindian site reported in western New Mexico and, from the presence of a Clovis projectile-point base on the surface and a Clovis-era radiocarbon date, possibly one of only a few such sites with a Clovis component in all of New Mexico. Others include the Clovis type site at Blackwater Draw (Hester 1972; Howard 1935) and the Mockingbird Gap site in Chupadera Wash (Holliday et al. 2009; Weber and Agogino 1997). While our work has just begun, our current understanding of the site suggests that it has excellent potential for interdisciplinary studies and clearly warrants further research.

This research has been funded by the Argonaut Archaeological Research Fund (University of Arizona Foundation), Escondida Research Group, LLC, the NM Office of Archaeological Studies and the New Mexico Friends of Archaeology (Museum of NM Foundation). Our thanks are extended to S. Hall, C.V. Haynes, D. Love, G. Morgan, M. Person, S. Smith and J. Taylor for helpful collaboration, to all those who assisted in the field, and to anonymous reviewers for their assistance in improving this paper.

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Anvil Reduction at the Early-Paleoindian Site of Paleo Crossing (33ME274), Northeast Ohio

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➤ **Keywords**: Lithic technology, Paleoindian, Great Lakes

As part of a larger analysis of the Paleo Crossing Paleoindian stone tool assemblage, I describe here the previously unreported evidence for anvil/bipolar reduction from the site.

Five anvil specimens have been identified (Figure 1), all manufactured from Wyandotte chert found 600 km southeast of the site (Tankersley and Holland 1994). Based on the location of retouch, specimen #1 appears to have been an alternate scraper (sensu Debenath and Dibble 1994:88) before being subjected to anvil reduction. At least two large flakes were removed from the piece, each from an opposing pole and face. Specimen #2 was originally an endscraper. One of the endscraper distal corners acted as one pole, while a large flake from the opposite pole removed the entire ventral surface. Specimen #3 is a large flake resulting from anvil reduction. As evidenced by crushing on each longitudinal end, the flake removed the entire face of its parent core. Specimen #4 is actually a "quadpolar" core. While there appears to be a principal percussion axis for detaching flakes, the specimen also exhibits crushing and scars on the perpendicular axis. Specimen #5 comprises two refitted pieces, the result of recent breakage (probably plowing). A retouched edged served as one pole, while a square edge served as the chief platform for flake removal.

Goodyear (1993) suggests that anvil reduction was one strategy for extending the use life of a toolkit. Shott's (1997:201) counts, however, show that other early-Paleoindian sites in the lower Great Lakes exhibiting long-distance procurement possess smaller numbers of bipolar cores (Udora, n = 2; Gainey, n = 2), while sites exhibiting more local procurement exhibit larger numbers (Arc, n = 35; Potts, n = 10). Rather than signifying a desperate attempt to extend the usefulness of an exhausted tool, these counts suggest that early-Paleoindian anvil reduction was an expedient technology utilized more often when raw material was abundant, rather than scarce. Nevertheless, given the purportedly extreme distance of a raw material source from Paleo Crossing, as

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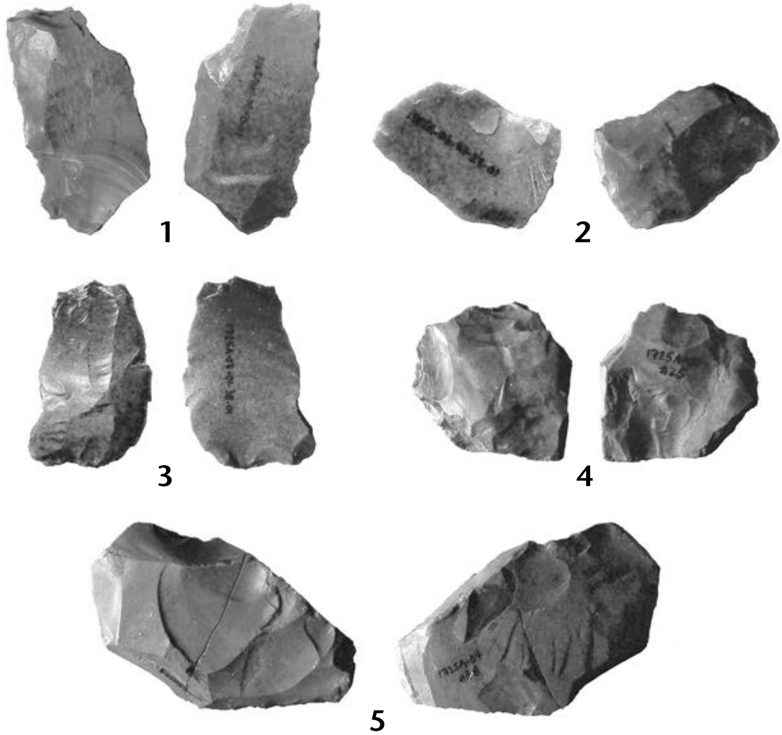

Specimen	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
1	15.5	48.99	25.28	9.24
2	11.5	38.59	25.79	8.63
3	6.7	40.98	24.77	7.08
4	13.5	39.01	30.68	10.88
5	30.8	59.02	35.08	11.74

Figure 1. Bipolar products in the Paleo Crossing assemblage. Specimens are oriented so that the principal axis of anvil reduction is vertical. Length was measured as the longest distance between any two points on the specimen. Width and thickness were measured at the central point of, and perpendicular to, the length axis.

well as the presence of other exhausted tools in the assemblage (Eren 2005, 2006; Eren et al. 2004, 2005), the presence of anvil reduction in this instance appears to be a simple function of raw material shortage as Goodyear (1993) argues, especially given that two of five Paleo Crossing anvil specimens were on finished tools.

The author is financially supported by a National Science Foundation Graduate Research Fellowship, and by Mustafa, Kathleen, and Nimet Eren. Thanks to Rebecca Catto, David Meltzer, and Brian Redmond for reading an early version of this manuscript.

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CA-SMI-701: A Paleocoastal Site on San Miguel Island, California

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➤ **Keywords**: Channel Islands, Paleocoastal technology, crescent

Once relatively obscure, California's Paleocoastal tradition has gained clarity as more assemblages have been identified, including numerous sites older than 9000 years, from the Northern Channel Islands (see Erlandson et al. 2008; Reeder et al. 2008). Many of these are shell middens that have produced few diagnostic artifacts, but two sites at Cardwell Bluffs on San Miguel Island have produced numerous bifaces, including crescents and stemmed points associated with shell middens dated ca. 12,000–11,500 CALYBP (Erlandson and Braje 2008). These terminal-Pleistocene sites are found on a raised marine terrace where over the millennia seasonal shrinking and swelling of clay-rich vertisols brought to the surface chert cobbles (Johnson 1972), which were collected and used by Paleocoastal peoples.

Here I report the recent discovery of a new Paleocoastal site identified during survey work on the same marine terrace landform near the Cardwell Bluffs sites. CA-SMI-701 is a low-density lithic site where chipped-stone artifacts are scattered over an eroded area ~50 m wide and 130 m long. Since artifacts were visible only where soil erosion had exposed them, the site may be considerably larger. A Paleocoastal age for CA-SMI-701 is based on: (1) the discovery of a chipped-stone crescent at the site (Figure 1); (2) proximity and

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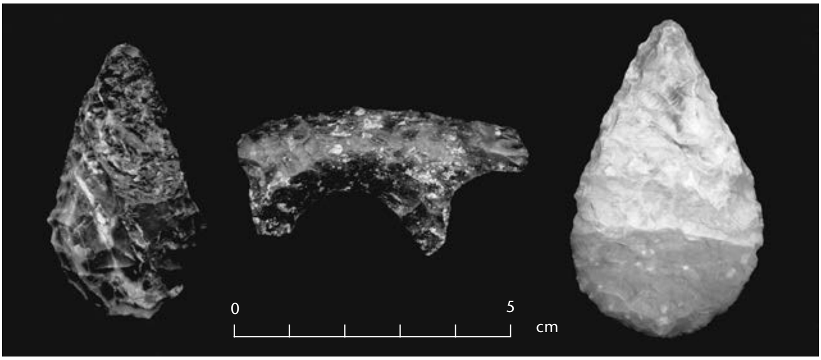

Figure 1. An "eccentric" crescent (center) and teardrop-shaped bifaces from CA-SMI-701 (photo by J. Erlandson).

similarity to terminal-Pleistocene sites at Cardwell Bluffs just to the east (Erlandson and Braje 2008; Erlandson et al. 2008); and the presence of chipped-stone artifacts embedded in remnants of a paleosol dated in nearby exposures to the late Pleistocene or Early Holocene. The crescent is an unusual "bear-shaped" specimen similar to other zoomorphic crescents found in California. I believe the zoomorphic shape of these crescents is largely accidental, as "eccentric" and deeply notched (or "legged") crescents are common in early California sites (see Fenenga and Hopkins 2010).

Along with the crescent, two teardrop-shaped bifaces were found on the site surface. These resemble Chindadn points found in terminal-Pleistocene sites in central Alaska and the Yukon (see Pearson 1999), as well as points found in some early sites on the Northwest Coast (Moss 2010). These teardrop bifaces could provide a cultural-historical link between early lithic traditions on the Channel Islands and northwestern North America, or the similarities could be entirely coincidental.

All three bifaces from CA-SMI-701 are made from Monterey chert, probably from local Tuqan chert cobbles found in the site vicinity. A raised marine beach deposit, probably of middle-Pleistocene age (N. Pinter, pers. comm., 2008), immediately underlies the site soil, with fossil (but unlithified) shells mixed with chipped-stone artifacts in some surface exposures. Occasional fragments of younger (and much better preserved) red abalone, turban snail, and mussel shells are found on the site surface, but so far none have been found in situ. In the future I hope to identify intact site remnants that contain datable organics and chipped-stone artifacts, allowing a more precise estimate of the age of the site. For now, CA-SMI-701 adds to the growing number of Paleocoastal sites known from California's Northern Channel Islands. Overall, the crescents and stemmed points from the Cardwell Bluffs sites also provide strong links between early lithic traditions in coastal California and the Great Basin (Erlandson and Braje 2008), which might support Beck and Jones's (2010) hypothesis that the Western Pluvial Lakes tradition originated from a terminal-Pleistocene coastal migration into the New World.

This research was supported by the National Science Foundation, National Park Service, and University of Oregon. I am grateful to Ted Goebel, Laurie Lind, and an anonymous reviewer for help in editing and producing this paper.

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A Stable, Buried Late-Pleistocene Levee in the Middle Tennessee River Valley

Matthew D. Gage and James J. Kocis

➤ **Keywords**: Geoarchaeology, Clovis, southeastern North America

The Tennessee River valley, particularly northern Alabama, has one of the densest concentrations of Clovis projectile points in North America (Anderson et al. 2009). The age of Clovis occupations remains poorly defined given the few dates published (see Anderson et al. 2005; Meeks and Anderson 2010) and lack of records concerning the valley's hydrological history (Collins et al. 1994). Previous geomorphological research suggests that a terminal-Pleistocene erosional phase scoured the valley including Paleoindian occupation sites (Collins and Goldberg 2000; Collins et al. 1994; Sherwood 2001; Sherwood et al. 2004). Recent investigations indicate that at least some relic landforms near the paleochannel remain intact.

The University of Tennessee Archaeological Research Laboratory conducted

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geoarchaeological studies at several sites within the Tennessee River system (Gage and Herrmann 2009). One component of this study was excavation of a riverbank profile at site 1MS389, Marshall County, Alabama (Figure 1). At 454 cm below surface (cmbs) a Clovis point manufactured from locally available Bangor chert was found in association with a buried late-Pleistocene levee.

The profile was recorded using standard morphological descriptions (Schoeneberger et al. 2002) and sampled at 2-cm intervals until contact with the water level (540 cmbs). A hand auger was then used to collect 10-cm-interval samples from water level to bedrock (890 cmbs). Proportions of sand, silt, and clay-sized particles were determined by hydrometer and wet sieve (Gee and Bauder 1986). One accelerator mass spectrometry (AMS) sample of wood charcoal (Beta-259532) from 227 cmbs was recovered from the 4Ab horizon. This assay returned a conventional radiocarbon age of 7220 ± 50. Corrected radiocarbon age was calibrated using Calib Rev 6.0.1 (Reimer et al. 2009a; Reimer and Reimer 2009b) and the weighted mean calendar age (8036 CALYBP) was calculated from the 2σ age probabilities (Telford et al. 2004a, 2004b).

The late-Pleistocene and early-Holocene section of the profile consists of fining-upward fluvial deposits (5Ab-5C2) designated as Pedofacies 1–2. The Clovis point was recovered from within the 5C1 horizon of Pedofacies Unit 2 (420–470 cmbs), ~200 cm below the AMS sample. This horizon consists of a yellowish brown (10YR 5/6) structureless, massive micaceous sandy loam deposit with few rounded cobbles. One sample of optically stimulated luminescence (OSL) dated sediment from 454 cmbs taken adjacent to the Clovis was analyzed. The OSL sample associated with the Clovis point yielded a date of 10,450 ± 780 yr BP (UIC2537)[1]. This date is too late for the accepted age of Clovis (ca. 13,100–12,750 CALYBP) (Anderson et al. 1996; Anderson et al. 2009; Meeks and Anderson 2010; Waters and Stafford 2007). The sedimentary deposits within the 5C1–5C2 horizons are interpreted as a coarsening-upward levee deposited adjacent to the paleochannel of the Tennessee River. The OSL date relates to an incipient surface within the aggrading levee and a time after the Clovis was deposited. If the Clovis was deposited in the early portion of the date range (11,230 yr BP), an occupation approximately 1500 years after other well-dated Clovis-age components obtained in the Southeast can be attributed to the site (Meeks and Anderson 2010). It seems more likely that the artifact was redeposited at the time the stable levee was buried by alluvial sediments. Regardless, the age of the landform indicates the potential for intact early levee deposits in an area previously considered likely to be devoid of such features.

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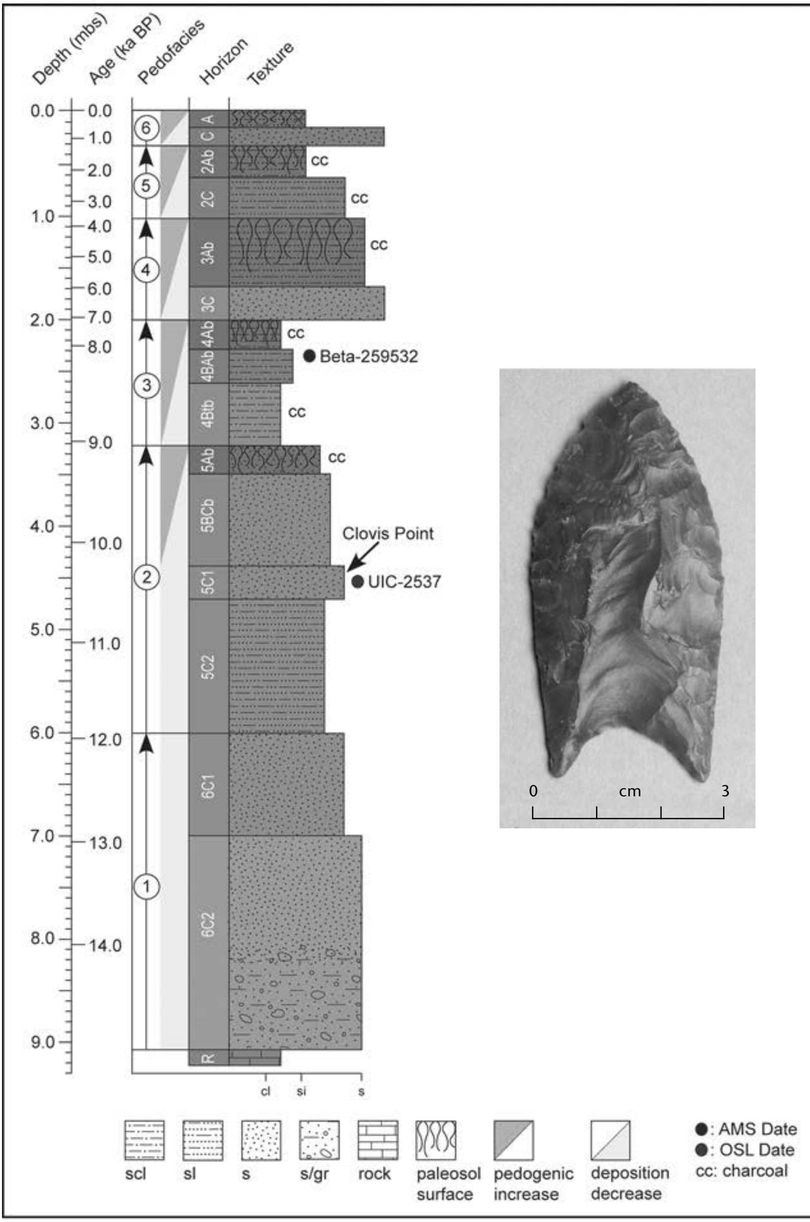

Figure 1. 1MS389 riverbank stratigraphic column and recovered Clovis.

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Revisiting the Plenge Paleoindian Site

Joseph A. M. Gingerich and R. Michael Stewart

➤ **Keywords**: Early Paleoindian, eastern North America, settlement patterns

The Plenge site (28WA636) is the largest known Paleoindian locality in New Jersey with surface finds of diagnostic projectile points spread over 22 acres of floodplain, terrace, and low upland settings along the Musconetcong River in the northwestern portion of the state. Nearly every known Paleoindian point type recognized in eastern North America has been recorded at this locality, which is best thought of as a site complex. A variety of Archaic and Woodland occupations also are represented. The last extensive study of Plenge was in the early 1970s, when Herbert Kraft conducted limited excavations and a preliminary analysis of the lithic assemblage (Kraft 1973). In 1975 Eisenberg (1978) examined a sample of 100 artifacts from Plenge as part of a regional study of Paleoindian settlement patterns. In 2002 Davis (2003) began a reanalysis of the Ziegler collection of fluted bifaces from Plenge, examining lithic materials and what they implied about settlement pattern strategies. Here we summarize over three decades of newly collected material and a brief discussion of the spatial distribution of Paleoindian finds.

In the summer of 2009, we visited Plenge and examined several collections that had been assembled since the 1970s. The amount of material collected from this locality was astonishing. Kraft (1973) reported the presence of 117 fluted artifacts (points, knives, preforms), 218 endscrapers, 5 slug-like scrapers (limaces), 28 gravers, 23 channel flakes, and 626 other artifacts that he attributed to the Paleoindian occupation of the site. Analysis of the projectile points indicates that the majority of fluted-point styles known in the northeastern U.S. are represented. Recognizable types include Gainey variants, Debert-Vail, Barnes, and Crowfield[1]. In recent years more attention to the attributes of fluted projectiles in the Delaware Valley and broader Middle Atlantic Region has led to the recognition of a variety of these more "northern" types (e.g., Carr and Adovasio 2002; Fogelman and Lantz 2006). In contrast to Kraft's classification (1973), we saw few examples to confidently classify as Clovis. Despite particular typological designations, patterns of variation between earlier and later fluted-point forms at Plenge are similar to those observed at other regional sites, especially with the occurrence of "stubby" or Mid-Paleo-phase projectiles (Gardner and Verrey 1979). Our analysis of the

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[1] Until recently, there have been few attempts to metrically characterize the point styles in eastern North America (except Deller and Ellis 1992; Ellis and Deller 1997). Recently, Bradley et al. (2008) have made a valiant effort to metrically define some point types. Here, we note that our classification of Gainey variants follows their description of Kings Road/Whipple, Bull Brook/West Athens Hill; Barnes corresponds to Michaud-Neponset phase.

new material collected from the site includes an additional 70 fluted-point fragments, 50 endscrapers, and 11 channel flakes.

When revisiting Plenge, we had several questions about the Paleoindian occupations. The first involved Kraft's hypothesis that the majority of raw material utilized at the site, jasper, was transported from large quarries located 30 to 50 miles distant in Pennsylvania (1973:62). Additional questions involved whether there was any spatial discreteness to particular Paleoindian surface finds, and whether there was any possibility of buried intact deposits over the diverse landforms being encompassed by the surface finds. Kraft's limited excavations encountered no buried deposits (1973:61).

Upon immediate inspection of the area we saw evidence of large, low-quality jasper boulders along the periphery of the upper terrace. While this material is not of knappable quality (even through heat treatment), it suggests the possibility of a closer source than the quarries of Pennsylvania. Inspection of cobbles within the Musconetcong also proved the existence of medium-sized cobbles of jasper and black chert that were of knappable quality; however, these pieces did not exceed 1070 g. Examination of the debitage collected from the site by the Ziegler family detected samples of large primary jasper flakes that exceeded 280 g. These data suggest that access to jasper and other raw material was in close proximity to Plenge.

Fieldwork involved mapping known artifact concentrations and fluted-point finds, as well as limited bucket-auger borings and test excavations to assist in geomorphic assessments and identifying paleosols. Our ability to spatially pinpoint individual finds was limited, but we were able to define several artifact concentrations. These concentrations are generally situated on the west-facing high terrace, 8 m above the Musconetcong River. Alluvial/colluvial fans on the lower terrace and floodplain are a second possible concentration area, as displaced fluted-point bases and early-Archaic projectile points have been found adjacent to these locations associated with sediments of historic/modern age. The third and most isolated area of Paleoindian material is located in the northernmost field of the Plenge complex, along a small spring drainage that empties into the Musconetcong. This is the only location where Plano-style points were recovered at Plenge (see Kraft 1973:82). No earlier or later biface forms are reported from this landform. Thus far, test excavations within the north field and along the lower terrace have yielded no intact deposits. Future tests will focus on identifying undisturbed deposits near the alluvial/colluvial fans and throughout areas subject to micro-depositional processes.

Given the amount of material that has been recovered thus far, the Plenge site obviously warrants additional investigation. The apparent reuse of Plenge and its association with nearby lithic sources is comparable to other sites in the region (e.g., Gardner 1989). However, minor occurrences of exotic cherts (e.g., Normanskill, Onondoga, and Munsungun; see Davis 2003, Kraft 1973, Pollock et al. 1999) suggest connections to Northern landscapes where Paleoindian sites rarely show the extensive use of secondary or local sources (Gardner 1974, 1989; Meltzer 1984). A better understanding of Plenge and its relationship to other Paleoindian localities in the region will increase our knowledge of landscape and resource use throughout the late Pleistocene. While future investigations of the site will attempt to identify intact cultural deposits, analyses of the bifaces, representing all stages of reduction, might prove to be an invaluable tool in further deciphering technological attributes of numerous understudied fluted-point forms in eastern North America.

We thank Leonard and Judy Ziegler and Jay Verkade who made this research possible. We also thank Joe Blondino, Mara Kaktins, Deirdre Kelleher, Jeremy Koch, Greg Lattanzi, Jim Lee, Paul Pluta, Allie Stewart, Tatiana Young, and Pence Ziegler and Gary Ziegler who assisted with the fieldwork. Finally, we thank Linda and Johnny Peters, Frank Staats, and Bill and Jack Stanley for access to their collections.

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Instrument-Assisted Fluting as a Techno-chronological Marker among North American Paleoindian Points

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➤ **Keywords**: post Clovis, fluting, instrument assisted

The fluted point continues to be the primary archaeological means of recognizing late-Pleistocene (11,200–10,200 RCYBP) human populations in North America. The technological and chronological definition of Clovis and Folsom fluted points has emerged as the most robust typological distinction to date. Studies of Clovis point manufacture using caches and quarry sites have resulted in the recognition of the primary role of percussion in biface reduction and basal thinning or fluting as the hallmark of Clovis (Bradley 1991; Callahan 1979; Collins 1990; Dickens 2005; Morrow 1995). For Folsom, replication studies of fluting (Crabtree 1966; Flenniken 1978) and preform analysis have revealed the role of pressure and/or indirect percussion using specially prepared isolated fluting platforms.

The end of Clovis culture and the emergence of Folsom and other fluted-point-using groups, especially in the eastern United States, has been based largely on the method of fluting. The term "instrument-assisted" has been employed (Goodyear 2006) to characterize various fluted points such as Gainey, Vail, Debert, and Redstone. They tend to share long, often full facial flutes with deep basal concavities (Figure 1). While the latter may be a hafting change away from the more slightly indented Clovis base, the deeper concavity is also a by-product of repeated platform preparations and fluting attempts. Such concavities would preclude direct percussion fluting and would require an intervening instrument (see Johnson 1996:198).

The recent reevaluation of the Redstone type (Goodyear 2006) has resulted in its widespread recognition in the Southeast (Anderson et al. 2010). Based on deep basal concavities, isolated fluting platforms, guide flakes and blade morphology, it is technologically equivalent to Gainey, Vail, and Debert points found farther north (Figure 1). Although undated in the Southeast, limited radiocarbon dating externally indicates an immediate post-Clovis time horizon. Debert in Nova Scotia has an average date of 10,600 RCYBP (MacDonald 1968:53); a subsequent AMS date from the Vail site in Maine is 10,710 ± 50 RCYBP, (Gramly 2009:108)); and one date of 10,710 ± 85 RCYBP from the Big Eddy site, Missouri, is thought to be associated with Gainey (Ray 2000:53). One deeply concave instrument-assisted fluted-point base (Figure 1C) was found in the deepest Clovis layer at Gault, Area 8 (Dickens 2005), suggesting the use of instruments in fluting was underway variously during Clovis times.

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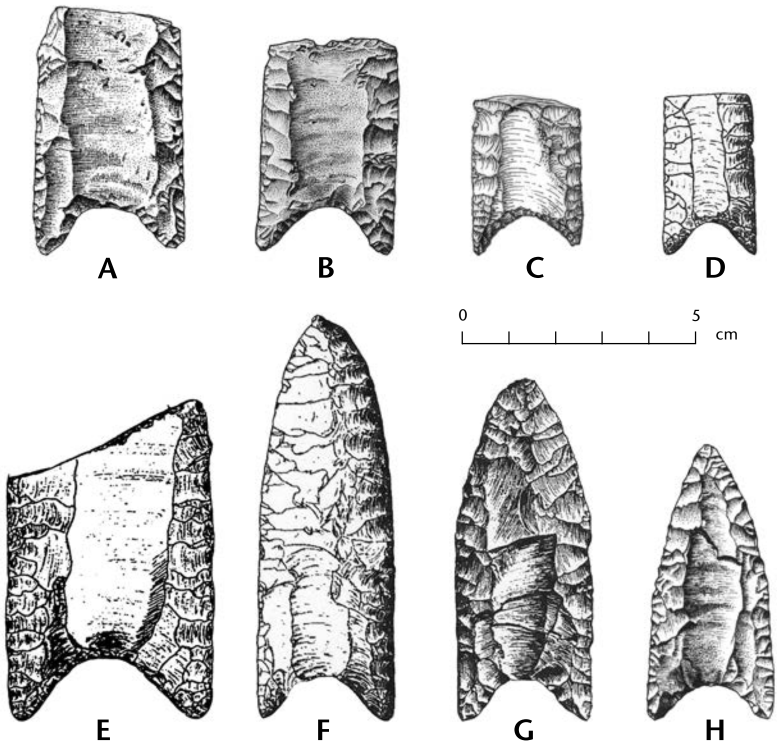

Figure 1. Examples of instrument-assisted fluted points from the eastern United States: **A,** Redstone point, South Carolina (SC214); **B,** Redstone point, North Carolina (NC266); **C,** Gault site, Area 8, Texas; **D,** Sedgwick point, Big Eddy site, Missouri; **E,** Redstone point, Chipola River, Florida; **F,** Gainey point, Needmore site, 23CE514, Missouri; G , Vail point, Vail site, Maine; **H,** Redstone point, South Carolina (SC157). Credits: **A, B,** and **H,** Southeastern Paleoamerican Survey (SEPAS); **C,** Dickens (2005: Figure 16); **D** and **F,** J. H. Ray (2000); **E,** Tesar and Whitfield (2002: Figure 2); **G,** Gramly and Funk (1990: Figure 4).

After Clovis, Folsom points on the Plains continued to be made for about 1000 years. In eastern North America, instrument-assisted fluted points appear to have been made for only three or four centuries with their frequency diminished greatly compared to Clovis.

I thank David Anderson, Mike Gramly, Julie Morrow, Jack Ray, and Dennis Stanford.

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A Concave-Based Projectile Point from New Excavations at the Owl Ridge Site, Central Alaska

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➤ **Keywords**: Owl Ridge site, Denali complex, Younger Dryas

Owl Ridge is a deeply buried, well-stratified multicomponent archaeological site located in central Alaska. The site rests on a south-facing glacial outwash terrace overlooking the Teklanika River about 2 km north of the northernmost boundary of Denali National Park. Previous test excavations of Owl Ridge established the presence of three separate cultural components and provided initial ^{14}C dates ranging from about 11,300 to 7000 RCYBP (13,200–7800 CALYBP) (Hoffecker 1988; Hoffecker et al. 1996b; Phippen 1988) (Figure 1A). Based

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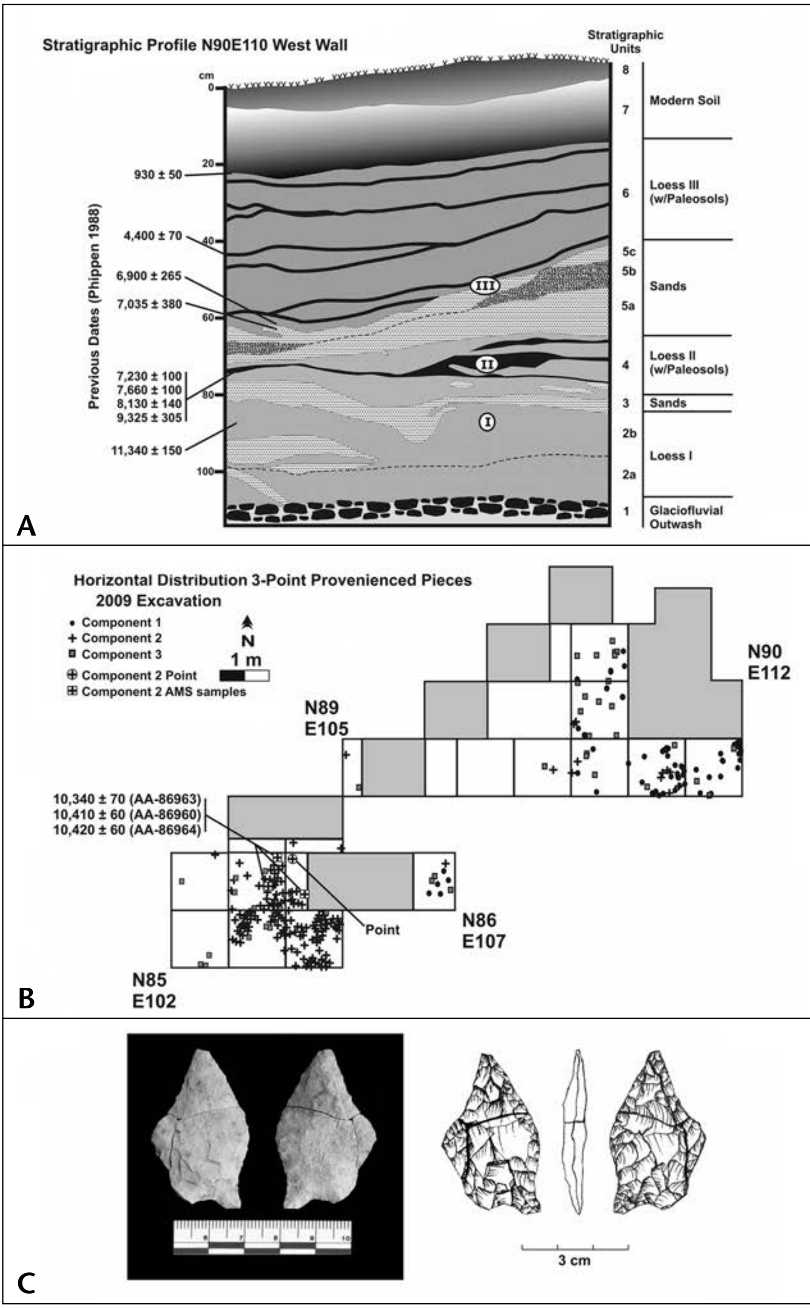

Figure 1. Owl Ridge site. **A,** Stratigraphic profile with original ^{14}C assays from Phippen (1988); **B,** horizontal distribution of provenienced pieces (lithics and charcoal) from 2009 excavation, including three new ^{14}C dates; **C,** photo and drawing of the component-2 projectile point.

primarily on the ^{14}C ages, Phippen (1988) contended that component 1 (found in stratum 2b) represents a Nenana-complex occupation and both components 2 (stratum 4) and 3 (strata 5/6 contact) represent later Denali-complex occupations. Early investigations, however, recovered no diagnostic artifacts to substantiate these cultural affiliations (Hoffecker 1988; Hoffecker et al. 1996b; Phippen 1988). In summer 2009, we began full excavations of the site with the anticipation of recovering datable cultural features and diagnostic artifacts. Our objectives were to refine the existing ^{14}C chronology and better understand human-environment interaction during the Pleistocene-to-Holocene transition at Owl Ridge. Below we present a new projectile point found in component 2 associated with three new AMS ^{14}C dates and discuss the implications of this find.

During our 2009 field season we excavated 14 m^2 from the modern surface to stratum-1 glacial deposits and encountered two discrete horizontal concentrations of lithic artifacts located approximately 4–5 m apart (Figure 1B). The easternmost concentration consisted of stratigraphically separated cultural materials from all three components of the site. The westernmost concentration of lithics was primarily limited to a dense, component-2 work area within stratum 4. It is from this locality that we found the projectile point and associated charcoal for dating (Figure 1B–C).

The Owl Ridge component-2 projectile point was found within the paleosol complex of stratum 4 in association with several wood charcoal pieces also found in the paleosol. We obtained three AMS ^{14}C dates of 10,420 ± 60 (AA-86964), 10,410 ± 60 (AA-86960), and 10,340 ± 70 (AA-86963) RCYBP on three wood (*Salix* sp.) charcoal samples found near the point in the component-2 cluster. The projectile point was discovered in three pieces, including tip, shoulder, and base, lying against each other, indicating the point experienced post-depositional breakage, perhaps as a result of freeze-thaw action. Reconstructed pieces represent a nearly complete point, measuring 56 mm long by 37.5 mm wide by 5.9 mm thick. The point has a slightly expanding concave base and waisted hafting element, but little to no edge grinding along its margins. Lateral margins are asymmetrical, likely resulting from rejuvenation of the blade portion. The point was manufactured on a gray-colored microcrystalline chert, the same raw material as most of the rest of the component-2 artifact cluster. A random flaking pattern with some basal thinning (but not fluting) characterizes the point, indicating it was manufactured through direct hammer percussion flaking and finished with pressure flaking. Other artifacts found in the component-2 artifact cluster include three early-stage biface fragments and biface-thinning flakes.

Originally, cultural component 2 at Owl Ridge was thought to represent an early-Holocene (about 9000–8000 RCYBP) Denali complex occupation, but the presence of a biface-reduction lithic cluster and associated ^{14}C dates now indicate component 2 represents a Younger Dryas (12,600–12,000 CALYBP) occupation in which a concave-based point was manufactured and rejuvenated. This Owl Ridge concave-based point may not be unique to Younger Dryas–age deposits in central Alaska because similar concave-based points have been found at sites such as Dry Creek, Broken Mammoth, and Swan Point (Hoffecker et al. 1996a; Holmes 2001; Kunz et al. 2003).

This research has been supported by the National Science Foundation Grant BCS/ARC-09176488. Thanks to Josh Keene and Heather Smith for their assistance during the summer 2009 field season.

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John Court: A Stratified Clovis Site in Hamilton County, Ohio

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➤ **Keywords**: Clovis, stratified site, megafauna

The John Court site is located on the University of Cincinnati Center for Field Studies (UCCFS), in Miami Whitewater Park, Hamilton County, Ohio. Geologically, it is situated on the first terrace of Howard Creek, a tributary of the Whitewater River, and underlain by late-Pleistocene outwash. Remains of late-Pleistocene megafauna including *Bootherium bombifrons* (helmeted musk ox) and *Mammut americanum* (American mastodon) have been recovered from the outwash within 60 m of the site (Tankersley et al. 1983). Although the megamammal remains were found in close proximity to the Clovis site, there are no lines of evidence for human associations.

A Clovis biface was serendipitously discovered during a phase I test excavation at the future site of the Court Archaeological Research Facility (CARF). A 1-m^2 unit was hand excavated in 10-cm levels to a depth of 88.0 cm. The upper 50 cm of overlying sediments consisted of a brown (10YR 4/3) finely laminated, silty, granular alluvium with an abrupt and smooth boundary. The Clovis biface was found at a depth of 65 cm below the surface and 15 cm within

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a yellowish brown (10YR 3/3 to 10YR 3/4) Bt paleosol. The paleosol is mottled and friable with a subangular blocky structure.

All sediments were dry screened through 0.64-mm mesh to recover artifacts and ecofacts. In total, 349 artifacts were recovered from the test unit including 3 bovid bone fragments, 4 square nails, 58 pieces of fired clay, 283 pieces of chert debitage, and a Clovis projectile point preform. Historic artifacts (i.e., bovid bone, nails, and fired clay) were recovered from the upper 20 cm and are likely associated with a Shaker occupation of the site (ca. 1840 to 1955).

Figure 1. A late-stage Clovis projectile point preform from the John C. Court Clovis site.

Like the Clovis preform, the debitage occurred in the Bt paleosol. The debitage is manufactured from Laurel chert, which naturally occurs as red and brown in color. Consequently, thermoluminescence is needed to determine if any of the debitage is actually heat altered or simply naturally oxidized.

The Clovis biface is a late-stage preform manufactured from a Mississippian, Blue River Group, Upper Ste. Genevieve chert (Tankersley 1989). The closest source for this material is 180 km west of the site in southern Indiana or north-central Kentucky. A finished Clovis projectile point manufactured from this chert was recovered from the nearby Mt. Nebo site (33Ha66) located near the Whitewater–Great Miami River confluence (Tankersley 1985:261). The recently discovered preform is the second Clovis artifact recovered from the site.

Rick Espelage, a retired Hamilton County Park Ranger, found a Clovis projectile point base from a nearby plowed surface in the late 1970s.

The Clovis point preform is approximately 51.95 mm long, 6.48 mm thick and 30.75 mm wide. It displays lateral and basal platform preparation and distinctively spaced, large percussion flake removals. One side of the biface was beveled with a few flake removals to create a fluting platform or nipple. Raised flake scar ridges near the center of the biface show polish, which may have resulted during transport (Figure 1). A heavy patina occurs on the surface of the biface and shows no physical evidence that it was recycled by a later Archaic, Woodland, or Fort Ancient group.

In addition to Sheriden Cave and the Paleo-crossing site, John Court is the third site in Ohio to yield Clovis artifacts in a buried, stratified context (Tankersley and Holland 1994; Waters et al. 2009).

This study was made possible with support from the Court Family Foundation, Charles Phelps Taft Foundation, and University of Cincinnati Research Council. The assistance of Angela Hood and Tyler Sweeny and cooperation of the Hamilton County Parks and the University of Cincinnati Center for Field Studies is greatly appreciated.

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Season of Bison Mortality at the Plainview Type Site (41HA1)

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➤ **Keywords**: Bison, seasonality, site formation

The type site of the Plainview complex is a large (90 m^2) bison bonebed located along Running Water Draw in northwestern Texas (Holliday et al. 1999; Sellards et al. 1947; Sellards 1952). My inventory of the 4335 bison

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specimens in extant museum collections suggests that at least 84 bison are present, based on the number of right fused second and third carpals. The bonebed also contains the remains of a coyote and peccary. There is a marked unevenness in skeletal part representation within the bison remains. The assemblage composition is likely biased by selective recovery and density mediated attribution, and shows a marked overrepresentation of lower limb (e.g., carpals, tarsals, phalanges, metapodials) and cranial (maxillary and mandibular teeth) elements, and an under-representation of limb (e.g., humerus, femur, radius, and tibia) and vertebrate elements.

The original site report (Sellards et al. 1947:934) comes to no definitive conclusions about the process(es) of site formation or the number of kill events represented. The size and uniformity of the bonebed, lack of stratigraphic breaks within the bonebed, and presence of several fetal skeletons were used to argue the site was a single spring or early-summer kill (Sellards et al. 1947:934–35; Sellards 1952:66); however, these authors also acknowledged that all or a portion of the site might have been produced by the time averaging of multiple natural deaths events or hunting episodes (Sellards et al. 1947:935). Unfortunately, later researchers' reanalyses of the site have produced various, often contradictory, interpretations for the season of mortality and number of events represented (Fawcett 1987; Guffee 1979; Holliday 1985, 1995, 1997; Holliday et al. 1999; Johnson 1989; Knudson 1983; Speer 1990).

I argue that a detailed study of mandibular tooth eruption and wear patterns provides the highest potential for accurately estimating the season(s) of the bison mortality and determining whether the assemblage represents a single kill event or multiple events. This analysis followed the general procedure for determining season of mortality outlined by Todd et al. (1996) and Niven and Hill (1998) for young bison (age groups 1–5) based on established stages of mandibular tooth eruption and occlusal wear. Below I describe the mandibular tooth eruption and wear patterns for the 36 complete mandibles, mandible fragments, and loose teeth from bison less than 5 years old (age group 1–5).

No fetal (dental age group 0) dentaries are present in the Plainview collection; however, a number of late-term fetus phalanges, which compare favorably in size and stage of development to a one-week-old calf, are present. Excavation notes indicate that other fetal remains were encountered during excavations but not collected owing to poor preservation.

Dental Age Group 1 (0.6-0.9 years) includes six mandibles, although only one specimen retains deciduous premolars. This specimen shows no wear on the dP_2 but has very light wear on the dP_3 and dP_4. The occlusal surface of the M_1s varies from specimens having light polish on the first cusp (facets I–IV) and light polish appearing on portions of the second cusp (facet VI) (wear code 3b), to others having advanced wear on facets I–IV and light wear present on facets V–VIII (wear code 5b) (Payne 1987; Todd et al. 1996). No group 1 mandibles have M_2 still in place, although three loose unworn M_2 teeth are present in the assemblage.

Dental Age Group 2 (1.6–1.9 years) includes seven loose M_2s showing highly variable wear patterns, ranging from very light wear on facets I and II (wear code 3d) to more advanced wear on facets I–IV with light and discontinuous wear on facets V to VIII (wear code 5b).

Dental Age Group 3 (2.6–2.7 years) consists of 11 loose M_3s, a loose dP_4, and a complete mandible. The complete mandible has the permanent P_2 and P_3 erupted but not in wear, and a heavily worn dP_4 with its roots being pushed above the alveolus. All Group 3 M_1s are in full wear (wear code 10a) but still have pointed cusps. The M_2s are moderately worn (wear code 8a). Ten of the M_3s have light wear on just Facets I and II (wear code 2a), while one specimen has light wear that extends from facet I to IV (wear code 3c).

Dental Age Group 4 (3.6–3.7 years) has nine isolated M_3s for this dental age group; these have a consistent pattern of moderate wear on facets I–IV and the enamel edge forming a nearly continuous line around the first cusp (wear code 6a), with the second cusp still separate from the first cusp and with light wear on facets V–VIII. In all cases the hypoconulid is unworn.

Dental Age Group 5 (4.6–4.7 years) includes just two loose M_3. Both teeth are in full wear (wear code 10e) but have high cusp peaks. There is a continuous enamel edge around the tooth expect for the posterior edge of the 2nd cusp (facet VII and VIII). The hypoconulid is unjoined to the cusp 2 and has light wear on facet IX, but not on IX.

Together the Plainview specimens indicate significant amounts of variability in tooth wear. As a group, Plainview dentitions suggest a seasonality estimate range from N+0.6 to 0.9 (late fall through early spring). The presence of late-term fetal bones likely concurs with this estimate. As suggested by Johnson (1989) and Fawcett (1987), the eruption and wear differences observed for the Plainview specimens can probably only be explained by the presence of multiple mortality events.

I wish to thank that staffs of the University of Texas Vertebrate Paleontology and Texas Archaeological Research labs for their help and support of this research. I especially want to thank Ernie Lundelius, Lyndon Murray, Laura Nightengale, Carolyn Spock, and Tim Rowe. Thanks also to Margaret Beck who provided financial and editorial support for this project.

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Clovis Evidence in Kansas

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➤ **Keywords**: Clovis artifact distribution, Clovis, Kansas

This paper is part of a broader study to update the Plains-wide distribution of Clovis evidence (Hofman et al. 1999). Here we review the distribution and lithic materials of 113 Clovis points and preforms from Kansas. This increase over previous studies (Blackmar 2001; Blackmar and Hofman 2006; Hofman and Hesse 1996, 2002; Holen 2001) reflects continued documentation of private and museum collections. Figure 1 includes 110 specimens for which we have county provenience.

The Kansas distribution of Clovis artifacts is notably uneven and limited. Clovis artifacts are recorded for only 37 of 105 Kansas counties. We expect Clovis people were active throughout Kansas and anticipate that Clovis artifacts will be documented from all counties. It is likely that geographic variation in Clovis evidence reflects multiple factors including the intensity or redundancy of Clovis activities (Blackmar 2001; Haynes 2002; Holen 2001; Kelly and Todd 1988), geomorphic processes (e.g., Mandel 2008), modern population and land use patterns (cf. Lepper 1983), and the uneven documentation of artifact collections (e.g., Blackmar 2001; Glover 1978; Hofman and Hesse 1996; Holen 1998, 2001; McLean and Peter 2004; Schmits 1987; Wetherill 1995). A basic question is whether known distributions reflect recurrent behaviors in specific regions or generalized adaptation (with current densities only reflecting sample bias). Continued research should enable us to answer this question.

The rarity of Clovis finds throughout central Kansas remains obvious (Blackmar 2001; Hofman and Hesse 2002), and similar distributional voids occur in nearby

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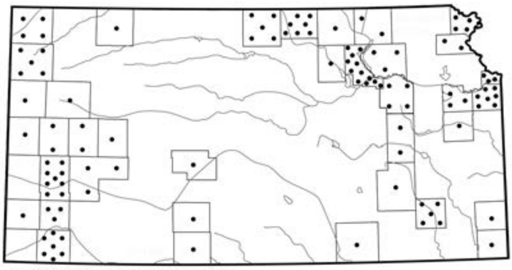

Figure 1. Distribution of Clovis points and preforms (n = 110) by counties in Kansas in 2009.

states (Blackmar 2001; Holen 2003; Meltzer and Bever 1995; Prasciunas et al. 2008; Wyckoff and Czaplewski 1997). Factors likely contributing to the present distribution are the uneven intensity of private collections documentation and archaeological field investigations. Clovis activity may have been more intensive in some areas, notably the northeastern till plains, the Kansas River basin, and the High Plains, but this possibility requires further evaluation.

Lithic materials are documented for 77 (68%) of the Kansas Clovis sample. Most common are Florence (Permian) cherts (n = 16, 21%), Smoky Hill jasper (n = 15, 20%), White River Group chalcedonies (n = 12, 16%), Alibates (n = 11, 14%), quartzites (n = 7, 9%), and Pennsylvanian cherts (n = 5, 7%). Also represented are other chalcedonies (n = 5), basalt (n = 3), fossil wood (n = 2), and Hartville chert (n = 1). One preform may represent Knife River flint. No specimens made from Edwards chert (central Texas) are documented, though this material is represented in Nebraska, Colorado, and Oklahoma samples.

Many professional and avocational colleagues have contributed to this effort. Our thanks for your input and apologies to any we have failed to mention. Errors or problems with this data set are our responsibility. The contributions of Steve Holen have been especially substantive. The records are maintained at the Archaeological Research Center at the University of Kansas. Special thanks to Brendy Allison, Jerry and Donna Ashberger, Robert Barton, Annette Bredthauer, Brook Briand, Dan Busse, Pete Bussen, Bret Clark, James Coons, Dick and Carol Eckles, Vance Ehmke, Dan Fox, Rick Frisbee, Gene Garman, William Graham, Mike Payne, Jason Peter, Bill Postma, Wayne Miller, Charlie Norton, Matt Ford, Walt Lambkin, Ted McMillan, Brian Obermeyer, Jason Peter, Leonard Rose, Rex Schmidt, Craig Smith, Richard Stauffer, Dean Stites, Jeff Trotman, and Darrel Wilson. Professionals and students who have contributed include Mary Adair, Bendon Asher, Will Banks, Don Blakeslee, Jeannette Blackmar, Mike Fosha, Matt E. Hill, India Hesse, Robert Hoard, Steve Holen, Al Johnson, Bill Johnson, Brad Logan, Rolfe Mandel, Larry Martin, Janice McLean, John Reynolds, Lauren Ritterbush, H. C. Smith, Larry Schmits, Martin Stein, Michael Stites, Mary Wildeman, Tom Witty, and Virginia Wulfkuhle.

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A Possible Clovis Biface from West-Central North Dakota

Lisa W. Huckell and Bruce B. Huckell

➤ **Keywords**: Clovis, biface, North Dakota

Shortly after 1916, Sverre Hundskjold Ambjor discovered a large biface in a pasture on the family farm 16 km south of Watford City, Mackenzie County, North Dakota. He does not recall finding similar artifacts or items in direct association with the biface, although he and the family found other prehistoric artifacts and features in this general area of rolling plains terrain near Spring Creek. The first author was shown the biface by her aunt Solveig

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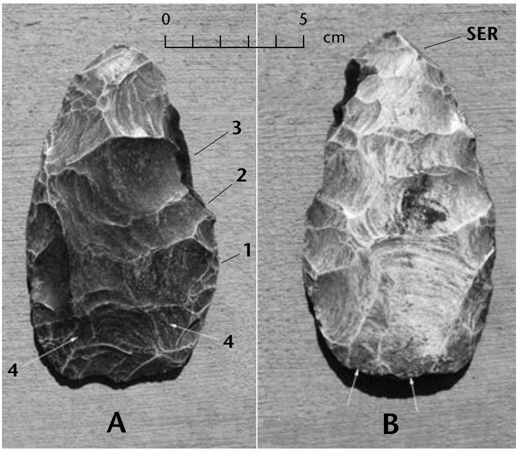

Figure 1. Both faces of the Ambjor biface. Numbered arrows mark near-overshot terminated flakes on Face A, in order of removal.

Ambjor Schweiss in March 2009 and recognized its similarity to large bifaces from northern Plains Clovis caches.

The Ambjor biface (Figure 1) is made of Knife River Flint, the nearest outcrops of which are some 50 km to the southeast. It is uniformly patinated to a dull white on one face (B) and slightly patinated on the opposite face (A), primarily on the ridges between flake scars and on ripple marks within some scars. It measures 141.7 mm long, and has a maximum width of 78.2 mm and a maximum thickness of 16.0 mm. Recent bifacial damage is evident along the upper part of one lateral margin. All extant flake scars appear to be percussion, and on face A there are three prominent scars (marked and numbered in order of removal) that extend from the right margin nearly to the left margin. None show clear evidence of overshot terminations, but the distal end of scar 1 has been removed by subsequent flaking from the left margin. Scars 2 and 3 are nearly overshot-terminated, reaching to within 6.5 mm of the edge. A nearly obliterated fourth scar, represented by two small remnants (indicated by arrows and 4) just above the base on face A, may be another overshot or near-overshot flake extending from the left margin nearly to the right. On face B there are two prominent end-thinning scars (arrows), the larger of which extends tipward for 56.5 mm. On the right margin of face B near the tip is the remnant of a nearly square edge (SER). These technological features suggest a Clovis affinity for the biface, and the development of patination indicates that the biface lay in a stable position over time.

This combination of near-overshot and end-thinning scars, as well as the square edge remnant (Wilke et al 1991:247), on the Ambjor biface closely matches that on specific bifaces from other Clovis caches, including at least two from the Simon cache (Butler 1963:Figure 5c, f), one from Crook County (Tankersley 2002: 113 bottom), seven from Anzick (Lahren 2001:Figure 1; Wilke et al. 1991:Figures. 6-9), three from East Wenatchee (also known as Richey) (Gramly 1993:37a, 41b, 46), and twelve from Fenn (Frison and Bradley 1999:Pls. 25–32, 42–44, 46). If it is indeed Clovis, the Ambjor biface may rank as one of the earliest discoveries of distinctive Clovis bifaces.

We thank Solveig Schweiss for keeping the biface as a family memento for all these years and entrusting it to us for study. She and her brother, Sverre "Amby" Ambjor, provided maps and recollections of life growing up on a farm in rural North Dakota. Thanks also to Matt Root for examining photos of the biface and offering his thoughts as to its potential age and affinity, and to Catherine Baudoin for help with Figure 1. We appreciate the helpful comments by reviewer Susan Mulholland.

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Two Fluted Points from Fish Lake, Central Utah

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➤ **Keywords**: Toolstone sources, Paleoindian, central Utah

Although fluted projectile points are well known on the Plains (Kornfeld et al. 2010), they are rare in Utah and so far restricted to surface finds (see Copeland and Fike 1988; Davis 1989; Russell and Stuart 2002; Schroedl 1991). This paper reports two fluted points, a Folsom and a Clovis, from the Fish Lake Basin, a high-altitude valley (~8900 ft) in central Utah (Janetski 2010). The former is a surface find made from obsidian; the latter came from a Late Prehistoric context and was manufactured from Green River Formation chert from southwestern Wyoming.

An avocational archaeologist found the Folsom point (MPC Accession No. 2000.83.2) on the west side of the north end of Fish Lake near the Lake Creek parking area. The specimen is a lateral basal fragment that includes one ear and portions of flutes on both faces (Figure 1A). The fragment is 29.4 mm long by 17.8 mm in maximum width. Maximum thickness is 3.4 mm, and thickness in the flute channel is 2.8 mm. Edge grinding is clearly visible on the existing margin, although some edge damage is present on the margin perhaps from trampling or attempts to rework the point. Flake scar ridges on one face are visibly worn; no such wear is visible on the obverse face. The flute on the worn face continues to the distal break while on the obverse there is a flat spot that the

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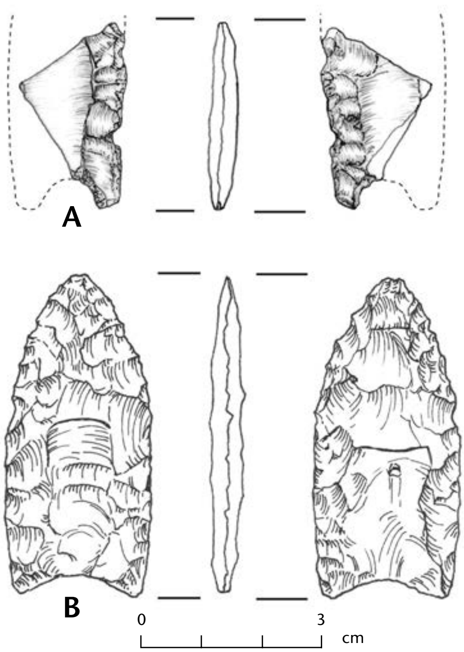

Figure 1. **A,** basal fragment of obsidian Folsom point from the Fish Lake Basin. The obsidian is from the Wild Horse Canyon source in south central Utah; **B,** complete reworked Clovis point from a Late Prehistoric (~A.D. 1600) context at the Moon Ridge site in the Fish Lake Basin, south-central Utah. Toolstone is Green River chert.

flute did not remove. Flake scars along the margin appear interrupted by the channel flake scar. Retouch is minimal. Energy dispersive x-ray fluorescence analysis was conducted on the Folsom point fragment (Hughes 2009) revealing that it was manufactured from obsidian of the Wild Horse Canyon (Mineral Mountains) chemical type located about 95 km to the west southwest of the site.

The complete Clovis point was recovered during excavations of a Late Prehistoric midden at Moon Ridge (42Sv2229) at Fish Lake in 1995 (Figure 1B). The point (MPC Accession No. 1993. 33.1905.1) is made of Green River chert, a dark brown, semi-translucent toolstone with lighter brown swirls. The point is fluted on both faces and edge ground on both lower margins and the basal concavity. It has been reworked by pressure flaking on the distal end above the flutes to form a slightly asymmetrical tip. Overall length is 52.4 mm, maximum width is 23.8 mm, and maximum thickness is 5.4 mm. The first flute traveled 26.3 mm up from the concavity before hinging. The maker lightly retouched the concavity sometime after this flute. The second flute on the obverse side is 22.1 mm in length with almost no concavity retouch. Both flutes interrupt percussion flake scars, which were then retouched with pressure flaking. The tool was undoubtedly curated by the A.D. 1600s occupants of the site. It cannot be known where they found the point, but the positive identification of the toolstone suggests a relatively local original find (or lost) site. The material is nearly identical to that used to produce Clovis projectile points and bifaces in the Fenn Cache (Frison and Bradley 1999). This is the first Clovis made of Green River chert reported from Utah.

Several obsidian fluted points have been traced to Utah sources. Vonn Larsen (1990:133) reported a probable Clovis base from Clear Creek Canyon in central Utah sourced to Wild Horse Canyon, while Janetski and Nelson (1999) reported sourcing data on two fluted points from the Sevier Desert, a Folsom and a probable reworked Clovis sourced to the Mineral Mountains and the Black Rock areas, respectively. Fluted points from eastern Nevada have also been traced to Utah obsidian flows including Modena as well as Wild Horse Canyon (Hockett et al. 2008:36). An obsidian Clovis point from Blackwater Draw in New Mexico came from Wild Horse Canyon (Hughes 1988), while another from that same site came from the Jemez Mountains region of northern New Mexico (Johnson et al. 1985).

This study underscores the importance of Mineral Mountains obsidian as well as exotic cherts during this early period. Although Paleoindians are known for their preference of high-quality stone, often from distant sources (Beck and Jones 2010), the above suggests either a more restrained catchment than seen on the southern Plains, or that excellent material was available locally relaxing (obviating?) the need for distant movements or trade connections.

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Updated Sourcing of Paleoindian Obsidian on the Southern High Plains

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➤ **Keywords**: Obsidian, Paleoindian, Southern High Plains

Twenty-five years ago, Johnson et al. (1985) reported on sourcing of Paleoindian obsidian artifacts from Lubbock Lake and Blackwater Draw Locality 1 (BWD#1) on the Southern High Plains using nondestructive X-ray fluorescence (XRF). At the time, two of the artifacts were sourced to the southeast side of the Valles Caldera (Jemez Mountains) in north-central New Mexico. The source of the third artifact could not be determined. Questions arose recently as to whether: 1) more precise provenience data could be obtained given new technology and greater, more detailed geochemical source information (Shackley 2005); and 2) the unknown source artifact could now be sourced. The common obsidian sources for the Southern High Plains and immediately adjacent areas were New Mexico (Boyd et al. 1993; Hester et al. 1994, 2006; Johnson 1997; Mitchell et al. 1980). The source for the third artifact, however, might prove significant in light of an Idaho source being identified (albeit for a much later time period) at a site on the westernmost Rolling Plains (Boyd et al. 1994) less than 35 km from the southeastern edge of the Southern High Plains.

The Lubbock Lake artifact (TTU-A39314) is a Lubbock point (Knudson et al. 1998), part of the type collection, from a stratum 2 ancient bison kill/butchering locale dating to ca. 9950 RCYBP (Knudson et al. 1998). The two BWD#1 artifacts are a Clovis point (TMM937-862) and a broken biface (TMM937-23). The Clovis point appears to come from the brown sand wedge (Hester 1972:49), i.e., Unit C (Haynes 1995), associated with mammoth remains (Shay 1956 mammoth). The biface is from a late-Paleoindian ancient bison bonebed (now interpreted to represent at least two kills) in the upper part of the carbonaceous silt (Hester 1972:37), i.e., Unit E, at TMM Station E (Evans 1949–50 excavation) with dates of ca. 8970 RCYBP and ca. 8690 RCYBP (Johnson and Holliday 1997:337).

While the original sourcing established six elemental values, the current sourcing employs 8 to 12 values to establish elemental composition using energy-dispersive XRF. Results of the analysis are as follows: TMM 937-862 Ti 709, Mn 475, Fe 8774, Zn 102, Rb 195, Sr 5, Y 61, Zr 175, Nb 97, Ba 17, Pb 35, Th25, source Cerro Toledo rhyolite; TMM937-23 Ti 875, Mn 417, Fe 9022, Zn 85, Rb 163, Sr 7, Y 40, Zr 171, Nb 53, Ba 40, Pb 27, Th 19, source Valles rhyolite;

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TTU-A39314 Ti 949, Mn 492, Fe 10555, Rb 202, Sr 0, Y 61, Zr 164, Nb 98, source Cerro Toledo rhyolite. The Lubbock and Clovis points, originally sourced to the Valles Caldera, now are sourced more specifically to the Cerro Toledo rhyolite, either the Cerro Toledo or Rabbit Mountain domes from the Cerro Toledo event 1.4 mya. Cerro Toledo rhyolite, however, also is available in small nodules up to 40 mm in the nearby northern Rio Grande alluvium (possibly as far south as Socorro). The previously unknown source biface now is sourced as the Valles rhyolite (Cerro del Medio) on the eastern side of the Valles Caldera. Nodules from this obsidian source are uncommon in the Rio Grande alluvium and of very small size (only up to 16 mm as far south as Tijeras Wash, Albuquerque) (Shackley 2005, 2010). The length of the Clovis point (ca. 70 cm) and broken biface (ca. 40 cm) indicates the obsidian must have been procured originally from the Valles Caldera proper. The same appears the case with the Lubbock point. Although the current length of the Lubbock point (ca. 36 cm) would fit within the nodule size in the alluvium at least as far south as Albuquerque, the blade has been reworked to extend its use life (Knudson et al. 1998) and originally would have been longer.

The Valles Caldera generally is 350 km and 500 km northwest of BWD#1 and Lubbock Lake, respectively. The results indicate not only more precise provenience but that obsidian from different eruptions in different parts of the caldera were being used by Paleoindians on the Southern High Plains, either through long distance travel or trade. The Valles rhyolite, however, is incorporated into the system much later in Paleoindian times; and currently, its presence at BWD#1 is the earliest known occurrence. The only other sourced Southern High Plains obsidian Paleoindian point (Milnesand) is Cerro Toledo rhyolite (Hester et al. 2006). The travel/trade relationship with New Mexico is a time-honored one (albeit with varying geographic emphasis and peoples) with its foundations in the Paleoindian period.

Thanks are due to Dr. Darrell Creel, Director, Texas Archeological Research Laboratory (University of Texas, Austin), for facilitating the loan of the BWD#1 material for analysis. The research was funded by the Museum of Texas Tech University. The Geoarchaeological XRF Laboratory at the University of California, Berkeley is supported by National Science Foundation funding (0716333, 0905411) to Shackley. The Lubbock Lake Landmark Collection is a state-associated collection housed at the Museum of Texas Tech University, held-in-trust for the people and State of Texas. The manuscript represents part of the ongoing Lubbock Lake Landmark regional research program into grasslands hunter-gatherers and adaptations to ecological change on the Southern Plains.

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Paleoindian Lithic Raw Material Use in the Tennessee River Valley

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➤ **Keywords**: Southeast, lithics, projectile points

The Midsouth region has long been known to produce large numbers of Paleoindian projectile points. In this paper, we analyze an extensive projectile-point assemblage to evaluate lithic raw material use in the west Tennessee River Valley during the late Pleistocene. A tripartite division of the Paleoindian occupation in the Midsouth and greater Southeast consisting of early, middle, and late periods has been the traditional chronological definition spanning 2500 years from ca. 12,500 to 10,000 RCYBP (Anderson et al. 1996). For the purposes of this paper, the following chronological scheme is employed. The early-Paleoindian period consists of the fluted-point horizon and includes Clovis, Clovis variants, as well as Cumberland projectile points. The middle-Paleoindian period consists of Quad, Beaver Lake, and Dalton

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projectile points. The late-Paleoindian period includes Greenbrier, Harpeth River, and western-style projectile points such as Agate Basin.

The archaeological data presented here were derived from the Tennessee-Duck River Paleoindian complex. The Tennessee–Duck River Paleoindian Complex (TDRPC) is defined here by six sites (40BN100; 40HS173, 174, 184, 186, 278) located near the confluence of the Tennessee and Duck Rivers in modern Benton and Humphreys Counties, Tennessee, in the upper portion of Kentucky Lake. The raw material data employed for this project were derived from the Tennessee Division of Archaeology Paleoindian survey (Broster and Norton 1996; see also http://pidba.utk.edu/tennessee.htm). Raw material data were recorded for each projectile point and processed in SPSS. Projectile points were grouped by period rather than specific type so that sample sizes were statistically significant and chronological trends could be more clearly recognized. Raw material usage was evaluated by period so that chronological trends in resource use could be characterized.

A total of 204 diagnostic projectile points have been recovered from the TDRPC. Of this total, data are available for 198 projectile points, or 97.06% of the assemblage. Six lithic raw material types as well as indeterminate raw materials are present in the assemblage. Dover is the most heavily represented type with 142 specimens (71.7%), followed by Fort Payne (n = 28; 14.1%), Waverly (n = 14; 7.1%), Camden (n = 5; 2.5%), Buffalo River (n = 4; 2.0%), and St. Louis (n = 1; .5%). Indeterminate raw materials account for four specimens (2.0%). As noted by Bradbury and Carr (2009) raw materials in the west Tennessee River Valley are abundant, ubiquitous, and of high quality making for difficulty in accounting for the effect of distance in raw material use. A total of 65 projectile points are assigned to the early-Paleoindian period including Clovis (n = 33), Redstone (n = 6), and Cumberland (n = 26); 80 are assigned to the middle-Paleoindian period including Quad (n = 27), Beaver Lake (n = 36), and Dalton (n = 17); 52 are included in the late-Paleoindian period assemblage including Greenbrier (n = 48) and Harpeth River (n = 4). Table 1 summarizes the raw materials by period.

Table 1. Projectile point frequencies by period and raw material type.

Period	Buffalo River	Camden	Dover	Ft. Payne	St. Louis	Waverly	Indet.	total
Early	4	2	36	14	1	7	1	65
Middle			62	12		4	2	80
Late		3	43	2		3	1	52
Total	4	5	141	28	1	14	4	197

The greatest raw material diversity appears in the early-Paleoindian period, when all raw material types are present. Buffalo River and St. Louis cherts are restricted to the early-Paleoindian period. The least diversity occurs in the middle-Paleoindian period with three raw material types and indeterminate. Four raw material types along with indeterminate are present in the late-Paleoindian assemblage. This indicates a pattern of initial high diversity followed by a decrease in diversity in the middle-Paleoindian period and a slight subsequent increase in diversity by the late-Paleoindian period. Perhaps more significant than raw material diversity by period is the use of Dover and Fort Payne cherts, which are the most frequently occurring types. Dover chert increases in use from the early-Paleoindian through late-Paleoindian periods while Fort Payne decreases in use. To test whether this association is significant or random, a chi-square test was conducted. Results ($X^2 = 15.22$; df = 2; $\alpha = .05$) indicate that the relationship is not random but is statistically significant.

The results of the analysis reveal the following patterns:

1. A pattern of generally decreasing diversity in raw material use is evident from the early- to late-Paleoindian periods;
2. Intensification of resource use is evident in the increased proportion of Dover chert projectile points from the early- to late-Paleoindian periods.

A version of this paper was originally presented at the 64th Annual Southeastern Archaeological Conference Knoxville, TN, Oct. 31- Nov. 3, 2007. The artifacts employed in this study are in private collections as well as some specimens curated by the Tennessee Division of Archaeology.

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An Isolated Clovis Point from Doña Ana County, New Mexico

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➤ **Keywords**: Clovis, projectile point, New Mexico

An isolated Clovis projectile-point base was discovered at White Flat in Doña Ana County, New Mexico, during an AT&T fiber optic project (Jones et al. 2010). It is the first Clovis point documented west of the Rio Grande in the low desert region of southwestern New Mexico. The point is broken diagonally along a natural fracture or material flaw (Figure 1). It is fluted on both faces, the margins are ground, and the base is concave with a central notch. The fragment is 22 mm long, 25 mm wide, and 6 mm thick; the basal indentation is approximately 14 mm deep. The point is gray chert with fossiliferous inclusions and minute vesicles. Although the source is unknown, the material

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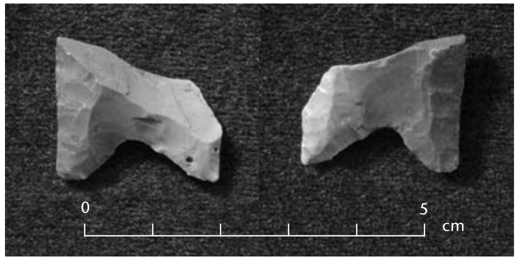

Figure 1. Two sides of a Clovis projectile point base from White Flat in Doña Ana County, New Mexico.

resembles Edwards Plateau chert. One edge of the break exhibits minute flake removals and crushing, damage that may have occurred during previous AT&T cable installation.

White Flat is directly north of the West Potrillo Mountains, approximately 36 km west of the Rio Grande. The broad area of playas, alluvial flats, and low sandy rises is directly north of an extensive volcanic field. The flats and playas are generally dry but would have held shallow ponds in the late Pleistocene. Current vegetation is desert scrub-grassland with scattered mesquite and soaptree yucca. During Clovis times, the area was potentially pinyon-oak-juniper woodland, and the flooded flats may have supported riparian vegetation (Holmgren et al. 2006; Van Devender and Worthington 1977; Van Devender et al. 1977; Wells 1966, 1977). Locally available lithic resources include fine-grained rhyolite, basalt, and chert.

The roughly 12 km^2 White Flat area was one of four locales in New Mexico that were designated areas of critical concern (ACCs) based on site density, depositional setting, and potential for buried resources (Kearns et al. 2001). The study area, the AT&T right-of-way, was 7.2 to 7.5 m wide, contained two previously installed cables, and extended 3.1 km across the southern edge of White Flat. Five sites were investigated, and the nonsite portion of the ACC was examined for surface artifacts and trenched by backhoe (McVickar and Smith 2010). The point base, an isolated surface artifact, was 500 m east of Mauries Lake, a prominent playa.

Nine backhoe trenches totaling 840 m were excavated across the nonsite area of White Flat ACC. The 1.2-m-deep trenches exposed one isolated hearth approximately 24 cm below the modern surface and roughly 14 m east of the Clovis point. A sample of saltbush (*Atriplex* sp.) from the hearth produced a ^{14}C age of 1370 ± 40 RCYBP (Beta-255478), placing it in the Late Pithouse period of the Mogollon sequence. Use of the White Flat area was also evidenced by diagnostic early- and middle-Archaic projectile points at four sites. The points indicated that the area remained an attractive locale for hunter-gatherer groups through much of the mid-Holocene.

Thanks to Western Cultural Resource Management, Inc., Andrea M. Greenaker, and Bob Estes for support.

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A Preliminary Report on the Andrew Farm Mastodon, Adams County, Illinois

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➤ **Keywords**: Mastodon, Illinois, cutmarks

The Andrew Farm locality (11A1578) was discovered in the late 1950s when Arthur Andrew found a large mastodon (*Mammut americanum*) tooth eroding out of a marl deposit near the former bed of Lima Lake in Adams County, Illinois. While potentially significant, the tooth and bone fragments found

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later received little attention. Local archaeologist Steve Tieken, aware of the find and lack of scientific study, persuaded the current owner of the tooth to allow an analysis and radiocarbon dating of the specimen. Dr. Hong Wang (Illinois State Geological Survey) extracted a small amount of bio-apatite from the enamel and obtained an AMS date of 10,775 ± 35 RCYBP (A1120), consistent with the youngest dated mastodons in the upper Midwest (Fisher 1984; Fisher et al. 1991, 1994; Kapp 1986; Woodman and Athfield 2009). To date, no stone tools or lithic debitage have been recovered in direct association with the mastodon remains in the marl deposit, although archaeological materials have been recovered elsewhere at the site.

The Andrew Farm faunal sample contains 304 pieces of bone. The majority are unidentifiable fragments from the single mastodon recognized at the site. The tooth is a right mandibular 2nd molar, with a small amount of attached jawbone. The proximal portion of a right rib and a thoracic vertebra neural spine also were identified. The remains of Blanding's (*Emydoidea blandingii*), snapping turtle (*Chelydra serpentina*), and indeterminate turtle also were present.

During a preliminary inspection, Tieken noticed possible cutmarks on the thoracic spine. As part of the faunal analysis, Kuehn (2008) examined the intact outer surface of all bone fragments obtained at Andrew Farm. Macroscopic examination of the exterior surfaces revealed linear striations on seven mastodon bone fragments, including the thoracic spine. Cutmarks were also observed on a snapping turtle humerus and an indeterminate turtle plastron fragment. These specimens were taken to the Illinois State Geological Survey for microscopic examination, and a series of micrograph images were recorded. The marks consist of short linear to slightly curving striations, occurring singly or in multiples (Figure 1). The multiple marks were generally

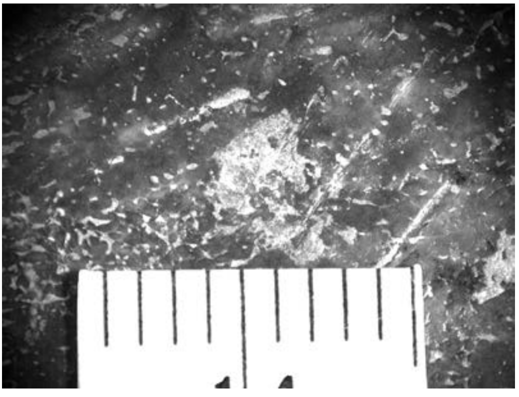

Figure 1. Possible cutmarks on Andrew Farm mastodon bone.

parallel in alignment. The probable butchery marks are typically narrow with a V-shaped cross section and were readily distinguishable from root etching, incidental abrasion, and similar modification (e.g., Fisher 1995; Lyman 1994). Analysis of the Andrew Farm assemblage continues; it is hoped that scanning electron microscope examination of the remains will provide sufficient detail to definitively identify the possible butchering marks (e.g., Shipman et al. 1984). The Andrew Farm mastodon and associated faunal assemblage represent a significant late-Pleistocene find (e.g., dated, possible butchery marks), a rarity in the Midwest (e.g., Cannon and Meltzer 2004; Grayson and Meltzer 2002). The Andrew Farm data can potentially address issues relating to human-mastodon interaction in the Midwest.

Our thanks to Drs. Hong Wang, Brandon Curry, and David Grimley (ISGS) and Dr. Thomas Emerson (ISAS, UIUC) for their assistance and support for this research project.

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Red Ocher, Endscrapers, and the Folsom Occupation of the Lindenmeier Site, Colorado

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➤ **Keywords**: Ocher, Folsom, Great Plains

The Colorado Museum of Natural History (CMNH)[1] tested the Lindenmeier site during the summer of 1935 (Cotter 1978), working alongside the Smithsonian Institution (Roberts 1935, 1936) and the Coffin family (Coffin 1937). Pit 13, located on the far western side of the site, yielded a large assemblage of artifacts dating primarily to the Folsom period. Recent reanalysis of the Pit 13 collection documents the presence of red ocher on chipped- and ground-stone tools, as well as faceted hematite abraders and a drilled hematite bead.

Thirty-six chipped-stone tools contain traces of ocher (Table 1), accounting for 12.5% of the Pit 13 chipped-stone tool assemblage. Residue identification, based on macroscopic and low-power microscopic examination of the artifacts, shows that ocher is present in small concavities and material voids, angular flake scar terminations, and within low spots of flake scars—areas ideal for residue preservation. Ten chipped-tool forms, classified by their morphology and edge angles, have ocher present. Endscrapers and other scrapers contain the highest percentage of ocher, whereas projectile points, preforms, retouched flakes, and channel flakes have the fewest occurrences. A chi-square test comparing endscrapers and other scrapers against all other chipped-stone tool forms, based on the presence/absence of ocher, proved significant (χ^2=7.66, p=0.0056), suggesting that using ocher and scraping were associated activities in Pit 13.

Other recovered forms of ocher include five faceted abraders[2], heavily polished and ground. The facets contain numerous fine thin lines, suggesting abraders were rubbed or pulled along the edges of lithic flakes and tools, either to dull the lithic edge or coat it in fine powder. As well, the flake scars of a drill covered with ocher suggest that this tool (or another just like it) was used to drill the hematite bead recovered from the CMNH excavation, as the contours of the drill bit fit the bead interior with a near perfect fit. Finally, ground stone from Pit 13 exhibits hematite staining related to pigment processing.

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[1] CMNH is now named the Denver Museum of Nature & Science.

[2] Cotter (1978:Table 109) reports 19 pieces of rubbed hematite and one piece of rubbed limonite from Pit 13. Our totals differ from those published by Cotter, whose manuscript was written in the 1930s. Part of the discrepancy is due to classification differences, but portions of the collection were loaned to other institutions and/or misplaced since the initial discovery.

Table 1. Chipped-stone tools containing ocher residue, Lindenmeier CMNH Pit 13.

Artifact type	Pit 13 total	Number with ocher	Percent with ocher
Projectile point	27	1	3.7
Channel flake	31	1	3.2
Drill	4	2	50.0
Preform	21	2	9.5
Retouched flake	42	2	4.8
Graver	29	3	10.3
Biface	26	4	15.4
Utilized flake	35	5	14.3
Other scraper	27	6	22.2
Endscraper	47	10	21.3
Total	289	36	12.5

There are several possible uses for the red ocher, not necessarily mutually exclusive. Functions might include symbolic use of the red color/powder, as an ingredient for mastic and hafting glue, for decoration, and/or as a hide preservative (Roper 1987, 1996; Stafford et al. 2003; Wadley 2005; Wadley et al. 2004). Hide processing was clearly a major activity at Lindenmeier, given the high frequency of endscrapers in the CMNH assemblage, as well as in the Smithsonian (Wilmsen and Roberts 1978) and Coffin collections (Ambler 1999; Gantt 2002). Maintaining high-quality hides, so that they did not deteriorate during the production process, would have been a major concern for Paleoindians putting up winter stores (Hill et al. 2010; Jodry 1999). Perhaps ocher was processed with ground stone, preparing a fine powder to coat fresh hides, and then subsequently worked against skins with endscrapers and other processing tools, coating those tools with residue.

Wilmsen and Roberts (1978:126-128) also documented ocher in Areas I and II of Lindenmeier. The Smithsonian excavation recovered 68 pieces of hematite (1978:16), all of which showed evidence of grinding/faceting. The ocher is spatially clustered, with close association to ground stone. Roberts's team also recovered a partially drilled hematite specimen (1978:Figure 121) and a piece of decorated turtle plastron with traces of ocher (1978:Figure 128a), confirming Folsom decorative items in Areas I and II, along with Pit 13. At least six other Folsom sites contain red ocher, including Agate Basin (Frison and Stanford 1982), Cattle Guard (Emery and Stanford 1982; Jodry 1999), Cooper (Bement 1999), Hanson (Frison and Bradley 1980), Mitchell (Boldurian 1990), and Powars II (Stafford et al. 2003). Red ocher has also been reported from later Paleoindian sites near Lindenmeier, including the Cody-complex Jurgens site (Wheat 1979), the Gordon Creek burial (Breternitz et al. 1971), and the Allen-complex O. V. Clary site (Hill et al. 2010). Most of these sites represent major encampments occupied for an extended time (on a relative temporal scale), where tool manufacture and maintenance, hide working, and leisure activities were undertaken (Andrews et al. 2008; Roper 1989, 1991).

The source of the Lindenmeier ocher is currently under investigation, with hopes of comparing the materials with other known sources (Erlandson et al. 1999; Popelka-Filcoff et al. 2007; Tankersley et al. 1995). Local sources of hematite are known (Coffin 1929; Wilmsen and Roberts: 1978:128); however, it is possible that the ocher is derived from a regional source, such as Powars II red ocher mine in the Hartville Uplift of southeastern Wyoming (Stafford et al. 2003; Tankersley et al. 1995). This is certainly plausible given the presence of other Wyoming toolstones in the Lindenmeier assemblage.

Thank you to Steve Holen for facilitating research with the Lindenmeier collection and supporting Cody Newton with the *Robert* L. *Akerley* Internship at DMNS. Thanks as well to Brian Andrews, Jason Chambers, Matthew G. Hill, and Chris von Wedell in regards to discussions regarding Folsom lithics and potential uses of red ocher.

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A Clovis Point from the Pacific Northwest Coast

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➤ **Keywords**: Clovis, Northwest

Fluted points are extremely rare in the coastal Pacific Northwest (western BC, WA, OR). There are no excavated fluted-point sites in the region; there are 13 fluted-point isolates reported from western Oregon (Connolly 1994; Ozbun et al. 1997; Ozbun and Stueber 2001), 7 from western Washington (Croes et al. 2008), and none from western British Columbia (Carlson and Magne 2008). Most of these artifacts are identified as Clovis points.

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One of the western Washington isolates is a complete Clovis point from Site 45KP139, also known as the Yukon Harbor Clovis site, on the Kitsap Peninsula, west of Seattle. In 1995, the landowner found the point (Figure 1) in backdirt on the edge of a pond that had recently been excavated in a wetland. Archaeologists from the University of Washington Burke Museum conducted shovel-

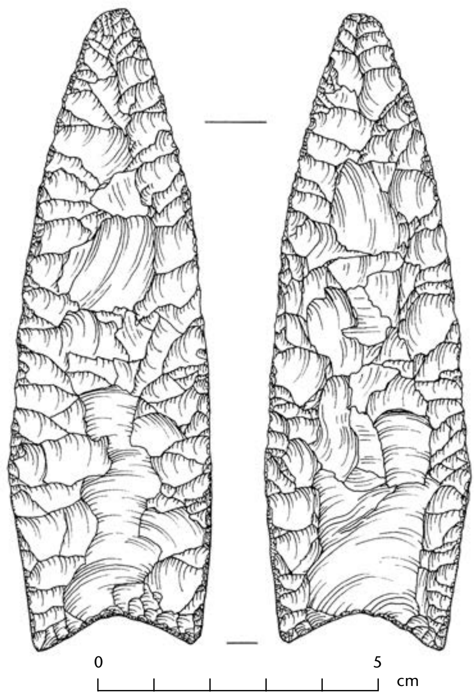

Figure 1. Clovis point from 45KP139. Face A on left, face B on right. Illustration by Sarah Moore from photographs by Roger Kiers.

probe surveys in the vicinity of the Clovis-point find in February 2004 (Stein et al. 2004) and August 2008 (LeTourneau and Hodges in prep.); no prehistoric artifacts were found. The wetland is situated in a topographic low in the glacial (Vashon Stade) landscape. In the immediate vicinity of the Clovis-point find, glacial drift sand underlies a late-Pleistocene/late-Holocene peat sequence that includes a layer of Mazama O tephra (LeTourneau and Hodges in prep.).

The point is high-quality reddish brown chert whose source is not known. It is 113.74 mm long. Maximum width is 36.87 mm, basal width is 29.36 mm, and maximum thickness is 8.51 mm (measured 60 mm from base). The cross section is biconvex, the base is concave, and the lateral margins expand toward the tip and then begin to converge at a distance of about 34 mm from the base. The basal margin is heavily ground, and both lateral margins have moderate grinding from the base to the widest part of the point.

Each face has a single flute scar; on face A it is 48.46 mm long (measured from basal corners) and 15.43 mm wide, and on face B it is 43.86 mm long and 22.19 mm wide. Maximum thickness measured in both flute scars is 6.99 mm. Facial flaking on both faces is largely obscured by the flutes and post-manufacture retouch. There are no clear overshot flake scars, although each face has one broad flake scar that extends well past the midline. The point was manufactured from an end-struck flake blank as evidenced by two areas of remnant original ventral surface on face B; rings of force on these remnants indicate that the flake's proximal end was at the proximal (basal) end of the point. Resharpening is evident in the abrupt shoulders at the widest part of the point and steep retouch along the right margin of each face that creates an alternate bevel when viewed in cross section.

The 45KP139 point is one of a number of western Washington locations with fluted points or other evidence of human activity associated with late-glacial peat bogs (Kenady et al. 2007, in press; Meltzer and Dunnell 1987). Late-Pleistocene landforms are common in western Washington, so the association with wetlands provides a good starting point in modeling locations of Clovis and other late-Pleistocene sites in that region.

I greatly appreciate the assistance of Laura Phillips and Kelley Meyers of the Burke Museum in arranging for me to study the 45KP139 Clovis point.

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The DeWulf Site (11Hy296): A New Late-Paleoindian Site in Northwest Illinois

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➤ **Keywords**: Late Paleoindian, lithics, Midwest

DeWulf is a single-component late-Paleoindian site located near the confluence of the Rock and Green rivers in Henry County, Illinois (Figure 1). It is situated on the crest and slope of a small ridge within the dissected upland margin overlooking the Green River. Systematic surface survey and limited excavations in June 2009 revealed a dense surface concentration of artifacts measuring 50 m by 25 m. Broken and burned bifaces, lanceolate projectile points, and large blocky and flake fragments characterize the assemblage. Typological comparison with Great Plains late-Paleoindian points suggests the site dates to 8500–9500 RCYBP.

Figure 1. Location of sites discussed in the text.

To date, the collection totals 4,935 specimens, including 2,117 blocky pieces, 2,124 flake fragments, 646 biface fragments, 32 unifacial tool fragments, and 16 miscellaneous items, mostly FCR. Most items are made from Galena and Blanding cherts, available within 100 km. About 5% of the specimens are made from Hixton silicified sandstone from Silver Mound, western

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Wisconsin, located 330 km north. Interestingly, Moline chert, which outcrops within 10 km of the site, is absent.

The biface sample includes 102 point fragments representing at least 31 different points. The points are thin, lanceolate, display parallel oblique flaking, lack basal grinding, and typologically are within the range of variation displayed by other late-Paleoindian points displaying parallel oblique flaking such as Allen, Fredrick, and Angostura (Frison 1991). Most mid-stage bifaces are manufactured on Galena or Blanding chert, although at least 12 larger Hixton specimens are present.

Two biface breakage patterns are evident, intentional and thermal. Intentional breaks include radial fractures and lipped bending fractures. Crenation fractures are the most common form of breakage within the entire assemblage, and they often intersect prior bend and radial fracture facets. Radial fractures are more common on Hixton bifaces, while bending fractures are more common on projectile points.

The complete lack of small biface thinning flakes and presence of tips and midsections indicates that points were not manufactured on site, nor do they represent discard of broken or exhausted hunting weaponry. The evidence suggests that finished and nearly finished tools were brought to the location and then intentionally broken and burned.

In summary, the overall pattern of behavior inferred from the evidence at DeWulf ties the site to several other sites in the Upper Midwest where mortuary activity is suspected, including Renier in northeast Wisconsin (Mason and Irwin 1960), Pope in central Wisconsin (Ritzenthaler 1972), and Gorto on the Upper Peninsula of Michigan (Buckmaster and Paquette 1988). In Ontario, burned or broken artifacts are reported from the Crowfield and Caradoc sites (Deller et al. 2009; Ellis 2009) and the Cummins site, which contained cremated human remains but no associated artifacts (Dawson 1983).

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33Ms391: A Paleoindian Site in Southeastern Ohio

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➤ **Keywords**: Paleoindian settlement, late Pleistocene, southern Ohio

A 2006 CRM study explored Paleoindian Site 33Ms391, located in Meigs County, southeastern Ohio, in the unglaciated Appalachian Plateaus province (GAI 2006a, 2006b). The site lies on a late-Pleistocene dune field that mantles a T3 terrace above the Ohio River.

Kollecker (1995) discovered Site 33Ms391 during surface survey, recovering a fragmentary fluted point. In 2006, surface collection and testing relocated Site 33Ms391, revealing a site footprint measuring 250 m by 150 m on high ground fronting a topographic basin. The site consists of five plowzone artifact clusters (cluster 1, 144 m^2; cluster 2, 108 m^2; cluster 3, 36 m^2; cluster 4, 72 m^2; cluster 5, 108 m^2). To the west, clusters 3 and 5 yielded Brewerton notched points, indicating late-Archaic occupations, while cluster 4 is undated. To the east, two fluted points in cluster 1 record a Paleoindian component, and a triangular endscraper suggests Paleoindian occupation in adjacent cluster 2.

Raw materials for Paleoindian artifacts in clusters 1 and 2 fall within the range of macroscopic variability for Brush Creek chert, which outcrops discontinuously across southeast Ohio, southwest Pennsylvania, and northwest West Virginia (Holland and Kagelmacher, pers. comm., 2007; Kagelmacher 2001). The closest reported outcrops of Brush Creek chert lie 40 km to the west-northwest in Meigs and Athens counties, Ohio (Stout and Schoenlaub 1945:98–99, 102).

Preliminary analysis of the Paleoindian component records two fluted points (one whole, one fragmentary), three failed fluted-point preforms, and three unifacial tools (Figure 1). Debitage consists of late-stage flaking debris, mostly from biface reduction. With dimensions of 77.2 by 27.0 by 7.3 mm, short flutes, and near-parallel lower lateral edges, the complete fluted point (FS 91) bears similarities to Midwest Clovis and Great Lakes Gainey forms (Bradley et al. 2008; Ellis 2004; Morrow and Morrow 2002), but its shallow basal concavity (2.6 mm) is characteristic of Clovis forms (J. Bradley et al. 2008:125). Consistent with this, overshot flaking—a diagnostic of Clovis biface reduction (B. Bradley et al. 2010:68-77)—appears to be present on the reverse face of fluted preform FS 93 (Figure 1).

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Site 33Ms391 reminds us of the potential role of local topography in Paleoindian site location. The Paleoindian component occupies the eastern, downwind margin of a small, seasonally wet topographic basin—a unique feature in this 53-hectare late-Pleistocene dune field. Paleoindians might have been drawn to this topographic basin if it harbored distinctive plant resources or was attractive to game animals.

Regionally, the dune-field setting of Site 33Ms391 parallels the Sandy Springs site (33Ad30) in Adams County, southern Ohio (Seeman et al. 1994).

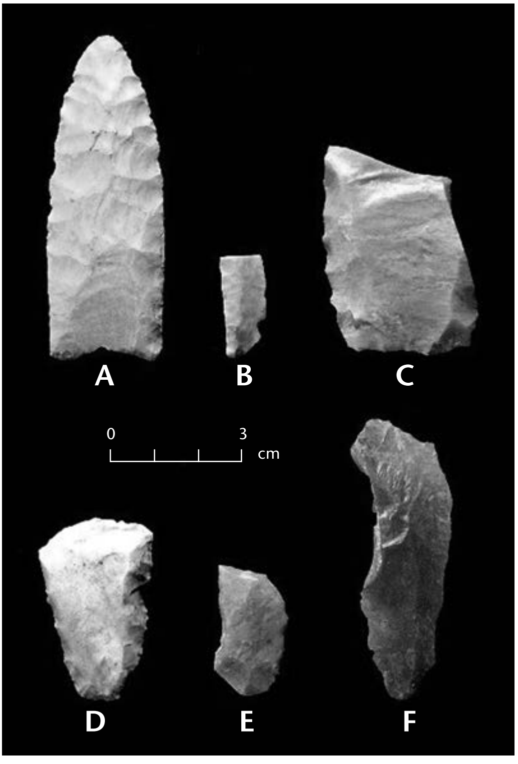

Figure 1. Select Paleoindian artifacts from 2006 investigation of Site 33Ms391. **A,** complete fluted point (FS 91); **B,** basal fragment of fluted point (FS 271); **C,** proximal fragment of point preform, fluted on obverse face only (FS 93); **D,** trianguloid endscraper (FS 156); **E,** flake graver (FS 271); **F,** utilized blade-like flake (FS 383). All artifacts likely Brush Creek chert. All specimens from cluster 1, except **D** (cluster 2).

This large early- and late-Paleoindian site straddles a late-Pleistocene dune field and terrace above the Ohio River. Modern saline springs at this dune field (Seeman et al. 1994:79) may have also played a role in site location. Looking east to the Hudson and Connecticut valleys and to Maine, several fluted-point sites there also lie on late-Pleistocene dune fields (e.g., Binzen 2005; J. Bradley et al. 2010; Chilton et al. 2005; Curran and Dincauze 1977; Gramly 1998; Spiess et al. 1998:230), further highlighting the potential importance of these valley eolian landscapes for early Paleoindians in the Midwest and New England.

Thanks to American Electric Power, sponsor of this investigation, to the Ohio Historic Preservation Office for timely project coordination, and to anonymous reviewers.

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Paleoindian Projectile Points from an 11,000-ft Site in the Rocky Mountains, Northern Colorado

Elizabeth Ann Morris

➤ **Keywords**: James Allen component, northern Colorado, high altitude

Thirteen Paleoindian projectile points were collected from the surface of the Carey Lake site (5LR230) and a nearby location, at nearly 11,000 ft (3350 m) a.s.l. in the Medicine Bow Mountains of northern Colorado. The assemblage also includes nine later projectile points, 37 other lithic artifacts, and 180 flakes. All Paleoindian points are broken. Most (Figure 1A–C, E–J) are basal or midsection fragments of even-grained, gray, tan, or reddish quartzite. Parallel-diagonal flaking and hafting-area grinding suggest they are Jimmy Allen points, with an age range of 9350–7900 RCYBP and a median age of 8780 RCYBP (Pitblado 2007). Five other tools and 103 flakes of the same materials are likely to belong to the James Allen component. A probable Scottsbluff point (Figure 1K) and the collaterally flaked midsection of a possible Eden point (Figure 1D), both translucent chert, were also collected.

Site 5LR230, a multicomponent base camp occupied since at least Paleoindian times, is the largest of 10 known resources in the Carey Lake cirque. Colleagues and members of the Colorado State University Department of Anthropology devoted over 100 person-days to collecting the site during annual visits spanning 25 years, between 1971 and 1996. New material was exposed each year due to erosion and pocket-gopher tunneling. Three additional multicomponent campsites (5LR227, 5LR228 and 5LR229), a kill site (5LR12608), and five isolated finds were also recorded in the cirque. Snowbanks persist there until late summer, feeding small lakes and streams that drain to the North Laramie River, a tributary to the North Platte. Faunal and floral resources, specifically large game, abound. Isolated stands of krummholz trees provide fuel and shelter in the timberline ecotone.

The presence of at least nine Jimmy Allen points, revealed by systematic monitoring of the natural turnover of shallow sediments, contributes to understanding the distribution of late-Paleoindian complexes in the region. Carey Lake is one of a number of recently reported locales where Jimmy Allen points have been found at high elevations (e.g., Millonig and Labelle 2010) or within the mountainous interior of Colorado (Wiesend and Frison 1998; Metcalf et al. 2010). Use of local raw materials at base camps in a range of mountainous settings indicates that James Allen Complex peoples were at least as well adapted to life in the high country as they were to the High Plains.

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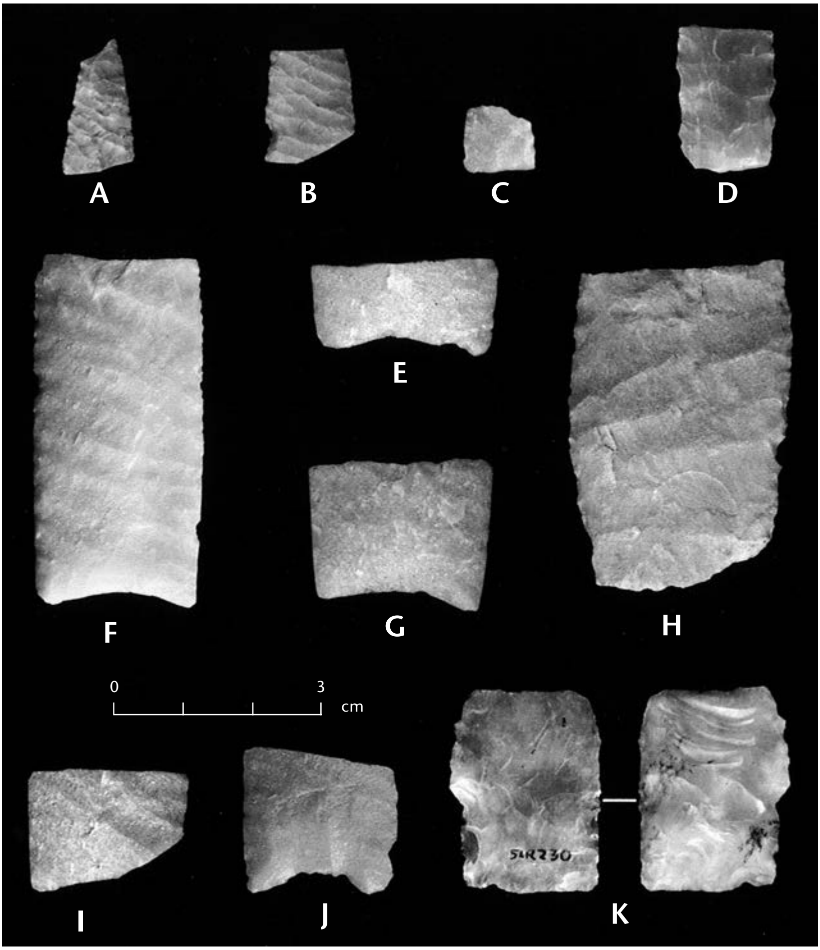

Figure 1. Paleoindian projectile point fragments from the Carey Lake site (5LR230): **A-C** and **E-J**, Jimmy Allen points; **D**, possible Eden point; **K**, probable Scottsbluff point.

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Two Fluted Quartz Points from Pine County, Minnesota

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➤ **Keywords**: vein quartz, fluted, Minnesota

Fluted projectile points of quartz crystal are a rare but consistent part of early-Paleoindian assemblages (Reher and Frison 1991). However, of four fluted quartz points from the upper Midwest, the only Minnesota specimen is not crystal but vein quartz (Mulholland 2006:130). A second Minnesota fluted quartz point, recently identified from ongoing collaboration with private collectors, is also vein quartz. The fluting indicates an early-Paleoindian association for both points, either Clovis or Gainey (Stoltman 1991).

The previously reported point (Neubauer #7; JN-8 in Shane n.d.; MFP.PN.6 in Higginbottom 1996:41) is complete with a flute on both faces (Figure 1A, B); slight grinding is present on both lateral edges. The base is very slightly concave with the lateral edges diverging from the base to the maximum width above the

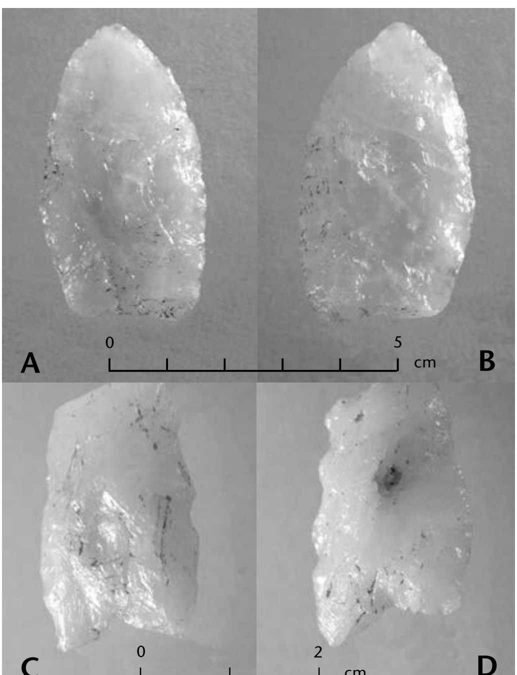

Figure 1. Fluted quartz points from Pine City area. **A,** Neubauer #7, obverse face; **B,** Neubauer #7, reverse face; **C,** Neubauer #31, obverse face; **D,** Neubauer #31, reverse face.

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grinding. Maximum length is 56.00 mm, maximum width 29.68 mm, maximum thickness 8.16 mm, basal width 18.59 mm, basal concavity 0.70 mm, interflute thickness 7.00 mm. The longitudinal profile is convex-planar; the transverse profile is convex–slightly concave. Flute scars are 17.66 mm long and 12.05 mm wide (obverse), and 33.58 mm long and 18.96 mm wide (reverse). The point was recovered from site 21PN21, on the Snake River upstream from Pokegama Lake.

The newly reported point (Neubauer #31) lacks the tip (by a recent break); one side is fluted, and the other has a failed flute (Figure 1C, D). The lateral edges are partially ground. The base is definitely concave with the lateral edges straight at the ground edges before constricting. It has been resharpened, with the blade reduced relative to the base. Maximum length is 30.44 mm (incomplete), maximum width 22.08 mm, maximum thickness 6.99 mm, basal width 18.84 mm, basal concavity 3.46 mm, interflute thickness 5.35 mm. The longitudinal and transverse profiles are biconvex. Flute scars are 18.57 mm long and 15.03 mm wide (obverse), and 6.59 mm long and 5.84 mm wide (reverse). The point was recovered from site 21PN86, on Mission Creek north of Pine City (Romano and Mulholland 2000:124).

Both points are of high-quality vein quartz that is partially translucent but not a quartz crystal. This choice of lithic material differs from quartz fluted points reported from Clovis sites on the Great Plains (Reher and Frison 1991) but is similar to late-Paleoindian quartz points in Minnesota (Mulholland 2006:131). High-quality quartz may be more widespread than quartz crystal deposits, increasing availability of knappable quartz sources. Quartz sources approximately 70 miles west in the vicinity of Little Falls, Minnesota, are well known to contain high-quality types (Birk 1991:4,53-54).

The Pine City area has the greatest recorded concentration of fluted points in Minnesota (Higginbottom 1996:61); most are artifacts collected by Joseph Neubauer, Sr. Ten of his early-Paleoindian points were previously documented (Shane n.d.); several additional points were recently recorded. Ongoing investigations of the Neubauer Collection (including site identification) will better document early-Paleoindian occupations in the Pine City area. This strong concentration of fluted points includes both western and eastern varieties of fluted points in an area that was open early from glacial ice (Mulholland et al. 1997:375). The use of high-quality vein quartz is only one aspect of this important collection.

Grateful acknowledgment is made to Joseph Neubauer, Sr., for providing access to his artifact collections. Special thanks are extended to David Peterson and Larry Furo for assisting in collections review. Access to the unpublished Shane material at the Science Museum of Minnesota was provided by Edward Fleming. Tony Romano first called Neubauer #7 to our attention.

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Clovis Points from East Texas

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➤ **Keywords**: East Texas Clovis, documentation of the Clovis record, Pineywoods

A concerted effort is needed in East Texas to discover and excavate Clovis sites (Bever and Meltzer 2007:92). We are optimistic that contextually intact Clovis sites will be discovered and studied by professional archeologists in this region, most likely in the Sulphur, Big Cypress, or Sabine River drainage basins (see Bever and Meltzer 2007:Figure 1). In the interim, this article puts on record two previously undocumented Clovis points from the east Texas Pineywoods (Diggs et al. 2006:Figure 4), one from Houston County in the Neches River basin, and the other from Upshur County, in the Little Cypress Creek drainage. The Houston and Upshur counties Clovis points represent the first documented finds from each county in the Texas Clovis Fluted Point Survey (see Bever and Meltzer 2007:Table 1).

The Houston County Clovis point was found on an alluvial landform along Hickory Creek, a tributary to the Neches River, near 41HO13; the site does not currently have a site trinomial. It was found at a depth of 60–70 cm below the modern surface in U.S. Forest Service Passport in Time excavations in archeological deposits that predominantly contain early-Woodland period (ca. 2500–1850 RCYBP) chipped-stone tools and lithic debris. No other Clovis-era tools have been identified in the extensive (+11,000) lithic assemblage of tools and

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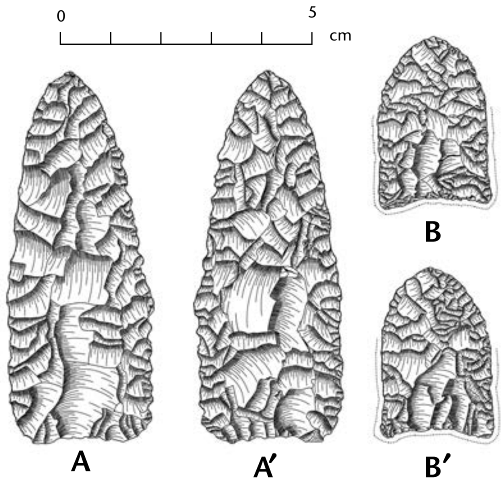

Figure 1. Clovis points from East Texas. **A,** Houston County; **B,** Upshur County. Drawings by Lance Trask.

debris from the site. The Hickory Creek specimen appears to be a nearly finished preform made of a gray Central Texas chert, with nearly parallel stem edges (Figure 1A). The Clovis preform is 73.0 mm long, 27.3 mm wide, and 7.6 mm thick. It was shaped by both percussion and fine pressure flaking, and one lateral blade edge appears to have been resharpened. The lateral stem edges and the base have not been ground. One side of the point preform has one large and two small fluting flake scars, the other has one large flute and one small, later flute scar. The larger flake fluting scars range from 36.6–38.0 mm in length and 12.0–15.8 mm in width.

The Upshur County Clovis point is from a multicomponent prehistoric site on an upland ridge projection above a small tributary of Little Cypress Creek; the site has not been formally recorded to date. Found at the site in addition to the Clovis point are a variety of early- to late-Archaic (ca. 10,000–2500 RCYBP) projectile points and chipped-stone tools. The Clovis point is made from a dark yellowish brown chert of non-local raw material, probably Edwards chert from central Texas. It has been extensively resharpened by pressure flaking on the blade (Figure 1B); the point itself was shaped by both percussion and fine pressure flaking. The resharpened point is 33.3 mm long, 21.8 mm wide, and 6.7 mm thick. Both lateral stem edges have been ground (18.6–19.2 mm in length), and the slightly concave base has also been well ground. One side of the point has one large and one small fluting flake scar, the other has one large flute scar. The larger fluting flake scars range from 16.2–18.6 mm in length and 14.1–16.4 mm in width.

In several different compilations, Meltzer (1986), Meltzer and Bever (1995), and Bever and Meltzer (2007) have discussed the spatial distribution of Clovis points across Texas, and explored various reasons why the Clovis archaeological record is structured the way it is. In their most recent summary, Bever and Meltzer (2007:Table 3) report that 74 Clovis points have been documented in east Texas, representing approximately 13.6% of the total number of Clovis points (n = 544) in the Texas Clovis Fluted Point Survey.

One of their findings is that the wooded east Texas region has the highest density of Clovis points per 10,000 mi^2 (Bever and Meltzer 2007:Table 4 and Figure 2) in the State of Texas, as well as the highest density of Clovis sites (7.47 sites per 10,000 mi^2) across the state (Bever and Meltzer 2007:Figure 3 and Table 5). Bever and Meltzer (2007:74, 91–92) note that this region of the state, like much of the Southeastern Woodlands of which it is a part (see Anderson et al. 2010:Figure 2), "has a rich Clovis record," one that may *not* have been left by "highly mobile hunter-foragers leaving behind an ephemeral archeological record," but by groups "engaged in the types of activities that left a structured, site-based archeological record." Nevertheless, because not a single Clovis site has been thoroughly excavated and studied in east Texas, the "understanding of Clovis lifeways in the east remains woefully underdeveloped" (Bever and Meltzer 2007:92).

We thank Barbara Williams of the National Forests and Grasslands in Texas for permission to study the prehistoric artifacts from the Hickory Creek site on the Davy Crockett National Forest in Houston County, Texas, and thank Lance Trask for the line drawings. Finally, we appreciate the comments of an anonymous reviewer on our manuscript.

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Preliminary Subsurface Exploration at the Fox Site, Southeastern Idaho

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➤ **Keywords**: Paleoamerican chronology, southeast Idaho, excavation

In summer 2008, Utah State University (USU) archaeologists recorded an archaeological site characterized by seven surface finds of Paleoamerican

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projectile points and tools (Figure 1, B–H). The Fox site, elevation of 1545 m, straddles a small permanent stream on a bench west of the Bear River in the Central Rockies. Paleoenvironmental data from Swan Lake (Bright 1966), 32 km west-southwest of the Fox site, and Grays Lake (Beiswenger 1991), 80 km to the north-northeast, indicate a predictably dynamic Pleistocene-Holocene transition in the area. During the period 12,000–10,800 RCYBP, cool, moist conditions and expanded spruce forests prevailed. Subsequent centuries saw an expansion of sagebrush steppe consistent with increased aridity.

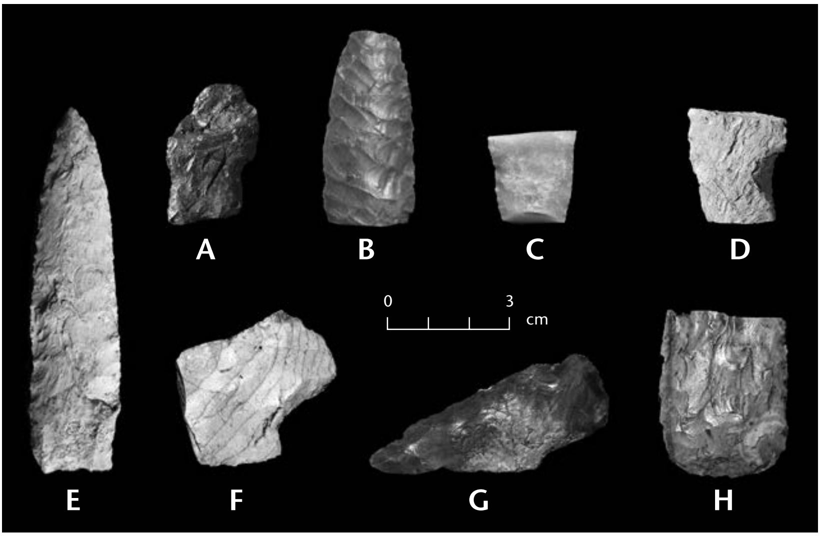

Figure 1. Fox site Paleoamerican projectile point and tool assemblage. **A,** excavated stemmed, indented-base point; **B–E,** parallel-obliquely flaked Angostura points; **F–G,** Cody knives; **H,** Great Basin Stemmed projectile-point base.

To determine whether Fox site sediments contain intact buried cultural deposits, a USU team in 2009 excavated 12 1-by-1 m units across the site and dug four backhoe trenches in variable microenvironments. Below fill from a recently constructed cabin, the test units revealed a thin cultural layer that produced a burnt stemmed, indented-base projectile point (Figure 1A), and dozens of flakes. An OSL sample from the level is being processed and will reveal whether and to what degree this cultural layer has been disturbed by cabin construction or other post-depositional activity. If the level is intact, the projectile point suggests occupation ca. 8000 RCYBP (Pitblado 2003:102).

The seven diagnostic surface finds, which do not match the buried specimen, represent three distinct Paleoamerican types: Angostura (Figure 1B–E); Cody (Figure 1F–G); and Great Basin Stemmed (Figure 1H). Angostura is a hallmark of Rocky Mountain occupation, 9700–7500 RCYBP; Cody knives are typically associated with Plains sites, 9500–8200 RCYBP; and Great Basin Stemmed specimens represent the entire Paleoamerican chronological spectrum across that region (Pitblado 2003). Given the variability in projectile point styles and, notably, material types (Figure 1), it is likely the specimens represent multiple occupations of the site, all ca. 10,000–8000 RCYBP.

Three of the four backhoe trenches revealed neither cultural material nor sediments dating to the late Pleistocene/early Holocene. The fourth trench, in deep alluvial sediments 25 m west-northwest of most of the test units, exposed flakes at 1.30 m below the ground surface (bgs) and a charcoal fleck at 1.55 m bgs (the bottom of the trench, but only because our small backhoe could excavate no farther). A ^{14}C date on the charcoal of 5640 ± 40 (Beta-265510) RCYBP offers hope that early-Holocene and late-Pleistocene sediments may occur deeper and may correlate with one or more of the projectile points exposed on the surface and/or with the shallower, thin sediments that yielded the buried stemmed projectile point.

Thanks so much to Lawrence Fox, for sharing his knowledge of the Fox site and thoughtful insights about the cultural landscape of southeastern Idaho, and for his great touch with a backhoe. I also gratefully acknowledge Richard and Joyce Shipley for their unflagging enthusiasm for archaeology and for financial support for the USU Southeastern Idaho and Northern Utah Paleoindian Research Program. Kudos to the stellar team of 2009 USU archaeological field school crew members and students who patiently probed the Fox site sediments, even as the hot July sun beamed relentlessly down on their shoulders.

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Understanding the Relationship between Bison Bone Beds at the Cody-age Finley Site

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➤ **Keywords**: Bison, taphonomy, site formation

The Finley site (48SE5), a Cody-age site located within the Killpecker dune field of Sweetwater County, Wyoming, has long been of interest to archaeologists and pothunters alike (Miller 1987). Here, between 1940 and 1942, a bison bone bed (Station A) located along the edge of a sand dune was investigated by researchers from the University Museum at the University of

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Pennsylvania and Nebraska State Museum (Hack 1943; Howard 1943; Moss 1951; Satterthwaite 1957). Several decades later, erosion of a dune approximately 73 m northeast of Station A exposed a second bone bed (Station B). Pothunters quickly began excavations of this area, causing extensive disturbance to the deposit. In the 1970s and 1980s, the University of Wyoming completely excavated the remaining portions of the pothunted Station B bone bed (Haspel and Frison 1987; Miller 1987).

Ethnoarchaeological research indicates that carcass transport decisions are based on efficiency and body-part utility (e.g., Binford 1978; Metcalf and Jones 1988; O'Connell et al. 1988). People transport the highest-utility body parts (e.g., upper limbs, pelvic girdle, shoulders) away from the kill site to the camp or processing area, leaving behind at the kill locality the lowest-utility body parts (e.g., heads, vertebra, and feet). The abundance of limb elements and paucity of axial elements recovered from the Station A deposit was therefore used to argue that Station A was a carcass-processing locality (Schultz and Frankforter 1951), and Station B was interpreted as the kill location (Frison 1991). While Frison (1991:185) postulated that the two localities might be related, the functional relationship between the two stations has never been tested, and our new analyses of the faunal remains from each station indicate that such a relationship is likely incorrect.

Our reanalysis of the Station B assemblage conducted in 2006 included an analysis of all appendicular elements and select axial elements (i.e., crania, atlas, and axis) (Hill 2008). We identified a minimum of 82 bison in the Station B assemblage (Hill 2008; see also Haspel and Frison 1987), and our inventory suggests that the majority of all skeletal parts are moderately or well represented (survivorship of 40–85%) (see Lyman 1994 for calculation procedure). While we see some limited evidence for carnivore damage to grease-rich upper limb elements, such as proximal humerus, proximal femur, and proximal tibia, the only elements systematically missing from the Station B assemblage are the smallest elements (e.g., fifth metacarpals, second metatarsals, and sesamoids). These are often missed by excavators when not fine-screening matrix, or they could have been removed by a number of sources (e.g., scavengers, shifting sand).

Our analysis of the Station A assemblage is ongoing and has resulted in the analysis of 3447 specimens and an MNI estimate of 77 bison for this locality. The majority of skeletal elements are either completely absent or very poorly represented. In fact, only carpal, tarsal, and phalange elements have survivorship rates greater than 30%. Importantly, our analyses indicate that volume density is not responsible for this assemblage bias; we instead conclude that the higher-valued elements were either taken to another location for further processing by humans, or were destroyed or removed by various agents (e.g., carnivore destruction, collection bias).

Todd and Hoffman's (1987) prior seasonality study suggests the Station B bison were killed during the fall (N +0.6). Our seasonality study of the 28 loose mandibular molars and premolars from Station A suggests that the Station A bison were killed sometime from late fall through early spring (N +0.6–0.9). While there is some overlap in the dental eruption and wear patterns for specimens from the two stations, it appears that the individuals from Station A are consistently older than those reported by Todd and Hoffman (1987) for Station B. In addition, the eruption and wear differences observed within the youngest Station A dental age groups likely exceed the expected natural range variation present in actual age cohorts in a living herd (Hill 2007). As a result, while a single kill event (or several closely timed events) seems to be represented at Station B, multiple mortality events may be represented in the Station A bone bed. We plan to radiocarbon date specimens for Station A to compare with dates from Station B reported by Craigie (1985:49), Frison (1991:Table 2.2), and Hill (2008); however, these results are not yet available.

In conclusion, we see no evidence supporting the hypothesis that Station A and Station B are functionally related to each other. In fact, we suspect that the kills represented at each station took place during slightly different seasons. In addition, the representation of various skeletal elements at each station does not represent what should be expected for associated kill and processing localities of the same kill event (i.e., with the lowest-utility elements left behind at the kill site and thus absent from the processing-locality assemblage). In fact, Station B contains many more high-ranked elements than Station A, and the most abundant skeletal parts at both stations are the same (low-utility) elements (i.e., carpals, tarsals, and phalanges). It is unlikely, then, that what we have at the Finley site is a kill site and processing station for one large bison kill. Instead, the collections from the Finley site likely contain at least 159 bison resulting from two or more kills.

George Corner of the Nebraska State Museum facilitated our access to the Station A collection, and George Frison, Marcel Kornfeld, Martha Rodgers, and Danny Walker of the University of Wyoming helped with the analysis of the Station B collection. We thank the University of Iowa (UI) Department of Anthropology, the UI Old Gold Summer Fellowship program, and the George C. Frison Institute of the University of Wyoming for financial support of this project. We also acknowledge the help of James Mayer, John Laughlin, David Boatwright, and Veronica Mraz in various aspects of this project. Finally, this paper benefitted from the comments of the journal editor and an anonymous reviewer.

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A Chert Clovis Point with Flute Scratching, Malheur County, Oregon

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➤ **Keywords**: Fluted point, non-obsidian flute scratching, Vale BLM District, Oregon

The Shell Rock Butte fluted point is unique in that it appears to be the only reported non-obsidian specimen with intentional flute scratching (Rondeau 2009a; Temple and Rondeau 2010). The presence of flute scratching on obsidian fluted points has usually been reported only in passing (e.g., Fagan 1988; Harrington 1948). In the past, only obsidian fluted points have shown the scratching, and even then only in a minority of the specimens (Rondeau 2009b).

This chert point is an isolated surface find made by Lynn Sylvia in 1996 in the Vale District of the Bureau of Land Management in Malheur County (Rondeau 2009a). The discovery was made during an archaeological survey for a seeding project that followed the Cow Hollow Fire near Shell Rock Butte. The region supports a plant community which includes sagebrush (*Artemisia L.*), rabbitbrush (*Chrysothamnus Nutt.)*, basin wild rye (*Leymus cinereus)*, and bluebunch wheatgrass (*Pseudoroegneria spicata*).

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The find spot is on a low ridge at an elevation of 1036 m. It overlooks the seasonal Cow Creek drainage that flows southeast into the Owyhee River. A lithic scatter, 35ML890, is 200 m down slope from the find. A nearby drainage has reportedly yielded camel bone, about which additional information is currently sought.

This is the second fluted point reported for Malheur County (Yohe and Uren 1993). It is a multicolored chert with pot lid fractures clearly overlying the flake scars on both faces. The pot lids may have resulted from the range fire. This base fragment is 30.66 mm long, 28.86 mm wide, 6.76 mm thick, has a basal depth of 5.34 mm, a basal width of 25.21 mm, and weighs 7.3 g. The transverse break creating this base fragment was a perverse fracture.

Both lateral edges and the basal margin have edge grinding. The concave base is shallow with a biconcave cross section. The flute scars on opposite faces diverge in the distal direction when viewed in long section (Rondeau 2009a). Both flute scars show basal constriction, indicating that there has been no basal damage or rejuvenation. The wider proximal end of the flute scar on the right-hand face of the point indicates loss of its most proximal portion during preparation of the platform for fluting the opposite face (Figure 1). The left-hand side shows a more complete and narrower proximal end to its flute scar, indicating it was the second side fluted.

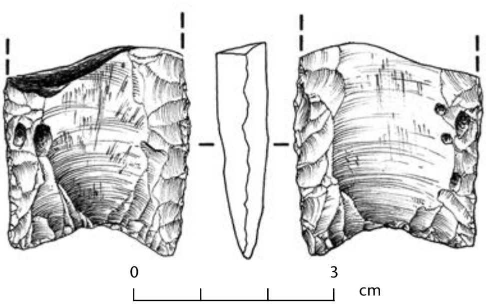

Figure 1. Shell Rock Butte fluted point. Illustration by Eric Carlson.

The flute scars on both faces are notably wide (19.76 and 17.41 mm). A majority of the scratching on the left-hand flute scar (Figure 1) runs from proximal left to distal right although at least one abrading stroke ran proximal right to distal left and another was generally perpendicular. The right-hand face shows flute scratching that runs from proximal right to distal left (Figure 1).

CalFLUTED studies indicate that a diagonal scratch pattern on flute scars from proximal left to distal right may be most common although other patterns, including a fan configuration expanding from proximal to distal, are present. The proximal left to distal right pattern may suggest a dominance of right handedness. However, variability ranges in extent and intensity from almost imperceptible to extreme examples that approach facial grinding (Rondeau 2009b). It has been suggested that flute scratching was done to aid in adhering the point to the shaft (Frison 1991). However, the purpose of flute scratching has received limited attention (Beers 2010; Tankersley 1994) and largely remains speculation. Additional research and reporting on the nature and range of flute scratching evidence is needed. Additional information on non-obsidian fluted points with flute scratching is currently being sought.

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A Technological Analysis of Clovis Blades from the Topper Site, 38AL23, Allendale County, South Carolina

Douglas A. Sain

➤ **Keywords**: Blade technology, Clovis, Southeast

The Topper site, a quarry-related Clovis site in the central Savannah River valley of South Carolina, continues to provide insights into Clovis lithic technology through annual excavations. Quarry sites, where raw material is extracted for the manufacture of stone tools, are important for documenting production strategies of specific tool forms. One common artifact type previ-

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ously documented at Topper is the prismatic blade (Steffy and Goodyear 2006). Blades are considered as diagnostic of Clovis as fluted points themselves (Beck and Jones 2010; Collins 1999). This report summarizes the findings of a recent technological analysis of the Topper blades (Sain 2010).

Previous studies have reported the presence of buried discrete Clovis deposits at Topper (Miller 2005). All the blades analyzed were drawn from excavated Clovis contexts from a terrace bordering the Savannah River and a hillside overlooking the terrace, totaling 596 m^2 of excavation. A chert outcrop conducive for lithic tool manufacture is centrally located between the terrace and hillside portions of the site.

A total of 257 blades, 139 of them complete, were examined for technological attributes. Most blades were recovered from four adjacent 2-by-2-m excavation units placed between the chert outcrop and a firebreak on the hillside. In sum, Topper blades are straight as opposed to curved, possess wide, thick platform remnants with angles of 60 degrees or greater, have diffuse bulbs of force, parallel margins, and triangular or trapezoidal cross sections (Figure 1: A and B). They can be as long as 140–150 mm, but typically they range from 50 to 75 mm in length, with a mean of 63.8 mm. A few are smaller, 15 to 30 mm long (Goodyear 2002/2003). In my study, I defined blades as those being more than 30 mm in length (Sain 2010). All but one blade are products of the local Allendale chert.

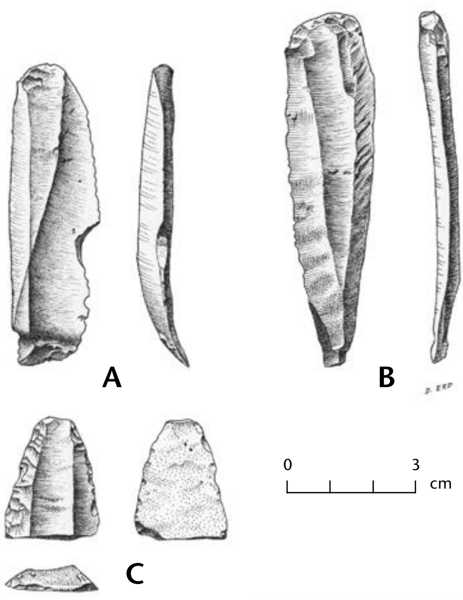

Figure 1. Clovis blades from the Hillside excavations at the Topper site, South Carolina. **A, B,** blades; **C,** retouched distal fragment of a macroblade from 38LX283.

Blades with retouch occur sporadically across the site. So far only eight examples have been identified. Modification was restricted to unifacial retouch of lateral edges and blade ends. In comparison, the nearby Big Pine Tree site has a higher percentage of worked blades than Topper (Sain 2009).

A total of 22 blade cores have been recovered. These include conical (2), cylindrical (1), and wedge (19) varieties. No core-tablet flakes have been observed thus far. Cores with few blade removals resemble a horse's hoof. These cores were rotated, with additional blade detachments resulting in the wedge-shaped cores.

The relative lack of technologically modified blades would seem to indicate that usable blades were routinely removed from Topper for use in other locations. Other unifacial tools made on flakes such as scrapers and denticulates were commonly made and used on site, indicating habitation activities were practiced at Topper (Goodyear et al. 2007). Modified blades made from Allendale chert are found in private collections throughout southern South Carolina (Sain 2010). These are thought to be Clovis in origin (Figure 1C).

Variation in blade attributes is expected at quarry-related sites such as Topper, where blades are found in all stages of production. If blades were removed from the site for use elsewhere, then desirable attributes would be reflected in examples recovered afield and most blades at Topper consequently would represent undesirable specimens or discards of the manufacturing process.

Clovis blades at Topper are typically shorter and less curved than blades reported from other Clovis assemblages (e.g., Collins 1999). At Topper, these characteristics appear to be a product of the small raw-material package sizes, nodular chert forms, and design choices made in response to material conditions on site. Now that blades are recognized as a standard component of the Clovis toolkit, studies that document variations in these tool forms across different regions are important for broadening our understanding of Clovis adaptations.

I thank David Kilby, Al Goodyear, Kenn Steffy, Ashley Smallwood, Shane Miller, Tom Pertierra, Dennis Stanford, Clariant Corporation, and members of the Allendale Paleoindian Expedition. Illustrations are by Darby Erd, courtesy of the Southeastern Paleoamerican Survey.

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A Scottsbluff Type II Point from the Savannah–Eastern Woodland Margins of Northeast Kansas

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➤ **Keywords**: Cody complex, Scottsbluff Type II points, Pennsylvanian chert

A little-known and extraordinarily rare Cody-complex point has been recovered in the Savannah–Eastern Woodland margins of northern Douglas County, northeast Kansas. This extensively resharpened broad, flat, relatively thin point (Figure 1) with a triangular blade, prominent shoulders, and bifacially beveled blade and stem edges (Bradley and Frison 1987:222–23, 230; Ingbar and Frison 1987:467, 470–71) is a type long regarded as distinctive of Northern High Plains technology (Bradley and Frison 1987:223, 225; Wheat 1972:152). Although this type has not been previously documented either east or south of the Scottsbluff type site (Schultz and Eiseley 1935) in southwest Nebraska (Jack Hofman, personal communication 2009), the fact that this point was manufactured from local Pennsylvanian-age Plattsmouth chert links it to the discovery locality some 800 km east-southeast of the Scottsbluff site.

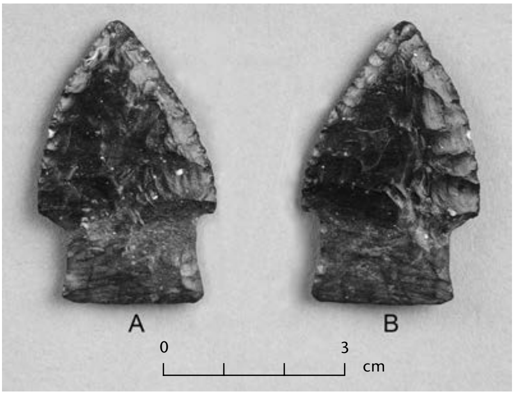

Figure 1. Slightly asymmetrical Scottsbluff II point from Douglas Co., northeast Kansas. Extant length, 47; extant shoulder width, 29.75; shoulder width reconstructed from the larger shoulder, 32.75; maximum blade thickness (at shoulders), 6.25; midpoint blade thickness, 6; stem length, 14; stem width, 21.5; stem thickness, 5.25; base width, 23.75; face **A** right blade edge (curve) length, 33.8; left blade edge (curve) length, 35.8. Cross section: flat stem and base edges. Heavily ground. (All dimensions in mm.)

Wormington (1957:137) designated these points as "Scottsbluff Type II" to distinguish them from better-known typically narrower and smaller-shouldered Scottsbluff dart points with relatively thick ovate cross sections, i.e., "Scottsbluff Type I," which are more widely distributed. While Irwin and Wormington (1970:27, 29) subsequently reclassified "Scottsbluff II" as a for-

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malized knife, i.e., "Cody knife Type II," based on relative thinness and a reported use-wear study, Bradley and Frison (1987:222) regard it as a specialized dart point with a secondary use as a knife. This form was produced not only by a very different reduction sequence from other Cody points (Ingbar and Frison 1987:470–71), but also by a parallel technology not derived from an antecedent or contemporaneous Cody dart-point technology (Bradley and Frison 1987:229-230). Except for stem placement relative to the blade, it is otherwise technologically identical to the specialized Cody knife (Ingbar and Frison 1987:470–71).

This reduced 47-mm-long point with one larger shoulder and asymmetrical blade suggests use as a knife, at least in this reduction stage, although it is still functional as a dart point. Similar refurbishing is evident in part of the earlier-stage southwest Wyoming Larson Cache sample (n = 37) (Ingbar and Frison 1987:472, Figures A6.2-4, Table A6.1), but is less conspicuous in the southwest Wyoming Findley site sample (n = 6) (Satterthwaite 1957: Figures 1, 4), and is not present in the northwest Wyoming Horner I site (n = 1) (Bradley and Frison 1987: Figure 6.17a) or the southwest Nebraska Scottsbluff site (n = 1) (Schultz and Eiseley 1935: Plate 8e) samples. The extant shoulder width (29.75 mm) of the artifact in Figure 1 is in the upper range of this combined sample (n = 46; range = 20.3–35 mm; mean = 26.2 mm). Reconstruction of original equal shoulders yields a width of 32.75 mm. This is wider than the entire comparative sample (n = 46), except for one 35-mm-wide point from the Finley site. The 6.25-mm maximum thickness (at shoulders) exceeds 44 of 46 total measurable sample points (range, 3.2–6 mm), excluding two Larson Cache outliers, which are 6.8 and 7.8 mm thick. This point is metrically closest to the Finley sample (Satterthwaite 1957: Table 2) in terms of width (range, 23–35 mm; mean, 29.1 mm) and thickness (range, 4.5–6 mm; mean, 5.1 mm).

However, in terms of extant flaking pattern, it is closer to the more widely and irregularly flaked Horner I and Larson Cache samples. The irregular flaking evident in Figure 1, especially on face A, contrasts with the narrow parallel transverse flaking of the Finley and Scottsbluff site samples that Howard (1943:234) emphasized "can hardly be differentiated on the basis of parallel flak[ing] . . . from [Scottsbluff dart points] that are found very widely distributed." From the same sample, Wormington (1957:137) concluded that distribution may be obscured because it has probably been "lumped" with Scottsbluff dart points. Yet, from a larger, more variable sample, an additional possibility is that this form is not always recognizable as a Cody artifact.

While the current regional dearth of other specimens simply indicates extraordinary rarity, attention should also be drawn to the comparative distribution of two versions of Irwin and Wormington's "Cody knife Type I": One-shouldered Cody knives (Bradley and Frison 1987: Figures 6.15a-c, f; Bradley and Stanford 1987: Figures A2.6c-e, A2.17) are known throughout the western High Plains, but not beyond. Two-shouldered Cody knives (Bradley and Frison 1987: Figure 6.15e; Ingbar and Frison 1987: Figure A6.1c), like the technologically identical but distinct projectile type represented in Figure 1 (1987:222), are not known outside the northern High Plains. Bradley and Frison (1987:225) find this contrast "difficult to explain if one concludes a cultural synchrony." However, an exclusive western High Plains focus overlooks yet another Cody conundrum. Not only have all three of these technologically identical forms been previously undocumented east of the High Plains, a fourth, technologically distinct form continues to be recovered from along an 875-km arc of the Eastern Woodlands margins from extreme southeast Texas to northeast Oklahoma (Johnson 1989: Figure 16, Table 3), and now southeast Kansas. Therein, formalized Scottsbluff dart points were routinely converted to non-formalized knives, even at an early stage, by beveling one edge of one face, thus producing an asymmetrical blade. Johnson (1989:37-39, Figures 21–23) designated these modified points as "Red River knives" to distinguish them from the technologically different Cody knives they are frequently "lumped" with. While this additional regional phenomenon makes concluding a cultural synchrony even more interesting, acknowledging these regional phenomena as such for whatever clues they may ultimately yield enlarges the database from which hypotheses can be formed.

I thank Don Wyckoff, Steven Holen, Donna Roper, and Michael Collins for responding to my inquiries about other reported finds of this Cody point type outside the Northern Plains, and Jack Hofman for evaluating the artifact, and for best summarizing the currently known geographical distribution. Thanks also to Bruce Huckell for the photography, to the two reviewers for valuable suggestions, and to Ted Goebel for encouragement.

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Late-Paleoindian Archaeology at the Eaton Site, Western New York

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➤ **Keywords**: Paleoindians, Northeast, Great Lakes

Similarities among early-Paleoindian projectile points in the Great Lakes, New England, and the Maritimes and the movement of high-grade lithics between these regions suggest that intensively interacting, mobile populations produced styles such as Gainey/Bull Brook, Debert, Barnes/Michaud-Neponset, and Crowfield (Bradley et al. 2008; Ellis and Deller 1997; Newby et al. 2005; Spiess et al. 1998; White 2006). However, the late-Paleoindian period is marked by increasing reliance upon local lithics and diverging regional sequences. Although parallels are drawn between late-Paleoindian Holcombe points from the western Great Lakes region and the recently defined Cormier-Nicholas style in New England (Bradley et al. 2008), subsequent Hi-Lo points of the central Great Lakes region are thought to have no correlates in New England or the Maritimes. Conversely, terminal-Paleoindian Agate Basin and Ste. Anne–Varney lanceolate styles have a clearly Northern distribution (Dumais 2000; Jackson 2004), replaced to the South by coeval Hi-Lo and notched projectile points linked to Southeastern and mid-continental early-Archaic complexes (Ellis 2004; Newby et al. 2005; Smith et al. 1998).

The period when these divergences may have begun, ca. 10,300–9500 RCYBP (Jackson 2004), is poorly documented in the lower Great Lakes region. Although both Holcombe and Hi-Lo points are widely distributed in southwestern Ontario (Ellis 2004; Jackson 2004; Stewart 2004; Woodley 2004), a survey of museum collections in western New York and the adjacent Niagara peninsula of Ontario recovered no Holcombe points, although Hi-Lo points were present in low numbers (Pengelly and Tinkler 2004; Smith et al. 1998).

Recently we identified three Holcombe points and three Hi-Lo points in excavated collections from two discrete loci at the Eaton site, Erie County, New York (Figure 1). The Eaton site is located on a silty loam terrace developed from glacial outwash and lacustrine silts originally deposited below early Lake Erie late-Pleistocene high stands. Ca. 10,400–10,100 RCYBP, the Lake Erie water plane fell 2.3–1.3 m below its current level (Pengelly et al. 1997). During this low stand, Cazenovia Creek cut down to expose resistant chert-bearing Onondaga Formation limestone bedrock, creating the terrace in the process.

Two of the Eaton Holcombe points were manufactured from Onondaga chert, accessible < 10 km from the site today and perhaps in Cazenovia

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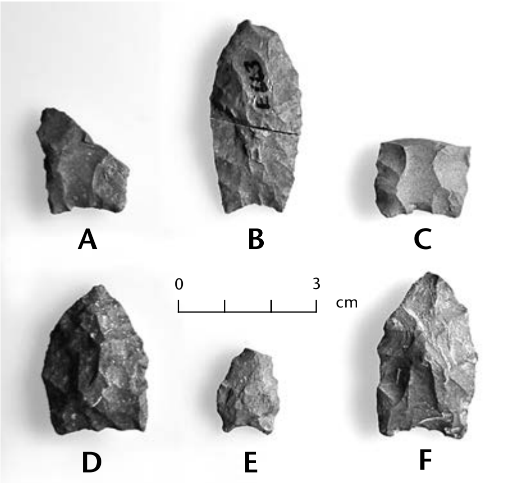

Figure 1: Late-Paleoindian diagnostics from the Eaton Site, Erie County, NY. **A, C,** failed Holcombe fluted preforms; **B,** complete, refit Holcombe point; **D, F,** complete, resharpened Hi-Lo points; **E,** miniature Hi-Lo point.

Creek's entrenched early-Holocene bed; the third is made from Seneca chert, accessible less than 2 km from the site. All three are delicate and symmetrically flaked. The complete point is 42.4 mm long, 13.2 mm wide at the base, 20.8 mm wide at midpoint, and 5.7 mm thick, with a 1.9 mm deeply concave base, sharp basal ears, and bifacial basal thinning. Two fragmentary Holcombe bases are 16.0 and 17.7 mm wide at the base, 4.1 and 5.0 mm thick, with basal concavities 1.3 and 1.9 mm deep, respectively. Both are unifacially fluted.

These points conform to published descriptions of Holcombe bifaces (Fitting et al. 1966; Jackson 2004; Justice 1995; White 2006). While the presence of three in close proximity suggests that a Holcombe component was present at Eaton, the site's multicomponent nature (Engelbrecht 1994), plowing, and continuous use of Onondaga and Seneca cherts make it impossible to separate a complete late-Paleoindian component from the Eaton site lithic assemblage.

In size and proportions, the Eaton site Holcombe points are intermediate between Holcombe points from Ontario (Jackson 2004) and Cormier-Nicholas points from the Nicholas and Esker (Maine) and Reagan (Vermont) sites (Moore 2002; Ritchie 1957; Robinson 2009), all of which are more delicate than Holcombe points from Michigan, Indiana, or Ohio. At the Esker and Hidden Creek (Connecticut) sites, these points are associated with dates of 10,090 ± 70 RCYBP (Beta-103284, Spiess et al. 1998) and 10,260 ± 70 RCBP, respectively (Bradley et al. 2008).

The Hi-Lo points from Eaton include two complete, resharpened examples (32.5 and 36.7 mm long) and one miniature point, 19.1 mm long and 14.1 mm wide. All are slightly side notched, thick (8.2 and 8.8 mm for the full-sized points), crudely flaked, basally thinned but unfluted. These conform to published examples from western New York (Smith et al. 1998; Tankersley et al. 1996), Ontario (Ellis 2004) and the Great Lakes region (Justice 1995) but have no clear parallels in New England.

The Eaton site expands the number of Holcombe and Hi-Lo points known from western New York. Although both metric and non-metric attributes of the Eaton site Holcombe points support assertions of affinity between the Holcombe and Cormier-Nicholas types, neither these nor the Eaton site Hi-Lo points directly address assertions of population replacement (White 2006) or in-situ development (Ellis 2004) at the Holcombe/Hi-Lo interface.

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Folsom Evidence in Nebraska

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➤ **Keywords**: Folsom, Nebraska

This study is part of a Plains-wide investigation of Folsom archaeology documenting patterning in Folsom artifact occurrences (cf. Andrews et al. 2008). Private and museum collections provide the basis for developing this database. Study goals include documenting technological variation, organization, lithic material use, land-use patterns, economy, and interrelationships of Folsom people in the region. The Nebraska Folsom database builds on earlier studies (e.g., Barbour and Schultz 1936; Myers 1987) and provides a comparative base for the Central Plains in Folsom time.

The current Nebraska sample includes 317 artifacts with 227 Folsom projectile points and fragments, 50 Folsom preforms, 9 channel flakes, and 31 Midland points. The sample is not assumed to reflect the actual Folsom artifact distribution for Nebraska. The sample provides an opportunity to document patterning, identify data gaps, and begin evaluating reasons for the observed patterns. Possible reasons for the observed patterning include: variation in redundancy and intensity of prehistoric land use (Andrews et al. 2008; Hofman 2003; Sellet 1999), geomorphic and erosional factors (Mandel 2008), and the location of studied private collections—that is, there could be bias in documented collections. Contemporary land-use practices and modern population patterns are also being considered as possible factors affecting artifact visibility.

The documented distribution is uneven and includes some obvious gaps

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suggesting that our sample does not fully reflect prehistoric Folsom behavior (Figure 1). Most Folsom artifacts are documented in western Nebraska, but with a secondary concentration in the southern tier of counties in the Kansas River basin. The absence of Folsom records for counties (e.g., Perkins and Logan) adjacent to counties with common Folsom evidence speaks directly to the need

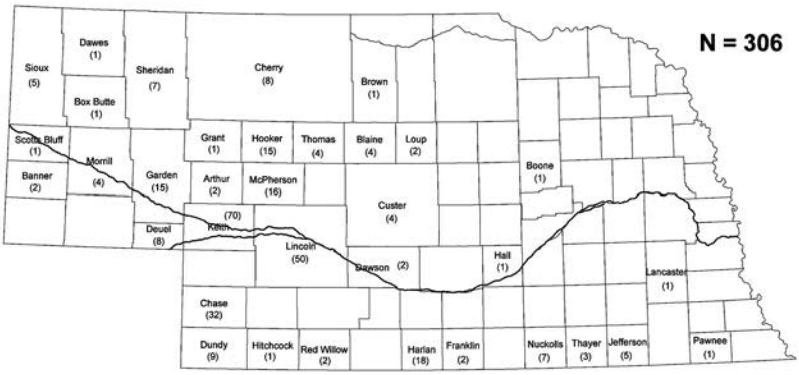

Figure 1. Nebraska Folsom distribution by county. Frequencies include both Folsom and Midland artifacts. Folsom artifacts that could not be assigned to specific counties were not included in this distribution.

for a more detailed analysis to distinguish between sample bias and actual Folsom land-use patterns. Seven counties have 10 or more Folsom artifacts, and the counties with the most specimens (Keith and Lincoln) are in the Platte River basin near the confluence of the North and South Platte rivers. While this was clearly a location of recurrent and relatively intensive Folsom activity and probably reflects focused Folsom occupation, our distribution also reflects documentation of several large collections from this area. The very limited Folsom evidence in eastern Nebraska is not simply from lack of archaeological research or documenting artifact collections in that area, since Clovis artifacts are well represented there (Holen 2001, 2003). Geomorphic factors of Holocene erosion and deposition, modern land use, and prehistoric activity are probably all contributing factors to this pattern. Acknowledging these sampling issues, this study provides our best available evidence for interpreting aspects of Folsom behavior in the region. This distributional study offers analytical and interpretive opportunities that would not be possible if the study were limited to excavated or site-based assemblages.

Special thanks are extended to Steve Holen who contributed substantially to the development of this database, and also to Gayle Carlson for his contributions to this study. We gratefully acknowledge the contributions of many individuals who facilitated recording of artifacts in their collections. In particular we need to mention Roy Whiteley, Dick and Carol Eckles, Tom and Myra Westfall, Pete Peters, and LeRoy and Jean Follis.

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Preliminary Results of Reanalysis of Bison Remains from Cherokee Sewer, Iowa

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➤ **Keywords**: Bison, Paleoindian, Midwest

Located in the northwest corner of Iowa, the Cherokee Sewer site is composed of four distinct cultural horizons ranging from late Paleoindian (horizons IIIb and IIIa, dating to 8445 and 8400 RCYBP, respectively) to early Archaic in age (horizons IIb and Ib, dating to 7200 and 6350 RCYBP, respectively) (Hoyer 1980:27; Shutler 1980:1). Excavated in the 1970s, the site has interested archaeologists because of its excellent preservation and integrity, as well as the fact that occupation spans the early-to-middle Holocene Altithermal climate event (Shutler 1980:1). This paper offers a reanalysis of the large collection of bison remains, which exhibit clear evidence of human processing for meat and marrow extraction (Pyle 1980:194), in order to reevaluate the interpretation of the site as a secondary processing center. Because the analysis of these remains is ongoing, the following results are preliminary.

The bison remains were first analyzed by Katherine Pyle (1980:171-196), who interpreted cultural horizons Ib, IIb, and IIIa as middle-to-late winter bison processing localities based on skeletal-part frequencies dominated by limbs and with limited skulls, atlas, and axis vertebra. Importantly, faunal remains were sorted during the original excavation based on whether they

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were identifiable; unidentifiable fragments were bagged and later reviewed for evidence of butchery (Pyle 1980:171–72). It is unclear how extensively these fragments were examined in terms of the skeletal parts they represent. Subsequent research on the dental and fetal remains by William Whittaker suggested that the Paleoindian horizon IIIa represents an early-winter kill, and the Archaic horizon IIb represents a late-fall through early-winter kill (1998:297–306).

The current study is an updated reanalysis of the bison remains calculating skeletal-element frequencies using a series of anatomically relevant and easily recognizable landmarks as the means of quantifying skeletal-part frequencies (Morlan 1994). The main objective for this research was to reevaluate previous interpretations of skeletal-part frequencies reported for the site by analyzing the remains deemed unidentifiable by the excavators. The results of the current study are similar to those reported by Pyle (1980), but there are some important contrasts. Of major importance is the addition of vertebral elements, which represent a greater percentage of the collection than originally reported. Significantly, when the axial elements are considered, it becomes evident that for a majority of the cultural horizons nearly all skeletal elements are represented, rather than assemblages principally characterized by an overabundance of limb elements. This is especially true within the Paleoindian horizons IIIa and IIIb, where nearly the entire axial skeleton is present, and calls into question the assessment of the site as a processing center for transported carcasses.

Another key goal of this project was to evaluate the site-formation history of the various deposits at Cherokee-Sewer. A number of taphonomic observations were made of the collection, including degree of weathering, root etching, and animal gnawing (rodent and carnivore). The bulk of the collection falls into weathering stage 2 (Todd 1987), defined as minimal surface cracking. The vast majority of the collection exhibited little to no root etching or animal gnawing, suggesting that perhaps these agents did not play a major role in the formation of the skeletal-element distributions. However, it is clear that density-mediated attrition shaped the skeletal assemblage. Percent survivorship is the measure of the how many specimens of a given element survived compared with how many may have been initially present at the site (Lyman 1994:239). When percent survivorship was correlated to the density index developed by Kreutzer (1992) for bison elements, it became clear that density played a statistically significant role in at least horizons Ib ($r_s = 0.535$ $p < 0.001$), IIb ($r_s = 0.490$ $p < 0.001$) and IIIa ($r_s = 0.450$ $p < 0.001$). In other words, the most commonly represented elements are also among the densest, including the tarsals and distal portion of the tibia. When % MAU, which is a proxy for the relative abundance of specific elements within the assemblage, was compared with the food-utility indices developed by Emerson (1990), it revealed that the Archaic horizons Ib ($r_s = -0.526$ $p = 0.003$) and IIb ($r_s = -0.487$ $p = 0.007$) are negatively correlated. The Paleoindian horizons IIIa ($r_s = -0.299$ $p = 0.115$) and IIIb ($r_s = -0.003$ $p = 0.986$) are also negatively correlated but not statistically significant. Overall, the most valuable elements tend to be the least represented in the assemblage, suggesting they may have been destroyed during processing.

Based on these observations, it seems clear that we cannot eliminate the possibility that Cherokee Sewer was a kill site rather than a processing center. The apparent dominance of limbs in the assemblage is likely explained by their relative high density and ability to be easily identified. The rest of the skeleton (e.g., vertebrae and ribs) is present in relatively high numbers, mostly as small fragmented pieces with a few complete specimens. It appears that these elements were heavily processed on site rather than transported away from the kill locality. A continued analysis of the remainder of the collection should help to clarify this possibility.

I thank Tiffany Adrain from the University of Iowa Paleontology Repository as well as John Cordell and John Doershuk of the Iowa Office of the State Archaeologist for allowing me access to the Cherokee Sewer collections. This research and paper would not have been possible without help and guidance from Matthew E. Hill, James G. Enloe, William Whittaker, Cerisa Reynolds, and Bryan Kendall.

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Geosciences

The Quaternary Outcrops of Punta Hermengo (Buenos Aires Province, Argentina): Magnetostratigraphy, Biostratigraphy and the Loss of Paleontological Heritage

Esteban Soibelzon, Eduardo P. Tonni, and Juan C. Bidegain

➤ **Keywords**: Mammals, Pleistocene, Pampean region, South America

Punta Hermengo (38° 17′ 13.8″ S, 57° 50′ 14.9″ W) is located near Miramar city on the coast of the Buenos Aires province (General Alvarado County).

The first reference to the geology and paleontology of this locality is by F. Ameghino (1908), who studied the sea cliffs exposed in Miramar, particularly from a paleontological point of view. Subsequently, this locality was the subject of numerous scientific contributions (for a summary see Soibelzon et al. 2006, 2009).

Kraglievich (1952) established a lithostratigraphic scheme for the sediments exposed along coastal cliffs between Mar del Plata and Miramar. In his scheme, Punta Hermengo is categorized as Plio-Pleistocene sediments (Vorohué, San Andres, Miramar, and Arroyo Seco geological formations).

The natural evolution of the landscape in the area is characterized by erosion of the cliff ledge and filling in of the bays, causing change in the coastline and finally a regular retreat of the coastline. This dynamic is highly modified by anthropic alteration (extraction of sand, urbanization, artificially fixed dunes, etc.) (Cenizo et al., in press).

The geological and magnetostratigraphic profile presented here is exposed at the "Vieja Farola" (Old Lighthouse) of Punta Hermengo and consists of eight units, but unfortunately the basal units are currently impossible to access (see below). Two discontinuities (d1 and d2) divide the profile into three major sections (Figure 1: I, II, III), and this sequence can be followed along

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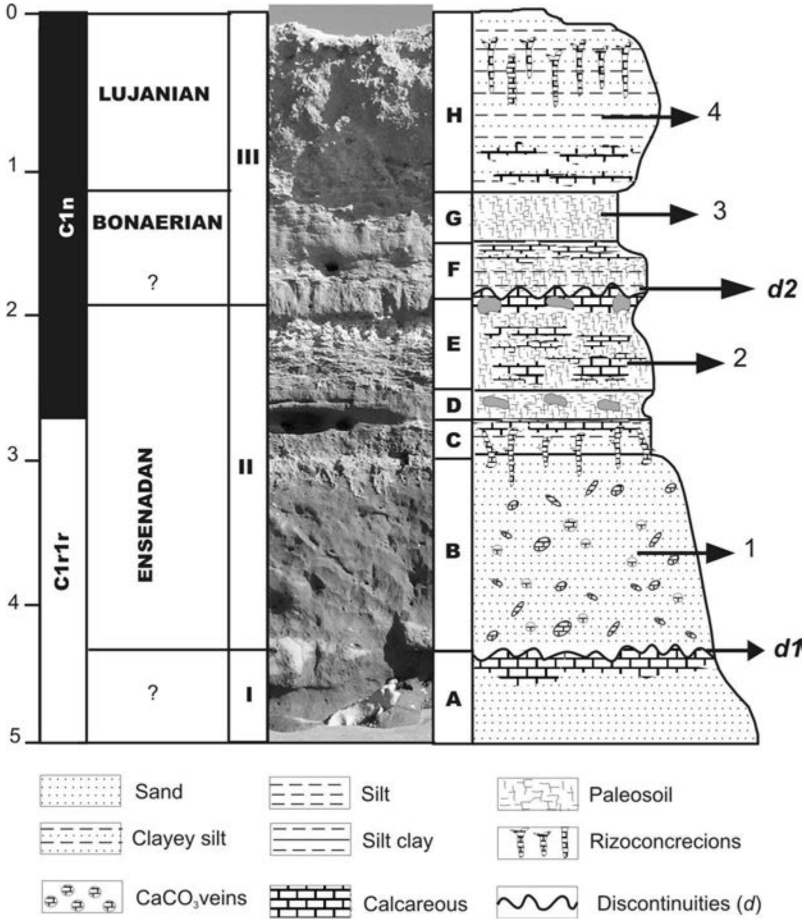

Figure 1. Geological and magnetostratigraphic profile of Punta Hermengo showing the three major sections (I, II, III), eight main geological units (A–H), the two discontinuities (*d1* and *d2*), and the provenance of the fossils remains. **1,** *Mesotherium cristatum;* **2,** *Arctotherium angustidens;* **3,** *Ctenomys kraglievichi;* **4,** *Equus* (*A.*) *neogaeus.* Vertical scale is in meters.

the coast for at least 2000 m. The base of unit A is only exposed during very low tide, and it constitutes the abrasion plains (Figure 1). A brief lithological description of the Punta Hermengo profile was provided by Soibelzon et al. (2009).

The lower half of the profile (section II, units B–E) contains Ensenadan fauna (lower to middle Pleistocene, Cione and Tonni 2005; Soibelzon et al. 2008). Overlying this is unit G, which includes Bonaerian fauna (middle Pleistocene), and unit H, which contains Lujanian fauna (late Pleistocene/ early Holocene). Biostratigraphically these units are characterized by *Mesotherium cristatum* and *Arctotherium angustidens* (Ensenadan), *Ctenomys kraglievichi* (Bonaerian) and *Equus* (*Amerhippus*) *neogaeus* (Lujanian). These finds partially correspond to those of Tonni and Fidalgo (1982) and Soibelzon et al. (2006) because here we recognize one more lithostratigraphic unit and one biostratigraphic stage (Bonaerian).

From a magnetostratigraphic point of view, units A–C are of reversed polarity and correspond to Chron C1r1r (c. 0.90 to 0.78 million years ago). Units D-H are of normal polarity and correspond to Chron C1n (< 0.78 million years ago).

In addition, it is important to note that the southern Punta Hermengo geological sequence is interrupted by numerous palaeochannels that hinder horizontal and regional correlations. Consequently, identifying the eight units becomes challenging. While units A, B, and H and the two discontinuities (d1 and d2) are clearly identifiable throughout this region, units D to G are individually indistinguishable to the south of "Vieja Farola" of Punta Hermengo. There they are integrated into two major units as unit D+E and unit F+G. It is also important to mention that in the southern area of Punta Hermengo, unit B contains *M. cristatum* remains, which allow us to determine the Ensenadan age for these unit.

The Punta Hermengo profile was used for comparison and correlation with other associations, not only at a regional level but also at a continental level. Unfortunately, the authorities of General Alvarado County placed quartzite blocks parallel to the cliffs to protect against erosion and retreat; consequently all sampling efforts and collection of new paleontological specimens were frustrated due to the impossibility of accessing to section I (those containing Ensenadan fauna) (more details in Cenizo et al., in press). With the loss of this important historical and natural place, the cultural heritage, part of the bulwark that gives a sense of identity and pertinence to the community, will disappear.

The authors thank Mr. Carlos Canelo and family from Miramar, for help during fieldwork, and Germán M. Gasparini for critical reading of the manuscript. Yamile Rico drew the profile of Punta Hermengo. We also thank the Agencia Nacional de Promoción Científica y Tecnológica, the Comisión de Investigaciones Científicas de la Provincia de Buenos Aires, the Consejo Nacional de Investigaciones Científicas y Técnicas and the Universidad Nacional de La Plata for their financial support.

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Marine Sediments Attributed to Marine Isotope Stage 3 in the Southeastern Buenos Aires Province, Argentina

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➤ **Keywords**: Marine Isotope Stage 3, marine sediments, Buenos Aires Province, Argentina

Approximately 200 m south of the mouth of Arroyo La Tigra (38° 20′ 55″ S and 57° 59′ 28″ W, Mar del Sur town, General Alvarado County, Buenos Aires Province), marine sediments crop out about 6 m above sea level. The stratigraphic unit, about 1 m thick, is composed of green yellowish silty-clayey sands, slightly compacted. It contains shells in life position of *Tagelus plebeius* (Lightfoot), a euhaline bivalve species that is a common inhabitant of estuaries and coastal lagoons of Argentina (Olivier et al. 1972). The *Tagelus plebeius* shells are associated with shells of *Heleobia australis* (d'Orbigny), a gastropod of wide range of salinity (mesohaline to euhaline, *ca.* 10–35‰), as well as isolated osteoderms of the extinct megamammal *Glyptodon* sp.

Ameghino (1908) described this outcrop as *"una capa marina que por la naturaleza del terreno y la posición de los moluscos que contiene indica una playa tranquila y fangosa"* [" a marine layer that by the nature of the terrain and the position of shellfishes it contains indicates a peaceful and muddy beach"] (Ameghino 1908:384). Ameghino later states that *"representa la transgresión marina que he llamado belgranense"* ["represents the marine transgression that I have called belgranense"] (Ameghino 1908:385). While all subsequent authors recognized the "Belgranense" as a marine deposit, more recently it was considered that under this name were included transgressive events developed during

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different warm episodes of the Pleistocene (e.g., Marine Isotope Stage (MIS) 11 and MIS 5e; see Cione et al. 2002; Pardiñas et al. 1996, Verzi et al. 2004).

In Mar del Sur two samples of shells of *Tagelus plebeius* were obtained for radiocarbon dating. Sample LP-2124 gave a conventional radiocarbon age of 25,700 ± 800 RCYBP, corrected by $\delta^{13}C$ at 0 ± 2‰. This sample is stratigraphically about 30 cm above sample LP-1757, which gave a conventional radiocarbon age of 33,780 ± 1200 RCYBP, also corrected for $\delta^{13}C$ at 0 ± 2‰.

This radiocarbon period corresponds to the end of MIS 3. During MIS 3 there were abrupt warmings in the Northern Hemisphere (Dansgaard-Oeschger events; see Huber et al. 2006; Van Meerbeeck et al. 2008), which were also manifested in the Southern Hemisphere (Bae et al. 2003).

Hodgson et al. (2009) described East Antarctica marine sediments at 8 m.a.s.l. According to radiocarbon dates these sediments were attributed to a rise in sea level that was developed in the radiocarbon period 26,650 ± 220 and 28,750 ± 300 RCYBP (i.e., the end of MIS 3). Previously, Cortelezzi (1977), Weiler et al. (1987), González and Ravizza (1987), and Weiler and González (1988) described coastal marine sediments in Buenos Aires Province attributed to the last Interstadial between 25,000–38,000 RCYBP. Rabassa (1983) described beach marine sediments from the Antarctic Peninsula considered to be isostatically raised and attributed to a partial glacier recession. Shells of the mollusk *Laternula elliptica* (King and Boderip) found in life position gave an age of 34,115 ± 1110 RCYBP (Hv-11002), which also corresponds to the end of MIS 3.

Martinez et al. (2001) described marine sediments in Puerto de Nueva Palmira (Colonia County, Uruguay, 33° 52′ S - 58° 25′ W) and provided radiocarbon dates. These dates were from shells of *Mactra isabelleana* (d'Orbigny) (31,000 ± 1,200 RCYBP; LP-738) and *Anomalocardia brasiliana* (Gmelin) (34,600 ± 2000 RCYBP; LP-730). The dated shells of *Anomalocardia brasiliana* had a 100% aragonitic composition, which are discarded alterations that may have affected the age obtained. In *Mactra isabelleana*, the composition is equally (50%) calcite and aragonite. According to Kennedy et al. (1969), the Mactridae have completely aragonitic shells, so the sample LP-738 has been affected, but this does not seem to have influenced the age obtained. In this case it is possible that it had been a partial crystallographic conversion of aragonite/calcite, and not a replacement of calcite of different ages. However, Martinez et al. (2001) consider these radiocarbon dates as minimum ages, concluding that the transgression which gave origin to the deposit must be correlated with the last interglacial (MIS 5e). From our point of view, however, these ages are finite, statistically distinguishable from the dating limit of the method. Consequently, they represent an event that occurred near the end of MIS 3 and not during MIS 5e.

The dates reported here for marine sediments of Mar del Sur provide new evidence about the abrupt warming that occurred during MIS 3, causing rising sea levels, probably not significant but still geologically expressed.

The authors thank Agencia Nacional de Promoción Científica y Tecnológica, Comisión de Investigaciones Científicas de la Provincia de Buenos Aires, Consejo Nacional de Investigaciones Científicas y Técnicas, and Universidad Nacional de La Plata for financial support.

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Paleobotany

A Nonsiliceous Algae Record of a Lake/Bog Transition, Douglas County, Wisconsin

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➤ **Keywords**: nonsiliceous algae, bog, Wisconsin

Nonsiliceous algae were extracted from the basal portion of a sediment core from an unnamed bog, referred to as Divide Bog, as part of a multidisciplinary archaeological investigation of site-settlement patterns. The site is a cedar swamp in Douglas County, Wisconsin (UTM: N5138150, E594750). Divide Bog is located in the Brule/St. Croix Spillway channel near the headwaters of the Bois Brule River and is on the divide between the Great Lakes/St. Lawrence drainage basin and the Mississippi River/Gulf of Mexico drainage basin (Engseth and Huber 1998).

An AMS radiocarbon date of 9050 ± 60 RCYBP (Beta-112985) was obtained on charcoal and *Picea* (spruce) needles and has a 2-sigma range of 9990 to 10,120 CALYBP (Engseth and Huber 1998). The 300-cm core retrieved from Divide Bog consists of three major units. The lower unit (296–300 cm) is composed of peaty gray silt. The middle unit (13–296 cm) is dark brown peat (Figure 1). The uppermost unit (0-13) is composed of light brown moss peat. Based on loss-on-ignition (Dean 1974), organic carbon is low (6% or less) at the base of the core (300–295 cm). Above 295 cm, organic carbon ranges from 71% to 85%.

Most of the nonsiliceous algae occur below 280 cm, with the majority occurring at or below the 295-cm level. Only *Gloeotrichia*-type (0.7%), a blue green algae (Cyanochloronta) occurs in the upper portion of the analyzed section of the core (260 cm). Eleven nonsiliceous algae taxa occur between 300 and 295 cm: *Gloeotrichia*-type (0.5–2.0%), *Tetraedron* (0.2–3.5%), *Botryococcus* (0.4–1.2%), *Scenedesmus* (0.5–0.6%), *Spirogyra*-type (0.2–0.9%), *Zygnema*-type (0.2–0.5%), *Pediastrum* undifferentiated (0.8%), *P. Boryanum* (0.2–2.5%), *P. Boryanum* var. *longicorne* (0.2–0.6%), *P. integrum* (0.2–7.4%), and *P. tetras* (0.2%). The most abundant nonsiliceous algae (*Tetraedron, P. Boryanum,* and *P. integrum*) all peak at 297 cm. Only *Tetraedron* and *Mougeotia* occur between 290 and 285 cm (Figure 1).

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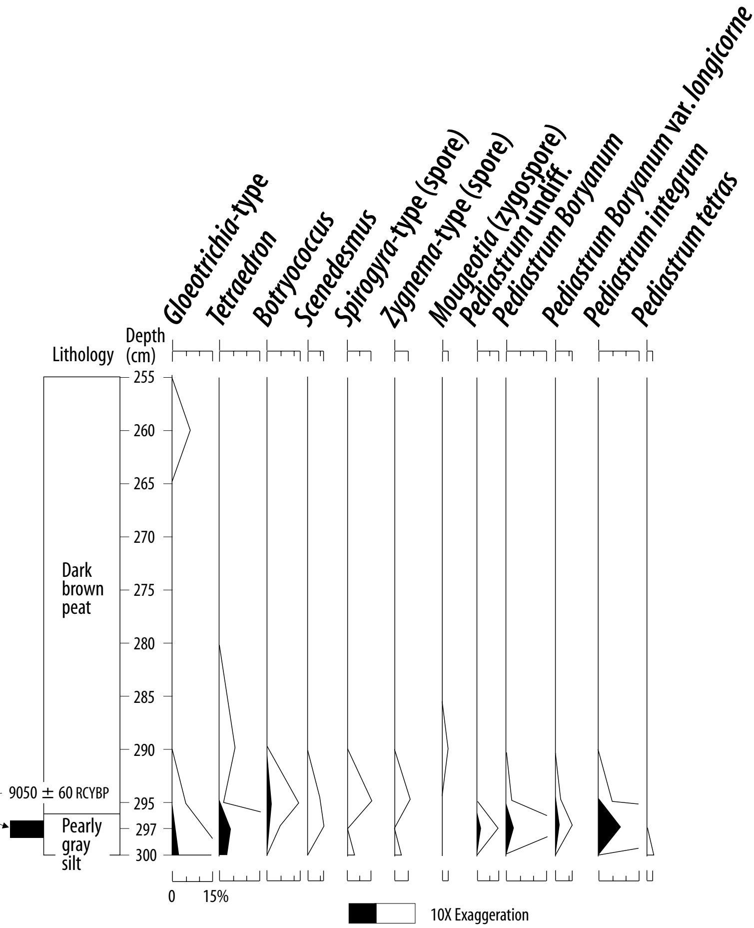

Figure 1. Percentage diagram of nonsiliceous algae, Divide Bog, Douglas County, Wisconsin. *Pediastrum* undifferentiated is composed of colonies lacking identifying characteristics. Percentage values for nonsiliceous algae were calculated by adding the pollen sum to the nonsiliceous algae sum. A minimum of 400 grains of trees, shrubs, and herbs (including vascular cryptogams) was identified within the pollen sum.

All the nonsiliceous algae taxa occurring in the basal sediments of the Divide Bog core are predominantly euplankton or tychoplankton. They are free-floating and commonly inhabit open-water lakes and/or shallow open-water lakes (Prescott 1962). The nonsiliceous algae record the initial colonization of Divide Bog when it began as a shallow water lake. The subsequent decline in algae abundance above 295 cm reflects the transition in lake dynamics from an open-water shallow lake to a bog environment. This change correlates well with the sediment lithology (Figure 1) and the organic carbon data. At Divide Bog this event occurs during the late-Pleistocene/early-Holocene transition.

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Paleontology

The Ecology of Early-Holocene Bison in the Greater Yellowstone Ecosystem, Wyoming: Preliminary Results from the Horner Site

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➤**Keywords**: Bison ecology, isotope analysis, Greater Yellowstone ecosystem

Stable-isotope studies can inform on diet (Tieszen 1994), habitat use (Koch et al. 1995), and paleoenvironmental reconstruction (Fricke and O'Neil 1996). In this study, we report on the results of microsampling from third molars (M_3) of three adult bison, aged 2.6 (1233H), 3.6 (2548H), 4.6 (1181H), from a Cody-complex bison-kill event (mean age of 9899 ± 79 RCYBP).

The Horner site is a bison kill located east of the Yellowstone Plateau on the edge of the arid intermountain Big Horn Basin. Excavations by Princeton University and Smithsonian Institution (Jepsen 1953) and University of Wyoming produced evidence of two distinct bison kills (Frison and Todd 1987). The Wyoming excavations produced a minimum of 65 *Bison* cf. *antiquus* individuals (Walker 1987) from a shallow depression formed by a low-gradient intermittent stream that may have been instrumental in trapping the bison (Reider 1987). Phytolith assemblages reflect a mixed grass environment in a humid and cool climate (Lewis 1987). Wetter conditions are also predicted by Whitlock and Bartlein (1993).

Samples were extracted for stable carbon, oxygen, and strontium isotope analysis (following Balasse 2002). This offers a high-resolution record of changing body values driven by seasonal changes in vegetation and water intake (Gadbury et al. 2000). Bison exhibit reproductive synchronicity, and isotopic data from different age cohorts can inform on individual and herd behavior (Berger and Cunningham 1994; Gadbury et al. 2000).

Horner site bison were compared with modern Yellowstone Plateau bison, which served as controls in this study (Figure 1). The results show interesting

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departures between the two samples. Strontium values of sedimentary and volcanic substrates are significantly different and indicate the Horner bison range did not extend onto the Yellowstone Plateau, but was restricted to the Bighorn Basin. Patterns reflect seasonal shifts in $\delta^{18}O$ values, but are significantly enriched in comparison to modern samples. Enrichment may reflect warmer temperatures and/or greater evaporation during the early Holocene.

The $\delta^{13}C$ values as a proxy for diet display limited variability in two of the samples (1.77‰ [1181H] and 0.96‰ [2548H]); with the youngest (1233H) illustrating much greater variability (4.72‰). Individuals illustrate significantly different values for both $\delta^{18}O$ ($t = 51.251$, $p = 0.000$) and $\delta^{13}C$ ($t = -14.937$, $p = 0.000$). This pattern suggests greater variability in the landscape from year to year, or less cohesion in herd dietary behavior and water-intake sources. Greater reliance on C_4 vegetation in the Horner bison is demonstrated by higher $\delta^{13}C$ values. These individuals also demonstrate greater variability than other early-

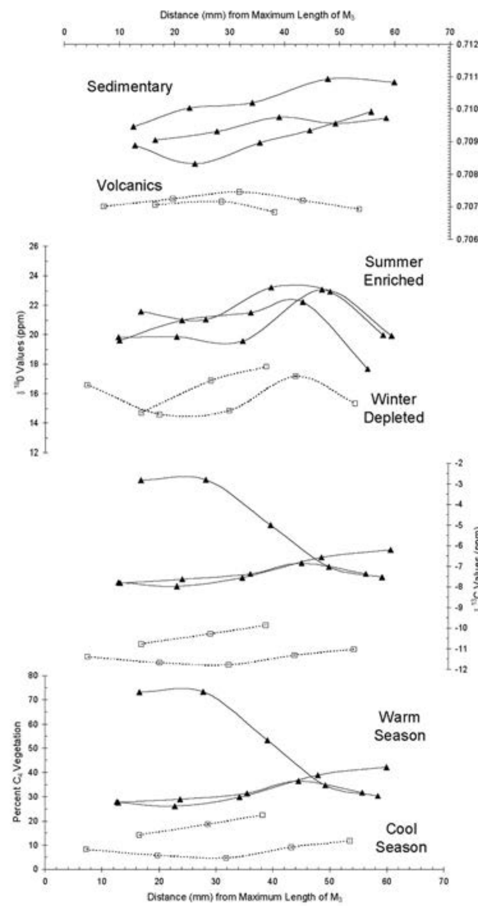

Figure 1. The Horner bison ratios (solid triangles) are compared with those from modern Yellowstone National Park (YNP) bison (hollow squares). YNP is characterized by volcanic substrates, higher elevation, cooler temperatures and less C_4 (warm season) grasses. Samples were extracted from lower third molars (M_3). Carbon and oxygen analyses were conducted under the supervision of Dr. David Dettman, University of Arizona. Values are reported in parts per mil (‰) units relative to PDB (^{13}C) and SMOW (^{18}O) standards. Dr. Douglas Walker, University of Kansas, supervised the strontium analysis.

Holocene bison assemblages (Cannon 2008). Calculated mean annual temperature based on $\delta^{13}C$ values (Hoppe 2006; Hoppe et al. 2006) indicates warmer temperatures during the early Holocene in contrast to phytolith and other proxy data (cf. Lewis 1987; Reider 1987). This pattern is consistent with bighorn sheep results from the region (Hughes 2003).

Support for this research was provided by the National Park Service and Jackson Chapter of the Wyoming Archaeological Society. We would also like to extend gratitude to the following individuals: Ralph Hartley, Cal Calabrese, David Wishart, Sheri Fritz, Alan Osborn, Karin Roberts, Dirk Van Vuren, Kathryn Hoppe, Danny Walker, Doug Walker, Sal Rodriguez, and especially Molly Boeka Cannon.

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The First Record of *Dasypus* (Xenarthra: Cingulata: Dasipodidae) in the Late Pleistocene of México

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➤ **Keywords**: *Dasypus,* late Pleistocene, México

The genus *Dasypus* includes seven living species, *Dasypus novemcinctus, D. hybridus, D. kappleri, D. pilosus, D. sabanicola, D. septemcinctus, D. yepesi* (Wilson and Reeder 2005), and one extinct species, *Dasypus bellus,* from the Blancan, Irvingtonian, and Rancholabrean of North America (McDonald and Naples 2008).

Dasypus bellus is known from numerous Pleistocene sites in the eastern U.S. (Schubert and Graham 2000), but in México there are no previous records of it until now (McDonald 2002). Here *Dasypus* cf. *D. bellus* is reported for first time from the late Pleistocene of México, based on an incomplete buckler osteoderm (catalog number IHNFG-0521, Museo de Paleontología of Chiapas) recovered from La Simpatía locality, at 16° 09′ 05″ N and 93° 18′ 55″ W, municipality of Villa Corzo, in the southern state of Chiapas (Figure 1A). This specimen was found in association with *Bison* sp.*, Mammuthus columbi* and *Equus conversidens* remains, which permits a Rancholabrean biochronological age assignment (Carbot-Chanona and Vázquez-Bautista 2006).

The preservation of IHNFG-0521 is poor, yet we can still observe that it has an isometric shape with one central figure and small peripheral figures. Their measurements are 11.81 mm maximum wide and 12.35 maximum length, and it is twice the size of the buckler osteoderms of the extant *Dasypus novemcinctus* (3.5–8 mm wide and 4–9 mm length), but similar in size and shape to extinct *D. bellus* from the U.S. (Klippel and Parmalee 1984). The central figure is slightly convex, semicircular in shape, large in proportion to the size of the osteoderm, and has an external surface sculptured by grooves and pits. The central figure is surrounded by a sulcus and separates the peripheral figures, and only one follicular pit is observed.

The shape of IHNFG-0521 resembles that of *Glyptotherium* shields, but shields in *Glyptotherium* are much larger, the central figure is concave, and the number of the peripheral figures is higher. Other contemporary cingulates are *Holmesina* and *Pampatherium,* but in these genera the dermal scutes are semisquare and much larger, with the center flat and without peripheral figures. The identification of the material of Chiapas was based on the large size compared with *D. novemcinctus* and morphology of buckler osteoderm. However, the fossil material is too poor to make a trustworthy determination and its preliminary determination is more like *Dasypus* cf. *D. bellus.*

The presence of this taxon in Chiapas documents the first record of *Dasypus*

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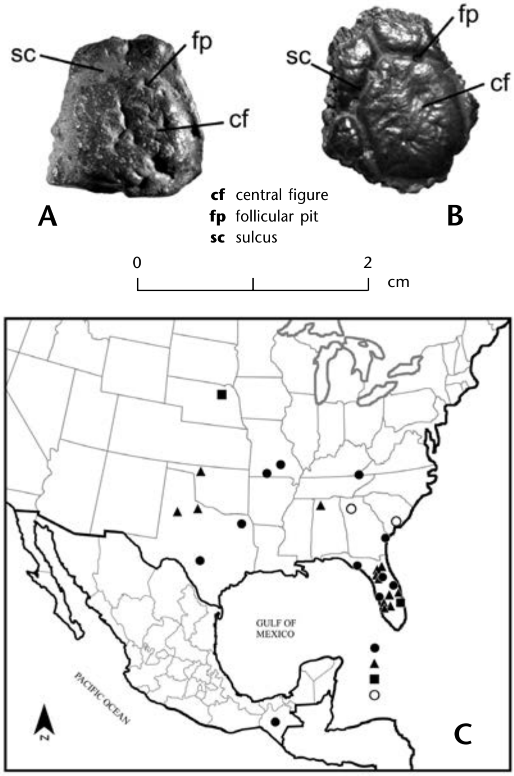

Figure 1. **A,** IHNFG-0521, buckler osteoderm of *Dasypus* cf. *D. bellus* from La Simpatía, Chiapas, Mexico; **B,** AMNH 23546, buckler osteoderm of *Dasypus bellus* from U.S. (taken from Rincón et al. 2008); **C,** map showing the occurrences of *Dasypus bellus* in North America.

for the late Pleistocene of México, as well as its southernmost range of distribution within North America (Figure 1C).

Dasypus bellus has been compared ecologically with *D. novemcinctus.* Currently, *D. novemcinctus* can be found throughout México in grasslands, scrublands, and deciduous forests of predominantly dry climate (Ceballos and Oliva 2005), so it is possible what *D. bellus* lived in similar habitats during the late Pleistocene in Chiapas. However, further studies are needed in the locality to clarify the dominant paleoenvironment in central Chiapas during the Rancholabrean.

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Preliminary Identification of Birds from Indianhead Canyon Local Fauna (Late Pleistocene), Eastern Idaho

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➤**Keywords**: Birds, Jaguar Cave, Indianhead Canyon local fauna, Idaho

Jaguar Cave and Indianhead Canyon local faunae (both previously called Jaguar Cave Entrance local fauna) are from Jaguar Cave, which is in Indianhead Canyon at the base of the Beaverhead Mountains in southernmost Lemhi County, eastern Idaho. The name of the Jaguar Entrance local fauna has been changed to Indianhead Canyon local fauna to avoid confusion with the Jaguar Cave local fauna, which was collected in the early 1960s. The cave is at an elevation of 2250 m with an entrance to the cave at about 12 m above the valley floor. In 1989–90, the Idaho Museum of Natural History excavated 2 m^3 of fossil-rich microvertebrate sediments from the entrance to the cave (Akersten and McCrady 1990). With support from the U.S. Bureau of Land Management (BLM), four samples of bone collagen from the cave have now been dated between 39,120 and > 48,400 RCYBP. The Beta dates are in stratigraphic order, with the oldest at the base of the excavation (39,120 ± 810 RCYBP, Beta-209101; 42,980 ± 1340 RCYBP, Beta-209102; 42,930 ± 1330 RCYBP, Beta-209103; > 48,400 RCYBP, Beta-209104) (Akersten 2006). Most bones and

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teeth from the cave display breakage and corrosion typical of remains attributable to raptors and mammalian carnivore scat. Microvertebrates identified so far include unidentified fish taxa, a natricine snake, a lizard in the genus *Phrynosoma* sp., and the following small mammals: *Sorex* sp., *Thomomys* sp., *Perognathus* sp., *Peromyscus* sp., *Neotoma* sp., *Phenacomys* sp., *Microtus* sp., *Lemmiscus* sp., *Dicrostonyx* sp., *Marmota* sp., *Spermophilus* sp., *Ochotona* sp., *Brachylagus* sp., and *Lepus/Sylvilagus* sp. (Akersten et al. 2007). Remains of a megafaunal component are scarce and fragmentary. To the Jaguar Cave Entrance fauna we now add birds.

After a preliminary sorting, 15 fossils were identified as birds. These represent two orders and three families of birds (Galliformes: Phasianidae and Passeriformes: Corvidae, Cardinalidae, and Icteridae). Identifiable bird fossils were either the proximal or distal ends of bones except for one complete carpometacarpus. The Indianhead Canyon local fauna now includes the following four bird taxa: greater sage grouse, *Centrocercus urophasianus* (IMNH 866/45837) left humerus proximal end; black-billed magpie, *Pica aff. P. hudsonia* (IMNH 865/48117) right ulna proximal end; bunting, *aff. Passerina amoena* (IMNH 865/48118) right coracoid humeral end, (IMNH 865/48119) left ulna proximal end, (IMNH 865/48120) left carpometacarpus; bobolink, *aff. Dolichonyx oryzivorus* (IMNH 865/48121) left humerus distal end, (IMNH 865/48122) right ulna distal end.

Fish in the fauna (Smith in prep.) indicates the presence of a year-round water resource, most likely a nearby stream (Akersten et al. 2007). A collared lemming (*Dicrostonyx* sp.) probably required some snow cover and cold winters, not unlike Idaho today, in which both the sage grouse and magpie thrive. Sage grouse today are associated with sagebrush areas of foothills and plains. The presence of two small migratory passerines, a bunting and bobolink, indicates that summers were snow free and warm enough to attract seasonal breeders north from their winter haunts in Central and South America. This is consistent with the *Artemisia* steppe biome (Akersten et al. 2007).

Chandler would like to thank Bill Akersten for the opportunity to study the birds from the Indianhead Canyon local fauna and his friendship over many years. We would like to thank Allen Mcready for his expertise and hard work in the excavation and screen washing of the fauna, colleagues who have studied other components of this microvertebrate fauna with Akersten in the past (see citations) the Bureau of Land Management for past support for dating the site, and Linda Chandler and Dennis Parmley for constructive criticisms on the manuscript.

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Observations from the Hiscock Site (New York) Bearing on a Possible Late-Pleistocene Extraterrestrial Impact Event

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➤ **Keywords**: Hiscock site, impact event, Pleistocene extinction

Firestone et al. (2007) offered compelling evidence for an extraterrestrial impact or airburst explosion in or above North America 12,900 CALYBP, resulting in megafaunal extinction, cultural dislocation and environmental changes. Some of the attempts to duplicate their reported observations have been unsuccessful (Haynes et al. 2010; Paquay et al., 2009). I offer here observations from the Hiscock site in western New York (Laub et al. 1988; Laub 2003) bearing on the extraterrestrial proposal. These are of a preliminary nature, and should be used more to judge the usefulness of Hiscock for evaluating the hypothesis than as a basis to judge the hypothesis itself.

Firestone et al. (*ibid.*, p. 16017) reported a discrete, thin sedimentary layer at the Younger Dryas upper boundary containing indicators of impact and wildfire. Among other features, they stated that the stratum includes magnetic grains and microspherules, and an elevated level of radioactivity. This layer underlies the "black mat" (Haynes 1991) where the latter is present. (A distinct black mat has not been recognized at Hiscock.)

The stratigraphy and chronology of the Hiscock site have been described by Laub (2003). A 133-cm continuous vertical sequence of 19 sediment samples, from late Pleistocene to Recent, was collected in 1991 from Hiscock quadrant I4SE. This complete stratigraphic section from one of the deeper parts of the site was examined for some of the reported features. All samples contained a magnetic fraction, which was extracted from subsamples using a neodymium magnet. A portion was placed on a conductive carbon tape slide and viewed with a Hitachi SU70 Field Emission SEM and an Oxford INCA Energy Dispersive X-ray Analyzer to collect x-ray spectra (SEM/EDS). All images were in backscattered electron mode. The samples were initially examined at magnifications of approximately 175x, and then objects of interest at 500x to 1000x. Iron-rich spherules, 50–65 μm in diameter, were found in the Pleistocene horizon (depths 99–104 and 109–114 cm) and also in the higher, late-Holocene levels (depths 26–36 cm). None of them have the surface smoothness of those figured by Firestone and his colleagues; the former may have originated geochemically.

Irregular-shaped grains rich in iron and titanium occur throughout the section. These may be ilmenite, derived from decomposed crystalline erratic rocks that are commonly reduced to grus here. Iron-rich grains, reportedly

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intruding cultural chert fragments at the Gainey site (Firestone et al. 2006), were not seen in the Hiscock Pleistocene artifacts.

Firestone et al. (2006, 2007) reported elevated levels of radioactivity at the Younger Dryas boundary. The Hiscock site I4SE sediment column was examined for radioactivity by University at Buffalo Radiation Safety Specialists Donald Sherman and Nathaniel Shaw, who initially analyzed the full suite of sediment samples using Geiger Mueller and low-energy gamma/beta survey probes. Subsequently, they performed 10-minute counts of subsamples using a Canberra/Tennelec XLB series 5, alpha/beta gas flow proportional counter. In neither case was the radioactivity level found to exceed that of a background soil sample.

The megafaunal extinction supposed to have occurred at 12,900 CALYBP, coinciding with the hypothesized catastrophic event, is not clearly evident at Hiscock. Most dates on mastodon remains at this site either precede 12,900 CALYBP (approximately 11,000 RCYBP) or overlap it at the younger end of its two-sigma range (Laub 2003). Dentine protein, however, extracted by alkali from a well-preserved mastodon tooth (field no. G2NW-19) yielded a conventional radiocarbon age of 10,430 ± 60 RCYBP (12,670 to 12,060 CALYBP; Beta-236608).

Further, the Hiscock fossiliferous Pleistocene horizon, unlike the Holocene, is pervaded by short conifer twigs. These appear to be mastodon digesta (Laub et al. 1994), a view that is supported by the occurrence of similar twigs at other mastodon sites such as Doerfel (Laub and McAndrews 1999) and Chemung (Griggs and Kromer 2008). Individual twigs from Hiscock are as old as 10,945 ± 185 RCYBP (13,200 to 12,670 CALYBP), but three date to the 9000s, as recent as 9090 ± 40 RCYBP (10,260 to 10,200 CALYBP; Laub 2003, 2006).

How significant are the Hiscock observations? The sediment grain study, based on a very small sample, is probably least informative. The Hiscock Pleistocene horizon is poorly stratified, no doubt because it was a salt lick at the time, heavily used by large animals (McAndrews 2003; Ponomarenko and Telka 2003). Hence, a distinctive, thin event horizon within this lithosome, and an associated radiation peak, might not be expected to survive (though this assumes the continued presence of a mastodon population to effect bioturbation). The radiocarbon dates, if the twigs have been correctly interpreted, could reflect the return to Hiscock of a surviving mastodon population.

On the other hand, the evidence cited by Firestone and his colleagues spans an enormous area, focusing around the Great Lakes and extending to Arizona, Alberta, and South Carolina. The Gainey site in Michigan, which gave early support to this hypothesis (Firestone et al. 2006), lies approximately 280 miles (450 km) from Hiscock, so it is surprising that evidence of the putative catastrophe is not more obvious here.

For example, during the Pleistocene, the Hiscock basin lay in a (mastodon-browsed?) clearing surrounded by coniferous forest (Miller 1973, 1988; Webb et al. 2003). The contemporary conifer twig fragments mentioned above are sufficiently preserved to reveal their growth increments (Ponomarenko and Telka, 2003). Yet, the Pleistocene strata almost entirely lack large pieces of wood. If a Tunguska-like event had occurred in the region, why weren't numerous Pleistocene logs blown into the basin?

I thank the following people for sharing their ideas and expertise during this study, although any errors are my responsibility: John H. McAndrews (Department of Ecology and Evolutionary Biology, University of Toronto), Peter Bush (Instrumentation Center, School of Dental Medicine, State University of New York at Buffalo), Donald Sherman and Nathaniel Shaw (Environment, Health and Safety Services, State University of New York at Buffalo), Joaquin Cortes (Department of Geology, State University of New York at Buffalo), and Darden Hood and Chris Patrick (Beta Analytic, Inc., Miami, Florida). Edward Schaefer, Marcia Richmond and Michael Grenier assisted with magnetic sampling. I also thank the hundreds of volunteers who have worked tirelessly to excavate the Hiscock site over the past 27 years. The Hiscock site project has been funded by the Buffalo Museum of Science, the George G. and Elizabeth G. Smith Foundation, the Grigg-Lewis Foundation, the Conable Family Foundation, the Agrilink/Pro-Fac Foundation, and the Gebbie Foundation.

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A Revised Age Determination for the Embden, North Dakota, Mammoth Using Optically Stimulated Luminescence Dating

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➤**Keywords**: Lake Agassiz, mammoth, OSL dating

Mammoth remains have been found throughout the upper Great Plains of North America, notably in Minnesota but also in North Dakota (reviewed in Harington and Ashworth 1986; see also FAUNMAP). Of the sites in North Dakota, at least two are associated with Herman-stage beach ridge deposits of Glacial Lake Agassiz. No mammoth remains have been reported from the beach deposits of lower stages of Lake Agassiz.

Warren Upham, in his 1895 monograph on Lake Agassiz, describes mammoth remains recovered from the base of a gravel quarry in Herman beach deposits at Ripon (present day Absaraka), North Dakota that was being excavated for railroad ballast. The remains included three teeth, two vertebrae, and a tusk measuring 11 ft long. Upham was, however, quite specific in indicating that "they [the mammoth remains] were embedded in the top of the till, and the overlying beach formation has yielded no bones, shells, or other fossils" (Upham 1895, pg. 322). No species distinction is indicated for this mammoth and no geologic date is available.

Harington and Ashworth (1986) describe a mammoth tooth found near

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Embden, North Dakota, that was recovered from a small gravel quarry within the Herman beach ridge. It was identified as an upper third molar (RM^3) of a woolly mammoth (*Mammuthus primigenius*). They inferred an age of 11,500 for the mammoth by correlation to a date of 11,740 ± 200 RCYBP[1] (Shay, 1967; Y-1327) from basal lake deposits of Qually Pond near Fertile, Minnesota. Qually Pond is situated atop a moraine on the opposite shore of the southern arm of Glacial Lake Agassiz and is approximately 90 km distant from the Embden mammoth site.

Recent work by Lepper and others (Fisher et al. 2008; Lepper et al. 2007) has successfully applied optically stimulated luminescence (OSL) dating to beach deposits of Glacial Lake Agassiz including the Herman beach ridge. The objective of this targeted project was to date the beach ridge deposits at the site where the Embden mammoth was recovered using OSL techniques, thereby providing a direct contextual age for the mammoth.

In summer 2009 the site was relocated (46° 53′ 42.57″ N; 97° 27′ 15.86″ W) and a sand sample was collected for OSL dating. A fresh pit was hand excavated in undisturbed beach deposits upslope of the abandoned, in-filled quarry. The sample was taken at a depth of 45 cm from a very fine to fine sand layer in the C soil horizon that exhibited weak planar bedding and included lenticular medium sand bodies (%H_2O = 15 ± 3). The preservation of these bedding structures supports our inference that the deposit was undisturbed. The depth at which the tooth was originally entombed is unknown, but beach ridge development on the shores of Lake Agassiz is inferred to have occurred over relatively short time periods with age separations of as little as 200 years occurring between successive ridges (Lepper et al. 2007).

OSL dating was conducted in the Optical Dating and Dosimetry (ODD) Lab at North Dakota State University. Clean quartz sand in the grain size range of 150–250 μm was isolated for measurement (see supplement to Lepper et al. 2007). Experimental methods included single-aliquot regeneration (SAR) data collection procedures (adapted from Murray and Wintle 2000, 2006) and the data-analysis approach described in the supplement to Lepper et al. (2007). The equivalent dose data distribution was symmetric (n = 95; M/m = 1.02); therefore, its mean and standard error were used for age calculation. Elemental concentrations of dosimetrically significant elements (K = 14846 ± 1207 ppm; Rb = 48.87 ± 3.33 ppm; Th = 3.05 ± 0.29 ppm; U = 1.05 ± 0.13 ppm) were obtained via instrumental neutron activation analysis (performed at the Ohio State University Research Reactor).

The OSL age obtained was 14,000 ± 1200 yr CAL. This age is approximately 400 years older than the age assigned to the mammoth by Harington and Ashworth (1986; from Shay 1967; Y-1327) of 13,590 ± 190 CALYBP (calibration via Fairbanks et al. 2005), but it is consistent within the uncertainty of the two techniques (^{14}C and OSL). The new age determination is also highly consistent with a composite OSL age of 13,900 ± 1300 yr CAL that was determined for the Herman-stage beach deposits near the southern outlet of Lake Agassiz

[1] We use RCYBP or CALYBP, as appropriate, for radiocarbon dates given in the manuscript; however, with OSL ages we use yr CAL.

(Lepper et al. 2007). Although the revised age may not significantly influence interpretations about when mammoths occupied the region, it does provide a direct contextual age for the Embden mammoth and more importantly it demonstrates that OSL dating can provide a means to retroactively determine geologic ages for mammoth remains or other fossils that have been recovered from beach ridge deposits.

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Central America: The Pleistocene Proboscidean Pathway

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➤**Keywords**: Central America, Pleistocene, proboscidean biogeography

Central America has a diverse and complex fossil record of proboscideans of Miocene-Pleistocene age. We count at least 74 localities in Central America

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that have yielded proboscidean fossils, about 43 of which are well documented. We recognize four genera of fossil proboscideans from Central America: *Gomphotherium*, *Cuvieronius*, *Mammut,* and *Mammuthus.* Other workers, including us (e.g., Arroyo-Cabrales et al. 2007; Lucas et al. 2007), have previously identified three other proboscidean genera from Central America—*Rhynchotherium, Stegomastodon,* and *Haplomastodon*—but based on new identifications and revised taxonomy (e.g., Cisneros 2008; Ferretti 2008; Laurito and Aguilar 2007; Lucas 2008; Lucas and Morgan 2008; Lucas et al. 2007, 2008), there are no demonstrable records of these proboscidean genera in Central America.

Proboscidean fossils are known from all Central American countries except Belize. Well-documented Guatemalan proboscidean records are of Miocene *Gomphotherium* and Pleistocene *Cuvieronius,* whereas a single mammoth record is of late-Pleistocene age (Lucas and Alvarado 1995; Lucas et al. 2007). Honduras has the most extensive record of Miocene *Gomphotherium* in Central America and a less extensive Pleistocene record of *Cuvieronius, Mammthus columbi,* and the single Central American (Pleistocene) record of *Mammut* (Lucas and Alvarado 1991; Webb and Perrigo 1984).

El Salvador has an extensive fossil record of proboscideans assigned to *Gomphotherium, Cuvieronius,* and *Mammuthus* (Cisneros 2008; Laurito and Aguilar 2007). Particularly significant is the Chalatenango record of the co-occurrence of primitive *Mammuthus* with *Cuvieronius,* which is confidently assigned an Irvingtonian age. This is the best evidence that both of these proboscidean genera were in Central America during the middle Pleistocene (Irvingtonian), though it seems certain that *Cuvieronius* dispersed into Central America by the early Pleistocene (late Blancan), given that the oldest definitive record of gomphotheres in South America is ~ 2.5 Ma (Marplatan) (López et al. 2001; Reguero et al. 2007). Other well-dated Irvingtonian records of *Cuvieronius* are from Barranca del Sisimico and Tomayate in El Salvador. The well-dated Rancholabrean record of *Cuvieronius* at El Hormiguero in El Salvador helps to establish its presence in Central America during the Rancholabrean.

All fossil records of proboscideans from Nicaragua are of *Cuvieronius* (rare) and more common *Mammuthus columbi* and appear to be of late-Pleistocene age (Lucas et al. 2008). Costa Rica has an extensive proboscidean-fossil record dominated by fossils of *Cuvieronius,* all apparently of Pleistocene age (Laurito 1988; Lucas et al. 1997). The southernmost record of *Mammuthus* (*M. columbi*) is from Hacienda del Silencio in central Costa Rica. The proboscidean fossils from San Gerardo de Limoncito and Santa Rita in southern Costa Rica (Laurito and Valerio 2005; Valerio and Laurito 2008), may be southernmost records of *Gomphotherium* (?), but they need to be further evaluated. Only two fossil records of proboscideans are known from Panama, both of *Cuvieronius,* and these are relatively young, ~ 45,000 years old (Pearson 2005).

We divide the history of Central American proboscideans into four immigrations: (1) arrival of *Gomphotherium* during the late Miocene (early Hemphillian); (2) arrival of *Cuvieronius* during the early Pleistocene (Blancan); (3) arrival of *Mammuthus* during the middle Pleistocene (Irvingtonian); and (4) arrival of

Mammut during the late Pleistocene (Rancholabrean). We see no evidence for endemic evolution or for a center of origin of proboscideans in Central America, as was most recently advocated by Woodburne et al. (2006). All proboscidean genera known from Central America are also known from North America, which is where they apparently originated. Central America acted as a one-way dispersal route for proboscideans from North America to Central America and, in one case (*Cuvieronius*), onward to South America. We therefore refer to Central America as the "proboscidean pathway."

The late-Pleistocene extinction of proboscideans in Central America was part of the global extinction of the late-Pleistocene mammalian megafauna. Unfortunately, there are few reliable data to precisely date the youngest proboscidean fossil records in Central America, though no data support an age younger than late Pleistocene. Despite claims to the contrary, we have concluded that there are no demonstrable human-proboscidean associations in Central America (Hurtado de Mendoza and Alvarado 1988; Lucas et al. 1997, 2008).

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Dung Analysis and its Correlation with Three Different Species of Extinct Megafauna in the Southern Argentinian Puna

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➤ **Keywords**: Extinct Pleistocene megafauna, dung analysis, Southern Argentinian Puna

This paper presents the results and implications of the analysis of various samples of dung assigned to extinct Pleistocene megafauna in the Southern Argentinian Puna (ca. 19,600–12,500 RCYBP) (Martínez et al. 2004, 2007). Although there are several works related to the study of coprolites of extinct Pleistocene megafauna in the Americas (Poinar et al. 1998, Steadman et al. 2005, Kropf et al. 2007, among others), only a few deal with morphological aspects.

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The samples under study are composed exclusively of plant remains recovered from stratigraphic excavations at Peñas de las Trampas 1.1 site (PT1.1), a rockshelter located at 3582 m.a.s.l. in Antofagasta de la Sierra (Catamarca), Southern Argentinian Puna. The extreme dryness of this environment allowed an exceptional preservation of these ancient organic remains.

The presence of two extinct species of megamammals, *Hippidion* sp. and a type of giant ground sloth (Megatheriinae), were previously reported in this environment (Martínez et al. 2004, 2007). These species were identified based on fragments of molars assigned to these taxa, which were embedded in a matrix formed by the extinct megafauna dung under analysis. The aim of this paper is to correlate the different morphological patterns of herbivore dung present in PT1.1 with their producers. Given the exceptional character of the preservation of plant remains for almost 20,000 years, our analysis addressed two aspects: taxonomic identification of plant material and external morphology of consolidated feces found in different stratigraphic layers of PT1.1. Note that Pleistocene dung was only detected in this site and in Cueva Cacao 1A (near to PT1.1) for all the Argentinian Puna. Its discovery is of great importance, given its potential as an indicator of megamammal paleodiet and as a paleoecological proxy record for the last part of late Pleistocene in this area.

Consolidated feces come from a matrix composed mainly of abundant loose plant remains produced by the disassembly of these droppings. The maximun thickness of these layers in PT1.1 is 70 cm in the 2E sector where a sample of feces yielded a ^{14}C date of 19,610 ± 290 RCYBP (Martínez et al. 2007). From the morphological standpoint, we present a description of the external appearance of the consolidated dung, which preserves its original form. On this basis, we define three distinct morphological "patterns" that could correlate with different taxa of extinct megamammals: *Hippidion* sp., Mylodontinae indet., and Megatheriinae indet.

Feces of *Hippidion* sp. present a suboval "flattened" external morphology characteristic identical to that of modern equines. The fecal unit measures 7 x 4 x 3 cm in length, width, and thickness, respectively.

The external morphology of the feces assigned to Megatheriinae is not clearly visible because it is not complete, but seems to be suboval with measurements of 12 x 6 x 5 cm. What links this type of feces with megatherins is that it contains abundant fragments of stems of woody plants, particularly cut obliquely at each end. The angle of these cuts is of 60° relative to the longitudinal axis of the plant stem, which coincides in general with the angle of the occlusal facets related to the transversal crests of Megatheriinae molars. Although experimental work has not yet been done on this pattern of cutting, it is very clear that these bevels have been produced by the shearing effect of this type of molar during mastication.

The feces that we assigned to Mylodontinae present a particular discoidal form (one unit). In most cases at PT1.1, this feces was preserved as several "disks" superimposed. The approximate measurements of each unit vary from 10 to 15 cm in diameter and from 2 to 3 cm in thickness. We assigned this excrement to Mylodontinae because they have the same pattern of other coprolites found in other Pleistocene sites in Argentina and Chile, which are frequently associated with dermal ossicles characteristic of this xenarthran subfamily, as one of us (JGM) observed in collections from Gruta del Indio (Mendoza, Argentina), Cueva del Milodón (Última Esperanza, Chile), and Cerro Casa de Piedra 7 (Santa Cruz, Argentina).

The taxonomic study of plant species that make up the three types of excrement described above were carried out by anatomical comparison with current material by histological cuts. The plants are also in an excellent state of preservation. The botanical macro-remains inside the feces of the three taxa are very small (< 0.5 cm in length). With respect to the three types of feces distinguished by external morphology, it is noteworthy also that they have corresponding variations in the type and proportion of plant species content.

In the feces assigned to *Hippidion* sp. there is a total dominance of herbaceous species of the family Poaceae (*Festuca chrysophylla, Deyeuxia eminens* var. *eminens,* and *Deyeuxia eminens* var. *fulva*). The discoidal feces assigned to Mylodontinae are dominated by herbaceous species (*Festuca chrysophylla*, 70%) and a smaller percentage (30%) of woody species of the family Fabaceae (*Adesmia horrida*). For Megatheriinae, the feces are composed almost exclusively of woody species of the family Fabaceae (*Adesmia horrida*), whose stems have shaped cuts forming oblique bevels. In addition we observed only a few fragments of "chewed" fibers of *Stipa frigida* (Poaceae).

Based on the these results, we highlight the correlation between three different types of feces and three different species of megamammals that inhabited the southern Puna of Argentina during the late Pleistocene to ca. 12,500 RCYBP. This is related to selective ingestion patterns of plant species by each type of megaherbivore. All identified plant species are now growing in the area surrounding PT1.1. However, it is important to note that at present the dominant species of the area is *Acantholippia salsoloides*, belonging to the family Verbenaceae, which is not present among the macro-remains found on the site. This allows us to infer changes in the flora over time, in correlation with significant paleoclimatic/paleoecological variations between the late Pleistocene and early Holocene.

Moreover, by virtue of their presence in a primary context ("coprocenosis"), the remains from PT1.1 indicate that these megafaunal taxa frequently used the rockshelter. It remains to be determined whether there was synchrony in the use of the same rockshelter by these three taxa.

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A New Record of American Mastodon, *Mammut americanum*, in Colorado

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➤ **Keywords**: American Mastodon, Colorado, distribution, paleoecology

While the American Mastodon, *Mammut americanum*, is widely distributed across North America (Shoshani 1990), its distribution is not uniform and within parts of its range remains of the species are rare. This is the case in the Intermountain West, where mastodon records are few compared with the number of records both to the east, specifically east of the Mississippi River, and to the west, along the West Coast of the United States. The Intermountain West is defined as including two records of *Mammut americanum* in western Montana, seven in Idaho, two in Utah, two in Wyoming, three in Colorado, eight in Arizona, and eight in New Mexico. As with other parts of the Intermountain West, the number of records of mastodon in Colorado is minimal especially compared with the number of mammoths. Graham et al. (2003) reported 78 mammoth finds in Colorado, although the count is now ca. 100. Hay (1924) reported two records of mastodon from Colorado, a tooth fragment from 15 miles northeast of Pueblo, Pueblo County, and an upper second molar from Golden, Jefferson County, to the west of Denver. Unfortunately the present location of both specimens is unknown. Consequently the recent discovery of parts of a mastodon, a partial lower jaw (DMNS 58820) and segment of tusk, by the two junior authors near Ken-Caryl, a suburb in southwest Denver, is a significant contribution to our understanding of the Pleistocene fauna of the region. As with the previous finds, this new record, called the KC^2 Mastodon, is from along the Front Range on the eastern flank

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of the Rocky Mountains. Portions of the tusk were still in situ, and it is possible that excavation may produce additional parts of the skeleton.

An absolute age for the remains has not been determined. The animal is preserved in what is currently mapped as undifferentiated sediments that may be either Pinedale (approximately 30,000–10,000 years ago) or Bull Lake in age (200,000–130,000 years ago) (Bryant et al. 1973).

In the eastern United States the American Mastodon is closely associated with coniferous (spruce/pine) forests (Jackson and Whitehead 1986; McAndrews and Jackson 1988; Whitehead et al. 1982). If mastodon was restricted in its distribution by its ties to coniferous habitat, then its distribution pattern in the West may simply reflect the differences in plant distribution in the West due to the greater range of elevation than exists in the East. Modern vegetation zonation in the Rocky Mountains is determined primarily by elevation and secondarily by exposure, aspect, and local microclimatic and edaphic factors (Petersen and Mehringer 1976). As elevation increases, vegetation changes from pinyon-juniper woodlands to Ponderosa pine and oak at 2290 m, and at 2740 m from Douglas fir and aspen to mixed conifer forest with Douglas fir, Engelmann spruce, white fir, subalpine fir, and aspen, which extends to treeline at 3050 m. The more geographically limited distribution of coniferous forest habitat in the Rocky Mountains and its restriction to specific zones defined by elevation probably limited the size of mastodon populations and accounts for their relative rarity in this region. During the Pleistocene, climate change caused the elevational limits of this habitat to shift to lower altitudes—300–600 m lower based on studies by Markgraf and Scott (1981) and 671 m lower based on work by Elias (1988)—than the elevations at which this habitat occurs today. Consequently the distribution of mastodons in this region would also have shifted as a secondary consequence of changes in the distribution of what is inferred to have been its preferred habitat. However, even with Elias's estimate of a maximum lowering of the vegetation zones, the lowest elevation for the mixed coniferous forest would have been about 2070 m, still well above the Ken Caryl mastodon locality at 1789 m. It seems more likely that mastodons were more flexible in their usage of different habitats than usually assumed. Since most Western mastodon records lack the in-depth data on associated vegetation available for Eastern records, we currently lack the needed documentation as to their habitat preference in the West. We also lack radiocarbon- or optically stimulated luminescence–dated mastodon specimens from this region that would confirm whether mastodons in the Western part of the United States were tracking any specific habitat(s) and whether changes in its distribution occurred over time in response to climatic change during the Pleistocene.

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AMS ^{14}C Dating of "Exotic" Mammals from South Siberian Caves

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➤ **Keywords**: Mammals, exotic species, Upper Pleistocene, AMS ^{14}C dating, Siberia

Composition of mammals from late-Pleistocene deposits in Siberia is relatively well known (e.g., Vereshchagin and Baryshnikov 1984; Vereshchagin and Kuz'mina 1986; see the latest summaries: Kosintsev and Vasiliev 2009; Vasil'ev 2003). However, several species are unexpectedly found far outside their common habitats. For Altai Mountains and southern part of eastern Siberia these are Vinogradov's porcupine, *Hystrix brachiura vinogradovi* Arguropulo, Asiatic black bear, *Ursus (Selenarctos)* cf. *thibetanus* G. Cuvier, and small cave bear, *Ursus (Spelaearctos) rossicus* Borissiak. The determination of age and (possibly) ecological conditions for these "exotic" species is therefore an important task.

In 2008–9, direct AMS ^{14}C dating of three bone samples from cave sites in southern Siberia was performed at the NSF-Arizona AMS Laboratory, following

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routine collagen extraction using bone demineralization by HCl (e.g., Kuzmin et al. 2009:92). Collagen yield was good (5.0–21.9%), well within accepted limits (e.g., Brock et al. 2007:190); and carbon yield from collagen was also reasonable (29.0–31.0%) (Table 1). Thus the material for ^{14}C dating appeared quite reliable with respect to collagen preservation. At the Arizona AMS Lab, bone blank is 0.01 ± 0.003 Fm (fraction of modern carbon). The limit of carbon detection for a sample with this kind of blank is < 0.006 Fm (see Stuiver and Polach 1977 for complete explanation), giving the limit of > 41,000 RCYBP.

Table 1. ^{14}C dates of "exotic" mammals from southern Siberia.

Site name, species	^{14}C date, RCYBP	Lab no.	δ^{13}C (‰)	Collagen yield (%)	C yield (%)
Razboinichya Cave, porcupine	27,600 ± 525	AA-83718	-20.4	5.0	30.0
Botovskaya Cave, Asiatic black bear	> 41,000	AA-83719	-18.2	16.9	29.0
Kremenshet Cave, small cave bear	> 41,000	AA-83722	-20.1	21.9	31.0

A small fragment of skull with a molar belonging to Vinogradov's or another subspecies of porcupine was found in the Razboinichya Cave, Altai Mountains (51° 18′ N, 84° 28′ E) (Ovodov 2000). Dating of the porcupine bone gave quite a young age, ca. 27,600 RCYBP (Table 1). This porcupine clearly existed in the Altai region in a relatively warm climate of MIS-3 (Karga in Siberia), as it was recently suggested (Kosintsev and Vasiliev 2009:95). More finds of porcupine bones and teeth are known from the Altai (Kosintsev and Vasiliev 2009; Ovodov 2000), and their direct ^{14}C dating is an urgent task.

The single find of Asiatic black bear in Siberia is known from the Botovskaya Cave in the upper course of the Lena River (54° 40′ N, 105° 13′ E); other localities are in the Russian Far East and neighboring northeast Asia (e.g., Ovodov 1977). The ^{14}C age of a bear left tibia from this cave is more than 41,000 RCYBP, beyond the limit of detection of the Arizona AMS machine (Table 1). Black bears use large trees to make dens for hibernation. There is a high probability that this kind of vegetation existed in the upper Lena River basin in the early part of the late Pleistocene (Ovodov and Filippov 2000).

The remains of small cave bears in Siberia are limited to Altai Mountains and the Yenisei and Ob' river basins (Ovodov and Filippov 2000). This is why identification of this species in Kremenshet Cave of the Eastern Sayan Mountains (54° 49′ N, 98° 09′ E) attracts our attention. The direct ^{14}C age of a skull fragment is more than 41,000 RCYBP (Table 1). Thus the existence of this species in the southern part of eastern Siberia may be limited to the early part of the late Pleistocene, or even before that.

Our conclusion is that even quite "exotic" mammals in southern Siberia could have existed in relatively recent time, as the porcupine case from Altai Mountains demonstrates. It is therefore necessary to make revisions of existing knowledge (e.g., Kosintsev and Vasiliev 2009) and apply AMS ^{14}C dating to particular species rather than bulk samples as was previously done in most studies.

This research was partly funded by the U.S. NSF (EAR 06-22305) and Russian RFFI (06-06-80258). We are grateful to Dr. A. J. Timothy Jull (NSF-Arizona AMS Laboratory) for some explanations.

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Small-Mammal Communities in the Pampean Region (Argentina) at the Time of Megafaunal Extinctions: Paleoenvironmental Meaning

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➤ **Keywords**: Buenos Aires Province, late Pleistocene, Lujanian, Sigmodontinae

The rich fossil record of Pleistocene mammals from southern South America has revealed many forms of species that became extinct around the Pleis-

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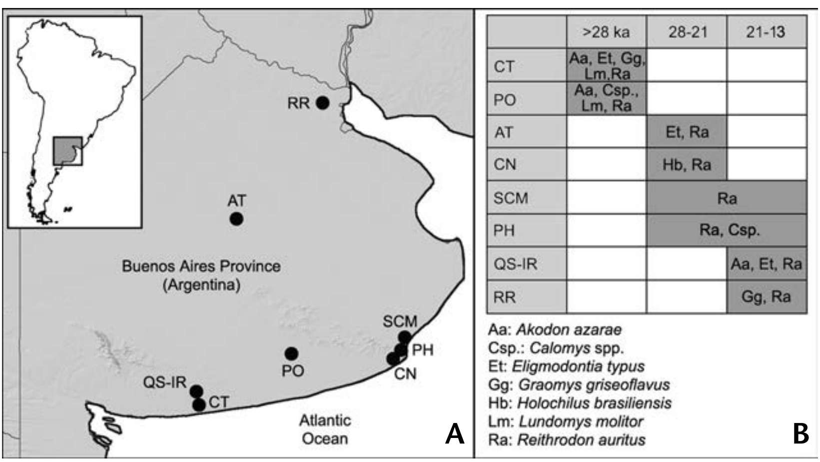
tocene-Holocene boundary. Many factors were linked with the megafaunal extinction, and several hypotheses have highlighted the presumed impact of abrupt climatic changes (Cione et al. 2009). Thus a complete understanding of climatic evolution ca. 30,000–13,000 RCYBP is crucial to appreciate its real influence on large-mammal extinctions. Small mammals are useful in making paleoclimatic inferences, but the late-Pleistocene fossil record of these forms is scarce (Pardiñas 1995). In this paper, we summarize knowledge of late-Pleistocene micromammalian assemblages at the Pampean region, Argentina, and make some paleoclimatic inferences based on these faunas.

We studied eight fossil samples, mostly collected from La Chumbiada or Guerrero members of the Luján Formation, located within the limits of the Pampean region between 33° S and 39° S (Figure 1). This widely extended grassy plain is characterized by a humid-temperate to subhumid-temperate climate, without dry season (Tonni et al. 1999). Rodent remains were identified by comparison with voucher specimens deposited in museum collections. Detailed description about collecting techniques, stratigraphic relationships, and chronologies for each site were summarized by Pardiñas (1999a, b) and Tonni et al. (1999). Paleoenvironmental reconstruction was based on comparisons among fossil samples and up to 100 modern micromammal assemblages, produced by owl predation, collected through the entire region (Pardiñas 1999b).



	>28 ka	28-21	21-13
CT	Aa, Et, Gg, Lm,Ra		
PO	Aa, Csp., Lm, Ra		
AT		Et, Ra	
CN		Hb, Ra	
SCM		Ra	
PH		Ra, Csp.	
QS-IR			Aa, Et, Ra
RR			Gg, Ra

Figure 1. **A,** Pampean region of Argentina, showing study localities. CT, Cueva del Tigre; PO, Paso Otero; AT, Arroyo Tapalqué; CN, Camet Norte; SCM, Santa Clara del Mar; PH, Punta Hermengo; QS-IR, Quequén Salado-Indio Rico; RR, Río de la Reconquista). **B**, chronology and species composition of each sample.

Most of the studied samples are dominated by *Reithrodon auritus*, a sigmodontine rodent that mainly occupied herbaceous and shrubby steppes under temperate to semiarid conditions. Fossil assemblages ca. 28,000–13,000 RCYBP are a mixture of typical temperate-grassland species, such as *Akodon azarae*, with representatives of more arid shrubby environments, such as

Eligmodontia typus or *Graomys griseoflavus*. The latter species, together with the low diversity values recorded, may reflect lower temperatures and precipitations related to the Last Glacial Maximum (LGM, 22,000–18,000 RCYBP) than today, as well as an increment of land surface. These cooler conditions were perhaps responsible for the disappearance of *Lundomys molitor* from central Argentina. *L. molitor* is a marsh rat restricted today to temperate and subtropical regions between 20° S and 35° S in Uruguay and southern Brazil, and was last recorded in the Pampean deposits around 30,000 RCYBP (Teta and Pardiñas 2006). A second regional extinction event occurred after 18,000 RCYBP, with extirpations of *Eligmodontia* and *Graomys* from a large portion of the Pampean region, probably as a result of better climatic conditions during postglacial times. This amelioration is also evident from the late-Pleistocene/early-Holocene assemblages (e.g., Cueva Tixi, Arroyo Seco site 2) with higher sigmodontine richness (Pardiñas 1999a).

Summarizing, Lujanian (34,000–13,000 RCYBP) micromammalian communities from the Pampean region of Argentina are typified by an impoverished pool of sigmodontine species. However, contrasting with those of the late Holocene, Lujanian assemblages cannot be ascribed as no-analog assemblages. The latter argue against abrupt or dramatic climate deterioration claimed by some authors (Tonni et al. 1999:268) and seem to be more in line with gradual environmental changes. In spite of the assumption of gradual environmental change, our knowledge about late-Pleistocene small-mammal assemblages is still very scarce. Multiple taphonomic biases could be responsible for the observed biological signatures. Therefore, new and detailed field work, including screen washing, at available geological exposures is much needed.

We thank CONICET for economic support.

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New Pleistocene Localities with *Cuvieronius* (Mammalia: Gomphotheriidae) Remains in the State of Veracruz, México

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➤ **Keywords**: Gomphotheres, late Pleistocene, Veracruz

The bunodont gomphothere *Cuvieronius* is endemic to the New World. It had a wide distribution, from the south of the U.S. to the south of Chile (Casamiquela et al. 1996; Kurtén and Anderson 1980). In Mexico the record of this genus is extensive; it has been found in the states of Sonora, Chihuahua, Colima, San Luis Potosí, Jalisco, Guerrero, Estado de México, Puebla, Morelia, Aguascalientes, Oaxaca, Michoacán, Yucatán, Chiapas, and Veracruz (Alberdi and Corona 2005, Arroyo-Cabrales et al. 2007). In Veracruz only three records had ever been reported, in the localities of Papantla, Tecolutla, and Acultzingo (Pichardo del Barrio 1960, Silva-Bárcenas 1969, Wilkkerson 1975). However, in recent years new records of the gomphothere *Cuvieronius* have been added to the State of Veracruz from 10 localities: Atoyac, Ixtaczoquitlán, Acayucan, Alvarado, San Andrés Tuxtla, Catemaco, Isla, Nogales, Maltrata, and Actopan (Figure 1). In all localities outcrop fluvial sediments formed by sand, sandy clay, and clay, and only on the Maltrata and Atoyac localities is observed volcanic ash not yet dated.

In the locality of Maltrata, *Cuvieronius* has been found in association with *Mammuthus columbi*, *Eremotherium laurillardi*, *Equus conversidens*, and *Bison* remains (Serrano and Lira 2005). In the locality of Atoyac, *Cuvieronius* has been found in association with *Eremotherium laurillardi, Trachemys scripta, Claudius angustatus*, and *Crocodylus* sp. In both localities a Rancholabrean age is assigned to the faunal association. In the rest of the localities only *Cuvieronius* remains have been found, and the age assigned is only Pleistocene owing to the absence of potential indicators such as index taxa, stratigraphy, and radiometric data.

Isolated molars were recovered at Atoyac, Actopan, Alvarado, San Andrés Tuxtla, Catemaco, Isla, Nogales, and Maltrata. At Acayucan one lower jaw with both m2 and m3 was recovered; at Ixtaczoquitlán incomplete upper tusk appendicular elements and isolated vertebrae were recovered. The molars show the typical morphology of the genus; they have 4–4.5 lophs/lophids and usually have relatively simple crowns in which there is a trefoil on the pretrite cusps/cuspids but no trefoil on the posttrite cusps/cuspids. The upper tusks

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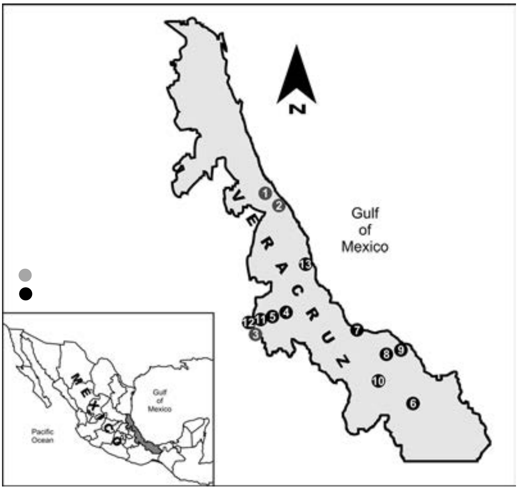

Figure 1. Map showing the distribution of *Cuvieronius* in the State of Veracruz.

collected on Ixtaczoquitlán have the spiral enamel band typical in *Cuvieronius.* The morphology of the molars and upper tusk identifies them as *Cuvieronius hyodon.* The fossil material of gomphotheres from the new localities in Veracruz is housed in private and institutional collections.

These findings provide a glimpse of the ecological context of these organisms in the State of Veracruz. In North America, *Cuvieronius* was a mixed-feeder genus with Neotropical distribution and generally is associated with open-woodland habitats as well as tropical lowland habitats farther to the south (Graham 2001). The presence of *Cuvieronius* and associated fauna in Veracruz might indicate habitats similar to those proposed for other areas of North America.

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Carbon Isotopic Values of Tooth Enamel of *Mammuthus columbi* from Tocuila, State of México, México

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➤ **Keywords**: México, Pleistocene mammals, stable isotopes

The late-Pleistocene paleontological locality at Tocuila in central México (State of México, 19° 31′ N, 98° 54′ W, 2,240 masl), has been the target of many interdisciplinary studies. Research has focused on the history of the deposit, as well as ecological studies of the species found at the locality and the probability of human association (Morett et al., 1998). The Tocuila fauna is composed of remains of Columbian mammoth (*Mammuthus columbi*), bison (*Bison* sp.), camel (*Camelops hesternus*), horses (*Equus* sp.), a large felid, hare (*Lepus* sp.), and Mexican vole (*Microtus mexicanus*). These remains were found in a fluvial deposit mainly composed of volcanic ash. It is probably an ancient lahar and has an average AMS age of 11,188 ± 76 RCYBP (Arroyo-Cabrales et al. 2002). Above the lahar deposits, on top of an indurated carbonate layer, there

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are lake sediments containing remains of fish, aquatic birds, and turtles.

Mammoth remains are the most abundant in the deposit, with as many as five individuals. They may have been grazers, according to inferences from morphological features (McDonald and Pelikan 2006). However, previous studies using biogeochemical analyses of Columbian mammoth specimens from El Cedral and Laguna de las Cruces (San Luis Potosí, north-central México) showed that this species had a mixed C_3/C_4 diet (Pérez-Crespo 2007; Pérez-Crespo et al. 2009). Our study objective was to evaluate mammoth feeding behavior using samples from Tocuila. Enamel samples for the five individuals were assayed for $\delta^{13}C$ composition, following Pérez-Crespo et al. (2009). The values obtained for isotopic carbon are expressed relative to the VPDB standard; estimates of the percentage of C_4 plants eaten ($\%C_4$) are calculated following Koch et al. (2004). The $\delta^{13}C$ values were compared with those for specimens from San Luis Potosí (Pérez-Crespo 2007; Pérez-Crespo et al. 2009) using the Mann-Whitney test (Hammer and Harper 2006). Statistical analyses were performed with the program NCCS and PASS (Hintze 2004); probability level was $p < 0.05$. Specimens are housed in the Paleontological Collection, Archaeolozoology Lab, National Institute of Anthropology and History; these specimens are uncatalogued, and the acronym TC was assigned (Table 1).

Table 1. Values of $\delta^{13}C$ obtained for enamel of *Mammuthus columbi* from Tocuila, México.

Sample	$\delta^{13}C_{VPDB}$ (‰)	C_4 (%)	Sample	$\delta^{13}C_{VPDB}$ (‰)	C_4 (%)
TC1	-3.9	57.1	TC4	-4.4	54
TC2	-3.5	59.8	TC5	-5.1	49.1
TC3	-1.3	74.3			

The values for C_4 (%) were obtained using the formula:

$$(100)\delta^{13}C_{sample} = (100\text{-}x)\delta^{13}C_{100\%\ C3\ enamel} + (X)\delta^{13}C_{100\%\ C4\ enamel}$$

The value for $\delta^{13}C_{100\%\ C3\ enamel}$ is -12.5‰

The value for $\delta^{13}C_{100\%\ C4\ enamel}$ is 2.5‰

These values are estimates for the late Pleistocene (after Koch et al. 2004; Koch 2007).

The results obtained show an average value of -3.67‰, with values ranging from -1.35‰ to -5.14‰. Comparisons between Tocuila and specimens from San Luis Potosí did not show any significant difference between mammoth groups (U: 17.5, d.f. 9, p< 0.87). On average, the Tocuila mammoth population had a mixed C_3/C_4 diet, with 58.9% C_4 plants. One individual was a dedicated grazer ($\%C_4$: 74.3%); four individuals were C_3/C_4 mixed feeders, including an individual that consumed more C_3 plants ($\%C_4$: 49.1%); and three individuals consumed more C_4 plants (Table 1). It is possible that those individuals had eaten aquatic plants, as well as leaves and bushes growing on the margins of the Texcoco Lake, which spread close to Tocuila during the late Pleistocene (Arroyo-Cabrales et al. 2002); such a behavior is known presently for African elephants. This feeding behavior is similar to that found in San Luis Potosi mammoths; this species in México was more of a generalist feeder than a specialist feeder.

Isotope analyses were carried out by F. J. Otero and R. Puente M. at the University Laboratory Isotope

Geochemistry (LUGIS), Institute of Geology, *Universidad Nacional Autonóma de México*. We thank Becket Lailson and Vance Holliday for their review of an earlier version of this manuscript.

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Quantifying Domestication: A Preliminary Look at the Variation in Skull Morphology between Wild Canids and the Domestic Dog

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➤ **Keywords**: *Canis*, domestication, morphology

Recognition of domestic dogs in an archaeological context is important to faunal interpretation, as well as to evaluating species utilization by various

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human populations. However, archaeologists have struggled for decades with the problem of determining whether canid remains at a site represent an early "dog" or a local wild species (Olsen 1985). While observable differences were noted in previous studies, there is a lack of quantifiable characteristics that distinguish wild canid skulls from those of domestic dogs. Typically, changes such as a reduction in overall skull size, shortening of the facial region of the cranium, and crowding of the teeth were reported (Morey 1992). Numerous sets of remains from various archaeological sites have been identified as either domestic dog or wild species by these or similar characteristics (Beebe 1980; Olsen 1976). Although these changes are usually observable on complete skulls, how they affect the rest of the skull is rarely recognized or considered.

Consequently we seek to utilize a landmark-based approach to quantify the total change in skull morphology associated with domestication. Wild species included in the analyses are: gray wolf (*Canis lupus*), coyote (*Canis latrans*), and red wolf (*Canis rufus*). All three wild species were utilized due to their close proximity to early human settlements and the likelihood of their being recovered in an archaeological context. Moreover, the phylogeny of domestic dogs is still controversial because of difficulty in determining specifically which canid species was the ancestral line. Therefore several statistical analyses were compiled to analyze the overall shape change within a "wild" skull, including a discriminant analysis, stepwise discriminant analysis, and a thin plate spline. With our preliminary results, only one of the initial thin plate splines warrants reporting. Specifically, this thin plate spline (Figure 1) illustrates a visual representation of modifications occurring between "wild" and domestic canids. Due to similar morphology of the wild canids and the degree of ancestral uncertainty mentioned above, all three species were utilized to create a "wild" consensus for direct comparison with that of the domestic sample. Results from this and subsequent splines will aid in evaluating the landmarks utilized.

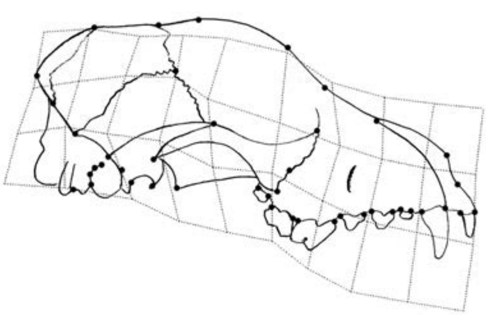

Figure 1. Thin plate spline (lateral view) showing the deformation of the consensus "wild" skull necessary to achieve a domestic morphology. If the landmarks (dots) were spaced equally between taxa, the grid would consist of symmetrical and aligned squares. Hence the degree and direction of morphologic change is clearly more complicated than previously suggested.

Major changes highlighted by the spline are expansion of the orbital region and a downward shift and compression of the rostrum. These two traits are most likely linked because the expansion of the orbit alters the angle and size of the frontal bone, resulting in the "shortened facial region." There is also a slight compression of the braincase, accompanied by the upward shift of this region of the skull. The combination of the downward movement of the rostrum and facial region, along with the upward movement of the orbit and braincase, gives the domestic dog a unique morphology that is markedly different from wild species. Though these results are preliminary, they still provide unique insight into cranial modifications that result from domestication. They also demonstrate that understanding large-scale changes in one portion of the skull may aid in identifying partial remains.

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Errata

1.

In Figure 1 of the article by Akira Iwase, **"Use-Wear Analysis of Sugikubo-type Points from the Uenohara site in Central Japan,"** we inadvertently deleted the portion of the legend that defines the range of striation. Following is Iwase's article with the corrected figure.

Use-Wear Analysis of Sugikubo-type Points from the Uenohara site in Central Japan

Akira Iwase

➤ **Keywords**: Use-wear analysis, Last Glacial Maximum, Japanese Archipelago

To understand the peopling of the Americas, archaeological evidence from northeast Asia around the time of the last glacial maximum (LGM) is worthy of note (e.g., Goebel 1999; Graf 2009; Madsen 2004). Graf (2009), for example, indicated that after the depopulation in Siberia at the LGM, a recolonization of the region originated from the maritime eastern Asia including Japan. Therefore investigating the technologies of the hunter-gatherers for adaptation to the temperate forests of the Japanese Archipelago, which differed from the cold and arid environments of the higher latitude of Asia, will contribute not only to understanding the reentering of Siberia, but also the peopling of the New World.

To be based on the above propositions, this paper reports results of a use-wear analysis of Sugikubo-type points of the Sugikubo blade industry from excavation 2 of the Uenohara site, Nagano Prefecture, central Japan (36° 48′ 46″ N, 138° 11′ 57″ E). This locality lies 600 m from excavation 5 (Iwase and Morisaki 2008; Nakamura et al. 2008). A total of 5,313 artifacts were recovered from excavation 2, from an area of about 1800 m^2. Uenohara locality 2 is a multicomponent Paleolithic site. Although separating the Sugikubo blade industry from other components by spatial distribution is difficult, it is easy to distinguish Sugikubo-type points and Kamiyama-type burins, which characterize this blade industry, by their techno-typological characteristics. The lithic industry contains various raw materials such as hard shale, tuff, andesite, and obsidian for manufacturing Sugikubo-type points (Nakamura and Iwase 2008).

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The Sugikubo industry dates to roughly 20,000–18,000 RCYBP in north-central Japan. The Sugikubo-type point has a tip formed by abrupt retouch and a pointed base formed by flat retouch on the ventral side. Both lateral edges are usually unretouched (Figure 1A–B). These points are considered to be chiefly used as spear heads; however, little analysis has been done to investigate their functions.

The use-wear analysis of Sugikubo-type points presented here followed the high-power approach developed by Keeley (1980). A digital microscope (KEYENCE VHX) was used, and identifications were made following Midoshima (1986), a reference of use-wear types on obsidian artifacts.

From a total of 20 Sugikubo-type points, 11 obsidian artifacts were sampled for analysis. Seven specimens showed traces of use. Six representative photographs of use-wear are shown in Figure 1. Specimen G5-250 (Figure 1A) shows remarkable striations accompanied by well-developed abrasion on both lateral edges. The striations running parallel to each working edge are formed both on the ventral and dorsal faces (Figure 1C, E). At the halfway point along the left margin (with the piece oriented tip up and base down, and dorsal face visible), the striations extend obliquely to the working edge on the ventral face (Figure 1D). The directions of striation suggest that this artifact was used for cutting or sawing and whittling. Although polish was not recognized, the marked abrasion suggests that these traces were formed by contact with a soft material such as meat or hide. The striations on the base suggest that this artifact was used without being hafted (Figure 1E). Specimen E3-13 is the tip of a Sugikubo-type point. On the right margin, microscars and striations running parallel to the working edge were observed both on the ventral and dorsal faces (Figure 1G, H). Polish was not recognized. Figure 1F shows a burin-like spall that could be described as an "impact fracture" (e.g., Bergman and Newcomer 1983) from the very tip of the piece. The striation and burin-like fracture indicate that this artifact was used not only as a spear head but also as a knife. Three other specimens also show the striations along working edges; two others have burin-like spalls.

The use-wear traces described above suggest that Sugikubo-type points had at least two functions, as spear head and knife. The impact fracture and striation also indicate that some were used successively in hunting and butchering activities. Similarly to the Kamiyama-type burin (Iwase and Morisaki 2008), this multifunctionality of Sugikubo-type point also shows the Sugikubo industry is another phenotype of Mode-4 blade industries (Clark 1977). The hunter-gatherers probably developed these versatile tools to be adapted to the temperate forests of central Japan.

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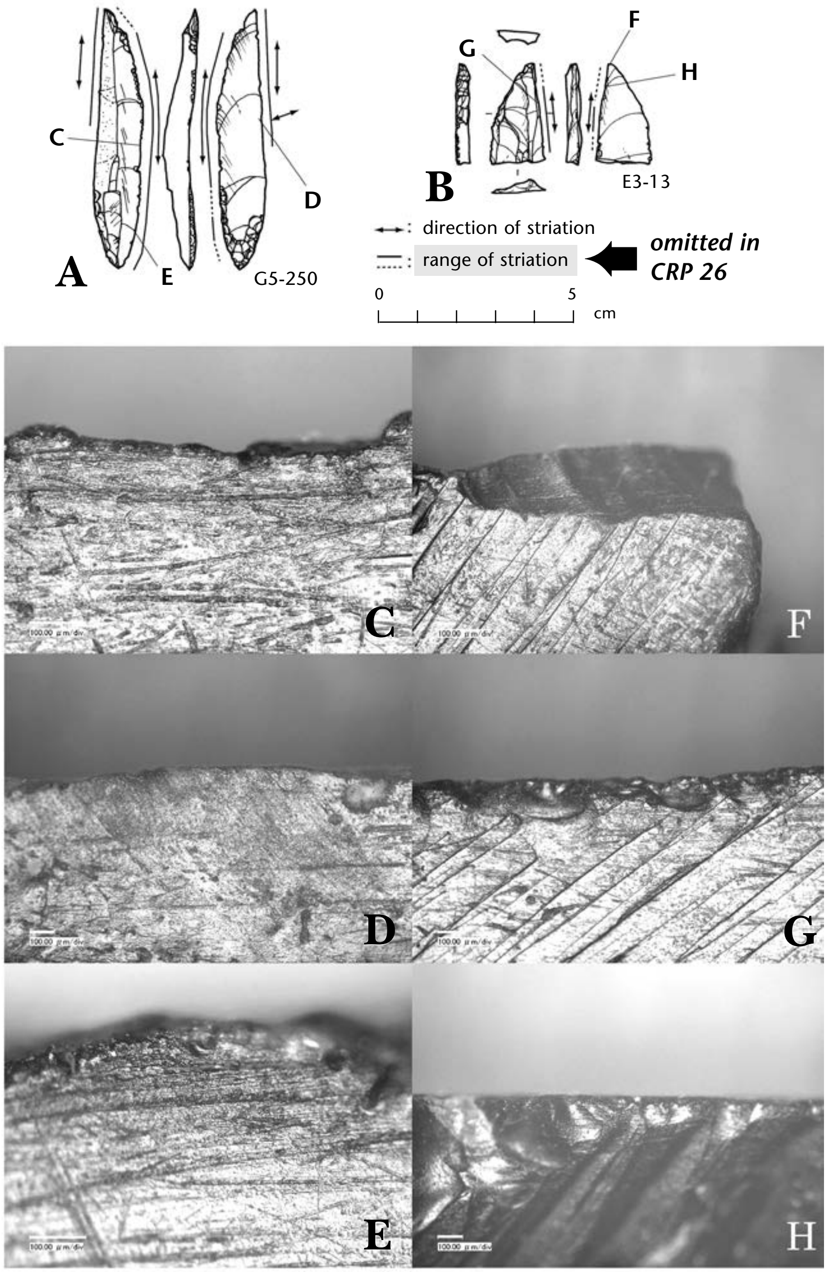

Figure 1. **A–B,** Sugikubo-type points; **C–H,** microscopic traces of use wear on the points. Letters in upper illustrations correspond to lower photographs.

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2.

In the article by Michael F. Rondeau and John W. Dougherty, **"The Twain Harte Fluted Point, Tuolumne County, California,"** the fluted point is mistakenly described as 43.54 mm long. Its actual length is 143.54 mm. Following is Rondeau and Dougherty's corrected article.

The Twain Harte Fluted Point, Tuolumne County, California

Michael F. Rondeau and John W. Dougherty

➤ **Keywords**: Fluted point, Mt. Hicks obsidian, California

In 1978 a fluted point was recovered near Twain Harte in Tuolumne County, California. The Twain Harte specimen is the first fluted point identified of Mt. Hicks obsidian (Hughes 2008), a source located in the Great Basin roughly 75 air miles from the find spot, beyond the crest of the Sierra Nevada to the east. This point is also the largest of seven found to date in the Sierra Nevada Mountains (Figure 1) and the second from a buried context. **It is 143.54 mm long,** 37.65 mm wide, 11.29 mm thick, has a basal depth of 6.83 mm, and weighs

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58.0 g. Pronounced flute scars are present on both faces, its base is concave, and edge grinding is present on both lateral margins and the basal edge. No flute scratching is present on either face. A small impact scar runs from the tip on one face, and one basal ear is missing. Obsidian hydration analyses produced average band-width readings of 6.4 μ (Origer 2008), 7.28 μ, 7.30 μ, and 7.34 μ (Carpenter 2009). However, these band widths appear to be too late in time, since Mt. Hicks artifacts have been found with readings of 10 μ band width (C. Skinner pers. comm. 2009). Specifically, some Great Basin Stemmed Series projectile points, generally thought to be later in time than fluted points, also show readings in the 10 μ range (J. Rosenthal pers. comm. 2009).

Found at an elevation of approximately 1,188 m, the fluted point was recovered from an approximate depth of 30 cm below ground surface during posthole excavation. It was broken in half at that time by a shovel strike. The find spot is located between an uphill spring and low bluffs that overlook a wetland. Ponderosa pine (*Pinus ponderosa*) is the dominant overstory. A visit to the find spot resulted in nothing that clearly signaled a prehistoric site in the area.

Maximum width, thickness, distal limits of edge grinding on both lateral margins, and the termination of the longer flute scar suggest a Clovis-like form (Rondeau 2009), although the relatively narrow obsidian-hydration band-width readings may suggest a later affiliation. The study of this specimen adds important information to a limited database on fluted points for the Sierra Nevada.

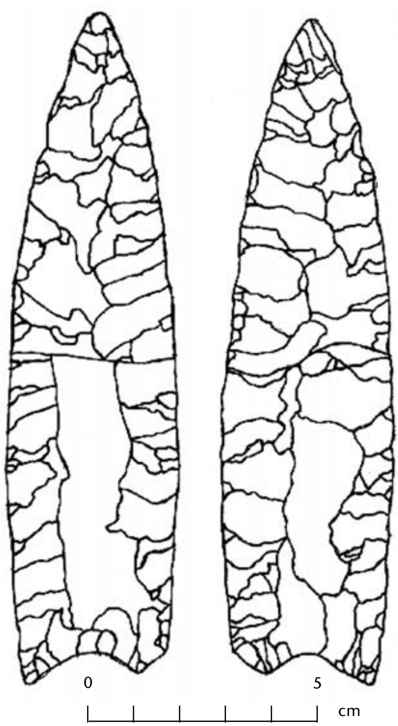

Figure 1. The Twain Harte fluted point.

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