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A Peopling of the Americas Publication

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ROBSON BONNICHSEN 1940–2004

Founder and Director, Center for the Study of the First Americans

Robson (Rob) Bonnichsen was born in Twin Falls, Idaho. While growing up in Idaho, he became enamored with prehistoric artifacts that he would find on his family's farm and during family outings. This ignited Rob's passion for archaeology that led him to earn a B.A. in anthropology from Idaho State University in 1965 and a Ph.D. from the University of Alberta in 1974. After his graduation, Rob took a position as an Assistant Professor at the University of Maine, where he established the Center for the Study of the First Americans in 1981. In 1991, he moved the Center to Oregon State University, where he taught for eleven years. In 2002, Rob moved the Center to Texas A&M University, where he was Director and Professor of Anthropology.



He was the holder of the Center for the Study of the First Americans Chair in Liberal Arts. Rob founded the *Mammoth Trumpet* (the quarterly newsletter of the **Center**) and *Current Research in the Pleistocene* (the **Center**'s annual journal). He shepherded 14 **Center** books to completion, wrote numerous articles, and made many public presentations. During his nearly four-decade-long career, Rob worked at numerous early archaeological sites all over the Americas.

Rob Bonnichsen was a unique individual. He was a pioneer and leader in the field of first American studies. His research and ability to synthesize diverse aspects of the field brought forth new ideas and ways of thinking about the past. Rob was also committed to sharing the story of the first Americans and the excitement associated with the quest for this knowledge with the public. Rob enjoyed working with students. He felt that it was important to train new researchers who could make new discoveries about the earliest inhabitants of the Americas. Rob was also a fighter who advocated for the rights of all archaeologists to pursue their research into the past. Rob was a guiding light in the study of the first Americans, and his absence is a great loss to the field. We will miss our friend and colleague.

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From the Editor

For more than 20 years now, *Current Research in the Pleistocene* has maintained its reputation as a peer-reviewed serial broadcasting new research results to an international audience of Quaternary scientists. We at the Center for the Study of the First Americans are pleased to present Volume 21 of the journal, which contains 51 papers covering the fields of archaeology, paleontology, paleobotany, geosciences, and physical anthropology. For their help in the reviewing of these papers, special thanks are due to our review board, including David Anderson, Luis Borrero, Daniel Fisher, Gary Haynes, Bradley Lepper, Francisco Mena, Paul Sciulli, Linda Shane, Sergei Slobodin, and Thomas Stafford.

Starting with Volume 22, we will renew the "Special Focus" section of *CRP* by soliciting a set of papers following the theme "Paleolithic Humans of the Siberian Mammoth-Steppe." Specifically we are looking for papers that present new information on the paleoecology, archaeology, and physical anthropology of northern Asia during full glacial times, 30,000–10,000 RCYBP. For Volume 23, the Special Focus section will be "New Developments in the Paleolithic of Japan." We are soliciting manuscripts that present new research results as well as reappraisals of previously investigated archaeological sites (in light of the recent Fujimura scandal). Although we are primarily interested in receiving manuscripts dealing with lower- and middle-Paleolithic archaeology, papers on the upper Paleolithic will also be considered for publication. Authors wishing to contribute a manuscript to Volume 23's Special Focus section should contact the *CRP* Editor (**goebel@unr.edu**) by November 15, 2005.

Also starting with Volume 22, *CRP* is moving toward an electronic manuscript-review process, in order to expedite review and production of the journal. We ask that authors submit manuscripts and supporting documents via e-mail to the following address: **csfa@tamu.edu** We prefer that manuscripts be in Microsoft Word or WordPerfect format for PC; Macintosh files should be saved so that they can be imported into one of these wordprocessing programs. Tables should be similarly submitted, while figures should be submitted in .jpg or .tif format. Please visit the *CRP* Web site at **http://www.centerfirstamericans.com**// for more information.

Ted Goebel

Archaeology-Eurasia

Studenoe 2: An Update

Ian Buvit, Karisa Terry, Aleksander V. Konstantinov, and Mikhail V. Konstantinov

Here we present new data from Studenoe 2, a multicomponent Paleolithic site in the Transbaikal Region, Russia (50°4′ N, 108°13′ E). The site is situated in sediments underlying the second terrace (T2) of the Chikoi River (Figure 1). Two publications in English (Buvit et al. 2003; Goebel et al. 2000) discuss previous archaeological and geoarchaeological studies of the site in detail.

Between 1998 and 2000, Russian archaeologists discovered four new cultural layers underlying cultural layer 5, which dates to $17,165 \pm 115$ RCYBP (Figure 1). From youngest to oldest, these are labeled 6, 7/1, 7/2, and 8 (Konstantinov 2001). In 2000, Russian archaeologists completed excavation of a Paleolithic dwelling in cultural layer 4/5. It is now apparent that six internal hearth features exist (Konstantinov 2001). Wedge-shaped core and microblade technology are found in cultural layers 4/5, 5, and 6, as well as flake and bone tools (Goebel et al. 2000; Konstantinov et al. 2003). Isolated faunal remains compose cultural layers 7/1 and 7/2. No unequivocal artifacts are associated with the animal bones in cultural layers 7/1 and 7/2. Cultural layer 8 consists of a dwelling feature associated with a scraper, flakes, bone fragments, and a bison tooth, but no evidence of microblade technology (Konstantinov et al. 2003).

Five new AMS ages, first reported in Konstantinov (2001), were obtained from hearth charcoal in cultural layer 4/5 (Figure 1). Many of the ages from this layer appear discordant. It could be argued that the dwelling was occupied on numerous occasions and that radiocarbon ages from the hearths represent different times when they were utilized. This seems unlikely since the range of the uncalibrated ages is greater than 4,000 years. If the surface were stable for this long, one would expect to see evidence of soil development. This is not the case. The reason for discrepancies in the ages from cultural layer 4/5 is unknown. The sixth new date $(20,620 \pm 90 \text{ RCYBP})$ (CAMS-90971) was obtained from a bison tooth in cultural layer 8. This age indicates vertical accretion of sediments underlying T2 began no earlier than ca. 20,500 RCYBP.

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Figure 1. Representative stratigraphic profile of Studenoe 2.

Goebel et al. (2000) suggest that microblade technology appeared in the Transbaikal between ca. 17,000 and 18,000 RCYBP. Dates of 17,165 \pm 115 RCYBP from cultural layer 5 and 20,620 \pm 90 RCYBP from cultural layer 8 bracket cultural layer 6 and its associated wedge-shaped core. This may indicate that microblade technology appeared in the Transbaikal somewhat earlier than Goebel et al. (2000) argue.

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On the Path of Upper-Paleolithic Obsidians in the Russian Far East

J. Christopher Gillam and Andrei V. Tabarev

Sometime after 20,000 CALYBP, hunter-gatherers established themselves in the river valleys of the interior rolling mountains and coastal zone of the Maritime Region in the Russian Far East (Kuzmin 1995, 2002; Vasil'ev et al. 2002). Organized in small bands, they were likely mobile populations in warm months moving between the coastal and mountain zones and focusing their way of life on the region's numerous river systems. Land mammals, seasonal salmon runs, and vegetation in the river valleys offered abundant resources on a seasonal basis.

In addition to abundant flora and fauna, obsidian sources along the gravel bars of mountain streams provided an expedient, high-quality lithic resource for the production of stone tools. These small obsidian cobbles were commonly modified using bipolar reduction and the use of wedge-shaped microblade cores (Tabarev 1998). The lithic technology of the region consisted of wedge-shaped microblade cores, conical blade cores, burins, scrapers, and simple bifaces. Recent geochemical analyses of obsidians from out-

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Archaeology—Eurasia

crops and archaeological samples revealed that long-distance trade or movement of these obsidians was common amongst prehistoric populations (Kuzmin et al. 1999, 2002a, 2002b).

A Geographic Information System (GIS) can be used to physically connect the occupation sites and obsidian sources across the landscape, highlighting potential paths of migration, interaction, and exchange throughout the region (e.g., Anderson and Gillam 2000). Using published archaeological data and U.S. Geological Survey (USGS) ETOPO30 digital elevation data for the Russian Far East we have begun to model potential movement corridors using least-cost paths analyses. The ETOPO30 dataset is a global 30-arc-second digital elevation model (DEM) with an approximate grid cell resolution of 1 km. This DEM is used to derive slope values for each grid cell in the study area; these are in turn used to generate a friction surface for the least-cost-paths analyses. The paths are generated using a 3-by-3 roving window technique with the obsidian source as the starting cell and occupation sites as the destination cells.

Preliminary analyses illustrate potential corridors of movement from obsidian sources to occupation sites throughout the region. The map illustrates paths from the Illistaya River obsidian source to known archaeological sites in the Maritime Region (Figure 1); similar paths have been modeled for each of the sources illustrated in the map. The paths demonstrate the most likely corridors of movement, highlighting the importance of the coastal zone, river valleys, and mountain passes to terrestrial movement, and emphasizing the potential interaction and exchange networks active in the region during the upper Paleolithic.

Combining results of the least-cost-paths analyses from the remaining obsid-



Figure 1. Paths from the Illistaya River obsidian source to Upper Paleolithic habitation sites.

ian sources, non-obsidian lithic sources, and other resource patches provides a unique predictive modeling tool for discovering new upper-Paleolithic sites. The discovery of new sites in the region is critical to furthering our knowledge of these Pleistocene peoples. Likewise, hypotheses regarding the peopling of the Americas can only be tested with empirical data, and the Russian Far East still holds great potential as a staging ground for ancient migrations to the New World. A greater understanding of regional migration, interaction, and exchange networks in the Far East will yield valuable insights into those processes at grander scales.

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Chronology of the Upper-Paleolithic Site Studenoe 2 (Transbaikal, Siberia): Case Study of the Multi-hearth Dwelling in Horizon 4/5

Yaroslav V. Kuzmin, A. J. Timothy Jull, and Irina I. Razgildeeva

Excavations of a unique multi-hearth surface dwelling in horizon 4/5 of the Studenoe 2 site in southern Transbaikal region (50° 10' N; 108° 29' E) (Konstantinov 2001) in 1996–99 (Figure 1) allowed us to obtain chronometric data for five of six hearths. Horizon 4/5 of Studenoe 2 is located at a depth of 2.6–2.7 m, in the middle part of alluvial sediments that constitute the second terrace of the Chikoi River (surface elevation is 9 m above the water level). Remains of six hearths, spots enriched with charcoal-ash substance, groups of stones, stone and bone artifacts, and animal bones were found in dwelling (Figure 1). Artifacts in the dwelling are represented by about 2,000 stone items including 7 cores (mainly wedge-shaped), 238 microblades, 12 bone tools, and 15 beads made of rhyolite and ostrich eggshells. Faunal remains belong mainly to brown bear (*Ursus arctos*), red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*), with minor proportions of *Ovis* sp., *Bos* sp., *Bison* sp., and *Poephagus* sp.

In 2000, we obtained five new charcoal ¹⁴C dates for the dwelling in horizon



Figure 1. Spatial structure of the dwelling in horizon 4/5 of the Studenoe 2 site (grid length is 1 m), with position of hearths (numbered in bold), ¹⁴C-dated samples, stones, main artifacts (c, core; t, tool; b, bone), large bone fragments; and charcoal-enriched areas (shown as spotted space) (after Konstantinov 2001).

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4/5 collected in 1999 (Figure 1), and here present their interpretation. Calibration of these dates was made with the help of CALIB rev. 4.3 software (Stuiver et al. 1998). Hearth 1 gave an age of $16,950 \pm 180$ RCYBP (AA-37962), or 20,950–19,450 CALYBP. Hearth 2 is dated to $17,840 \pm 110$ RCYBP (AA-37963), or 21,930–20,520 CALYBP. Hearth 4 yielded an age of $17,550 \pm 90$ RCYBP (AA-37964), or 21,570–20,210 CALYBP. Hearth 5 returned an age of $16,215 \pm 80$ RCYBP (AA-37965), or 19,990–18,740 CALYBP. Finally, the ¹⁴C date of hearth 6 is 14,485 ± 75 RCYBP (AA-37966), or 17,900–16,850 CALYBP.

Previously (Goebel et al. 2000), two charcoal ¹⁴C dates were obtained for hearth 1, 17,885 ± 120 RCYBP (AA-23653), or 21,990–20,570 CALYBP; and for hearth 2, 17,225 ± 115 RCYBP (AA-23655), or 21,200–19,830 CALYBP. Also, a bone date of 18,830 ± 300 RCYBP (AA-26739), or 23,370–21,400 CALYBP, was obtained near hearth 1.

Two calendar ages for hearth 1 are intercepted with ± 2 sigma and can be averaged (Long and Rippeteau 1974); the mean age is 21,590–20,220 CALYBP. For hearth 2, the mean age is 21,650–20,310 CALYBP. Hearths 1 and 2 coexisted with hearth 4 dated to 21,570–20,210 CALYBP. Hearths 5 and 6 were respectively in use about 1,700 and about 3,600 calendar years after hearths 1, 2, and 4. Spatial reconstruction of the occupation complex gives us a double-hearth (No. 1 and 2) dwelling and adjacent household area with two other hearths (No. 3 and 4), and a separate living structure in the northern part with two hearths (No. 5 and 6).

Thus, the six-hearth dwelling in horizon 4/5 is a complex structure which existed for about 3,600 calendar years, from about 21,000 CALYBP until about 17,400 CALYBP, with at least two periods of abandonment at about 21,000–19,300 CALYBP and about 19,300–17,400 CALYBP. The main part of the dwelling was occupied at about 18,800–17,200 RCYBP, during the Last Glacial Maximum (LGM), and this is contrary to the opinion of Goebel et al. (2000:574) about the dwelling occupation *after* the LGM. The ¹⁴C value of 18,830 ± 300 RCYBP obtained on a bone fragment near hearth 1 after calibration does not contradict calendar mean values for hearths 1 and 2. Thus, it may be accepted as an age determination of the horizon 4/5; previously it was rejected (Goebel et al. 2000:572).

This study was partially supported by grants from U.S. NSF (EAR97-30699 and EAR01-15488). We are grateful to Prof. A. V. Konstantinov for supplying us with samples for dating.

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Archaeology—Latin America

Recent Excavations in the Cueva Encantada, Chimalacatlán, Morelos, México

Joaquín Arroyo-Cabrales, Eduardo Corona-M., Oscar J. Polaco, José Alberto Cruz Silva, Mario Córdova, Gisselle Canto, and Oscar Basante

Fossil deposits in caves are important due to both the possible completeness of the faunal stratigraphical record for evolutionary and paleoecological studies, and the relationship with early human presence (Schubert et al. 2003).

One of the caves that have shown a great potential to provide a complete fossil record during the time of human appearance in México is Cueva Encantada of Chimalacatlán. This cave was discovered in 1947. Geological and archaeological excavations were undertaken, documenting the presence of proboscidean and deer remains as well as evidence of human occupation, but without stating if the occupation was contemporary with the Pleistocene fauna (Arellano and Müller 1948). This paper presents new information in regard to the cave fauna from the recent excavations of it.

The cave is located in the Municipality of Tlalquitenango, in the state of Morelos, 2 km east of the town of Chimalacatlán. It has a wide horizontal entrance, and is composed of a large 100-by-20-m main room and several small passages.

After the 1947 excavations, the cave was not accessible. The local people used it to obtain potable water from a spring inside the cave, and they did not want the spring to become dirty or contaminated by further excavations. However, after a tube line was set directly on the spring in 2001, they again allowed excavations in the cave. When excavating for the line, several remains of fossil animals were uncovered. The local people requested the advice of local authorities and the National Institute of Anthropology and History (INAH).

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Initial study of the material led to the identification of metapodials and molars of horse (*Equus*) and deer (*Odocoileus*); molars, tusk fragments, and postcranial bones of a bundont gomphotherid, a tropical extinct proboscidean; and a posterior fragment of a large skull of a xenarthran mylodont. A few bones show marks of possible human origin, adding to the previous evidence of human occupation; further analysis is warranted. Because of that circumstance, INAH has undertaken a scientific project to evaluate the importance of this site to Mexican prehistory. Also, INAH personnel are advising the local people on organizing a small community display of the specimens recovered from the spring pipeline digging.

In 2002, initial excavations were conducted with the aim of (1) mapping the cave, (2) locating any previously dug hole, (3) setting a complete archaeological grid for the cave, and (4) verifying the stratigraphic sequence proposed by Arellano and Müller (1948). The stratigraphy was exposed through the excavation of two 2-by-2-m units, 10 m deep, one at the entrance and the other deep inside the cave. At present, the excavated materials are still under study, but initial identifications include mollusks, amphibians (*Rana, Bufo*), lizards, snakes, turtles (*Kinosternon*), birds, and mammals. The mammal list currently is composed of opossums (*Didelphis, Marmosa*), bats (*Artibeus, Myotis*), xenarthrans (*Paramylodon, Tamandua, Dasypus*), carnivores (*Nasua* cf. *Puma*), perissodactyls (*Equus*), artiodactyls (*Tayassu, Odocoileus*, camelid), proboscideans (cf. *Cuvieronius*), and rodents (*Reithrodontomys, Sigmodon*).

The fossil fauna is inferred to be from Pleistocene tropical biomes based on the presence of mylodont (cf. *Paramylodon harlani*) and bunodont gomphotherid (McDonald 2002; Polaco 2002). This new locality for the known distribution of the gomphotherids can be added to the recent discoveries obtained in Taxco, Guerrero (Corona-M. et al. 1999), and Nexpa, Morelos (Corona-M. et al. 2000), both in southern México. These sites are located within 50 km of Chimalacatlán.

Overall, Cueva Encantada has a unique importance because it contains a rich Pleistocene fauna possibly associated with human remains in a region characterized by the contact of the Mexican Highland and Pacific Slope biota (Arroyo-Cabrales and Polaco 2003). Few places located inside the Mexican tropical area have the potential for a complete record of the time period when earliest humans arrived in México. A detailed study of the deposit is required to discern the agents of bone accumulation through time and to refine the chronology of when those remains were deposited. Because specimens from inside the cave are in paleontological contexts, while those at the entrance may be associated with prehispanic cultures, further analyses are required to ascertain the actual association of fossil taxa with human artifacts.

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New Possible Paleoamerican Fish-tail Point Finds at Laguna Negra, Northern Peru

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South American fish-tail points found in undisturbed contexts are recognized as a hallmark of the terminal Pleistocene/early Holocene (Lavallée 2000:80– 81). Although they are found mostly in some specific regions of the southern continent, from Honduras to Argentina, they are scarce in Peru (Dillehay 2000:127). In spite of the ongoing analysis and lack of the complete report of the excavations of the Laguna Negra site, and because of their possible chronological significance and their geographical location, we report here preliminarily the first fish-tail points found in one of the highest zones above sea level in easternmost Peru.

Excavations carried out in this zone by the second senior author between October and November 2003 have unearthed at least two pieces related to the

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Paleoindian fish-tail point technology (Figure 1A, 1B) within a level (called 2B) composed of 225 lithic artifacts, as a whole, at the Laguna Negra rockshelter, Alto Chicama, Northern Highland of Peru.



Figure 1. Lithic artifacts from Laguna Negra rockshelter:1A, fish-tail point;1B, preform of fish-tail point.

The rockshelter is about 3.8 m long and 1.6 m wide, and located specifically at 80° 71′ 27″ W, 9° 12′ 14″ S, upstream of the Shuyuhual River (confluence of the Marañon Basin) at about 3,775 m above sea level. At least two anthropogenic levels are recorded, namely 1A and 2B. Radiocarbon samples were impossible to find because of the occurrence of some taphonomic problems originating from natural factors. Taking into account similar Paleoindian artifacts in South America, we assume the high probability that these artifacts date to the early Holocene (at least between ca. 11,000–8000 RCYBP).

The fish-tail point is 5.5 cm long, 3.8 cm wide and 0.6 cm thick (Figure 1A). Its outline is atypical, compared with similar finds in southern South America (Lavallée 2000:81, Figure 11). Its shape is different from similar finds found in Peru (Briceño 1999; Chauchat and Briceño 1998; Chauchat and Zevallos-Quiñones 1979; Ossa 1976), but similar to a specimen reported from Butler Island, Panama (Bird and Cooke 1977: Figures 4c, 8). Despite lacking the characteristic shape known from fish-tail points from Fell (Bird 1938), El Inga (Bell 1960, 1965; Mayer-Oakes 1986) and other sites (Politis 1991), it fits into the typological definition of fish-tail points (Bird 1969:56–57). It is made of highly crystallized red jasper, a high-quality raw material. The flat retouch indicates the possible use of soft-hammer (probably deer antler) percussion, followed by pressure retouch along some edges. At its proximal end, there is a

vertical scar, known also as fluting (Figure 1A, right). Within the assemblage there is another piece that could be recognized as an outline, (i.e., a roughout or preform) of a fish-tail point (Figure 1B). This fish-tail point preform is made of a flake removed from a core by hard-hammer percussion. In fact, its dorsal face exhibits several retouch scars and already a notch at the distal end of the flake, which indicates the beginning of the process of shaping the stem of the point. Such segments of the fish-tail point *chaîne opératoire* are poorly reported, and are important in order to shed light on one of the first lithic technologies of the South American Paleoindian period.

Laguna Negra rockshelter is the nearest southern site from the El Inga site, contributing therefore to the mapping of the fish-tail point's distribution (Morrow and Morrow 1999). In addition, the occurrence of possible fish-tail points at this high altitude is important for the understanding of the capacity of early humans adapted to this part of the Andean region.

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Ground Sloth Predation in the Northern Semiarid Region of Chile

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Mylodon sp. records in Chile have been well documented in several sites of southern Patagonia and Tierra del Fuego (Borrero 1997, 2001, 2003; Borrero et al. 1988, 1991, 1997; Massone 1987, 1996; Nami 1987; Prieto 1991, San Román et al. 2000). Anthropological and taphonomic factors have been suggested to account for the presence of this large Pleistocene herbivore in archaeological contexts (Borrero 2001). Although at first Borrero (1986) stated the possibility that humans had preyed upon *Mylodon* sp., he later postulated a more plausible scenario of human scavenging (Borrero et al. 1988). This argument is partially based on hypothesized competition between human groups and large carnivores who coexisted in the same habitat 10,000 RCYBP. It has been proposed (Borrero 2001) that the natural death of this sloth must have provided abundant meat for carnivores and scavengers, and even leftovers for humans.

Recent research at the semiarid coastal locality of Los Vilos (Choapa Province, 31°S, FONDECYT project 1030585) has allowed us to record several sites yielding extinct mammals, including *Mylodon* sp., in some cases with cultural associations (Núñez et al. 1994; Jackson 2002). While evidence of hunting is still ambiguous, indicators of animal predation and scavenging have been clearly noticed. Observed evidences are dermal bones with gastric acid corrosion, their discrete accumulation (< 80 in 1 m²) suggesting desegregated feces, the absence of other skeletal parts, punctures in cervical vertebrae, carnivore-type fractures, and significant bone dispersal. Locally, *Palaeolama* sp. and *Equus (Amerhippus)* sp. exhibit similar patterns.

The carnivore paleontological record in the area is scarce, consisting of a phalanx identified as cf. *Felis concolor* at the Quereo site (Núñez et al. 1994). Nevertheless it remains unclear whether this felid could have caused the predation and concentration of all the remains of extinct fauna in the area. In the area, carnivore marks are registered on adult animals exceeding 500 kg (*Equus [A.]* sp. and *Palaeolama* sp.). A phalanx with digestive acid traces and punctures on a cervical vertebra were observed among the *Palaeolama* remains at the El Membrillo site. In the case of *Mylodon* sp., evidence of predation was recorded in juvenile animals, although age distinctions are difficult to establish based exclusively on dermal bones. In relation to other possible carnivores, the canid record (*Dusicyon* sp.) in the lowest level of Quereo (Núñez et al. 1994), given its small size, does not appear related to taphonomic evidences on *Mylodon*, even though it could account for bone dispersal, as has been actually observed (Jackson and Jackson 1999).

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Assuming contemporaneity of at least some of the sites yielding *Mylodon*, and given their significant proximity (<3 km from Quereo site to the El Membrillo site), we can suggest a distributional pattern similar to the action radius of a carnivore. This pattern could be related to fresh water availability along ravines and edges of ancient lacustrine basins. The absence of a more diagnostic paleontological record limits a clearer scenario. Future research should assess the possibility of more than one type of predator during late-Pleistocene times, just as in southern Patagonia with the case of *Panthera onca mesembrina*, *Smilodon*, *Arctodus*, and large canids like *Ducisyon avus*.

These new findings allow us to reevaluate the use of space and its resources by the first human groups who inhabited the semiarid region during the late Pleistocene. Until now, gathered evidence has not fully accounted for the hunting of megaherbivores. At the El Membrillo surface site (dated to $13,500 \pm 65$ RCYBP [NSRL-11081], Jackson 2002) two *Mylodon* sp. bone loci were observed. Cut marks, fractures on fresh bones, and associated lithic artifacts suggest human activity (Jackson 2002). This assemblage proposes issues similar to those stated by Borrero (2001) for the debate about Patagonian hunting versus scavenging. We think this problem admits new research lines, particularly related to the possible dispute between extinct carnivores and the first hunter-gatherers in the region. As open-air sites, they also compare to assemblages from Patagonia and Tierra del Fuego that are exclusively recorded at caves and rockshelters.

Current knowledge regarding *Mylodon* sp. along the semiarid coast of Chile cannot be solely explained by exclusive models, namely Paleoindian hunting or carnivore predation. Present evidence suggests a more complex Pleistocene scenario possibly integrating both arguments.

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New Archaeological Evidences from the Late-Pleistocene/Early-Holocene Paso Otero 5 Site (Pampean Region, Argentina)

G. Martínez, M. A. Gutierrez, and J. L. Prado

The archaeological knowledge of the early human occupations of the Pampean Region has improved through the finding of new archaeological sites dated between 10,000 and 11,200 RCYBP (Martínez et al. 2003; Politis 2003). Among them, Paso Otero 5 (Martínez 2001), dated between ca. 10,000 and 10,400 RCYBP, is characterized by the presence of extinct megamammals and modern species in association with "fish-tail" projectile points (Holliday et al. in press; Martínez 2001; Martínez et al. 2003).

The goal of this paper is to update the information recovered from the site. As part of a broader archaeological project, data on fauna, lithics, stratigraphy, chronology, pollen, silicophytoliths, diatoms, stable isotopes on gastropods, geoarchaeology, taphonomy, and diagenesis have been recovered (Martínez et al. 2003). In this paper we present preliminary results of faunal and lithic analyses, present new ¹⁴C ages, and discuss the ¹⁴C chronology in light of bone diagenesis and preservation. Analyses of other materials are in process.

The site was discovered in 1994 and has been studied since then. The current excavated surface is 98 m². A total of ca. 80,000 complete and fragmented bones of extinct megamammals and modern species were recorded. Among them, only 58 bone specimens are taxonomically determinable (Table 1). The preliminary bone analysis shows a high degree of fragmentation and an extremely high proportion of burnt bone (ca. 91 percent).

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axonomic determination	NISP
Xenarthra indet.	5
Pilosa indet.	1
Scelidotherium sp.	1
Glossotherium sp.	2
Mylodon sp.	1?
Lestodon armatus	2
Megatherium americanum	29
Glyptodon sp.	1
Toxodon sp.	3
Litopterna cf. Macrauchenia	2
Macrauchenia patachonica	1
Equus sp.	1
Equus neogeus	2
Hemiauchenia sp.	1
Lama guanicoe	5
Dusicyon patagonicus cultriden	1
Total	58

Table 1. Taxonomic determination and quantification of bone specimens recovered from Paso Otero 5.

Of a total of 85 lithic artifacts, 79 are small flakes and debris, mostly on quartzite. The most relevant tools recorded are two fractured "fish-tail" projectile points and a stem fragment of a probable third fish-tail point. Also found were a small piece of a bifacially reduced artifact and two marginally fractured retouched tools made on flakes.

The stratigraphic sequence is composed of sediments of the Luján Formation that consists of two members: the late-Pleistocene Guerrero Member and the early- to middle-Holocene Río Salado Member. At Paso Otero 5, the sedimentary column of the Río Salado Member shows six periods of landscape stability represented by buried A horizons of soils. The sixth stabilization surface, which separates the two members, is a regional paleosol named Puesto Callejón Viejo; it is chronologically situated at the Pleistocene-Holocene transition (Fidalgo and Tonni 1978; Holliday et al. 2003). The archaeological component is mainly recorded within this paleosol.

Fourteen AMS attempts were made to date the bone assemblages, but the majority of them failed owing to the poor content of collagen. Eight of the samples failed, three were anomalous, and three yielded expected ages considering the archaeological context and stratigraphic position. The first ¹⁴C dates were conducted on megafauna bones and yielded ages of 10,440 ± 100 RCYBP (AA-39363) and 10,190 ± 120 RCYBP (AA-19291) (Martínez 2001). Moreover, a sample of sediment organic matter from the paleosol yielded an age of about 9400 RCYBP (Holliday et al. 2003). Four other bone specimens processed yielded the following results: 1) *Macrauchenia patachonica*, 4150 ± 30 RCYBP (GX-29792); 2) *Equus neogeous*, 2110 ± 30 RCYBP (GX29794); 3) *Lama guanicoe*, 2090 ± 40 RCYBP (GX-29793); and 4) *Megatherium americanum*, 9560 ± 50 RCYBP (GX-29795).

Previous work at the Paso Otero archaeological locality (Gutierrez 1998, 2001; Gutierrez et al. 2001) highlighted the importance of the diagenetic aspects of site formation in the area. We have concluded that the diagenetic alterations severely influenced the microscopic features of the bones and, as a consequence, their biological signals (Gutierrez 1998, 2001; Gutierrez et al.

2001). New diagenetic analyses were conducted on 15 bone samples, and the results are consistent with those obtained in former studies. In this sense, the percent N quantities (protein content) found in every sample were below 0.3 percent (error margin), indicating a high degree of collagen decay. Although all the sites of the locality are characterized by histological alterations induced by microorganisms, there is no statistical correlation between this variable and the percent N, indicating that the microorganism attack is not the only responsible agent in the collagen decay. We propose that the combination of intense microorganism activity and chemical hydrolysis were the processes responsible for the poor bone collagen preservation.

Although the construction of an absolute chronology based on bone is problematic, the recovered evidence is indicative of the late-Pleistocene/ early-Holocene age of the site. This assumption is sustained by the faunal (megafauna) and lithic (fish-tail points) association, as well as the stratigraphic position of the cultural component. As a consequence, the three late dates reported in this paper are rejected. The chronological anomalies and failures are the results of diagenetic alterations. It is remarkable that the three late-Pleistocene and early-Holocene ages were obtained on burnt bones, suggesting that the burning process favors the collagen preservation (Gutierrez et al. 2001).

The preliminary results presented in this paper shed new light on faunal diversity during the Pleistocene-Holocene transition. The presence of at least 10 species of megamammals is explained by the human reoccupation of the same place and by the possibility of bone scavenging of nearby carcasses. The large amount and variety of burnt/calcined and mixed thermal alteration stages of bones (Joly 1999–2000) are the result of using megamammals as a food resource and their bones as fuel (Martínez 2001).

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Zooarchaeological Record in Early Sediments of Caves from Tandilia Range, Argentina

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In the Pampean Region of Argentina a good record exists of early human occupations in the hills of Tandilia and the plains of the Llanura Interserrana. Regrettably only a few Paleoindian archaeological sites contain fauna, two of them in the plains (Paso Otero 5 and Arroyo Seco), one in western Tandilia (La Moderna) and two in eastern Tandilia (Cueva Tixi and Cueva El Abra). In this last area of Tandilia the largest concentration of human occupations of the Pampean Region is located: Cueva Burucuyá, Abrigo Los Pinos, Amalia Sitio 2, Cueva La Brava, Cueva El Abra and Cueva Tixi (Mazzanti 2003); and some other sites more toward the west, Cerro La China, Cerro el Sombrero and Los Helechos (Flegenheimer et al. 2003).

Cueva Tixi (¹⁴C dated by charcoal to $10,045 \pm 95$ [AA-12131] and $10,375 \pm 90$ [AA-12130] RCYBP) and Cueva El Abra (¹⁴C dated by charcoal to 9834 ± 65 [AA-38098] RCYBP) are separated by about 4 km and present very different faunal records. The Paleoindian bone sample of Cueva Tixi has 1,726 identified remains belonging to 33 species, 9 of them showing evidence of human use (including cut marks and tool use wear). Most of the unexploited species were transported into the cave, when the site was not occupied by humans, by birds of prey that vomited their bones in pellets. The condition of these bones is good, with moderate fragmentation. The results indicate that the occupants of this cave developed a generalist strategy of subsistence. They captured highranked resources such as guanaco (Lama guanicoe) and deer (Ozotoceros bezoarticus); low-ranked such as vizcachas (Lagostomus maximus), coipos (Myocastor coypus), ñandú eggs, and three species of armadillos (Chaetophractus villosus, Dasypus hibrydus and Zaedyus pichyi); and intermediate species such as ñandú (Rhea americana) and the giant armadillo (Eutatus seguini) (Quintana and Mazzanti 2001).

The sample of Cueva El Abra has 138 identified remains (1,389 not identified) belonging to 10 species, but only one shows indubitable evidence of

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human exploitation. The state of the bones is poor; all are broken into fragments, there are no bone tools, and the poor state of the bone surfaces does not allow the conservation of cut-marks. There are no remains that can be linked to transport by predatory birds. In this site there only exists evidence of deer exploitation by humans (intentional fractures and burning); however, armadillos and the vizcacha were possibly also utilized, since these species do not inhabit caves, they are in an archaeological context, and they were exploited in other sites of the same antiquity. It is important to point out the apparent absence of guanaco, the most frequent ungulate in archaeological sites of this sector of the Pampean Region. The splinters of long bones of large mammals are numerous; some of them have negative impact marks. Some of the splinters may be of guanaco.

The two sites have a very similar archaeological context, and both have thousands of lithic remains in a context of recurring human occupations. But the faunal record in general and the zooarchaeological one in particular seem to differentiate these caves. However, two incidental factors at Cueva El Abra inhibit the use of its faunal record for proposing formal environmental or subsistence hypotheses. First, the absence of pellet deposits created a record that lacks microvertebrate species diversity near the cave. One other difference from Cueva Tixi is the very small number of bones and species used for human subsistence, the result of the greater state of fragmentation and the poor quality of preservation of the bones.

Thus, the sample of Cueva El Abra cannot be used for detailed zooarchaeological interpretations, and we cannot affirm if the subsistence represented in Cueva El Abra was different from or similar to that of Cueva Tixi.

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Archaeology—North America

The McNine Collection: A Possible Cache of Great Basin Stemmed Bifaces from Northwestern Nevada

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A remarkable collection of obsidian tools apparently resulted from poorly documented excavations in an unknown cave in the Nevada High Rock Country in 1974. Detailed technological analysis and comparisons suggest this assemblage may represent a ritual cache (Amick 2004). These unusually large tools correspond to the Parman variety of the Great Basin Stemmed (GBS) cluster, associated with terminal-Pleistocene/early-Holocene occupations of the Great Basin (Beck and Jones 1997; Bryan and Touhy 1999; Jones and Beck 1999; Justice 2002:85–101; Layton 1972, 1979:47). The assemblage contains six Parman projectile points, four stemmed bifacial preforms, five bipointed bifacial preforms, two ovoid bifacial blanks, one small triangular biface, and one scraper. All are traced to secondary cobble sources in northwest Nevada (Hughes 1986, 1999): 12 from Bordwell Spring; 3 from Fox Mountain; 2 from Pinto Peak; the largest preform is from Windmill Quarry while the smallest point is from Cowhead Lake.

Several attributes of the stemmed bifaces resemble those reported from Clovis biface caches including their unusually large size (2X average for this type), the grouping of a patterned set of various stage forms that reflect the general manufacture sequence (Figure 1), leaving prepared striking platforms on the margins, evidence of abrasion on dorsal ridges that resulted from transport wear, and ocher-like mineral staining. Utilitarian purposes are often assumed when hoards of unfinished implements display a high degree of uniformity or are cached in an environment scarce in raw material. However, the McNine assemblage lies in obsidian-rich surroundings and the diversity of unfinished stage forms argues against production for later retrieval, finishing, and use. Production analysis suggests this unique assemblage may also symbolize the blueprints for making these GBS points.

Archaeological interpretation of the prehistoric intention motivating the construction of a cache deposit is complicated, and it can be difficult to

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Figure 1. Overlapping outlines of the 14 most complete preforms and points in the McNine assemblage. Mishandling and careless excavation techniques resulted in breakage on several specimens. Preform averages: length, 147 mm; width, 65 mm; thickness, 12 mm; weight, 117 g (n = 9). Projectile point averages: length, 111 mm; width, 43 mm; thickness, 7 mm; weight, 31 g (n = 6).

distinguish between banking caches and ritual caches, especially in the absence of formal shrines (Collins 1999:175; Schiffer 1987:79). It may be equally difficult to distinguish grave goods from such caches in the absence of human skeletal remains. Schiffer (1987:79) characterizes ritual caches as "reasonably discrete concentration[s] of artifacts, usually not found in a secondary refuse deposit; in addition, ritual caches generally contain complete artifacts, sometimes unused that are intact or easily restored."

General coherence of the distinctive technological and stylistic attributes within the McNine assemblage provides the strongest argument for its proposed interpretation as a ritual cache of lithic artifacts. A variety of production stages are represented in this collection, but none are manufacturing failures and none show evidence of use. The projectile points exhibit intentionally blunted tips which may have been designed to prepare them for the distinctive "squared-off chisel bit" or "burin-faceted" finishing documented among GBS points (Green et al. 1998:449; Tuohy 1969:139). Although the relative thickness of these bifaces was maintained by continuous thinning, there was no progressive reduction in the ratio of width to thickness. Thinning goals appear to have been achieved in the earliest stages; shaping seems to be a more important objective in these subsequent stages, with the ratio of width to thickness staying fairly constant around the mean of 5.73. Interestingly, similar patterns in size and shape can be seen in the general production sequences described for several Clovis biface caches (Frison and Bradley 1999; Gramly 1993; Wilke et al. 1991; Woods and Timus 1985).

Special thanks to Moe and Mary Royels, Steve Wallmann, and Lorraine Hoss for assisting my study of this collection. Dr. Richard Hughes conducted the X-ray fluorescence analysis and determined the obsidian source assignments. Funding for his analysis was provided by the Sundance Archaeological Research Fund at the University of Nevada, Reno. Support for this study was facilitated by travel and research grants from the College of Arts and Sciences at Loyola University Chicago. Finally, thanks to the many fine people who examined this collection and offered useful observations about it, including Peter Ainsworth, Charlotte Beck, Bruce Bradley, Dewey Dietz, John Fagan, Richard Hughes, Tom Jones, Tom Loebel, Mike Rondeau, Betsy Skinner, and Steve Wallmann.

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An 8700 CALYBP Shell Midden from the South Coast of San Miguel Island, California

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University of Oregon archaeologists have spent much of the past decade studying the archaeology and historical ecology of San Miguel and the other Northern Channel Islands (Erlandson 1994; Kennett 2004; Rick 2004; Vellanoweth 2001). One aspect of this research has been an intensive search for early sites. On San Miguel Island alone, as many as 16 sites with shell middens dated between 11,000 and 8000 CALYBP have been documented. Until recently, however, all these early sites were located along the north coast, where a nearly continuous series of large and multicomponent shell middens has attracted the attention of archaeologists and antiquarians for over a century.

Historically, the south coast of San Miguel was thought to have been sparsely settled. Rogers (1929) surveyed the perimeter of the island in the 1920s, but found little evidence for human settlement. More recent and systematic surveys (Greenwood 1978; Rozaire 1978) documented some sites along the south coast, but site densities are much lower than other island areas. Until our recent research, only one site from San Miguel's south coast had been ¹⁴C dated, a shell midden dated to about 6000 CALYBP.

The apparent dearth of archaeological sites on the south coast is surprising because shell middens, including historic Chumash villages, are relatively common on the southern coasts of nearby Santa Rosa and Santa Cruz Islands. Moreover, the south coast is relatively sheltered from the northwesterly winds that batter the island, and several sources of fresh water have been identified.

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The south coast also contains extensive kelp forests and rocky reefs that support an abundance of marine resources.

Our recent survey efforts suggest that prehistoric use of San Miguel's south coast was more extensive than previously thought. One reason few sites have been recorded in the area may be related to the fact that much of the coastal plain was blanketed historically by dune sand deposited after historic overgrazing destabilized the island's extensive dune fields (Erlandson et al. 2004). Our recent work shows that thick layers of sand cover portions of the south coast, and numerous shell middens have been identified eroding from paleosols exposed in gullies that are cutting through this sand overburden.

It now appears that human settlement of the south coast also began earlier than previously believed. One of the buried shell middens we recently identified is exposed in an actively eroding arroyo complex located about 1 km east of Crook Point in the central area of San Miguel's south coast. This site, known as CA-SMI-608, consists of a dense shell midden up to 20 cm thick that is embedded in a well-developed paleosol. Erosional exposures are extensive, and materials from this midden are also found redeposited for at least 60 m downstream. Existing exposures show that the shell midden is composed primarily of black abalone (Haliotis cracherodii), California mussel (Mytilus californianus), and owl limpet (Lottia gigantea) shells, with smaller amounts of barnacle (Balanus spp.), red abalone (H. rufescens), and other rocky shore taxa. Despite a careful search, we also observed no animal bone in the extensive site exposures. Together, these characteristics of the faunal assemblage led us to believe that CA-SMI-608 may date to the early Holocene. The artifacts observed on the site-expedient flake tools, core tools, and hammerstones made from igneous, chert, and quartzite cobbles-are consistent with this hypothesis.

As part of a larger effort to develop a chronology of human settlement along San Miguel's south coast, we submitted a well-preserved mussel shell from near the base of the midden for 14 C dating. A conventional date of 8020 ± 80 RCYBP (Beta-180771) provides a calibrated age of approximately 8700 CALYBP (8900–8575 CALYBP range at 1 sigma) for the occupation of CA-SMI-608. This date confirms the early-Holocene age of the midden, extends the earliest known occupation of the south coast by nearly 3,000 years, and expands the number and geographic range of early shell middens on San Miguel Island. Later this year, we plan to return to the site to collect samples that will help us document the nature of local environments, as well as the resources and technologies used by the early maritime people who occupied the site.

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Metric Analysis of a Complete Bison Radius from the Hot Tubb Folsom Site, Crane County, Texas

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A large number of fragmented bison bones were recovered from the Hot Tubb site (Seebach 2004). Although the primary diagnostic artifacts from Hot Tubb are Folsom projectile points, later-period artifacts are present, rendering the association between the bison remains and Folsom tools uncertain. Efforts to ¹⁴C-date bone have proven unsuccessful, owing to insufficient collagen preservation. Therefore, we undertook a morphometric study of one of the few intact elements, a complete bison radius, to determine if the animal was within the range of *Bison antiquus* or *Bison bison* (McDonald 1981, Todd 1987a).

Two measurements described by Todd (1987b:376-77) are used in our analysis, (RD2 [greatest length] and RD3 [greatest breadth of the proximal end]), as these are best represented in sampled archaeofaunas. Radii from five archaeological sites and two modern specimens comprising various ages, sexes, and species are compared. These are: 1) Bonfire Shelter (BB2-average values), associated with *Bison antiquus* (Lorrain 1968); Lipscomb, associated with *Bison antiquus* (Todd et al. 1992); 3) Horner, associated with *Bison antiquus* (Todd 1987a, 1987b); 4) Kaplan-Hoover, associated with *Bison bison* (S. L. Potter pers. comm. 2003; Todd et al. 2001); and 5) Mustang Springs, associated with *Bison bison* (Byerly and Meltzer 2004).

The Hot Tubb specimen is a large, fully fused right bison radius that is intact despite diaphyseal cracking and crushing to the posteromedial portion of the proximal end. Because of this damage, RD3 is estimated. A scatterplot of RD3 vs. RD2 (Figure 1) indicates the Hot Tubb radius falls within the range of Horner males and Lipscomb females, suggesting association with *Bison*

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Figure 1. RD3 (greatest breadth of proximal end) vs. RD2 (greatest length) for archaeological and comparative samples. For the Hot Tubb specimen, RD2 = 365 mm and RD3[est.] = 100 mm (measured value = 95 mm).

antiquus. Thus, point t-tests (Sokal and Rohlf 2001:227-29) were conducted for RD2 measurements to examine whether the Hot Tubb specimen could come from the same statistical population as either the Lipscomb or Horner samples. Results indicate that there is a higher probability the Hot Tubb radius came from a population similar to Lipscomb ($t_s = -.82$, $p = .50 \ge x \ge .40$) and Horner males ($t_s = 1.09$, $p = .40 \ge x \ge .20$) rather than Lipscomb ($t_s = 2.34$, $p = .05 \ge x \ge .02$) and Horner ($t_s = 4.58$, $p \le .001$) females. Given these data, and assuming a valid correlation between radius dimensions and time, we accept that the Hot Tubb specimen is from a population of similar proportions to Lipscomb and Horner *Bison antiquus* males, indicating an association with Folsom and not later components.

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New Dates for the Lind Coulee Site (45GR97), Washington

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The Lind Coulee site (45GR97) is a Western Stemmed Tradition site in central Washington known as the type site for the Lind Coulee–style biface forms and the northernmost find of a chipped-stone crescent. Although the site is of great interest as the northern extent of the Western Stemmed manifestation, the age of the site is still in question. This paper summarizes past efforts to date the Lind Coulee site and reviews new chronological data.

Lyman (2000) outlines several problems with the dating of materials excavated at Lind Coulee in the 1950s. Daugherty (1956) obtained a date of 8700 ± 400 RCYBP (C-827), but Lyman (2000) notes that this date is questioned since ¹⁴C dating was relatively new then and some questions exist as to what was actually dated. Additional dates include one obtained by Roald Fryxell of 8600 ± 65 RCYBP (WSU-1422) from a humic lens; however, this age represents an apparent mean residence time of carbon in the soil layer rather than a target event in a sediment layer (Sheppard and Chatters 1976). A bone sample from a bison scapula beneath tephra identified as Mount St. Helens J was also dated and yielded an average age of 12,830 ± 1050 RCYBP (WSU-1707) (Irwin and Moody 1978). However, Moody (1978) believes this sample to be poorly preserved; moreover, it contained a minimal amount of collagen, causing an inaccurate age. Bone material from five different elevation levels yielded an average date of 8720 ± 299 RCYBP (WSU-1709) (Irwin and Moody 1978; Moody 1978). Because of these problematic dates, it is difficult to narrow the age estimate of the cultural materials much beyond the limits designated by the

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Mount Mazama (6700 ± 100 RCYBP) and uppermost of Mount St. Helens S set (12,120 ± 350 RCYBP) tephras, which bracket the cultural material at the site (Irwin and Moody 1978).

To address this problem, additional samples were assayed using AMS dating. The samples consisted of collagen extracted from large bone fragments of either bison or elk found in the cultural deposits at 0.29–0.39 m below datum (CAMS-94856), 0.20–0.25 m below datum (CAMS-94857), and 0.30–0.40 m above the datum (CAMS-95524). Each of the three bone samples was selected based on the quality of the specimen for dating determined by thickness, texture, and lack of weathering. The bone collagen extraction was performed by Stafford Labs, Inc., and the AMS was done by the Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry.

Preliminary results for the dates are $10,060 \pm 45$ RCYBP (CAMS-94856), $10,250 \pm 40$ RCYBP (CAMS-94857), and $9,810 \pm 40$ RCYBP (CAMS-95524). The two lowest samples are significantly older than previous radiometric dates have indicated. Calibrating these ages at the 2-sigma level to approximately 12,000 to 11,250, 12,350 to 11,700, and 11,260 to 11,165 CALYBP, respectively, demonstrates a much narrower occupation span of these Western Stemmed materials than previously thought. Notwithstanding the narrower age range for Lind Coulee, a significant chronological depth at the site still exists since the youngest date does not overlap the older ages. Since all these ages lie within the cultural levels of the site, more dates should be obtained to more specifically bracket the age of these materials.

The new AMS dates of the cultural deposits at the Lind Coulee site are significant because they demonstrate that the Lind Coulee biface styles (Daugherty 1956) and crescents fit into contexts older than previously thought. It will be important to consider the different ages in contexts when these styles are used as time markers on Plateau and Great Basin sites. This is also beneficial in our greater understanding of late-Pleistocene Plateau prehistory. Work at the Sentinel Gap site located in central Washington has revealed Western Stemmed Tradition materials in contexts older than 10,000 RCYBP (Galm and Gough 2000; Galm et al. 2002). Also, recent work at the Cooper's Ferry site investigated the lowest components, which contained Lind Coulee–style bifaces with similar ages as the Lind Coulee site materials (Davis 2001, Davis and Sisson 1998). The older age range of these sites' materials places the Western Stemmed Tradition occupation in a much cooler Pleistocene environment previously believed to be occupied only by Clovis people in this region.

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Early-Holocene Radiocarbon Dates from Lemitar Shelter, Socorro County, New Mexico

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A new program of archaeological field research was completed at Lemitar Shelter (LA18139) during spring 2003. This rockshelter site is on the Sevilleta National Wildlife Refuge in Socorro County, New Mexico. Work at the site was completed by the lead author and members of Escondida Research Group, LLC, a private archaeological consulting firm.

Historically, archaeological investigations at Lemitar Shelter began with an exploratory trench excavated by C. Vance Haynes, Gerald C. Shelton, and others in 1952. This was followed by extensive block excavations completed by University of New Mexico graduate student William Weinrod in 1953. Results of the 1952 efforts are detailed in field notes (Haynes 1952) and in a newspaper article (Raynor 1952), while results of the 1953 efforts are documented in museum notes (Weinrod 1953). Additional block excavations by Ronald Anzalone in 1972 resulted in a master's thesis at Eastern New Mexico University in Portales (Anzalone 1973). The temporally diagnostic artifacts recovered by these previous efforts suggested use of the site from the late-Archaic through the Ancestral Puebloan periods. Unfortunately, the charcoal and other organic samples collected during these early projects remain undated.

More recently, Dello-Russo (2002) summarized the three previous efforts at the site, assessed the nature and integrity of the remaining deposits, and evaluated the status of the previous collections. Because the previous block and trench excavations, located inside the shelter drip line, were left open and unbackfilled, the subsequent slumping of intact deposits into these open

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excavations created a broad crater that today averages about 1 m in depth. Nevertheless, Dello-Russo's work in 2002 suggested that deep, intact deposits still remained at the site, and this finding served as the impetus for the 2003 test excavation project.

The main goals of the 2003 project were to investigate the lower levels of the site, in an attempt, 1) to characterize the geological deposits found below earlier archaeological excavations, and 2) to test the potential for the presence of late-Pleistocene/early-Holocene cultural deposits. The 2003 excavations were completed within a hand-excavated grid measuring 3 m north-south by 3 m east-west. The grid was placed inside the aforementioned crater to expedite deeper investigations. At their deepest point (in Study Unit 2), excavations reached 4.29 m below the original ground surface. A total volume of 16.26 m³ was removed. Three-dimensional provenience control in the study unit excavations was maintained with a Nikon total station.

Our findings suggest that, within the excavated sediments of Lemitar Shelter, there are seven geological strata. The delineation of the upper strata in the newly exposed profiles was complicated by 50 years of crater formation processes, while the activities of rodents and other larger burrowing mammals impacted the stratigraphy of the entire excavation. Descriptions of these strata currently await the completion of laboratory analyses.

Radiocarbon dates for six charcoal samples recovered during the 2003 project now represent the first chronometric dates from Lemitar Shelter (Table 1). The two dated samples recovered from intact sediments in Stratum V are associated with lithic artifacts and, subsequently, provide evidence of cultural occupations during the late-Archaic and middle-Archaic periods. While no artifacts were found in the intact sediments of Strata VI and VII

Sample no.	Laboratory no. (Beta)	Study Unit no.	Soil Stratum	Depth below orig. ground surface (m)	Feature	Age, RCYBP	2-sigma calibrated age (CALYBP)
74	180553	4	V	2.31	2	3000 ± 40	3330-3065
79	180554	1	V	2.46	6	3840 ± 40	4405–4140 4115–4100
89	180555	1	VI	3.02	7	4460 ± 50	5300-4875
96	180556	2	VI	3.30	-	4480 ± 40	5300-4970
98	180557	1	VI	3.47	-	8010 ± 50	9020-8665
99	180558	2	VII	3.95	-	7910 ± 40	8985-8600

Table 1. Early-Holocene radiocarbon dates from Lemitar Shelter, Socorro County, New Mexico.

(investigated only in Study Units 1 and 2), the remaining four dated samples from these strata indicate the presence of early-Holocene sediments and suggest a potential for early-Holocene human use of the site. It is hoped that more extensive excavations in Strata VI and VII at Lemitar Shelter will provide additional dates and associated cultural materials indicative of late-Paleoindian and earlier cultural occupations.

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A Unique Example of Early Technology and Land Use in the Eastern Great Basin

Daron G. Duke, D. Craig Young, and James A. Carter

The southern Great Salt Lake Desert once supported vast wetlands that contained valuable resources for early Great Basin inhabitants (Carter et al. 2004; Oviatt et al. 2003). Research at Wild Isle, a 13,500-acre dunefield on U.S. Air Force lands in western Utah, documented over 100 Paleoarchaic sites containing 340 Western Stemmed Tradition (WST) bifaces and 10,000 associated artifacts (Carter 1999; Carter and Young 2002; Carter et al. 2004; also see Arkush and Pitblado 2000; Duke 2003). These remains attest to intensive use of the wetlands while conditions were productive. People abandoned the area when the marshes disappeared owing to early-Holocene drying approximately 8500 RCYBP (Carter et al. 2004; Oviatt et al. 2003). The unique value of these wetlands to Paleoarchaic groups is evident in the extreme measures stone tool users took to supply and maintain lithic resources.

Occupation of the Wild Isle area is estimated to have begun roughly 10,300 RCYBP (Madsen 2000), following its emergence from the receding waters of Lake Bonneville. A lush marshland existed at that time, in association with a distributary stream network at the northern reaches of the now-extinct Old River. The modern dunefield is anchored by the ancient levees of these streams (Carter and Young 2002; Young 2002).

Stone tool technology centers on the use of basalt and, to a lesser extent,

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obsidian; chert was rarely used. Paleoarchaic sites across the Great Basin show similar material choices, but with important differences. Unusual at Wild Isle are exceedingly crude WST bifaces, a near-absence of chert (< 3.5 percent), and extreme obsidian conservation. We infer that these patterns represent longer stays at the Old River delta than in other parts of the eastern Great Basin.

This delta is believed to have been biotically rich compared with other areas, but it lies out in the Bonneville basin near little solid rock. The remote distance of Wild Isle from toolstone—at least 30 km—placed stress on technology that can be measured by examining the flaking techniques used. This relates directly to the lack of workmanship and high frequency of remnant stone blank attributes (i.e., flake-like morphology, non-invasive flaking) found on Wild Isle artifacts.

It is not unusual in early Great Basin assemblages for basalt bifaces to be roughly formed. This contrasts with the pattern of refined toolmaking that is characteristic of Paleoamerican technologies across most of North America, in which tools were carefully reduced in order to maximize use-life and, thereby, toolstone (cf. Goodyear 1979; Kelly and Todd 1988). That the Great Basin pattern of local, expedient basalt use is accentuated at Wild Isle reflects the stronger influence of alternative economic factors in this region.

Kuhn (1995) makes a technological distinction between the *provisioning of individuals* and the *provisioning of places*. The former is effective for longdistance mobility. Individuals must transport their entire technology with each residential move, and it benefits them to have light, versatile tools. By contrast, provisioning of place (stockpiling) is cost-effective when the location of activities is known and occupation is expected to be of some duration. Provisioning of place is indicated at Wild Isle. Whether inhabitants preferred tabular cobbles, flake blank stores, or exceedingly large bifacial cores (ca. 15– 25 cm) is not yet clear, but debitage analysis indicates all were present.

Marsh resources were reliable and abundant enough to warrant long stays (Oviatt et al. 2003). This justified the extended logistics of basalt acquisition. Lengthy occupations are further evinced by how other toolstones were used. Tools that are usually made from chert in the eastern Great Basin, such as certain scrapers and crescents (Beck and Jones 1990), are made from basalt at Wild Isle. After transport into the area, these tools were apparently replaced with basalt as stays continued. Obsidian use was also adjusted. People smashed expended obsidian stemmed points to generate diminutive tools, leaving an abundant class of minuscule biface fragments (< 5 g) (Carter et al. 2004). This level of obsidian economizing has not been reported elsewhere. The expectation for this behavior is directly related to length of stay, since mobile huntergatherers could reacquire obsidian in every direction if moving about frequently on a large regional scale (cf. Jones et al. 2003).

It is widely recognized that Paleoarchaic groups were dependent to some degree on lake-margin resources, but whether they moved about different basins on long-range annual rounds or stayed tethered to specific basins for long periods is unknown (see Jones et al. 2003; Willig and Aikens 1988). Wild Isle technological organization reflects a reality that lies somewhere in between. Obsidian sourcing demonstrates that people came from distant areas,

but upon arrival, they modified their method of lithic resource use to meet the unique demands of this place. Work continues to ascertain whether this is a late-Paleoarchaic pattern resulting from the loss of previously exploited basins during early-Holocene drying, or an ever-present seasonal priority of early eastern Great Basin peoples.

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Paleoamerican Prismatic Blade Economy from the Nuckolls Site (40Hs60), Lower Tennessee River Valley, Tennessee

Elijah C. Ellerbusch

The Nuckolls site is situated on a submerged knoll in the lower Tennessee River Valley, approximately 20 km northeast of Camden, Tennessee, and 1 km west of the Greenbrier Creek outlet (Figure 1A). Highly biodiverse, complex deciduous forests dominated the area from ca. 14,000 to 11,500 CALYBP (Delcourt and Delcourt 1981). Ecological richness and abundant high-quality chert resources encouraged early colonizing Paleoamericans to settle the area. Direct tributary access to the western Highland Rim Spruce/Jack Pine forests made this hypothesized "staging area" (Anderson 1990, 1996) a true ecotone conferring an obvious economic advantage to its initial inhabitants.

John Nuckolls collected numerous Paleoamerican artifacts from the Nuckolls site for many years. In the late 1950s, he donated a sizeable lithic artifact assemblage to the University of Tennessee Department of Anthropology. Subsequent archaeological testing in 1958 by Madeline Kneberg and T. M. N. Lewis verified that the 1940s damming of the Tennessee River to create the Kentucky Lake Reservoir resulted in the annual erosion and deflation of the rich Paleoamerican cultural deposits (Lewis and Kneberg 1958).

The lithic assemblage is dominated by evidence of the production of formal bifaces and standardized prismatic blades. It includes approximately 1,100 production flakes (reflecting all stages of biface reduction), 1,400 retouched flakes and blade-like flakes, and 1,000 bifaces and biface fragments. Surface collections of the site yielded at least 175 diagnostic Paleoamerican bifaces and biface fragments including, but not limited to, 13 Clovis, 25 Cumberland, 9 Dalton, 3 Quad, and 26 Beaver Lake varieties. Additionally, 319 prismatic blade artifacts were recovered. The artifacts are curated at the University of Tennessee McClung Museum. Relative artifact density and assemblage diversity suggest the Nuckolls site represents a habitation locale (see Andrefsky 1998:189–210).

Analysis of complete blade lengths, blade widths, platform widths, and platform thicknesses suggests the Nuckolls blades are morphologically and technologically analogous to those manufactured from polyhedral and wedgeshaped cores at several regional Clovis sites. The Nuckolls prismatic blades were primarily (93 percent) manufactured from local Fort Payne cherts including Dover and Buffalo River (Waverly) varieties. The Adams (15Ch90), Carson-Conn-Short (40Bn190), and Wells Creek (40Sw63) habitation/quarry sites also exhibit blade assemblages unambiguously dominated by locally available, high-quality cherts (Broster and Norton 1996; Broster et al. 1994, 1996; Dragoo 1973; Gramly and Yahnig 1991; Sanders 1990). This suggests

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that in the mid-South 1) prismatic blade production was tethered to local outcrops of suitable raw material, and 2) blade curation was geographically restricted to limited ranges of mobility.

Analysis of several technological attributes suggests nearly all stages of blade production occurred at Nuckolls. Initial stages of core reduction (outer cortex removal and initial core shaping), however, perhaps occurred at stone quarry locations. The incidence of blades exhibiting little or no dorsal cortex is high (99 percent). Furthermore, 310 blades (98 percent) exhibit two to eight previous blade removal scars, indicative of middle- to late-stage blade production. Detached complete blades exhibit edges that were either left unretouched (38 percent), laterally retouched (51 percent), or terminally retouched (11 percent). Many of the proximal, distal, and medial blade fragments exhibit similar retouch patterns or intentional terminal bend fractures. None of the blades exhibits exhaustive retouch.

A high-power microscopic use-wear analysis of a limited sample (n = 16, 5 percent) of Nuckolls blades, using Keeley's (1980) and Kay's (1999) methodological procedures, revealed interesting patterns of prismatic blade usage. Use-related alterations of polish topography and striation constellations were observed at 200- to 500-diameter magnification using an incident-light metallurgical microscope. Well-developed polish and striation constellations were counted according to MUFs (minimum units of functionality), reflecting minimum potential blade-use activities. Results of the analysis suggest that Paleoamericans at Nuckolls used blades and blade fragments for a variety of tasks. Tool fabrication was the principal activity conducted with prismatic blade implements; the planing, cutting, and grooving of bone and wood materials occurred at an incidence of 64.7 percent (Figure 1C). Prismatic



Figure 1. A, location of Nuckolls site in Tennessee; B, soft-plant polish from cutting/shredding; C, bone/antler polish from planing/graving.

blades were also used to scrape and cut hide (19.62 percent), butcher game (11.76 percent), and cut or shred soft plant materials (3.92 percent), perhaps indicative of plant processing for subsistence or the manufacture of woven materials (Figure 1B). Prismatic blade durability and tool flexibility met the needs of a multiplicity of daily economic activities.

The economic patterning of prismatic blade production, use, and discard from the Nuckolls site suggests that, 1) utilitarian blade use frequently complemented bifacial tool use in local Paleoamerican stone tool economies, and 2) habitation/quarry localities adjacent to high-quality chert resources were the preferred contexts for these activities. Building upon Collins (1999), this research further encourages archaeologists to reconsider the importance of Paleoamerican blade economic systems in the mid-South. Future research should consider the relationships between prismatic blade production and use and Paleoamerican settlement and subsistence organization in the region.

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The Paleo Crossing (33-ME-274) Fluted-point Assemblage

Metin I. Eren, Brian G. Redmond, and Mark A. Kollecker

The Paleo Crossing site (33-ME-274) is a Paleoamerican occupation in Sharon Township, Medina County, Ohio. From 1989 through 1993, surface collections and test excavations by the Cleveland Museum of Natural History (CMNH) recovered a total of 34 fluted points (Barrish 1995; Brose 1994). Brose (1994:65) used an averaged, uncalibrated radiocarbon determination of 10,980 \pm 75 RCYBP to date the Paleoamerican component. The late Barbara Barrish (1995) described 26 fluted points from the site in her master's thesis; however, these data were never published. During summer 2003, one of the authors (Eren) undertook a reorganization and re-inventory of the Paleo Crossing lithic assemblage and found eight additional fluted points. All measurements were taken with Mitutoyo Digimatic Calipers and a Ha We Contact Goniometer. Raw material identifications were made through visual inspection with a 10x magnifying lens and by comparison with the lithic reference collection curated at the CMNH. Any measurements or attributes already recorded by Barrish were remeasured and reexamined.

Twenty-three fluted points (67.6 percent) are crafted from Wyandotte chert, which outcrops 600 km southwest of the Paleo Crossing site in southcentral Indiana and northwestern Kentucky (Tankersley and Holland 1994). Six fluted points (17.6 percent) are made from Upper Mercer chert; two (5.9 percent) are made from Ohio Flint Ridge chalcedony; two (5.9 percent) are made from Delaware chert; and one (2.9 percent) is made of indeterminate chert (Carlson 1991; DeRegnaucourt and Georgiady 1998; Stout and Schoenlaub 1945). Six fluted points (17.6 percent) exhibit heat damage; 21 (61.8 percent) show evidence of basal grinding. There are seven complete points (20.6 percent), five tips (14.7 percent), nine bases (26.5 percent), eight midsections (23.5 percent), four half-bases (11.8 percent), and one longitudinal half (2.9 percent).

Metric attributes are summarized in Table 1. While some discrepancies

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were uncovered between the Barrish (1995) results and this study, the overall findings remain consistent. Barrish's analysis revealed that the Paleo Crossing assemblage differed significantly from a sample of points from the Gainey type site in the mean values for maximum width, basal width, maximum thickness, flute length, and flute width (Barrish 1995:77-90). Thus, Paleo Crossing fluted points were found to be wider and thicker in form with shorter but wider flutes than the predominant (Ten Mile Creek chert) variety of points from the Gainey site. Even though the metric attribute values of this study and the Barrish study differ slightly, these differences do not negate the fact that the Paleo Crossing fluted points contrast drastically with fluted points from the Gainey site. The plural results of our reanalysis do not contradict this overall assessment.

				8		
	n	Mean	Median	Minimum	Maximum	Standard deviation
Length (mm)	8	52.11	48.27	41.27	76.25	11.56
Medial width (mm)	24	23.40	23.71	18.36	29.13	3.09
Medial thickness (mm)	25	6.58	6.59	3.79	8.53	1.07
Length/width ratio	7	2.35	2.39	1.98	2.75	0.28
Basal width (mm)	13	21.07	21.78	17.49	24.11	2.12
Basal concavity depth (mm)	15	2.63	3.37	0.00	5.13	1.90
Flute length (mm)	31	20.97	18.87	9.75	38.87	6.12
Flute width (mm)	34	12.78	12.33	8.82	18.32	2.59
Flute thickness (mm)	17	4.53	4.50	3.44	6.20	0.76
Grinding length (mm)	9	23.38	22.87	18.37	31.87	4.54
Blade length (mm)	12	36.47	40.68	18.73	51.34	12.22
Face angle (deg)	7	90.29	91.00	82.00	94.00	4.42

Table 1.	Summary	metric	data (of fluted	points from	the Paleo	Crossing	site
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Shawnee-Minisink Revisited: New Excavations of the Paleoindian Level

Joseph A. M. Gingerich

In early September 2003 a new excavation unit (3 m²) was opened into the Paleoindian level of the Shawnee-Minisink site (36MR43), Monroe County, Pennsylvania. Donald Kline, who originally discovered the site in 1972, initiated the excavation and was joined by the author and archaeology students from Temple University, Philadelphia, Pennsylvania. An excavation strategy and recording system was devised that would correlate with the methodology previously used at the site. Here I alert readers to the renewed effort at the site and its preliminary results.

Over 25 years ago the Shawnee-Minisink site was the major focus of the Upper Delaware Valley Early Man Project (UDVEMP). During this time an area of 365 m² was excavated, representing about a quarter of the site's extent, and producing over 55,000 artifacts (Dent 2002; McNett et al. 1985). The excavated Paleoindian component of the site encompassed an area of 120 m² and produced 4,860 artifacts (Marshall 1985). Shawnee-Minisink is located in the Upper Delaware Valley of northeast Pennsylvania in the Ridge and Valley province. The site is positioned at the confluence of the Delaware River and Brodheads Creek. Situated on the second terrace at a height of approximately 6.5 m, the site would have been on a high point of the landscape during the late Pleistocene, a desirable location for settlement. The terrace upon which the site rests consists of alluvial deposits from the two nearby streams as well as some loess deposits (Dent 2002). The stratum that contains the Paleoindian artifacts is approximately 240 cm below surface and is separated from later components by almost 1 m of culturally sterile alluvial deposits. The Paleoindian stratum is approximately 28 cm thick and has been interpreted as a loess deposit (Dent 2002; McNett et al. 1985; D. Wagner pers. comm. 2003). Shawnee-Minisink represents one of the most intact Clovis assemblages in the East. It is one of only eight sites in the Northeast that have produced chronometric dates associated with fluted projectile points (Carr and Adovasio 2002). Initial radiocarbon assays from the site put the Paleoindian occupation at 10,590-10,750 RCYBP (Dent 2002; McNett et al. 1985). However, a recent AMS date on charred hawthorn plum seeds recovered within a Paleoindian hearth has provided an assay of $10,940 \pm 90$ RCYBP (Dent 2002).

To assist in identifying activity loci and microstratigraphy at the site, all artifacts were mapped using XYZ coordinates. All excavated matrix was water screened through 1/8-inch mesh; a small sample was processed through geological sieves of 1.2 and 0.7 mm. Flotation and soil samples were taken from each level. Similar methods were employed by UDVEMP in the 1970s (McNett et al. 1985). Pedologist Daniel P. Wagner of Geo-Sci Consultants

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provided detailed soil and profile descriptions. This season's excavations removed approximately 75 percent of the stratum containing the Paleoindian occupation. The remaining 25 percent will be excavated in spring 2004.

The stratigraphy encountered in the new excavation is comparable to that of the original excavations located approximately 9 to 12 m away. Artifact processing and data analysis are in progress. More than 1,500 artifacts were recovered, including one blade scraper and nine endscrapers. These scrapers add to the 126 scrapers found in the original excavations. Exact provenience mapping of artifacts will allow us to eventually reconstruct lithic reduction activities. So far two distinct chipping clusters have been identified within the 3-m² area. Preliminary analysis of artifacts from these two clusters indicates that the activities represented are similar to those identified by Marshall (1985) in the original excavations, in that they include intensive tool use and rejuvenation but limited tool manufacturing.

The volume of artifacts in the new unit warrants some reevaluation of the site. During the original excavations of the Paleoindian level, a 120-m² area was excavated producing 4,860 lithic artifacts including tools and flakes (Marshall 1985). Thus far 75 percent of the new 3-m² area has produced more than 1,500 lithic artifacts, and I expect that once excavations are complete this figure will be well over 2,500. The volume of artifacts in this unit indicates intensive Paleoindian activities. While some previous units contained dense deposits, this new activity locus indicates that Shawnee-Minisink consists of several discrete areas over the presumed extent of the site, some of which may be the result of subsequent Paleoindian occupations.

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A Kirk Corner-Notched Point Cache from the Nipper Creek Site (38RD18), South Carolina

Albert C. Goodyear, William Radisch, Ruth Wetmore, and V. Ann Tippitt

The Nipper Creek site (38RD18) has been previously discussed in this journal owing to its unique geoarchaeological context (Goodyear et al. 1986). It is located 15 km northwest of Columbia, South Carolina, near the junction of Nipper Creek and the Broad River. Although located in the Carolina Slate Belt of the Piedmont Province, the site is dominated by the mass wastage of sands related to the decomposition of a granite pluton that locally invaded the Slate Belt rocks. This has created a colluvial fan of sands that has been burying land surfaces downslope for over 16,000 years (Goodyear et al. 2003). Nipper Creek is a stratified, multicomponent, prehistoric site with occupations ranging from Paleoindian to Mississippian times (Wetmore 1987; Wetmore and Goodyear 1986). The early-Archaic (10,000-8000 RCYBP) remains are particularly rich. The cache was found during the 1986 University of South Carolina field school directed by Goodyear and Wetmore. In 1970, sand was stripped from about 6 ha of the site for commercial use. Archaic-age artifacts were widely exposed from mechanical stripping. The cache was exposed from the mining in the extreme northeast area of the site.

Two points were exposed on the surface 5 cm apart. The immediate area was troweled, and a third point was found 10 cm from the first two. Two more points were found 15 cm to the west of the first three, and a sixth point was found 60 cm to the north of the other five. A total area of 10 contiguous square meters was excavated around the point cluster to ensure that no other points were present. The original five points came from an area 12 by 22 cm. These points, plus the sixth one to the north, were all found vertically within 5-10 cm of each. No pattern was present in terms of the orientation of the tips. No pit outline was seen, and the points appear to have been resting on a common surface or in a very shallow pit. Although their exact depth below the original ground surface is unknown, small flakes and pieces of fire-cracked rock were present in the firm soil matrix around the points, indicating that they were part of the original archaeological deposit. No other worked artifacts or faunal remains were found in the 10-m² area. Bone is not typically preserved in the acidic sandy soils of the site (Wetmore and Goodyear 1986).

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Because of stripping, it cannot be determined that every item in the original cache was recovered. However, there is no doubt that the six whole points represent intentional human placement. Such a cache is highly unusual in southeastern U.S. archaeology, so their attributes are worth reporting.

All six points seem serviceable as projectile points (Figure 1). The tips are intact, and the shoulders are wider than the bases. One has a needlelike tip, typical of early-stage early-Archaic notched points. The blade edges are all bifacially retouched, typical of metavolcanic early-Archaic points in the Carolinas. The five metavolcanic points are heavily ground on their bases. The Ridge and Valley chert point (Figure 1E) is only lightly ground on its base. The metavolcanic pieces are a high-quality rhyolite, typically found in the Uwharrie Mountains area of central North Carolina. Three of these (Figure 1B, D, F) are the classic flow-banded type known to come from the Morrow Mountain quarry area (Daniel 1998). The other two may be flow-banded also but are too weathered to tell. The single Ridge and Valley chert



Figure 1. The six Kirk Corner-Notched points from Feature 24, the Nipper Creek Site, 38RD18, South Carolina. Photo by SCIAA-Daryl P. Miller.

point is probably from the eastern Tennessee area (S. Upchurch pers. comm. 1987). Early-Archaic notched points made from this exotic chert consistently show up in small percentages in the Carolinas.

Caches in archaeology are like time capsules in that all items must be

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considered contemporaneous. In this case, only corner-notched points were included, a finding expected with the 9500–8900 RCYBP Kirk time horizon (Chapman 1985). The raw materials are all exotic to South Carolina; the North Carolina rhyolite source is some 150 km away to the northeast, and the single chert point is likely from eastern Tennessee, some 300 km or more to the west. Extensive geographic mobility or exchange is implied.

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Long-distance Movement of a Clovis Obsidian Projectile Point

Steven R. Holen

The Blackwater Draw site was brought to the attention of E. B. Howard of the University Museum in Philadelphia by A. W. Anderson of Clovis, New Mexico, in 1932 (Howard 1935:299). Both Anderson and George O. Roberts are known to have collected extensively from this and other nearby sites and to have assisted Howard with the original work at the site (Howard 1935:299; J. Hester 1972:3). George Roberts donated an obsidian Clovis point (Figure 1) to the Colorado Museum of Natural History (now the Denver Museum of Nature and Science) in 1936 that is thought to have come from the Blackwater Draw site. It is possible, however, that the point was collected from one of the nearby blowouts in Blackwater Draw.

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Figure 1. Obsidian Clovis projectile point found by George Roberts in the Blackwater Draw area, face A on the left.

The artifact is made from a type of obsidian that is banded and partially translucent clear and gray to black in color. It is fluted on both faces (Figure 1) and has a ground base. It is complete except that it is missing the extreme tip and one ear. Dimensions in cm are:

length	10.26
width	3.58
basal width	3.28
thickness	1.06
fluted thickness	0.47

The artifact weighs 36.8 grams. The left edge of face A is battered and dulled, and it is apparent this artifact was last used as a butchering tool.

At least one other obsidian Clovis artifact from Blackwater Draw is reported by J. Hester (1972:49), who indicates one "shattered obsidian projectile point of undoubted Clovis type was present two inches from the next vertebrae" of a mammoth. Johnson et al. (1985) used X-ray fluorescence to source this obsidian to the Jemez Mountains in northern New Mexico some 350 km northwest of Blackwater Draw.

The Clovis point found by Roberts was sent to Richard Hughes for X-ray fluorescence analysis, and it was determined that its source is located in the Wild Horse Canyon area of the Mineral Mountain Range in southwestern Utah, approximately 950 km from the Blackwater Draw Site. This obsidian was first identified by Nelson and Holmes (1979) and Nelson (1984). This record of obsidian movement is the second-longest distance movement of an obsidian Clovis artifact recorded in North America. The single example of longer-distance Clovis movement of obsidian is recorded from the Kincaid Shelter on the southwestern edge of the Edwards Plateau in Texas (Collins 1999:181; T. Hester et al. 1985). The source of obsidian from which this broken projectile point was manufactured is near Queretaro in central Mexico, some 1,000 km from the site. This Clovis point represents the longest-distance Clovis movement of obsidian reported in North America.

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New Data on Late-Pleistocene Lithic Artifacts from the Hiscock Site (Western New York)

John D. Holland

The late-Quaternary Hiscock site (Laub 2003; Laub et al. 1988) contains an extensive assemblage of Pleistocene fauna as well as Paleoindian artifacts. Lithic tools are not numerous at the site (Ellis et al. 2003), hence this report on a new specimen and additional data on another.

In 2003, a trianguloid endscraper (Buffalo Museum of Science catalog number C30362; Figure 1A–D) was discovered deep within the productive Pleistocene unit. Its dimensions (30.9 mm long, 22.2 mm wide, and 11.3 mm thick) were compared with the average for 106 specimens from the Arc site (Tankersley et al. 1997), 24 km away, and fell well within the norm. Damage occurred to the left lateral section of the hafting area by an undetermined

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incident. Frequent resharpening of the distal edge resulted in a steep beveled angle.

A multi-spurred graver, also known as a coronet graver (Buffalo Museum of Science catalog number C30361, Figure 1 E–F), found in 1994, was described by Ellis et al. (2003) and is illustrated here for the first time. The artifact measures 16.1 mm long, 13.4 mm wide, and 4.1 mm thick, comparing favorably to the average proportions of three Arc site examples: 23.4 mm long, 21.6 mm wide, and 5.2 mm thick. Five of the six spurs are intact and display usewear patterns. The sixth was broken close to its base, although it is not clear if the fracture was through use or postdepositional agencies.



Figure 1. Pleistocene lithic artifacts from the Hiscock Site. **A–D**, trianguloid endscraper (Buffalo Museum of Science catalogue no. C30362); **A**, dorsal view; **B**, right lateral view; **C**, left lateral view; **D**, distal view. **E–G**, multispurred graver (BMS catalog no. C30361). Illustrations by William L. Parsons.

Both tools were made from local chert, the endscraper of Onondaga, the graver of Lockport. The Onondaga Formation in western New York comprises five chert-bearing members: Seneca, Moorehouse, Nedrow, Clarence, and Edgecliff (Holland, in press). Locally, Onondaga chert is exposed in outcrops, whereas Lockport chert has been found only in gravel deposits. All these lithic types were obtainable within 8 km of the Hiscock site.

While trianguloid endscrapers were constructed from nearly any quality of chert, multi-spurred gravers required more workable characteristics for finer flaking. Their needlelike projections for delicate tasks were made on very thin chert flakes. The two artifacts are probably of about the same age, yet their conditions are vastly different. The endscraper surface has severely deteriorated, muting the flake scars and smoothing the entire surface. The graver shows insignificant damage, especially to fragile spurs. Differential deterioration of these artifacts could be attributed to the interaction of factors such as oxidation, hydration, dissolution, and leaching (Honea 1964), the composition of the lithic material itself, and environmental associations. These two artifacts are added to an assemblage (Ellis et al., 2003; Tomenchuk, 2003) that reflects processing of materials rather than the killing of prey.

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Test Investigations at Deann's Folsom Site, North-Central New Mexico

Bruce B. Huckell and Susan Ruth

A 2000–2001 survey for Paleoindian sites near the Albuquerque Volcanoes resulted in the discovery of a small scatter of flaked-stone artifacts along the western edge of Petroglyph National Monument (Huckell 2002). A single channel flake fragment, along with several artifacts of a lustrous opaque white chert, suggested the site was possibly of early-Paleoindian age. However, it was unclear if (1) the site was a single-component occupation, or (2) if subsurface artifacts were present. With permission from the land owner, surface collection, mapping, and test excavation were initiated in July 2002 to resolve these questions; testing ended in November 2003.

The site-named for survey crew member Deann Muller, who found it-is

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located in a sheet sand deposit at the foot of a 10-m-high basalt butte at an elevation of approximately 1,475 m in a Plains or Great Basin grassland dominated by galleta, grama, three-awn, and rice grass, punctuated by scattered yucca, winterfat, fringed sage, and prickly pear. Approximately 60 m to the north is a small playa basin. The scatter measures approximately 75 m by 60 m in extent, with an area of high artifact density some 16 m by 12 m into which seven judgmentally placed 1-m² test units were excavated. The test units revealed portions of two soils: an older buried soil with Btb, Btkb, and Bkb horizons, above which lay Bw and A horizons from a younger soil. An abrupt, probably erosional boundary separated the Btb and Bw horizons, but artifacts were concentrated within both horizons.

A sample of 247 flaked-stone artifacts was recovered from surface (185) and subsurface (62) contexts. Fourteen (5.7 percent) were tools, including a Folsom point midsection, two biface fragments, six complete and fragmentary unifaces, a graver, and four utilized flakes. Also present were five channel flake fragments, which together with the point fragment are compelling evidence that the site is of Folsom age. Approximately a third of the tools and channel flakes were from subsurface contexts. The debitage, virtually all chert, made up the remaining 94.3 percent of the assemblage. In addition to the opaque white chert, locally known as "china" or San Andres Correo china (Amick 1994:129; LeTourneau 2000:431) and thought to come from the Zuni Mountains about 120 km to the west, a pale to dark mottled brown chert was dominant. This chert closely matches cobbles available in a Plio-Pleistocene fluvial gravel exposed 10 km west of the site in the Rio Puerco escarpment (Kelley 1977; Phillips 2003). Many of the flakes of this chert exhibited cortex, unlike the "china" flakes. This suite of raw materials strongly contrasts with those from the Boca Negra Wash site only 4 km to the east, which is dominated by Jemez obsidian, Pedernal chert, and Chuska (also known as Washington or Narbona Pass) chert (Huckell and Kilby 2000; Huckell et al. 2002, 2003). We hypothesize that the group occupying Deann's site came from the west or southwest, in contrast to the occupants of Boca Negra Wash who had come from the north and northwest. These differences indicate that Folsom mobility and land use patterns in northwestern New Mexico varied.

Also recovered were 40 small fragments of tooth enamel, 25 from surface and 15 from subsurface contexts. Both in thickness and general morphology, they most closely match bison; all were found in close association with the lithic artifacts. They are identical to enamel fragments from Boca Negra Wash (Huckell et al. 2003). We hypothesize that their occurrence at these two sites is evidence of opportunistic Folsom kills of small groups of bison around playas accompanied by short-term processing camps.

Hand auger and Giddings core exploration of the playa revealed lacustrine deposits over an area measuring at least 80 m in diameter and extending to a maximum depth of approximately 1.8 m. These deposits rest atop eolian sand and display significant internal variation in texture, color, and other sedimentological properties similar to the Boca Negra Wash playa. As is true of this latter playa, Deann's playa may contain a good paleoenvironmental record (Huckell et al. 2002).

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In late 2002, we discovered that W. James Judge had recorded this site 35 years earlier during his landmark study of Middle Rio Grande Paleoindian occupation (Judge 1973). He listed it as 9SI9, a Folsom locality, from which he collected two channel flake fragments, three pieces of debitage, and a complete San Jose point of basalt. We suspect that the latter is intrusive, and believe that testing has demonstrated that Deann's site is a single-component Folsom site with considerable research potential. Intensive excavations are planned for the future.

Thanks to Matt Schmader, City of Albuquerque; Gretchen Ward, Mike Medrano, and Michael Quijano, Petroglyph National Monument; and the State of New Mexico Historic Preservation Division for permission to test Deann's site. The site was discovered during a survey funded by the Historic Preservation Division, Office of Cultural Affairs, State of New Mexico (Project No. 35-00-15334.16); we gratefully acknowledge their support. We are indebted to UNM student volunteer excavators Oskar Burger, Marcus Hamilton, David Kilby, Kristin Koshgarian, Colby Phillips, and Christina Sinkovec. We also appreciate the work of Vance Holliday and James Mayer (both University of Arizona) to core the playa with a Giddings rig.

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A New ¹⁴C Date for the Late-Paleoindian Perry Ranch (34JK81) Bison Kill Site

Stance Hurst and Don G. Wyckoff

Elmer Craft and Lawrence LeVick discovered the Perry Ranch site in spring 1974 near Turkey Creek, a tributary of the Salt Fork of Red River in southwestern Oklahoma (Hofman and Todd 1997) (Figure 1C). Craft originally discovered the basal portion of a point (Figure 1A), and subsequent excavations by Saunders and Penman (1979) uncovered a second complete projectile point (Figure 1B) associated with a bison bone bed. Both projectile points were



Figure 1. Location of the Perry Ranch site in southwestern Oklahoma in relation to regional raw material sources, and the two projectile points uncovered from the site (point drawings by Don G. Wyckoff).

manufactured from Alibates agatized dolomite (Saunders and Penman 1979:56).

The main lingering question about the site concerns its chronological placement. Saunders and Penman (1979) concluded that the two projectile points were of the Plainview type. However, a bison bone yielded a ¹⁴C date of 7030 \pm 190 RCYBP (TX-2190), which is far younger than other Plainview sites (Johnson and Holliday 1980). Johnson and Holliday (1980:104) determined

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that the points were of the Golondrina type based on their morphological and technological characteristics and the late radiocarbon date. Johnson (1989:47–48) commented that the recurved edges of the points were "Dalton-like."

Hofman and Todd (1997:105) found that the Perry Ranch points fell within the morphological and metric range of the original Plainview-type specimens. They also found through chemical analysis of a long bone sample that the faunal material from the site was not reliable for obtaining accurate ¹⁴C dates even at the molecular level (Hofman and Todd 1997:106; Stafford et al. 1987). The ¹⁴C date of 7030 \pm 190 RCYBP was therefore considered by these researchers to be several thousand years too recent (Hofman and Todd 1997:107).

Recently, another attempt to accurately date the site was made on a petrous bone from the bone bed using the AMS technique. The very dense petrous bone was selected for dating because it was possibly less susceptible to contamination (L. Bement pers. comm. 2002). The analysis was performed by Stafford Research Laboratories, Inc., upon the XAD-Gelatin (KOH-Collagen) chemical fraction. The resulting date is 8460 ± 45 RCYBP (CAMS-95513).

The new bone date is closer to the currently accepted ¹⁴C age range for Plainview sites than was the first date from Perry Ranch. Plainview most likely dates to about 10,000 \pm 200 RCYBP, and might extend to as late as 9000 RCYBP. Thus, the new Perry Ranch date occurs too late in time to be acceptable as Plainview (Holliday 2000:268). Attempts by Holliday et al. (1999) to date the Plainview bone bed by AMS ¹⁴C, however, yielded a wide range of dates, the youngest of which was 8380 \pm 100 RCYBP (CAMS-38694). This, too, was rejected as too young for Plainview.

Three alternative conclusions can be drawn from the new Perry Ranch ¹⁴C date. First, the ¹⁴C date may be in error. Second, the date may indicate that the manufacture of the Plainview style continued to about 8500 RCYBP. Third, the two Perry Ranch projectile points may not be Plainview points at all. Continued investigations in the Southern Plains leading to the discovery of new late-Paleoamerican sites with good contexts for dating are needed to understand the development and transmission of projectile point styles during the early-Holocene period.

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Micromorphological Investigations at the Hedden Site (4.10), a Buried Paleoindian Occupation along the Southern Maine Coast

Richard L. Josephs and Arthur E. Spiess

The Hedden site (4.10) is a buried Paleoindian occupation along the southern Maine coast, York County, that dates to ca. 10,500 RCYBP (Spiess and Mosher 1994; Spiess et al. 1995). The site was discovered in 1990 during an archaeological survey of the area conducted by personnel from the Maine Historic Preservation Commission. Over the past 13 years, numerous lithic artifacts, diagnostic of the Paleoindian period, have been collected at the site. The occupation surface is a glacial outwash deposit that was subsequently buried by a "linear eolian landform," most likely a longitudinal dune, which appears to have remained relatively stable since the late Pleistocene (McKeon 1989; Spiess et al. 1995). The dune-outwash interface is not distinguished by the presence of a paleosol, indicating that environmental conditions were not conducive for pedogenesis or that the paleosurface was rapidly buried. Modern spodosols are developed in the overlying eolian parent material (Spiess and Mosher 1994; Spiess et al. 1995).

Micromorphology was used to investigate geologic and anthropogenic processes affecting the site (Courty et al. 1989; French 2003; Goldberg 1992; Goldberg and Arpin 1999; Josephs 2000; Simpson et al. 1999). The primary focus of the investigation was the interface between the outwash deposits and the overlying eolian sediments, i.e., the Paleoindian surface. A total of 24 sample boxes, yielding 48 thin sections, were collected from selected test unit profiles during the 2001 field season (Josephs and Bettis 2003). The thin sections were prepared by National Petrographic, Inc., Houston, Texas, and examined at the Department of Geology and Geological Engineering, University of North Dakota, with a Nikon Optiphot-Pol polarizing microscope. The procedure identified and described soil microstructure, basic mineral components, organic (plant remains) and anthropogenic (microdebitage) inclusions, and features resulting from soil-forming processes (pedofeatures). The descriptions follow the terminology of Bullock et al. (1985) and Stoops (2003).

Thin sections prepared from sample columns collected across the dune-

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outwash boundary evince clear distinctions between the upper eolian material and the underlying glacial outwash. The dune sediment is composed primarily of unoriented, moderately sorted, subrounded, medium sand-size, mono- and polymineralic grains with frequent (30–50 percent) void space. The outwash deposit is composed of unoriented, poorly sorted, subangular, predominantly sand-size, mono- and polymineralic grains. Void space is small (5–15 percent) owing to the higher percentage of finer material. The decrease in void space is vertically gradational from the dune material into the outwash deposit. Very few (< 5 percent) plant residues were observed in either of the depositional units.

In micromorphological terms, the dune sands display a single-spaced enaulic-related distribution pattern with a single-grain to intergrain microaggregate structure (Bullock et al. 1985; Stoops 2003). The outwash material has a single-spaced fine enaulic to porphyro-enaulic-related distribution pattern with an intergrain microaggregate structure (Bullock et al. 1985; Stoops 2003). The micromorphology strongly supports the results of previous grain-size analyses performed at the site (Spiess et al. 1995).

Chert was the predominant lithic raw material used at the Hedden site (Spiess and Mosher 1994). Because the nearest chert source is more than 100 km distant, all chert found at the site is considered to be the result of human transport and subsequent lithic reduction (Spiess and Wilson 1989). Chert fragments were present in all 48 thin sections. Overall, chert fragments from samples collected at or near the occupation surface are larger and more angular than those observed in the overlying eolian deposit. The smaller size and smoother edges of the fragments in the dune material suggest transport-related mechanical weathering. A variety of chert was used in the manufacture of stone tools at the Hedden site (Spiess and Mosher 1994); however, no attempt was made to identify the chert fragments seen in thin section to a specific type (e.g., Munsungun, Coxsackie, etc.).

Owing to the age and ephemeral nature of Paleoindian occupations, physical evidence of human presence is typically scarce. Quite possibly, the best evidence for such transitory occupations may well be found at the microscopic level. The results of this investigation are consistent with the previously published geomorphic, sedimentologic, and archeological findings (Spiess and Mosher 1994; Spiess et al. 1995). Not only did micromorphology corroborate the results of the larger scale studies, it also promoted its use as a technique for identifying potential archaeological sites where physical remains are sparse to nonexistent.

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Battered Implements and Milling Slab Rejuvenation from a Paleoindian/Archaic Transition Site

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There has been controversy concerning the presence of ground stone during the Paleoindian/Archaic transition (Erlandson 1994:45–47; Warren and Crabtree 1986:184, 187). The Skyrocket site (CA-CAL-629/630), located on Littlejohns Creek, 40 miles east of Stockton, California, has a sealed deposit, with a large concentration of ground stone (183 milling slabs and 70 hand stones) associated with a rock platform (Fagan 2003:86-98; La Jeunesse and Pryor 2003:42-44), and dated between 9410 \pm 250 (WSU 4929) and 7000 \pm 70 RCYBP (WSU 4616). Since ground stone has been treated as a "stepchild" in lithic analysis, there are processes related to its manufacture and refurbishing that have often gone unnoticed. The results of our analysis of the Skyrocket materials shows that a specific type of pecking stone (Adams 2002:152–153) was used to roughen the surface of the site's milling slabs, making them more effective as grinding tools (Binning pers. comm. 2004;

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Dodd 1979:231–242; Flenniken pers. comm. 2004). This type of pecking stone should be considered a potential "marker" for the Milling Stone Horizon and should be included in descriptions of ground-stone assemblages (Figure 1C–E).

Directly associated with Skyrocket's ground-stone assemblage are 118 pecking stones that appear to be *at variance* with either the site's lithic debitage or its formal tool assemblages. These implements, unlike the other tools, were often made from stream cobbles that still retained a significant amount of cortex, whereas the bifaces and unifaces were further along in their reduction sequences, following a different lithic trajectory. These pecking stones were predominantly manufactured from coarse greenstone, whereas the bifaces and unifaces were primarily made from a fine-grained greenstone (i.e., cryptocrystalline), making it unlikely that these tools would be used for lithic production, since they would be softer than the material being struck. It is our contention that these implements were manufactured and used to roughen the surfaces of the site's milling slabs.

All the ground stone from the earliest components at Skyrocket were exhausted, and a majority of them had had their surfaces rejuvenated through pecking (Figure 1A–B). The pattern of polish and pecking on Skyrocket's milling slabs is consistent with both our experimental work and reports by others (J. Binning pers. comm. 2004; Dodd 1979:232–34), in that the act of milling polishes the implement's surface, reducing its effectiveness by reducing the potential for shearing forces. The consequence is that repeated episodes of rejuvenation are necessary, deepening the milling slab's basin, and ultimately leading to its failure (Figure 1A).



Figure 1. Milling slab rejuvenation.

At the Skyrocket site, rejuvenation tools are broadly classified as pecking stones made from either cobbles (mean = 189.4 g) or cores (mean = 186.7). The former are either discoidal or multi-facial, while the latter are typed as bifacial, unifacial, or discoidal (Figure 1D, E, and C, respectively).

Irrespective of tool type, it appears that the tool users preferred tools with sinusoidal edges and sharp points for rejuvenating milling slabs. As a result of their efforts, the surfaces of slabs were gouged, producing longitudinal depressions (Figure 1B). Through repeated use the tool's edges became blunted (Figure 1E), requiring resharpening, which restored the edge and left behind a characteristic flake (J. Flenniken pers. comm. 2004).

Often archaeologists think of lithic production as a male activity, while ground stone is associated with women (Conkey and Spector 1984:11). However, the need to refurbish grinding equipment requires that the individual know something about lithic production as well as its rejuvenation, which questions the notion of gender-specific tool use.

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The Hiscock Site: Some New Developments

Richard S. Laub

The Hiscock site, a late-Quaternary locality in western New York State (Laub and Haynes 1988) was the subject of a symposium held in October 2001. The proceedings of this conference (Laub 2003a) consolidate the data and interpretations that have developed over the past two decades. The present paper updates matters that arose subsequent to the symposium.

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Several new radiocarbon dates were obtained. A specimen of conifer wood (probably spruce, field no. J5SW-38) is the first large piece of wood to be found in the Pleistocene horizon. It measures about 62 cm in length and 12 cm in diameter, and yielded an AMS date of $11,020 \pm 50$ RCYBP (Beta-172323).

A caribou (*Rangifer tarandus*) antler base gave an AMS date of $11,575 \pm 35$ RCYBP (field no. J4SE-33; CAMS-94852). This is the oldest date yet obtained from the Hiscock site. It is noteworthy that the next oldest, $11,450 \pm 50$ RCYBP, is also from a caribou antler base (field no. I3NE-164; CAMS-72353), which presents the possibility that caribou was a pioneer species in this region.

Laub (2003b:266-267) and Tomenchuk (2003:257) consider the possibility that Paleoindians at Hiscock were preying on caribou. The two foregoing ages predate the evidence of human presence here (Laub 2003a:266). A date of $11,040 \pm 40$ RCYBP on a third antler, however (field no. J4NE-49; CAMS-105852), is more consistent with human-caribou interaction.

From the mid to late 1990s, a concentration of mastodon tusks was found in the vicinity of a Pleistocene spring vent in one corner of the excavation area. This consisted of 7 of the 11 tusks found up to that time. In a recent publication (Laub 2003b:265, Fig. 10), it was speculated that this cluster was assembled by Paleoindians as part of a work area. Subsequently, a second concentration of tusks was discovered, also near a spring vent. This suggests an alternative and more parsimonious hypothesis: the concentrations reflect areas where mastodons focused their activities.

The vent where the second cluster was found is in the area of greatest spring activity today, and sedimentary features suggest this was also the case in the late Pleistocene. Unlike other spring vents that have been located at the site, this one is quite distinct. It is a vertical hole, 20 cm in diameter, that extends from the base of the fossiliferous Pleistocene unit (the Fibrous Gravelly Clay; see Laub 2003c:20–21) at least 1 m down into the underlying silt that constitutes the basement of the site. The vent is filled with sediment of the Fibrous Gravelly Clay unit, and so was active at the time of the mastodon presence here. It is located in the center of excavation quadrant I2NE (see Laub 2003c:Fig. 6).

In 1987, a tusk (H6SW-154) was discovered with an unusual feature. Almost its entire length was eroded into a flat surface that exposed the growth increments. Since 2001, three more tusks have been found with the same condition, and several others in which this condition is possibly incipient. The beveling affects the lateral rather than the medial side of the tusk and extends along the surface that forms the sides of the pulp cavity, suggesting that the erosion occurred after the tusks had come out of the socket in the skull (i.e., the erosion was post-mortem).

A Pleistocene lithic scraper (specimen I2SE-87) was found during the 2003 field season. Because lithic artifacts are uncommon at Hiscock, this specimen is figured and described in detail in a separate article by John D. Holland in this issue. A second Pleistocene lithic artifact (a graver, specimen F7SW-169), which was described earlier (Ellis et al. 2003), is illustrated for the first time in Holland's article.

One of the most significant new interpretations of the 2001 conference is

that, during the late Pleistocene, Hiscock was a salt lick (McAndrews 2003; Ponomarenko & Telka 2003). This explains the signs here of extensive animal activity, and apparent well-digging (Laub 2003d; Laub and Haynes 1998), at a time when postglacial lakes probably existed nearby. It also suggests why no evidence of long-term occupation of the site by Paleoindians has yet been found, since the high mineral content may have made this a poor source for drinking water. Finally, it even suggests that sediment ingestion by mastodons may have had a role in the formation of the basin itself (McAndrews 2003).

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The Distribution of Edwards Chert Folsom Artifacts in Socorro County, New Mexico

Philippe D. LeTourneau and Robert H. Weber

Socorro County, west-central New Mexico, covers a broad area from the Plains of San Agustín (PSA) on the west to just past Chupadera Mesa on the east. In between are several mountain ranges, the Rio Grande Valley (RGV), and the northern portion of the Jornada del Muerto (JDM), a structural basin east of the Rio Grande. The county also is home to numerous primary and secondary toolstone sources. In contrast to the Albuquerque Basin immediately to the north (Amick 1994a; Dawson and Judge 1969; Huckell and Kilby 2002; Huckell et al. 2003; Judge 1973; LeTourneau 2000), the nature of Folsom occupations in Socorro County has not been intensively studied, despite the fact that over 100 Folsom sites and isolated finds accounting for almost 1,000 diagnostic Folsom artifacts (Folsom points, preforms, and channel flakes, and Midland points) are dispersed across the county (LeTourneau and Weber 2004). About half of these artifacts have been briefly mentioned in the literature (Amick 1994a: Table 3.1, 365-366, 374-377). The sample discussed here provides an important opportunity to further examine Folsom technology and raw material use in New Mexico.

Our sample of 972 Folsom artifacts from 125 localities (sites and isolated finds) consists primarily of artifacts documented over a period of 50 years by the second author (Weber 1963). Represented in the sample are a wide variety of cherts (including Chuska, Cumbres Pass, Edwards, and Lake Valley Fm.), as well as quartzite, silicified volcanic sediment, silicified rhyolite, and obsidian from the El Rechuelos Rhyolite and Grants Ridge/Horace Mesa sources (LeTourneau and Weber 2004). In all cases we identified toolstone types macroscopically under white or ultraviolet light.

The toolstone from the most distant source is the Edwards chert. This chert, found in the several formations of the Edwards Group (Frederick and Ringstaff 1994:Figure 6.5), was one of the most widely transported materials during the Folsom period, reaching almost 1,000 km from its source areas (Hofman et al. 1991:304). The most comprehensive study of Folsom artifacts in Socorro County to date identified no Edwards chert (Amick 1994a: 365–66, 374–77; 1994b:60).

In the current sample, 71 artifacts from 21 sites (no isolated finds) are made of Edwards chert (Table 1). All but five of these artifacts are from sites in the northern JDM. One of the artifacts is from the eastern edge of the RGV, two are from the vicinity of Socorro Canyon (Dello-Russo 2001:15) just west of the Rio Grande, and two are from the PSA. All the artifacts are fragments; both points and preforms are represented by bases, midsections, and tips.

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While Edwards chert accounts for only 7 percent of all 972 artifacts, 17 percent of all 125 localities have some Edwards. The proportion of Edwards chert diagnostic artifacts at sites ranges from 3 percent to 100 percent (3 percent to 62 percent at sites with more than one Folsom diagnostic). Several of the 21 sites also have Edwards chert debitage and scrapers, although, because they are all surface manifestations, these nondiagnostic artifacts cannot be definitively linked to the Folsom occupations.

Region	Localities	Folsom points	Midland points	Preforms	Channel flakes	Artifact totals
PSA	2	2	0	0	0	2
RGV	3	1	1	0	1	3
JDM	16	9	6	8	43	66
totals	21	12	7	8	44	71

Table 1. Edwards chert Folsom artifacts in Socorro County.

The artifacts in our study are at the westernmost edge of the known distribution of Edwards chert Folsom artifacts. The closest recorded Edwards source near Big Spring, Texas (Frederick and Ringstaff 1994:Figure 6.5), is about 530 km east of the JDM sites, 570 km east of the RGV sites, and 625 km east of the sites on the PSA. It should be noted, however, that closer, more northwesterly Edwards Group outcrops may contain usable chert (Frederick and Ringstaff 1994). The two Folsom points from the PSA are the westernmost Edwards chert Folsom artifacts thus far identified in New Mexico.

In an examination of Folsom technology represented by our sample, it is worth noting that 73 percent of the Edwards artifacts are broken pieces from fluted-point manufacture (preforms and channel flakes). This is interesting evidence for fluted-point manufacture so far from the source. These artifacts are distributed among 12 sites, evidence that manufacturing was not an isolated occurrence. It appears that at least some of the preforms and channel flakes were produced on site rather than transported as curated items: 50 percent of the preform fragments are tips, and only 9 percent of the channel flakes have macroscopically visible use wear. By comparison, in a sample of 174 Edwards chert diagnostic Folsom artifacts from the Clovis site at Blackwater Draw, 290 km from Big Spring, only 33 percent are preforms or channel flakes (LeTourneau 2000).

One factor likely influencing this distant fluted-point manufacture is the proximity of high-quality toolstone sources to these Edwards fluted-point manufacturing sites. Distance to sources such as Socorro silicified rhyolite (Dello Russo 2004) and gravels of the Spears Formation and Santa Fe Group (LeTourneau 2000) averages only 12 km. Assuming direct toolstone procurement, it appears that some Folsom groups entering the northern Jornada del Muerto decided to reduce their stocks of surplus Edwards chert in anticipation of restocking at the nearby sources.

We are continuing our efforts to document the rich Folsom and other Paleoindian record in Socorro County.

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11Ls981: A New Fluted-point Site in Northern Illinois

Thomas J. Loebel

Recorded during an ongoing Midwest effort to produce broad geographic data on Clovis-period occupations (Hill et al. 1998, Loebel 1999, 2001), 11Ls981 represents a newly reported site containing the largest known early-

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Paleoindian assemblage (n = 170) manufactured on Hixton silicified sandstone ("Hixton") in Illinois. Located in LaSalle County, over 350 km south of the Hixton source area, the site's position on the south flank of the Arlington Moraine near the Little Vermillion River is well located to take advantage of upland resources and riparian settings. Pollen studies suggest the environment during occupation may have been a transitioning mixed coniferous and deciduous hardwood forest (King 1981).

Hixton accounts for 57 percent of the total lithic items recovered during controlled surface collections (n = 296). Surface distributions and recovery rates are suggestive of a buried component being brought to the surface by plowing and hillslope erosion. Local (25–50 km) cherts compose the bulk of the remaining items (n = 92), while smaller amounts (n = 34) of regionally (about 125 km) available cherts (Burlington, Moline, Payson) are also present. A light scatter of Holocene-period points, all manufactured on locally available cherts, has been recovered from the general site area. No later-period artifacts manufactured on Hixton have been recovered from the site or the immediately surrounding area; therefore it can be argued that all Hixton artifacts belong to the early-Paleoindian component. A flake of Jasper Taconite, likely derived from secondary sources near the Hixton outcrop areas, is considered to belong to the fluted-point assemblage.

Five bifaces, 34 unifacial tools, and 131 pieces of debitage have been recovered to date. Unifacial tools are dominated by sidescrapers and sidescraper fragments (n = 22), followed by endscrapers (n = 5), retouched flakes (n = 2), gravers (n = 1), and scraper fragments (n = 4). End-struck core flakes served as blanks for 14 unifaces, while 2 retouched flakes were manufactured on biface thinning flakes.

Bifaces include one fluted point, three Stage 3, and one Stage 5 manufacturing rejects (following Callahan 1991). The fluted point is a large (120 mm), well-fluted Gainey/Clovis–style biface with heavy grinding along the lower lateral edges and basal concavity. Although no channel flakes have been recovered, the presence of biface thinning flakes and mid-stage manufacturing rejects suggests biface manufacture on site.

Among Hixton flakes that retain intact platforms, biface thinning and core reduction flakes are represented in almost equal proportions, suggesting both tool manufacture and maintenance activities occurred on site. Unflaked weathered surfaces or cortex were present on 29 percent of debitage and 53 percent of tools, unusual considering transport distance. Flake size and weight were used to evaluate the state of the imported toolkit. Intact core reduction flakes had a mean weight of 21.2 g, a mean maximum size of 4.8 cm, and a mean minimum size of 3.9 cm. Intact biface thinning flakes had a mean weight of 8.9 g, a mean maximum size of 4.0 cm, and a mean minimum size of 2.5 cm. Average weight of the entire debitage assemblage was 5.5 grams per item, suggestive that some primary reduction occurred on site despite the distance from quarry source.

Platform attributes, debitage size, and cortex suggest that the discarded assemblage arrived on site in the form of minimally modified tabular flake blanks. The lack of cores within the assemblage supports the inference that transported flake blanks served mainly as the basis for tool manufacturing and maintenance activities conducted on site, although the large average size and weight of biface thinning flakes may be residual evidence of transported biface cores within the toolkit.

A certain logistical element is implied in the long-distance transport of a minimally modified toolkit. Transport of assemblages for reduction elsewhere may indicate decisions made to conserve toolstone in anticipation of future needs, which may signal the pursuit of relatively predictable resources. Large scrapers/butchery tools abandoned on site may also signal a decision to reduce transport costs or the intention to retool at nearby sources. A separate locality 1.2 km east has yielded several fluted points on locally available materials; scrapers of Moline, Burlington, and Knife River Flint; and a single flake of Hixton.

An assemblage dominated by sidescrapers indicates that processing- or butchering-related activities were primary on site, while biface manufacturing rejects suggest weaponry retooling after a hunting/kill event. Although the debitage sample is small, attributes suggest both biface manufacture and uniface tool manufacture and maintenance activities were conducted on site. While the assemblage is dominated by processing- and weaponry-related implements, the presence of endscrapers, traditionally associated with women in many hunter-gatherer ethnographic studies, suggests the site was occupied by a mixed foraging group (Halperin 1980, Hughes 1991).

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New Paleoindian Evidence from East-Central Kansas

Janice A. McLean and Jason Peter

Paleoindian artifacts are rare in the Kansas Osage Plains, yet this ecotone is a logical place to seek Paleoindian lithic material evidence linking the Great Plains grasslands to the oak-hickory forests of the Ozark Plateaus (Blackmar 2001; Hofman and Hesse 2002:21; Madole et al. 1991; Wetherill 1995). Did the Permian chert-rich Flint Hills, roughly intermediate between the Mississippian cherts of the western Ozarks and the lithic resources of the Kansas High Plains, function as a retooling stop between these regions, or do projectile point type distributions pattern with respect to this physiographic divide? What role, if any, did waterways play in transporting people and toolstone within and between these ecologically diverse regions? This paper attempts to instigate a macroscale approach to Paleoindian land use in eastern Kansas by summarizing lithic material and type assignments for 12 projectile points from Lyon, Morris, Chase, and Saline counties in the central Flint Hills section of the Osage Plains.

The archaeological sites and specimen numbers referenced in this paper include 14CS00362 (Dalton base RSBA-01), 14MO00412 (Dalton bases RSBA-02 and RSBA-03), 14MO00335 (Dalton base RSBA-04), 14CS00413 (Dalton base RSBA-05), 14LY00707 (Dalton bases RSBA-06 and RSBA-07, complete Clovis points RSBA-08 and RSBA-09, and Alberta stem fragment RSBA-10), 14SA00462 (Alberta midsection RSBA-11), and 14SA00453 (Allen midsection RSBA-12). Supplemental artifact documentation is filed according to site and specimen number in the on-line archaeological site database maintained by the Kansas State Historical Society in Topeka.

The two fluted Clovis points in this sample (RSBA-08 and RSBA-09) are both from 14LY00707, a site located in the Cottonwood River, drainage on the eastern edge of the Kansas Flint Hills. The only river south of the Kansas that traverses the east-west width of the Flint Hills, the Cottonwood River allows easy access between the Great Plains and the eastern Osage Plains. Clovis specimen RSBA-08 is manufactured from heat-treated Burlington-Keokuk chert from the Springfield Plateau section of the western Ozark Plateaus (Madole et al. 1991; Ray 1998, 2000). The second Clovis (RSBA-09) is made of Smoky Hill silicified chalk from northwestern Kansas or south-central Nebraska (Banks 1990). At a minimum of 300 straight-line km to the nearest bedrock outcrop, RSBA-09 is potentially the longest recorded Clovis movement of Niobrara jasper (Holen 2001:137). The exotic lithic material identifications for the 14LY00707 Clovis sample support models of Plains Clovis land use involving long-distance movements or toolstone transactions that transcend major physiographic and Ho-

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locene ecological divisions (Blackmar 2001:77–78; Holen 2001). Three additional Paleoindian artifacts from 14LY00707 include a thermally fractured Alberta stem fragment (RSBA-10) made from Permian chert, a Dalton point base (RSBA-06) made from Reeds Springs (Mississippian) chert, and a second Dalton point base (RSBA-07) made from thermally altered white Mississippian chert. The concentration of Paleoindian artifacts at 14LY00707 is unique for this area (Myers 1989), as is its concentration of thermally altered exotic lithics. Further research is needed to ascertain what enduring attraction this Flint Hills locality held for Paleoindians, and why Clovis and Dalton Paleoindians heattreated certain Mississippian cherts for transport into the Osage Plains, but apparently only rarely did so in the western Ozark Plateaus (Ray 1998:255–57).

The two Alberta specimens in this sample (RSBA-10 and RSBA-11) are both manufactured from high-quality Permian cherts that demonstrate a high level of familiarity with the toolstone resources of the central Flint Hills. Specimen RSBA-10 from 14LY00707 testifies to Alberta Complex utilization of the Cottonwood River, and RSBA-11 from 14SA00462 is significant because it documents westward movement of Permian chert via the Smoky Hill River basin. Aside from hinting at a grassland-oriented economy, these Alberta data help identify the Cottonwood-Smoky Hill River corridor as a potential route for long-distance transport of chert from the Ozark Plateaus to the west-central High Plains by subsequent Cody Complex Paleoindians (Myers 1989:43–45).

The Dalton sample (n = 7) includes artifacts from sites in the Neosho (14MO00412, 14MO00335) and Cottonwood (14CS00363, 14CS00413, 14LY00707) drainages. In addition to the two Mississippian chert specimens from 14LY00707, a third Dalton base (RSBA-03) is manufactured from an unidentified, thermally altered chert of probable Mississippian origin. The remaining four Dalton artifacts (RSBA-01, RSBA-02, RSBA-04, and RSBA-05) are all manufactured from unheated Permian cherts. This cluster of Dalton artifacts is of typological interest because the specimens, although broken, resemble "classic" Dalton specimens like those identified at the Sloan site (Bradley 1997). The typological confusion associated with Meserve-Dalton-Plainview clinal variation on the Plains (Knudson 2002; McLean 2003) is strikingly absent from this sample. This set of artifacts appears to represent groups who moved directly into the Flint Hills from the Ozark Plateaus, presumably via the Neosho River corridor, before the advent of social interaction and subsistence shifts that instigated reorganization of Dalton technology along the Plains-Prairie border. The Dalton artifacts from the Cottonwood drainage sites help document the gradual westward movement along riverine galley forests that preceded those evolutionary changes (Johnson 1989; Myers and Lambert 1985).

The final specimen, from 14SA00453 in Saline County, Kansas, is an Allen point (RSBA-12) fragment manufactured from Smoky Hill silicified chalk. Although several Allen complex sites in western Kansas hint at a redundant pattern of High Plains land use (Mandel and Hofman 2003), Allen points made of Permian cherts and Smoky Hill silicified chalk are common in private collections from drainages located in the Kansas and Oklahoma Flint Hills (Fox 2003:39–44). The largely unpublished distribution of Allen projectile

points in the Central Plains suggests a focal grassland adaptation, with the Flint Hills functioning as the approximate eastern boundary for this type distribution.

The study of Paleoindian land use requires scaling up data collection and analytical efforts to interpret data sets within and across regional boundaries. Significantly, the artifacts in this small sample are all from archaeological sites adjacent to or near major waterways. This fact implies that water transportation helped shaped Paleoindian land use and access to lithic materials in regions bordering the Kansas Osage Plains. While it is improbable that direct archaeological evidence of watercraft in the Plains archaeological record will be found, the concept merits consideration in regional studies of technological organization and land use. Research aimed at documenting Paleoindian gravel bar isolates by drainage segment, type, and lithic material would undoubtedly help clarify the role of riverine corridors as routes for moving people and toolstone within and across the Osage Plains. The preliminary lithic material data presented here suggest the study of type-level patterning with respect to ecological parameters is a complex issue requiring a substantial influx of new data. Research on Paleoindian land use patterns and lithic material economies in general would benefit from systematic initiatives to locate and document Paleoindian artifacts in private collections throughout the United States (Hofman 1996:77).

We thank Richard Stauffer and Brendy Allison for sharing their Paleoindian artifacts with us, and for the hospitality extended by Richard, Brendy, Mary Stauffer and Lee Allison on 17 January 2004 when we documented the specimens used in this study. The entire Stauffer-Allison collection (10,000+ artifacts) was recently donated to Wichita State University. Craig Smith coordinated our access to the Paleoindian artifacts in the Stauffer-Allison collection. Requests for the artifact documentation mentioned in this paper should be directed in writing to the State Archeologist, Archeology Office— Kansas State Historical Society, 6425 S.W. 6th Ave., Topeka, Kansas 66615-1099.

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Local Quartzite Utilization by Folsom Peoples in the Southern Plains

Shannon R. Ryan, K. Bruner, and Jack L. Hofman

The Vincent-Donovan site (Locality A) is the first documented Folsom assemblage in Kansas. The site is on an eroded terrace remnant in the Red Hills of Barber County in south-central Kansas. Recently, the base of an Edwards chert Folsom point (Figure 1A, A') was discovered near the edge of the terrace and the site was reported to the Kansas State Historical Society. Archaeologists with the Odyssey Archaeological Research Team visited the site in summer 2003.

Two test units on the edge of the terrace remnant yielded nine flakes. A probable midsection of an Edwards chert channel flake was among these artifacts. Two endscrapers were found on the slump surface, having eroded out of the

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Figure 1. Selected Edwards chert artifacts from Vincent-Donovan: **A** and **A'**, Folsom point base; **B**, endscraper.

terrace. One is a thin Edwards chert endscraper (Figure 1B) and the other a spurred endscraper of Dakota Quartzite. The presence of these four diagnostic Paleoamerican artifacts, in addition to other chipped-stone artifacts (modified and unmodified flakes, a chopper, and cores) of both local and non-local lithic sources, suggests a Folsom campsite with intensive use of local cobbles.

Seventy-four chipped-stone artifacts are recorded from Vincent-Donovan. Modified flakes and tools compose only 4.4 percent of the assemblage, while unmodified flakes account for the majority of the sample (95.6 percent). Among the unmodified flakes, quartzites (Dakota and Ogallala) constitute 66.7 percent, while non-local materials, including Alibates and Edwards chert, account for just over 15 percent. Among the modified flakes and tools, however, the proportion of non-local material is about 40 percent, while local quartzites account for 59 percent of this portion of the assemblage.

The presence of local quartzite at Vincent-Donovan is notable. Although use of quartzite has previously been documented in Folsom assemblages (Hofman et al. 2001; Jodry 1999; Meltzer et al. 2002; Stiger 2002; Wormington 1957), it has not commonly been associated with Folsom collections. Of flakes from Vincent-Donovan, 46 percent have cortex, indicating the use of local quartzite cobbles in conjunction with material from quarries (following Stein 1985). The use of local quartzite at Vincent-Donovan provides further evidence of Folsom groups utilizing diverse lithic materials. Further investigations at the Vincent-Donovan site should increase our understanding of Folsom lithic material utilization in the Southern Plains.

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Investigations at the Hot Tubb Folsom Site (41CR10), Crane County, Texas

John D. Seebach

Field investigations were recently carried out at the Hot Tubb site, located in the sandhills east of Crane, Texas. In the early 1980s, three Folsom points were found eroding from a large interdunal blowout. The projectile points were in apparent association with many complete bison bones. The site was reported to Michael Collins, who visited the locale in 1985. With several others, Collins hypothesized that Hot Tubb contained intact evidence of a Folsom-age bison kill (State Site File, Texas Archaeological Research Laboratory).

SMU-QUEST initiated fieldwork at Hot Tubb in 2002, which continued in 2003. Because artifacts and bones are eroding onto the floor of an active dune, we undertook a series of "surface skims," whereby the surficial mantle of eolian blowsand was shovel-skimmed and screened (through 1/8-inch mesh) and all archaeological remains were collected. A total area of 364 contiguous m^2 of the blowout and surrounding dunes was skimmed. Additionally, a number of test excavation units were excavated. This brief report documents primarily those remains recovered through the surface skims.

Hot Tubb is known primarily as a Folsom site, yet not all the collected remains are referable to the Paleoindian period. Our work, however, did yield eight Folsom and Midland points, primarily fragments. Between the time of the site's discovery and the present day, avocationals collected an additional four point fragments. The total number of Folsom/Midland projectiles known from Hot Tubb is 15. A large number of bone elements and fragments that probably represent Folsom-age bison (Byerly and Seebach 2004) were also recovered.

Approximately 57 kg of bone (497 g are burned) and 18,903 flakes were

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collected from the surface skims. The majority of the faunal remains are fragmentary and not indicative of specific elements, much less species. However, a number of specimens, predominantly the densest elements in the skeleton (e.g., sesamoids, tarsals, carpals), are assigned to *Bison* sp. Preliminary examination of the faunal collection has also identified various portions of bison cranial, axial, and long bone elements. In addition to these, a concentration of bone was uncovered during excavation. Among the bones uncovered were a complete proximal femur and a complete radius. Both are attributable to *Bison*.

Despite evidence for mixing of the archaeological materials at Hot Tubb, the surface skim data indicate the distribution of artifacts and faunal remains is nonrandom. The majority of lithic debris is found directly to the north of the bone distribution, which extends in an arc for approximately 5–7 m. All the burned bone is highly localized to the east of the non-burned bone. Furthermore, the area rich in burned bone from surface contexts generally corresponds to the subsurface concentration of bone, some of which is burned as well. All the diagnostic Folsom artifacts, including those collected avocationally, have been found to the north and west of the area yielding the greatest amount of bone. Relative to the projectile bases, a number of Folsom ear fragments have been found closer to the bone area. The clustering of these remains, unexpected in such an active sand dune setting, may suggest that erosion has not been so severe as to completely mask prior spatial patterning.

The current data from Hot Tubb therefore suggest the possible presence of discrete occupational loci during the Folsom occupation. That the majority of bones have been found well away from the locations of the Folsom basal fragments suggests a retooling location away from a kill/butchery locale. Four projectile ear fragments found closer to the bone distribution may represent pieces that were lost during a kill episode. Ongoing geoarchaeological analyses of the sediments at Hot Tubb will aid in assessing the integrity of the Folsom materials at the site.

The work at Hot Tubb was gratefully funded by QUEST Archaeological Research, David J. Meltzer, director. I also thank Dave for his editorial expertise, though he is not to be blamed for any inconsistencies in the text. Lastly, I would like to thank the Hot Tubb crew: Brian Andrews, Ryan Byerly, Judy Cooper, Liv Fetterman, Adam Graves, Curt Harrell, Tom Jennings, David Meltzer, Brian Mueller, Bert Pelletier, Michelle Rich, Joanna Roberson, Richard Rose, John Taylor-Montoya and Chris Wolff, most of whom spent many a long sweltering day doing nothing but surface skims.

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Paleoarchaic Obsidian Procurement Strategies in North-West Nevada

Geoffrey M. Smith

Addressing questions of mobility and technological organization of earlyperiod hunter-gatherers has become a major theme in Great Basin archaeological research (Elston and Zeanah 2002). Recently, geologic source provenance studies of artifacts from Paleoarchaic sites in the central and western Great Basin have identified obsidian procurement ranges that extend up to 450 km and follow a predominantly north-south pattern of distribution (Graf 2002; Jones et al. 2003). This pattern suggests that Paleoarchaic populations were highly mobile foragers with large settlement ranges who moved through the long and narrow north-south valleys of Nevada.

To further consider this model of far-ranging Paleoarchaic foraging, the Sundance Paleoindian research program has initiated a long-term study of technological organization and settlement in the Black Rock-High Rock region of northwest Nevada. This region is unique for Nevada because it is characterized by typical basin and range as well as volcanic tableland topography, and it also contains a number of obsidian sources. In this paper, we present the first results of our project, focusing on lithic assemblages from two Paleoarchaic sites, Moonshadow Spring and Moonshine Spring South. Located around upland springs in the Rabbithole Creek drainage along the western slope of the Antelope Range, these temporally discrete, typologically "clean" sites contain Great Basin Stemmed projectile points (Parman/ Haskett) (Pendleton 1979) and associated lithic tools, suggesting an occupation between 11,500 and 7500 RCYBP (Beck and Jones 1990, 1997). Twenty-six tools were collected from Moonshine Spring South and 73 tools were collected from Moonshadow Spring in August 2003. Obsidian is the dominant raw material of each assemblage, while cryptocrystalline silicates and finegrained volcanics occurred less frequently.

X-ray fluorescence (XRF) analysis of 59 obsidian artifacts from both sites has identified five known sources. Specifically, the Moonshine Spring South sample includes 11 artifacts of Mt. Majuba obsidian, three of Double H/ Whitehorse obsidian, and three of Massacre Lake/Guano Valley obsidian. The Moonshadow Spring sample includes 32 artifacts of Mt. Majuba obsidian, four of Double H/Whitehorse obsidian, and one each of Massacre Lake/ Guano Valley, Bog Hot Springs, and Hawk's Valley obsidian. Additionally, three artifacts from Moonshadow Spring are made on unknown obsidians. These sources lie between about 18 km and 143 km from the spring sites.

When obsidian procurement from Moonshine Spring South and Moonshadow Spring is compared with the nearby Coleman site, contrasting patterns emerge (Figure 1). The Coleman site, located in the Winnemucca Lake basin

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Figure 1. Map of northwestern Nevada showing locations of sites mentioned in text and respective obsidian sources.

only 65 km southwest of the Black Rock sites, exhibits a linear north-south pattern (Graf 2002), similar to those observed at other Paleoarchaic sites in the central and western Great Basin (Jones et al. 2003). In contrast, Moonshine Spring South and Moonshadow Spring exhibit a truncated pattern of procurement, with the bulk of material originating north of the sites. While the north-south distance in obsidian procurement at Coleman is over 350 km, it is only approximately 165 km for the Black Rock sites. Further, while the Coleman obsidian procurement sphere is linear in shape, the Black Rock sphere appears more radial. This suggests there may have been variation in the toolstone

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procurement strategies or subsistence ranges of early-period hunter-gatherers in northwest Nevada and central-western Nevada. Additional studies of this sort, modeled after those of Jones et al. (2003) and Graf (2002), may reveal that earlyperiod settlement ranges in the Great Basin were highly variable and perhaps structured according to differences in regional resource distributions. Whether such variation may also be the result of regional topography or some other factor is currently unclear and will be the focus of upcoming research.

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Results of the Lithic Analysis at Indian Sands (35CU67C), a Late-Pleistocene Site on the Southern Oregon Coast

Samuel C. Willis

Excavations conducted at Indian Sands (35CU67C), located in Curry County on the southern Oregon coast, during the 2003 field season recovered additional cultural material associated with a late-Pleistocene paleosol dated to $10,430 \pm 150$ RCYBP (Beta-173811, charcoal) (Davis et al. 2002-2004). The artifact assemblage is composed entirely of lithic tools (n = 23) and debitage (n = 2,775). Multiple analyses conducted on the recovered assemblage at 35CU67C were designed for the understanding of site function, toolkit organization, and possible activities associated with the assemblage (Davis et al. 2002–2004; Willis 2003). Raw material surveys undertaken at the site revealed that toolstone was readily available in Jurassic Otter Point (JOP) chert-bearing

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outcrops, which surround 35CU67C. Additional raw material studies including X-ray fluorescence (XRF) analysis demonstrate that the inhabitants were utilizing imported obsidian for toolstone as well. Results from the data at 35CU67C lend themselves to general ideas of late-Pleistocene mobility and technological organization utilized in the southern Oregon coast region.

Lithic tool and debitage trends allow for interpretations of site function. The minimally diverse recovered tools include 15 bifaces in varying degrees of production, one formal radial/tabular-shaped uniface, and seven non-formal unimarginally modified flake tools. The tool analysis reveals a high percentage (67 percent) of the biface sample falling within preform I and preform II stages (following Johnson 1989). The remaining biface assemblage comprises five foliate/leaf-shaped finished biface basal fragments. Aside from the one formal retouched unifacial endscraper, all non-formal flake tools are modified through utilization, resulting in unimarginal edge characteristics. Debitage analyses (following Andrefsky 1994, 1998) implementing a freestanding typology identified a high amount of broken flakes and flake fragments (93 percent), while a technological typology revealed multiple bifacial thinning flakes and core reduction flakes. Platform-bearing flakes with multifaceted and lipped platforms composed 45 percent of the sample. The lithic tool and debitage analyses in conjunction with raw material surveys conducted at the site corroborate earlier ideas of site 35CU67C being an upland site utilized for extracting usable toolstone with an emphasis on the manufacture and maintenance of bifacial implements (Willis 2003). Interestingly, results of the aggregate analyses and triple-cortex typology are not indicative of quarrylike behavior. However, chert nodules found within the surrounding JOP formations generally lack a weathered cortex and are of moderate size, which may account for this discrepancy (Willis 2003).

Multidirectional core use is evident from large core reduction flakes exhibiting high amounts of dorsal scars, following a multidirectional pattern, and platform lipping. Additionally, all bifacial, formal, and non-formal modified flake tools are made on medium to large flakes and lack true blade production. Generally speaking, toolkit organization at 35CU67C seems to be geared towards a multidirectional core and flake technology. Although direct evidence of cobble utilization is absent within the lithic assemblage from the paleosol, it is noted that foliate/leaf-shaped finished bifaces together with a core and flake industry provisionally resemble known "Pebble Tool Tradition" assemblages found at many early sites on the Northwest Coast. Because these sites are usually associated with the early Holocene (Carlson 1996), future analyses comparing the 35CU67C assemblage with other known "Pebble Tool Tradition" assemblages can address this matter.

XRF studies demonstrate that the moderate amount of obsidian tools and debitage recovered at 35CU67C (4.1 percent) were imported from interior sources in south-central Oregon and northern California. Specimens were sourced to Spodue Mountain and Silver Lake/Sycan Marsh volcanic sources of interior Oregon. Northern California volcanic sources represented in the lithic assemblage include Grasshopper Flat, Lost Iron Well, Red Switchback, and East Medicine Lake. Raw material procurement practices coupled with the use of a portable and generalized multidirectional core and flake toolkit focusing upon the manufacture of bifacial and unimarginal flake tools suggest inhabitants of 35CU67C followed a mobile and probable generalist-forager lifeway (Ames 2003; Kelly 1988). Although 35CU67C is in close proximity to the coast, evidence of marine resources within the paleosol is lacking. This may be due to the fact that the Pacific shoreline, and its potential food sources, was located 1.5-2.0 km away at $10,430 \pm 150$ RCYBP (Davis et al. 2002–2004). Another possibility may be attributed to the highly acidic nature of Northwest Coast soils, which may preclude organic preservation.

Finally, 35CU67C reveals that the use of an upland location adjacent to the Pacific coast, a generalized and flexible toolkit organization potentially functional in both terrestrial and maritime economies (Carlson 1998), and lithic raw material procurement strategies focusing on local and non-local toolstone sources are indicative of mobile late-Pleistocene peoples exploiting diverse resources with a well-developed knowledge of the southern Oregon coast region.

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Physical Anthropology

A New Early Human Skeleton from Brazil: Support for the "Two Main Biological Components Model" for the Settlement of the Americas

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Since late 1980s, one of us (WAN) has been suggesting that the cranial morphology of the first Americans (culturally called Paleoindians) is very different from that of late and modern Native Americans, and late and modern Northern Asians (Neves and Pucciarelli 1989, 1990, 1991). This finding was reinforced by further analysis involving other early South, Central and North American human skeletons (Brace et al. 2001; Chatters et al. 1999; Gonzaléz-José et al. 2002; Jantz and Owsley 2001; Munford 1999; Munford et al. 1995; Neves and Blum 2000, 2001; Neves et al. 1993, 1996, 1998, 1999a, 1999b, 2003; Powell and Neves 1999; Steele and Powell 1992, 1994, 1999). In brief, while the first South and Central Americans display a cranial morphology similar to that seen today among Africans and Australo-Melanesians, their contemporaries in North America tend to cluster morphologically with South Asians and Ainu-Polynesians (but see Powell et al. 1999 for an example of Australo-Melanesian morphology in USA).

Here we present further evidence from South America supporting the view that the peculiar morphology of the first Americans is a real trend of this population and not the result of sample bias (Dillehay 2000; Roosevelt et al. 2002) acting on a highly variable population (Van Vark et al. 2003).

Toca das Onças is a rich paleontological site located in the State of Bahia, Northeastern Brazil, explored by one of us (CC) in the late 1970s (Cartelle and Bohórquez 1982). Human skeletal remains pertaining to at least two individuals (one adult and one adolescent) were found in the same locus of

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the cave where different species of extinct mammalian megafauna (*Eremotherium laurillardi, Glyptodon clavipes, Pampatherium paulacorti* and *Smilodon populator*) were also uncovered. However, no clear stratigraphic association between the human and the megafauna remains could be established owing to damages caused by previous work of fossil hunters on the site. AMS radiocarbon dating proved impossible owing to insufficiently preserved collagen in the human specimens.

Different methods of multivariate analyses were applied to assess the morphological affinities of the adult male found at Toca das Onças. Howells's databank (Howells 1973, 1989, 1995) was used as comparative material, supplemented by a series of late Paleoindians from Lagoa Santa (Prous and Fogaça 1999) and two late-Archaic coastal populations (Tapera and Base Aérea) from southern Brazil (Neves 1988).

The results obtained by Principal Components Analyses (size and shape, and shape alone) based on 35 craniometric traits are shown in Figure 1. In both graphics the specimen shows an unequivocal association with Lagoa Santa and the African and Australo-Melanesian series, while the two Brazilian late-Archaic samples are clearly associated with present Amerindians. Discriminant Function Analysis (size and shape) was also performed based on 31 craniometric variables. The specimen was classified as Lagoa Santa, Tolai, and Teita, in this order. Mahalanobis distances performed between the isolated specimen from Bahia and the comparative samples resulted in the following figures:

	\mathbf{D}^2	Typicality (%)	Posterior probability (%)
Lagoa Santa	31.2	45.4	39.6
Teita	40.0	12.8	11.2
Tolai	40.4	12.0	10.5

The remaining comparative series generated typicalities and posterior probabilities smaller than 10.0 percent.

Our results support the conclusion that the adult early male specimen from Toca das Onças, Bahia, exhibits the same cranial morphological pattern as other Paleoindian samples from South and Central America, and is very likely of an early-Holocene antiquity. The idea that the peculiar "Australo-Melanesian" morphology of the first Americans can be simply explained by sampling bias acting on a highly variable population is becoming more and more indefensible, as several isolated individuals from very different parts of the continent generate convergent results.

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Figure 1. Relationship between the series analyzed as seen through the first two Principal Components. The upper graphic shows the series without size correction, and the lower one shows the series corrected for size effects. Note the clear association of Toca das Onças (TOCA) with Lagoa Santa (LSANTA) and African and Australo-Melanesian series. Both analyses were performed based on the following Howells variables: GOL, NOL, XCB, XFB, ZYB, AUB, ASB, OBH, OBB, MDB, FMB, NAS, DKB, WNB, IML, XML, MLS, WMH, SOS, GLS, FRC, FRS, FRF, PAC, PAS, PAF, OCC, OCS, OCF, NAR, DKR, ZOR, FMR, EKR and ZMR.

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Further Evidence of a Highly Cariogenic Diet among Late Paleoindians of Central Brazil

Walter A. Neves and Renato Kipnis

South American archaeology is becoming a crucial player in the debate of the initial colonization of the Americas. As Dillehay (2000:2) has recently stated, "In the last twenty years, excavations in South America have raised exciting new ideas and questions about the first Native Americans." One such issue is the subsistence economy of late-Pleistocene/early-Holocene foraging societies of the neotropics. Archaeological studies in the Amazon (Roosevelt et al. 1996, 2002) and in central Brazil (Kipnis 1998, 2002) have suggested that the subsistence economy of the late Paleoindians was centered on plant collecting. In the present paper we present further evidence to support this claim.

We report here a high incidence of dental cavities among the adult (all categories) human skeletons (29 individuals) uncovered by Peter Lund at Sumidouro Cave (Lagoa Santa) in 1842/1843. These human remains are now known to be older than 8000 RCYBP (Piló et al. in press). Figures in Table 1 refer to a sub-sample of 91 teeth still lodged in their original sockets. Caries frequency is 7.7 percent, a high incidence for hunter-gatherers (Larsen 1987;

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Tooth	Upper dentition	Lower dentition	Total
C1	-	0/4	0/4
L1	-	0/4	0/4
С	-	0/4	0/4
PM1	-	0/4	0/4
PM2	-	0/8	0/8
M1	1/7	1/18	2/25
M2	1/11	3/19	4/30
M3	1/1	0/11	1/12
	3/19 (15.8%)	4/72 (5.5%)	7/91(7.7%)

Table 1. Frequency distribution of dental cavities in Sumidouro dentition (number of carious teeth divided by total number of dental pieces studied).

Turner 1979). As a control, a set of isolated teeth found in the same site was also screened. This sub-sample generated an incidence of 9.2 percent (5/54). With the two sub-samples taken together (differences are not significant), the rate reaches 8.3 percent (12/145). If a 95-percent confidence interval is determined for this proportion, the upper and lower limits are respectively 14.2 percent and 4.3 percent. The lower limit is still well above the range of caries incidence (1-2 percent) among hunter-gatherers presented by Turner (1979). Because of the extremely high degree of dental wear among the individuals from Sumidouro, our figures should be seen, in principle, as an underestimation. However, the predominance of posterior teeth in the sample may have counterbalanced this trend.

The incidence of tooth decay in Sumidouro is similar to the one reported for a late-Paleoindian occupation at Santana do Riacho I (SR1), not far from Sumidouro. The overall frequency of caries at SR1 for adults is 11.0 percent (Neves and Cornero 1997). The frequency of dental cavities at SR1 and Sumidouro are high values for hunter-gatherers, and they suggest a diet rich in carbohydrates (Larsen 1987). The values reinforce the idea that at least in South America, Paleoindian subsistence was not based on big-game hunting, and that the first South Americans relied significantly on plant resources for their survival, an idea opposite to the still-prevailing belief that the first Americans specialized in big-game hunting (Dixon 2001).

This should be no surprise because diet breadth models constructed on evolutionary ecology theory and paleoenvironmental data suggest that plant resources should have been an important part of the diet because high-ranked resources were absent or extremely rare in neotropical South America (Kipnis 2002). This seems to be the case for late-Pleistocene and early-Holocene occupations in central Brazil (Kipnis 2002) and Amazonia (Gnecco 1999; Gnecco and Mora 1997; Roosevelt et al.1996).

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Paleoenvironments: Plants

A Younger Dryas Pollen Spectrum from Blacktail Cave, Lewis and Clark County, Montana

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Blacktail Cave, in the Northern Rocky Mountains of west central Montana, contains a lithostratigraphic and biotic record ranging from the middle Wisconsinan to the late Wisconsinan. It is in Lewis and Clark County, on the east side of the Continental Divide, within the drainage of the Dearborn River. AMS ¹⁴C dates on bone collagen from the deposit range from 37,000 to 10,000 RCYBP (Hill 2001). Four sediment samples form the Blacktail Cave sedimentary sequence were analyzed for pollen; a single sample contained pollen. Here we describe the pollen spectrum from this sample and its chronologic and stratigraphic context.

The Blacktail Cave sample was collected from the north wall of excavation Unit F, away from a late-Pleistocene entrance into the cave. The sample is from near the top of the stratigraphic section that is overlain by a calcite flowstone deposit (Hill 2001). Bone collagen from mammal fossils recovered in the same stratigraphic unit as the pollen sample has radiocarbon ages of $11,240 \pm 80$ RCYBP (Gx-21557) and $10,270 \pm 115$ RCYBP (Gx-21558). Prior to the deposition of the flowstone, the sediments containing the pollen sample were probably part of or dating to the surface of the cave floor, near the late Pleistocene approximately just before or during the time associated with the Younger Dryas chronozone.

The pollen sample collected from Blacktail Cave was treated with a modified Faegri and Iverson (1975) technique (addition of KOH, HCl, HF, and acetolysis), sieved through 7-micrometer Nitex screens (Cwynar et al. 1979), stained with safranin, and stored in silicone oil for counting. In addition, one standard *Eucalyptus* tablet was added to each sample in order to determine pollen concentration values (Maher 1972).

The Blacktail Cave pollen spectrum is slightly dominated by arboreal pollen (52 percent). *Pinus* (pine, 32 percent) is the most abundant arboreal pollen type, followed by *Salix* (willow, 10 percent), then *Betula* (birch, 7 percent). *Picea*

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(spruce), *Populus* (aspen), *Alnus* (alder), and *Corylus* (hazel) are all less than 2 percent. The composites, Liguliflorae (subfamily of Asteraceae, 13 percent), Tubuliflorae (subfamily of Asteraceae, 10 percent), *Artemisia* (sage/wormwood, 6 percent), and *Ambrosia*-type (ragweed, 2 percent) are the most abundant nonarboreal pollen types. Other prominent herbs are Cyperaceae (sedge, 5 percent) and Poaceae (grass, 4 percent). Chenopodiaceae/Amaranthaceae (goosefoot/amaranth), Caryophyllaceae (Pink family), Rosaceae (Rose family), Brassicaceae (Mustard family), and Lamiaceae (Mint family) are all present with values of less than 2 percent. *Pteridium*-type (bracken fern), *Dryopteris*-type (shield fern), and *Sphagnum* (sphagnum) occur at less than 3 percent.

The abundance of Pinus (pine), Salix (willow), and Betula (birch), and open-ground herbaceous plants suggests the presence of an open conifer/ deciduous parkland. The abundance of Liguliflorae (subfamily of Asteraceae), which is insect pollinated, may be the result of artificial concentration by deterioration, deposited by digger bees, or deposited as part of animal fecal material (Dimbleby 1985). Although Pinus is more abundant, the pollen spectrum from Blacktail Cave is similar to the pollen spectra recovered from the Oahe Formation (Huber and Hill 2003) and Holter Lake (Huber and Hill 2002). The Holter Lake samples represent late-glacial conditions, since they were recovered from sediments of Glacial Lake Great Falls, estimated to date to oxygen isotope stage 2 (Feathers and Hill 2003). The Blacktail Cave pollen spectrum reflects a slightly younger landscape approximately contemporaneous with the Younger Dryas chronozone, which might also be represented by deposits of the Oahe Formation along the Deer Creek drainage (Huber and Hill 2003) and OTL Ridge in eastern Montana (Hill 2003). The pollen spectrum from Blacktail Cave can be correlated to very similar pollen spectra of the same age from Forest Lake and Telegraph Creek, Montana (Brant 1980). However, the pollen spectrum from Blacktail Cave can not be directly correlated with the pollen spectra from Guardipee Lake, Glacier County, Montana (Barnosky 1989).

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A Late-Pleistocene Pollen Record from the Continental Shelf of Western Canada

Terri Lacourse

Heusser (1960) and Fladmark (1979) proposed that humans entered North America by traveling down the Pacific coast in the late-glacial period, when large portions of the continental shelf were exposed owing to low relative sea levels. To characterize the vegetation and paleoenvironment of the exposed continental shelf, I conducted pollen analyses on paleolake sediments retrieved from the shelf in Logan Inlet, located north of Richardson Island, one of the Queen Charlotte Islands on the coast of British Columbia, Canada. Diatom analyses indicate that Logan Inlet was a large freshwater lake between 12,000 and 10,400 RCYBP (Josenhans et al. 1997). The chronology (Figure 1) is based on linear interpolation among four AMS-dated plant macrofossils: 12,020 \pm 70 (CAMS-19510), 10,870 \pm 60 (CAMS-18753), 10,560 \pm 70 (CAMS-18752), and 10,440 \pm 50 (CAMS-18751) RCYBP.

At Logan Inlet, there is no evidence of the tundra vegetation that predates 12,500 RCYBP at most sites along the Pacific coast (Figure 1). The pollen spectra from this locality begin during the period of lodgepole pine (*Pinus contorta*) dominance and record the transition from pine- to spruce-dominated forests. Evidence for pine abundance is strong: pine pollen concentrations (up to 135,000 grains/cm³) and relative frequencies are high. Its local presence is confirmed by needles and their stomata in Logan Inlet sediments, as well as cones, wood, and rooted stumps at nearby sites (Fedje and Josenhans 2000; Lacourse et al. 2003). The only other tree that accompanied pine before 11,200 RCYBP was mountain hemlock (*Tsuga mertensiana*). Though its frequencies are low, they are sufficient to infer its local presence, probably as scattered upland trees. The principal palynological change occurs at 11,200 RCYBP,

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Logan Inlet Paleolake, Queen Charlotte Islands

Figure 1. Pollen and spore percentage diagram from a freshwater lake that occupied Logan Inlet on the coast of British Columbia in the late-glacial period. Only the most abundant pollen and spore types, plus a few indicator taxa, are shown. Gray curves represent 10x exaggeration. Total accumulation rates include pollen and spores from all taxa except aquatics. Triangles indicate the stratigraphic provenience of AMS radiocarbon dates.

when pine is replaced by spruce, likely sitka spruce (*Picea sitchensis*) or hybrid spruce (Warner and Chmielewski 1987). Shrub alder (*Alnus crispa*) and fern percentages and total accumulation rates are highest during the transition from pine to spruce forests. Fern spores are consistently abundant, suggesting ferns probably dominated the understory vegetation and edge communities. Other important components of the shelf vegetation include willow (*Salix*) and crowberry (*Empetrum nigrum*). There is limited pollen evidence of crowberry shrub; however, an AMS date of $11,990 \pm 50$ RCYBP on crowberry seeds (CAMS-61255) from a small pond on Richardson Island confirms its local presence. Wet meadow vegetation is represented by grass (Poaceae), sedge (Cyperaceae), valerian (*Valeriana sitchensis*), fireweed (*Epilobium*), gentian (*Gentiana douglasiana*), cow parsnip (*Heracleum lanatum*), and bunchberry (*Cornus unalaschkensis*) pollen.

These results are consistent with previous research (Barrie et al. 1993; Hetherington and Reid 2003; Lacourse et al. 2003) that demonstrated that the continental shelf along the coast of British Columbia was available for human occupation and movement between at least 13,500 and 9500 RCYBP, when moderate climatic conditions supported diverse and productive vegetation and intertidal fauna.

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Paleoenvironments: Vertebrates

First Data on Differential Use of the Environment by Pleistocene Megafauna Species (San Juan, Argentina)

Eduardo Martínez Carretero, Alejandro García, and María A. Dacar

Archaeological excavations at Gruta 1 and Gruta 2 rockshelters in the Morrillos de Ansilta locality ($31^{\circ} 43'$ S, $69^{\circ} 42'$ W, 3000 m a.s.l.) yielded some remains of *Megatherium* cf. *americanum* (a cranium and several teeth) and *Hippidion* sp. (bones and hooves) (Gambier 1995). These findings were associated with coprolites dated to $27,530 \pm 1800$ RCYBP (A-2930) (Gambier 1985). According to their size and morphology, one group of coprolites was assigned to *Megatherium* and a second group to *Hippidion* (Gambier 1995:20; Salmi 1955:315–316; Stokstad 1998:319). In order to obtain information related to the diet of these species and regional plant communities in the late Pleistocene, microhistological studies of three coprolites of *Hippidion* and one of *Megatherium* were performed (Table 1).

The species included in the diet belong mainly to the phytogeographic

Species	Hippidion (n = 3)	Megatherium (n = 1)
Hordeum sp.	20	7
Stipa frigida	50	
Descourainia sp.	10	
Fabiana peckii	10	21
Ephedra breana	10	37
Acantholippia seriphioides		7
Junellia seriphioides		7
Chuquiraga ruscifolia		21
Herbaceous plants (%)	80	7
Woody plants (%)	20	93

 Table 1. Specific composition of analyzed coprolites, given in percentages.

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provinces of Puna and Monte, such as *Stipa frigida* and *Chuquiraga ruscifolia* for the former, and *Acantholippia seriphioides* and *Fabiana peckii* for the latter. Besides these, the presence of *Hordeum* sp. and *Descourainia* sp. indicates a more humid environment, such as a *vega*. The clear difference in diet composition, specifically the exclusive foraging of *Stipa* and *Descourainia* by *Hippidion*, and of *Acantholippia seriphioides*, *Junellia seriphioides*, and *Chuquiraga ruscifolia* by *Megatherium*, is remarkable.

This information suggests a differential use of the environment by both megafauna species. *Hippidion* preferably consumed grasses (mainly *Stipa frigida* and *Hordeum* sp.), concentrating its activity in the *vega* at the foot of the slope where rockshelters are located, whereas *Megatherium* browsed the woody plants (i.e., *Fabiana peckii, Ephedra breana*, and *Chuquiraga ruscifolia*) dominating the landscape. Therefore, probably there was little competition between the two species for forage resources. Also, these data indicate a marked stability of the landscape and general environmental conditions at Los Morrillos from the late Pleistocene to the present, since this locality is situated in the present Puna-Monte transition and shows a vegetation similar to that one inferred from the archaeological record.

Additionally, this study allows further comparisons at a regional level with other similar records of ca. 30,000 RCYBP (Dacar et al. 2001; García and Lagiglia 1999), thus enhancing our database for discussing issues such as the paleoenvironmental conditions between 30° and 34° S, the diet of Pleistocene megafauna, and the causes of its extinction (García 1999).

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A Jefferson's Ground Sloth (*Megalonyx jeffersonii*) from the Terminal Pleistocene of Central Washington

James C. Chatters, Steven Hackenberger, and H. Gregory McDonald

In 1997, Dave Bishop and his wife, Jeanie Range, encountered fragments of bone and teeth while excavating for a drainage pipe on land they lease from the Washington State Department of Fish and Wildlife in Grant County, Washington (47° 09′ 50″ N, 119° 58′ 46″ W). During a visit to Bishop's ranch in 1999, the first two authors identified the remains as belonging to a ground sloth, which we later more precisely labeled *Megalonyx jeffersoni* on the basis of triangular-cross-sectioned molariform teeth. Subsequently, staff and students from Central Washington University reopened and expanded Bishop's drainage trench in an effort to establish the fossil's stratigraphic context. Despite obtaining additional bone and tooth fragments from trench fill, we did not find any bone in situ until a fragment of tooth was found in spring 2002.

The fossil consists of a fragmentary skull, eight teeth, the atlas, third cervical vertebra, fifth or sixth cervical vertebra, and a 16-mm-thick fragment of longbone shaft. Skull fragments include the nearly complete occipital and articulated portions of both temporals, with their zygomatic processes; a fragment of one jugal bone; alveolar and zygomatic portions of the right maxilla, with all four molariform teeth; the anterior alveolar portion of the left maxilla, with the first and second molariform; the palate; nasal processes of both maxillae, with the right caniniform; and unidentifiable fragments of neurocranium. The in situ tooth fragment is the mesial portion of the lower left caniniform. Measurements of the right caniniform (32 mm long, 16 mm wide) place this individual near the small end of the species' size range (see McDonald 1998a: 216, Fig. 4), indicating it was probably a female.

Antemortem and postmortem damage is evident in the bones that were recovered. Pathology of the neck is indicated by collapse, along with extreme pitting and osteophyte formation, in the body of the fifth or sixth cervical vertebra along with asymmetry in the articular surfaces and muscle attachments of the atlas and occipital. Carnivore gnawing marks the occipital condyles, and the superior surfaces of the skull were variably weathered to Behrensmeyer's (1978) stages 3 and 4 before burial. The lower caniniform and longbone fragment are also severely weathered.

Geologic context and ¹⁴C dating of bone collagen place the find in the

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terminal Pleistocene, when recession of the Okanogan Lobe of Cordilleran ice was well under way. The lower caniniform was found in massive eolian silt loam at a depth of 106 cm from the disturbed ground surface, 24 cm above the uppermost of a series of 13 rythmites that are attributable to outburst floods from glacial Lake Missoula. The last of these floods occurred approximately 12,700 RCYBP (Waitt 1985). AMS dating of collagen from a fragment of molariform tooth dentin produced a ¹⁴C age of 12,130 ± 50 RCYBP (15,500–14,500 CALYBP @ 2 sigma) (SR-5437).

Megalonyx jeffersoni has a widespread distribution throughout North America (Gillette et al. 1999; McDonald et al. 2000), but this is only the second find of the species in Washington State (McDonald 1998b). This new specimen, known as the Bishop Springs Ground Sloth, will be housed at the North Central Washington Museum, Wenatchee, Washington, under accession number NWSM 002-28.

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Middle-Wisconsinan (Pre–Last Glacial Maximum Interstadial) Mammoths in the Northern Plains, Western Interior North America

Christopher L. Hill

Strata and fossils assigned to the middle-Wisconsinan interstadial on the Northern Plains within the basins of the Missouri and Saskatchewan Rivers reflect regional conditions for the time interval immediately before the Last Glacial Maximum (LGM). This report provides AMS collagen ages and a description of mammoth remains recovered near Box Creek, Montana, and places these data within the regional context of other ¹⁴C ages and vertebrate remains for the non-glacial interval between the Illinoian and late-Wisconsinan glaciations.

Deposits attributed to the early-Wisconsinan or Illinoian glaciations are present in the upper Missouri Basin (Fullerton and Colton 1986; Klassen 1994; Lemke et al. 1965; Soller 1994). The late-Wisconsinan (Woodfordian) limit for the Laurentide ice sheet, with an estimated age of about 18,000 RCYBP, also appears to have extended into northeastern Montana and North Dakota. Within this glaciated region, Sandra Schillinger discovered fragments of a tusk in the vicinity of Box Creek, Montana. Don Lofgren, Director of the Raymond M. Alf Museum of Paleontology (Claremont, California) made the first collections of fossils and delivered them to Montana State University (Bozeman). Subsequent studies were undertaken (by the author) to assess the geologic context and age of the locality, as well as identify the taxa represented in the faunal assemblage recovered near Box Creek.

Box Creek is within the maximum extent of both the Illinoian (Wood Mountain Lobe, Markles Point till) and the late-Wisconsinan (Missouri Valley Lobe, Crazy Horse till) margins (Dyke et al. 2003, Fullerton and Colton 1986; Soller 1994). The Box Creek locality, Garfield County, Montana, is at an elevation of 689 m a.s.l. along the shoreline of Fort Peck Reservoir. It is about 5.6 km west of the McCone County–Garfield County Line and Rock Creek Bay (Ash Creek East, U.S.G.S. 7.5 Minute Quadrangle). The assemblage contains *Equus* (horse) and *Mammuthus* (mammoth). The metric attributes of a mammoth tooth indicate a possible affiliation with *M. columbi*, based on an M6(M3) with more than 18 plates (number of lamellae) and lamellar frequency ranging from 7 to 9. Two AMS ages are available. Analyses of tusk fragments indicate an age of $33,280 \pm 320$ RCYBP (Beta-155639) on collagen (extraction with alkali, KOH) and $32,660 \pm 620$ RCYBP (SR-6023, CAMS-82944) on XAD-gelatin (KOH collagen).

No other vertebrate remains in this immediate area have ¹⁴C ages associated with this time, although ¹⁴C ages are available from surrounding regions. For example, to the south, there are ages associated with just before or approxi-

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mately contemporaneous with the LGM. These include *Bison* with an age of 19,930 ± 70 RCYBP (Melton and Davis 1999), mammoth remains from the Yellowstone River valley in Montana recovered from Glendive terrace gravels with an age of 20,470 ± 80 RCYBP (Beta-155642) (Hill 2003), and proboscidean remains from the Beaver Creek gravels near Wibaux with an age of 26,000 ± 120 RCYBP (SR-6086) (Hill 2003). To the southwest, in northern Wyoming, fossils from strata 3–4 at Natural Trap Cave including *Camelops* (camel), *Equus, Symbos* (musk ox), *Arctodus* (short-faced bear), *Acinonyx* (cheetah), and *Panthera* (lion) are associated with ¹⁴C ages ranging from 21,370 +830/-920 (Dicarb-1689) to 17,620 +490/-1820 RCYBP (Dicarb-690), while mammoth is present in deposits younger than 14,670 +70/-730 RCYBP (Dicarb-689) (Chomko and Gilbert 1987). To the southeast, in South Dakota, remains of *Mammuthus columbi* and *Arctodus* are dated to about 26,000 RCYBP (Agenbroad 1994).

North of the Box Creek locality, mammoth remains are known from the glaciated region of northern Montana and southern Canada. Remains of Mammuthus from Tiger Butte near Frazer, Montana, are attributed to "Mammuthus boreus Hay (Mammuthus primigenius Blumenbach-Parelephas jeffersoni Osborne)" (Jensen and Varnes 1964). Remains of Mammuthus and Equus from south of Frazer were found in gravel overlain by a possible "Woodfordian" till, implying they are also older than the LGM (Jensen and Varnes 1964). Near Medicine Hat, southwest Alberta, ¹⁴C ages of 37,900 ± 1100 (GSC-1442-1) and 38,700 ± 1100 RCYBP (GSC-1442-2) on wood are stratigraphically at the base of fossil-bearing sediments containing Mammuthus, as well as Nothrotherium (ground sloth), Equus, Camelops, and Symbos (Stalker and Churcher 1982; Stalker 1996). Wood fragments with ages of 28,630 ± 800 (GSC-543) to 24,290 ± 200 RCYBP (GSC-205) were recovered from sediment stratigraphically above the fossil-bearing deposits (Stalker 1996; Stalker and Churcher 1982). Radiocarbon ages on vertebrate remains and wood for the region to the northwest ranging from about 46,000 to 21,000 RCYBP (Burns 1996) also appear to demonstrate habitable conditions during the non-glacial middle Wisconsinan. To the northeast, ages range from 38,000 to 21,000 RCYBP, with two ages similar to Box Creek on carbonaceous silt of 33,500 ± 2000 (S-252) and 33,000 ± 2000 (S-267) (Christiansen 1971, 1992).

The *Mammuthus* and *Equus* remains from the Box Creek locality appear to represent part of a biotic community that was present in the Northern Plains of the western interior of Northern America during the non-glacial before the LGM. The fauna at Medicine Hat may be approximately contemporary.

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New Information on the Pleistocene Mammals from Nicaragua

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Relatively little is known of the Pleistocene mammal fossils of Nicaragua, much less than of other Central American countries (Lucas et al. 1997). In February 2001, with the support of the Museo Nacional de Nicaragua, I was able to examine all the Pleistocene mammal fossils in the museum's collections and visit known fossil localities in Nicaragua.

The fossils come from three of the four physiographic provinces of Nicara-

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gua identified by McBirney and Williams (1965): the Pacific Coastal Plain, the Nicaraguan Depression and Interior Highlands. The swamps and rain forests of the Atlantic Coastal Plain have not yielded any Pleistocene mammals.

There are eight Pleistocene mammal localities in Nicaragua. Each of these is described below.

- 1. Jalapa is located near the Honduran border, where micaceous sands of an ancestral Rio Chorro yielded the fossil mammals reported by Leidy (1886). He identified the sloth *Megatherium*, a proboscidean, the horse *Equus*, the toxodont "*Toxodon*" (= *Mixotoxodon*), and a new species of capybara, "*Hydrochoerus*" (= *Neochoerus*) robustus. Some of these fossils (the horse, toxodont, and capybara) are still housed in the Academy of Natural Sciences, Philadelphia.
- 2. El Bosque is a debris flow and pond deposit southwest of Pueblo Nuevo, northern Nicaragua, documented by Espinoza (1976) and Page (1978). Pleistocene mammal taxa present include *Eremotherium*, the sloth family Megalonychidae, the glyptodont *Glyptotherium*, the gomphothere *Cuvieronius* (previously misidentified as *Stegomastodon*), *Equus*, the deer *Odocoileus*, and a notoungulate (Page 1978). ¹⁴C dates suggest the bones are older than 32,000 RCYBP. Espinoza (1976) claimed an association of stone tools with the Pleistocene mammals, but the "tools" he illustrated (also see Gruhn 1978) all appear to be fragments of rhyolitic volcanic rocks or igneous chert that are common at the site, so a human association with the Pleistocene mammals is not demonstrated. Unfortunately, all the fossil and archaeological collections from El Bosque apparently have been lost.
- 3. South of Lake Aranas (north of Jinotepe) some proboscidean postcrania were collected from lacustrine sediments, but these have been lost.
- 4. Palo Verde is located 8 km northeast of Sebaco. At that site, some proboscidean postcrania were also collected from lacustrine sediments, but these have been lost.
- 5. At Matagalpa, numerous bones and a molar of *Cuvieronius* were collected from the bank of the Río Viejo.
- 6. At Las Banderas, between Lake Nicaragua and Lake Managua, part of the skeleton of a fossil procyonid was collected from a pumiceous tuff, and mammoth bones were collected from overlying alluvium.
- 7. At Masachapa on the Pacific Coast, gray fluvial sands and gravels yielded bones of *Eremotherium* and bones and teeth of *Mammuthus columbi*.
- 8. At El Palmar, 7 km south of Rivas in southern Nicaragua, a partial skeleton, including a complete lower jaw, of *Mammuthus columbi* was collected from volcaniclastic pebbly sandstone. The lower jaw has a vertical ascending ramus, deep and robust horizontal ramus, and a vertical chin with essentially no spout. Dental measurements of the lower third molar are: length, 300+ mm; width, 95 mm; number of plates, 21+; plate ratio, 6; enamel thickness, 3.0 mm.

The Nicaraguan fossil record of Pleistocene mammals is meager, but a few preliminary conclusions can be drawn. First, like other Central American Pleistocene mammal records, a microfauna, especially of rodents, is essentially absent and needs to be a goal of further fieldwork. Second, like other Central American Pleistocene mammal records, the Pleistocene mammals of Nicaragua are almost all large edentates and ungulates, and are a nearly equal mixture of South American (glyptodonts, sloths, toxodonts) and North American (horses, deer, proboscideans) immigrants. Third, there is no demonstrated association of humans with extinct Pleistocene mammals in Nicaragua. Fourth, the relative rarity of the common Central American gomphothere *Cuvieronius* and relative abundance of *Mammuthus* may suggest a greater prevalence of savanna in western Nicaragua during the Pleistocene than in other Central American countries. However, this conclusion should be considered speculative given the lack of a detailed chronology of Nicaraguan Pleistocene mammal records and the small number of localities.

Frederick Lange, Ramiro Garcia and Edgar Espinoza made my work in Nicaragua possible.

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Late-Pleistocene Female *Bison antiquus* from Central Missouri

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In the United States, most well-dated late-glacial (15,000–10,000 yr B.P.) bison remains come from the Great Plains, Southwest, or Southeast (Faunmap

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Working Group 1994). We recently obtained a direct radiocarbon age on a *Bison antiquus* skull recovered from central Missouri. The specimen comprises both frontals, both temporals, both complete horn cores, and the occipital. All preserved sutures are fully fused, indicating that the represented individual was mature at death. Because the maximum spread of the horn cores of the central Missouri specimen we describe here fell near the middle of the chronocline presented by Wilson (1978:13) for terminal Pleistocene–Ho-locene horn core spread, we anticipated an age of 6000 to 8000 years. We obtained a single AMS date on collagen of 11,770 \pm 40 RCYBP (Beta–178174) [2 sigma calibration: B.C. 12,070–11,540]. The unanticipated late-Pleistocene age of this specimen, plus the paucity of well-dated late-Pleistocene bison remains from Missouri, suggest that it is worthwhile to place a brief description of the specimen in the literature. We use measurements defined by McDonald (1981:46; measurement number designations are his). In summary, the measurements are:

- 1 Horn core spread: 77.5 cm
- 3 Horn core length, upper curve: left 23.0 cm, right 23.0 cm
- 5 Dorsal horn core, straight line distance: left 22.5 cm, right 22.5 cm
- 6 Dorsoventral diameter, horn core base: left 7.34 cm, right 7.30 cm
- 7 Minimum circumference, horn core base: left 23.0 cm, right 22.5 cm
- 8 Width of occipital at auditory openings: 25.5 cm
- 9 Width of occipital condyles: 13.52 cm
- 12 Anteroposterior diameter, horn core base: left 7.13 cm, right 7.35 cm
- 14 Least width of frontals, between horn cores and orbits: 27.0 cm
- 15 Greatest width of frontals at orbits: 32.5 cm.

We compared these measurements with the averages of each for male and for female *Bison antiquus antiquus* as summarized by McDonald (1981:77). The central Missouri specimen is not statistically significantly different from either the male or female averages for measurements 1, 3, 5, 8, or 9 (Student's *t* test, p > 0.075 for all, one-tailed test). The specimen is not significantly different from the averages for females for measurements 6, 7, 12, 14, and 15 (p > 0.075for all, one-tailed test), but it is significantly smaller than the averages of those measurements for males (p < 0.025 for all, one-tailed test). On the basis of these statistical tests, we conclude that the central Missouri specimen represents a female.

If *Bison antiquus* behaved much like modern *Bison bison*, then it is likely that the central Missouri specimen we describe was part of a group of females (cows) of all ages, and a few young bulls. Mature bulls of modern bison tend to form separate groups except during the rutting season (Lott 2002; Shaw and Meagher 2000). The cranium of a breeding-age female suggests a resident group of bison occurred in central Missouri during the late Pleistocene.

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Late-Pleistocene Megafauna at Cueva del Puma, Pali-Aike Lava Field, Chile

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The Pali-Aike region is located in the steppes of Southern Patagonia, Chile and Argentina. It is characterized by a volcanic landscape, which is expressed as extinct craters, maars and lava plateaus. The modern fauna includes native species like the guanaco (*Lama guanicoe*), foxes (*Pseudalopex griseus* and *P. culpaeus*), puma (*Puma concolor*), skunk (*Conepatus humboldtii*) and ñandú (*Pterocnemia pennata*). Exotic fauna, mainly sheep, cattle, and horses, were massively introduced near the end of the 19th century. The presence of dogs is recorded well before that time.

Previous archaeological research in the region produced a detailed record of extinct fauna that includes ground sloth (*Mylodon* sp.), *Lama* sp., horse (*Hippidion saldiasi*), bear (*Pararctotherium* sp.), panther (*Panthera onca mesembrina*), and fox (*Dusicyon avus*) (Alberdi and Prieto 2000; Bird 1988; Prevosti et al. 2003; San Román et al. 2000).

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Taphonomic research focusing on the recovery and study of faunal remains at Cueva del Puma was initiated in October 2002. The cave is located at the Estancia "Brazo Norte," Chile, about 2 km from the Chico River. Its small entry opens toward the north on the external wall of an extinct crater. The cave was known to locals for decades, and in 1975 researchers of the Centro de Estudios del Hombre Austral, Instituto de la Patagonia, were notified of its existence. In 1999 members of this center visited the cave in order to evaluate its research potential. They found fresh guanaco, ñandú, and sheep carcasses on the surface near the rear end of the cave. On this basis the first phase of field work was planned.

Cueva del Puma is a large cave, whose maximum length is 49 m, with a variable width. Several lateral chambers of varied shape and size define a complex tunnel system. A 16-m-long passage, almost filled with sediments, leads to a large and complex dark chamber. The topography of this chamber is irregular and its height is variable, reaching a maximum of ca. 6 m. Both surface and stratigraphic samples were collected.

An important bone accumulation of both modern and extinct species was recorded on the surface. Modern fauna also included introduced species, which are particularly abundant in the main chamber. Their study clearly points to carnivores as the agents involved in their accumulation. The abundance of puma skeletons and scats, as well as the marks on the bones, strongly suggests the recent involvement of pumas. Other surface accumulations include *Lama* sp., horse, panther, bear, and canids remains, some of them with carnivore marks.

A test pit was dug in the entry passage. This sector is full of sediments, with bones of exotic and native species on the surface. The test pit immediately produced bones of extinct species, including horse. The size of the passage, about 60 cm in height, prevents adult medium-sized mammals from finding their way to the interior. Another test pit was located in the main chamber, and bones of Pleistocene fauna were found. Bad preservation makes it impossible to produce a date on an extinct horse tibia found at the lower level of this pit, but one radio-ulna splinter of *Lama* sp. with carnivore marks from the upper level of the pit was dated to $11,575 \pm 80$ RCYBP (Ua-21035), and a bear femur found on the surface was dated to $10,345 \pm 75$ RCYBP (Ua-21033).

The cave can be interpreted as a den that was used by more than one carnivore species, but it is not yet clear which are the specific agents that caused the bone accumulations. As already observed, the abundance of isolated puma bones and partial carcasses suggest that pumas were major agents. One puma humerus collected on the surface—and presenting good preservation of soft tissues—was dated to 98.4 ± 0.4 RCYBP (Ua-21034), demonstrating very recent use of the cave. Thus, it is not yet clear which are the carnivores implicated in the Pleistocene bone accumulations.

The importance of the modern taphonomic assemblage is that it has produced additional evidence on the puma behavior of transporting prey bones to cave dens. This behavior was previously recognized in Pali-Aike (San Román et al. 2000) and Lago Argentino, Provincia de Santa Cruz, Argentina (Martin and Borrero 1997).

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As for the older assemblages, the paleoecology of Pleistocene megamammals is poorly known, and we hope that our samples will provide useful evidence to amplify previous results (Bird 1938, 1988; Poulain-Jossien 1963; Prevosti et al. 2003; San Román et al. 2000; Scillato Yané 1976), with information on their size, diet, habitat, etc. Preliminary results suggest that panthers and other carnivores were agents in the accumulation of Pleistocene faunas at other Patagonian sites (Borrero et al. 1997).

The only evidence of human activity so far discovered at Cueva del Puma is a single sidescraper found on the surface of one of the lateral chambers. However, no evidence in the form of cut marks was found on the bones. All the evidence suggests it is basically a paleontological accumulation.

It must be emphasized that Cueva del Puma, with a temporal span of some 10,300 radiocarbon years, presents an impressive example of averaged fauna on the surface. Effectively, modern fauna—including both native and exotic species—are physically associated with extinct species on the surface of the cave. A dark and cold environment not exposed to the action of wind, rain, and sun, plus the activity of extinct and modern carnivores, and perhaps also humans, are responsible for this long-term accumulation of bones.

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First Evidence of Extinct Megafauna in the Southern Argentinian Puna

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Recent research carried out in the southern Argentinian Puna, specifically in Antofagasta de la Sierra (Catamarca Province, northwest Argentina), has led to the recovery of material corresponding to two species of extinct megafauna dated to the late Pleistocene. We have identified a species of ground sloth (*Megatheriinae*) and extinct horse (*Hippidion* sp.) that had not been previously detected in this region of the Argentinean Puna (26° 04' S, 67° 24' W).

Evidence of the presence of megaherbivores in this eco-region located above 3,300 m a.s.l. comes from the archaeological sites of Peñas de las Trampas 1.1 (PT1.1) and Cueva Cacao 1A (CC1A). The remains were found in the deepest strata of these sites, while archaeological occupations occur stratigraphically above them in Holocene-age strata. It is necessary to emphasize that in both cases, although no association was observed between the Holocene archaeological and Pleistocene paleontological remains, an evident sedimentary hiatus does not exist between them. In the case of rockshelter PT1.1 this time separation spans from 12,920 ± 190 RCYBP (UGA-9074) and 12,510 ± 240 RCYBP (UGA-9258) to 8440 ± 40 RCYBP (UGA-9073). For rockshelter CC1A, the interval is even larger and spans from 13,350 ± 300 RCYBP (UGA-9075) to about 3600 RCYBP. In both sites, the Pleistocene-dated layers have a matrix characterized by abundant vegetable macro-vestiges corresponding to disintegrated dung that include complete excreta belonging to the identified megaherbivores. Because of the excellent degree of preservation of these vegetable macro-remains-and particularly by the contents in the excreta-a detailed archaeobotanical study could be carried out. It was determined that the vegetable species consumed by these megafauna species are similar to existing species. On the other hand, analysis of these excrements confirms two clearly distinguishable types of phytophagous habits (considering composition and morphology): browser-grazer for the megaterino, grazer for Hippidion sp. Within this matrix diverse fossil remains were recovered, including fragments of diagnostic teeth for the taxonomic identification of the mentioned animals.

The discovery of this extinct fauna in the Puna has great relevance to

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paleontology, paleobiology, paleoenvironmental research, and archaeology. This becomes significant, since there is distinct evidence of synchrony between extinct fauna and human occupations in various sites assigned to the late Pleistocene/early Holocene of the Argentinean Pampas (Politis and Gutiérrez 1998), Argentinean and Chilean Patagonia territory (Borrero 1997, 2003; Borrero and Franco 1997; Miotti 1993), central Chile (Núñez et al. 1994, 2001), and recently Salar de Atacama (Núñez et al. 2002).

Particularly for Antofagasta de la Sierra, although neither contextual nor chronological associations with cultural components exist at this moment, the presence of this megafauna in the late Pleistocene opens a completely new avenue for exploring possible coexistence with the first human groups that inhabited this sector of the Puna. It is necessary to note that remains of *Hippidion* sp. were previously found in the northern Argentinean Puna (in Barro Negro at 3,820 m a.s.l.; Jujuy Province) between ca. 12,550 and 10,200 RCYBP (Fernández 1984-1985), without cultural association. Although the first human occupations of northwest Argentina took place within this period of time, the association of humans and megafauna has not been registered in any of the places dated to about 10,800–9800 RCYBP, such as at Inca Cueva 4 (Aguerre et al. 1973, 1975; Aschero 1980, 1984), Cueva Huachichocana III (Fernández Distel 1974, 1986), Pintoscayoc 1 (Hernández Llosas et al. 1996), and Quebrada Seca 3 (Aschero et al. 1991; Elkin 1996; Pintar 1996; Rodríguez 1998).

These discoveries outline an important point for the study of the paleoecological conditions of the late Pleistocene, keeping in mind the current extreme aridity of this southern sector of the Argentinean Puna (with precipitation less than 100 mm/yr). In this sense, the presence of these species establishes that paleoenvironmental conditions were wetter, producing sufficient vegetable covering and density to sustain the identified megaherbivores. This corresponds to the paleoclimatic model outlined for the period from 12,000 to 8000 RCYBP, the Tauca Phase, in other sectors of the Puna and its surrounding environment (Grosjean 1998; Núñez et al. 2002; Olivera et al. 2002).

The earliest archaeological materials of the southern Argentinean Puna come from the already mentioned Quebrada Seca 3 site (about 9800 RCYBP), where the interaction of humans and fauna is characterized mainly by the systematic hunting of wild Camelidae (*Vicugna vicugna* and *Lama guanicoe*) (Elkin 1996). Nevertheless, the proposition of the existence of even earlier human occupations than those provided by this site, dating to the period of about 12,000–10,000 RCYBP, corresponding to the transition of the Pleistocene/Holocene, seems plausible. In pursuit of this hypothesis, new evidence is being sought in archaeological sites in basins and lower courses of beds with permanent water that are linked to wetlands (*vegas*) or paleo-*vegas*.

It is still necessary to define, through interdisciplinary research, the paleoecological aspects that favored the survival, as well as the causes of extinction or disappearance, of the Puna megafauna, and the impact of the earliest human hunting in this sector of the central-south Andes.

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A *Bison antiquus* from Archuleta Creek, Folsom, New Mexico

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The remains of a bison were recently discovered along Archuleta Creek, a tributary of the Dry Cimarron River, at a spot just ca. 4 km from the Folsom type site. The bones were exposed in a deeply undercut, eroding section of the south bank of the creek. They consisted of a series of ordered vertebrae lying flat with their dorsal surfaces protruding out of the stream bank, suggesting the skeleton was on its side, oriented roughly parallel to the present drainage. The remains were found ca. 4 m below the present surface, lying along the upper, undulating surface of what appeared to be Pleistocene-age gravel, and largely contained within and overlain by fine, overbank sediments.

On initial field examination it was apparent the bones were from a very large bison, perhaps an animal within the size range of *Bison antiquus*. Its suspected age and taxonomic identity, and proximity to the Folsom site, raised the question of whether it was a paleontological or an archaeological occurrence, and, if the latter, whether the animal had escaped from the kill at Folsom and died on the floor of this nearby drainage.

The layout of the exposed vertebrae suggested much of the skeleton was still contained within the bank, but removing it would require deeply undercutting an already undercut profile, endangering both the skeletal remains and the crew. It was decided to excavate only the visible and most vulnerable skeletal elements and to examine the remains for associated artifacts.

Ultimately, 14 bones were exposed. All are part of the vertebral column, and

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include the atlas and axis, thoracic spines, lumbar vertebrae (including the sacrum), and scattered rib fragments. The bones occurred at intervals along a horizontal distance of ca. 2 m, but over a narrow vertical span (< 15 cm). The atlas and axis were removed for study; the remaining elements extended too deeply into the wall for safe removal. The latter were recorded, plaster-jacketed, covered, and left in situ. A rock diversion wall was built to deflect the stream's energy away from the section.

In general the bone is in excellent condition, having had only minimal subaerial exposure and surface weathering, and no apparent carnivore modification. With a few exceptions, the bones were flat or nearly so. Modal inclination values were $< 5^{\circ}$, which, along with the lack of patterned orientation and the absence of scratch marks on the bone surface, suggest fluvial reworking or animal trampling was minimal. There was, however, some slight post-mortem but pre-disarticulation contortion: both the neck and sacrum twisted outward toward the stream bed. The cranium would thus have been one of the first elements exposed and lost when the bank began to erode.

The absence of a cranium hinders ready taxonomic identification. However, the atlas and axis can be compared with metric data on *Bison antiquus* from Bonfire (Texas) Bone Bed 2 (Dibble and Lorrain 1968) and Finley (Wyoming) (Haspel and Frison 1987), and *Bison bison* from Glenrock (Wyoming) (data collected by LaBelle) and Bonfire Bone Bed 3 (Dibble and Lorrain 1968). As seen in Table 1, the maximum breadth and maximum length (variables M1 and M2 in Haspel and Frison 1987) of the atlases of *B. antiquus* are larger than those of *B. bison*; the differences are not significant (as measured by t tests). In turn, the Archuleta atlas is much larger in both dimensions (though again not significantly) than *B. antiquus*. Similar results are obtained in comparisons using the axis. The Archuleta bison is thus within the range of *B. antiquus*, and was perhaps a (very) large bull.

Species	Site	n	M1 (mm)	M2 (mm)
Bison bison	Bonfire Rockshelter Bone Bed 3; Glenrock (latter includes both males and females)	18	176.3	119.6
Bison antiquus	Bonfire Rockshelter Bone Bed 2; Finley	6	181.1	120.4
Bison sp. cf. antiquus	Archuleta bison	1	218.0	144.8

Table 1. Summary mean metric data for atlas breadth (M1) and length (M2) for *Bison bison* and *Bison antiquus* specimens compared with the Archuleta bison (comparative published data from Dibble and Lorrain 1968, and Haspel and Frison 1987).

A crucial question is whether the Archuleta specimen is the same antiquity as the Folsom bison, which have a mean radiocarbon age of 10,490 ± 20 RCYBP (Meltzer et al. 2002). The axis of the Archuleta bison yielded an age of 10,190 ± 30 RCYBP (δ^{13} C = -10.8) (CAMS-96033), younger by some 300 radiocarbon years than the remains at Folsom. When calibrated (CALIB 4.4), the respective radiocarbon ages overlap, but only at the 2-sigma level.

Although it seems unlikely that the Achuleta and Folsom bison were once part of the same herd, these ages fall squarely within the Younger Dryas, with

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its radiocarbon-distorting plateaus, and may ultimately prove to have a more significant temporal overlap. That said, we did not recover any Folsom artifacts in the sediment with the Archuleta remains. Barring any future discoveries of artifacts with the skeleton still deeply buried in the stream bank, we conclude the Archuleta bison died of natural causes, some time after the kill at Folsom.

Bison of late-Glacial age are quite rare in this region—save for those at the Folsom site—but the Archuleta bison is important beyond simply providing an additional data point or showing that the Folsom herd is not an anomaly. There is emerging paleoecological evidence that the region in Younger Dryas times was prime bison habitat, at least in summer. The Folsom and Archuleta records confirm that bison were indeed present on that landscape; and, more importantly, their geomorphic settings may help us gain a better sense of why such remains are otherwise rare in the fossil record of the region.

We would like to thank Jim Doherty for permission to work on the site; Leo Quintanilla for logistical support; Ethan Meltzer for help with the excavations; Ryan Byerly for aid in the faunal analysis; and Paul Matheus for isotopic and radiocarbon analyses. This work was part of a larger project on the geomorphic history of the Upper Dry Cimarron River, conducted under the auspices of the Quest Archaeological Research Program, Southern Methodist University.

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Narrowing the Spatial Range of Megafaunal Distributions on the Semiarid Coast of Chile

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

Archaeological studies over the last 13 years reveal a significant concentration of megafaunal remains in a restricted area of the semiarid coast of Chile (31° 50′ S), south of the Los Vilos locality (Jackson et al. 2003). Three prior research projects (FONDECYT 91-0026, 1950372, and 1990699) underscored the importance of these findings and led to further systematic investigation of

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this issue (FONDECYT 1030585). In 2003, surface surveys were conducted to establish where and under which conditions these particular bone assemblages appeared. The ultimate goal of this project is to assess eventual association with late-Pleistocene humans.

Given that the general area had been intensely explored before (six systematic surveys), the methodological strategy was structured with geomorphological and paleogeographic directives that promised the greatest potential for yielding Pleistocene records (Prieto and Jackson 1997; Varela 1981). Thus the search focused on drainages, their mouths, dune fields, recently eroded gorges on paleodunes, and small lacustrine basins. Surveys covered a total area of 101 km², along 25 small east-west drainages (with Pacific outlets), distributed along a coastal margin ca. 24 km long. Results were particularly clear. They confirmed the spatial concentration previously noted, a total of 22 sites yielding bones of extinct megafauna within 29 km². The research team found just two isolated sites outside this area; bone distribution defined the limits north-south and east-west. This area encloses a paleolacustrine basin originally defined (J. Varela 1981; Núñez et al. 1994) as the "Graben Central," a depressed tectonic basin filled with late-Pleistocene deposits. Field observations noted the existence of small restricted microbasins within this zone. We suggest that the relative altitude (m a.s.l.) of the bone deposits may be the result of varying contractions of these small lagoons due to increasing aridity towards the end of the Pleistocene.

Surveys showed 8 stratigraphic and 16 surface sites. The latter are a common feature given strong coastal eolian deflation caused by southwest winds. Some of the surface bone scatters are spatially associated with cultural remains, including lithic artifacts and ephemeral sea mollusk concentrations, as previously noted in the study area (Jackson 2002). Most commonly observed taxa were *Palaeolama* sp., *Mylodon* sp., and native horse, and in few occasions proboscideans. Anthropogenic marks on bones were registered in minimum quantity, in the form of systematic edge flaking and fresh fractures. To date, within the limits of this area, the only thoroughly investigated sites yielding extinct fauna are Quereo (Núñez et al. 1994) and El Membrillo (Jackson 2002), but only the former exhibits unambiguous cultural associations (Dillehay 2000).

Our conclusions about spatial tendencies are supported by these factors:

- 1. Since the system of lacustrine basins constitutes a propitious habitat for megaherbivores, the area and bone distributions are indicative of the Pleistocene environment.
- 2. Regional geomorphologic agents have exposed the remains of extinct fauna, which suggest the probable existence of deeply buried remains in other areas. Strong wind deflation over dune fields around the "Graben" has been especially instrumental in revealing faunal remains. Specific details about reported spatial concentrations are unlikely the result of observer bias, since the region is uniformly visible over its entire extent.
- 3. Differential preservation across the region probably helps to account for the presence or absence of findings in this area.

In summary, local paleogeographic factors led to the existence of small lagoons and an ecological refuge (Núñez et al. 1994) where herbivores, responding to environmental changes, congregated. Consequently, if human agency could be confirmed for at least some of the observed assemblages, that would imply a nucleated settlement pattern, strongly bonded to the presence of megafauna, towards the end of the Pleistocene. Future field campaigns will evaluate the issues and the hypothesis raised by means of systematic subsurface surveys in areas with the potential for Pleistocene records and by digging some of the sites herein presented.

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A New Last Interglacial Continental Vertebrate Assemblage in Central-Eastern Argentina

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The profuse vertebrate record of the Argentinian pampas during Pleistocene and Holocene times suggests mainly dry, cold, and open environments (Tonni et al. 1999). Several tropical and subtropical taxa have been found, indicating the occurrence of warm pulses (Vucetich et al. 1997). However, some of these taxa have been recorded in assemblages dominated by temperate or desert and semidesert vertebrates (Pardiñas 2004, in press).

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Recently we found a rich vertebrate assemblage in the top of a continental sequence in the Atlantic marine cliffs near Mar del Plata ($37^{\circ} 59' S, 57^{\circ} 33' W$, southeastern Buenos Aires province) (Figure 1A). In this fossiliferous locality, called Constitución, the vertebrate-bearing sediments form a thin (< 0.5 m) green-clay deposit (Figure 1B). Bone and tooth remains of more than 20 taxa (including fishes, frogs, lizards, birds, and mammals) were obtained by washing and screening.



Figure 1. Constitución locality. **A**, geographic location in southeastern Buenos Aires province; **B**, schematic stratigraphic profile. Arrow indicates the fosiliferous deposit studied here.

The assemblage is characterized by rodents that live in tropical and subtropical South American environments today. These is the case of some cricetids, such as *Bibimys* sp., *Scapteromys* sp., and *Kunsia* cf. *K. fronto*. The latter has a present distribution restricted to some few isolated localities in central Brazil and northeastern Argentina (Hershkovitz 1966). In the Constitución assemblage we also recorded numerous remains of an echimyid closely related to the living *Clyomys* (Vucetich et al. 1997). The spine rat *Clyomys* currently inhabits the Paraguayan Chaco to the Brazilian Cerrado (Avila Pires and Wutke 1981).

Sympatry area (*sensu* Rhodes 1984) for the cricetid rodents (except *Reithrodon* sp.) recovered at Constitución is located about nine degrees northward (ca. $26^{\circ} 50'$ S, $58^{\circ} 40'$ W). Raw extrapolation of climatic parameters indicates that the fossil assemblage was deposited under more humid and warmer conditions (ca. 1,500 mm of mean annual precipitation, and ca. 22° C of mean annual temperature; Formosa, 1981–1990 period) than those present in southeastern Buenos Aires province (mean annual precipitation = 921 mm, mean annual temperature = 14.05° C; Mar del Plata, 1981–1990 period). This paleo-environmental scenario is in agreement with interglacial conditions. In addition, there is no taxonomic indicator of cold-dry environments at Constitución.

We have no absolute dates for the Constitución assemblage (TL samples were negative), but assignment of this faunal assemblage to the last Interglacial (Isotope Stage 5e, ca. 120,000 yr B.P.) appears consistent with stratigraphic, magnetostratigraphic, and paleontological evidence. The deposit overlies loessic beds where the Brunhes-Matuyama boundary was recorded (Bidegain et al. 1998). In addition, the giant extinct armadillo *Propraopus* cf. *P. grandis* is present in the assemblage. This taxon is restricted to beds of middleupper Pleistocene age and was also recorded in last Interglacial deposits (dated by TL) at Centinela del Mar, another coastal locality ca. 70 km SSW of Constitución (Isla et al. 2000).

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Occurrence of Toxodonts in the Pleistocene of México

Oscar J. Polaco, Ana Fabiola Guzmán, and Gloria Tapia Ramírez

Toxodonts were American rhinoceros-like mammals, poorly known because of the scarcity of their remains. In October 2003, while attending a fossil recovery in Hihuitlán, Michoacán, by staff of the Instituto Nacional de

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Antropología e Historia, toxodont remains were identified; this finding confirms another one made in 1993 at La Estribera, Veracruz. In this paper we present the details of the Hihuitlán and La Estribera specimens.

The material recovered at Hihuitlán (18° 52′ 30″ N, 103° 24′ 14″ W, 351 m) includes a right horizontal ramus. It is broken at the posterior end of m_3 , so that it lacks the coronoid and angular processes, and it lacks the anterior part of the mandibular symphysis. Preserved in the horizontal ramus are a p_1 alveolus, p_2 , p_3 , and p_4 broken at the occlusal surface, and complete m_1 - m_3 (Figure 1). Also, an almost complete left m_3 occurs.



Figure 1. Toxodont right horizontal ramus from Hihuitlán, Michoacán (m1-m3 length is 145.4 mm).

The following measurements (in mm) and dental terminology follow Van Frank (1957), Madden (1997), and Nassif et al. (2000). For the horizontal ramus, symphyseal length is 143.3+, and maximum height (p_4 - m_1 level) is 104.8. For the teeth, p_1 - p_4 length is 91.4, m_1 - m_3 length is 145.4, i_3 maximum transversal length is 32.0, maximum anteroposterior length is 22.5; p_2 length is 18.5, maximum breadth is 11.5; p_3 length is 27.3, maximum breadth is 15.0; p_4 length is 29.8, maximum breadth is 16.1; m_1 length is 43.4, trigonid breadth is 18.4; m_2 length is 41.6, trigonid breadth is 18.0; right m_3 length is 56.9, trigonid breadth is 16.5; left m_3 length is 56.3, trigonid breadth is 16.3.

From La Estribera (18° 06′ 28″ N, 94° 53′ 13″ W) we found fragments of labial enamel of two upper molars with very fine grooves and ridges visible as parallel, transverse striations, similar to those described by Van Frank (1957), as well as an incomplete upper incisor with triangular profile, a deep groove in the middle of the labial surface, and enamel in the labial surface and in a narrow band in the lateral side.

Toxodonts are known from Central and South America, with the northernmost record being from Río Santa Amelia, Petén, Guatemala (Woodburne 1969). All Central American fossils have been assigned to *Mixotoxodon larensis* Van Frank, 1957 (Laurito 1993; Lucas et al. 1997; Webb and Perrigo 1984). The Mexican fossils show characteristics of this species; however, the m₃ exhibits differences that have been used for naming species or genera. Specifically, the meta-entoconid fold is a vertical trough (compare Figure 8A of Van Frank 1957) and presents a deep, closed ento-hypoconid fold in the lingual side of the talonid (Figure 1). These features make the Mexican material different from other toxodonts, including *Mixotoxodon larensis*. Thus, more material is needed in order to establish the specific identity of the remains.

Both Michoacán and Veracruz toxodonts were associated with the giant ground sloth *Eremotherium laurillardi*, suggesting a late-Pleistocene age for these findings. These records confirm the occurrence of toxodonts in México, previously suggested by Hulbert (2001).

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A Full-Glacial Short-Faced Bear (Arctodus simus) from Perkins Cave, Missouri

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Although the giant short-faced bear (*Arctodus simus*) is known from over 100 localities in North America, there are few radiocarbon dates on this species from the lower 48 states, and most of these are conventional dates. During the recent analysis of an *A. simus* skeleton from Big Bear Cave, Pulaski County, Missouri, funding was obtained for AMS ¹⁴C dating, but pretreatment techniques indicated the submitted specimen was not dateable (Schubert and Kaufmann 2003). After noting the lack of AMS ¹⁴C dates on this taxon outside Beringia (where the species has been well dated, see Matheus 1997: Table 5),

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an attempt was made to date *A. simus* from another Ozark locality (Perkins Cave). A right lower molar (m1) from this site (Fig. 1; ISM 496852) was sent to Stafford Research Laboratories, Inc., Boulder, Colorado, and a portion of the distal-most root was sampled (processing procedures followed Stafford et al. 1991). A date of 16,910 \pm 50 RCYBP (CAMS 77882) was obtained from the XAD-gelatin (KOH-Collagen) chemical fraction of this root fragment. The m1 was used because the combination of an accessory labial cusp between the trigonid and talonid and the size of the tooth allowed for species designation (Kurtén and Anderson 1980; Richards et al. 1996).



Figure 1. Arctodus simus right m1 from Perkins Cave (ISM 496852, previously CM 123.51). **A**, Occlusal view; **B**, labial view; **C**, basal view (white outline indicates the portion sampled for AMS ¹⁴C analysis).

Perkins Cave is located 15 km northwest of Richland on the west side of Wet Glaize Valley, Camden County, Missouri (37° 58' 25" N, 92° 30' 26" W). The dated specimen represents one of two relatively small adult *A. simus* individuals that were collected approximately 335 m from the current entrance in a deposit interpreted as a hibernaculum or den (Hawksley 1965). Eight *A. simus* localities are reported from the Ozarks, and all of these are from horizontal cave passageways (Schubert 2001; Schubert and Kaufmann 2003). The small size of these specimens and the lack of associated bacula may indicate that females used these caves for denning (Schubert and Kaufmann 2003).

The AMS ¹⁴C date presented here places *Arctodus simus* in the Ozarks during the Wisconsinan full-glacial. Paleoenvironmental interpretations based on micromammals from Peccary Cave, northwestern Arkansas (Semken 1984; Stafford et al. 1999), and botanical remains from Boney Spring, western Missouri (Saunders 1977; 1988) indicate that forests were primarily coniferous and summers were relatively cool in the Ozarks during this time frame.

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Paleoenvironments: Geosciences

Late-Quaternary Soil-Sediment Stratigraphy and Cultural Materials along Bull Creek, Oklahoma Panhandle

Brian J. Carter and Leland Bement

Eight buried soils and three late-Pleistocene through early-Holocene strata are exposed on a bluff face in the Oklahoma Panhandle. The northwest-facing bluff occurs along Bull Creek, a short (18 km) ephemeral tributary of the Beaver (N. Canadian) River. The total exposure height is 7.68 m above the Bull Creek floodplain, and width is approximately 50 m. Three strata occur in a vertical sequence, with the bottom unit 1 as alluvium (3.51 to 5.15 m below surface), the middle unit 2 as colluvium (1.44 to 3.51 m below surface), and the top unit 3 as loess (0 to 1.44 m below surface). The colluvium and loess contain five and three buried soils, respectively (Table 1). Based on the recovery of cultural material, the site is recorded as 34BV176, the Bull Creek site.

A similar adjacent bluff-face exposure within Bull Creek reveals Permian bedrock collapse with overlying late-Quaternary strata similar to the soil profile described in Table 1. The collapse features are probably produced by Permian salt dissolution (Frye 1942; Gustavson and Finley 1985). During the late Pleistocene, Bull Creek deposited sands and gravels (unit 1, alluvium) in collapse features forming along its reach. At the end of the Pleistocene (11,070 ± 60 RCYBP, Beta-184854 for 2Akb8), stream deposition ended and colluvium (unit 2) filled the collapse area during the early Holocene (10,400 ± 120 RCYBP Beta-18452 for 2Ab5). During and after the early Holocene, eolian deposits covered the colluvium (unit 3, loess).

Contained within the colluvium (2Ab6) between the 2Akb7 and 2Ab5 soils are bison remains and chert debitage attributable to human occupation. A radiocarbon date of $10,850 \pm 210$ RCYBP (Beta-180546) was obtained on 2Ab6 colluvium surrounding a bison atlas vertebra. The bison remains are distributed along the bluff face for a distance of at least 35 m. The extent of the cultural material away from the bluff face remains unknown; however, the soil

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Horizon	Depth (cm)	Color Moist	Str▲	Tex▼	Cons◆	B₽	Eff■	Special features
А	0–25	7.5YR4/2	2fGr	SiL	fr	c	ve	loess (unit 3); many fine and medium roots
Ab	46	7.5YR3/2	2fGr	SiL	fr	g	ve	loess (unit 3); many fine and medium roots
Akb2	65	10YR3/3	1fSBK	SiL	fr	с	ve	loess (unit 3); many fine and medium roots; few fine CaCO ₃ soft bodies in pores
Akb3	97	10YR3/2	2fSBK	SiL	fr	g	ve	loess (unit 3); many fine and medium roots; common fine $CaCO_3$ soft bodies in pores; $7660 \pm 80 \text{ RCYBP} (^{13}\text{C}/^{12}\text{C} \text{ is} -17.3)$ Beta-184850 on soil carbon
ABkb3	144	10YR3/3	2mSBK	SiL	fr	g	ve	loess (unit 3); many fine and medium roots; few fine CaCO ₃ soft bodies in pores
2Akb4	171	10YR3/2	2mSBK	SiL	fr	c	ve	colluvium (unit 2) few gravels; many fine and medium roots; common fine CaCO ₃ soft bodies in pores; 9850 \pm 90 RCYBP ($^{13}C/^{12}C$ is -16.7) Beta-184851on soil carbon
2Bkb4	199	7.5YR3/3	2mSBK	L	fr	с	ve	colluvium (unit 2); 5% gravels; many fine roots; few fine CaCO ₃ soft bodies in pores
2Ab5	231	7.5YR3/2	2mSBK	GCoSL	. fr	с	ve	colluvium (unit 2); 15% gravels; common fine roots; few fine $CaCO_3$ soft bodies on gravels; 10,400 ± 120 RCYBP ($^{13}C_1^{12}C$ is -17.4) Beta-18452 on soil carbon
2Ab6	246	7.5YR3/3	1mSBK	SCL	fr	с	ve	colluvium (unit 2); 2% gravels; com- mon fine roots; few fine $CaCO_3$ soft bodies in pores; few very fine charcoal fragments; 10,850 ± 210 RCYBP ($^{13}C/^{12}C$ is -19.0) Beta-180546 on soil carbon; bison vertebra
2Bwb6	262	7.5YR4/3	1mSBK	CoSL	fr	с	ve	colluvium; few gravels; common fine roots; few fine CaCO ₃ soft bodies on gravels; bison bone and flakes

Table 1. Soil profile description for Bull Creek site (34BV176), Beaver County, OK (28 Sept. 2003).

sequence extends at least 25 m. The bison material includes a humerus, metacarpal, and radius. All display helical fractures. In addition, two camel elements have been identified in the dislodged material at the base of the bluff face. The camelid elements include a thoracic vertebra and distal tibia. The lithic artifacts are a red quartzite tertiary flake and a large thin unidentified chert biface thinning flake. No formal tools or temporally diagnostic projectile points have been found at this locality.

Soil-geoarchaeological work in the Oklahoma Panhandle will assist in developing a regional geologic framework for the late Quaternary. The Bull Creek profile contains buried soils and sediments that are very similar to those described for late-Quaternary valley fills on the Southern High Plains of Texas (Holliday 1995) and may indicate a similar soil-geologic history. In central Kansas, Mandel (1992) suggested that early- and middle-Holocene deposits in small valleys can be completely removed by stream erosion. The Bull Creek site represents a unique remnant of late-Quaternary strata for the Great Plains. Also, eolian deposition after 9850 ± 90 RCYBP (Beta-184851 for soil horizon 2Akb4 in colluvium) and during the middle Holocene (7660 ± 80 RCYBP; Beta-184850 for soil horizon Akb3 in loess), as indicated for this

Table 1. (continued)
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Horizon	Depth (cm)	Color Moist	Str▲	Tex♥	Cons [◆]	₿₽	Eff■	Special features
2Akb7	279	7.5YR3/4	2mSBK	SiL	fr	с	ve	colluvium (unit 2); few fine roots; com- mon fine CaCO ₃ soft bodies in pores; $10,350 \pm 210$ RCYBP (13 C/ 12 C is -19.4) Beta-184853 on soil carbon
2Bkb7	289	7.5YR4/4	2mSBK	SiL	fr	g	ve	colluvium (unit 2); few coarse sands; few fine roots; many fine $CaCO_3$ soft bodies in pores
2Akb8	307	7.5YR4/3	2mSBK	SiL	fr	g	ve	colluvium (unit 2); few gravels; few fine roots; many fine CaCO ₃ soft bodies in pores; 11,070 \pm 60 RCYBP (¹³ C/ ¹² C is -19.2) Beta-184854 on soil carbon
2ACb8	351	7.5YR3/4	1mSBK	L	fr	а	ve	colluvium (unit 2); few gravels; few fine roots; few fine CaCO ₃ soft bodies in pores
3C1b8	362	7.5YR5/3	SG	VGLCoS	5 vfr	а	e	alluvium (unit 1); 40% gravels; few fine roots; few fine CaCO ₃ soft bodies on rock fragments
3C2b8	386	7.5YR5/8	MA	SL	fr	g	e	alluvium (unit 1); few gravels; few fine roots; few fine CaCO ₃ soft bodies on rock fragments
3C3b8	422	7.5YR4/6	MA	VFSL	fr	а	ve	alluvium (unit 1); few fine roots; common fine CaCO ₃ softbodies in pores
3C4b8	473	7.5YR6/4	SG	LS	vfr	а	ve	alluvium (unit 1); few gravels; few fine roots
3C5b8	515	5YR6/4	SG	GCoS	1	а	ve	alluvium (unit 1); 30% gravels
R	615+	2.5YR5/6	MA	-	vfi	-	e	residuum (unit 0); Permian Cloud Chief sandstone
▲ Structu	ire		▼Texture		*Consi	stend	:y	Boundary Effervescence
1 wea	k		VF very	fine	v v	ery		c clear ve violent
2 mod	lerate		S sand		fr fi	riable		g gradual e moderate
f fine			Si silt			oose		a abrupt
m med	lum		L loam		ti ti	rm		
SBK suba MA mas SG sing	ingular bloc sive le grain	ky	G grave	elly				

Oklahoma Panhandle site (Table 1), is slightly older than the 6000–6700 RCYBP loess identified for west-central Kansas (Olson et al. 1997). Continued work at this site and others in the Oklahoma Panhandle (Carter and Bement 2002; LaBelle et. al. 2003) identify periods of soil formation and human occupation during the late Quaternary.

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Age of Peoria Loess and Sand in Todd Valley, Lower Platte River Basin, Nebraska

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Condra (1903) described an abandoned valley of the lower Platte River that stretches for 45 km (28 mi) across eastern Nebraska and named it Todd Valley. Reed and Dreeszen (1965) classified the sandy fill in the valley as the Todd Valley member of the late-Wisconsin Peoria Formation. The age of this alluvium is important for reconstructions of regional landscape changes, including the timing of drainage capture and abandonment of Todd Valley by the Platte River (Lueninghoener 1947; Wayne 1987).

The Cedar Lakes roadcut at the northern end of Todd Valley exposes the uppermost 1 m or more of well-sorted sand and the overlying lowermost 4 m of 13 m of Peoria Loess (Figure 1). In much of the valley, and possibly at Cedar Lakes roadcut, the sand immediately below Peoria Loess is eolian and drapes a low-relief fluvial surface (Joe Mason, pers. comm. 2004). Locally, the properties of the lowest 2.5 m of Peoria Loess are unusual. First, there is considerable soft sediment deformation. Second, much of the loess is olive gray; it apparently was deposited, oxidized, and then deoxidized. There is a 13-cm-thick oxidized zone immediately above the deoxidized zone. Third, much of the lowermost loess is horizontally laminated (11.2-12.5 m deep). I infer from these properties that the lowermost loess was deposited rapidly and a perched water table developed above the silt-sand contact. Bettis (1994) and Mandel and Bettis (1995) have suggested that laminations in basal Peoria loess in western Iowa and other parts of eastern Nebraska likely have been produced by solifluction. The Cedar Lakes roadcut is 0.9 km from the eastern edge of Todd Valley, so this is not likely here.

Total humates in the upper 10 cm of the deoxidized zone at the Cedar Lakes roadcut, which is 1.7 m above the base of Peoria Loess, have a conventional radiocarbon age of $20,900 \pm 410$ RCYBP (Beta-46934) (Figure 1). Thus, the probable sequence is that Todd Valley filled with alluvium and was abandoned, the surface of the fluvial sands was reworked by wind, and Peoria Loess started accumulating before 21,000 RCYBP. The radiocarbon age is similar to

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Figure 1. Stratigraphic section at the Cedar Lakes Roadcut. The roadcut is at the north end of Todd Valley (2.5 km north of Cedar Bluffs and 9 km west of Fremont) in the Southwest 1/4 of the Southwest 1/4 of Section 22, Township 17 North, Range 7 East.

ages for basal Peoria Loess from western Iowa to southern Nebraska (Forman et al. 1992; Mandel and Bettis 1995; Martin 1993; May and Holen 1993) and for uppermost fluvial sediment beneath the Fort Calhoun Terrace on the Missouri (Mason 2001; Miller 1964). Thus, the alluvial valley fill in Todd Valley is older than most, if not all, Peoria Loess in eastern Nebraska and likely is the Gilman Canyon Formation (Reed and Dreeszen 1965) or the recently proposed Severence Formation (Mandel and Bettis 2001).

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Carbon Isotope Evidence for Younger Dryas–age Climate Variability in Southwest Missouri

Lori A. Wozniak

Although first documented in the North Atlantic region, a growing body of evidence suggests that the Younger Dryas climatic oscillation was global in extent (Peteet 1995; Thompson et al. 1997; Yu and Wright 2001; Zhou et al. 1996). Several studies have also documented Younger Dryas–age climate variability in North America (Denniston et al. 2001; Mathewes 1993; Mayle and Cwynar 1995; Peteet 1995; Shane 1987; Shuman et al. 2002; Wilkins et al. 1991; Yu and Wright 2001). Unfortunately, long, continuous, high-resolution paleoclimate records that span the Younger Dryas chronozone in the southern Midwest are extremely rare (Denniston et al. 2001; Yu and Wright 2001).

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Establishing the geographic extent and expression of Younger Dryas environmental change is important to fully understanding the causes and atmospheric transmittal mechanisms of the abrupt climate oscillations that characterized the last glacial-interglacial transition (Yu and Wright 2001). Here I present stable carbon isotope evidence for a Younger Dryas–age climatic fluctuation in southwest Missouri.

Carbon isotope analyses were conducted on soil organic matter (SOM) from the Big Eddy archaeological site (23CE426) in southwest Missouri. The site is located in the lower Sac River valley in Cedar County, Missouri. Nearly uninterrupted deposition by the Sac River since the late Pleistocene has resulted in a T1a terrace sediment assemblage with a remarkably complete organic δ^{13} C record that is ideal for reconstructing regional climate change since the end of the Pleistocene (Hajic et al. 1998). During brief periods of landscape stability, moderately expressed soils developed in the organic-rich alluvium (Hajic et al. 1998). Six soil profiles spanning the late-Pleistocene/Holocene transition were sampled every 2 cm for isotopic analysis. Temporal control for this project is based on the previously established ¹⁴C chronology from the Big Eddy site (Hajic et al. 1998, 2000).

Several studies have demonstrated that δ^{13} C values of SOM are reliable indicators of vegetation dynamics and climatic conditions over time (Boutton 1996; Boutton et al. 1998; Kelly et al. 1998). The feasibility of using δ^{13} C values as a proxy for paleoenvironmental conditions is based on the fact that the isotopic composition of SOM reflects the relative proportions of C₃ and C₄ biomass. The δ^{13} C values can be converted to relative abundances of the two plant types by using a common mass balance equation (Boutton 1996). In turn, the dominant plant type is strongly correlated with environmental parameters such as precipitation and temperature. In general, the higher water-use efficiency of C₄ plants allows them to outcompete C₃ plants under warm and dry conditions. Although the distribution and abundance of C₄ plants is strongly correlated with higher growing season temperatures (Terri and Stowe 1976), studies of modern plant distributions have shown that precipitation and its seasonal distribution are also critical controls (Clark et al. 2002; Epstein et al. 1997; Paruelo and Lauenroth 1996; Tieszen 1994).

Carbon isotope analyses of SOM at Big Eddy show a significant increase in δ^{13} C values between 11,190 ± 75 RCYBP (AA-27482) and 10,185 ± 75 RCYBP (AA-26653). δ^{13} C values increased by 4 to 5‰ across the sampled area (from about -23‰ to -18‰) during this period, reflecting an increase in C₄ biomass potentially as large as 40 percent. I propose that the carbon isotope results from the Big Eddy site reflect an expansion of C₄ grasses in response to increased regional aridity during the Younger Dryas, an interpretation corroborated by recent studies in adjacent areas, which indicate a return to colder and/or arid conditions during the Younger Dryas. Carbon and oxygen isotope analyses of speleothem calcite from south-central Missouri suggest a Younger Dryas decrease in mean annual temperature (ca. 4°C), although there is some uncertainty regarding the timing of this change (Denniston et al. 2001). Pollen records of ¹⁴C-dated lake sediments in north-central Illinois show a concurrent increase in spruce and decline in black ash that is indicative

of a colder, drier environment during the Younger Dryas (Grimm and Maher 2002; Schubert et al. 2004). Widespread eolian deposition on the Southern High Plains also suggests increased aridity during this period (Holliday 2000). The Big Eddy site is situated in the ecotone between the Western tallgrass prairie and the Eastern deciduous forest, a region known to be very sensitive to fluctuations in temperature and precipitation. The significant increase in C₄ vegetation seen in southwestern Missouri may reflect an eastward shift of the prairie/forest ecotone, perhaps in response to a more zonal atmospheric circulation pattern during the Younger Dryas.

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Errata

1.

In "New Excavations in Valsequillo, Puebla, México" by Patricia Ochoa-Castillo et al., which appeared in last year's issue of *Current Research in the Pleistocene* (Vol. 20, 2003), pp. 61–63, the incorrect illustration was published for Figure 1 on page 62. Below is the original illustration supplied by coauthor Ana Lillian Martín del Pozzo.



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

2.

In "The Eden Projectile Point Manufacturing Sequence at Hell Gap, Locality V, Wyoming" by Edward J. Knell, which appeared in last year's issue of *Current Research in the Pleistocene* (Vol. 20, 2003), pp. 37–39, the incorrect figure caption and callouts were published for Figure 1 on page 38. Below are the article as originally published and the correct figure and caption for Figure 1.

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

Edward J. Knell

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

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

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

Stage 2 (n = 5) represents initial thinning and shaping to create a parallelsided biface free of major humps and ridges (Figure 1A). Knappers at Locality V selectively removed transmedial flakes with large, shallow flake scars and bending initiations, indicating a soft hammer (baton) was used to thin the preforms. The flake blank platform and bulb were removed by non-serial percussion flaking. One tip fragment was thinned by selective, transmedial percussion flaking and has a triangular plan view.

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

Stage 4 (n = 5) represents both serial percussion and pressure flaking (Figure 1C). The tip segment has the earliest evidence of serial comedial pressure flaking in the reduction sequence. The midsection and basal segments have serial percussion and pressure flake scars that approach the

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Figure 1. Composite of Eden projectile point preforms by sequential manufacture stage. **A** = Stage 2, **B** = Stage 3, **C** = Stage 4, **D** = Stage 5, **E** = Stage 6, **F** = Stage 7, and **G** = technologically complete, reworked Eden point.

midline. The basal portions are thinned and shaped by longitudinal and lateral pressure flakes. The stem is square, but not refined like finished Eden points.

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

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

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

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

Thanks to Bruce Bradley and Matt Root for their editorial comments on previous versions of this

paper, and to Mary Lou Larson and Marcel Kornfeld for their hospitality and encouragement during my visit to Laramie to analyze the preforms. Any errors or misinterpretations of fact are mine alone.

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Information for Contributors

GENERAL INFORMATION

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