# CURRENT RESEARCH IN THE PLEISTOCENE

Volume 13

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# Volume 13

# 1996

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### From the Editor

Since last year's volume of *CRP*, with its Special Focus on the Native American Graves Protection and Repatriation Act (NAGPRA), a number of things have happened which bode ill for the future of American archaeology. The NAGPRA Review Committee issued their *Draft Recommendations on the Disposition of Culturally Unidentifiable Native American Remains* which included the statement that "human remains and associated funerary objects...no matter how ancient... should be treated according to the wishes of the Native American community." The Committee made no effort to define "Native American community," thereby dropping all pretense of establishing any sort of biological or cultural relationship as a basis for repatriation. This has paved the way for the imminent surrender of a 9,300-year-old human skeleton, uncovered by the U.S. Army Corps of Engineers, to the Umatilla Indians for reburial (Gibbons 1996). For further information see Alan Schneider's update to his 1995 CRP article, "NAGPRA and First American Studies."

Lest other Quaternary scientists think it is only archaeologists and physical anthropologists who need feel concern at these developments, it should be noted that a mastodon skeleton, bearing no apparent relationship to Native American burials, has been "repatriated" to Indians in Florida and reburied (*Florida Anthropologist* 1996:159–160). While this mastodon was given to rebury pursuant to a Florida administrative policy and not NAGPRA, certainly the national political climate, driven in large part by NAGPRA, influenced the decision of Florida bureaucrats. Moreover, Florida's decision establishes a frightening precedent for other states to follow.

Another disturbing development was the publication of Vine Deloria's mean-spirited attack on archaeology, science, and rational thought—*Red Earth, White Lies: Native Americans and the Myth of Scientific Fact.* Deloria believes archaeologists, particularly those who subscribe to Paul Martin's overkill hypothesis, are racists who are engaging in "something akin to a southern lynching" (Deloria 1996:128). Now I have argued against the overkill hypothesis, sometimes rather passionately (e.g., Lepper 1990; 1993), but it never would have occurred to me to accuse Martin of homicidal racism.

Deloria ridicules archaeologists' attempts to understand the peopling of the Americas and the extinction of the megafauna. He offers, instead, the Velikovskian notion that American Indian oral traditions, when properly understood, are inerrant records of actual historic events. Based on a farrago of sometimes contradictory stories, myths, and legends delved from the traditions of many Native American groups, Deloria proposes, at one point, that American Indians lived peaceably amid dinosaurs and mammoths until a boorish race of giant white-skinned Europeans killed off all these remarkable animals demonstrating "as little regard for the environment or other forms of life" as modern white-skinned folk (Deloria 1996:153).

Deloria's book represents the worst sort of pseudoscientific gobbledygook. Throughout the book, Deloria demonstrates a bold and comprehensive ignorance of elementary physics, chemistry, geology, biology, and anthropology. He claims that animals and people reached gigantic proportions in the Pleistocene because they were breathing an atmosphere enriched in carbon dioxide (1996:173); he seriously suggests that Einstein's theory of relativity has something to do with "the concept of relatedness" in biology (1996:57); and he characterizes Darwin's theory of evolution by natural selection as the notion that "a benign and clever 'Mother Nature' ... threw dice with organic genetics and always came up a winner" (1996:62). But more frightening than Deloria's nonsense is the astonishing fact that his book received an overwhelmingly positive review in the pages of the *American Anthropologist* (Mohawk 1996).

American archaeology is under siege, from within and without. We must speak out against ignorance and against the efforts of those who would exchange the goals and methods of reasoned inquiry and scholarly discourse for fundamentalist dogma and self-righteous cant (cf. Sagan 1995). I am not saying that NAGPRA is all bad. Clearly there are wrongs to be redressed; but the pendulum is swinging too far in the opposite direction. We can work together with American Indians to find a middle-ground of compromise; but to meekly accede to the reburial of Paleoindian skeletons and mastodons is to consign the past to an unredeemable oblivion.

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#### **References Cited**

Florida Anthropological Society Symposium: Burials, Native American Artifacts, and the Law 1996 *The Florida Anthropologist* 49(3):149-160.

Gibbons, A. 1996 DNA Enters Dust Up Over Bones. Science 274:172.

Lepper, B. T. 1990 Song of the Mammoth Hunters: A Fit of Ice Age Doggerel. *Mammoth Trumpet* 6(2):8.

Lepper, B. T. 1993 Ice Age Peoples of the Great Lakes. Michigan Archaeological Society, Datum Points 2(1):3-8.

Mohawk, J. 1996 Book review: Red Earth, White Lies: Native Americans and the Myth of Scientific Fact, by Vine Deloria Jr. American Anthropologist 98(3):650-651.

Sagan, C. 1995 The Demon-Haunted World: Science as a Candle in the Dark. Random House, New York.

### Recent NAGPRA Developments

### Alan L. Schneider

The Native American Graves Protection and Repatriation Act of 1990 ("NAGPRA" or the "Act") is now slightly over six years old. In many respects, NAGPRA remains as vague and uncertain as ever. During the past year, however, there were a number of NAGPRA-related developments that could have significance for the future course of First Americans research in the United States. Some of these new developments are outlined below.

Adoption of Final Regulations Final regulations (the "Regulations") for implementing NAGPRA were published in the Federal Register on December 4, 1995 (Vol. 60, No 232 at 62134). They became effective on January 3, 1996. Although there are some similarities in overall format and structure, the final Regulations differ in many respects from the proposed regulations originally published in the Federal Register on May 28, 1993 (Vol. 58, No 102 at 31122).

Of potential interest to First American scholars is the fact that the final Regulations exclude from the Act's coverage any "... portions of remains that may reasonably be determined to have been freely given or naturally shed by the individual from whose body they were obtained..." See Regulations, Section 10.1 (d) (1). This exclusion will be important to scholars who wish to conduct DNA analysis and other studies on hair, fingernail or toenail clippings, coprolites and other nonburial biological materials.

Also of interest is the Regulations' definition of the term "Native American." This definition is important since NAGPRA only applies to Native American human remains and "cultural items." Under the Act, the term "Native American" is defined as meaning "... of, or relating to, a tribe, people or culture *that is* indigenous to the United States." See Act, Section 2(9) (emphasis added). Use of the phrase "that is" in this definition would seem to imply that human remains and "cultural items" are not subject to the Act unless there is a demonstrated relationship to present-day Native Americans. The definition found in the Regulations, however, deletes the phrase "that is." See Regulations, Section 10.1(d) ("... a tribe, people or culture indigenous to the United States....") Whether this choice of wording will be given a different interpretation from the Acts's definition, and if so, whether it will be upheld by the courts, remains to be determined.

The final Regulations leave a number of important issues unresolved. One of these is the treatment and disposition of culturally unidentifiable human remains. This issue has been left for resolution in future regulations. Another

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unresolved issue is the meaning and scope of the "scientific study" exception found in Section 7(b) of the Act. The Regulations merely repeat the wording of the Act and give no clarifying definitions or other guidelines for this potentially important provision.

**Kennewick Man Lawsuit** A group of eight scientists has filed a lawsuit in federal court to challenge repatriation of a 9,300-year-old skeleton found on Army Corps of Engineers property near Kennewick, Washington, on July 26, 1996. (Bonnichsen et al. v. U.S., District Court, Civil No. CV 96-1481JE). The skeleton (dubbed "Kennewick Man" or "Richland Man" by the press) is reported to be virtually intact and is the oldest skeleton found to date in the Pacific Northwest. Bone taken from a metacarpal has been subjected to <sup>14</sup>C testing at UC Riverside and yielded an uncalibrated radiocarbon date of  $8,410 \pm 60$  years (UCR 3478). Shortly after receipt of the <sup>14</sup>C date, the Army Corps published notice of intent to repatriate the skeleton to the Confederated Tribes of the Umatilla Reservation. All requests for study of the skeleton by outside scientists were refused by the Army Corps.

The lawsuit filed by the eight scientists contends that the Army Corps repatriation decision is not supported by sufficient evidence to establish that the skeleton is Native American within the meaning of the Act or to demonstrate that it is culturally affiliated to the Umatillas. Three local anthropologists who examined the skeleton in connection with a forensic investigation by the Benton County Coroner reported that it has a number of Caucasoid-type characteristics not typical of current Northwest Native American groups. It is said to have a long, narrow braincase, a long thin face, and teeth displaying a possible sundadont pattern. One of the anthropologists, Grover Krantz of Washington State University, concluded that "... the Richland Man belonged to a native culture that no longer exists, and one which has no living descendants" (letter to James Chatters dated September 2, 1996).

The eight scientists also contend that the Army Corps refusal to permit further study and testing of the skeleton by them and other scientists is arbitrary, capricious and contrary to law. The only study of the skeleton conducted to date was a forensic examination undertaken by the Benton County Coroner's office. This study, headed by anthropologist James Chatters of Applied Paleoscience, was cut short by the Army Corps before it could be completed. The scientists' complaint asserts that further study of the skeleton would be of major benefit to the United States. Among other things, it could provide important information on the initial peopling of the Americas and on human evolution in general.

The court has yet to rule on the merits of the scientists' claims. However, repatriation of the skeleton has been halted until their claims can be heard.

**Proposed NAGPRA Amendment** Shortly before adjournment of the last Congress, the Senate Committee on Indian Affairs adopted a proposed measure to further restrict scientific study of human remains. The proposal (Senate Bill 1983) would amend NAGPRA to prohibit any excavation of Native American human remains for purposes of study unless prior approval is obtained from all "appropriate" tribes. This new restriction would apply to all excavations on federal and tribal land. The proposed amendment did not reach the Senate

floor in time for a vote before adjournment for the November elections. It may be reintroduced when the new Congress convenes in January, 1997.

**New Review Committee Recommendations** The NAGPRA Review Committee has withdrawn its proposed recommendations dated May 5, 1995, concerning the adoption of regulations for the disposition of culturally unidentifiable human remains. In their place, the Review Committee has proposed new draft recommendations (Federal Register Vol. 61, No 162 at 43071). These recommendations would modify the concept of cultural affiliation to permit more than one Indian tribe or Native Hawaiian group to claim a "shared group identity" with the same earlier historic or prehistoric group. The purpose of this proposed change is to reduce the level of evidence needed to establish affiliation for those human remains that would otherwise be classified as culturally unidentifiable. This proposed change could have potential significance for First Americans research since ancient remains are likely to come within the category of culturally unidentifiable remains (assuming they can be shown to be Native American as defined by the Act).

Another noteworthy feature of the draft recommendations is an acknowledgment by the Review Committee that doubts may exist concerning the status of ancient remains. The introduction to the draft recommendations states: "The committee believes that decisions regarding disposition of a small number of generally very ancient human remains will require amendments to NAGPRA by Congress." Federal Register at 43071. The draft recommendations do not include a specific request for a statutory amendment to deal with this issue, although they do recommend amendments on several other points (i.e., to allow repatriation claims by nonfederally recognized Native American groups, and to require repatriation of culturally unidentifiable associated funerary objects) The formal comment period for the draft recommendations expired on October 15, 1996.

### Archaeology

## The Boles Wells Folsom Locality in the Tularosa Basin, New Mexico

### Daniel S. Amick, Raymond P. Mauldin and Beth L. O'Leary

This paper describes Boles Wells (LA 104,267), a small Folsom locality found during recent CRM survey work on Holloman Air Force Base (Mauldin and O'Leary 1994). The Boles Wells site is approximately 8 km south of Alamogordo, New Mexico. Several factors distinguish this site relative to other Folsom localities in the region (Amick 1991, 1995; Amick and Stanford 1996). First, nearly all Folsom localities in the Tularosa Basin are found in eolian deposits, which dominate low elevations at the center of the basin, but Boles Wells lies on an alluvial fan. Second, the Boles Wells assemblage contains relatively high proportions of Edwards chert. Although the archaeological record of the New Mexico Basin and Range is dominated by small Folsom localities, very few of these have been studied as carefully as Boles Wells.

Folsom artifacts at Boles Wells are eroding from silty sediments at the terminus of alluvial fans extending from the Sacramento Mountains, which lie less than 2 km east. This depositional unit, which is Holocene in age, exhibits weakly developed soil structure and contains stage-one carbonate accumulation (Monger 1994). It correlates with the regionally recognized Organ alluvium of Gile et al. (1981) and the Q3 unit of Blair et al. (1990), which are less than 7,500 years old. This association suggests the 10,000- to 11,000-year-old Folsom artifacts at Boles Wells are redeposited in younger sediments. Severe sheet erosion at the site is exposing these archaeological components as surface lag.

Like many sites in the Tularosa Basin, multiple components are mixed at Boles Wells. Surface collection produced 270 chipped-stone artifacts, 7

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groundstone fragments, and 1 brownware sherd; limited subsurface excavations added 273 flakes. Folsom diagnostic artifacts from the surface collection are limited to two projectile-point fragments (one distal, one base), three Folsom preform fragments (two distal, one medial), nine channel-flake fragments (one proximal, three medial, four lateral, and one distal) and one transverse endscraper. Efforts to refit these artifact fragments were unsuccessful. Radial-break tools, which may be diagnostic of Folsom technology (Frison and Bradley 1980), were also identified in the Boles Wells assemblage.

The surface collection of chipped stone contained one flake of Chuska chert, Rancheria chert (16%, n = 44), Edwards chert (27%, n = 72), mixed lithology Rio Grande gravels (44%, n = 119), and local coarse-grain lithics (13%, n = 34). Several measures suggest the Edwards and Rancheria debitage was produced primarily during the later stages of tool manufacture and resharpening. Edwards and Rancheria flakes at Boles Wells also show the highest incidence (84%) of platform preparation (ground, multifaceted). Only 3% of the Edwards flakes exhibit cortex, which reflects the considerable distance from Edwards sources (ca. 500 km). Rancheria sources lie about 70–200 km away, and only 16% of the Rancheria flakes exhibit cortex. Edwards and Rancheria flakes also show the highest incidence of breakage (53% are medial/distal fragments) and represent the thinnest flakes (median of 1.5–2.0 mm).

Strong reliance on Rancheria chert characterizes Folsom technology in the Tularosa Basin and Southern Jornada del Muerto (Amick 1994a, 1994b, 1996; Amick and Stanford 1996). Edwards chert from the southeastern High Plains represents about 6% of all Folsom diagnostics from the Tularosa Basin, but much higher proportions are found at a few localities including Moody Tank (29%) and Tres Hermanos (18%). Eight (53%) of the Boles Wells Folsom diagnostics (two preforms, five channel flakes, and the endscraper) are Edwards; six (40%) are Rancheria (two points, one preform, and three channel flakes); and the remaining channel-flake fragment is an unknown chert possibly from local Rio Grande gravel deposits.

The relationship of these Folsom diagnostics to the total lithic assemblage is equivocal, but flakes of similar high-quality lithic material are concentrated near the center of the site. Although this lithic scatter extends over 9,100 square meters, 13 of the 15 Folsom diagnostics are found in an elliptical area of 350 m<sup>2</sup>. This same area contains most Edwards and Rancheria flakes and debitage with characteristics of advanced stages of reduction. A single small Folsom camp was probably present at the center of this locality upon which a scatter of later occupational debris was deflated.

The Folsom component at Boles Wells was initially thought to be limited to an isolated projectile-point base. Study of the debitage and bifaces revealed additional diagnostics of Folsom occupation (point tip, preforms, channel flakes, radial breaks). Lithic material types and spatial patterns support the presence of a discrete Folsom component at Boles Wells. Folsom isolates previously reported in the Tularosa Basin may represent similar small sites that remain unrecognized.

This CRM survey work at Boles Wells was conducted by Human Systems Research (HSR) and funded by the U.S. Air Force. Thanks to Pete Eidenbach and Karl Laumbach at HSR for facilitating this

collaborative study. Thanks also to the support of Martyn Tagg, archaeologist with Holloman Air Force Base, and Bob Burton, archaeologist with White Sands Missile Range.

#### **References Cited**

Amick, D. S. 1991 Folsom Landuse Patterns in the Tularosa Basin. *Current Research in the Pleistocene* 8:3-5.

Amick, D. S. 1994a Technological Organization and the Structure of Inference in Lithic Analysis: An Examination of Folsom Hunting Behavior in the American Southwest. In *The Organization of Prehistoric North American Chipped Stone Tool Technologies*, edited by P. Carr, pp. 9–34. Archaeological Series No. 7. International Monographs in Prehistory, Ann Arbor.

Amick, D. S. 1994b Edwards Chert Use by Folsom Hunters in New Mexico. *Current Research in the Pleistocene* 11:59–61.

Amick, D. S. 1995 Folsom Patterns of Lithic Procurement and Occupation in the Tularosa Basin and Southern Jornada del Muerto. In *Proceedings of the 8th Jornada-Mogollon Conference*, edited by D. Carmichael, in press, University of Texas at El Paso.

Amick, D. S. 1996 Regional Patterns of Folsom Mobility and Land Use in the American Southwest. *World Archaeology* 27: 411–426.

Amick, D. S., and D. J. Stanford 1996 Folsom Occupation in the Tularosa Basin of New Mexico. In *Folsom Archaeology: Early Holocene Environments and Human Adaptations*, edited by M. Jodry and D. Stanford, in press. Smithsonian Institution Press, Washington.

Blair, T. C., J. S. Clark, and S. G. Wells 1990 Quaternary Stratigraphy and Landscape Evolution and its Application to Archaeological Studies. In *Landscape Archaeology in the Southern Tularosa Basin*, Vol 1., edited by K. Anschuetz, W. Doleman, and R. Chapman, pp. 167–206. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Frison, G. C., and B. A. Bradley 1980 Folsom Tools and Technology at the Hanson Site, Wyoming. University of New Mexico Press, Albuquerque.

Gile, L. H., J. W. Hawley, and R. B. Grossman 1981 *Soils and Geomorphology in the Basin and Range Area of Southern New Mexico*. Bureau of Mines and Mineral Resources Memoir No. 39. New Mexico Institute of Mining and Technology, Socorro.

Mauldin, R. P., and B. L. O'Leary 1994 HAR-074 (LA 104,267), The Boles Wells Paleoindian Site, Data Collection and Test Excavations, Holloman Air Force Base, Otero County, New Mexico. HAFB Report No. 1994-021 (HSR 9349E). Prepared for Holloman Air Force Base, White Sands Missile Range Contract No. DAAD07-89-D-0050, Delivery Order No. 0062, prepared by Human Systems Research, Tularosa, New Mexico.

Monger, H. C. 1994 Geomorphic Setting of a Folsom Site on the Holloman Air Force Base. In *HAR-074 (LA 104,267), The Boles Wells Paleoindian Site, Data Collection and Test Excavations, Holloman Air Force Base, Otero County, New Mexico,* by R. Mauldin and B. O'Leary. HAFB Report No. 1994-021 (HSR 9349E). Prepared for Holloman Air Force Base, White Sands Missile Range Contract No. DAAD07-89-D-0050, Delivery Order No. 0062, by Human Systems Research, Tularosa, New Mexico.

## Skyrocket, A Central Sierran Paleoindian Archaic Transition Site

### David G. Bieling, Roger Marks La Jeunesse, and John Howard Pryor

The Skyrocket site, located in the central Sierran foothills 80 km east of Stockton, California, has a lower component, sealed by layers of clay, dated between  $9,050 \pm 90$  and  $7,000 \pm 70$  yr B.P. (WSU-4615, 4616).

This deposit contains a Western Pluvial Lakes (WPL) assemblage with a *mixture* of Paleoindian and early-Archaic attributes. The Paleoindian characteristics are evident in lithic technology shown in the manufacture of large stemmed series points and broad thinned bifaces (Figure 1b, a). These biface forms, made from locally obtained fine-grained greenstone, are well thinned, edge-trimmed, with minor edge abrasion, and width-thickness ratios often 5.0. Scars on many biface surfaces show evidence of "overshots," "end-thinning," and well-prepared striking platforms, all of which served to flatten the biface's surface without sacrificing width.

Besides the Paleoindian technological attributes, the assemblage includes large proportions of blade, end, and keeled scrapers, large leaf-shaped bifaces (some, possibly stemmed point preforms), as well as a single fluted point (Figure 1c). Even though this point is most likely "scavenged," the large quantity of the other lithic materials showing Paleoindian technological attributes strongly suggests the latter were not "curated."

Technological and morphological similarities exist between Skyrocket and a number of early assemblages in the western U.S. and the Great Plains (Amsden 1937, Hester, et al. 1972, Irwin and Wormington 1970, Rogers 1966, Warren 1966, and Young and Collins 1989). In central California, the most immediate comparisons are with materials from Texas Charley Gulch (Moratto 1983) and Clarks Flat (Peak and Crew 1990).

The early Archaic is represented by a  $10 \times 10 \times 0.5$ -m stone platform, comprising hundreds of spent milling slabs and handstones, situated on the margins of a marsh. Most of the lithic materials from the earliest component were found in this feature. Its size and complexity suggest more sedentary habits.

In addition to the artifacts with Paleoindian characteristics, a number of dart points were also recovered. Attributed to the Stanislaus Broad Stemmed Series (Peak and Crew 1990), these points are thought to be analogous to Pinto and Silver Lake (Figure 1d, e, and f). Three-quarters of them were made from non-

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Figure 1. Skyrocket bifaces.

local materials, which sharply contrasts with the material type used to make the bifaces and other tools of the stemmed-series assemblage.

The co-association of Paleoindian and Pinto-like points strongly suggests that Skyrocket's lower component has recorded the transition between mobile biggame hunters, and more sedentary peoples, who exhibited greater dependence upon plant food.

#### **References Cited**

Amsden, C. A. 1937 The Lake Mojave Artifacts. Southwest Museum Papers 11.

Hester, J. J., E. L. Lundelius, Jr., and R. Fryxell 1972 Blackwater Locality No. 1: A Stratified Early Man Site in Eastern New Mexico. Fort Burgwin Research Center Publication 8.

Irwin, H. T., and H. M. Wormington 1970 Paleo-Indian Tool Types in the Great Plains. *American Antiquity* 35(1):24–34.

La Jeunesse, R. M., and. J. H. Pryor n.d. *Skyrocket Site (CA-CAL-629/630), Final Report.* Department of Anthropology, California State University, Fresno.

Moratto, M. J. ed. 1986 Archeological Investigations, 1968–1980 at 65 Indian Activity Sites near the Stanislaus River, Calaveras and Tuolumne Counties, California. INFOTEC Development, Inc.

Peak, A. S., and H. L. Crew 1990 An Archaeological Data Recovery Project at CA-CAL-S342, Clarks

Flat, Calaveras County, California. Cultural Resource Studies, North Fork Stanislaus River Hydroelectric Development Project. Northern California Power Agency.

Rogers, M. J. 1966 Ancient Hunters of the Far West. Union-Tribune, San Diego.

Warren, C. N. ed. 1966 The San Dieguito Type Site: M. J. Roger's 1938 Excavation on the San Dieguito River. *San Diego Museum Papers* 5:1-39.

Young, B., and M. B. Collins 1989 A Cache of Blades with Clovis Affinities from Northeastern Texas. *Current Research in the Pleistocene* 6:26–28.

## The Coats-Hines Site: Tennessee's First Paleoindian-Mastodon Association

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The Coats-Hines site (40Wm31) is located along the south side of a small spring of Spencer Creek, Williamson County, Tennessee (Breitburg and Broster 1995). Mastodon (*Mammut americanum*) remains rested within a late-Pleistocene stratum, a randomly mixed lattice of illite and montmorillonite, overlain by 70 cm of buried Braxton soil, and sealed by a meter of redeposited light brown silty phosphatic Huntington loam. Slight rounding of chert cobbles and pebbles implies the area was an old stream channel, filled sinkhole, or beaver pond. The soil-mineral content is almost all quartz, chert, and sand-sized or larger grains of tripoli, but the silt-sized quartz grains are most abundant in all strata. Sparse exotic heavy zircon and tourmaline minerals are only known from Middle Tennessee loess, a dust blown in from dried Mississippi River flood plain soils to the west.

Disarticulated mastodon remains (Figure 1) consist of molar teeth, tusk, hyoid, two cervical and seven thoracic vertebrae, numerous rib shaft, humerus, radius, and pelvic bones and respective epiphyses. The metrical dimensions of the humerus and its proximal epiphysis imply the animal was a young male, 18–23 years of age. The associated faunal complex includes horse (*Equus* spp.) teeth, deer (*Odocoileus* sp.) antler, muskrat (*Ondatra zibethicus*) humerus and metapodial, dog-sized (*Canis* sp.) first phalanx, turkey (*Meleagris gallopavo*) phalanx, frog (*Rana* spp.) humeri, painted turtle (*Chrysemys* cf. *picta*) plastron, and carapace and plastron fragments of indeterminate semiaquatic turtles.

Thirty-four chert specimens that were mapped or recovered within the thoracic cavity and its immediate vicinity include 10 formal tool parts and 24 resharpening flakes. The tools include part of a prismatic blade, proximal bifacial knife, two gravers, two uniface side scrapers, and two scrapers/cores.

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Figure 1. Location of the Coats-Hines Site mastodon remains, cut bone, and Paleoindian artifacts.

All the tools are made of Fort Payne chert except one scraper, which is probably St. Louis chert. Flakes range from 4.84 to 27.13 mm, grading toward smaller fragments; they show fine bifacial retouching of tools for butchering purposes. All but two (one each of Dover and St. Louis cherts) flakes are made of Fort Payne chert.

Soil, bone, and cultural deposits lead to inescapable hypotheses and conclusions: 1) mastodon remains rest in relatively undisturbed context and in direct contact with tools known only from Paleoindian kill or task-specific butchering sites; 2) distinct V-shaped cut marks on a thoracic spinous process in direct contact with resharpening flakes imply the removal of the dorsal muscles of the backbone; 3) one polished bone showing fine striae and antler-tine tip breakage imply domestic and tool-fabrication tasks; and 4) presence of a single first phalanx that compares very favorably to domestic dog (Canis familiaris), all lead to a very strong probability and conclusion that the Coats-Hines site is the first documented Paleoindian-mastodon site for the state. On the downside, the chronometric integrity of bone and soil samples is compromised by the lack of bone collagen and by extensive disturbance of soil sediments by angle worms and tree-root growth. In spite of these problems, <sup>14</sup>C dates provide an age range of deposition spanning 27,050 ± 200 yr B.P. (Beta-80169) to 6530 ± 70 yr B.P. (Beta-75403). The latter date was taken from organic soil and plant material from within dental cusps. The earliest date relates to the sediments below the bone deposit and is associated with iron-impregnated horse teeth. Given the nature of the site, associated tool complex, and the probable presence of domestic dog, if better dating were possible, we would anticipate a date of at least 11,000 to 11,500 yr B.P. for Paleoindian site activity and occupation.

The investigation of the Coats-Hines site involved exemplary cooperation between professional and avocational archaeologists, and developers. We are most grateful to Robert P. Voyles, David Wilson, and Sharon Meadows of the Hines Interests Limited Partnership for allowing access to the site, and

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### **References Cited**

Breitburg, E., and J. B. Broster 1995 A Hunt for Big Game: Does Coats-hines Site Confirm Human-Mastodon Contact? *The Tennessee Conservationist* 61(4):18–26.

# Renewed Investigations at Milnesand and Ted Williamson Paleoindian Sites, Southern High Plains

### Briggs Buchanan, Luc Litwinionek, Eileen Johnson, Vance T. Holliday, and J. Kent Hicks

As part of the regional research program of the Lubbock Lake Landmark, investigations of the Milnesand and Ted Williamson sites were renewed (Johnson et al. 1986; Sellards 1955, n.d.) in 1995. Both sites are Paleoindian bison kill/ butchering locales located on the Southern High Plains in eastern New Mexico. Milnesand, originally excavated in 1953 (Sellards 1955), revealed a then unknown, uniquely shaped projectile point designated the Milnesand type, associated with the remains of Bison antiquus. A lack of stratigraphic integrity and radiocarbon ages left the site without placement in the late-Paleoindian chronology of the Southern High Plains (Johnson et al. 1986; Warnica and Williamson 1968). Ted Williamson (Sellards n.d.) was excavated concurrently with Milnesand, although the data never published. Points recovered from the Bison antiquus bone bed were primarily of Plainview design. This site also remained undated (Johnson et al. 1986). Current field investigations and analyses focused on the recovery of additional field information and on the landowner's private collections for a reappraisal of the geomorphic, chronologic, and typologic relationships of the two sites.

The sites are located on the High Plains surface approximately 40 km from the western margin of the Southern High Plains. They are about 550 m apart and exposed in two blowouts within a west-to-east-trending dune field. Sand dunes enclose three sides of both sites. The number of bison in each bone bed is uncertain. The extant collections indicate that at least 32 bison were represented in the Milnesand bone bed (Drake 1994). The bone beds at both sites rested on the upper Blackwater Draw formation, an archaeologically

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sterile Pleistocene deposit. The two features probably formed in microtopographic lows on the surface of the formation. At both sites, the bone bed was encased in a layer of sand ca. 25 cm thick. Remnants of this layer are preserved adjacent to the blowouts and yielded lithic debris at both sites. This evidence indicates that the kills were contemporaneous with deposition of an aeolian sandsheet. At Milnesand, sand that encased and covered the bone was part of an A horizon, based on examination of soil samples taken from segments of the bone bed preserved in plaster jackets. This surficial soil zone probably formed by slow accretion of sand on the heavily vegetated surface of the Blackwater Draw formation.

The surfaces of both sites were covered with weathered bone scrap and burned caliche that were mapped and plotted for spatial analysis. A total of 15 test units were placed within the two sites. The Paleoindian layer was located in all units. Numerous flakes were recovered within this layer, the majority of which are small resharpening flakes.

Analysis of the private collection was limited because the artifacts were mounted with glue on a board so that both sides could not be documented in most cases. The Milnesand collection contains 78 artifacts, 59 of which are projectile points. Of these, 52 are classified as Milnesand and seven as Plainview. More than 50% of the points are complete, 95% of which exhibit signs of resharpening. Of the incomplete specimens, 50% are distal or mesio-distal fragments. The predominant raw material is Edwards formation chert (<75%) followed by Alibates (20%). The Ted Williamson collection contains 154 artifacts, 146 of which are projectile points. Of these, 142 points are classified as Plainview and four as Milnesand. Only 40% of the points are complete, all of which exhibit signs of resharpening. Of the incomplete specimens, 50% are proximal or mesio-proximal fragments. More than 50% of the artifacts are produced from Edwards formation chert, while a chert from an unknown source represents 25% of the points.

Flaking patterns are similar in both collections with sub-parallel removal of flakes. The pattern becomes less regular as the projectile points were rejuvenated. In both collections, heavy resharpening is indicated by the great variation in size between individual projectile points. Initial results from the analysis suggest different production strategies used in the manufacturing of the Milnesand versus Plainview designs. The Milnesand points from both sites generally are shorter and wider than Plainview points from both sites. The maximum width of the Milnesand points usually is much greater than the width of the base, in contrast to the Plainview points that are more lanceolate in shape. Significant distinctions between the types mostly are related to the preparation of the base. Milnesand points exhibit heavy grinding of the base, most of which are straight or slightly convex. The base is defined by the removal of small thinning flakes running parallel to the long axis and subsequent grinding of the edge. Plainview points have concave bases that are thinner and prepared by removal of thinning flakes and long, thin flakes running perpendicular to the basal edge.

The presence of both Milnesand and Plainview types in both assemblages suggests contemporaneous occupations and co-occurrence of these point types. Radiocarbon dating of Plainview assemblages from other sites in the region dates the Plainview design to ca. 10,000 yr B.P. (Johnson and Holliday 1980, 1987; Johnson et al. 1982).

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#### **References Cited**

Drake, D. 1994 The Milnesand Site: 40 years Later. Plains Anthropological Conference, *Abstracts* 52:46–47.

Johnson, E., and V. T. Holliday 1980 A Plainview Kill Butchering Locale on the Llano Estacado: The Lubbock Lake Site. *Plains Anthropologist* 25:89–111.

Johnson, E., and V. T. Holliday 1987 Introduction. In Lubbock Lake. Late Quaternary Studies on the Southern High Plains edited by Eileen Johnson, pp. 1–13. Texas A&M University Press, College Station.

Johnson, E., V. T. Holliday, and R. W. Neck 1982 Lake Theo: Late Quaternary Paleoenvironmental Data and New Plainview (Paleoindian) Date. *North American Archaeologist* 3(2):113–137.

Johnson, E., V. T. Holliday, J. Warnica, and T. Williamson 1986 The Milnesand and Ted Williamson Paleoindian Sites, East-Central New Mexico. *Current Research in the Pleistocene* 3:9–11.

Sellards, E. H. 1955 Fossil Bison and Associated Artifacts from Milnesand, New Mexico. *American Antiquity* 20:336–344.

Sellards, E. H. n.d. The Ted Williamson Site. Manuscript on file at the Texas Memorial Museum, Austin.

Warnica, J. M., and T. Williamson 1968 The Milnesand Site-Revisited. American Antiquity 33:16-24.

# A Revised Chronology for Cultural and Non-Cultural Mammoth and Mastodon Fossils in the Southwestern Lake Michigan Basin

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We report new radiocarbon dates for mammoth and mastodon fossils discovered during continuing paleontological research by J. E. Dallman (cf. West and Dallman 1980). During Dallman's research on late-Wisconsinan Green Bay lobe landscapes in southeastern Wisconsin (Schneider 1983), he recov-

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ered four mastodons (*Mammut americanum*) and one woolly mammoth (*Mammuthus primigenius*). Radiocarbon dating of either bone collagen from these proboscideans or organic matter associated with them yielded ages clustering in the 9,000 to 9,600 yr B.P. range (Table 1). A sixth specimen (UWZP-20500) was estimated to date approximately 11,500 yr B.P. based on its stratigraphic position relative to overlying, dated organic matter.

 Table 1. Comparison of conventional and AMS <sup>14</sup>C dates. (Conventional and accelerator mass spectrometer (AMS) radiocarbon dates on American mastodont (Mammut americanum) and woolly mammoth (Mammuthus primigenius.)

	Museum Number		
Taxon	or Site Name	Conventional <sup>14</sup> C Age, yr	AMS <sup>14</sup> C Age, yr
Mammut americanum	UWZP-19580	9630 ± 110 (WIS-267)	10,790 ± 60 (CAMS-24943)
Mammut americanum	UWZP-19581	9480 ± 100 (WIS-265)	10,910 ± 60 (CAMS-24428)
Mammuthus primigenius	Lake Mills Mammoth	9065 ± 90 (WIS-704)	
Mammuthus primigenius	UWZP-20500	11,500 (Geological est.)	11,150 ± 60 (CAMS-24945)
Mammuthus primigenius	Schaefer Mammoth	10,960 ± 100 (Beta-62822)	

All ages are in uncalibrated radiocarbon years. The abbreviation (WIS-) indicates the University of Wisconsin Radiocarbon Laboratory; (CAMS-) is the Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, California. UWZP- designates the University of Wisconsin Zoology Program. The Lake Mills mammoth is curated at UW, and the Schaefer specimen is curated at the Kenosha, Wisconsin, Public Museum.)

Overstreet (Overstreet 1993, 1995; Overstreet et al, 1995) excavated two woolly mammoths from similar contexts in southeastern Wisconsin. These mammoths were from landscapes on the Lake Michigan Lobe (Schneider 1983) and were approximately 60 km from Dallman's sites. One of these elephants, the Schaefer mammoth, was associated with chipped-stone tools. Bone collagen from the Schaefer mammoth yielded a date of 10,960 ± 100 yr (BETA 62822), an age estimate significantly older than ages assigned to Dallman's fossils (Table 1). These different sets of ages for mammoths and mastodons present several interpretation problems. First, the Holocene dates contrast with a hypothesized ca. 11,000 yr. B.P. extinction of the North American Pleistocene megafauna (Martin 1984); second, if the radiocarbon dates were correct, they would indicate that mastodons survived at least 1000 years later than mammoths; and third, the lithic artifacts associated with the mammoths suggest that mastodon-human associations should also occur and that these associations should be rigorously explored (cf. Fisher 1987).

To evaluate these hypotheses, we dated one mastodon and re-dated two others to determine if their chronologies were correct. The justification was that bone radiocarbon dates are often erroneous because geologically young contaminants remain in collagen, especially when large amounts of bone are dated by conventional radiocarbon methods. More accurate ages on fossil bone collagen result when extensive chemical purification is combined with AMS radiocarbon dating (Stafford 1990; Stafford et al. 1988, 1991). The new results (Table 1) are a confirmation of a late-Pleistocene age for one previously undated specimen (UWZP-20500, 11,500  $\pm$  60) and ages for the mastodons that were 1,000 to 1,400 years older than their previous radiocarbon dates. Because these AMS radiocarbon dates were on "XAD-purified gelatin hydrolyzate" and the bone collagen was well preserved chemically (Stafford et al. 1991), we believe these dates are an accurate estimate of the fossils' geologic ages.

These results are a cautionary note for establishing chronologies of megafauna extinctions and human-proboscidean associations in the Great Lakes region. We suggest that direct dates on fossil bone are preferred and the bone collagen radiocarbon dates should assay the most highly purified chemical fraction possible. When human associations are possible or proven, establishing chronologies should be even more rigorous and should include the dating of multiple samples, stratigraphically associated organic matter to bracket bone radiocarbon dates, and one or more chemical fractions from bone collagen. Discrepancies in these results will indicate unforeseen errors in one or more of the dating methods. For example, Dallman's age estimate for the UWZP-20500 mastodon proved more accurate than age estimates based on conventional bone collagen radiocarbon dates. In this case, stratigraphic information portended errors in the radiocarbon dating. These errors were resolved by redating the fossil bone with contemporary methods and better techniques.

We conclude that previous, Holocene ages for American mastodon (*Mammut americanum*) in the Great Lakes region were incorrect and that mastodons had become extinct by approximately 10,800 yr B.P.. We also suggest that conventional radiocarbon dates on bone collagen be used cautiously and that dates could be too young by more than 1,000 years.

#### **References Cited**

Fisher, D.C. 1987 Mastodont Procurement by Paleoindians of the Great Lakes Region: Hunting or Scavenging? In *The Evolution of Human Hunting*, edited by M. H. Nitecki and D. V. Nitecki, pp. 309–421. Plenum Press, New York.

Martin, P. S. 1984 Prehistoric Overkill: the Global Model. In: Paul S. Martin and Richard Klein, eds., *Quaternary Extinctions*, University of Arizona Press, Tucson, 354–403.

Overstreet, D. F. 1993 Chesrow—A Paleoindian Complex in the Southern Lake Michigan Basin. Case Studies in Great Lakes Archaeology No. 2. Great Lakes Archaeological Press, Milwaukee.

Overstreet, D. F. 1995 Late Pleistocene Geochronology and the Paleoindian Penetration of the Southwestern Lake Michigan Basin. Paper presented at the 40th Annual Midwest Archaeological Conference. October 25, 1995, Beloit College, Beloit, Wisconsin.

Overstreet, D. F., D. J. Joyce, and D. Wasion 1995 More on Cultural Contexts of Mammoth and Mastodont in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene* 12, 40–42.

Schneider, A. F. 1983 Wisconsinan Stratigraphy and Glacial Sequence in Southeastern Wisconsin. In Late Pleistocene History of Southeastern Wisconsin, edited by D. M. Mickelsen and L. Clayton, pp. 59–85. *Geoscience Wisconsin* 7.

Stafford, T. W., Jr. 1990 Late Pleistocene Megafauna Extinctions and the Clovis Culture: Absolute Ages Based on Accelerator <sup>14</sup>C Dating of Skeletal Remains. In *Megafauna and Man-Discovery of America's Heartland*, edited by L. Agenbrod, J. Mead, and L. Nelson, pp. 118–122. The Mammoth Site of Hot Springs, South Dakota, Inc., Scientific Papers, Vol. 1. Hot Springs, South Dakota.

Stafford, T. W., Jr. 1988 Accelerator <sup>14</sup>C dating of late Pleistocene megafauna. *Current Research in the Pteistocene*, 5:41–43.

Stafford, T. W. Jr., A. J. T. Jull, K. Brendel, R. C. Duhamel, and D. Donahue 1987 Study of Bone Radiocarbon Dating Accuracy at the University of Arizona NSF Accelerator Facility for Radioiso-tope Analysis. *Radiocarbon*, Vol 29 (1): 24–44.

Stafford, T. W. Jr., P. E. Harc, L. A. Currie, A. J. T. Jull, and D. Donohue 1991 Accelerator Radiocarbon Dating at the Molecular Level. *Journal of Archaeological Sciences* 18:35–72.

West, R. M., and J. E. Dallman 1980 Late Pleistocene and Holocene Vertebrate Fossil Record of Wisconsin. *Geoscience Wisconsin*, Vol. 4, Madison.

# Further Evidence for a Terminal-Pleistocene Occupation of Daisy Cave, San Miguel Island, California

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The southern California coast has one of the earliest and best documented records of coastal adaptations in the New World, including several early shell middens dated to about 9,000 yr B.P. and two sites on the Northern Channel Islands that may push coastal occupation back another millennium or more (Erlandson 1994). One of these island sites is Daisy Cave (CA-SMI-261), located on San Miguel Island about 40 km off the Santa Barbara coast, where evidence for a possible terminal-Pleistocene occupation has been found (Erlandson 1991, 1993). The confirmation of a terminal-Pleistocene maritime occupation of Daisy Cave has major implications for understanding the antiquity of coastal adaptations in the New World.

CA-SMI-261 contains a narrow fissurelike cave (Cave A) about 12 m long, a small rockshelter a few meters to the east, and a slope outside the cave/rockshelter covered with stratified occupational debris (Erlandson 1993:18–19). Cave A contains three small chambers separated by two low ceiling constrictions that must be crawled under. Erlandson (1993) focused on excavations straddling the drip line of the rockshelter, where shell midden strata dated to about 3,200, 6,000, and 8,000 to 9,300 yr B.P. have been identified. Early-Holocene deposits (strata E and F) just inside the drip line produced two basketryfragments and hundreds of pieces of cordage (Connolly et al. 1995). The early-Holocene shell midden also contains relatively large numbers of expedient chipped stone tools and debitage, along with small numbers of bone gorges and shell beads.

Below this midden is a thin paleosol (Stratum G) containing a low-density scatter of shell and bone fragments, charcoal, and chipped-stone artifacts. Marine shells from Stratum G produced uncorrected dates of  $10,260 \pm 90$  (Beta-14660) and  $10,180 \pm 70$  yr B.P. (Beta-52360), while charcoal was dated to  $10,390 \pm 130$  yr B.P. (CAMS-9094). Limited excavation in Stratum G produced a small number of chert and siliceous shale artifacts. During 1993–94 excavations, however, little stratigraphic separation and limited mixing between Strata F and G were found outside the rockshelter, raising questions about the

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associations of most artifacts found with the terminal-Pleistocene shell and charcoal. Thus, relatively unambiguous evidence for a terminal Pleistocene occupation rested on one siliceous shale flake tool found in situ in Stratum G, where it was stratigraphically distinct from Stratum F.

To more decisively determine if Daisy Cave was occupied during the terminal Pleistocene, we excavated a small sounding in the middle chamber of Cave A, where we hoped to identify early-Holocene and terminal-Pleistocene deposits with clearer stratigraphic separation than found outside the cave. We found about 50 cm of stratified shell midden underlain by 30-50 cm of homogeneous sterile silt and small angular rock debris. Below this sterile unit was a thin layer of silty sediment containing diffuse charcoal smears and burned rock. Careful excavation of this possible hearth feature produced a single large chert flake of clear cultural origin, found in situ in a charcoal smear. Paired samples of marine shell and charcoal collected from near the base of the shell midden that caps this sequence were AMS dated to  $9,110 \pm 90$  (CAMS-12456) and  $9,180 \pm 60$  (CAMS-14366) yr B.P. These dates suggest that the chert flake and associated evidence for fire found about 40 cm below the shell midden date to the terminal Pleistocene. Unfortunately, no datable charcoal fragments could be isolated from the burned feature itself.

In 1994, we excavated deeper into the floor of Cave A, digging a 25-cm-wide column from the surface to a depth of 180 cm. Below the possible hearth feature encountered in 1993, we found several similar lenses containing charcoal, burned rock, and in some cases welded sediment, burned bone, or unburned wood. In the field, these features were interpreted as most likely being cultural in origin. A sample of charcoal weighing 16.5 g from the lowest of these burned layers (150–160 cm below surface) was dated to 15,780  $\pm$  120 yrB.P. (Beta-77070). The sample consisted of relatively large chunks of burned wood that appeared to be from large branches or a log, however, so an "old wood" effect (Schiffer 1986) was anticipated at the time of submittal. A pine forest still existed near Daisy Cave about 11,000 yrB.P. (West and Erlandson 1994), and the cave occupants may have burned relict logs from this forest or old driftwood logs from nearby beaches. We are also exploring the possibility that natural agents may account for the formation of the burned strata in the depths of Daisy Cave.

So far, little evidence for cultural associations has been found for any but the uppermost of these "fire areas" inside Daisy Cave. The excavated sample is limited to less than 0.003 m<sup>3</sup> of sediment per stratum, however, and larger excavation samples may be required to identify evidence for an ephemeral occupation. Excavations in 1996 will further explore the antiquity, nature, and contents of the terminal-Pleistocene deposits at Daisy Cave. In the interim, the chert flake found in situ ca. 40 cm below a shell midden dated to 9,200 yr B.P. provides additional evidence that Daisy Cave and the Northern Channel Islands were occupied during the terminal Pleistocene. At present, it seems most likely that this flake, and the associated evidence for fire, correlate with the occupation of Stratum G outside the cave, dated to about 10,300 yr B.P.

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#### **References Cited**

Connolly, T. J., J. M. Erlandson, and S. E. Norris 1995 Early Holocene Basketry and Cordage from Daisy Cave, San Miguel Island, California. *American Antiquity* 60(2):309–318.

Erlandson, J. M. 1991 Early Maritime Adaptations on the Northern Channel Islands. In *Hunter-Gatherers of Early Holocene Coastal California*, edited by J. M. Erlandson and R. H. Colten, pp. 101–111. Institute of Archaeology, University of California, Los Angeles.

Erlandson, J. M. 1993 Evidence for a Terminal Pleistocene Human Occupation of Daisy Cave, San Miguel Island, California. *Current Research in the Pleistocene* 10:17–21.

Erlandson, J. M. 1994 Early Hunter-Gatherers of the California Coast. Plenum, New York.

Schiffer, M. G. 1986 Radiocarbon Dating and the "Old Wood" Problem: The Case of the Hohokam Chronology. *Journal of Archaeological Science* 13:13–30.

West, G. J., and J. Erlandson 1994 A Late Pleistocene–Early Holocene Pollen Record from San Miguel Island, California: Preliminary Results. *American Quaternary Association Abstracts*.

# Buried Paleoindian and Early Archaic Components at the Compensatory Basin North Site (11-Ms-1348) in the American Bottom, Madison County, Illinois

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The Compensatory Basin North (CB-North) site (11-Ms-1348), located in Madison County, Illinois, in the American Bottom flood plain of the Mississippi River, has recently yielded buried early early-Archaic and Paleoindian materials and features. It is located approximately 5.25 km east of the present-day Mississippi River. The site, situated on a low terrace, contains Pleistocene-derived silty sands, clay loams and sandy clay loams. The sands are exposed on the northern part of the site, but dip to the southwest and become more clayey. These sands are contiguous with a series of sandy clay loam horizons that are buried, at the southern part of the site, by Holocene upland-derived clay loam deposits. A 30- to 70-cm-thick sandyclay loam horizon that is buried by 80 to 160 cm of clay loam contains a diffuse lithic scatter near two large pit features and a number of rock clusters. Field investigations included the excavation of three geomorphology trenches, a machine-scraped block used to expose a portion of the buried cultural horizon and 23 test units each measuring 2 x 2 m. The site area is approximately 40,000 sq m.

The presence of two Barnes-like fluted projectile points and two small, unfluted lanceolate types, suggest that this zone contains Paleoindian material. (One of these fluted projectile points was looted by a local collector, who was persuaded to loan it to a third party for the purpose of photographing and

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measuring; he would not, however, return the point.) The two unfluted lanceolate projectile points (one is complete, the other is broken just above the base) are believed to be made by the same groups who made the fluted points because they are morphologically and metrically similar and were found in association with the fluted points. The two fluted points, one of which is a preform exhibiting a fluting platform, more closely resemble Barnes points (Deller and Ellis 1992) associated with sites located in the Great Lakes region than Cumberland points, thought to be a contemporaneous southern variant (Justice 1987:25).

A feature associated with the Paleoindian component (Feature 1) is large (3.20 m by 1.88 m) and oval-shaped with a shallow basin-shaped profile. Its maximum depth is .25 m. A small poorly preserved charcoal sample was recovered from Feature 1. Other Feature 1 materials include a large overshot flake exhibiting use wear along the lateral margins, a denticulate graver tool, and six small flakes. Preliminary analysis suggests that all these materials are produced from local Burlington chert. The large size of Feature 1 suggests that it may be the basin of a structure, though posts were not evident. A similar, but smaller, "bathtub-shaped depression" was excavated from Paleoindian context at the Bostrom site in nearby St. Clair County, Illinois (Tankersley et al. 1993).

Within the upper portion of the same cultural horizon, five rockcluster features and a large pit feature, tentatively assigned to the early early-Archaic Period, have been recovered from a small (approximately 10 x 10 m) area of the site. While no definitive temporally diagnostic materials were recovered from this area, one tip of an acutely beveled projectile point exhibiting parallel pressure flakes was found adjacent to the five rockclusters. The presence of rockcluster features and parallel-flaked and beveled points (such as Dalton, Hardin Barbed and Thebes varieties) are characteristics of early early-Archaic in the American Bottom and surrounding areas (Higgins 1990; Justice 1987).

The pit feature (Feature 4) is oval in plan like Feature 1, but is smaller  $(2.80 \times 2.12 \text{ m})$  and deeper (.76 m). The profile is basin-shaped. Eleven cultural items recovered from Feature 4 include an unidentified tool (knife/spoke-shave/graver), a small, crude biface fragment, two utilized flakes and six pieces of debitage. Four of these items are produced from local Burlington chert, four appear to be local Mississippi River gravel cherts (available on the site), one is Cobden/Dongola, and one is unidentified. The function of this large basin is not known, though the possibility of its use as a structural component is being considered.

A high number of materials from both the Paleoindian and early early-Archaic occupations appear to be from chert river cobbles that could have been picked up on the site or from nearby gravel bars of the Mississippi River. Overall, the tool assemblage looks to be an expedient one with a particularly high flaketool:bifacial-tool ratio. Cooperative efforts by the Illinois Department of Transportation and the Illinois Transportation Archaeological Research Program at the University of Illinois have modified plans related to I-255 construction so that unexcavated portions of the site are preserved.

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#### **References Cited**

Deller, D. B., and C. J. Ellis 1992 Thedford II: A Paleo-Indian Site in the Ausable River Watershed of Southwestern Ontario. Memoirs No. 24. Museum of Anthropology. University of Michigan, Ann Arbor.

Higgins, M. J. 1990 The Nochta Site: The Early, Middle and Late Archaic Occupations. University of Illinois Press, Urbana.

Justice, N. D. 1987 Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference. Indiana University Press, Bloomington.

Tankersley, K. B., B. Koldehoff, and E. R. Hajic 1993 The Bostrom Site: A Paleoindian Habitation in Southwestern Illinois. *North American Archaeologist* 14:43–69.

# Surface Fell's Cave Stemmed Points in the Argentine Pampas

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Surface fishtail or Fell's Cave Stemmed (FCS) points were considered important evidence in the past when discussing the peopling of South America. Yet interpretations based upon them are currently more cautious (Borrero 1983; Politis 1991). Three localities including these points in stratigraphy, dated between 10,000 and 11,000 yr B.P., are being studied in the Tandilia Range, Argentine Pampas (Flegenheimer 1991; Mazzanti in press). A non-systematic screening of private collections reveals they are present in the plains too.

Politis (1991) reviewed several isolated regional FCS points. Also Ameghino (1880 Figure 42) published a point corresponding to a resharpened FCS. Most of the artifacts described here are mentioned by Flegenheimer (1994). Two points were found at inland locations. A white quartzite recycled point (Figure 1A) was associated with recent artifacts at a surface site in the Sauce Chico Valley. A resharpened quartz point (Figure 1B) was collected 50 km southwest of the three localities mentioned above, in a plowed field near two scrapers and a bifacial blank.

The remaining six artifacts were collected near the present Atlantic coast. A yellow quartzite point found by the Arroyo Ballenera (Kristkautzky Collection) has a fractured stem and is reworked; it originally measured approximately 4 cm long. A yellow resharpened and abraded quartzite point (Figure 1C) is scantily retouched. Figure 1D is a yellow quartzite resharpened point. Two points were found near Los Angeles. One, of yellow quartzite (Figure 1E), is modified by resharpening; recent artifactswerefound nearby. The other, of an igneous rock (basalt?) approximately 4 cm long, is abraded by sandblasting (Zapiain Collection). Finally, figure 1F represents a FCS point of an igneous rock (Rhyolite?).

Stems are dulled; most points present remnants of the original blank at least on one face, and none is fluted. They are manufactured on highly selected regional rocks, transported tens or hundreds of kilometers from their sources.

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Figure 1 Fell's Cave Stemmed points. **A**, point reworked into scraper (Ibarra site, N. Cinquini collection); **B**, point from east La Querencia (J. P. Demey collection); **C**, point found near Miramar (Museo Monte Hermoso); **D**, point from Ao. Carolina near Mar del Sur (R. Parodi collection); **E**, reworked point from blowout near Los Angeles, Ca. (C. Hagen collection); **F**, point found near Monte Hermoso (Museo Monte Hermoso).

Points are resharpened or recycled, evidencing long use. The concentration of coastal finds coincides with the area preferred by avocational archaeologists. Also, most were found in environments with deflated eolian features. The presence of wind abrasion on some, results from their long surface exposure. Possibly different situations are represented in the sample: scavenging by later groups, or exposure by erosion of old deposits. These finds open for consideration the possibility of an extensive regional occupation by early groups in an area with current low visibility.

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#### **References Cited**

Ameghino, F. 1880 La Antigüedad del Hombre en el Plata. Mason-Igon. Buenos Aires.

Borrero, L. A. 1983 Distribuciones Discontínuas de Puntas de Proyectil en Sudamérica. Paper presented at the 11th International Congress of Anthropological and Ethnological Sciences. Vancouver, Canada.

Flegenheimer, N. 1991 Bifacialidad y Piedra con Picado, Abrasión y Pulido en Sitios Pamp eanos Tempranos. *Shincal* 3 (2):64–78, Universidad Nacional de Catamarca, Argentina.

Flegenheimer, N. 1994 Consideraciones Sobre el uso del Espacio en las Sierras de Loberías (provincia de Buenos Aires). *Revista del Museo de Historia Natural de San Rafael.* Tomo XIII (1/4):14–18. Mendoza.

Mazzanti, D. in press Arqueología del Borde Oriental de Tandilia. Cambios y Continuidad es en el Uso del Espacio. Shincal 5, Universidad de Catamarca.

Politis, G. 1991 Fishtail Projectile Points in the Southern Cone of South America: An Overview. In *Clovis: Origins and Adaptations*, edited by R. Bonnichsen and K. Turnmire, pp. 287–301. Center for the Study of the First Americans, Oregon State University, Corvallis.

# The East Wenatchee Clovis Site (Richey-Roberts Site): Summary of Findings and Current Status

Richard Michael Gramly

The East Wenatchee Clovis site was discovered in 1987 at SUMAC Orchards, East Wenatchee, Douglas County, central Washington State (Mehringer 1989a, 1989b). In 1990 and 1991 field crews directed by the author continued and expanded the investigations initiated by Mehringer in 1988 (Gramly 1991, 1993; see Figure 1).

Mehringer reported thatvolcanic ash adhering to the downward-facing sides of flaked tools from the site was from the Glacier Peak eruption of c. 11,000 years ago (Mehringer and Foit 1990). At least three radiocarbon dates were obtained on artifactual bone from Feature 1 (the Richey Clovis Cache, per se), but only one of these determinations has been reported in the literature (Gramly 1993:60). This result was a disappointingly recent  $5,215 \pm 90$  yr B.P. (Beta-43663, ETH-7827). The unreported dates on samples submitted by Washington State University to the University of Arizona for tandem linear mass spectroscopy, likewise, were young. An explanation for the anomalous absolute dates with the myriad chemicals that are applied every year in a commercial orchard where table apples are grown.

The author's 1990 fieldwork determined the nature of the primary deposit of artifacts to be a cache in a shallow, covered pit. Nearby was a second, deeper pit (Feature 2) that was nearly devoid of artifacts. Neither feature contained human remains, nor are there any grounds for assuming that either pit ever did. Similar features are known to have been associated with habitations occupied by Paleoindians using fluted points (e.g., Gramly 1982), and a domestic function seems likely.

A rumor persists that many of the flaked tools in the Richey Clovis Cache were dressed with red ochre like implements from the Anzick Clovis site in Montana. In fact, there is very little ochre on any tool except for two of the large fluted knives, where it is confined to the hafting area suggesting the former presence of red-painted wooden handles.

Flintknapper D. C. Waldorf argues that three craftsmen are represented among the group of 14 Clovis points from Feature 1. In his opinion, one of them was left-handed and extremely skilled (Waldorf 1991:4). The use of overshot

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**Figure 1.** Location of East Wenatchee Clovis site (Richey-Roberts site) in relation to Grant Road and orchard tree lines. Blackened 1-meter squares were excavated initially in 1988; open squares were explored in 1990. Features 1 and 2 lie at the edge of an hypothesized habitation area (shown dotted) whose presence is suggested by flaked stone debitage unearthed in 1988 and 1990. This habitation area may extend underneath Grant Road where the paved surface at centerline is .48 m above site datum. The berm edge on the south side of the road is .84 m below datum. In 1991 a few test pits were dug along the north edge of Grant Road opposite the find-spot of 1987–1990, but no significant discoveries were made.

flaking to thin large agate points with as few removals as possible is masterful and has few parallels among ancient—or modern—specimens. A study of the geometry of the Wenatchee points also suggests that two, possibly three, craftsmen are represented (L. Borst, pers. comm.; cf. Borst, n.d.).

The entire assemblage of artifacts recovered in 1987–1990 was gifted to the Washington State Historical Society in Tacoma by Mack and Susan Richey in 1993. The site itself has returned to orchard, and the rights to excavation, also owned by Washington State, cannot be exercised until 2008. Unfortunately, in the meanwhile the application of chemicals continues unabated and the ground is kept moist by irrigation. There is little doubt that bone objects still in the earth are deteriorating.

#### **References Cited**

Borst, L. B. n.d. *Geometry of Folsom and Clovis Projectile Points*. Ms. on file, Twin Bridge Press, 7 Twin Bridge Lane, Williamsville, NY 14221.

Gramly, R. M. 1982 The Vail Site: A Palaeo-Indian Encampment in Maine. *Bulletin of the Buffalo Society of Natural Sciences*. 30. Buffalo, New York.

Gramly, R. M. 1991 Blood Residue upon Tools from the East Wenatchee Clovis Site, Douglas County, Washington. *Ohio Archaeologist* 41(4):4–9.

Gramly, R. M. 1993 The Richey Clovis Cache: Earliest Americans along the Columbia River. Persimmon Press, Buffalo, New York.

Mehringer, P. J. 1989a Age of the Clovis Cache at East Wenatchee. A report to the Washington State Historic Preservation Office, 30 September 1989.

Mehringer, P. J. 1989b Of Apples and Archaeology. *Universe* 1(2):2–8. Washington State University, Pullman.

Mehringer, P. J., and F. F. Foit, Jr. 1990 Volcanic Ash Dating of the Clovis Cache at East Wenatchee, Washington. *National Geographic Research* 6(4):495–503.

Waldorf, D. C. 1991 The Richey Cache: Some Observations. Chips 3(1):4-7.

# Small-Scale Excavations at the Sugarloaf Site: A Bull Brook Phase Encampment in the Connecticut River Valley

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Archaeological reconnaissance during 1978 on the site of an industrial park in the town of Deerfield, Franklin County, Massachusetts, revealed a large Paleoindian encampment that was intact beneath a modern tilth zone (Ulrich 1978). Artifacts lay within soil of the Windsor series (USDA 1967:159) that had developed upon lake sediments and dune fields of pro-glacial Lake Hitchcock (Little 1984). Lake Hitchcock is thought to have disappeared from the Connecticut River Valley by 12,900 yr B.P. (Curran and Dincauze 1977).

Since its discovery the exact age and cultural affiliation of the Sugarloaf Paleoindian site (named after a prominent nearby hill) have remained unknown; indeed, the very existence of the site has been kept secret in order to protect it. A 2-acre section was capped with 1–3 m of sand to discourage looters. Another acre or two of artifact-bearing soil, however, lies on private land outside the protected section. Farming activities and proposed industrial development have placed this part of the Sugarloaf site at risk, and in 1995 the writer decided to conduct small-scale excavations before more of the ancient encampment was destroyed.

One of our 1995 test pits encountered a Paleoindian hearth with many flakedstone unifacial and bifacial tools around it. Fine debitage from tool maintenance and resharpening as well as minute calcined bone fragments and charcoal marked the hearth itself. Notable discoveries near this feature were a drilled stone bead (Figure 1c), a complete fluted point of felsite (Figure 1 a), a heap or cache of 30 chert and felsite tools including a fluted-point preform and a point abandoned during fluting, and a fragmentary fluted drill (Figure 1b). This latter specimen, fashioned of felsite, belongs to the category of so-called twist drills—*fossiles directeurs* of the Bull Brook Phase, Eastern Fluted Point Tradition. During this phase the initial settlement of New England occurred.

The source areas of the cherts represented in the Sugarloaf assemblage lie

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Figure 1. Stone artifacts from vicinity of hearth, 1995 excavations, Sugarloaf site. A, shallowly concave fluted point of felsite; B, distal portion of fluted "twist drill" of felsite; C, drilled bead, unidentified raw material. Drawings by V. Waldorf from actual specimens.

approximately 150 km to the west in the Hudson River valley. The felsites, on the other had, may have originated in the opposite direction—100 km to the east in volcanic complexes near Boston. In any event, few of the raw materials were procured from local sources in the central Connecticut River valley.

A study of the 556 calcined bone fragments (weighing a scant 39 grams) in the hearth gave inconclusive results (Arthur Spiess, pers. comm.). Cervid bone and cervid antler were noted, but species could not be determined. None of this bone nor any of the charcoal that accompanied it has (as yet) been submitted for radiocarbon dating.

On the face of it, the Sugarloaf site appears to be a very large (3–4 acres) Paleoindian encampment that served as a central meeting place for hunters who roamed a broad region. Future archaeological explorations may reveal that it is comparable in size and density of artifacts to the legendary Bull Brook site (see Grimes 1979 for a summary), Ipswich, Massachusetts. Such a site may be expected to yield uncommon artifacts, such as the stone bead discovered in 1995.

#### **References** Cited

Curran, M., and D. Dincauze 1977 Paleoindians and Paleo-lakes: New Data from the Connecticut Drainage. Annals of the New York Academy of Science 288:333-348.

Grimes, J. R. 1979 A New Look at Bull Brook. Anthropology 3(1-2):109-130.

Little, R. D. 1984 Dinosaurs, Dunes, and Drifting Continents: The Geohistory of the Connecticut Valley. Greenfield Community College, Massachusetts.

Ulrich, T. G. 1979 An Archaeological Survey of the Deerfield Industrial Park. Report on file at the Deerfield Economic Development and Industrial Corporation, South Deerfield, MA 011373.

USDA [United States Department of Agriculture] 1967 Soil Survey of Franklin County, Massachusetts. Washington, D.C.

### The Occurrence of Clovis Points in Kansas

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The origins and dispersal of Clovis culture and technology remain important and debated issues in archaeology (Bonnichsen and Turnmire 1991). The study of Clovis artifact distribution in Kansas is updated here as a small part of broader efforts concerning the peopling of the New World (e.g., Faught et al. 1994).

Previous summaries of Clovis evidence in Kansas provide limited information on patterns in the Clovis artifact sample (e.g., Brown and Logan 1987; Holen 1989; Rogers and Martin 1982; Schmits 1987; Wetherill 1995). In recent years, we have opportunistically recorded detailed information on Kansas Clovis points. This now enables a preliminary discussion of 62 Clovis points from the state (Hofman and Hesse 1996).

Clovis points are reported from 27 counties (Figure 1; three specimens lack county provenience). Information on lithic material, condition, and metric attributes are available for more than half of the sample. Clovis points are documented from all corners of the state, but the distribution is uneven.



Figure 1. Distribution of Clovis points in Kansas by county (n = 59, 1995).

Notable is the rarity of reported finds in central and southeastern Kansas. The northeastern glaciated region, the northern Flint Hills, and the western High Plains have yielded the majority of Clovis finds. This pattern may reflect uneven investigation of collections and archaeological research, or it may be a reflection of Clovis peoples' preference for these areas. If evidence from other regions is used as an indicator, however, Clovis sites in alluvial or loess deposits may often be too deeply buried to be encountered by traditional archaeological survey or site testing studies (Ferring 1994). The counties with "high densities" of reported Clovis points (Johnson, Riley, Kearny, and Stevens) reflect the systematic study of avocational archaeological collections in those areas (Glover 1978; Hofman and Hesse 1996; Schmits 1987; Wetherill 1995).

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By comparison, only 38 Folsom points are now documented from Kansas (cf. Hofman 1994). Folsom points also occur in the northeast glaciated region and the western High Plains. Clovis points are fairly evenly distributed east and west of 98 degrees W. Longitude, whereas Folsom points are significantly more common to the west. This pattern may reflect an economic or subsistence shift which occurred at the close of the Pleistocene with the extinction of mammoth and other species and the expansion of bison populations. The Folsom artifact distribution may correspond to a bioecological and paleobiological boundary, the Tatschl Line, recognized based on Pleistocene and Holocene faunal evidence (Kuchler 1970; Martin and Hoffman 1987). It may be that regionalized adaptation had not yet occurred during Clovis time (Kelly and Todd 1988), or perhaps ecological differentiation between eastern and western Kansas was not as extreme during Clovis time.

A variety of lithic materials and sources are represented in the Kansas sample, and these provide clues as to direction and distance of Clovis group or individual movements. Currently we have material information for half of the 62 specimens. The most common identified material is Flattop chalcedony (23%), followed by Niobrara jasper (19%) and Alibates flint (16%). Quartzites (16%), probably from a variety of sources including those in southeast Colorado and southwestern Kansas (Banks 1990; Stein 1985), were also used for Clovis-point manufacture. Less well represented materials include chalcedony, basalt, Florence A, and fossilized wood.

Kansas Clovis points are commonly complete or nearly so (60%), but many of these have been reworked at least once. There are no tip fragments in the sample, an indication of the difficulty in distinguishing Clovis point tips from those of other large point types. Fractures observed on distal ends indicate that 25% of the points have impact damage (e.g., Ahler 1971; Odell and Cowan 1986). More than half (57%) of the distal ends of the Kansas sample have been reworked or resharpened after breakage, and one third (33%) have been reshaped along their lateral blade margins.

Current patterns in Clovis-point distribution, fragment types, and lithic materials may reflect as much about sampling, reporting, and recognition as they do about past human behavior. Continuing study of known and rumored finds will improve knowledge of Clovis activity in the region.

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#### **References Cited**

Ahler, S. A. 1971 Projectile Point Form and Function at Rodgers Shelter, Missouri. Missouri Archaeological Society Research Series 8. Columbia.

Banks, L. 1990 From Mountain Peaks to Alligator Stomachs: Memoir 4 of the Oklahoma Anthropological Society.

Bonnichsen, R., and K. Turnmire (editors) 1991 *Clovis Origins and Adaptations*. Center for the Study of the First Americans, Corvallis.
Brown, K., and B. Logan 1987 The Distribution of Paleoindian Sites in Kansas. In *Quaternary Environments of Kansas*, edited by W. C. Johnson, Kansas Geological Survey Guidebook 5. Lawrence.

Faught, M. K, D. G.Anderson, and A. Gisiger 1994 North American Paleoindian Database: An Update. *Current Research in the Pleistocene* 11:32–35.

Ferring, C. R. 1994 The Role of Geoarchaeology in Paleoindian Research. In *Method and Theory for Investigating the Peopling of the Americas*, edited by R. Bonnichsen and G. Steele, pp. 57–72. Center for the Study of the First Americans, Corvallis.

Glover, G. F. 1978 An Analysis of Early Paleo-Indian Projectile Points with New Data from Southwestern Kansas. Master's thesis, Department of Anthropology, Wichita State University.

Hofman, J. L. 1994 Kansas Folsom Evidence. The Kansas Anthropologist 15(2):31-43.

Hofman, J. L., and I. S. Hesse 1996 Clovis in Kansas. Paper presented at the 10th meeting of the Tertiary-Quaternary Institute, Lawrence, Kansas.

Holen, S. R. 1989 Two Late Pleistocene Sites in the Central Plains: Preliminary Statements. Paper presented at the 47th annual Plains Anthropological Conference. Sioux Falls, South Dakota.

Kelly, R. L., and L. C. Todd 1988 Coming into the Country: Early Paleoindian Hunting and Mobility. *American Antiquity* 53(2):231–244.

Kuchler, A. W. 1970 A Biogeographical Boundary-the Tatschl Line. *Transactions of the Kansas Academy of Science* 73:298–301.

Martin, L. D., and R. S. Hoffman 1987 Pleistocene Faunal Provinces and Holocene Biomes of the Central Great Plains. In *Quaternary Environments of Kansas*, William C. Johnson (ed.), pp. 159–165. Guidebook Series 5, Kansas Geological Survey, Lawrence.

Odell, G., and F. Cowan 1986 Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13(2):195–212.

Rogers, R. A., and L. D. Martin 1982 A Clovis Point from the Kansas River. *Transactions of the Kansas Academy of Sciences* 85(2):78–81.

Schmits, L. 1987 The Diskau Site: A Paleoindian Occupation in Northeast Kansas. Current Research in the Pleistocene 4:69-70.

Stein, M. 1985 The Schmidt Quartzite Quarry (14KY303): A Source of Stone in the Arkansas River Valley. *Journal of the Kansas Anthropological Association* 5(3):101–116.

Wetherill, B. 1995 A Comparative Study of Paleoindian Evidence at the Bonner Spring Locality, Lower Kansas River Basin, Kansas. Master's thesis, Department of Anthropology, University of Kansas. Lawrence.

## Folsom in the Colorado High Country: The Black Mountain Site

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The Smithsonian Institution in cooperation with the Rio Grande National Forest is currently engaged in the interdisciplinary study of a buried Folsom

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hunting camp at 3096 m (10,160 feet) in the San Juan Mountains of southern Colorado. As the first Folsom site excavated in the high-altitude ecotone near upper timberline, this camp firmly establishes the seasonal use of high mountain environs as a component of Folsom settlement systems in the Southern Rocky Mountains.

The Black Mountain site is in the headwaters of the Rio Grande, just south of the Continental Divide in Hinsdale County, Colorado. Although the majority of the valleys in this region were glaciated, the North Clear Creek valley, occupied by the Folsom people at Black Mountain, remained ice-free throughout the late Pleistocene. Thus this particular valley was well disposed to an earlier establishment of postglacial soils and vegetation relative to surrounding areas and may have been especially attractive in terms of resources for early human populations.

The site currently occupies a subalpine setting characterized by open parkland but may have been above upper timberline in late-Pleistocene times. Situated in a topographically protected bowl created by a high pre-Pinedale-age outwash terrace to the north and east, and by Black Mountain to the southwest, the camp provided protection from prevailing winds and cold air drainage, an unshaded setting warmed by early morning sunlight, and easy access to water and fuel (cf. Benedict 1992). The setting was also advantageously placed with regard to hunting opportunities.

Near the site, North Clear Creek cuts a narrow gap between the outwash terrace and the mountain slope, creating a natural funnel for animals moving along the creek. This funnel extends along the backside of a long, isolated ridge sandwiched between the creek and the site. The ridge itself forms an excellent overlook. From its vantage 20 m above the camp, one can view animals moving through the gap or grazing in the broad expanse of well-watered parkland downstream.

The site was discovered along a jeep trail in 1977 during a survey preceding a timber sale on the Rio Grande National Forest. Test excavations in 1993 by Smithsonian crews, augmented by Earthwatch volunteers, exposed a 32-m<sup>2</sup> area. Thus far, Folsom is the only cultural component represented. The lithic assemblage includes a double graver, four curated end scrapers, an early-stage biface broken in manufacture, portions of five preforms, four channel flakes, several utilized flakes, and more than a thousand flakes resulting from tool maintenance and the later stages of biface production. Toolstone is dominated by fine-grained cherts and silicified woods of local and unknown origins. They differ from the materials represented in Folsom sites in the San Luis and middle Rio Grande Valleys to the southeast and possibly suggest more westwardlooking connections. No faunal material was recovered in these acidic soils.

Sediments deriving primarily from outwash terrace deposits and colluvium from the ridge buried the site. The lithics exhibit a U-shaped vertical distribution from the surface to 40 cm below, with the majority buried by 25 to 30 cm of overburden. Bioturbation by rodents and earthworms contributed to some redistribution. For example, an end scraper recovered in the buried Folsom horizon refits a use/resharpening flake displaced 30 cm higher (horizontal separation was 3.5 m).

More than 300 flecks of charcoal (3-11 mm length) were piece-plotted. No hearth is yet identified, but the charcoal concentrations complement the lithic distributions. Two of the charcoal flecks were AMS radiocarbon dated in 1995. The first sample, split in two portions by Vance Haynes, dates 7,888 ± 72 yr B.P. (AA#14461) and 8,110 ± 70 yr B.P. (UCR-3416/TAMS 24193). The second sample dates 10,631 ± 84 yr B.P. (AA#14462). The origins (natural and/or cultural) of the charcoal are still being investigated.

Ongoing research includes additional AMS dating, use-wear analysis, and the coring of Black Mountain Lake sediments for paleoenvironmental study. Funding is being sought for continued excavation to investigate: 1) the geomorphological and depositional site history, 2) the possible presence of a hearth in the vicinity of the concentrated charcoal and Folsom artifacts, and 3) the horizontal limits of the site.

The Smithsonian's Paleoindian/Paleoecology Program funded the 1993 excavations, while interdisciplinary expertise, logistical and morale support were generously provided by the Rio Grande National Forest and the Bureau of Land Management. We thank Earthwatch volunteers and the good people of Creede, Colorado for assisting the Smithsonian crew.

#### **References Cited**

Benedict, J. B. 1992 Footprints in the Snow: High Altitude Cultural Ecology of the Colorado Front Range, U.S.A. Arctic and Alpine Research 24(1):1–16.

# A Possible Association between *Camelops* cf. *hesternus* and Lithic Artifacts from the Sunshine Locality in Eastern Nevada

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The Sunshine Locality is a National Historic Register Paleoindian site located in Long Valley, eastern Nevada. In 1993 we conducted test excavations at this site (Beck et al. 1994; Jones et al. in press), which were continued in 1995. These excavations revealed a deeply buried (>5 m) alluvial sequence containing artifacts as well as the bones of *Camelops* cf. *hesternus*. Above the alluvial sequence is a cienega paleosol, which corresponds in stratigraphic placement to, but dates slightly later than (Quade), the "black mats" at sites in the Southwest (Haynes 1991).

Excavations in 1995 were carried out at two locations: ST3 and LT1. A gravel lens at the base of the alluvial section in ST3 yielded a stem section of a Western

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Stemmed Tradition projectile point. This and other lithic tools were found adjacent to and directly beneath several bones of *Camelops* cf. *hesternus*. The sedimentary context suggests redeposition, but the size and orientation of the bones and artifacts are not consistent with deposit bedding, nor do they exhibit transport damage.

Although no charcoal was recovered from the alluvium in ST3, four <sup>14</sup>C dates from alluvial beds in other units (Table 1) suggest a general age for the artifacts and bones. Two dates were obtained in 1993, averaging 10,245 yr B.P. A date of 10,340  $\pm$  60 yr B.P. was obtained in 1995 from charcoal adjacent to a mandible and tooth of *Camelops* cf. *hesternus* in the wall of the backhoe trench adjacent to ST3. Finally, a date of 10,320  $\pm$  50 yr B.P. was obtained from the sands in LT1, 12 cm above a fluted point.

Year Obtained <sup>1</sup>	Beta Number	Material Dated <sup>2</sup>	<sup>14</sup> C Age Years B.P.
1993-A	69779	СМ	10,240 ± 80
1993-A	69780	CM	$10,250 \pm 60$
1993-C	69781	OS	8,560 ± 100
1993-C	69782	CM	9,820 ± 60
1995-A	83090	CM	10,340 ± 60
1995-C	86198	CM	9,920 ± 60
1995-C	86199	OS	7,420 ± 60
1995-C	86200	OS	9,040 ± 190
1995-C	86201	CM	9,880 ± 50
1995-C	86202	CM	9,910 ± 50
1995-C	86203	OS	9,940 ± 50
1995-C	86204	OS	10,060 ± 50
1995-A	86205	CM	10,320 ± 50
1995-C	86206	CM	9,880 ± 50

Table 1. Radiocarbon dates from the Sunshine locality.

<sup>1</sup>Sample collected from alluvium (A) or cienega (C). <sup>2</sup>Material dated is either charred material (CM) or organic sediment (OS).

Among the small artifact sample recovered from the alluvial sediments in LT1 was the basal section of a fluted point as well as a crescent fragment. The  $10,320 \pm 50$  yr B.P. date noted above provides a limiting date for both point and crescent. Lying above the alluvial sequence, the cienega deposit generally contains few artifacts. Thirty-seven artifacts were recovered from this stratum in 1993, including a complete stemmed projectile point with an associated date of  $9,820 \pm 60$  yr B.P. Only two artifacts were recovered from the cienega in 1995. These specimens are sections of a single biface, the larger of which was found in situ and associated with a date of  $9,910 \pm 50$  yr B.P.

In all, ten <sup>14</sup>C dates were obtained on material collected from the cienega; seven range between 10,060 and 9,820 yr B.P. The remaining three dates were obtained on organic sediment, which is more subject to contamination than charred material (Hedges and van Klinken 1992). If these three dates are considered aberrant, then the cienega was relatively short-lived, lasting less than 250 years. We believe that significant habitation at the Sunshine Locality ceased with the drying of the cienega, approximately 9,800 yr B.P.

#### **References Cited**

Beck, C., G. T. Jones, and F. Nials 1994 Recent Excavations at the Sunshine Locality, A Late Pleistocene/Early Holocene Site in Eastern Nevada. *Current Research in the Pleistocene* 11:6–7.

Haynes, C.V., Jr. 1991 Contributions of Radiocarbon Dating to the Geochronology of the Peopling of the New World. In *Radiocarbon after Four Decades*, edited by R. E. Taylor, A. Long, and R. S. Kra, pp. 355–374. Sprinter-Verlag, New York.

Hedges, R. E. M., and G. J. van Klinken 1992 A Review of Current Approaches in the Pretreatment of Bone for Radiocarbon Dating by AMS. *Radiocarbon* 34:279–291.

Jones, G. T., C. Beck, F. L. Nials, J. J. Neudorfer, B. J. Brownholtz, and H. B. Gilbert in press Recent Archaeological and Geological Investigations at the Sunshine Locality, Long Valley, Nevada. *Journal of California and Great Basin Anthropology*.

Quade, J. 1996 Black Mats, Spring Fed Streams, and Late Glacial-Age Recharge in the Southern Great Basin. Manuscript in preparation.

## Evidence of Late Pleistocene/Early Holocene Occupation at Site 40MT344, Montgomery County, Tennessee

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Recent cultural resource investigations in Montgomery County, Tennessee, have provided additional information concerning an already rich record of late-Pleistocene/early-Holocene occupation in the Midsouth. Archaeological site 40MT344 is within the boundaries of Fort Campbell Military Reservation and was originally recorded by O'Malley et al. (1983) as a non-diagnostic lithic scatter during cultural resource reconnaissance. This site is situated on a terrace above the flood plain of Noahs Spring Fork, a secondary tributary in the uplands of the lower Cumberland River drainage. Because this and other nearby sites will be impacted by pending military activities, cultural resource investigations were conducted during the summer and fall of 1995 to determine the potential for intact archaeological deposits.

Pedestrian survey and shovel testing were utilized to determine the distribution and extent of cultural material in the project area. This level of investigations determined lithic material to be moderately distributed over a much larger area than previously thought. Diagnostic artifacts from the late or transitional Paleoindian through Archaic and Woodland periods were recovered. However, shovel testing suggested that intact subsurface deposits were not likely to be encountered. Two 1-m<sup>2</sup> test units were excavated to subsoil in an area of high lithic concentration, while 15 large strip blocks were exposed with the aid of a backhoe. No subsurface features were encountered in any of the test units or strip blocks, largely due to previous agricultural and military activities.

A single example of a Dalton or Dalton-like projectile point was recovered

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during surface reconnaissance (Figure 1). This point does not exhibit resharpening, suggesting that it was not reworked or brought to the site by later occupants. Supporting the notion of an actual Dalton or late-Pleistocene/early-Holocene occupation are two unifacial end scrapers characteristic of Paleoindian and/or early-Archaic assemblages (Figure 1).



Figure 1. Late-Pleistocene/early-Holocene artifacts recovered from 40MT355. **A** and **B** are unifacial end scrapers; **C** is a Dalton projectile point.

Dalton occupation in the Southeast U.S. has been dated from 10,600 to 9,900 yr B.P. (Goodyear 1982). Two sites near the vicinity of 40MT344 have radiocarbon-dated Dalton occupations. The Puckett site located on the lower Cumberland River in Stewart County, Tennessee, provides a date of 9,790  $\pm$  160 yr B.P. (Norton and Broster 1993). Gramly and Funk (1991) report a date of 9,115  $\pm$  100 yr B.P. for Dalton occupation at the Olive Branch site in southernmost Illinois. The former date supports the younger end of Goodyear's (1982) range, while the latter appears to be somewhat young. Gramly and Funk (1991) do indicate that additional Dalton artifacts were found stratigraphically below where the radiocarbon sample was recovered.

While no intact deposits were discovered and the recovered assemblage is small, sites such as 40MT344 should not be ignored. Differences in artifact and site distributions between major river valleys, smaller tributaries, and adjacent uplands in the emerging Holocene environments provide clues to settlement and adaptive patterns that are now only beginning to be deciphered. Sites such as 40MT344 in conjunction with larger sites with intact deposits indicate broader patterns of late-Pleistocene/early-Holocene adaptations in the Midsouth. A sizable amount of information has already begun to be accumulated. An additional site located in the flood plain of a tertiary stream in Fort Campbell has produced a Dalton point (O'Malley et al. 1983). Conversely, larger drainages near Fort Campbell have produced a greater amount of information relating to the Dalton complex. The Kentucky Lake region of westcentral Tennessee has produced an exceptional number of late-Paleoindian diagnostic artifacts and sites (Broster et al. 1991) including the Nuckolls and Nuckolls extension sites (Lewis and Kneberg 1958; Norton and Broster 1992). A number of Dalton or Dalton-related sites have been recorded in the Red River drainage in west-central Tennessee and Kentucky (Barker 1994). Factors such as availability of high-quality lithic raw materials undoubtedly played a role in attracting early occupants to the area. It is essential that information, however scant, derived from pure research or cultural resource management be provided so that all pieces of the puzzle may be available.

#### **References** Cited

Barker, G. 1994 Paleoindian Occupation in the Upper Red River of North-Central Tennessee and South-Central Kentucky. *Current Research in the Pleistocene* 11:3–5.

Broster, J. B., M. R. Norton, and R. Anderson 1991 Clovis and Cumberland Sites in the Kentucky Lake Region. *Current Research in the Pleistocene* 8:10–12.

Goodyear, A. III 1982 The Chronological Position of the Dalton Horizon in the Southeastern United States. *American Antiquity* 47:382–395.

Gramly, M. R., and R. E. Funk 1991 Olive Branch: A Dalton and Pre-Dalton Encampment at Thebes Gap, Alexander County, Illinois. In *The Archaic Period in the Midsouth* edited by C. M. McNutt. Proceedings of the 1989 Midsouth Archaeological Conference, Occasional Papers No. 16, Memphis State University, Memphis.

Lewis, T. M. N., and M. Kneberg 1958 The Nuckolls Site: A Possible Dalton-Meserve Chipping Complex in the Kentucky Lake Area. *Tennessee Archaeologist* 14:61–79.

O'Malley, N., J. Funk, C. Jobe, T. Gatus, and J. Riesenweber 1983 *Cultural Resource Reconnaissance of Ft. Campbell, Kentucky-Tennessee.* Report submitted to U.S. Army Corps of Engineers, Nashville District.

Norton, M. R., and J. B. Broster 1992 40HS200: The Nuckolls Extension Site. *Tennessee Anthropologist* 17(1):13–32.

Norton, M. R., and J. B. Broster 1993 Archaeological Investigations at the Puckett Site (40SW228): A Paleoindian/Early Archaic Occupation on the Cumberland River, Stewart County, Tennessee *Tennessee Anthropologist* 18(1):45–58.

## Reinvestigation of Marks Beach: A Possible Early/ Mid-Holocene Campsite on Blackwater Draw

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The Marks Beach site (41LA4) is located in a dunefield on the northern edge of Blackwater Draw, Lamb County, Texas. Initial excavations of approximately 149 m<sup>2</sup> of the site by Kenneth Honea between 1968 and 1970 (Honea 1980; Randall 1970) indicated the presence of several components, ranging from

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Paleoindian to late prehistoric in age, and a stratigraphic sequence Honea believed was similar to those at Blackwater Draw Locality No. 1 and Lubbock Lake (respectively, "updraw" and "downdraw" of Marks Beach). As at those other sites, the basal stratigraphy of Marks Beach is composed of a sand/gravel unit, overlain by thick and distinctive diatomite beds, and in turn by marls. On the Southern High Plains generally, such sections range from the late Pleistocene through the early/mid-Holocene in age, but at Marks Beach these units were not well dated. The only chronological control came from a <sup>14</sup>C date of 9920  $\pm$  380 yr B.P. (GX-1458), obtained from a (possibly culturally associated) *Bison antiquus* innominate located below 30 cm of diatomite (Honea 1980:261–262).

Atop the diatomite beds, Honea reported a water well dug from what he presumed was a middle-Holocene (Altithermal) erosional surface—his Zone IIIB/IIIA contact. On the same surface in the area surrounding the well were several caliche hearths, scrapers, hammerstones, abrading stones, and lithic-reduction debitage. No absolute date was obtained for the well, and its relative age was inferred from the regional stratigraphy and diagnostic projectile points.

Marks Beach is today of great importance, as work by Holliday (1995, also Meltzer 1995) indicates it was one of a handful of late-Pleistocene/early-Holocene freshwater springs on the Southern High Plains (as marked by its thick diatomite beds), and possibly, one of the few known localities to yield middle-Holocene water wells (other sites are Blackwater Draw Locality No. 1 [Evans 1951; Hester 1972], Mustang Springs [Meltzer 1991], and Wingert Well [Quigg et al. 1994]). But because its stratigraphy and archaeology were not fully known or well dated, and because of its potential importance for Paleoindian and altithermal archaeology, additional field work was undertaken.

Periodic work at Marks Beach over the last several years (1991–1995) has consisted of augering, machine coring, ground penetrating radar (GPR) surveys, and hand excavations, partly in the draw itself, but mostly in the dune blowout. The GPR work was designed specifically to locate wells or other subsurface features, and while several intriguing anomalies were encountered (Longo-Hughston et al. 1993), subsequent ground-truthing did not reveal any water wells. The most extensive excavations took place in the summer of 1995, and were aimed at expanding upon Honea's original descriptions of the site and clarifying its stratigraphy and cultural deposits.

One of the excavation units, N607 E610 (9 m<sup>2</sup>), was placed 2.5 m from the location of Honea's original well, so as to test whether more wells were present on the site, to expose any activity areas on the nearby surfaces, and to gain a clearer picture of the stratigraphy. Our excavations did not reveal any wells at the IIIB/IIIA contact, but on that surface we found a caliche hearth, a heavily reworked side-notched projectile point, several utilized flakes, resharpening debitage, and bison (*Bison bison*, MNI 2) and pronghorn (*Antilocapra americana*, MNI 1) bone. The lithic debitage is primarily from Edwards, Tecovas, and Alibates sources. One specific variety of Edwards chert from Big Springs, Texas (240 km distant), constituted a small proportion of the assemblage. Additionally, three small obsidian flakes were recovered and sourced to the Mule Creek area of southwestern New Mexico (Richard Hughes, pers. comm. 1995), a distance of approximately 700 km. The wide diversity of lithic materials from

such distant sources suggest wide-ranging and highly mobile populations on the Southern High Plains during this period. However, radiocarbon dating of samples recovered during the 1995 season indicate this unit may not be middle Holocene, as Honea supposed, but rather late Holocene in age (ca. 2650 B.P.). At the base of excavations, approximately 2.5 m bs, a <sup>14</sup>C date of  $10,430 \pm 220$  (A-8622) was obtained from a cienaga layer located within a bed of diatomite. This age overlaps statistically the <sup>14</sup>C date reported by Honea.

This work indicates that the reported well may not be part of the suspected Altithermal occupation; nonetheless, the Marks Beach site holds considerable potential for investigating the environments and possibly adaptations of groups on the Southern High Plains in late-Pleistocene and later Holocene times. More work is planned at this locality.

We are grateful to the Cain family of Springlake, Texas, especially Hollis and Charlotte, for graciously permitting our field work on their ranch during the last several years, and for helping out in so many ways. Our thanks go as well to the field crew (especially Kevin Johns, Shannon Bangle, and Marie Blanche Mishoe), Dr. Eileen Johnson and the several members of the Lubbock Lake research team for their help in faunal identification and preservation: to George McMechan for undertaking and overseeing the GPR survey; and, especially, to Dr. Vance T. Holliday for his help on the stratigraphy of the Gibson Ranch area.

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#### **References Cited**

Evans, G. L. 1951 Prehistoric Wells in Eastern New Mexico. American Antiquity 17:1-9.

Hester, J. J. 1972 Blackwater Draw Locality No. 1: A Stratified, Early Man Site in Eastern New Mexico. Fort Burgwin Research Center 8, Southern Methodist University, Dallas.

Holliday, V. T. 1995 Stratigraphy and Paleoenvironments of Late Quaternary Valley Fills on the Southern High Plains. *Geological Society of America*, Memoir 186, Boulder.

Honea, K. 1980 Marks Beach, Stratified Paleoindian Site, Lamb County, Texas: Preliminary Report. Bulletin of the Texas Archeological Society 51:243–269.

Longo-Hughston, L., D. J. Meltzer, and G. McMechan 1993 Ground Penetrating Radar Investigation of Altithermal Age Site on the Southern High Plains. Poster presentation at the 53rd Annual Meeting, Society for American Archaeology, St. Louis.

Meltzer, D. J. 1991 Altithermal Archaeology and Paleoecology at Mustang Springs, on the Southern High Plains of Texas. *American Antiquity* 56:236–267.

Meltzer, D. J. 1995 Modelling the Prehistoric Response to Altithermal Climates on the Southern High Plains. In *Ancient Peoples and Landscapes*, edited by E. Johnson. Museum of Texas Tech, Lubbock.

Quigg, J. M., C. D. Frederick, and C. Lintz 1994 Sulphur Springs Draw: Geoarchaeological and Archaeological Investigations at Sulphur Draw Reservoir, Martin County, Texas. *Mariah Technical Report No.* 776, Mariah Associates, Inc., Austin.

Randall, M. 1970 The Archeology of the Lamb County, Texas Area. *Lower Plains Archeological Society Bulletin* No 1.

## The Clovis Component of the Klostermeier Site (11JY241), Jersey County, Illinois

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The Klostermeier site is situated in a cultivated upland field north of Elsah in Jersey County, Illinois. It is about 6 km east of the Ready/Lincoln Hills site (Morrow 1995; Morrow and Morrow 1993) and 4 km north of the Mississippi River. The surface geology consists of Wisconsinan loess underlain by glacial drift of Illinoian age (Willman et al. 1975). The bedrock in the site vicinity has been mapped as the middle Valmeyeran Series of the Mississippian System, which includes the Salem and Warsaw Formations (Willman et al. 1967). A sinkhole 200 ft (61 m) in diameter lies near the center of the site.

During the mid 1980s, David Klostermeier made a controlled surface collection of the site, which covers approximately 15 to 20 acres (6 to 8 hectares). He made a sketch map of the site area, dividing it into nine roughly equidimensional collection areas, and kept the artifacts recovered from each collection unit separate. I visited the site with him in 1991, during which time the entire area was fallow and covered with grass, affording limited surface visibility.

Artifacts diagnostic of the early-Paleoindian (Clovis points), late-Paleoindian (Agate Basin point), late-Archaic (fragments of a gorget and a ¾ grooved axe), late-Woodland (Klunk and Schild points), and Mississippian (Madison point) periods have been recovered from the surface of the Klostermeier site. Results of the controlled surface collection conducted by Klostermeier suggest that the early-Paleoindian component of the site (represented by fluted bifaces, end scrapers, and blades) occurs primarily in the area around the head of the upland drainage east of the sinkhole. Future investigations, including controlled surface collections and test excavations, will test the validity of this pattern.

Artifacts related to the early-Paleoindian component at the site include one stage-4 biface, fluted on both faces (see Morrow 1995) and broken by lateral fracture; a proximal (base) fragment of a finished Clovis point; a complete heavily resharpened Clovis point; four blades (three retouched blades and one utilized blade); and one large retouched blade-like flake (Figure 1). There are also six end scrapers in the collection that probably relate to the Clovis occupation of the site. The early-Paleoindian assemblage is dominated by locally available cherts, the most common of which is Burlington chert. The second most common is Salem/St. Louis chert. The complete fluted point is made of Fern Glen chert. All these raw materials are available within 5 km of the site.

#### **References Cited**

Morrow, J. E. 1995 Clovis Point Manufacture: A Perspective from the Ready/Lincoln Hills site in Jersey County, Illinois. *Midcontinental Journal of Archaeology* 20(2):167–191.

Morrow, J. E., and T. A. Morrow 1993 Fluted Point Manufacture at the Ready/Lincoln Hills Site, Jersey County, Illinois. *Current Research in the Pleistocene* 10:59–61.

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Willman, H. B., et al. 1967 Geologic Map of Illinois. Illinois State Geological Survey, Urbana.

Willman, H. B., E. Atherton, T. C. Buschbach, C. Collinson, J. C. Frye, M.E. Hopkins, J. A. Lineback, and J. A. Simon 1975 Handbook of Illinois Stratigraphy. Bulletin No. 95, Illinois State Geological Survey, Urbana.



Figure 1. Clovis artifacts from the Klostermeier site (11JY241): A-C, blades; D, stage-4 fluted biface: E-G, end scrapers; H-I, finished fluted points.

## Still More on Cultural Contexts of Mammoth and Mastodon in the Southwestern Lake Michigan Basin

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Three sites in the southwestern Lake Michigan basin (Fenske, Mud Lake and Schaefer) were inferred to have indirect evidence of human-mammoth (*Mammuthus primigenius*)/mastodon (*Mammut americanum*) interaction (Overstreet 1991, 1993a; Overstreet et al. 1993). Initial inference was based on bone modification. Subsequent excavation at the Schaefer site (47Kn252) recovered a complete woolly mammoth intimately associated with chipped-stone tools (Overstreet 1995; Overstreet et al. 1995). The tools, found beneath the pelvis of the Schaefer mammoth, included a chert waste flake and the edge of a broken biface. The biface-fragment morphology is consistent with so-called "edge-slivers" described by Frison (1978, see also Frison et al. 1976). A single standard bone collagen <sup>14</sup>C assay produced a date for the Schaefer mammoth of 10,960 ± 110 yr B.P. (BETA-62822).

In 1994 excavations carried out at the Hebior Mammoth site (47Kn265), situated on the same landscape but 1.25 km south of Schaefer, recovered an adult male woolly mammoth. Like Schaefer, the Hebior mammoth bears unambiguous butchery marks and is also intimately associated with chipped-stone tools (Figure 1). The Hebior excavations produced two bifacial chert knives, the first found immediately adjacent to a cluster of two ribs and two vertebrae (Figure 1-1). The second, a sinuous-edged bifacial chert knife fashioned from a chert cobble, still retains cortical surface at its base. Knife 2 is indicated at Figure 1-2. A chert flake was found immediately beneath the pelvis (Figure 1-3). Afourth implement, a crude dolomite "chopper," was found c. 1.0 m north of the north limit of the bone pile on the same pond sediments as the bone pile (Figure 1-4). Absolute chronology will be established by precision AMS dating of bone collagen.

Similar landscape/stratigraphic contexts (Kolb and Overstreet, n.d.), lithic raw materials, and bone-pile configurations of these two cultural contexts are interpreted to reflect contemporaneity. Confirmation of that contemporaneity awaits the results of precision bone-collagen dating byAMS techniques (Stafford 1988, 1990). While demonstrating human-mammoth interaction in the southwestern Lake Michigan basin from the contexts at Schaefer, Hebior, Fenske, and Mud Lake is rewarding, I am unable to provide an unequivocal association with any defined unit of time-space systematics for Great Lakes Paleoindian owing to a lack of culturally diagnostic bifaces. I believe (Overstreet 1995) that the mammoth kill (scavenge?) sites are associated with the Chesrow complex (Overstreet 1993). This hypothesis is supported by the close proximity of

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**Figure 1.** Bone pile, Hebior Mammoth Site (47Kn265), Kenosha County, Wisconsin. 1-1, chert bifacial knife; 1-2, chert bifacial knife w/cortex remnant on base; 1-3, chert flake under pelvis; 1-4, crude dolomite "chopper."

numerous Chesrow-complex components and the absence of any Clovis-affinis or Gainey-complex sites on the Lake Border Moraine System (Schneider 1983) in spite of nine years of systematic and biased survey and examination of private and public collections (Overstreet 1991, 1993a, 1993b, 1995).

#### **References** Cited

Frison, G. C. 1978 Prehistoric Hunters of the High Plains. Academic Press. New York.

Frison, G. C., M. Wilson, and D. J. Wilson 1976 Fossil bison and artifacts from an early Altithermal period arroyo trap in Wyoming. *American Antiquity* 41 (1):28-57.

Kolb, M., and D. F. Overstreet n.d. Landscape/Stratigraphic Contexts at the Schaefer and Hebior Mammoth Sites, Southwestern Lake Michigan Basin (unpublished field notes).

Overstreet, D. F. 1991 Paleoindian Study Unit: Region 9, Southeastern Wisconsin. *The Wisconsin Archeologist* 72 (3-4):265–366.

Overstreet, D. F. 1993 FY1992 Historic Preservation Survey and Planning Grant-Early Holocene Megafauna Exploitation, Kenosha County, Wisconsin. Great Lakes Archaeological Research Center, Inc., Reports of Investigation No. 325. Milwaukee.

Overstreet, D. F. 1993a Chesrow, A Paleoindian Complex in the Southern Lake Michigan Basin. Case Studies in Great Lakes Archaeology, No. 2. Great Lakes Archaeological Press. Milwaukee.

Overstreet, D. F. 1995 Late Pleistocene Geochronology and the Paleoindian Penetration of the Southwestern Lake Michigan Basin. Paper presented at the 40th Annual Midwest Archaeological Conference, Beloit College, Beloit, Wisconsin.

Overstreet, D. F., D. J. Joyce, K. Hallin, and D. Wasion 1993 Cultural Contexts of Mammoth and Mastodon in the Southwestern Lake Michigan Basin. *Current Research in The Pleistocene* 10:75–77.

Overstreet, D. F., D. J. Joyce, and D. Wasion 1995 More on Cultural Contexts of Mammoth and Mastodon in the Southwestern Lake Michigan Basin. *Current Research in The Pleistocene* 12:40–42.

Schneider, A. F. 1983 Wisconsinan Stratigraphy and Glacial Sequence in Southeastern Wisconsin. In *Late Pleistocene History of Southeastern Wisconsin* edited by D. M. Mickelsen, and L. Clayton, pp. 59–85. Geoscience Wisconsin.

Stafford, T. W. Jr. 1990 Late Pleistocene Megafauna Extinctions and the Clovis Culture: Absolute Ages Based on Accelerator <sup>14</sup>C Dating of Skeletal Remains. In *Megafauna and Man: Discovery of America's Heartland* edited by L. D. Agenbrod, J. I. Mead, L. W. Nelson, pp. 118–122. The Mammoth Site of Hot Springs, South Dakota, Inc., Scientific Papers, Volume 1. Hot Springs, South Dakota.

Stafford, T. W., Jr. 1988 Accelerator <sup>14</sup>C dating of late Pleistocene megafauna. *Current Research in the Pleistocene*, 5:41–43.

## The Bobtail Wolf Site: An Update on Recent Excavations

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The Bobtail Wolf site is a Folsom camp and lithic workshop in the Knife River flint quarry area, North Dakota. From 1992 to 1994, we excavated 481 m<sup>2</sup>, including six large blocks and many small tests. We placed one block in the southern part of the site, where flint procurement and stone-tool production were important activities. We only discuss this 122 m<sup>2</sup> area, labeled Block 4. Folsom artifacts are within the Leonard Paleosol and in a Btn horizon, which developed during the mid to late Holocene (Timpson 1995). The Btn overlies the paleosol in the south, but overprinted the paleosol in the north part of the block. Radiocarbon ages from pairs of insoluble and base-soluble humate fractions from the top of the paleosol are  $10,670 \pm 190$  yr B.P. (WSU-4444) and  $10,430 \pm 190$  yr B.P. (WSU-4445), and ages from the bottom are  $10,770 \pm 220$  yr B.P. (WSU-4446) and  $10,580 \pm 400$  yr B.P. (WSU-4447) (Root 1993; Root and Emerson 1994).

Folsom artifact densities exhibit peaks at 30 and 60 cm below surface in the southern part of the block, suggesting that at least two occupations are represented. These horizons rise and merge northward, where a single Folsom

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layer is centered at 5–10 cm below surface at the north edge of excavations. One Folsom preform, five channel flakes, and three post-Folsom diagnostics are from recently disturbed surface sediments, indicating that the uppermost Folsom deposits are eroded and mixed with later artifacts. Fourteen refits (29 artifacts) have vertical separations ranging from 2 to 58 cm with a mean of 13 cm. We excavated two Folsom points, three preforms (Figure 1a–d), and 15 channel flakes from subsurface horizons, but no later diagnostics. Thus, considerable vertical movement of artifacts occurred, but no evidence indicates major intrusion of later artifacts into the Folsom horizons, though some occurred.

In addition to the 20 points and channel flakes, the subsurface Folsom deposits contain 90 tested cobbles, 42 cores, 155 bifacial blanks, 15 bifacial cutting tools, 156 retouched or utilized flakes, 23 steep-edged tools that might



Figure 1. Folsom artifacts from the Bobtail Wolf site. A and C, Folsom-point preforms; B and D, Folsom points; E-H, radial-break flake tools.

be wood planes, 68 burin-like slotting tools, 4 scrapers, 8 denticulates, 4 hammerstones, 1 graver, and 11 other miscellaneous tools. Thus, 287 (49.6%) of these are tested materials, cores, and blanks, and along with an associated 152,894 flakes indicate the importance of stone-tool production. The remaining 292 implements, of which 78 were made by radial fracture (Figure 1e-h; Frison and Bradley 1980:97–99), suggest that people carried out tasks such as repair and manufacture of wood or bone tools as part of gearing up at the flint quarries.

#### **References Cited**

Frison, G. C., and B. A. Bradley 1980 Folsom Tools and Technology at the Hanson Site, Wyoming. University of New Mexico Press, Albuquerque.

Root, M. J. 1993 Site 32DU955A: Folsom Occupation of the Knife River Flint Primary Source Area, edited by M. J. Root. Submitted to the U.S. Fish and Wildlife Service, Denver Colorado. Contract No. 14-16-0010-90-0003. Center for Northwest Anthropology, Department of Anthropology, Washington State University, Project Report No. 22, Pullman.

Root, M. J., and A. M. Emerson 1994 Archaeology of the Bobtail Wolf Site (32DU955A): 1993-1994 Progress Report, edited by M. J. Root. Submitted to the U.S. Fish and Wildlife Service, Denver Colorado and the University of North Dakota. Center for Northwest Anthropology, Department of Anthropology, Washington State University, Project Report 26, Pullman.

Timpson, M. E. 1995 Quaternary Geology and Soils in the Lake Ilo Basin. Paper presented at the 53rd Annual Plains Anthropological Conference, Laramie, Wyoming.

## Variability in the Use of Ochre during the Paleoindian Period

Donna C. Roper

In previous articles in this and other sources, I have reviewed the evidence for the use of red ochre during the Paleoindian period on the North American Plains. To date, however, I have dealt with the period as a whole and have not examined trends within and among the various Paleoindian complexes. In the intervening years, I have continued to assemble data on the occurrence and context of the use of ochre on the Plains throughout the prehistoric era. The data show more variation within the Paleoindian period than previously recognized and also may reflect the emergence of broad ethnic distinctions in the region.

Ochre has long been recognized as an element of the Clovis artifact complex and, indeed, ochre is prominent in certain Clovis sites—in, however, a restricted set of circumstances. The context with which ochre is most strongly associated is the cache of finished artifacts; the cache may or may not be

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associated with burials. The Anzick, Busse, Fenn, Simon, and Richey-Roberts caches (several of which are from beyond the Plains) had greater or lesser quantities of ochre; collectively, these instances account for most Clovis caches of this type. Blade caches, lacking diagnostic artifacts and assigned to this tradition on technological grounds, uniformly lack ochre. Nor do Clovis kill sites or quarry/workshop sites contain ochre, except, of course, for the Powars II or Sunrise ochre quarry in southeast Wyoming (Tankersleyet al. 1995). Clovis campsites with good context are rare; of the few reported instances only Sheaman (Frison and Stanford 1982:144–145) yielded ochre. Except at the quarry, ochre in Clovis sites appears as a coating on artifacts or a living surface. The Busse cache in extreme northwest Kansas (Hofman 1995) is the southeasternmost occurrence of ochre in Clovis context.

With the very special exception of the Cooper site (Carter and Bement 1995:109), ochre remains absent from Folsom kill and kill-processing sites. It does, however, appear in some Folsom living sites. Almost without exception (and the exceptions have problematic context), the large camp sites that Hofman (1994:356) regards as possible aggregation sites have yielded ochre, often in some quantity. Smaller campsites sometimes do and sometimes do not have ochre; small hunting overlooks do not have ochre. When present, the material often appears as pebbles and on grinding stones, suggesting pigment preparation at these sites. What the pigment was applied to and how it functioned symbolically is an intriguing question for Folsom-site studies. Ochre is more widely distributed in Folsom context, appearing in sites in Wyoming, Colorado, Oklahoma, western Texas, and eastern New Mexico.

Trends within the post-Folsom part of the Paleoindian period are a bit more confusing. Over a dozen instances of ochre presence in sites of this age are recorded. Two are burial sites (Gordon Creek, Brown's Valley); the remainder are camp sites, which in two instances are associated with kills. The few caches assigned to this period seem to lack ochre. Late-Paleoindian sites with ochre are spread from southern Saskatchewan to central Texas, but are considerably more common on the Northwestern Plains and western Central Plains than elsewhere. The data set shows more occurrences in Cody-complex sites than in any other specific context.

It also is in the Northern Plains and parts of North America extending east across the Great Lakes/upper Midwest to New England and the Maritime Provinces that ochre is found in mortuary sites, caches, some habitation sites, and special ritual (e.g., medicine wheel) contexts for many millennia following the end of the Paleoindian period. This area was occupied in historic times by speakers of Algonquian languages. Moreover, contexts involving ochre or similar red coloring as a ritual object persisted into historic times among many Algonquian-speaking peoples. In contrast, in post-Paleoindian complexes in parts of the Plains occupied by speakers of Keresiouan languages (Siouan, Caddoan, and others), when ochre appears at all, it is not in a ritual context so much as it is a medium for stylistic expression, and to the extent that it appears in ritual context, the ochre-decorated artifact and not the ochre itself is the ritual object. Linguistic (Ruhlen 1991:349–350) and genetic (Cavalli-Sforza et al. 1994:323; Spuhler 1979:150) distances between Algonquian and Keresiouan speakers are greater than distances among Keresiouans, suggesting that the divergence of these languages/populations precedes the internal differentiation of Keresiouan groups. Might this divergence have begun as late-Paleoindian people responded to post-Pleistocene conditions by developing adaptive strategies specific to a region, and might the differential use of ochre be a cultural trait monitoring this divergence?

My thanks to Karen Turnmire for periodically listening to me go on at some length about ochre, reading this manuscript, and making excellent editorial suggestions. The format of this journal precludes the customary detailed referencing, which would be extensive since the study relies on an intensive literature search. This summary of patterns in the data will be fully referenced in a later detailed article.

#### **References Cited**

Carter, B. J., and L. C. Bement 1995 Soil Investigations at the Cooper Site. Current Research in the Pleistocene 12:109-111.

Cavalli-Sforza, L. L., P. Menozzi, and A. Piazza 1994 The History and Geography of Human Genes. Princeton University Press, Princeton, New Jersey.

Frison, G. C., and D. J. Stanford 1982 The Agate Basin Site. Academic Press, New York.

Hofman, J. L. 1994 Paleoindian Aggregations on the Great Plains. *Journal of Anthropological Archaeology* 13(4):341–370.

Hofman, J. L. 1995 The Busse Cache: A Clovis-Age Find in Northwestern Kansas. Current Research in the Pleistocene 12:17-19.

Ruhlen, M. 1991 The Amerind Phylum and the Prehistory of the New World. In *Sprung from Some Common Source: Investigations into the Prehistory of Languages*, edited by S. M. Lamb and E. D. Mitchell, pp. 328–350. Stanford University Press, Stanford, California.

Spuhler, J. N. 1979 Genetic Distances, Trees, and Maps of North American Indians. In *The First Americans: Origins, Affinities, and Adaptations*, edited by W. S. Laughlin and A. B. Harper, pp. 135–183. Gustav Fischer, New York and Stuttgart.

Tankersley, K. B., K. O. Tankersley, N. R. Shaffer, M. D. Hess, J. S. Benz, F. R. Turner, M. D. Stafford, G. M. Ziemens, and G. C. Frison 1995 They Have a Rock That Bleeds: Sunrise Red Ochre and its Early Paleoindian Occurrence at the Hell Gap Site, Wyoming. *Plains Anthropologist* 40(152):185–194.

## Investigations at Young-Man-Chief, a Folsom Site in Western North Dakota

## Lisa K. Shifrin and Jerry D. William

Young-Man-Chief is a multicomponent camp and lithic workshop in the Knife River flint (KRF) quarry area. Folsom deposits cover 1.55 ha of a late-Pleistocene terrace of Spring Creek and an adjoining low rise. Two other Folsom sites are adjacent, Big Black to the north (William 1994; William and Shifrin 1995) and Bobtail Wolf to the south (Root and Emerson 1994). The rise is eroded,

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exposing Folsom, Archaic, and late-Prehistoric artifacts on the surface. Holocene terrace veneer deposits southwest of the rise overlie the latest-Pleistocene to early-Holocene Leonard Paleosol.

We excavated one KRF stage-4 (Callahan 1979) biface broken during manufacture and 567 flakes from 13 m<sup>2</sup> of intact deposits in the Paleosol. Extensive excavations at Big Black and Bobtail Wolf documented only Folsom deposits in the paleosol, indicating the Folsom affiliation of the artifacts at Young-Man-Chief. We also surface collected two stage-6 Folsom preforms (Frison and Bradley 1980), two finished point fragments, one channel flake, one ultrathin biface (Root et al. 1994), and one early-stage biface that may be a stage-4 Folsom preform (Figure 1). All preforms are Rainy Buttes silicified wood, which occurs 100 km to the south. One finished fluted point (stage 11) is KRF and one is silicified wood, probably from a nonlocal source. Both broke during use. The channel flake and ultrathin biface are also KRF. Other non-diagnostic Folsom tools and flakes are probably included in the surface collection. Most flakes (n = 561, 99%) are KRF; five flakes are of other local types of stone, and one is Rainy Buttes silicified wood. Flake analysis indicates that late stages of tool manufacture and resharpening occurred. Thirty-four (18%) of 186 flakes technologically classified are biface thinning flakes.

Staged tool production (Hofman 1992) likely occurred at Young-Man-Chief.



Figure 1. Folsom artifacts from the Young-Man-Chief site (32DU955D). A, stage-4 Folsom point preform; B and C, stage-6 Folsom-point preforms; D and E, Folsom points; F, ultrathin biface; G, Folsom channel flake.

Knappers probably made point preforms at the Rainy Buttes locality and imported them to Young-Man-Chief, where they fluted them. The KRF channel flake indicates on-site fluted-point production using local stone. The broken, finished Folsom points may reflect discard of heavily used weapon tips during retooling. Similar patterns occur at Big Black and Bobtail Wolf, each of which contains hundreds of thousands of Folsom artifacts. A site such as Young-Man-Chief may represent limited Folsom activity directly related to the nearby larger camp and workshop occupations. Alternatively, it may represent short-term camps occupied at times other than those represented at Big Black and Bobtail Wolf. Excavations at Young-Man-Chief suggest that there is a nearly continuous deposit of Folsom artifacts in the Leonard Paleosol stretching 400 m from Big Black to Bobtail Wolf.

#### **References Cited**

Callahan, E. 1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. Archaeology of Eastern North America 7:1–180.

Frison, G. C., and B. A. Bradley 1980 Folsom Tools and Technology at the Hanson Site, Wyoming. University of New Mexico Press, Albuquerque.

Hofman, J. L. 1992 Recognition and Interpretation of Folsom Technological Variability on the Southern Plains. In *Ice Age Hunters of the Rockies*, edited by D. J. Stanford and J. S. Day, pp. 193–224. Denver Museum of Natural History and University of Colorado Press, Niwot, Colorado.

Root, M. J., and A. M. Emerson 1994 Archaeology of the Bobtail Wolf Site (32DU955A): 1993–1994 Progress Report. Submitted to the U.S. Fish and Wildlife Service, Denver, Colorado and the University of North Dakota. Center for Northwest Anthropology, Department of Anthropology, Washington State University, Project Report 26, Pullman.

Root, M. J., J. D. William, S. A. Ahler, and L. K. Shifrin 1994 Ultrathin Biface and Radial Fracture Technology at Two Folsom Localities in the Knife River Flint Quarry Area, North Dakota. Paper presented at the 52nd Annual Plains Anthropological Conference, Lubbock.

William, J. D. (editor) 1994 Site 32DU955C: A Folsom Complex Workshop in the Knife River Flint Primary Source Area. Quaternary Studies Program, Northern Arizona University, Flagstaff. Submitted to the U.S. Fish and Wildlife Service, Denver.

William, J. D., and L. K. Shifrin (editors) 1995 The Big Black Site (32DU955C): A Folsom Complex Workshop in the Knife River Flint Primary Source Area, A Progress Report for the 1994 Field Season. Quaternary Studies Program, Northern Arizona University, Flagstaff. Submitted to the U.S. Fish and Wildlife Service, Denver.

## Foreshaft Sockets as Possible Clovis Hafting Devices Dennis Stanford

Among the Clovis artifacts found at the Anzick cache in Montana are cylindrical bevelled bone rods previously interpreted as foreshafts (Lahren and Bonnichsen 1974). All the specimens except one are alternately bevelled and scored on both

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ends. A single specimen is bevelled only on one end, while its opposite end is slightly tapered and rounded. Lahren and Bonnichsen hypothesized that Clovis projectile points were hafted to one bevelled surface, while the other attached to a mainshaft.

I have long noted that the singularly beveled and scored tangs on the unibeveled Anzick specimen is very reminiscent of an Eskimo technique for hafting bone foreshafts to wooden mainshafts. In the Eskimo case, a triangular endblade, not too dissimilar to a Clovis point, is wedged into a slot cut into the distal end of a harpoon head. A drilled socket in the base of the harpoon head



Figure 1. Hypothesized Clovis hafting system illustrated with Indiana foreshaft socket and casts of an Anzick Clovis point and bone rod.

received the foreshaft.

A similar system may be a reasonable model for Clovis weaponry. The singlebeveled Anzick bone rod would serve as the distal end of the foreshaft. Its blunt end would seat into a foreshaft socket piece that in turn held the Clovis point. In this model, the extra bi-bevelled rods are viewed as composite pieces which fit together to create a lengthened foreshaft capable of lethal penetration into a mammoth.

In a recent and fortuitous turn of events, Allan Roberts of Richmond, Indiana, asked the Smithsonian to identify faunal and lithic specimens that his family collected from a local peat bog. Among these artifacts was a foreshaft socket (Figure 1D). This antler specimen is 83 mm in length and has a distal slot 18.44 mm deep (Figure 1C, D). A slightly tapering hole (44.49 mm long, maximum diameter of 10.26 mm) is drilled into its base to receive a foreshaft (Figure 1E, F). Two sharp basal tangs flare outward. These tangs probably toggled after entering an animal, causing a severe wound and enhanced bleeding. The lack of a line-hole suggests that it was made for hunting terrestrial animals.

The fits between the Anzick Clovis projectile points and the blunt end of the single-beveled bone rod, and the distal and proximal ends, respectively, of the antler socket foreshaft are remarkable (Figure 1A, B). The point thicknesses fit comfortably in the blade slot, and their edge grinding approximates its depth. Likewise, the hole drilled in the antler socket is 44.49 mm long, while the corresponding 44 mm portion of the bone rod has been deliberately modified by longitudinal shaving, which produced a taper that is only slightly wider than the Indiana specimen. It is significant that the blunt portion of the bone rod is free of scoring along the 44 mm length which presumably seats within a socket. Just beyond the socket, scored lines circumscribe the rod for a length of c. 85 mm, presumably as a hafting device.

An AMS date of the insoluble portion of extracted collagen from the antler socket by Robert Hedges, Oxford University, is  $7,990 \pm 120$  yr B.P. (OxA-5008). Dr. Hedges suggests that contamination may be present and may have affected this date by up to 1 ka. He states that it is safe to say the antler is older than 7,000 yr B.P. and is unlikely to be as old as 10,000 yr B.P.

Although this particular socket postdates Clovis, the hafting technology of which it is part may be very long-lived in North America, and I propose that Clovis people may have used a similar system.

I wish to thank M. Bakry, E. Hare, G. Goodfriend, P. Jodry, V. Krantz, D. Rogers, L. Snyder, and D. Von Endt for help preparing the Indiana specimen for dating, illustration, and publication.

#### **References Cited**

Lahren, L., and R. Bonnichsen 1974 Bone Foreshafts from a Clovis Burial in Southwestern Montana. *Science* 186:147–150.

## Early Holocene Occupation at the West Lost River Site, Klamath County, Oregon

## Douglas C. Wilson, John L. Fagan, Dorothy E. Freidel, and Susan M. Colby

Excavations at the West Lost River Site (35KL972) provide new insights on early-Holocene occupation of southwestern Oregon. Situated on the west bank of the Lost River, 35KL972 is approximately 17 km east of Klamath Falls and was found in May 1991 during a survey for Northwest Pipeline Corporation's Klamath Falls Natural Gas Replacement Line (Fagan et al. 1991:128). It was tested in November and December 1991, with supplemental testing and data recovery in August and September 1992 (Wilson 1996). A total of 86 m<sup>2</sup> (68.4 m<sup>3</sup>) from 33 1x1-m test units and six excavation blocks (53 m<sup>2</sup>) was hand-excavated. Three backhoe trenches exposed strata to search for subsurface features.

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While no materials suitable for <sup>14</sup>C dating were obtained, the antiquity of the site is established through geochronological inference, diagnostic artifacts, and obsidian hydration results. The majority of artifacts recovered from the site were found directly above, lodged within, and below a well-developed duripan (between 40 and 80 cm below surface) that appears to date to the late Pleistocene or early Holocene. Further west, the duripan pinched out and two paleosols were identified. These paleosols probably formed in overbank deposits associated with an old channel or slough of the Lost River, and the lower one (approximately 1 m below surface) contains artifacts that appear to be contemporaneous with the ones associated with the duripan.

The few diagnostic projectile-point fragments recovered from the site are representative of Windust, Cascade, or Northern Side-notched types. The tool assemblage is extremely limited in number and variety of tools, consisting primarily of projectile points, preforms, bifaces, scrapers, and expedient flake tools. Given the types of tools present, combined with the results of the debitage analysis, lithic-reduction activities at the site apparently were geared to the production of large, extremely thin bifacial tools, probably projectile points, from large flake blanks, and the resharpening and rejuvenation of these tools. This debitage profile is similar to the Paleoindian Western Stemmed complex component at the Dietz site, 180 km to the northeast of 35KL972 (Fagan 1988). No postholes, pits, or other features were identified at 35KL972, and there is little indication that use of the site changed much through time.

Obsidian X-ray fluorescence and hydration analyses were conducted on 8 bifaces, 193 pieces of debitage, and 3 small natural obsidian nodules found on the site. The majority of the obsidian samples (n = 108) were from the Drews Creek/Butcher Flat source, which is found approximately 80 km to the east. Other identified sources were Spodue Mountain (n = 55), which the analysis of the natural obsidian nodules determined is a local source; Medicine Lake Highlands sources from northern California, including the "Grasshopper Group" (Grasshopper Flat, Lost Iron Well, Red Switchback, and East Medicine Lake (n = 17) and Cougar Butte (n = 1); and other sources found to the east and northeast: Buck Mountain (n = 3); Rainbow Mines (n = 2); Sugar Hill (n = 5); Blue Mountain (n = 1); and Coglan Buttes (n = 1). In contrast to obsidian use documented for the middle- to late-Archaic periods at other nearby sites, the Spodue Mountain source was not as frequently used at 35KL972 as the Drews Creek/Butcher Flat obsidian, possibly because the locally available nodules are too small for the production of the large bifacial tools that were the focus of reduction activities at the site.

Most of the obsidian specimens from 35KL972 contained hydration rinds between 5 and 8 microns thick. Employing the Nightfire Island hydration rate for Grasshopper Group obsidian (Basgall and Hildebrandt 1989:196-198), occupation of 35KL972 was between about 5,500 yr B.P. and 8,250 yr B.P. The Drews Creek/Butcher Flat specimens and the Spodue Mountain specimens tend to contain thicker rinds than the Grasshopper Group specimens, often thicker than 7 microns. As the Grasshopper Group and Spodue Mountain sources probably hydrate at about the same rate (see Pettigrew and Lebow [1987:9.10–9.18,10.23–10.27]), the most intensive occupation of the site likely occurred towards the earlier periods (c. 8,000 yr B.P.). A Western Stemmed complex occupation of the site is also supported by comparisons with other sites where hydration-rind thicknesses of between 8 and 12 microns have been associated with fluted Clovis points, basally thinned, concave-base points, and wide-stemmed projectile point forms (see Layton [1972a, 1972b]; Willig and Aikens [1988:11]).

Faunal remains attributed to the prehistoric occupation, include both largesized (*Odocoileus*[deer], *Cervus*[elk]) and small-sized mammals (*Citellus beldingi* [Belding's ground squirrel]). Avifaunal remains suggest use of migratory waterfowl. Surprisingly, fish remains are not associated with the prehistoric occupation, suggesting that fish may not have been an important subsistence resource at this early period.

#### **References Cited**

Basgall. M. E, and W. R. Hildebrandt 1989 Prehistory of the Sacramento River Canyon, Shasta County, California: Excavation at CA-Sha-1176, Sha-1175, Sha-1169, Sha-476. Far Western Anthropological Research Group, Inc. Center for Archaeological Research at Davis, Publication No. 9. University of California, Davis.

Fagan, J. L. 1988 Clovis and Western Pluvial Lakes Tradition Lithic Technologies at the Dietz Site in South-central Oregon. In *Early Human Occupation in Far Western North America: the Clovis-Archaic Interface*, edited by J. A. Willig, C. M. Aikens, and J. L. Fagan, pp. 389–416. Nevada State Museum Anthropological Papers Number 21, Carson City, Nevada.

Fagan, J. L., C. L. Armitage, C. B. Hemphill, J. Reese, and J. Witherow 1991 Northwest Pipeline System Expansion Project: Culturel Resources Assessment Report, Oregon Segments: Phase 1: Survey, Inventory, and Preliminary Assessment. Archaeological Investigations Northwest, Inc. Report No. 15, Portland, Oregon. Submitted to Northwest Pipeline Corporation, Salt Lake City.

Layton, T. N. 1972a A 12,000 Year Obsidian Hydration Record of Occupation, Abandonment and Lithic Change from the Northwestern Great Basin. *Tebiwa* 15(2):22–28.

Layton, T. N. 1972b Lithic Chronology in the Fort Rock Valley, Oregon. Tebiwa 15(2):1-21.

Pettigrew, R. M., and C. G. Lebow 1987 Data Recovery at Sites 35JA27, 35JA59, and 35JA100, Elk Creek Lake Project, Jackson County, Oregon, 2 Vols. Infotec Research Inc. Report No. PNW87-7, Eugene, Oregon. Prepared for U.S. Army Corps of Engineers, Portland District, Portland, OR, Contract No. DACW57-86-C-106.

Willig, J. A., and C. M. Aikens 1988 The Clovis-Archaic Interface in Far Western North America. In *Early Human Occupation in Far Western North America: the Clovis-Archaic Interface*, edited by J. A. Willig, C. M. Aikens, and J. L. Fagan, pp. 1–40. Nevada State Museum Anthropological Papers Number 21, Carson City, Nevada.

Wilson, D. C. 1996 Data Recovery for the West Lost River Site, 35KL972. In Northwest Pipeline Corporation System Expansion Phase I: Phase 3—Data Recovery and Site Treatment Reports for Oregon Segments, Volume III, Klamath Basin Area. Edited by J. L. Fagan, pp. 2-1 to 2-56. Archaeological Investigations Northwest, Inc. Report No. 50, Portland, Oregon. Submitted to Northwest Pipeline Corporation, Salt Lake City. (In review).

## Physical Anthropology

## Radiocarbon Dates from Spirit Cave, Nevada: Early Holocene Occupation of the Western Great Basin

## Donald R. Tuohy and Amy J. Dansie

When Dr. R. Erv Taylor approached the Nevada State Museum in 1994 and asked if we had any mummies with hair on their heads, we assured him we did have some. He came personally to Carson City to choose the hair and bone samples as a test of the dating of human hair, and the results are now in press in the journal *Radiocarbon* (Taylor et al. 1994).

One of the mummies chosen was the mummy from Spirit Cave, close to Fallon, Nevada. Spirit Cave is located 13 miles east of Fallon in the foothills of the Stillwater Mountains at an elevation of 4,154 feet (1266.1 m), about 211 feet (64.3 m) below the last high stand of Lake Lahontan, which has an elevation of about 4,365 feet (1330.4 m). The Nevada State Museum published the Spirit Cave report (Wheeler and Wheeler 1969:68–78), and the most recent mentions of it were made in the reports on Hidden Cave (Thomas 1985) and a report on the Stillwater Marsh area (Larsen and Kelly 1995).

The Spirit Cave male mummy, in storage for 56 years since the Wheelers exhumed him in 1940, turned out to be the oldest mummy found in North America (See Table 1). The seven <sup>14</sup>C radiocarbon dates have a mean date of  $9,410 \pm 60$  years ago. This means that the Spirit Cave mummy is far older than the Egyptian mummies of the pre-dynastic period of north Africa, which date to c 4,000 B.C., and the recent find of the "Tyrolean Ice Man" dating from 3,120 to 3,350 B.C. (Nedden et al. 1994).

The Wheelers thought there were four burials in Spirit cave; they recorded two burials wrapped in plaited tule matting, and two cremations in twined apocynum bags (one placed within another tule bag), each stacked one on top of the other. But in checking the burials, scattered bone and artifacts from Spirit Cave we counted five portions of human remains among the 66 artifacts. One of the cremation bags is plaited tule, the same type of weaving that wrapped the

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unburned burials. As of this writing we are awaiting three additional <sup>14</sup>C radiocarbon dates on the cremations and on the extra subadult pelvis, which will date the three cremation bags.

Lab Sample #	Material	Date	
CAM5 24194	Twined tule mat	9410 ± 60	total amino acids
CAMS 24197	Twined tule mat	9460 ± 60	total amino acids
CAMS 24199	Diamond plaited mat	9430 ± 70	total amino acids
CAMS 12354	hair	9360 ± 60	water only
CAMS 12353	hair	9350 ± 70	total amino acids
CAMS 14224	hair	9440 ± 60	water only
CAMS 12352	bone	9430 ± 60	total amino acids
		9410 ± 60	weighted mean

Table 1. Spirit Cave mummy dates, 26Chlf (AHUR 2064).

#### **References Cited**

Larsen, C. S., and R. L. Kelly 1995 Bioarchaeology of the Stillwater Marsh Prehistoric Human Adaptation in the Western Great Basin. *American Museum of Natural History, Anthropological Papers,* Number 77.

Nedden, D., K. Wicke, and R. Knapp 1994 New Findings on the Tyrolean "Ice Man": Archaeological and CT-Body Analysis Suggest Personal Disaster Before Death. *Journal of Archaeological Science* (1994)21,809–818.

Taylor, R. E., P. E. Hare, C. Prior, D. Kirner, L. Wan and R. Burky 1994 Radiocarbon Dating of Biochemically Characterized Hair. A paper submitted to *Radiocarbon*. In Press.

Wheeler, S. M., and G. N. Wheeler 1969 Miscellaneous Paper No. 3 in *Nevada State Museum Anthropological Papers Number 14*, Miscellaneous Papers on Nevada Archaeology, "Cave Burials near Fallon, Churchill County, Nevada," pp. 70–78, Carson City, Nevada.

## **Lithic Studies**

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

Daniel S. Amick

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

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

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

Current knowledge of lithic procurement and mobility ranges for early Great Basin occupants is limited (Amick 1993, 1995; Beck and Jones 1990; Fagan 1990). This paper contributes sourcing results for 50 obsidian projectile points (Richard Hughes, Geochemical Research Laboratory, Letter Report 95–42). Specimens were selected to span the visual diversity of obsidian

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and include 27 Alberta/Cody, 16 stemmed, and 7 concave-base points. Eleven known sources (Massacre Lake and Guano Valley sources are indistinguishable) are identified for 74% (n = 37) of these artifacts. Most source locations are found 60–150 km northwest or east of the Black Rock, but one point is assigned to Riley (270 km north).

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

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#### **References Cited**

Amick, D. S. 1993 Toolstone Use and Distributional Patterns Among Western Pluvial Lakes Tradition Points From Southern Nevada. *Current Research in the Pleistocene* 10:49–51.

Amick, D. S. 1995 Raw Material Selection Patterns among Paleoindian Tools from the Black Rock Desert, Nevada. *Current Research in the Pleistocene* 12:55–57.

Beck, C., and G. T. Jones 1990 Toolstone Selection and Lithic Technology in Early Great Basin Prehistory. *Journal of Field Archaeology* 17:283–299.

Bradley, B. A. 1991 Flaked Stone Technology in the Northern High Plains. In *Prehistoric Hunters of the High Plains*, 2nd ed., edited by G. Frison, pp. 369–395. Academic Press, NY.

Bradley, B. A., and G. C. Frison 1987 Projectile Points and Specialized Bifaces from the Horner Site. In *The Horner Site: Type Site of the Cody Cultural Complex*, edited by G. Frison and L. Todd, pp. 199–231. Academic Press, NY.

Clewlow, C. W. 1968 Surface Archaeology of the Black Rock Desert, Nevada. University of California Archaeological Survey Reports No. 73. Berkeley.

Fagan, J. L. 1990 Temporal and Technological Variability in the Use of Obsidian at the Dietz Site. Paper presented at the 43rd annual Northwest Anthropological Conference, Eugene. OR.

Frison, G. C. 1991 Prehistoric Hunters of the High Plains. 2nd ed. Academic Press, NY.

Huckell, B. 1978 Hudson-Meng Chipped Stone. In *The Hudson-Meng Site: An Alberta Bison Kill in the Nebraska High Plains*, edited by L. Agenbroad, pp. 153–189. University Press of America, Washington.

Hutchinson, P. 1988 The Prehistoric Dwellers at Lake Hubbs. In *Human Occupation in Far Western North America*, edited by J. Willig, M. Aikens, and J. Fagan, pp. 303–318. Nevada State Museum Anthropological Papers No. 21. Carson City.

Pendleton, I.. 1979 Lithic Technology in Early Nevada Assemblages. Unpublished M.A. thesis, Department of Anthropology, California State University, Long Beach.

Riddell, F., and W. Olsen 1969 An Early Man Site in the San Joaquin Valley. American Antiquity 34:121–130.

Wallmann, S., and D. S. Amick 1991 Cody Complex Occupations in the Black Rock Desert, Nevada. *Current Research in the Pleistocene* 8:51–53.

## The Wichita Cache: A Core Rejuvenation Tablet from Southwest Oklahoma

Jesse A. M. Ballenger

A 1996 pedestrian survey of 2,400 acres around the Washita River valley near Anadarko, Oklahoma, resulted in the recovery of 12 lithic items with probable Clovis affiliation. The find was made in dissected uplands on a high terrace overlooking an intermittent drainage. Field terracing, levee construction, and vehicular traffic have all impacted the locality. Eleven of the pieces were found on the surface. One additional piece was discovered via probing at 4 cm below the surface. All the items were found within, or can be refitted to others that were found within, a 5m<sup>2</sup> area. Based on the close association of the artifacts, they are interpreted as a disturbed cache.

The raw material is Edwards chert, a high-quality Cretaceous-age cryptocrystalline from central Texas (Banks 1990:59–60). Commonly recognized as the "rootbeer" variety, all the pieces have color values of 10YR 4/4 with a thick bluish-to-white patina that ranges from 2.5Y 7/0 to 2.5Y 8/0. Cortex, when present, is porous and orange (7.5YR 5/8). Many of the items exhibit fresh breaks, likely caused by plowing activities in the area. The inventory consists of one polyhedral core tablet, one large flake, two small blade fragments, and one small edge margin of another polyhedral core.

The tablet (Figure 1a) demonstrates affinity to Clovis-age core rejuvenation tablets recovered from the Pavo Real site in southern Texas (Stanford 1991:2–5), the Aubrey site in north-central Texas, and the Evant Core cache in central Texas (Stanford 1991:2–5; Ferring 1990:10–12; Goode and Mallouf 1991:67–70). Metrically, the tablet is larger than most reported from the Southern Plains (maximum diameter 94 mm), but technologically it compares very favorably.

As discussed by Goode and Mallouf (1991:68), "During the process of blade production, damaged or deficient core platforms were repeatedly rejuvenated through the removal of two to three flakes . . . struck from the platform edge, and followed by a series of smaller removals." The Wichita tablet attests to a remarkably similar technique. The dorsal surface is occupied by three primary removals (Fig. 1a, R2) with several minor flake scars along the edge margins. As evident by the early flake-scar surface in the center of the tablet (Fig. 1a, R1), the platform experienced at least two such rejuvenations before it was entirely detached.

Produced via hard hammer percussion, the rejuvenation scars are deep and

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Figure 1. A, Core rejuvenation tablet from Anadarko, Oklahoma; B, Refitted flake from blocky core. Shading indicates plow damage.

expanding. The most striking characteristic of these removals is their deeply hinging terminations. This gives the platform surfaces a "dished" form that has been observed on the Pavo Real and Evant cores (Stanford 1991:2–5; Goode and Mallouf 1991:68), and is thought to relate to the proper seating of the fabricator for indirect percussion and blade removal. On the Wichita tablet, these hinging removals were initiated immediately above a prominent ridge. Located on each side of these ridges (inside of old blade surfaces) are crushed facets, making the ridge protrude slightly. Edge angles above the ridges are 80 degrees.

The large flake in the cache (Figure 1b) removed a prominent ridge on a blocky core. Although the platform is missing, the thickness of this flake (max. 20mm) suggests that it was struck with a hammerstone. This item is the only piece with cortex.

It is worth noting that the original Anadarko Blade cache (Hammett 1970), a large cache of impressive prismatic blades and cores made from Edwards chert and Alibates, was reportedly found approximately 3 km east of this cache, along the first terrace of the Washita River. The Garland cache (Duncan 1994), another cache made from Edwards chert that contained cores and blades with Clovis characteristics, was recovered 11 km to the south. Finally, the Domebo mammoth kill site (Leonhardy 1966), bearing Clovis points made from Edwards chert and located approximately 20 km to the southwest, also demonstrates a heavy presence of Clovis groups in this portion of Oklahoma.

Lee Bement is responsible for recognizing the antiquity of the Wichita tablet. He and Don Wyckoff both provided editorial comments to this paper. The author also appreciates the cooperation of Virgil Swift (Wichita and Affiliated Tribes), K.C. Kraft, and Timothy Baugh.

#### **References Cited**

Banks, L. D. 1990 From Mountain Peaks to Alligator Stomachs. Oklahoma Anthropological Society. Memoir #4. University of Oklahoma, Norman.

#### CRP 13, 1996

Duncan, M. 1994 An Edwards Chert Blade Cache from Western Oklahoma. Paper presented at the 52nd Annual Plains Conference, Lubbock, Texas.

Ferring, C. R. 1990 The 1989 Investigations at the Aubrey Clovis Site, Texas. Current Research in the Pleistocene 7:10–12.

Goode, G. T, and R. J. Mallouf 1991 The Evant Cores: Polyhedral Blade Cores from North-Central Texas. *Current Research in the Pleistocene* 8:67–69.

Hammett, H. H. 1970 A Paleo-Indian Butchering Kit. American Antiquity 35:141-152.

Leonhardy, F. C. 1966 Domebo: A Paleo-Indian Mammoth Kill in the Prairie-Plains. *Contributions of the Museum of the Great Plains*, No. 1.

Stanford, D. 1991 Clovis Origins and Adaptations: An Introductory Perspective. In *Clovis: Origins and Adaptations*, edited by R. Bonnichsen and K. L. Turnmire. Center for the Study of the First Americans. Oregon State University, Corvallis.

## Microwear Analysis of Chipped Stone Tools from the Martins Creek Mastodon Site, Holmes County, Ohio

Nigel Brush and Richard W. Yerkes

In the summer of 1993, excavations at the Martins Creek Mastodon site in Holmes County, Ohio, resulted in the recovery of several flint flakes and scrapers in association with mastodon (*Mammut americanum*) and deer bones (Brush & Smith 1994). The presence of the flint flakes immediately brought to mind the experimental work of Nicholas Toth (1987) on the value of flakes as butchering tools. Threeflintflakes and two scrapers from the Martins Creek site were submitted to MargaretNewman at the University of Calgary for immunological analysis of possible blood residues. Two of the flint flakes gave positive results—one for elephant antisera and one for deer antisera (Brush, Newman, & Smith 1994). These flakes and scrapers, plus an additional five flint artifacts, were subsequently submitted to Bruce Hardy at Indiana University for DNA analysis. Unfortunately, possible DNA residues on the tools could not be sequenced because of their poor state of preservation (Hardy pers. comm.).

After the immunological and DNA analyses were completed, the flakes and scrapers from Martins Creek were submitted to Richard Yerkes at the Ohio State University for microwear analysis. These artifacts included: two side/end scrapers, one biface fragment, one retouched flake, and six unretouched flakes. They were cleaned in an ultrasonic cleaner with "Top Job" detergent, a 10% solution of HCL, and a 30% solution of H<sub>o</sub>O<sub>o</sub>.

Microscopic examination was conducted with an Olympus metallurgical microscope under incident light at magnifications between 50x and 1500x. This technique is often referred to as the "high-power approach" and is contrasted

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with the "low-power approach" of stereo microscopy that uses reflected light at magnifications between 10x and 100x (Juel Jensen 1988:53–54; Yerkes 1987:114). Both the high-power and low-power techniques of microwear analysis provide information on tool use, but the low-power techniques do not allow the analyst to discriminate between different types of worked materials (Juel Jensen 1988; Yerkes 1987). The identification and interpretation of the microwear traces on the implements from the Martins Creek Site was aided by reference to the use wear traces on over 155 experimental flint and chert tools in the Archaeology Laboratory at the Ohio State University.

Microwear analysis showed that 4 of the 10 artifacts from Martins Creek were utilized for cutting meat and removing fresh hide. Artifact No. 2, a retouched flake, displayed a weakly developed, dull, greasy-looking meat and/or fresh hide polish along its left lateral edge and at its distal edge. There was some abrasion on the edges, but no striations. The flake appears to have been used for expedient butchering. (Elephant antisera had previously been identified on this artifact.) Artifact No. 3, an unretouched flake, also contained a weakly developed, dull, greasy-looking meat and/or fresh hide polish along its right lateral edge. There was some edge damage but no striations. Orientation of wear traces indicates that this edge was used to cut and scrape meat or fresh hide. There is also evidence that the tool came into contact with bone. (Deer antisera had previously been found on this artifact.) Artifact No. 4 was used as a side and end scraper. All edges show dull, greasy fresh hide polish oriented normal to the tool margin. The most intensive use of the tool was on the proximal and left lateral edges. Lacking any evidence for hafting, the tool was probably used in an expedient fashion to scrape fresh hide. Artifact No. 5 was also used as a side and end scraper. The proximal left corner and distal edge are rounded and have dull, greasy fresh hide polish oriented normal to the tool margin. Both lateral edges show dull, greasy fresh hide polish, but some patches are oriented normal to the tool margin, while others are parallel or oblique, indicating that the tool was used as both a scraper and a knife. Wear traces are not well developed, and there is no evidence for hafting. The tool was apparently used in an expedient fashion to cut and scrape fresh hide.

In conclusion, microwear analysis has shown us that two of the flakes, as well as both scrapers, from Martins Creek were utilized to cut and scrape meat and fresh hide. Significantly, the two flint flakes that tested positive for elephant and deer antisera also displayed butchering edgewear. Although microwear analysis cannot tell us the exact identity of the animals being butchered, the edgewear found on four of the flint artifacts adds further support to the interpretation that Martins Creek was indeed a Paleoindian butchery site.

#### **References Cited**

Brush, N., and F. Smith 1994 The Martins Creek Mastodon: A Paleoindian Butchery Site in Holmes County, Ohio. *Current Research in the Pleistocene* 11:14–15.

Brush, N., M. Newman, and F. Smith 1994 Immunological Analysis of Flint Flakes from the Martins Creek Mastodon Site. *Current Research in the Pleistocene* 11:16–18.

Hardy, B. 1995 Personal communication.

Juel Jensen, H. 1988 Functional Analysis of Prehistoric Flint Tools by High-Power Microscopy: A Review of West European Research. *Journal of World Prehistory* 2:53–88.

Toth, N. 1987 The First Technology. Scientific American 256(4):112-121.

Yerkes, R. W. 1987 Prehistoric Life on the Mississippi Floodplain: Stone Tool Use, Settlement Organization, and Subsistence Practices at the Labras Lake Site, Illinois. University of Chicago Press, Chicago.

## Early Obsidian Use and Depletion at Yucca Mountain, Southern Nevada: Evidence from Obsidian Hydration Studies

### William T. Hartwell, Gregory M. Haynes, and David Rhode

Recent obsidian hydration studies conducted by the Desert Research Institute for the U.S. Department of Energy's Yucca Mountain Site Characterization Project on the Nevada Test Site give credence to the idea that locally available obsidian has been significantly depleted by terminal-Pleistocene/early-Holocene human populations. Three large archaeological sites (26NY1011, 26NY4759, 26NY7920) located along deeply entrenched ephemeral washes are the subject of the hydration study. The sites are primarily surficial in nature, and each contains a significant early-Archaic component of points representing the Western Stemmed tradition (Bryan 1980; Willig and Aikens 1989), although diagnostic projectiles spanning the entire range of human occupation in the region are represented.

The sites are situated in the lowlands of the Nevada Test Site along Yucca and Fortymile Washes, where obsidian nodules occur as secondary deposits in the alluvial terrace gravels. The sites show evidence of on-site reduction of obsidian in the form of split cobbles (cf. Amick et al. 1991:37–39) and interior flakes. Hydration-band measurements were obtained for 104 pieces of obsidian debitage from the three sites as part of a continuing program of obsidian studies near Yucca Mountain (Rhode 1992). Eighty-seven of the 104 pieces, or nearly 84%, are represented by band measurements in the 8–13 micron range. A hydration rate for the local Fortymile Wash obsidian source (8.56–8.99  $\mu$ m<sup>2</sup>/1000 years), derived from measured density of internal water content (Ambrose and Stevenson, in press; Stevenson 1995, pers. comm.), suggests that hydration values greater than 8 microns are in excess of 7,500 years in age. These values are consistent with measurements obtained from Western Stemmed tradition and Pinto points made from local obsidian sources, and are indicative of the

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earliest intensive occupation in the region. The data suggest a significant dropoff in production of obsidian debitage after eight microns at these sites.

It is hypothesized that early exhaustive use of large obsidian nodules ("highgrading") significantly depleted this resource in the Yucca Mountain region, so that large nodules were not readily available to later populations. Factors other than depletion (i.e., occupational intensity) may have contributed to the results obtained from the hydration study (e.g., Haynes and Buck 1995). However, the presence of large flakes at the sites indicates that obsidian nodules with diameters greater than 7 cm occurred within the local alluvium in the past. Nodules of this size are now quite rare. Indeed, it is difficult to find nodules greater than2-3 cm in diameter. Additionally, Buck et al. (1994:119, Table 5.1) show that, at least with regard to projectile-point manufacture, there is an increasing reliance on non-obsidian resources at the Nevada Test Site through time. Nearly 89% of all Western Stemmed tradition and Pinto points (n = 192) are made from obsidian, while later point styles show a decreasing proportion of obsidian use through time (Humboldt points, 73%; Gatecliff points, 57%; Elko points, 49%; Rosegate points, 43%). There is an increase in the proportion of Desert Series points manufactured from obsidian (63%). However, this may be a result of the generally small size of this arrow point, which would allow for use of the small nodules still common in the alluvium. It is hypothesized that this trend toward use of lithic materials other than obsidian reflects an increasingly limited obsidian supply in the Yucca Mountain region. It is unlikely that this shift is reflective of a change in preference of material, since obsidian remains the dominant material for all later point types from the Nevada Test Site.

Western Stemmed tradition point technology appears to have relied especially heavily on obsidian use in much of the Great Basin, regardless of the availability of other lithic materials (Amick 1993, 1995), a practice that likely contributed to significant depletion of this resource early in human prehistory in areas such as the Nevada Test Site, where primary sources of obsidian are unknown. Western Stemmed tradition points in the Yucca Mountain region typically exhibit significant battering damage presumably incurred during attempts to recycle them. Buck et al. (1994:69) note that "battering impacts are generally weathered to the same degree as the rest of the artifact, suggesting that heavy blunting of the edges occurred within the use life of the tool." Evidence for depletion and significant recycling of lithic resources has been noted at other sites on the Nevada Test Site (Amick 1990; Amick et al. 1991), and likely had significant consequences for procurement strategies and land use patterns. Buck et al. (1994:113) suggest that two possible results of resource depletion may have included an increased emphasis on opportunistic exploitation and an alteration of settlement strategies incorporating visits to alternative lithic resources.

#### **References Cited**

Ambrose, W. R., and C. M. Stevenson in press Estimating Obsidian Water Content and Hydration Rates from Density Measurements. Submitted to *American Antiquity*.

Amick, D. S. 1990 Lithic Reduction and Recycling Strategies at an Obsidian Nodule Source in

Southern Nevada. Paper presented at the 22nd Great Basin Anthropological Conference, Reno, Nevada.

Amick, D. S. 1993 Toolstone Use and Distribution Patterns Among Pluvial Lakes Tradition Points from Southern Nevada. *Current Research in the Pleistocene* 10:49–51.

Amick, D. S. 1995 Raw Material Selection Patterns among Paleoindian Tools from the Black Rock Desert, Nevada. *Current Research in the Pleistocene* 12:55–57.

Amick, D. S., G. H. Henton, and L. C. Pippin 1991 Archaeological Investigations on the Buckboard Mesa Road Project. Technical Report 69. Quaternary Sciences Center, Desert Research Institute, Reno.

Bryan, A. 1980 The Stemmed Point Tradition: An Early Technological Tradition in Western North America. In *Anthropological Papers in Memory of Earl H. Swanson, Jr.*, edited by L. B. Harten, C. N. Warren, and D. R. Tuohy, pp. 77–107. Special Publications of the Idaho State Museum, Pocatello, Idaho.

Buck, P. E., D. S. Amick, and W. T. Hartwell 1994 *The Midway Valley Site (26NY4759): A Prehistoric Lithic Quarry near Yucca Mountain, Nye County, Nevada.* Topics in Yucca Mountain Archaeology No. 1. Quaternary Sciences Center, Desert Research Institute, Las Vegas.

Haynes, G. M., and P. E. Buck 1995 Technological Diversity at Prehistoric Sites near Yucca Mountain, Nye County, Nevada. Paper presented at the 60th Annual Meeting of the Society for American Archaeology, Minneapolis, Minnesota.

Rhode, D. 1992 The World According to a Hydrating Obsidian Flake: Steps Towards Chronological Control of an Archaeological Landscape. Paper presented at the 23rd Great Basin Anthropological Conference, Boise, Idaho.

Willig, J. A., and C. M. Aikens. 1989. The Clovis-Archaic Interface in Far Western North America. In Early Human Occupation in Far Western North America: The ClovisArchaic Interface, edited by J. A. Willig, C. M. Aikens, and F. L. Fagan, 1–40. Nevada State Museum Anthropological Paper No. 21.

## Analysis of Obsidian Folsom Artifacts from New Mexico

Philippe D. LeTourneau, M. Steven Shackley, James M. Warnica, and Jan Cummings

Reports of obsidian artifacts from Folsom contexts are rare. We report the occurrence and geologic sources of obsidian Folsom artifacts from three sites in the Albuquerque Basin and Llano Estacado regions of New Mexico. For the Albuquerque Basin, Dawson and Judge (1969:156, 158) noted that obsidian is one of the most common toolstones at the Los Lunas site and a less common one at the Rio Rancho site, and Amick (1994:331, 335) and Judge (1973:164) have identified obsidian points at other nearby sites. There are no reports of obsidian Folsom artifacts on the Llano Estacado. Farther afield, obsidian

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Folsom artifacts are reported from the Hanson (Frison and Bradley 1980:13), Indian Creek (Davis and Greiser 1992:265, 269; Davis et al. 1987:6), Lindenmeier (Wilmsen 1974:114; Wilmsen and Roberts 1978:112), Linger (Stanford and Broilo 1981:5), and Lone Butte (Amick 1994:330) sites.

Marquez Wash is a Folsom-Cody-Archaic site located along an arroyo in Sandoval County in the Rio Salado-Jemez River drainage just south of the Jemez Mountains. The surface-collected Folsom assemblage consists of three preforms and one channel flake; one of the preforms is obsidian. Rio Rancho, a Folsom-Cody-Archaic-Anasazi site, is located in southern Sandoval County above an arroyo on the mesa between the Rio Grande and Rio Puerco (Dawson and Judge 1969:156-159). Dawson and Judge (1969:158) and Amick (1994:326) report the presence of obsidian at this site, but details of its prevalence in the assemblage have not been previously published. The excavated and surface-collected Folsom assemblage consists of 32 Folsom and Midland points, 46 preforms, and 136 channel flakes; 4 Folsom points, 6 preforms, and 15 channel flakes are obsidian. Site RO-4-45 is a Folsom-Plainview site in southern Roosevelt County located in sand dunes surrounding a small lake bed approximately 75 km south of the Blackwater Draw site. The surface-collected Folsom assemblage consists of 7 Folsom and Midland points, 1 preform, and 14 channel flakes. A single Folsom point is obsidian, while the remainder of the artifacts are Edwards chert.

Shackley analyzed the obsidian preform from Marquez Wash; three points, four preforms, and six channel flakes from Rio Rancho; and the obsidian point from RO-4-45 by nondestructive energy-dispersive X-ray fluorescence (see Shackley 1995 for a discussion of the technique). The primary geologic source for the RO-4-45 point is the Cerro Toledo Rhyolite, while that for the remaining artifacts is the Valle Grande Member of the Valles Rhyolite. Based on visual characteristics, the remaining Rio Rancho obsidian artifacts are all Valle Grande Member, except for one preform of Grants Ridge obsidian. Primary sources for the Cerro Toledo Rhyolite and Valle Grande Member obsidians are located in the Jemez Mountains, while both are also present as secondary cobbles in Rio Grande gravels (Baugh and Nelson 1987). For all three sites, the Rio Grande gravels are the closest sources for the obsidian. The gravels are located 330 km to the west of RO-4-45, 15 km east of Rio Rancho, and 50 km east of Marquez Wash. Primary sources are located 375 km to the northwest of RO-4-45, 80 km to the northeast of Rio Rancho, and 60 km to the northeast of Marquez Wash.

Both the primary and secondary sources for the Jemez obsidians are the obsidian sources closest to all three sites, so these results are not unexpected. Interestingly, the Marquez Wash preform and 19 of the 24 Rio Rancho Valle Grande Member obsidian artifacts are a semi-translucent mahogany glass that has not been previously reported from that source. The remaining five are a translucent gray color that is typical of that formation. This same mahogany variety is present at other Albuquerque Basin sites and always occurs as Folsom artifacts. We speculate that the Folsom-point knappers exploited a small primary source of this material in the Jemez Mountains, rather than a secondary gravel source.

Our results confirm the pattern of primarily local Folsom toolstone procure-
ment in the Albuquerque Basin (Dawson and Judge 1969:159, 160; Amick 1994:362, 363, 381–391), and provide information on a heretofore unknown procurement pattern for the Llano Estacado. The RO-4-45 point is the first obsidian Folsom artifact reported for the Llano Estacado and is the first confirmed Folsom artifact from that region made of an Albuquerque Basin toolstone (although the use of Jemez obsidian parallels that of other Paleoindian periods in the region (Johnson et al. 1985:51–53)).

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#### **References Cited**

Amick, D. S. 1994 Folsom Diet Breadth and Land Use in the American Southwest. Unpublished Ph.D. dissertation. Department of Anthropology, University of New Mexico, Albuquerque.

Baugh, T. G., and F. W. Nelson, Jr. 1987 New Mexico Obsidian Sources and Exchange on the Southern Plains. *Journal of Field Archaeology* 14(3):313–329.

Davis, L. B., and S. T. Greiser 1992 Indian Creek Paleoindians: Early Occupation of the Elkhorn Mountains' Southeast Flank, West-Central Montana. In *Ice Age Hunters of the Rockies*, edited by D. J. Stanford and J. S. Day, pp. 225–283. Denver Museum of Natural History, Denver.

Davis, L. B., S. T. Greiser, and T. W. Greiser 1987 Spring Cleanup at a Folsom Campsite in the Northern Rockies. *Current Research in the Pleistocene* 4:5–6.

Dawson, J., and W. J. Judge 1969 Paleo-Indian Sites and Topography in the Middle Rio Grande Valley of New Mexico. *Plains Anthropologist* 14(44):149–163.

Frison, G. C., and B. A. Bradley 1980 Folsom Tools and Technology at the Hanson Site, Wyoming. University of New Mexico Press, Albuquerque.

Johnson, E., V. T. Holliday, F. Asaro, F. Stross, and H. Michel 1985 Trace Element Analysis of Paleoindian Obsidian Artifacts from the Southern High Plains. *Current Research in the Pleistocene* 2:51–53.

Judge, W. J. 1973 Paleoindian Occupation of the Central Rio Grande Valley in New Mexico. University of New Mexico Press, Albuquerque.

Shackley, M. S. 1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60(3):531–551.

Stanford, D. J., and F. Broilo 1981 Frank's Folsom Campsite. The Artifact 19(3-4):1-11.

Wilmsen, E. N. 1974 Lindenmeier: A Pleistocene Hunting Society. Harper and Row, New York.

Wilmsen, E. N., and F. H. H. Roberts, Jr. 1978 Lindenmeier, 1934-1974: Concluding Report on Investigations. Smithsonian Contributions to Anthropology Number 24. Smithsonian Institution Press, Washington.

# Comments on Eastern Clovis Lithic Technology at the Carson Conn Short Site (40bn190), Tennessee River Valley

Hugo G. Nami, Mark R. Norton, Dennis Stanford, and John B. Broster

Since the early 1950s, numerous published reports illustrated the exceptional quantity of Paleoindian artifacts and great potential for Paleoindian research in Tennessee. However, in spite of this potential, systematic investigation on this topic has only recently begun. During the last seven years, an intensive site and projectile-point survey was conducted by the Tennessee Division of Archaeology under the direction of John Broster. As a result of this survey several important Paleoindian sites have been located and tested. Among these, the Carson-Conn-Short site (40BN190) (CCS), located near a major chert source, has produced an extraordinary abundance of Paleoindian lithic specimens (Broster and Norton n.d., Broster et al. 1994). Pit features occurred on the site that contain burned chert, discarded artifacts and limestone and are thought to be evidence for Clovis heat treating of the local chert.

The lithic inventory from this site includes cores, early stages of manufacture of both biface and uniface implements, finished specimens, and lithic debitage that will provide extensive information about the reduction systems employed by Clovis peoples in Tennessee. Studies of the CCS site will provide information on the Clovis lithic-reduction system from raw-material procurement through the finished artifact. Although these studies have only recently begun, we present here some preliminary observations.

The site is located near primary sources of Buffalo River chert, a regional variety of Fort Payne chert. The chert occurs in extensive deposits consisting of veins and tabular nodules ranging from 5 to 3 cm thick. In addition, artifacts made of non-local materials such as St. Louis and Ste. Genevieve cherts are also present in the assemblage.

Although Buffalo River chert in natural form has good to moderate flaking qualities, recent experiments conducted by the authors indicated that heat-treating the chert to between 4,500 and 5,500° F minimum temperatures for at least four hours followed by slow cooling improves its workability. This procedure causes changes in the color and texture, generally turning the chert from a light gray color to darker gray and pink and also making it less grainy. These attributes are present in the archaeological specimens, especially the prepared cores, bifaces, projectile points and bifacial debitage. In addition, there is a

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broken biface that has a "crenate" fracture produced during the heating (cf. Purdy 1975 Plate 4 a–b). This biface is reddish in color, and differential luster in the flake scars suggests heat treatment during the bifacial reduction process. Fire-cracked debris recovered in the pit features might be the result from rapid elevation of temperature during the heat treatment (cf. Purdy 1975: Plate 2 a).

Nodules from the local outcrops were reduced, using both bifacial and core technologies for obtaining flakes and blades. There is a broad range of variation in both the preparation and the morphology of the cores, including amorphous, polyhedral, discoidal, and Levallois-like cores. For blade production, some unprepared cores were started by utilizing natural ridges of tabular nodules. In other cases, the Clovis knappers prepared a "keel" or "crete" (see Bordes and Crabtree 1969) for the first removals (also see photo in Broster et al. n.d.: fig. 8). Cores were recovered in different stages of preparation illustrating the various stages of production sequences, especially for those prepared by using a Levallois-like technique. This strategy was employed to obtain flakes and blades, and is similar to the biface end-thinning techniques described by Callahan (1979: fig. 20 a to e). The flakes and blades were used as blanks for unifacial stone tools such as end and lateral scrapers, knives, backed blades, perforators, and probably burins.

There is a broad range of variation in the sizes of the blades and blade-like flakes including a megablade that measures over 20 cm in length. Replicative experiments show that these artifacts can be produced by simple direct billet soft percussion flaking.

Bifacial artifacts represent the whole reduction sequence of Eastern Clovis projectile points. These include early stages 2, 3 and 4 bifaces (Callahan 1979), unfluted and fluted broken preforms, and finished specimens. These artifacts show a sequence similar to that Callahan (1979) proposed for Eastern fluted points, particularly in the width-thickness ratios, angle averages, lateral and end thinning. An interesting case of preform preparation shows that after the bifacial thinning, like many Folsom preforms (cf. Flenniken 1978, Nami 1996), only one face was prepared by pressure flaking before the fluting.

In general the CCS assemblage is comparable to the Clovis blade and bifacial technology reported for the Adams site in Kentucky (Sanders 1990), and Williamson in Virginia (McCary 1975, McAvoy 1992). Similarities are also seen to Clovis assemblages from Texas (cf. Young and Collins 1989, Collins 1995, Henderson and Goode 1991), New Mexico (Hester 1972: fig. 93–94) and the blades from the East Wenatchee site in Washington (Gramly 1993).

Although more work needs to be conducted on the site and artifacts, we can now provide a general picture of the lithic technology at the CCS site. Ongoing analyses of the lithic remains and putative-heat treating pits will provide additional information on Clovis lithic technology.

#### **References Cited**

Bordes, F., and D. Crabtree 1969 The Corbiac Blade Technique and other Experiments. *Tebiwa* 12(2):1–21.

Broster, J. B., and M. R. Norton n.d. Recent Paleoindian Research in Tennessee. In The

Paleoindian and Early Archaic Southeast, edited by D. G. Anderson and K. E. Sassaman, pp. 289–296, The University of Alabama Press, in press.

Broster, J. B., M. R. Norton, D. J. Stanford, C. V. Haynes, Jr., and M. Jodry 1994 Eastern Clovis Adaptations in the Tennessee River Valley. *Current Research in the Pleistocene* 11:12–14.

Broster, J. B., M. R. Norton, D. J. Stanford, C. V. Haynes, Jr., and M. Jodry n.d. Stratified Fluted Point Deposits in the Western Valley of Tennessee. *Proceedings of the 14th Mid-South Archaeological Conference*, in press.

Callahan, E. 1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition. A Manual for Flintknappers and Lithic Analysts. Archaeology of Eastern North Americe 7(1):1–180.

Collins, M. 1995 Lecture presented at the Clovis Workshop organized by G. Goode, Laboratory of Archaeology, University of Texas at Austin.

Flenniken, J. 1978 Reevaluation of the Lindenmeier Folsom: A Replication Experiment in Lithic Technology. *American Antiquity* 43 (3):473–480.

Gramly, M. 1993 The Richey Clovis Cache. Earliest American Along the Columbia River. Persimmon Press, 70 pp., Buffalo.

Henderson, J., and G. T. Goode 1991 Pavo Real: An Early Paleoindian Site in South-Central Texas. *Current Research in the Pleistocene* 8:26–28.

Hester, J. J. 1972 Blackwater Locality No. 1. A Stratified, Early Man Site in Eastern New Mexico. Publication of the Fort Burwin Research Center, 8, 239 pp., New Mexico.

McAvoy, J. M. 1992 Nottoway River Survey. Part I. Clovis Settlement Patterns. Archaeological Society of Virginia, Special Publication, 29, p. 171, Richmond.

McCrary, B. 1975 The Williamson Paleo-Indian Site. Dinwiddie County, Virginia. *The Chesopiean* 13(3-4):48–131.

Nami, H. G. 1996 The Folsom Biface Reduction Sequence: Evidence from the Lindenmeier Collection. Submitted to: *Exploring Patterns and Variation in Folsom Lithic Technology*, edited by D. S. Amick, in press.

Purdy, B. A. 1975 Fractures for the Archaeologist. In Lithic Technology: Making and Using Stone Tools edited by E.H. Swanson, pp.132–141, Mouton, The Hague.

Sanders, T. N. 1990 Adams: The Manufacturing of Flaked Stone Tools at a Paleoindian site in Western Kentucky. p. 159, Persimmon Press, Buffalo.

Young, B., and M. B. Collins 1989 A Cache of Blades with Clovis Affinities from Norteastern Texas. *Current Research in the Pleistocene* 6:26–28.

### Multidisciplinary Research at an Early Paleoindian Source of Toolstone, Southern Ontario

Peter L. Storck, Peter J. Barnett, L. Denis Delorme, Stephen G. Monckton, and Peter von Bitter

As part of an ongoing research program (Storck 1992), a 3-year multidisciplinary project was initiated in 1995 at the recently discovered Red Wing site (Storck 1995). The site is located in the geological source area of Fossil Hill Formation

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chert, a toolstone highly preferred by early-Paleoindian peoples of the Parkhill complex (Storck and von Bitter 1989). The Red Wing site occurs in a topographic setting not previously investigated in the chert source area, a deep hollow adjacent to a marsh.

The objectives of the project are to determine (1) why this chert type was preferred for tool making, (2) what social unit(s) exploited the chert (the band as a whole or, alternatively, special task groups from outside the region), and (3) how the chert was exploited. A solution to the first objective will be sought through a reconstruction of the paleoecology of the site area and its biological potential for food resources. A working hypothesis is that a locally (and perhaps seasonally) abundant food resource may have led to the initial discovery and long-term use of Fossil Hill chert (Storck and von Bitter 1995). Solutions to the second and third objectives are expected to be found in the composition of the tool assemblage and from data relating to the structure of the site (i.e., the presence, or absence, and contents of firepits, storage features, dumps, etc.).

Preliminary geological and paleoecological studies indicate that during late glacial times the present-day marsh was a small lake of intermittently varying depths. The absence of fish remains and zooplankton fossils indicates that fish were probably not present. Thus, if Paleoindians exploited the lake habitat for food they must have used other faunal or plant resources. Palynological data suggest that the lake was contemporaneous with the spruce pollen zone indicating the surrounding vegetation consisted of a spruce parkland, dated elsewhere between ca. 13,000 and 10,000 yr B.P. (see, for example, McAndrews 1994). The lake disappeared at the end of this interval, and the basin became sufficiently dry to have preserved no record of the Holocene until European settlement. This suggests that the basin may have been attractive to human occupation only during Paleoindian times.

Artifact material recovered from the Red Wing site indicates that preform manufacture was a dominant activity. However, a large number of spontaneously used flakes and angular chert fragments also appear to exhibit significant use-wear (most notably a highly reflective polish) suggesting that the site was also used for the processing of organic materials, possibly derived from the former lake. Future paleoecological and use-wear studies will attempt to identify the nature/identity of the substance that was worked and its potential role in both attracting occupation to the site and influencing the scheduling (timing) of Paleoindian chert procurement. Continued excavation in 1996 will explore the structure of the site, search for evidence that chert was heat-treated (which is suggested by the appearance of some bifaces and debitage), attempt to find other evidence of subsistence, and recover diagnostic tools indicating which of the early-Paleoindian complexes is represented.

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#### **References** Cited

McAndrews, J. H. 1994 Pollen Diagrams for Southern Ontario Applied to Archaeology. In Great

Lakes Archaeology and Paleoecology: Exploring Interdisciplinary Initiatives for the Nineties, edited by R. I. MacDonald, pp. 179–195. Quaternary Sciences Institute, University of Waterloo.

Storck, P. L. 1992 Recent Investigations at the Thomson Site Complex, Ontario, Canada. *Current Research in the Pleistocene* 9:38–40.

Storck, P. L. 1995 Windows Where Walls Once Stood: Looking for New Insights Into the Past. *Royal Ontario Museum Archaeological Newsletter* (Series II) 57:1-4.

Storck, P. L., and P. von Bitter 1989 The Geological Age and Occurrence of Fossil Hill Formation Chert: Implications for Early Paleoindian Settlement Patterns. In *Eastern Paleoindian Lithic Resource Use*, edited by C. J. Ellis and J. C. Lothrop, pp.165–189. Westview Press.

Storck, P. L., and P. von Bitter 1995 The Significance of the Niagara Escarpment in Early Paleo-Indian Land-Use and Subsistence During the Late Pleistocene. In *Leading Edge '94: A Conference Linking Research, Planning and Community in the Niagara Escarpment*, pp. 144–149. Proceedings published by the Ontario Ministry of Environment and Energy in cooperation with the Niagara Escarpment Commission, Canadian Heritage/Parks Canada and the Ontario Heritage Foundation.

# Use-Wear Studies at an Early Paleoindian Source of Toolstone, Southern Ontario

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Use-wear studies are being conducted as part of a larger multidisciplinary project (see Storck et al., this volume) at a Paleoindian chert-reduction/ manufacturing site (Red Wing) adjacent to a source of toolstone. The objectives of the use-wear study are to determine (1) whether any activities took place at the site other than chert reduction and preform manufacture and, if so, (2) whether these activities were conducted on raw materials that might have been as important as the toolstone itself in attracting Paleoindians to the site and to the general area.

The first season's excavation in 1995 produced a large number of complete and fragmentary bifaces, as well as a small number of tools such a single-spurred and a large multiple-spurred graver (Figure 1), a complete end scraper and perhaps fragments of several others, and a number of unifacially worked tool fragments with steeply retouched working edges. A large number of spontaneously used flake tools were also recovered, many with prominent glossy patches that appeared to be the result of use.

Selected samples of tools are being examined for evidence of use-wear with low-power microscopy. Preliminary findings suggest that most of the expedient tools were used to work wood and/or a fibrous plant material. It is of interest to note that not all the glossy patches commented upon above may be the product of use-wear; some may have been produced through friction created by flake release during the knapping process. Further studies of these two types of

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Figure 1. Multiple-spurred flake graver. Use-wear indicates the isolated spur. S1, was used to pierce or drill while the other five spurs were used together like a sawto cutwood or shred fibrous plant material. Artwork by Emile Huston, Department of New World Archaeology, Royal Ontario Museum.

glossy patches are planned using a scanning electron microscope and possibly an electron probe.

Bifacially worked artifacts, initially regarded as preforms, are also being examined. Surprisingly, over 50 percent of the artifacts studied to date appear to have been used for working wood or, less likely, saturated antler. Future studies will attempt to relate patterns of use-wear to the manufacturing sequence for the purpose of determining whether the bifaces were deliberately made for some processing activity at the Red Wing site, rather than as preforms to be transported elsewhere, or, alternatively, employed opportunistically in an effort to "recycle" rejected bifaces or those broken during the manufacturing process.

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### **Taphonomy—Bone Modification**

# The Lovewell Mammoth: A Late Wisconsinan Site in North-Central Kansas

### Steven R. Holen

The Lovewell mammoth was discovered in 1969 during low lake levels at Lovewell Reservoir in north-central Kansas. Archaeologists from the Kansas State Historical Society reported green fractured and stacked mammoth bone. However, a geologist interpreted the stratigraphy as more than 100,000 yr B.P., causing the archaeologists to abandon the site. Rising lake levels soon inundated the mammoth.

During low lake levels in 1991, the author investigated the Eckles Clovis site (Holen and Eckles 1989) 900 m west of the Lovewell mammoth site. Geomorphic research indicated that the north shoreline of the lake consists of late-Farmdalian/Woodfordian terrace fill (Holen et al. 1995). This evidence contradicts the previous geological assessment. Survey of the mammoth site documented scattered mammoth bone with one heavy concentration of small fragments. A 5-m<sup>2</sup> test unit in the heavy concentration was excavated into fine-grained alluvium. A 4-cm-thick upper level, consisting of numerous small mammoth bone fragments in fine silts, was found above an in situ mammoth bone level. Evidence of high-velocity impact points and bone flaking was noted on cortical limb-bone fragments.

The proximal 3.5 cm of a slender bone artifact was excavated in the upper unit. The artifact (Figure 1) retains a high polish and fits easily within the morphological characteristics of Clovis bone technology. These artifacts have been termed foreshafts (Frison 1982; Lahren and Bonnichsen 1974), projectile points (Frison 1982; Hester 1972), parts of composite flaking tools (Wilke et al. 1991), or expedient pry bars used as butchering tools (Saunders and Daeschler 1994). The artifact tip has been broken, by snapping or impact, with the fracture subsequently rounded by use. Root etching on the artifact surface is consistent with etching on other small bone fragments, strongly inferring the artifact was associated with the mammoth. Initially, the site was interpreted as Clovis (Holen 1993).

Subsequent radiocarbon dating of mammoth bone from the site was conducted by Thomas Stafford at the Laboratory for AMS Research CU-INSTAAR.

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Figure 1. Bone artifact found with the Lovewell Mammoth. Note root etching on surface.

The fraction dated was XAD-treated KOH-extracted collagen hydrolyzate (Stafford et al. 1991) from a spirally fractured limb-bone fragment, excavated from in situ deposits. This sample yielded a radiocarbon age of  $18,250 \pm 90$  yr B.P. (CAMS-15636). This age is consistent with other radiocarbon ages of sediments and bone samples from the north shore of the reservoir. Additional age determinations at the Lovewell mammoth site are planned for 1996.

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### **References** Cited

Frison, G. C. 1982 The Sheaman Site: A Clovis Component. In *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains*, G. C. Frison and D. Stanford, pp.143–157. Academic Press, New York.

Hester, J. J. 1972 Blackwater Locality No. 1: A Stratified, Early Man Site in Eastern New Mexico. Fort Burgwin Research Center, Southern Methodist University, Dallas.

Holen, S. R. 1993 The Lovewell Mammoth: A Late Wisconsinan Man/Mammoth Association in Northcentral Kansas. Paper Presented at the Flint Hills Conference, Wichita, Kansas.

Holen, S. R., and R. Eckles 1989 Report on the Eckles Site, 14JW4: A Clovis Occupation At Lovewell Reservoir, Jewell County, Kansas. Report Submitted to the Bureau of Reclamation, Grand Island Office.

Holen, S. R., R. G. Corner, and R. D. Mandel 1995 A Late Farmdalian-Woodfordian Fauna From Lovewell Reservoir, Jewell County, Kansas. *Current Research in the Pleistocene* 12:108.

Lahren, L., and R. Bonnichsen 1974 Bone Foreshafts from a Clovis Burial in Southwestern Montana. *Science* 186: 147–150.

Saunders, J. J., and E. B. Daeschler 1994 Descriptive Analysis and Taphonomical Observations of Culturally-Modified Mammoths Excavated at "The Gravel Pit," Near Clovis, New Mexico in 1936. *Proceedings of the Academy of Natural Sciences of Philadelphia* 145:1–28.

Stafford, T. W., Jr., P. E. Hare, L. A. Curie, A. J. T. Jull 1991 Accelerator Radiocarbon Dating at the Molecular Level. *Journal of Archaeological Science* 18: 35–72.

Wilke, P. J., J. J. Flenniken, and T. L. Ozbun 1991 Clovis Technology at the Anzick Site, Montana. *Journal of California and Great Basin Anthropology* 13(2): 242–272.

# Taphonomic Effects of Tree-Falls: Examples from the Hiscock Site (Late Quaternary, Western New York State) *Bichard S. Laub*

The Hiscock site (late Quaternary; Genesee Co., New York) includes a 0.8hectare basin containing late-Pleistocene spring-deposited gravel overlain by Holocene peat (Laub et al., 1988). The Pleistocene horizon contains abundant dissociated bones of some half-dozen vertebrate species, predominantly*Mammut americanum*. Floral remains coeval with this horizon are limited to short pieces of conifer twig, interpreted as mastodon feces and gastrointestinal contents (Laub et al., 1994), and occasional cones of jack-pine (*Pinus banksiana*) (Miller, 1988, 1990; Steadman & Miller, 1987).

When large pieces of wood occur in the Pleistocene level, they intrude from the overlying Holocene peat, where their upper ends are truncated. Initially they were suspected of being stakes emplaced in the ground by human hands, but the absence of sharpened ends and any obvious distributional pattern, the observation that several stood at a wide angle to the vertical, and the discovery of one that branched downward caused us to rethink this interpretation. In view of evidence that the site was forested during much of the Holocene and that the substrate was frequently moist, we have concluded that these objects were not stakes, but rather branches that penetrated the ground when trees fell over. At least two probable tree-throws (areas of substrate torn up by the roots of toppling trees) have been identified.

During the 1995 field season at Hiscock, we discovered a remarkable example of how such penetrating branches can affect the fossil record. A segment of branch (Bflo Mus. Sci. E26964), approximately 1 m long and 7.5 cm in diameter, was found penetrating the strata at approximately 50 degrees from the vertical. Its top was in the middle of the peat, just below the level where European influences appear. The branch extended through the Pleistocene spring gravel and ended on the upper surface of a shattered mastodon rib (E26965). That the rib was damaged when struck by the branch seems inescapable. A radiocarbon date of  $590 \pm 60$  yr B.P. (Beta-90010, uncorrected) was obtained for the wooden branch (*Fraxinus nigra*, John H. McAndrews, Royal Ontario Museum, pers. comm.). The mastodon rib yielded a radiocarbon age of  $10,790 \pm 70$  yr B.P. (CAMS-27143, corrected). It is remarkable that this bone was thus physically affected by an event that postdated its burial by some 10,000 years.

During the same field season, a large male mastodon tusk (E26966) was found in a remarkably shattered condition, and was even broken completely through in some places. Because it lay no more than two meters from the branch and shattered rib, and because several unusually long pieces of wood lay

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horizontally in the peat less than 0.3 m above the tusk, it seems reasonable to suppose that it was shattered by the falling of a large tree sometime during the Holocene.

A smaller tusk (E26967) that lay in the same general area was damaged in an even more dramatic way. A hole had been punched in its stratigraphic upper surface. The hole was asymmetrical in the plane of the tusk's cross section, indicating that the force had come from above and to the side. In another area of the same surface, splinters of ivory had been moved from their original position as by a glancing blow, and the pulp cavity was vertically compressed. In light of the branch and its effect on the rib, it seems likely that this tusk was damaged in a similar manner, although the offending branch was not preserved. The event occurred during the late Holocene, based upon the age of the pollen contained in the sediment filling the hole.

Pleistocene bones at Hiscock are mostly in a damaged condition. This appears to be due to weathering, trampling, gnawing by animals, possibly abrasion by sediment, and probably human manipulation (Tomenchuk & Laub, 1995). The observations cited here indicate that trees, under the proper conditions, can also be significant taphonomic agents, capable of modifying objects that had long been buried.

### **References Cited**

Laub, R. S., M. F. DeRemer, C. A. Dufort, and W. L. Parsons 1988 The Hiscock Site: A Rich Late Quaternary Locality in Western New York State. In *Late Pleistocene and Early Holocene Paleoecology and Archeology of the Eastern Great Lakes Region*, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 67–81. Bulletin of the Buffalo Society of Natural Sciences 33.

Laub, R. S., C. A. Dufort, and D. J. Christensen 1994 Possible Mastodon Gastrointestinal and Fecal Contents from the Late Pleistocene of the Hiscock Site, Western New York State. In *Studies in Stratigraphy and Paleontology in Honor of Donald W. Fisher*, edited by E. Landing, pp. 135–148. New York State Museum Bulletin 481.

Miller, N. G. 1988 The Late Quaternary Hiscock Site, Genesee County, New York: Paleoecological Studies Based on Pollen and Plant Macrofossils. In *Late Pleistocene and Early Holocene Paleoecology* and Archeology of the Eastern Great Lakes Region, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 83–93. Bulletin of the Buffalo Society of Natural Sciences 33.

Miller, N. G. 1990 Late-Pleistocene Cones of Jack Pine (*Pinus banksiana*) at the Hiscock Site, Western New York. *Current Research in the Pleistocene* 7(95–98).

Steadman, D. W., and N. G. Miller 1987 California Condor Associated With Spruce-Jack Pine Woodland in the Late Pleistocene of New York. *Quaternary Research* 28(415–426).

Tomenchuk, J., and R. S. Laub 1995 New Insignts into Late-Pleistocene Bone Technology at the Hiscock Site, Western New York State. *Current Research in the Pleistocene* 12(71–74).

# The Cracow Spadzista Street (B) Upper Paleolithic Site

Piotr Wojtal

Cracow Spadzista Street (B) is one part of a well-known Pleistocene site in Poland (Kozlowski 1983; Kozlowski and Sobczyk 1987; Kubiak and Zakrzewska 1974; Wiktor 1969). Radiometric dates place the occupation to the Last Glacial Maximum. The stone artifacts belong to Upper Paleolithic industries of the Kostienki-Avdeevo type (Kozlowski 1983). Some mammoth bones were originally interpreted as the remains of dwellings built in a largely treeless environment, using mammoth body parts to support a shelter framework (Kozlowski et al. 1974). Other finds in the larger site include a few decorated bone fragments and artwork.

New excavations in site B since 1989 have increased the number of excavated bones to 8,700, of which 5,507 are identifiable. About 99% of the bones are from woolly mammoth (*Mammuthus primigenius*). Also found were single bones or teeth of woolly rhinoceros (*Coelodonta antiquitatis*), horse (*Equus caballus*), reindeer (*Rangifer tarandus*), bear (*Ursus* sp.), wolf (*Canis lupus*), and arctic fox (*Alopex lagopus*) (Kubiak and Zakrzewska 1974).

The minimum number of individuals (MNI) is 71 mammoths. All body parts of mammoth are represented (Table 1), including a large number of ribs (NISP = 2065, minimum number of elements [MNE] = 715), vertebrae (NISP = 1062, MNE = 767), sesamoids (NISP = 85), and phalanges (NISP = 172). Most ribs are broken, and only a small number of complete vertebrae have been recovered. Parts of skulls were present, but their preservation is poor.

The great difference between the highest and lowest MNIs must reflect a number of factors, including preservation and recovery techniques. The smaller bones of younger animals may have been filtered out of the assemblage by diagenetic processes after deposition, but the assemblage did contain mammoth fetal bones, consisting of two humeri, two ulnae, one tibia, and three femora from a minimum of two individuals, so the bone-subtractive processes were selective. Some bones may have been burned in hearths found at the site's southern part.

The mammoth age profile is stable (Lipecki and Wojtal), with 42% of the totalMNI (71) being subadults (in the 0–12 African-elephant-years [AEY] class), similar to profile Type A in Haynes (1991), which is created in nature by time-averaged but nonselective deaths, or which also results from human kills that are abrupt, nonselective, and affect whole herds (Haynes 1991; see also Soffer 1993).

About 0.6% of the mammoth bones show visible teeth marks made by rodents. Most marks are situated on long bones and ribs. About 6% of identifiable bones were gnawed by carnivores. Carnivore gnaw marks are similar in morphology and size to marks made by wolf and spotted hyena

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Element	Number of Identified Specimens (NISP)	Minimum Number of Individuals (MNI)
Atlas	92	62
Axis	51	30
Scapula	103	23
Humerus	84	26
Ulna	106	42
Radius	119	45
Carpal	234 (a)	(a)
Metacarpal	115 (b)	(b)
Pelvis	135	26
Femur	125	31
Tibia	101	27
Fibula	80	33
Tarsal	240(c)	(c)
Metatarsal	84(d)	(d)
Rib	2065	(e)
Vertebra	1062	(e)

Table 1. Mammoth bones and MNI.

Notes: (a) the highest carpal count is from the Lunate (NISP=40, MNI=25);

(b) the highest metacarpal count is from Metacarpal IV (NISP=32, MNI=17);

(c) the highest tarsal count is from the Astragalus (NISP=59, MNI=30);

(d) the highest metatarsal count is from Metatarsal III (NISP=28, MNI=14);

(e) not counted.

(Haynes 1983). The presence of gnawing marks on most body parts suggests that large scavengers returned to the mammoth carcasses several times before the bones were buried. In Africa scavenging hyenas will chew elephant bones that remain greasy three years or longer after the elephants died (Haynes 1986).

Cut marks are very rare, with only a very few bones showing the clear incisions that may have resulted from stone implements. However, even if some or all the mammoths had been butchered by humans, a scarcity of cutmarks would be expected: experiments and ethnographic observations of elephant butchering indicate that few or no identifiable cut marks may be found on butchered elephant bones (see Haynes 1991).

Some bones (0.75% of identifiable elements) show marks that may be the result of trampling, perhaps indicating the bone deposit was visited several times by mammoths before final burial. About 8% of the identifiable bones have marks that appear to be root-etching, a common bone-surface modification in wet grasses or sedges (Haynes 1981). This is expectable, because the mammoth bones had been deposited in tundra or tundra-steppe, and the bones were buried in wet, fine-grained sediments.

Most bones are in weathering stage 0 (no signs of decay) (Behrensmeyer 1978). Only 8.2% of the total assemblage show the first signs of weathering (Behrensmeyer stage 1), and only 0.001% (nine bones) show Behrensmeyer stage 2 and 3. Some bones therefore appear to have been exposed longer than others on ground surfaces. In cold environments the process of weathering is much slower than in warm or tropical environments (Behrensmeyer 1978; Haynes 1981), and therefore the inferred exposure time of the bone assemblage may have been decades or even centuries.

The site may be the remains of a mass drive of mammoths by Ice Age humans, who later butchered the animals, but taphonomic analyses suggest other origins. Soffer (1993) proposed that such deposits—containing large numbers of mammoth bones together with the presence of all skeletal elements and all age classes, as well as a scarcity of cut marks and a relatively extensive record of scavenger gnaw marks—are noncultural accumulations. But a deposit of so many bones from 71 individuals in a very small spatial area (137 square meters) is still puzzling, even if the accumulation is noncultural. The site may have been often visited by mammoths, and at several times herd groups died (or were killed) together there.

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#### **References Cited**

Haynes, G. 1981 Bone Modifications and Skeletal Disturbances by Natural Agencies: Studies in North America. Unpublished Ph.D. dissertation, Catholic University of America.

Haynes, G. 1983 A Guide for Differentiating Mammalian Carnivore Taxa Responsible for Gnaw Damage to Herbivore Limb Bones. *Paleobiology* 9:164–72.

Haynes, G. 1986 Spiral Fracture and Cutmark-Mimics in Noncultural Elephant Assemblages. *Current Research in the Pleistocene* 3:45–6.

Haynes, G. 1991 Mammoths, Mastodonts, and Elephants: Biology, Behavior, and the Fossil Record. Cambridge University Press.

Kozlowski, J. K. 1983 Le Paléolithique Supérieur en Pologne. L'Anthropologie 87:49-82.

Kozlowski, J. K., and K. Sobczyk 1987 The Upper Paleolithic Site Krakow-Spadzista Street C2: Excavations 1980. Jagiellenian University.

Kubiak, H., and G. Zakrzewska 1974 Fossil Mammals. In *Upper Paleolithic Site with Dwellings of Mammoth Bones* edited by J. K. Kozlowski, H. Kubiak, E. Sachse-Kozowska, B. Vliet, and G. Zakrzewska. Cracow Spadzista Street (B). Folia Quaternaria 44:77–95.

Lipecki, G., and P. Wojtal in press *Mammoth Population from Cracow Spadzista Street (B) Site.* Polish Academy of Science.

Soffer, O. 1993 Upper Paleolithic Adaptations in Central and Eastern Europe and Man-Mammoth Interactions. In *From Kostenki to Clovis: Upper Paleolithic: Paleo-Indian Adaptations*, edited by O. Soffer and N. D. Praslov. Plenum Press, New York.

Wiktor, A. 1969 Mieczaki Stanowiska Paleolitycznego Krakow-ul. Spadzista. Folia Quaternaria 31:61-62.

### Methods

# Limiting Age of the Miami Mastodon by Thermoluminescence

Glenn W. Berger

In their comments on a thermoluminescence (TL) age of  $41.7 \pm 6.1$  (1) ka for undeveloped loess just underlying the Miami Mastodon (Missouri), Dunnell and Hamilton (1995) neglect to mention affiliation of this author and some important details about the ionizing-radiation dose rate. This note clarifies their comments.

TL age equals equivalent dose  $(D_{\rm g})$ /effective dose rate  $(D_{\rm R})$ . The partialbleach R-beta procedure (Aitken, 1985; Berger, 1996; Berger et al., 1992) was used to measure  $D_{\rm g}$  values. Figure 1 inset shows the excellent measured plateau in  $D_{\rm g}$  values used for age calculation. To calculate  $D_{\rm R}$  from the loess, the following key parameter values were measured:  $K_{\rm g}O = 2.36 \pm 0.03\%$ ,  $U = 3.12 \pm 0.35$  ppm, and Th =  $7.5 \pm 1.2$  ppm. Water =  $20 \pm 8\%$  was indirectly estimated. These yield  $D_{\rm R} = 3.57 \pm 0.30$  Gy/ka. From  $D_{\rm R}$  and the plateau  $D_{\rm g}$ value (Fig. 1), the TL age =  $41.7 \pm 6.1$  ka.

Only 40% of this dose rate represents the gamma-ray or surrounding-matrix component. According to Dunnell (pers. comm., April, 1994), the TL sample was centered 8.5 cm beneath a layer of bone material 2–3 cm thick, not 4 cm beneath as stated by Dunnell and Hamilton (1995). As an extremum estimate of the effect on  $D_R$  of the bone, based on information from Dunnell supplied to me (April, 1994), I estimate that bone volume represents a maximum of 25% of the volume of a 30-cm-radius sphere of gamma-ray influence (Aitken, 1985) centered on the TL sample. Using the values of  $^{238}U = 10.56 \pm 0.56$  ppm,  $^{232}Th = 0.97 \pm 0.45$  ppm, and K = 0 (Dunnell, personal communication, April, 1994) for the bone, I estimate the probable effect on dose rate to be±0.009 Gy/ ka—insignificant. This assumes that the above U, Th and K are the initial values for the bone. If these values were zero throughout 40 ka, then the dose rate to the TL sample would be less by 7.3%, assuming a maximum 25% volume effect. This implies an increase in TL age by 7.3% or 3 ka. I consider this improbable and accept the 41.7 ka result.

If the TL sample was 8.5 cm below the bone, then based on typical deposition

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**Figure 1.** Partial-bleach TL dose-response curves and resultant  $D_{\rm g}$ . T plot (inset, with 1 errors) for Miami loess. Weighted saturating exponential regression was used for the dose-response curves. The 240–380°C plateau  $D_{\rm g}$  value is 149 ± 18 Gy.

rates for worldwide loess of 0.2-0.3 mm/yr (Pye, 1987), the bone was deposited probably at most 450 yr after the TL-dated sample, not detectably younger than the TL age. I conclude that the Miami Mastodon was buried close to 41 (± 6) ka. This was a time of major loess (Roxanna Silt) deposition in the middle continent (Leigh and Knox, 1993).

### **References Cited**

Aitken, M. J. 1985 Thermoluminescence Dating. Academic Press, New York.

Berger, G. W. 1996 Progress in Luminescence Dating Methods for Quaternary Sediments. In *Dating Methods for Quaternary Deposits*, edited by N. W. Rutter, and N. Catto. Geological Association of Canada, GEOtext no. 2, 81–103.

Berger, G. W., B. J. Pillans, and A. S. Palmer 1992 Dating Loess up to 800 ka by Thermoluminescence. *Geology* 20:403-406.

Dunnell, R. C., and T. M. Hamilton 1995 Age of the Miami Mastodon. *Current Research in the Pleistocene*. 12:91–92.

Leigh, D. S., and J. C. Knox 1993 AMS Radiocarbon Age of the Upper Mississippi Valley Roxana Silt. *Quaternary Research* 39:282–289.

Pye, K. 1987 Aeolian Dust and Dust Deposits. Academic Press, San Diego, California.

# A Database of Alluvial Radiocarbon Ages from the Central Great Plains (Kansas and Nebraska)

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During the last two decades there has been a dramatic increase in geomorphic research conducted in stream valleys of Kansas and Nebraska. Most of this research has been associated with CRM projects conducted on public lands (e.g., reservoirs and other water-resource developments, highway corridors, military reservations). An offshoot of this geoarchaeological research has been near-exponential growth in the number of radiocarbon age determinations from alluvial environments. Moreover, upon the completion of two multi-year geoarchaeological projects currently underway in Kansas, the resulting radiocarbon ages from alluvial environments will likely more than double the size of the database.

The first attempt at compilation and synthesis of the alluvial radiocarbon record in the central Great Plains, by Johnson and others (1980), recognized only 24 studies with radiocarbon-dated alluvium in Kansas, Nebraska, Missouri, and Oklahoma. Johnson and Martin (1987) subsequently updated the list of alluvial radiocarbon ages for the same group of states. Concurrently, May (1986) compiled a list of sites and associated radiocarbon ages for Nebraska and adjacent areas of Iowa, Kansas, South Dakota, and Wyoming. In reference to soils buried in alluvium, Johnson and Logan (1990) presented arecord of those radiocarbon ages from the Kansas River basin (Kansas, Nebraska, and Colorado) that dated terminal soil development. Mandel (1991, 1994) assembled a review of all studies in Nebraska, eastern Iowa, Missouri, Kansas and Oklahoma that provided information, including radiocarbon ages, about late-Quaternary terraces and alluvial fills. Most recent compilations include those by Mandel (1995) and Johnson (in press), but these and earlier versions exist only in text files, not as database files that facilitate ready updating and analysis.

Although the Central Great Plains Radiocarbon Database (CGPRDB) is presently restricted to only alluvial radiocarbon ages, it consists of about 400 ages from nearly 100 sites. The size of the database is appreciably less than other similar databases, such as the comprehensive record for Alaska (Galloway, 1995), but it is rapidly expanding and providing specific age data of prime importance for interpreting the archaeological record and reconstructing the paleoenvironment.

CGPRDB was compiled using Microsoft Access and consists of 17 fields of information for each radiocarbon age: (1) state (KS or NE), (2) river basin (e.g., Platte, Kansas), (3) landscape code (at present all are A for alluvial), (4) site name, (5) latitude in degrees and minutes, (6) longitude in degrees and

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minutes, (7) sample material (e.g., wood, charcoal, soil fraction dated), (8) sample depth in m, (9) laboratory code (e.g., Tx, Beta), (10) laboratory number, (11) uncorrected <sup>14</sup>C age in yrB.P., (12) uncorrected one-sigma error, (13) <sup>13</sup>C determination (‰), (14) corrected <sup>14</sup>C age in yrB.P., (15) corrected onesigma error, (16) calibrated age (after Stuiver and Reimer, 1993), and (17) author citation, which is indexed to a full bibliographic listing in Microsoft Word. For each radiocarbon record, a comment file has been added to provide information such as township and range location, relevant 1:24,000 topographic map(s), details about the sampling procedures, and any particular significance noted in the reference. These particular fields were selected to facilitate data compilation while making possible statistical and geographic information system analyses. Unpublished ages are included in the table only with the appropriate investigator's permission or by request, and upon publication the record will be amended to include the citation. In any form, CGPRDB will probably never be all-inclusive, but age records, new and old, will be added as they come to the attention of the authors.

Continued growth of the database occurs as various CRM projects are conducted within the two states. Immediate plans involve an expansion of the data set to include those radiocarbon ages from non-alluvial landscape settings; most of the latter currently exist as an unpublished text file. The current form of CGPRDB is available in hard copy and diskette form as Kansas Geological Survey Open-file Report 96-9 (Johnson et al., 1996).

#### **References Cited**

Galloway, J. P. 1995 The U.S. Geological Survey Alaskan Radiocarbon Database. *Current Research in the Pleistocene* 12:80–82.

Johnson, W. C. in press Late Wisconsinan and Holocene Environmental History of the Central Great Plains. In Archaeology and Paleoecology of the Central Great Plains, edited by J. L. Hofman, Arkansas Archaeological Survey Resource Series.

Johnson, W. C., W. Dort, Jr., and C. J. Sorenson 1980 An Episode of Late Holocene Soil Development on Floodplains of the Central Great Plains. *American Quaternary Association Abstracts and Program*, p. 116

Johnson, W. C., and B. Logan 1990 Geoarchaeology of the Kansas River Basin, Central Great Plains. In *Archaeological Geology of North America*, edited by N. P. Lasca and J. Donahue, pp. 267–299. Geological Society of America Centennial Special Volume 4.

Johnson, W. C., and C. W. Martin 1987 Holocene Alluvial-Stratigraphic Studies from Kansas and Adjoining States of the East-Central Plains. In *Quaternary Environments of Kansas*, edited by W. C. Johnson, pp. 109–122. Kansas Geological Survey Guidebook Series 5.

Johnson, W. C., R. D. Mandel, and D. W. May 1996 A Radiocarbon Database for the Central Great Plains: Kansas and Nebraska. Kansas Geological Survey Open-file Report 96-9.

Mandel, R. D. 1991 Holocene Landscape Evolution in the Pawnee River Valley, Southwestern Kansas. Unpublished Ph.D. dissertation, University of Kansas.

Mandel, R. D. 1994 Holocene Landscape Evolution in the Pawnee River Valley, Southwestern Kansas. *Kansas Geological Society Bulletin* 236, 117 p.

Mandel, R. D. 1995 Geomorphic Controls of the Archaic Record in the Central Plains of the United States. In *Archaeological Geology of the Archaic Period in North America*, edited by E. A. Bettis, III, pp. 37–66. Geological Society of America Special Paper 297.

May, D. W. 1986 Holocene Alluviation, Soil Genesis, and Erosion in the South Loup Valley, Nebraska. Unpublished Ph.D. dissertation, University of Wisconsin-Madison.

Stuiver, M., and P. J. Reimer 1993 Extended <sup>14</sup>C Database and Revised CALIB 3.0 <sup>14</sup>C Age Calibration Program. *Radiocarbon* 35(1):215–230.

## An Archaeological Database for Stone Age Sites in Eastern Siberia

Kenneth B. Tankersley and Yaroslav V. Kuzmin

We recently compiled a database for Upper Paleolithic and Mesolithic sites in eastern Siberia (Figure 1). To date, approximately 60 archaeological sites with 122 cultural strata older than c. 8,000 yr B.P. have been documented in this region (Abramova 1979; Dikov 1977, 1979; Kuzmin 1992a, 1992b; Kuzmin and Tankersley 1996; Larichev et al. 1990, 1992; Medvedev et al. 1990; Mochanov 1977, 1986; Tseitlin 1979; Tseitlin and Aseev 1982; Vasiljevsky and Gladyishev 1989). Of these, 66 Upper Paleolithic strata have been exposed at 38 archaeological sites older than c. 10,000 yr B.P. Roughly 56 Mesolithic strata were excavated at 22 archaeological sites that date between c. 10,000 and 8,000 yrB.P. These sites are located between 40° and 75° N latitude, and 100° E and 170° W longitude. This area consists of nine regions: the Angara river basin; the Upper Lena river basin and Lake Baikal area; Transbaikal; Yakutia; the Russian Far East (the Amur river basin and adjacent area); the Kolyma river basin; Kamchatka; the High Arctic; and Chukotka.

The database includes information on the geographic location of Stone Age sites (latitude and longitude, degree and minutes, political district), radiocarbon dates (sample composition, context, depth below the surface, laboratory number, cultural layer), stratigraphy, sediment composition, landforms, contexts, faunal associations (genus and species), material culture (stone and bone industries and types), and published Russian references. In addition to listing all published radiocarbon dates, we critically evaluated the radiocarbon samples according to the materials dated and their stratigraphic context. Of the 150 radiocarbon dates obtained from Upper Paleolithic and Mesolithic contexts in eastern Siberia, only 63 have been made on charcoal from undisturbed sediments. It is also important to note that presently there are only nine such "reliable" radiocarbon dates older than c. 10,000 yr B.P. from the area located between 55° and 75° N latitude and 135° and 180° E longitude. This situation is unfortunate given that the archaeology of this region is crucial to our understanding of the peopling of the New World.

The compiled data will be published in a variety of professional journals such as *Quaternary International* (Tankersley and Kuzmin 1996) and the *Journal of Archaeological Science* (Kuzmin and Tankersley 1996). Additionally, the authors

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will make available the raw data on diskette to any serious researcher of the prehistory of eastern Siberia. It is our fervent hope that these data will be used to test hypotheses about human colonization, adaptation, and culture change during the Pleistocene-Holocene transition.



Figure 1. Distribution of Upper Paleolithic and Mesolithic sites in eastern Siberia.

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#### **References** Cited

Abramova, Z. A. 1979 On the Dating of the Paleolithic of Aldan. *Soviet Archaeology* 4:5–14 (in Russian).

Dikov, N. N. 1977 Archaeological Sites in Kamchatka, Chukotka, and Kolyma River Headwaters. Moscow: Nauka Publication (in Russian). Dikov, N. N. 1979 Ancient Cultures of the Northeast Asia. Moscow: Nauka Publication (in Russian).

Dikov, N. N., T. D. Davidovich, A. V. Lozhkin, and E. E Titov 1976 The Complex Study of the Multilayered Paleolithic Site Ushki V on Kamchatka. In *Natural Resources of the Northeastern USSR*, A. V. Lozhkin, Editor, pp. 116–131. Vladivostok: Far Eastern Scientific Center (in Russian).

Kuzmin, Y. V. 1992a Geoarchaeological Study of the Late Paleolithic Sites in Primorye, the Far East Russia. *Quaternary Research* 31: 243–254.

Kuzmin, Y. V. 1992b Paleoecology of the Paleolithic of the Russian Far East. Bulletin of the Institute of Prehistory, Chungbuk National University 1: 143–159 (in Russian).

Kuzmin, Y. V. 1994 Prehistoric Colonization of Northeastern Siberia and Migration to America: Radiocarbon Evidences. *Radiocarbon* 36:367–376.

Kuzmin, Y. V., and K. B. Tankersley 1996 The Colonization of Eastern Siberia: An Evaluation of the Paleolithic Age Radiocarbon Dates. *Journal of Archaeological Science* (in press).

Larichev, V., U. Kholushkin, and I. Laricheva 1990 The Upper Paleolithic of Northern Asia: Achievements, Problems, and Perspectives: II Central and Eastern Siberia. *Journal of World Prehistory* 4:347–385.

Larichev, V., U. Kholushkin, and I. Laricheva 1992 The Upper Paleolithic of Northern Asia: Achievements, Problems, and Perspectives: III Northeastern Siberia and the Russian Far East. *Journal of World Prehistory* 6:441-476.

Medvedev, G. I., N. A. Saveliev, and V. V. Svinin 1990 Stratigraphy, Paleogeography and Archaeology of the Southern Middle Siberia. Irkutsk: Irkutsk State University Press (in Russian).

Mochanov, Y. A. 1977 The Earliest Stages of Human Occupation of Northeast Asia. Novosibirsk: Nauka Publication (in Russian).

Mochanov, Y. A. 1986 Paleolithic Finds in Siberia. In *Beringia in the Cenezoic Era*, edited by V. L. Kontrimavichus, pp. 694–724. A.A. Balkema, Rotterdam, The Netherlands.

Tankersley, K. B., and Y. V. Kuzmin 1996 Patterns of Culture Change in Eastern Siberia During the Pleistocene-Holocene Transition. *Quaternary International* (in press).

Tseitlin, S. M. 1979 Geology of the Paleolithic of Northern Asia. Moscow: Nauka Publication (in Russian).

Tseitlin, S. M., and I. V. Aseev 1982 Geology and Culture of the Ancient Sites in the West Transbaikal. Novosibirsk: Nauka Publication (in Russian).

Vasiljevsky, R. S., and S. A. Gladyishev 1989 The Upper Paleolithic of the Southern Primorye. Novosibirsk: Nauka Publication (in Russian).

### **Paleoenvironments: Plants**

### Barton Gulch Site Geochronology and Paleoecology

### Stephen A. Aaberg, Leslie B. Davis, Clen G. Fredlund, Linda Scott Cummings, and Kathryrn Puseman

The Barton Gulch site (24MA171), a Paleoindian base camp, is west of the Greenhorn Range, east of the Ruby Reservoir in the Madison River drainage of southwestern Montana (Davis et al. 1988, 1989. An artifact-bearing section composed of 5.85 m of colluvial/alluvial fill (Eckerle 1988) atop gravelly boulder deposits forms the north scarp of the centrally placer-mined Barton Gulch valley. Five stratified prehistoric artifact-bearing zones were excavated (1978-1993) at five localities along the scarp.

Natural charcoal-bearing strata were radiocarbon dated, from  $10,360 \pm 90$  yr B.P. at the gravelly boulder/lowermost fines contact in a downstream mining cut (Davis and Hill 1995), to  $9.565 \pm 120$  yr B.P. (Beta-23219/ETH-3524) in Area B. Those strata underlie the Alder complex (Paleoindian) living floor, dated at 9,410 yr B.P. in Area B (Davis 1993; Davis et al. 1989, 1994). Overlying that assemblage, 1 m higher in the section, is a Hardinger complex (Paleoindian) component dated at 8,870 yr B.P. (Davis et al. 1989).

The excavated 640-m<sup>2</sup> fraction of the Alder complex surface was prominently defined by 213 scooped-out subfloor depressions arrayed in 16 spatially discrete aggregates (Armstrong 1993; Davis 1993): 56 (26.4%) were earth ovens filled with utilized deer (*Odocoileus hemionus* and *virginianus*), hare (*Lepus* sp.), rabbit (*Sylvilagus* sp.), and porcupine (*Erethizon dorsatum*) bone scrap, charcoal and ash, and lithic artifacts. Cottonwood or willow (*Salicaceae*), sagebrush (*Artemisia* sp.), and pine (*Pinus* sp.) were burned as fuel (Puseman 1992). Plant use for food (Aaberg 1993; Davis et al. 1994) involved plants in 36 taxa and in five indeterminate taxa. Charred seeds of prickly pear cactus (*Opuntia polycantha*)

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and slimleaf goosefoot (*Chenopodium leptophyllum*) were present nearly equally (Davis et al. 1994).

Pollen (Cummings 1993) indicated that a cool sagebrush steppe environment likely existed at Barton Gulch c. 11,000 yr B.P. By 7,000 yr B.P., warmer temperatures were concurrent with a Mt. Mazama ashfall (Cummings 1993). A warmer but not necessarily drier interval occurred between the ashfall and c. 5,000 yr B.P., during which interval an occupation by Bitterroot-complex peoples took place. A return to cooler climate at c. 4,000 yr B.P. marked the abandonment of Barton Gulch by late–Middle Period foragers.

The pollen and opal phytolith content of 10 Alder complex earth ovens (Fredlund 1989) varied across ovens. Major pollen taxa, in order of average relative abundance, were pine (*Pinus* spp., 45.1%), juniper (*Juniperus* sp., 1.3%), spruce (*Picea* sp., 1.4%), sagebrush (*Artemisia* sp., 28.7%), Cheno-Am type (*Chenopodiaceae* and *Amaranthaceae* families, 9.1%, including greasewood (*Sarcobatus*), .6%), grasses (*Poaceae*, 4.3%), and sedges (*Cyperaceae*, .6%). The repeated occurrence of wild onion (cf. *Alliumsp.*) and prickly pear (*Opuntiasp.*), rare pollen types, strongly suggested use by Alder-complex occupants. Cheno-Am pollen and pine pollen (cf. *P. flexilis* or *albicaulus*) might also represent plant use. Aaberg's (1993) data support the human use of limber pine.

Barton Gulch paleoecology c. 9,400 yr B.P. was probably similar to that of today: open pine parklands interspersed with patches of sagebrush and grassland. One minor difference might have been the distribution of conifer species within the lower-elevation parklands: ponderosa pine (*P. ponderosa*) is more abundant today in the site vicinity, but limber and lodgepole pine (*P. contorta*) are common if not abundant on nearby ridges and updrainage, respectively (Aaberg 1993). The relatively low *Artemisia*/Poaceae ratio, high frequencies of Cheno-Am type pollen, and the occurrence of *Opuntia* are xeric indicators. Because of those drier conditions, limber pine, a xeric-adapted species often found on poor, rocky soils and escarpments, may have been more important in the site vicinity. Phytoliths indicate that cool-season (C3) grasses dominated the local grass community c. 9,400 yr B.P. (Fredlund 1989).

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### **References Cited**

Aaberg, S. A. 1993 Preliminary Report on Plant Macrofossil Data From the Barton Gulch Site (24MA171). Report to the Museum of the Rockies by Aaberg Cultural Resources Consulting Service, Lewistown.

Armstrong, S. W. 1993 Alder Complex Kitchens: Experimental Replication of Paleoindian Cooking Facilities. Archaeology in Montana 34(2):1-66.

Cummings, L. S. 1993 Stratigraphic Pollen Analysis of Sediments From Barton Gulch (24MA171), Southwestern Montana. PaleoResearch Labs Technical Report 93-53 to the Museum of the Rockies, Montana State University, Bozeman.

Davis, L. B. 1993 Paleo-Indian Archaeology in the High Plains and Rocky Mountains of Montana. In *From Kostenki to Clovis: Upper Paleolithic Paleoindian Adaptations*, edited by O. Soffer and N. D. Praslov, pp. 263–277. Interdisciplinary Contributions To Archaeology. Plenum Press Corporation, New York. Davis, L. B., S. A. Aaberg, and L. S. Cummings 1994 Northern Rocky Mountain Paleoecology in Archaeological, Paleobotanical, and Paleoethnobotanical Perspective. In *Plants and Their Environments: Proceedings of the First Biennial Scientific Conference on the Greater Yellowstone Ecosystem*, edited by D. G. Despain, pp. 113–130. Technical Report NPS/NRYELL/NRTR-93XX. Natural Resources Publication Office. Denver.

Davis, L. B., S. A. Aaberg, W. P. Eckerle, J. W. Fisher, Jr., and S. T. Greiser 1989 Montane Paleoindian Occupation of the Barton Gulch Site, Ruby Valley, Southwestern Montana. *Current Research in the Pleistocene* 6:7–9.

Davis, L. B., S. A. Aaberg, and S. T. Greiser 1988 Paleoindians in Transmontane Southwestern Montana: The Barton Gulch Occupations, Ruby River Drainage. *Current Research in the Pleistocene* 5:9–11.

Davis, L. B., and C. L. Hill 1995 Locating Paleoamerican Occupations in S.W. Montana Placered Valleys. *Current Research in the Pleistocene* 12:111–113.

Eckerle, W. P. 1988 Geoarchaeological Analysis of 24MA171: Locality B, 1988 Excavation Area, Early Holocene Section. Report to Department of Sociology, Montana State University, Bozeman, by Western Geoarch Research, Salt Lake City.

Fredlund, G. G. 1989 Preliminary Analysis of Pollen and Opal Phytoliths From the Late Paleoindian Occupation at the Barton Gulch Site (24MA171), Montana. Report to the Museum of the Rockies, Montana State University, Bozeman.

Puseman, K. 1992 Charcoal Identification for Barton Gulch, Montana. PaleoResearch Labs Technical Report 92–27.

## Late Pleistocene Vegetation of Hebior Mammoth Site, Southeastern Wisconsin

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Excavation at the Hebior site (47KN265), Kenosha County, Wisconsin, brought to light several simple chipped-stone artifacts in direct association with a nearly complete skeleton of an adult male mammoth (Oversteet 1994). The age of the Hebior Site, although not yet firmly established, is believed to be contemporaneous with other nearby Paleoindian remains (ca. 11,000 yr B.P.). In this paper we report the results from the Hebior Site pollen analysis. Our objective is to better place the local Paleoindian cultural complex (Overstreet et al., 1993, 1995) in its environmental setting.

The Hebior site lies along the margin of a small inter-moraine lake created by the retreat of the Lake Michigan glacial lobe. The mammoth itself lies within clastic-rich peat. Lake depositional facies lie only meters away from the site. The

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geomorphic context indicates progressive vegetative succession, peatland expansion, and infilling of the lake. The depositional environment is complicated by layers of coarse well-sorted sand which appear to have been injected both above and below the bone bed under hydraulic pressure by springs sometime after deposition.

Pollen samples come from the peat in direct contact with mammoth bone. Sample associations included the tibia/fibula, scapula, mandible, proximal femur, toe bone, radius/ulna, and rib. The coarse sand layers were not analyzed. Pollen extraction was a noncorrosive heavy liquid flotation method following the protocol in Johnson and Fredlund (1985). Pollen concentrations were estimated using the indirect method: the introduction of a known quantity of exotic spores to each sample. Pollen recovery was too sparse to be useable in vegetation reconstruction. These low-recovery samples are excluded from the analysis. Pollen concentrations for the remaining five samples averaged only 5,500 grains per gram (dry weight). A minimum of 500 pollen grains were identified for each of the reported samples. Pollen assemblages are mostly consistent across all samples. We report the average percentage from the five samples. Percentages are based on the total identified pollen sum (including *Cyperaceae* and aquatics).

Arboreal pollen (AP) composes over 82% of the Quaternary assemblages. Spruce (*Picea*) pollen at 84% is by far the dominated AP type. The wide range in *Picea* pollen diametersuggests that both white (*P. glauca*) and black (*P. mariana*) spruce were present. Following spruce in importance is pine (*Pinus*, 5.7%), birch (*Betula*, 1.9%), alder (*Alnus*, 1.7%), oak (*Quercus*, 1.3%), aspen/cottonwood (*Populus*, 1.0%). Pollen from fir (*Abies*), white cedar and juniper (*Thuja-Junipenus* type), hazelnut (*Corylus*), larch (*Larix*), green ash (*Fraxinus pennsylvanica* type), willow (*Salix*), maple (*Acer*), walnut (*Juglans*), elm (*Ulmus*), bunchberry (*Cornus canadensis*), and june berry (*Vaccinium* type) are present in trace amounts (less than 1%).

Non-arboreal pollen (NAP) composes 18% of the total Quaternary sum. The five highest NAP values were sedges (*Cyperaceae*, 6.4%), wormwood/sage (*Artemesia*, 3.6%), grasses (*Poaceae*, 1.9%), ragweed (*Ambrosia*, 1.1%), and horse-tail (*Equisetum*). Aquatic pollen included the water-milfoils (*Myriophyllum*, 2.8%) and pondweed (*Potamogeton*, 0.5%). A number of other NAP and semiaquatic pollen taxa were identified as individual grains.

The Hebior pollen assemblage correlates well with established regional pollen zones for the Pleistocene-Holocene transition (Baker et al., 1992; Huber and Rapp, 1989; Maher, 1982; Webb, 1987). These regional records show a progression of vegetative change between 12,000 and 9,500 yr B.P. as climate warmed and postglacial migration of plant species from the south progressed. The Hebior pollen assemblage conforms with the late-Pleistocene zone of these regional records. The Hebior mammoth died before birch and pine populations increased locally. This record suggests, as do the other pollen records, that open spruce parklands or woodlands were the characteristic upland vegetation at the close of the Pleistocene. Populations of deciduous taxa (oak, elm, walnut), if locally present, must have been restricted to isolated, edaphically favorable patches. Three generally contemporaneous proboscidean finds in

Michigan were considered by Oltz et al. (1963) to be similarly located in sprucedominated forest. The Rostock mammoth in Ontario (McAndrews and Jackson, 1988) also conforms to this pattern but with comparatively more pine, birch and oak.

### **References Cited**

Baker, R. G., L. J. Maher, C. A. Chumbley, and K. L. Van Zant 1992 Patterns of Holocene Environmental Change in the Midwestern United States. *Quaternary Research* 37, 379–389.

Huber, J. K., and G. Rapp 1992 Results of a Pollen Study from Southeastern Kenosha County, Wisconsin. In Archaeological Studies on the Southeastern Wisconsin Uplands, edited by D. F. Overstreet, pp. 74–131. Great Lakes Archaeological Press, Milwaukee.

Johnson, W. C., and G. G. Fredlund 1985 A Procedure for Extracting Palynomorphs (Pollen and Spores) from Clastic Sediments. Transactions of the Kansas Academy of Science 88, 51–58.

Maher, L. J. 1982 The Palynology of Devils Lake, Sauk County, Wisconsin. In *Quaternery History* of the Driftless Area. pp. 119–135. University of Wisconsin Extension, Geological and Natural History Survey, Madison, WI.

McAndrews, J. H., and L. J. Jackson 1988 Age and Environment of Late Pleistocene Mastodont and Mammoth in Southern Ontario. *Bulletin of the Buffalo Society of Natural Sciences* 33:161–173.

Oltz, D. F., and R. O. Kapp 1963 Plant Remains Associated with Mastodon and Mammoth Remain in Central Michigan. *American Midland Naturalist* 70:339–346.

Overstreet, D. F., D. J. Joyce, K. F. Hallin, and D. Wasion 1993 Cultural Contexts of Mammoth and Mastodon in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene* 10:75–77.

Overstreet, D. F., D. J. Joyce, and D. Wasion 1995 More on Cultural Contexts of Mammoth and Mastodon in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene* 12:40–42.

Webb, S. L. 1987 Beech Range Extension and Vegetation History: Pollen Stratigraphy of Two Wisconsin Lakes. *Ecology* 68:1993–2005.

# Palynological Evidence for the Last Glacial Maximum in the Venezuelan Andes: Preliminary Results

### Valentí Rull and Teresa Vegas-Vilarrúbi

The last glaciation is represented in the Venezuelan Andes by two morainic levels, representing two glacial advances (Schubert 1974). The uppermost level (3,000–3,500 m altitude) was developed during the last glacial maximum, between about 19 and 16.5 ka (Schubert & Rinaldi 1987). The present report shows the preliminary results of a pollen analysis in the top of Mesa del Caballo,

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an outwash plain developed when the moraines of the uppermost level were active.

The interpretation of pollen data is based on modern deposition patterns and previous postglacial and Holocene works (Rull 1996; Salgado-Labouriau 1991). Paleoclimatic trends have been deduced from vertical shifts of the uppermost Andean ecological belts (*Subpáramo, Páramo, Superpáramo*), having characteristic and very distinctive palynological assemblages.

The pollen diagram from Mesa del Caballo (Figure 1) has been divided into five pollen zones, representing the sequential replacement of two assemblages. Assemblage A (zones MC-1, MC-3 and MC-5) has very low pollen concentrations. *Gramineae* dominate in percentage, most *páramo* indicators are absent, and *Montia* occurs. This assemblage represents almost bare terrains with scattered vegetation of the uppermost altitudinal levels close to the snowline. Assemblage B (zones MC-2 and MC-4) shows slightly higher values in pollen concentration, co-dominance of *Gramineae* and *Compositae*, occurrence of the



Figure 1. Simplified pollen diagram of Mesa del Caballo. Forest trees: Alnus, Hedyosmum, Podocarpus, Cecropia, Vallea, Juglans; Páramo shrubs: Compositae; Páramo herbs: Gramineae, Cyperaceae, Montia, Draba, Gentiana, Plantago, Arenaria-type, Portulacaceae; Fern spores: Isoëtes, Polypodium (verrucate), Alsophila-type, Jamesonia, Lycopodium.

most important *páramo* indicators, and absence of *Montia*. This can be interpreted as the beginning of the establishment of *Superpáramo* communities from lower elevations, indicating an upwards displacement of vegetational belts. The establishment of full *Superpáramo* vegetation, however, is unlikely; assemblage B probably represents the uppermost *Superpáramo* plant associations.

Paleoclimatically, assemblage A indicates colder and drier phases, possibly related to glacier readvances; whereas assemblage B represents less cold and more humid phases, probably associated with glacier retreats. The whole sequence can be interpreted as an extended cold phase spiked with two short interstadial pulses. El Caballo III (zone MC-3, 16,500  $\pm$  290 radiocarbon yr B.P.) is probably the colder and drier phase, and can be considered a stadial culmination. The present snowline is at 4,700 m elevation, around 1,200 m higher than the sampling site. Considering a temperature change with altitude similar to that at present (-0.6° C/100 m; Salgado-Labouriau, 1979), average temperatures during the El Caballo III could have been around 7° C lower than today.

Taxonomical and paleoecological studies based on other biotic remains such as diatoms, fungi, algae, animal remains and *Incertae sedis* are in progress in order to obtain a more detailed reconstruction.

#### **References** Cited

Rull, V. 1996 Late Pleistocene and Holocene Climates of Venezuela. *Quaternary International*, 31:85–94.

Salgado-Labouriau, M. L. 1979 Modern Pollen Deposition in the Venezuelan Andes. *Grana*, 18:53-68.

Salgado-Labouriau, M. L. 1991 Palynology of the Venezuelan Andes. Grana, 30(2):342-349.

Schubert, C. 1974 Late Pleistocene Mérida Glaciation, Venezuelan Andes. Boreas, 3:147-152.

Schubert, C., and M. Rinaldi 1987 Nuevos Datos Sobre la Cronología del Estadio Tardío de la Glaciación Mérida, Andes Venezolanos. *Acta Científica Venezolana*, 38:135–136.

### **Paleoenvironments: Vertebrates**

## New Records of Fossil Tapir from Northeastern Mexico

### Joaquin Arroyo-Cabrales, Oscar J. Polaco, Ticul Alvarez, and Eileen Johnson

The tapir *Tapirus (Perissodactyla, Tapiridae)* is an endangered mammal in most of its distributional area, occurring in the Americas from Mexico south to Paraguay with three species (*T. bairdii, T. pinchaque,* and *T. terrestris*), and an isolated species in southeast Asia (*T. indicus*) (Wilson and Reeder 1993). *Tapirus bairdii* is the only species living in North America. It presently inhabits southeastern Mexico with a few scattered populations (March 1994). In general, tapirs occur close to water sources in tropical woodlands or grasslands. They are heavily built, semiaquatic browsers that have retained a primitive limb structure. Limb elements are short, and a fibula is present and separate from the tibia; the ulna is complete and unfused to the radius. The front foot has four toes and the hind foot three toes (Kurtén and Anderson 1980; Romer 1966). They have low-crowned molars with a simple pattern of cross crests (lower) and crosslophs and short ectoloph (upper). Cranial modification of the nasal cavity and nasal bones has occurred with the specialized development of a short proboscis, seen in both Pleistocene fossil forms and the modern genus (Romer 1966:270).

The fossil record for *Tapiridae* is very poor, but it is known from the Holartic region since the Oligocene. However, most records for *Tapirus* in North America are from the late Pliocene and Pleistocene (Kurtén and Anderson 1980). Pleistocene tapirs occurred south of the glaciated region (Graham and Lundelius 1994:431), in areas with at least 500 mm of mean annual rainfall and a humid mesothermal climate (Simpson 1945). None has been found in association with ancient peoples (Anderson 1984).

In Mexico, fossil tapirs are known from Actun Lara, Yucatan (*Tapirus bairdii*; Hatt et al. 1953), El Golfo, Sonora (*T. californicus*; Jefferson 1989), El Cedral, San Luis Potosí (Alvarez and Polaco 1981), and Mina, Nuevo León (Franzen

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1994). Further analysis of the late-Pleistocene specimens from northeast Mexico was warranted, and this study highlights the El Cedral and Mina materials and a new record from that region.

El Cedral (Alvarez and Polaco 1981) is an archaeological site located at an old spring within an arid region. The deposits date between 40,000 and 2,000 yr B.P. A late-Pleistocene Rancholabrean fauna is known from the earlier deposits. Tapir specimens include 26 cranial elements and 39 postcranial bones. At Mina (Franzen 1994), the Rancholabrean fauna is dated between 70.000 and 11.000 yr B.P. The tapir is represented by a lower molar. Primarily grassland forms are known, and the tapir is the only animal from a more humid environment. An isolated upper molar from a tapir was recovered during follow-up visits at San Josecito Cave, Nuevo Leon, after the 1990 excavations (Arroyo-Cabrales et al. 1993) that concentrated on an area known as Stock's Pit. The tooth was collected from Stock's (1943) backdirt adjacent to this pit. Sediments from this pit were dated between 28,000 and 44,000 yrB.P. (Arroyo-Cabrales et al. 1995). The 28,000-year-old fauna was composed of primarily temperate animals, most of which occur in the region today (Arroyo-Cabrales 1994). This tapir represents a new record for the extensive late-Pleistocene faunal assemblage at San Josecito Cave.

Based mainly on molar measurement, all these specimens are assigned to *Tapirus haysii* (Leidy, 1859). This species is known to occur in eastern and central United States during the late Pleistocene (Ray and Sanders 1984). These new records extend its distribution to the south. This species is one of the largest tapir species in the North American Pleistocene (Jefferson 1989; Kurtén and Anderson 1980). The presence of tapir in northeastern Mexico, and most importantly in the present arid region at El Cedral, clearly points to extreme climatic changes having occurred during the last 120,000 years.

The El Cedral and San Josecito Cave specimens are in the Paleontological Collection of the Paleozoology Lab, Instituto Nacional de Antropologia e Historia (INAH). The Mina molar is in the collections of the Facultad de Ciencias de la Tierra, Universidad Autónoma de Nuevo León, Linares. We thank Dr. Wolfgang Stinnesbeck of the Facultad de Ciencias de la Tierra, Universidad Autónoma de Nuevo León, for the donation of a cast of the Mina molar to INAH. This study is part of a joint endeavor between the Paleozoology Lab, INAH, Mexico, and the Museum of Texas Tech University.

### **References** Cited

Anderson, E. 1984 Who's Who in the Pleistocene: A Mammalian Bestiary. In *Quaternary Extinctions. A Prehistoric Revolution*, edited by P. S. Martin and R. G. Klein, pp. 40–89. University of Arizona Press, Tucson.

Alvarez, T., and O. J. Polaco 1981 Fauna Obtenida de las Excavaciones Realizadas en el Sitio Rancho La Amapola-El Cedral, S.L.P. In Coloquio. Evidencia Arqueológica de la Ocupación Humana en América Anterior a 11,500 Años a.p., edited by A. L. Bryan, pp. 123–124. Comission 12 Peopling of the Americas, 10th Meeting, International Union of Prehistoric and Protohistoric Sciences, Mexico, D.F.

Arroyo-Cabrales, J. 1994 Taphonomy and Paleoecology of San Josecito Cave, Nuevo Leon, Mexico. Unpublished Ph.D. dissertation, Department of Biological Sciences, Texas Tech University, Lubbock.

Arroyo-Cabrales, J., E. Johnson, and R. W. Ralph 1993 New Excavations at San Josecito Cave, Nuevo Leon, Mexico. *Current Research in the Pleistocene* 10:91–94.

#### CRP 13, 1996

Arroyo-Cabrales, J., E. Johnson, H. Haas, M. de los Ríos-Paredes, R. W. Ralph, and W. T. Hartwell 1995 First Radiocarbon Dates for San Josecito Cave, Nuevo León, Mexico. *Quaternary Research* 43:255–258.

Franzen, J. L. 1994 Eine Rancho-La-Brea Fauna aus Nordost-Mexiko (Bundesstaat Nuevo León). *Natur und Museum* 124:241–272.

Graham, R. W., and E. L. Lundelius Jr. 1994 Faunmap. A Database Documenting Late Quaternary Distributions of Mammal Species in the United States. Illinois State Museum, Scientific Papers 25(2):289-690.

Hatt, R. T., H. I. Fisher, D. A. Langebartel, and G. W. Brainerd 1953 Faunal and Archeological Researches in Yucatan Caves. *Cranbrook Institute of Science Bulletin* 33:1–119.

Jefferson, G. T. 1989 Late Cenozoic Tapirs (Mammalia: *Perissodactyla*) of Western North America. Natural History Museum of Los Angeles County, *Contributions in Science* 406:1–21.

Kurtén, B., and E. Anderson 1980 Pleistocene Mammals of North America. Columbia University Press, New York.

March M. I. J. 1994 Situación Actual del Tapir en Mexico. Centro de Investigaciones Ecológicas del Sureste, *Serie Monográfica* 1:1–37.

Ray, C. E., and A. E. Sanders 1984 Pleistocene Tapirs in the Eastern United States. In *Contributions in Quaternary Vertebrate Paleontology: A Volume in Memorial to John E. Guilday*, edited by H. H. Genoways and M. R. Dawson. Special Publication of the Carnegie Museum of Natural History 8:283–315.

Romer, A. S. 1966 Vertebrate Paleontology. Third edition. University of Chicago Press, Chicago.

Simpson, G. G. 1945 Notes on Pleistocene and Recent Tapirs. Bulletin of the American Museum of Natural History 86(2):37-81.

Wilson, D. E., and D. M. Reeder 1993 Mammal Species of the World. A Taxonomic and Geographic Reference. Second edition. Smithsonian Institution Press, Washington, D.C.

### Epiphyseal Fusion in Bison antiquus

Leland C. Bement and Susan Basmajian

The Folsom-age Cooper bison kill in northwest Oklahoma contained numerous articulated skeletons of an extinct bison species tentatively identified as *Bison antiquus* (Bement 1994). The age at death of these animals, determined from eruption and wear patterns of the mandibular dentitions (Reher 1974), produced an age profile containing multiple individuals in each of the yearly groups from calf to seven years. The season of death for all three kills at the site is late summer to early fall ( $\pm 0.3$  yr).

The presence of 22 articulated skeletons of known age provided the opportunity to develop an epiphyseal fusion schedule for the appendicular skeleton. A number between 0 and 3 rated the stage of epiphyseal fusion for each element (Todd 1987:122). A rank of 0 indicated no fusion, and a 3 indicated complete fusion. No bones exhibited stage 1 (fusion beginning), and only the calcaneus ranked a stage 2 (mostly fused). The sparsity of stage 1 and 2 fusion is attributed

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to the yearlong interval between age groups. This indicates that fusion began and ended within a year's time and that the  $\pm$  0.3-year age of cohorts either precedes the onset of or follows complete fusion. Intermediate fusion stages are probably visible in age cohorts of  $\pm$  0.6 or  $\pm$  0.9 year.

The Cooper bison produced a fusion table that tracked growth and development at almost yearly intervals (Table 1). Complete fusion of the proximal epiphysis of the second phalanx, distal humerus, and proximal radius occurred by 1.3 years of age. Likewise, the proximal epiphysis of the first phalanx fused by 2.3 years. No differences were found in the fusion sequence of pes and manus phalanges. The distal metacarpal and metatarsal epiphyses fused by 3.3 years, as did the distal tibia. The remaining epiphyses (distal radius, ulna, proximal humerus, proximal tibia, and distal and proximal femur) fused at 5.3 years. No element fusion marked the 4.3-year-olds. The step-like epiphyseal fusion of the lower leg elements provides a reliable, annual resolution for aging animals found in catastrophic kill events.

Element	Koch 1935 B. bonasus	Sisson and Grossman 1950 B. taurus	Cooper site B. antiquus
Prox. Femur	5-5.5	3.5	5.3
Dist. Femur	5.5-6	3.5-4	5.3
Prox. Tibia	5.5-6	3.5-4	5.3
Dist. Tibia	4.5	2-2.5	3.3
Calcaneus	4.5-5		5.3
Dist. Metapodial	4.5-5	2-2.5	3.3
Prox. 1st Phalange	4.5	1.5-2	2.3
Prox. 2nd Phalange	2 or 3	2.5	1.3
Prox. Humerus	6	3.5-4	5.3
Dist. Humerus	4	1.5	1.3
Ulna Olecranon	5	3.5-4	5.3
Prox. Radius	4.5-5	1-1.5	1.3
Dist. Radius	6	3.5-4	5.3

 Table 1. Age at time of complete fusion for select appendicular elements.

Comparison of this schedule with data presented by Sisson and Grossman (1950) for modern cattle (*Bos taurus*) and Koch (1935) for European bison (*Bos or Bison bonasus*) show significant differences (Table 1). These differences can affect the accuracy of age profiles and MNI analyses. A more complete fusion chart including elements of the axial skeleton is a goal of continued analysis of the Cooper material.

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#### **References** Cited

Bement, L. C. 1994 The Cooper Site: A Stratified Paleoindian Bison Kill in Northwest Oklahoma. *Current Research in the Pleistocene* 11:7–9.

Koch, W. 1935 The Age Order of Epiphyseal Union in the European Bison (Bos bonasus L.). Anat. Record 61:371-376.

Reher, C. A. 1974 Population Study of the Casper Site Bison. In *The Casper Site<sub>2</sub>* A *Hell Gap bison kill on the High Plains*, edited by G. C. Frison. New York: Academic Press.

Sisson, S. and J.D. Grossman 1950 The Anatomy of the Domestic Animals, third edition. W. B. Saunders Co. Philadelphia.

Todd, L. C. 1987 Taphonomy of the Horner II Bone Bed. In *The Horner Site: The Type Site of the Cody Cultural Comptex*, edited by G. C. Frison and L. C. Todd, pp. 107–198. Academic Press, Orlando.

## A Preliminary Report on the Fossil Birds of Padcaya in the Tarija Basin, Bolivia

Robert M. Chandler

For five years (1922–1927) Elmer Riggs of the Field Museum of Natural History, Chicago, led paleontological expeditions to Argentina and Bolivia. In southern Bolivia near the city of Padcaya in the Tarija Basin he made large collections of fossil vertebrates from the local Pleistocene deposits (see Marshall 1978, 1991). The fossil mammals have been studied (e.g., Hoffstetter 1986; Marshall et al. 1984; Takai 1982; Takai et al. 1984). Hoffstetter (1986) considers the Tarija mammal fauna (26 families, 52 genera, 63 species) to be the most important Andean Pleistocene fauna known. Until now the fossil birds have remained unstudied.

While studying phorusrhacoids collected by Riggs in Argentina, I made a general survey of the fossil bird collection in the Vertebrate Paleontology Section at the Field Museum. There I came upon the large collection (104 specimens) of birds collected at Padcaya, many identified only as "bird." The fossils are from mid-Pleistocene (Ensenadan South American Land Mammal Age, 1.0-0.7 megannum) of the Tarija Formation (MacFadden et al. 1983). My preliminary identification of the avifauna includes nine orders with a minimum of nine families and at least 12 species. Represented are the following orders and families: Rheiformes, Rheidae (rheas); Podicepidiformes, Podicepididae (grebes); Pelecaniformes, Phalacrocoracidae (cormorants); Anseriformes, Anatidae (ducks); Gruiformes, Rallidae (rails); Phoenicopteriformes, Phoenicopteridae, (flamingos); Ciconiiformes, Cathartidae (New Worldvultures); Falconiformes, Accipitridae (hawks); Passeriformes (perching birds). The only published fossil bird from Bolivia coincidentally is also from Tarija, Vultur patruus Lonnberg (1902). Campbell (1979) reappraised V. patruus and concluded that the holotype tarsometatarsus is from a modern Andean condor, Vultur gryphus. The significance of the avifauna from Padcaya is twofold: it increases our knowledge of the biodiversity of the known vertebrate fauna of the Tarija basin, and it gives us a better paleoenvironmental view of the region. The large number of water birds like grebes, a cormorant, ducks, rails, and a flamingo indicates the presence of a large perennial lake for nesting, feeding, and possibly staging or wintering grounds for migrating birds. The perching birds and hawks would require

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riparian habitat for nesting and hunting; this would also provide roosting sites for vultures. Until now the paleo-lake environment has not been indicated by the mammalian fauna. However, there is an extensive Andean lake system known from other Pleistocene localities (Hoffstetter 1986).

I would like to thank Dr. John Bolt and Bill Simpson of the Field Museum for access to collections and allowing me to study these fossils. Dr. David Willard, Division of Ornithology, Field Museum, gave access to the modern comparative osteological collection. I appreciate his help. Also, I thank the Visiting Scholars Award committee for the funds to travel to the Field Museum. I want to thank Linda Dryden Chandler and Drs. David Webb and David Steadman for helpful comments on this manuscript. This is University of Florida Contribution to Paleontology Number 473.

### **References Cited**

Campbell, K. E., Jr. 1979 The NonPasserine Pleistocene Avifauna of the Talara Tar Seeps, Northwestern Peru. Royal Ontario Museum, Life Sciences Contribution 118.

Hoffstetter, R. 1986 Development of Mammalian Faunas in the High Tropical Andes During the Plio-Pleistocene. In *High Altitude Tropical Biogeography*, edited by F. Vuilleumier and M. Monasterio. Oxford Press.

MacFadden, B. J., O. Siles, P. Zeitler, N. M. Johnson, and K. E. Campbell, Jr. 1983 Magnetic Polarity Stratigraphy of the Middle Pleistocene (Ensenadan) Tarija Formation of Southern Bolivia. *Quaternary Research* 19:172–187.

Marshall, L. G. 1978 Bolivian Adventure in Search of the Bones of Giants. Field Museum of Natural History Bulletin 49(5):16-23.

Marshall, L. G. 1991 The Marshall Field Paleontological Expeditions to Tarija and Padcaya in Southern Bolivia (1924, 1927) Under the Leadership of Elmer S. Riggs. In *Fosiles y Facies de Bolivia Vol. J Vertebrados*, edited by R. Suarez-Soruco, Revista Tecnica de YPFB, 12 (3-4):693–699.

Marshall, L. G., A. Berta, R. Hoffstetter, R. Pascual, O. A. Reig, M. Bombin, and A. Mones 1984 Mammals and Stratigraphy: Geochronology of the Continental Mammalbearing Quaternary of South America, pp. 1–76 Palaeovertebrata, Memoire Extraordinare, Montepellier.

Takai, F. 1982 Fossil Mammals from the Tarija Basin, Bolivia. In *Tarija Mammal-Bearing Forma*tion in Bolivia. Research Institute of Evolutionary Biology., Tokyo, Japan.

Takai, F., B. Arozqueta P., T. Mizuno, A. Yoshida, and H. Kondo 1984 On Fossil Mammals from the Tarija Department, Southern Bolivia. Research Institute of Evolutionary Biology publication No. 4, Tokyo, Japan.

# Records for the Hawk Genus *Buteo* (Lacepede) from the Mexican Pleistocene

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Few recent studies in Mexican paleontology focus on fossil bird remains. Because of this, knowledge of taxonomy and biogeography of Mexican birds has

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not been enhanced, nor has their importance as paleoenvironmental indicators been fully recognized fully.

The senior author recently began summarizing a checklist of locations and records of fossil birds from Mexican sites, as well as studying unidentified materials housed in the Paleontological Collection of the Laboratorio de Paleozoologia at Instituto Nacional de Antropologia e Historia (INAH) in Mexico City. The initial results of this project are documented here. The identifications, ages, and locality data presented are taken from reviewed published literature, but further study of the actual specimens is warranted.

Hawks of the genus *Buteo* (Falconiformes: Accipitridae are found in the North American fossil record from the Middle Oligocene to the Pleistocene (Becker 1987; Brodkorb 1964). In Mexico, the oldest record is from the late Pliocene/early Pleistocene. Recently records have been added for the late Pleistocene, with new studies in San Josecito Cave (Steadman et al. 1994) and a review of collection materials from El Cedral, San Luis Potosí.

The records for the genus *Buteo* are from three localities, as follows, listed in the A.O.U. (1983):

### Buteo sp. (Lacepede)

Description	fragments of 1 femur, 1 humerus, and 1 phalanx
Locality name	Santa Anita
Locality data	14 km NE Sta. Anita downtown (Los Cabos Region)
State	Baja California Sur.
Age	late Pliocene/early Pleistocene (Blancan)
Housed	Instituto de Geologia, UNAM
Reference	Miller 1980

### Buteo nitidus (Latham)

Description	3 femora, 1 humerus, 1 tarsometatarsus
Locality data	Municipality of General Zaragoza, about 1 km SSW Ejido San Joecito and 8 km SW of Aramberri (lat. 23° 57′ 21″ N, long. 99° 54′ 45″ W)
State	Nuevo León
Age	late Pleistocene—11,000 to 27,000 yr B.P.
Housed	Los Angeles County Museum
Reference	Steadman et al. 1994

### Buteo jamaicensis (Gmelin)

Description	1 manus phalanx
Locality name	Cueva de San Josecito
Locality data	same as indicated above
State	Nuevo León
Age	late Pleistocene—11,000 to 27,000 yr B.P.
Housed	Laboratorio de Paleozoologia-INAH
Reference	Steadman et al. 1994

### B. Jamaicensis (Gmelin)

Description	1 coracoid
Locality name	Rancho La Amapola, El Cedral
Locality data	lat. 23° 49′ N and long. 100° 43′ W
State	San Luis Potosí
Age	late Pleistocene—33,000 yr B.P.
Housed	Laboratorio de Paleozoologia-INAH
Reference	Corona M. 1995

### Buteo cf. B. regalis (Gray)

Description	1 corasoide, 1 humerus, 1 ulna
Locality	Cueva de San Josecito
Localization	same as indicated above
State	Nuevo León
Age	late Pleistocene—11,000 to 27,000 yr B.P.
Housed	Los Angeles County Museum
Reference	Steadman et al. 1994

Three species of the genus *Buteo* are known from the Pleistocene of Mexico, of which only one species had two records (*Buteo jamaicensis*). Two of the species are known previously as fossils in North America (Brodkorb 1964). The occurrence of *B. regalis* is the first record in the North American Pleistocene.

The three species occur today in Mexico in habitats associated with grasslands and montane forests. Locality data show that the fossil hawk distribution is concentrated in northern region of the country. These data are congruent with the modern distribution of the genus (A.O.U. 1983; Howell and Webb 1995). However, an increased search is necessary to document additional records of the genus in order to make better distribution correlations.

The initial results of this study point out the importance of continued curation of Paleontological collections as a source of new data (Teichert et al. 1987). These data will be modified by further studies on museum materials that have been housed as unidentified remains or identified only to family level.

#### **References Cited**

American Ornithologist's Union 1983 Check-list of North American Birds. 6th Edition, American Ornithologist's Union, Lawrence.

Becker, J. J. 1987 Neogene Avian Localities of North America. Smithsonian Institution Press, Washington, D.C., 171 pp.

Brodkorb, P. 1964 Catalogue of Fossil Birds. Part 2 (Anseriformes through Galliformes). Bulletin of Florida State Museum, Biological Sciences, 8(3):195–335.

Corona, E. M. 1995 Segundo Registro de Buteo Jamaicensis (Gmelin) Para el Pleistocene de Mexico. pp. 4-5 in Memorias del V Congreso Nacional de Paleontologia. Sociedad Mexicana de Paleontologia, Mexico.

Howell, S. N. G., and S. Webb 1995 *A Guide to the Birds of Mexico and Central America.* Oxford University Press, New York, 851 pp.
Miller, E. W. 1980 The Late Pliocene Las Tunas Local from Southernmost Baja California, Mexico. Journal of Paleontology, (54) 4:762-805

Steadman, D. W., J. Arroyo-Cabrales, E. Johnson, and A. F. Gusmen 1994 New information on the Late Pleistocene birds from San Josecito Cave, Nuevo León, Mexico. *The Condor*, 96:577–589.

Teichert, C. W. C. Sweet, and A. J. Boucot 1987 The Unpublished Fossil Record: Implications. Senckenbergiana Letha, 68(1/4):5-19.

# Blacktail Cave: A Late-Glacial to Post-Glacial Faunal Catchment at the Southern Outlet of the Ice-free Corridor, West-Central Montana Rockies

### Leslie B. Davis, Jan Saysette, David C. Batten, and John F. Rittel

Blacktail Cave (24LC151), situated along the South Fork of the Dearborn River in west-central Montana, was discovered in 1946 by Tag Rittel, present operator of the Blacktail Ranch. The site is located in an unglaciated area southeast of the Dearborn River Glacier and west of Glacial Lake Great Falls, within the southern outlet of the hypothesized Rocky Mountain Front Range ice-free corridor (C. L. Hill, pers. comm.).

Montana Archaeological Society members, led by Lew Napton (1988), excavated deposits in the "Alcove Locality" in 1960. William Melton, Jr. and John Rittel identified woodland musk ox (then referred to *Ovibos cavifrons*) and elements of brown bear (*Ursus arctos*). In 1977, Dee Taylor visited the cave with Melton and identified a projectile point recovered by John Rittel from sediments near the woodland musk ox skull as a "Plainfield" point, which was corrected to Plainview by Napton (1988:45). Melton (1979), who obtained a grant from the National Geographic Society to extend the investigation in 1978, also recovered remains of wolverine (*Gulo* sp.) and wolf (*Canis lupus*).

A photograph by Melton shows seven thick flakes composed of the same brownish yellow chert as the points that were found nearby. Two basalt points were collected from separate locations on the cave floor by Tag Rittel. The three points are attributed to two Paleoindian complexes: Goshen-Plainview in the first instance (after Frison 1996), dated c. 11,250–10,900 yr B.P.; and the Hardinger (Barton Gulch in Davis et al. 1988) complex, dated c. 8,800 yr B.P. The apparent presence of Paleoindian points within the cave indicates potential for discovering intact fossil/artifact associations.

The 1995 Museum of the Rockies excavations sampled cave fill beneath a

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travertine cap to a depth of 2.2 m. Test pits were placed in undisturbed and previously excavated portions of the locality from which remains of musk ox (since referred to Bootherium bombifrons by McDonald and Ray 1989) and Ursus arctos had previously been recovered (Melton 1979). The possible co-association of fossil bones and artifacts was tested by means of controlled archaeological excavation. No artifacts were found. Remains of numerous animals were recovered, notably giant short-faced bear (Arctodus simus), a proboscidean, Arctic hare (Lepus arcticus), Ice Age horse (Equus cf. conversidens), badger (Taxidea taxus), yellow-bellied marmot (Marmota flaviventris), hoary marmot (*M. caligata*), red fox (*Vulpes vulpes*), deer (*Odocoileus* sp.), pronghorn antelope (Antilocapra americana), wolf (Canis lupus), coyote (C. latrans), snowshoe hare (L. americanus), bushy-tailed wood rat (Neotoma cf. cinerea), white-footed vole (Phenacomys paraphenacomys albipes), Hibbard's tundra vole (Microtus cf. paroperarius), and other rodents, amphibians, snakes, and birds. The radiocarbon dating of bone collagen extracted from identified fossils recovered in 1995 yielded the following mean ages (Libby half-life and <sup>13</sup>C correction; C. L. Hill, pers. comm.): Equus sp., 27,200 B.P.; Bootherium bombifrons, 11,240 B.P.; Arctodus simus, 10,930 B.P.; and artiodactyl (possibly musk ox, based on proximity), 10,270 B.P.

The Blacktail Cave project was supported by the Kokopelli Archaeological Research Fund which underwrites the First Montanans Search Program and the Quaternary Stratigraphy and Geochronology (or Ice Age Research) Program at the MOR. An MSU-Bozeman MONTS EPSCoR grant to Christopher L. Hill purchased theradiocarbon dates. The 1995 MOR excavations were organized by Davis and coordinated by Hill and Batten, assisted by John Rittel. Jan Saysette provided faunal identifications. We are grateful to Tag Rittel and Sandra Renner for permitting fieldwork on the Blacktail Ranch and according generous Western hospitality to the crew.

#### **References Cited**

Davis, L. B., S. A. Aaberg, and S. T. Greiser 1988 Paleoindians in Transmontane Southwestern Montana: The Barton Gulch Occupations, Ruby River Drainage. *Current Research in the Pleistocene* 5:9–11.

Frison, G. C. (editor) 1996 The Mill Iron Site. University of New Mexico Press, Albuquerque.

McDonald, J. N., and C. E. Ray 1989 The Autochthonous North American Musk Oxen Bootherium, Symbos and Gidleya (Mammalia: Artiodactyla: Bovidae). Smithsonian Contributions To Paleobiology 66:1-77.

Melton, W. G., Jr. 1979 Late Pleistocene? Mammals and Artifacts Recovered From Blacktail Cave, Lewis and Clark County, Montana. *National Geographic Society Research Reports, 1978 Projects.* pp. 415–421. Washington, D.C.

Napton, L. K. 1988 Blacktail Cave, Montana: Archaeological Excavations in the Alcove Locality. Archaeology in Montana 29(2):25–46.

## Late Pleistocene Fauna from the Merrell Locality, Centennial Valley, Montana: Summary of the Vertebrate Remains from the 1994 and 1995 Excavations

Robert G. Dundas, Christopher L. Hill, and David C. Batten

The Merrell Locality (site 24BE1659), situated on the west side of the Centennial Valley in southwestern Montana, consists of a sedimentary sequence containing Pleistocene fauna. Fossils were first discovered at the site by local residents in the fall of 1988 (Dundas 1992). A previous archaeological survey of the area (Murray et al. 1977) made no mention of the presence of Pleistocene fossils. The initial fossil find was reported to the Bureau of Land Management (BLM) by area resident D. Merrell. This prompted a reconnaissance of the site by BLM archaeologist G. R. Clark, who collected the exposed remains. The Clark collection and faunal remains recovered during a more extensive site assessment and surface salvage operation, directed by T.A. Foor in 1989, are conserved in the University of Montana Museum of Paleontologyvertebrate collections and were analyzed by Dundas (1990, 1992). Besides the first reported presence of scimitar cat (Homotherium serum) in Montana, other fauna recovered in 1988 and 1989 include black bear (Ursus americanus), beaver (Castor canadensis), horse (Equus sp.), muskrat (Ondatra zibethicus), Yesterday's camel (Camelops cf. C. hesternus), pronghorn antelope (Antilocapridae), bison (Bisonsp.), mammoth (Mammuthus cf. M. columbi), and waterfowl (Anseriformes) (Dundas 1990, 1992).

Excavations were conducted at the Merrell Locality in 1994 and 1995 by a team organized by L. B. Davis of the Museum of the Rockies (MOR), Montana State University–Bozeman (MSU) (Davis et al. 1995). In 1994, test excavations were coordinated by D. Batten and geologic studies were conducted by J. Albanese and C. L. Hill (Albanese et al. 1995; Hill et al. 1995), complementing previous soil studies by R. Bump (1989). The 1995 excavations were coordinated by Hill and Batten and included further stratigraphic mapping by Albanese and Hill. These studies were conducted to evaluate the sedimentologic, taphonomic, chronologic, and paleoenvironmental contexts associated with the Pleistocene fossils.

Within the stratigraphic succession at the Merrell Locality is an easily observed organic-rich deposit, designated Unit B in Albanese et al. (1995) and interpreted as the remnant of a marsh. Residual organics from mammoth bone in this deposit provided an age of around 36,500 yr B.P., but radiocarbon

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measurements on collagen of a mammoth fibula (>33,990 [B-36206]) and on humates (>41,940 [B-83614]) both gave infinite radiocarbon measurements (Dundas 1992; Hill et al. 1995). Bones were found within Unit B, along its lower boundary with Unit A, and in the top of Unit A. Most of the identifiable bones recovered in 1994 and 1995 from this area are attributable to mammoth (*Mammuthus* sp.) and include fragments of: teeth, limb bones, ribs, tusks, and possibly vertebrae. Some of these elements have surface striations and grooves probably resulting from trampling by large mammalian herbivores. Signs of post-depositional distortion of the deposits are prevalent, including liquefaction features (Hill et al. 1995). Scattered fauna were also recovered from sediments above Unit B.

A younger set of Pleistocene fossil remains are part of a nearby debris flow (Unit D in Albanese et al. 1995). Radiocarbon measurements on collagen indicate an age range from about 25,000 (B-36205) to 19,000 yr B.P. (B-77826) for thisfaunal assemblage (Dundas 1992; Hill et al. 1995). Mammoth (*Mammuthus* sp.) remains comprise most of the identifiable bones from the debris flow, including not only tusk, molar, rib shaft, and limb bone fragments but also a partial pelvis, a proximal ulna, a thoracic vertebra, and a distal phalanx. Some of the remains have surface marks including grooves and striations indicative of trampling. A phalanx, a molar, and a mandibular symphysis attributable to horse (*Equus* sp.) as well as a proximal phalange from a bison (*Bison* sp.) were also recovered from this deposit.

Mammoth (*Mammuthussp.*) dominate the faunal assemblage recovered from the MOR 1994–1995 excavations, but camel (*Camelops* sp.), horse (*Equus* sp.), and bison (*Bisonsp.*) are also among the large Pleistocene mammals recovered. The fauna are apparently associated with habitats related to at least two time intervals, a period earlier than 42,000 yr B.P. and a time around 25,000 and 19,000 yr B.P., providing some indication of the biotic community within Centennial Valley prior to and around the last glacial maximum. As a result of the MOR 1994–1995 excavations, the following taxa are added to the list of Pleistocene fauna from the Merrell Locality: fish (Osteichthyes), duck (Anatidae), frog (cf. *Rana*), sagebrush vole (*Lemmiscus curtatus*), ground squirrel (*Spermophilussp.*), coyote (*Canis latrans*), Gray or Timber Wolf (*Canis lupus*), American pronghorn (cf. *Antilocapra americana*), white-tail or mule deer (cf. *Odocoileus* sp.) and a large species of cervid (Cervidae).

The 1994–1995 excavations were a cooperative effort between the Bureau of Land Management (BLM) and MOR/MSU under a permit to L. B. Davis, who directs the Kokopelli Archaeological Research Fund. Additional support in 1995 was provided by a MONTS-EPSCOR grant to C. L. Hill. We thank other members of the field crew, including Dave "Hairy" Austin, Mike Christian, Chris Crofutt, Jackie Gillete, Rebecca Gilluly, Jennifer Husted, Kyle McGuire, Roy Reynolds, Cheryl Robson, Jenny Younger, Seth Wolfgram, and Terry Wolfgram. We are grateful for the help provided by Mark Sant, Robert Bump, John Albanese, and Les Davis. Thanks also to D. J. Long and C. J. Bell for aid in identification of the fish, amphibian, bird and rodent remains. D. Dyer of the University of Montana Zoology Museum kindly provided access to needed comparative specimens.

#### **References** Cited

Albanese, J. P., C. L. Hill, and L. B. Davis 1995 Upper Pleistocene Geology of the Merrell Site (24BE 1659), Centennial Valley, S.W. Montana. *Current Research in the Pleistocene* 12:107–109.

#### CRP 13, 1996

Bump, R. 1989 Soil Formation and Paleoenvironmental Interpretation at the Merrell Pleistocene Fauna Sile; Centennial Valley, Beaverhead County, Montana. Unpublished report, Bureau of Land Management, Dillon, Montana.

Davis, L. B., C. L. Hill, J. P. Albanese, and K. W. Karsmizki 1995 *The 1994 Geoarchaeological Assessment of the Merrell Locality (24BE1659), Centennial Valley, Southwest Montana.* Interim Technical Report to the Dillon Resource Office, Butte District, Bureau of Land Management.

Dundas, R. G. 1990 The Merrell Locality: A Late Pleistocene Fauna from Southwestern Montana. *Geological Society of America Abstracts with Programs* 22(6):8–9.

Dundas, R. G. 1992 A Scimitar Cat (*Homotherium serum*) from the Late Pleistocene Merrell Locality, Southwestern Montana. *Paleobios* 14(1):9–12.

Hill, C. L., L. B. Davis, and J. P. Albanese 1995 Stratigraphic and Climatic Context of Upper Pleistocene Faunas from the Centennial Valley, Southwest Montana. *Geological Society of America Abstracts with Programs* 27(4):14.

Murray, A. L., J. D. Keyser, and F. W. Sharrock. 1977 A Preliminary Shoreline Survey of Lima Reservoir: Archaeology in the Centennial Valley of Southwestern Montana. *Plains Anthropologist* 2(75):51–57.

## Partial Carcass of a Small Pleistocene Horse from Last Chance Creek near Dawson City, Yukon

C. R. Harington and Marcia Eggleston-Stott

The small Pleistocene caballoid horse (Equus lambei) evidently occupied eastern Beringia in great numbers during the late Pleistocene (Forstén 1986; Harington 1977; Harington and Clulow 1973; Hay 1917; Hughes et al. 1981). A partial carcass of this horse was found by placer miners Lee Olynyk and Ron Toews in September 1993 on Last Chance Creek (15 Pup) near Dawson City. It consists of most of the right foreleg of an adult with dried flesh, skin and dark brown hair on the lower parts. The wall of the hoof is missing, and the proximal end of the humerus was gnawed penecontemporaneously (the dark brown staining on the outer surface of the exposed bone also covers the gnawed portion) by a medium-sized carnivore, possibly a wolf. Although the foreleg had fallen to the base of the section, a large part of the hide was collected in place above it, near the base of the organic silt ("muck") unit that overlies the goldbearing gravel and bedrock and underlies the Holocene peat unit that caps the section. The hide, extending from ear to tail, including long, blondish mane and tail hair and some coarse, whitish body hair (winterpelage?), was collected with portions of the gut and its contents. The gut contents will be studied later in the hope that they may shed light not only on the diet of E. lambei and endoparasites, but on its habitat.

A sample of bone yielded anAMS <sup>14</sup>C date of 26,280 ± 210 yrB.P. (Beta-67407),

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indicating that the horse died during a relatively warm interval (interstadial) before the peak of the last (McConnell/Wisconsinan) glaciation about 20,000 to 18,000 years ago (Harington et al. 1995). This date conforms with Hopkins's (1982) observation that most of the large mammal carcasses found in northeastern Siberia and Alaska date from 45,000 to 30,000 yr B.P. and from 14,000 to 10,000 yr B.P. It also fits well with our knowledge of the stratigraphic position of the horse specimen.

Microscopic, chemical and elemental analyses of the hide and hair (Young et al. 1995) employing such techniques as X-ray diffraction, scanning electron microscopy, shrinkage temperature measurements of collagen fibers, as well as histological and histochemical investigation) show that little microbial or geochemical deterioration has occurred since the horse died. When the hide is fully dried after cleaning and surface sampling, a search will be made for possible predator punctures or scratches (e.g., Guthrie 1990, Figs. 3.4, 3.11), as well as ectoparasites.

Genomic DNA was isolated from muscle and bone samples and successfully analyzed with a polymerase chain reaction (PCR) –based test for 11 microsatellite DNA markers. Microsatellites are used in identity testing, gene mapping and analysis of genetic variation. In modern domestic horses the same microsatellite alleles are observed throughout all breeds, albeit at different frequencies.

The well-preserved state of the *E. lambei* remains, and PCR technology have provided the opportunity for initial assessment of the evolutionary relationship between *E. lambei* and modern horses. These studies have demonstrated a high degree of conservation between *E. lambei* and *E. caballus* at the microsatellite loci tested. Allele sizes vary slightly or not at all between the two species; in contrast non-caballoid Equidae species possess fewer alleles or alleles of markedly different sizes.

We are grateful to: Lee Olynyk and Ron Toews for their generosity in donating Pleistocene mammal specimens from their placer mining site; Dr. Ruth Gotthardt and Greg Hare (Heritage Branch, Yukon Tourism, Whitehorse) for collecting the pelt and gut contents; Jeff Hunston, Director of the Heritage Branch, for supplying funds for the radiocarbon date; and to Tara Grant (Archaeology Laboratory, Canadian Conservation Institute, Ottawa) and her colleagues for their patience in cleaning and analyzing the pelt.

#### **References** Cited

Forstén, A. 1986 Equus lambei Hay, the Yukon Wild Horse, not Ass. Journal of Mammalogy 67:422-423.

Guthrie, R. D. 1990 Frozen Fauna of the Mammoth Steppe. The Story of Blue Babe. University of Chicago Press, Chicago.

Harington, C. R. 1977 Pleistocene Mammals of the Yukon Territory. Ph.D. Thesis. Zoology, University of Alberta, Edmonton.

Harington, C. R., and F. V. Clulow 1973 Pleistocene Mammals from Gold Run Creek, Yukon Territory. *Canadian Journal of Earth Sciences* 10:697–759.

Harington, C. R., R. M. Gotthardt, G. Hare, and S. Morison 1995 A 26,000 B.P. Horse Carcass from Last Chance Creek near Dawson City, Yukon. CANQUA-CGRG Joint Meeting (St. John's, June 5–7), Programme, Abstracts, Field Guides. p. CA20.

Hay, O. P. 1917 Description of a New Species of Extinct Horse, *Equus lambei*, from the Pleistocene of Yukon Territory. *Proceedings of the United States National Museum* 53:435-443.

Hopkins, D. M. 1982 Aspects of the paleogeography of Beringia during the Late Pleistocene. In *Paleoecology of Beringia*, edited by D. M. Hopkins, J. V. Matthews, Jr., C. E. Schweger, and S. B. Young, pp. 3–28. Academic Press, New York.

Hughes, O. L., C. R. Harington, J. A. Janssens, J. V. Matthews, Jr., R. E. Morlan, N. W. Rutter, and C. E. Schweger 1981 Upper Pleistocene Stratigraphy, Paleoecology, and Archaeology of the Northern Yukon Interior, Eastern Beringia 1. Bonnet Plume Basin. *Arctic* 34:329–365.

Young, G., M. MacDonald, K. Helwig, and E. Moffat 1995 Characterization of an *Equus lambei* Hide. Canadian Conservation Institute Analytical Report ARS 3282:1-4.

### The Tolo Lake Mammoth Site, Idaho

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In the fall of 1994, heavy-equipment operators completing a rehabilitation project at Tolo Lake, north-central Idaho, encountered fossil bone and tusk in the drained 30-acre lake bed. The find was reported to the Idaho State Archaeologist, and a quick-response cadre from Idaho academic institutions and agencies arrived at the site to determine the nature and extent of the discovery. The late-season investigation focused on a concentration of fossil mammoth at the northeastern margin of the lake and confirmed the potential for further investigation. A few specimens were removed and the rest reburied for protection. An intensive field effort, reported here, was conducted in the summer of 1995.

Tolo Lake is five miles west of Grangeville, Idaho County, near the southern margin of Camas Prairie. The Prairie is an area of gentle topographic relief (average 350 m a.s.l.) dissected by streams and defined by the Clearwater River to the east and north and the Salmon River Canyon to the south and west. A fairly thin soil on bedrock of massive late-Cenozoic Columbia River basalt supports grasslands and dry farms.

Over 400 fossils of subadult to adult mammoth (*Mammuthus* sp., cf. *M. columbi*; MNI 10); *Bison* sp., cf. *B. antiquus* (MNI 3); and an unidentified smaller bovid were recovered during the 3-month field season, representing just a fraction of the fossils suspected to be in the lake bed. The fossils are well preserved and retain small- and large-scale anatomical and postmortem detail. Surprisingly, fine-mesh water screen processing of several tons of sediment produced only one small vertebrate and no invertebrate fossils. No evidence for cultural association with the fossils was found. Initial radiocarbon dates on mammoth bone (collagen extracted with alkali;  $4,300 \pm 70$  yr B.P.; Beta-76459/CAMS-15940) and sedimentary carbonate ( $5,150 \pm 110$  yr B.P.; WSU-4637) are anomalously young.

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Two taphonomic settings were investigated at Tolo Lake. Seven contiguous 5 x 5-m blocks were excavated in a near-shore area (now known as the "Ivory Coast") of shallow sandy-silt deposits on basalt rubble. Bones and tusks were found on, between, and under slightly angular to sub-rounded boulders. The fossils ranged from whole, unmodified elements to fragments exhibiting damage such as occasional sharp-edged breaks, localized battering and faceting, striations, and extensive surficial abrasion. Initial field observations noted infrequent root etching, no chemical erosion, and no obvious carnivore or rodent gnawing on the bones. The pattern of element alteration and distribution for the Ivory Coast suggests carcass or element deposition in shallow water, fairly gradual decomposition and gentle dispersal of skeletal units, followed by rolling, abrasion, and burial.

The mammoth-fossil deposition pattern changes with distance from shore and deepening of the lake sediments toward an increase in number and completeness of elements, a clustering of bones of suspected individuals, and partial carcasses. A nearly complete skeleton of an adult male, Mammoth No. 1, was recovered 30 m south of the Ivory Coast area, and a partial adult skeleton, Mammoth No. 3, from 100 m to the southeast. Both mammoths were embedded in deeper-lake fine sediments on a paleosurface about 50 cm above the rocky lake floor. The nearly complete skeleton of Mammoth No. 1, with the exception of a few small element outliers, was confined to a carcass-sized area. Mammoth No. 3 is represented by the forelimbs, a tusk and other postcranial elements. There is only minor evidence (Behrensmeyer Stages 1) of subaerial weathering on both of the skeletons. The reconstructed scenario for Mammoths 1 and 3 involves death at or transport to slightly deeper offshore locations in Tolo Lake, very slow decomposition in water, disarticulation, and slow burial. Episodes of drying accompanied by rooted vegetation, layers of coarser sediment, rodent burrowing, and minor soil development occurred during the lake's history.

Multidisciplinary team members recruited from the participating institutions will continue the research on the Quaternary geologic history and paleoenvironments of the Tolo Lake region, the taxonomy, taphonomy and natural history of the megafauna, and options for future field work at the lake. The fossils from Tolo Lake are under preparation and curation at the Idaho Museum of Natural History, Pocatello.

The 1995 season was made possible by labor, logistical and material support from state and federal agencies, the participating institutions, local citizens and private firms. The summer's program included training and utilization of volunteers, responding to intense public and mediainterest, and providing tours and interpretive material for several thousand visitors including 1,700 school children. An educational, interactive homepage on the Tolo Lake project is accessible on Internet: <http://viper.idbsu.edu:80/bsuradio/mammoth/>.

# A Clovis-Age Mammoth from Garvin County, Oklahoma: The Hill Site (34Gv80)

Larry Neal, Frank Force and Sheri Mueller

In 1994 deeply buried elephant tusks were exposed in a near-vertical cut bank of Panther Creek in Garvin County, Oklahoma. This drainage originates in the Table Top Hills, dissected mesa-like remnants of the Arbuckle Hills. Oklahoma Archeological Survey investigators noted that the exposed tusks were less than 100 linear feet from a mammoth mandible recovered from the channel in 1977, and suspected an association between these two occurrences. Excavations created a 10-m-wide vertical profile and stabilized the 9-m-high bank.

A series of cut and fill episodes have affected the elephant remains (Figure 1). The tusks and bone are eroding from sediments contained in a north/ south-aligned channel cut into blue-green sandy clay (Zone VIII) of Pliocene or early-Pleistocene age. The basal sediment between the channel bottom and the base of the bones is red loamy coarse sand (Zone VII). This appears to be the bottom of the channel at the time of deposition. Bedded fine sand (Zone VI) surrounds much of the bone in the southern half of the exposure, as well as an intact rib 2 m south of the tusks. Above the remains this fine sand is truncated by coarse sand and gravel (Zone V) that had cut into and abraded parts of the tusks and the upper part of the skull to the maxilla. A deteriorated rib perpendicular to and below the left tusk 1.43-1.56 m below line datum (BLD) extends northward 60 cm into this coarse gravelly sand. Slightly higher and 1 m north of the rib's end (1.2 m BLD), a small lanceolate biface made from a flake of locally redeposited chalcedony was found while cutting back the profile (Figure 1).

The bone distribution reflects natural dispersal. Taphonomic experiments (Todd and Frison 1986) using Indian elephant remains demonstrate that even large skeletal elements may be moved by sufficiently powerful water flow, depending on density and size of the bones. The skull may have moved downstream slightly, the brain case and hollow sinus cavities acting as a slight flotation chamber; however, the dense, heavy tusks and teeth would drag and retard the skull's movement. Although ribs with their length, lighter weight, and more lenticular cross section are more mobile, they are trapped beneath the tusks and in the lee of the skull. Most postcranial elements are missing. The presence and good condition of the single rib in the fine sand south of the skull and tusks supports a relatively rapid postmortem relocation and burial. This may indicate that other elements were flushed by later channel formation and movement. Some postcranial bones may be redeposited downstream in the banks of Panther Creek.

Species determination is derived using the criteria of Haynes (1990), Maglio (1973), and Madden (1981). Speciation as *Mammuthus columbi* is based on

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Figure 1. West bank profile of Panther Creek showing position of Hill mammoth and redeposited biface.

number of lamellae, crown width, enamel thickness, and lamellae frequency (Haynes 1990; Madden 1981; Magilio 1973). Law's (1966) criteria of tooth eruption and wear were used for aging. The teeth used in Law's age study are from mandibles of Loxidonta africanus, whereas the Hill mammoth teeth are from the maxilla. This analysis assumes that the ages of tooth eruption in the maxilla and mandible are closely similar or congruent in both genera, but this was not confirmed in any reference. The Hill mammoth teeth fit Laws's classification as fifth molars (M5), typical of Law's age groups XV or XVI. At this point in the life cycle, M5 is the predominant tooth in the jaw as M4 passes out of the mouth and M6 has yet to erupt. The Hill mammoth teeth appear to be on a border between the two age groups, probably closer to group XVI; all lamellae are in occlusion though not as extensively as in age group XVI; there is no evidence of M6 in the maxilla remains. This would place the age of the Hill mammoth as equivalent to about  $26 \pm 2$  African elephant years, a sexually mature adult. The lack of postcranial elements makes assessment of sex tentative, but based on the 21-cm diameter of the tusks the sex is likely male.

The mandible recovered from the Panther Creek channel in 1977 was relocated at the Oklahoma Museum of Natural History and compared with the 1994 find. Although the teeth have fractured occlusal surfaces, they were assessed as M4 and M5 on the basis of morphology and size. The crown width appears to be substantially smaller, and M4 is predominant. These are characteristics of a individual younger than the one represented by the maxilla and tusks. A third set of deteriorated mammoth remains is located in a side gully of the creek about 300 m southwest of 34Gv80. The presence of as many as three mammoths in a confined area far from a modern major stream channel should rule out most catastrophic-death scenarios and is a matter for future research.

Immediately underlying the maxilla and teeth of the Hill mammoth in the loamy coarse sand (Zone VII), a small lump of wood charcoal was recovered and submitted to Beta Analytic for AMS dating. A raw age of  $11,600 \pm 80$  yr B.P. was obtained. The  ${}^{13}C/{}^{12}C$  ratio of -26.5 per mil yielded a conventional radio-carbon age of  $11,580 \pm 80$  yr B.P. (Beta-80785). This date conforms to the suggested early presence of the Clovis culture in the southern United States, and makes it possible that Paleoindians could have killed the Hill mammoth. The biface from the coarse gravel does little to corroborate a human association, in part due to the clear evidence for its later deposition. Although the biface is a lanceolate, it is unlike any classic Paleoindian projectile point, and is certainly not Clovis. Analysis of the few ribs recovered does not reveal evidence of butchering. Although the Clovis-age date from the charred wood is tantalizing, there is not a clear association between humans and the Hill Mammoth.

#### **References Cited**

Haynes, G. 1990 Mammoths, Mastodonts, & Elephants: Biology, Behavior, and the Fossil Record. Cambridge University Press, Cambridge.

Laws, R. M. 1966 Age Criteria for the African elephant Loxodonta a. africana. East African Wildlife Journal 4:1-37.

Madden, C. T. 1981 *Mammoths of North America*. Unpublished Dissertation, University of Colorado, Boulder.

Maglio, V. J. 1973 Origin and Evolution of the Elephantidae. *Transactions of the American Philosophical Society* 63(3): 1–149.

Osborn, H. F. 1942 Proboscidea: A Monograph of the Discovery, Evolution, Migration, and Extinction of the Mastodonts and Elephants of the World. Vol.. II: Stegodontoidea, Elephantoidea. American Museum of Natural History, New York.

Todd, L. C., and G. C. Frison 1986 Taphonomic Study of the Colby Site Mammoth Bones. In *The Colby Mammoth Site, Taphonomy and Archaeology of a Clovis Kill in Northern Wyoming*, by G. C. Frison and L. C. Todd. University of New Mexico Press, Albuquerque.

### The Grove Mammoth Site, Kamiah, Idaho

Antony T. Plastino, Carl E. Gustafson, Bruce D. Cochran, Robert L. Sappington, and Paul A. McDaniel

The Grove Mammoth site is situated in Kamiah, Idaho, on an unpaired terrace of the Clearwater River, at an elevation of 374 m. A flaked cobble (Figure 1) and skeletal elements from a large mammoth (*Mammuthus columbi*) were recovered. A proximal femoral epiphysis indicates the mammoth was approximately 27 to 40 African elephant years of age at death (Haynes 1991:345, Table A11). Mammoth-rib fragments produced a<sup>14</sup>C date of 14,770 ± 150B.P. (Beta 89262). Lower-range taphonomic theory (Bonnichsen 1989:518–521) suggests that site features were formed by several processes.



**Figure 1.** A view of the battered lateral edges of the large chalcedony cobble tool found near a concentration of mammoth ribs. Note the short prominent step or hinge fractures initiated perpendicular (normal) to the lateral face, and the thick cortex visible on the lower (proximal) surface. Historic period disturbance makes it difficult to determine if the artifact and faunal material are associated.

Alluvial-fan gravel in a matrix of reddish silty clay loam lay beneath the bones. Above this the mammoth was contained in a sedimentary unit interpreted as a channelized, subaqueous debris flow. Poorly sorted basalt clasts and bones were deposited in a matrix of reddish silty clay loam, intercalated with yellow brown fine sands and silts. Some bones in this stratum were semi-plastically deformed, bent and broken during transport and/or burial.

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The percentage of surviving articulations (Burgett 1990:155) is extremely low (<2%). Most bones were highly fragmented and disarticulated, roughly sorted into bone piles or lodged amidst boulders along the periphery of a channel or scour feature. However, the position of some elements in near anatomical order, such as the proximal tibia/fibula and several foot bones, suggests that the animal was entrained as a semi-ligamentous skeleton and deposited on site.

The presence of all three Voorhies Groups (Voorhies 1969) indicates that deposition was rapid and that the bones were not subjected to intensive hydrodynamic sorting prior to deposition. Many (>30%) of the rod-shaped bones display a preferred orientation, aligned with the long axis of the channel feature. This may indicate a depositional hiatus during which lower-energy currents reoriented long bones prior to final burial. The nature of the enclosing sediments suggests that the mammoth was deposited into a standing body of water.

Recurrent Pleistocene flooding was common in the Columbia and Snake river drainage systems (Cochran 1988; McDonald and Busacca 1992). Mammoth remains rested on substrates that varied from cobble gravel to fine micaceous sands and silts, which graded into a stratum mantling the site composed of micaceous silt loam. This depositional unit contains numerous load-deformational structures similar to load casts, graded beds and clastic dikes—features often associated with rapid deposition under supersaturated conditions (Bouma 1962). Inundation and density current flow during a flood event may explain a large part of the site depositional sequence.

The Grove Mammoth site was excavated in June 1995 as a University of Idaho field school. Partial funding was provided by a grant from the Idaho Humanities Council to the Lewis County Historical Society. The project would have been impossible but for the assistance of numerous volunteers, students and otherwise interested parties.

#### **References Cited**

Bonnichsen, R. 1989 Construction of Taphonomic Models: Theory, Assumptions, and Procedures. In *Bone Modification*, edited by R. Bonnichsen pp. 515–526. Center for the Study of the First Americans, Orono.

Bouma, A. 1962 Sedimentology of Some Flysch Deposits. Elsevier: Amsterdam.

Burgett, G. B. 1990 The Bones of the Beast: Resolving Questions of Faunal Assemblage Formation Processes Through Actualistic Research. Doctoral Dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Cochran, B. D. 1988 The Significance of Holocene Alluvial Cycles in the Pacific Northwest and Interior. Doctoral Dissertation, Department of Geology, University of Idaho, Moscow.

Haynes, G. 1991 Mammoths, Mastodonts, and Elephants. Cambridge University Press, Cambridge.

McDonald, E. V., and A. J. Busacca 1992 Late Quaternary Stratigraphy of Loess in the Channeled Scabland and Palouse Regions of Washington State, *Quaternary Research*, 38:141–156.

Voorhies, M. R. 1969 Taphonomy and Population Dynamics of the Early Pliocene Vertebrate Fauna, Knox County Nebraska. *Contributions to Geol. Spec. Paper, No. 1.* 

# Radiocarbon Dating of Extinct Pleistocene Megafauna from the Kansas River, Bonner Springs Locality, Kansas

### Thomas W. Stafford, Jr., Larry D. Martin, Wakefield Dort, and Jack L. Hofman

The age of the Pleistocene fauna from the Kansas River near Bonner Springs, Wyandotte and Johnson Counties Kansas has been hypothesized to be latest Wisconsinan (Johnson 1987) based on biostratigraphy. Sandbars along a 20-km stretch of the river yielded specimens of 6 Holocene mammals, 13 extinct Pleistocene species, and isolated human skeletal elements. The fauna provides an opportunity to examine species frequencies, alluvial taphonomy, mortality profiles, natural vs. human bone modification (Rogers and Martin 1989), archaeological associations (Rogers and Martin 1983; Wetherill 1995), and Pleistocene extinction chronologies. This report presents accelerator mass spectrometer (AMS) <sup>14</sup>C dates on extinct and extant species from Bonner Springs. The AMS <sup>14</sup>C dating followed procedures in Stafford, et al., 1991.

Holocene and late-Pleistocene ages of the Bonner Springs fossils are based on species composition. Extant species include wolf (*Canis lupus*), mountain lion (*Puma concolor*), black bear (*Ursus americanus*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), and bison (*Bison bison*). Extinct Pleistocene mammals include armadillo (*Dasypus bellus*), ground sloth (*Megalonyx jeffersoni*), dire wolf (*Canis dirus*), short-faced bear (*Arctodus simus*), tapir (*Tapirus* spp.), American mastodon (*Mammut americanum*), mammoth (*Mammuthus* spp.), long-nosed peccary (*Mylohyus nasutus*), camel (*Hemiauchenia* sp.), stagmoose (*Cervalces scotti*), bison (*Bison bison antiquus*), woodland musk ox (*Bootherium bombifrons*) and giant beaver (*Castoroides kansasensis*). The tapir is the first occurrence of this genus in Kansas.

Based on <sup>14</sup>C ages and bone-protein preservation, at least four ages are represented at Bonner Springs: recent, early Holocene, late Pleistocene, and possibly a Pleistocene interstadial. The most recent specimen was KUVP-347, a mandible from the *Equus laurentius* holotype (Table 1). Its modern age indicates the species requires revision as a Pleistocene species. The 9,630  $\pm$  60 date for KUVP-81230, identified as *Arctodus simus*, is the youngest age for an extinct Pleistocene mammal dated by modern AMS techniques. The taxonomic identification is based on the size of the lumbar vertebra; the width, depth and thickness of the centrum are 105 mm, 70 mm and 70 mm, respectively. These

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Species	museum no. (KUVP- )	element analyzed	collagen yield (%)	AMS <sup>14</sup> C age (yr <u>±</u> s.d.)	<sup>14</sup> C lab no. (CAMS- )
Equus laurentius	347	mandible	19.4	110 ± 60	20005
cf. Arctodus simus	81230	lumbar vertebra	16.9	9,630 ± 60	20007
B. b antiquus	126205	cranium	6.0	11,500 ± 70	20001
Castoroides kansasensis	104035	mandible	1.9	12,150 ± 80	20004
cf. Mammuthus spp.	63758	femur shaft	3 <del></del> 1	12,360 ± 110	6370
Bootherium bombifrons	96130	cervical vertebra	7.6	13,850 ± 50	20003
Bootherium bombifrons	94575	cranium	4.1	13,890 ± 60	20002
Dasypus bellus	110101	dermal plate	< 0.5	not dateable	: <u></u> 1
Mylohyus nasutus	126207	mandible	< 0.5	not dateable	
Tapirus spp.	126206	mandible	< 0.5	not dateable	_
Cervalces scotti	119664	metatarsal	< 0.5	not dateable	_
Megalonyx jeffersoni	88315	mandible	< 0.5	not dateable	
Hemiauchenia sp.	94003	phalange	< 0.5	not dateable	

Table 1. AMS radiocarbon measurements for Bonner Springs fauna.

Percent yield of collagen is relative to 20% for modern bone. Ages are the uncalibrated AMS <sup>14</sup>C date  $\pm$  1 s.d. corrected for  $\partial^{13}$ C. CAMS- is the lab number from the Lawrence Livermore National Laboratory.

values are substantially larger than any available *Arctodus* lumbar centra, including those from a Rock Creek, Texas, female *Arctodus*, whose centra widths ranged from 76 to 84 mm (Kurtén, 1967:29,55, Table 8). Kost (1984) noted that KUVP-81230 was one of the largest known specimens attributed to *Arctodus*. This specimen, and others identified as *Arctodus*, will be investigated further to clarify the possible late occurrence of this extinct genus.

The remaining 11 specimens, representing 9 extinct Pleistocene species, divide into two groups. The first series had dateable amounts of collagen; the second group contained negligible amounts of bone protein and were not dateable by present <sup>14</sup>C techniques. The very low protein contents in the second group could reflect their greater geological age or the fossils having been buried in different lithologies than the dateable bone. Within the valley alluvium we observed no significant lithologic differences that would have preserved protein better in one stratum than another. Consequently, we hypothesize that specimens with poor chemical preservation represent fossils significantly older than those dating 11,500 to 13,890 yr B.P. Except for Stagmoose (*Cervalces scotti*) the poorly preserved fossils represent species from a warmer climate regime and therefore may date from an earlier Pleistocene interstadial.

Our results demonstrate the biostratigraphic significance of the Kansas River fauna for reconstructing Holocene and late-Pleistocene vertebrate communities. By using chemistry and direct AMS <sup>14</sup>C dating of individual fossils identified to species, we identified an invalid Pleistocene horse species and demonstrated that at least two Pleistocene fossil ages existed.

We extend special thanks to Jerry and Donna Ashberger, who have contributed substantially to the documentation of the Kansas River fauna. The support of Robert Papp is greatly appreciated. AMS <sup>14</sup>C dating was partially funded by NSF grants EAR 90-1895 and EAR 91-18683 to T. Stafford, R. Graham and H. Semken.

#### **References Cited**

Johnson, W. C. 1987 Bonner Springs Site. In *Quaternary Environments of Kansas*, edited by W. C. Johnson, pp. 41–52. Kansas Geological Survey Guidebook Series, 5. Kansas Geological Survey, Lawrence.

Kost, E. 1984 A Giant Pleistocene Bear from Northwestern Kansas. Kansas Academy of Science Abstracts. 3:23-24. Topeka.

Kurtén, B. 1967 Pleistocene Bears of North America, II: Genus Arctodus, short-faced bears. Acta Zollologica Fennica 117:2–60.

Rogers, R. A., and L. D. Martin 1983 American Indian Artifacts from the Kansas River. *Transactions of the Nebraska Academy of Sciences* 11:13–18.

Rogers, R. A., and L. D. Martin 1989 Possible Bone Artifacts from the Kansas River. *Current Research in the Pleistocene* 6:43–44.

Stafford, T. W., Jr., P. E. Hare, L. Currie, and A. J. T. Jull 1991 Accelerator Radiocarbon Dating at the Molecular Level. *Journal of Archaeological Sciences* 18:35–72.

Wetherill, B. 1995 A Comparative Study of Paleoindian Evidence at the Bonner Springs Locality, Lower Kansas River Basin, Texas. Master's thesis, Department of Anthropology, University of Kansas, Lawrence.

### **Paleoenvironments: Geosciences**

## The Munsungun Chert Utilization and Paleoindians in Southwestern Maine

Nathan D. Hamilton and Stephen G. Pollock

Recent geoarchaeological investigations in Cumberland and York counties, southwestern Maine, have identified two single-component occupations that are significant for assessing lithic raw-material utilization and regional reconstructions of mobility, seasonality, settlement patterns and social interaction. The Point Sebago site (ME 12.24) in the Presumpscot River drainage has undergone excavation of 40 m<sup>2</sup>, ca. 50 percent of a single locus. The site preserves an elongate locus of flaked-stone tools and debitage upon a knoll of till some 5 m above and 20 m from the present shore of Sebago Lake. The other site, known as Spillers Farm (ME 4.13), is situated on silt and clay deposits of the PresumpscotFormation. The site is adjacent to a small bedrock knoll overlooking the Merriland River, a small drainage flowing to the Gulf of Maine in the town of Wells. At present, Spiller Farm is known from an excavation and surface collection of 286 flaked-stone tools. Both sites represent an additional exception to the regional pattern in Maine of Paleoindian selection of sandy soil deposits (Spiess and Wilson 1989). Previously other exceptions to the pattern were the quarry-related sites on the thoroughfare between Munsungun and Chase Lake (Bonnichsen et al. 1991) and the 39.1 Paleoindian site on the Georges River in Searsmont (Cox et al. 1994).

The Point Sebago site was first identified in a phase I evaluation of a proposed condominium/golf course development at the north end of the lake. A phase II excavation revealed 6 chert tools and 26 pieces of debitage in a locus about 3 x 6 m. The landowners, Mr. and Mrs. Lawrence Gould, set aside the site area from development after the significance was revealed. In the summer of 1994 the University of Maine (USM) conducted a block excavation of 38m<sup>2</sup>. The phase I and II excavations combined with the 1994 USM work for 48m<sup>2</sup> and produced 115 (289 g) chert tools or fragments of tools and 1,424 (174 g) pieces of chert debitage. All the 1994 USM work was conducted with 1/8" (3.35 mm) mesh screens to recover microflakes. About 90% of the flakes are in the size

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range of 1/8 to 1/4''. A moderate number of these exhibit bifacial thinning and unifacial retouching.

The cultural remains are vertically distributed in the till matrix to over 75 cm in depth. Spatially they extend over an area about  $12 \times 5$  m, although the northern end was slightly truncated by a parking space. It is notable that 25% of the tools and 40% of the debitage (551) occur in a single area measuring 1 x 1 m.

Cultural remains at Point Sebago are all chert. These include one fluted biface base of red chert derived from the Munsungun Lake Formation, 24 end scrapers, 14 side scrapers, 5 *pièces esquillées*, 2 gravers, and 69 others. Of significance, 98% of the tools are clearly assignable to the Munsungun Formation (Pollock 1987) and are likely from Norway Bluff and Willard Brook quarries north of Munsungun Lake in northern Maine, some 500 km to the north (cf. Bonnichsen 1981, Bonnichsen et al., 1991). In addition, five artifacts exhibit similarities to artifacts manufactured from Nova Scotia chalcedonies. These artifacts which we assign to a Nova Scotia origin represent the first unequivocal use of these materials in a Paleoindian context in western Maine. One piece was identified as the so-called "Sandy River" Jasper.

The Spillers Farm site was identified by the landowner after the shallow plowing of silt and clay deposits for strawberry fields. Surface artifact plotting and collection reveal a locus of chert tools and flakes that likely extends to undisturbed portions. Some 286 (1,381g) tools of chert or felsite include 4 fluted basal portions, 3 midsections and 2 tips, 1 unfluted biface, 41 end scrapers, 23 side scrapers, 9 *pièces esquillées* and 5 gravers. All but 8 of the tools recovered thus far are Munsungun formation chert. The debitage includes 2,182 (323 g) flakes of chert (98%) and rhyolite.

To date the diagnostic deeply indented fluted biface bases from Point Sebago and Spiller Farm exhibit similarities to the Vail and Debert Paleoindian sites. The large, thicker bifaces from Spiller Farm are similar to forms from Bull Brook in northeastern Massachusetts and the Windy City site at Munsungun Lake. In the two southwestern Maine sites, Munsungun chert by artifact numbers and weight reveals the regional importance of this raw material in Paleoindian context in western Maine. Current research in raw materials assessment involves x-ray diffraction analysis, neutron activation, ICP and microscopic study. Continued research will focus on the excavation of Point Sebago and Spiller Farm and the geochemical study of the Munsungun Quarries (Pollock 1987) and archaeological specimens with good intrasite provenience. The data should allow an unique opportunity to examine the initial colonization of the Maine-Maritime region by Paleoindians as well as allow enhanced resolution patterns of utilizations of and regional trade and/ or exchange patterns of Munsungun chert in northern Maine. Munsungun chert is also present in the Bull Brook and Neponset in northeastern Massachusetts as minor amounts. Additionally, several fluted point specimens of this material have been recovered in the Merrimack drainage.

#### **References Cited**

Bennichsen, R. G. 1981 Archaeological Research at Munsungun Lake: 1981 Preliminary Tech-

nical Report of Activities; Munsungun Lake Paper No. 7, Institute for Quaternary Studies and the Center for the Study of Early Man, University of Maine at Orono, Orono, ME, 51 pp.

Bonnichsen, R, G., D. Keenlyside, and K. Turnmire 1991 Paleoindian patterns in Maine and the Maritimes. In Prehistoric Archaeology in the Maritime Provinces: Past and Present Research; M. Deal and S. Blair, eds. Reports in Archaeology No. 8., Council of Premiers; pp. 1–36.

Cox, S. B. Bourque, R. Corey, R. Doyle and R. Lewis 1994 Phase II Investigations of Site 39.1, Searsmont, Maine. MHPC Document 2789.

Pollock, S. G. 1987 Chert formation in an Ordovician volcanic arc. Journal of Sedimentary Petrology 57:75-87.

Spiess, A. E., and D. B. Wilson 1989 Paleoindian Lithic Distributions in New England— Maritimes region; C. J. Ellis, and J. C. Lothrop, eds., Eastern Paleoindian Lithic resource Use; pp. 75–97.

# Geo-Ecologic Dynamics in the Glacial Lakes Duluth-Agassiz Region (Northern Minnesota) During the Late Pleistocene and Early Holocene *Christopher L. Hill and James K. Huber*

Studies of the late-Quaternary stratigraphy, geomorphology and vegetative chronology of the area immediately west of the Lake Superior basin provide an opportunity to evaluate the dynamic interactions between the geosphere and the biosphere. These interactions have ramifications for understanding the timing and character of local potential Paleo-American adaptations. Quaternary strata and landforms in northeastern Minnesota indicate a physical context associated with ice margin, pro-glacial lakes, and changing drainage systems, while the biostratigraphic record can be used to develop a postglacial vegetational chronology (Hill 1995; Huber 1992, 1995; Phillips et al. 1994).

A series of glacial advances affected the region from prior to 12,500 to around 9,900 yr B.P. (Hill 1995; Phillips and Hill 1994). Ice lobes advanced from the northwest, north, and northeast. In the central region, melting of the Rainy lobe created a series of recessional moraines, eventually reaching the Vermilion moraine ice margin by 12,500 yr B.P. Glacial lakes formed south of this margin. At about this same time, the Automba-phase Superior ice lobe occupied the region to the east. As this ice lobe melted back into the Superior basin, another glacial lake was created. Between about 12,000 and 10,500 yr B.P., Alborn-phase ice advanced from the northwest and Thompson-Nickerson phase ice advanced from the northeast. Meltwater from the various ice lobes contributed to the creation of Glacial Lakes Upham II, Koochiching, Norwood, and Nemadji (or

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incipient Duluth). A rise in the level of Lake Agassiz appears to have been a response to the Marquette-phase advance of the Superior lobe which may have reached the Marks-Mackenzie ice margin around 9,900 yr B.P.

Three major sets of proglacial lakes existed in northeastern Minnesota during the end of the Pleistocene and earliest Holocene. Two intervals of lakes on the Aitkin and Upham plains were separated by the Alborn-phase ice advance, with the possibility of glacial lake persistence to about 9,000 B.P. (cf. Hobbs 1983). North and west of this region, a series of lakes formed, eventually leading to the development of Glacial Lake Agassiz which persisted in northern Minnesota to about 9,000 yr B.P. Fluctuating ice margins resulted in different lake levels leading to the Houghton low stand by about 8,000 yr B.P. in the Superior basin.

The dynamics associated with glacial ice margins and the locations of glacial outwash lakes and drainage patterns influenced the postglacial biotic character of the region. A tundra-type setting appears to have been established in some deglaciated areas as early as 14,700 yrB.P. (Huber 1992). By 12,000 yrB.P. a shrub or tundra parkland may have existed in the southern part of the region. There are some indications for the presence of a late-Pleistocene mosaic ecologic pattern. The region bounded between Glacial Lake Agassiz to the northwest and Glacial Lake Duluth to the southeast between 11,000 and 10,500 yr B.P. may have been characterized by two generalized vegetational landscapes as inferred from fossil pollen assemblages (cf. Julig and McAndrews 1993). The southwest may have been a "lichen woodland" or shrub parkland, while the area to the northeast may have been tundra, tundra parkland or shrub parkland (Huber 1992, Julig and McAndrews 1993). After the melting of the Marquette-phase Superior lobe and during the Minong-Houghton transition within the Superior basin (starting ca. 9,500 to 9,000 yr B.P.), the region was likely a boreal forest landscape dominated by spruce and pine (cf. Cushing 1967). A conifer or conifer-hardwood forest was likely established in the region by 8,300 yr B.P. (Huber 1992). If the proposed transition from a lichen woodland/shrub parkland and tundra-type/tundra or shrub parkland ecotone setting-bounded by large glacial lakes and the Laurentide ice margin-to a landscape dominated by a postglacial boreal forest context sometime around 10,000 yr B.P. can be substantiated, it might be used to predict the presence of two temporally distinct Paleo-American adaptive strategies in the region between Glacial Lakes Duluth and Agassiz (cf. Julig and McAndrews 1993). The interrelationships between physical environments and biota (plants and animals) can viewed from a geo-ecologic perspective (Hugget 1995) combining landscape ecology and biogeography to model paleoecologic dynamics. Based on the presence of a major geo-ecologic transition around 10,000 yr B.P. we propose that prehistoric human populations who may have occupied the area during the late Pleistocene and early Holocene would have had temporally distinct adaptive strategies. These strategies may be reflected in the prehistoric record by potentially distinct archaeologic taxonomic entities representing the presence of local early-Paleo-American and late-Paleo-American populations. A further postulate would argue that biotic adaptations, including Paleo-American strategies, prior to about 10,000 yr B.P. may reflect a mosaic habitat setting while later adaptations would be associated with a less variable, more homogeneous ecologic context.

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#### **References Cited**

Cushing, E. J. 1967 Late-Wisconsin Pollen Stratigraphy and the Glacial Sequence in Minnesota. In *Quaternary Paleoecology*, edited by E. J. Cushing and H. E. Wright, pp. 59–88. Yale University Press, New Haven.

Hill, C. L. 1995 Geological Context of Paleo-Indian Occurrences. In *The Paleo-Indian of Southern St. Louis Co., Minnesota: The Reservoir Lakes Complex*, pp. 89–100. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Hobbs, H. C. 1983 Drainage Relationships of Early Glacial Lakes Aitkin and Upham and Early Lake Agassiz in Northeastern Minnesota. In *Glacial Lake Agassiz*, edited by J. T. Teller and L. Clayton, pp. 245–259. Geological Association of Canada Special Paper 26.

Huber, J. K. 1992 An Overview of the Vegetational History of the Arrowhead Region, Northeastern Minnesota. In *Field Trip Guidebook for the Glacial Geology of the Laurentian Divide Area, St. Louis and Lake Counties, Minnesota*, pp. 55–64, Minnesota Geological Survey Guidebook Series No. 18. St. Paul, Minnesota.

Huber, J. K. 1995 Vegetational History. In *The Paleo-Indian of Southern St. Louis Co., Minnesota: The Reservoir Lakes Complex*, pp. 125–151. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Hugget, R. J. 1995 Geoecology: An Evolutionary Approach, Routledge, London.

Julig, P. J., and J. H. McAndrews 1993 Paleoindian Cultures in the Great Lakes Region of North America: Paleoclimatic, Geomorphic, and Stratigraphic Context. *L'Anthropologie* 97(4):623–650.

Phillips, B. A. M., and C. L. Hill 1994 *The Geology, Glacial and Shoreline History and Archaeological Potential of the Minnesota North Shore of Lake Superior*, Technical Report to the Minnesota Department of Natural Resources.

Phillips, B. A. M., C. L. Hill, P. W. Fralick, and B. Ross 1994 *PostGlacial Lake Shorelines and Paleoindian Migration along the Northwestern Shore of Lake Superior*, Guidebook for Field Trip E, 13th Biennial Meeting of the American Quaternary Association, Minneapolis, Minnesota.

# The Aggie Brown Member of the Oahe Formation: A Late Pleistocene/Early Holocene Marker Horizon in Western North Dakota

### David D. Kuehn

The Oahe formation is the only formally recognized post-Wisconsin lithostratigraphic unit in North Dakota. Defined to include silt deposited on upland surfaces (Clayton et al. 1976), the Oahe formation was expanded to include all late-Quaternary sediment overlying Pleistocene glacial, glaciofluvial, and glacio-lacustrine sediment in North Dakota (Clayton and Moran 1979). The Oahe formation comprises eolian, fluvial, and pond lithofacies (Clayton and Moran 1979), and is divided into four members (Clayton et al.

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1976). From oldest to youngest, these members are: (1) the Mallard Island member, c. 14,000–13,000 yr B.P.; (2) the Aggie Brown member, c. 13,000–8,500 yr B.P.; (3) the Pick City member, c. 8,500–4,500 yr B.P.; and the Riverdale member c. 4,500–0 yr B.P. (Artz 1995; Clayton et al. 1976).

Stratigraphic investigations in the Little Missouri Badlands of western North Dakota indicate that archaeological sites dating from the late Pleistocene/early Holocene are most likely to be found in association with the eolian facies of the Oahe formation. These sediments are primarily limited to small depositional basins in upland settings (Artz 1995; Kuehn 1995). The other principal Oahe formation lithofacies (i.e., fluvial) are located in lowland settings and were deposited within the last 7,000 years (Kuehn 1995). Likewise, of the four recognized Oahe formation members, only the Aggie Brown, Pick City, and Riverdale are present in the badlands region. Of these, only the Aggie Brown member is contemporaneous with the Paleoindian tradition. The others (i.e., the Pick City and Riverdale) postdate the Paleoindian period (Clayton et al. 1976). Fortunately for archaeologists, the Aggie Brown is easily recognizable on the basis of stratigraphic position and pedogenic composition.

As illustrated in Figure 1, the Aggie Brown member (in the badlands region) is situated at the bottom of the upland sequence, overlying Tertiary bedrock or Pleistocene gravels. At any given section, the Aggie Brown member contains between one and nine beds, defined on the basis of bounding inconformities.



Figure 1. Generalized stratigraphic section of late-Quaternary upland sediments in the Little Missouri Badlands, North Dakota.

Each of the units is capped with a soil, ranging from Entisols to Mollisols. In their original description of the Aggie Brown member, Clayton et al. (1976) recognized only one soil, the Leonard Paleosol (Bickley 1972). Quite distinctive due to its exceptionally dark color, the Leonard Paleosol has proven valuable as an aid to locating Paleoindian components in the Knife River Flint Primary Source Area of west-central North Dakota (Artz 1995; Root et al. 1986).

In the Little Missouri Badlands, because the Aggie Brown member contains as many as nine soils, depending upon local geomorphic conditions, the concept of a single "Leonard Paleosol" is problematic; hence, the soil is not a practical temporal marker. However, the Aggie Brown member is a distinctive, traceable lithostratigraphic unit, and therefore is an extremely useful marker horizon for late-Pleistocene and early-Holocene sediments, and consequently for possible Paleoindian materials.

#### **References Cited**

Artz, J. A. 1995 Geological Contexts of the Early and Middle Holocene Archaeological Record in North Dakota and Adjoining Areas of the Northern Plains. In *Archaeological Geology of the Archaic Period in North America*, ed. by E. A. Bettis, III, pp. 67–86. Geological Society of America, Special Paper 297.

Bickley, W. B., Jr. 1972 Stratigraphy and History of the Sakakawea Sequence, South-Central North Dakota. Unpublished Ph.D. dissertation, University of North Dakota, Grand Forks.

Clayton, L., and S. R. Moran 1979 Oahe Formation. In *Geology and Geohydrology of the Knife River Basin and Adjacent Areas of West-Central North Dakota*, edited by G. H. Groenewold, L. R. Hemish, J. A. Cherry, B. W. Rehm, G. N. Meyer, and L. M. Winczewski, pp. 337–339. North Dakota Geological Survey Reports of Investigations 64.

Clayton, L., S. R. Moran, and W. B. Bickley, Jr. 1976 Stratigraphy, Chronology, and Climatic Implications of Late Quaternary Upland Silt in North Dakota. North Dakota Geological Survey Miscellaneous Series, 54.

Kuehn, D. D. 1995 The Geoarchaeology of the Little Missouri Badlands: The Late Quaternary Stratigraphic and Paleoenvironmental Context of the Archaeological Record. Ph.D. Dissertation, Texas A&M University. University Microfilms, Ann Arbor.

Root, M. J., S. A. Ahler, C. R. Falk, J. E. Foss, H. Haas, and J. A. Artz 1986 Archeological Investigations in the Knife River Flint Primary Source Area, Dunn County, North Dakota: 1982–1986 Program. University of North Dakota, Department of Anthropology, Contribution 234.

## A Terminal Pleistocene Paleoshoreline Feature on Admiralty Island, Southeast Alaska

Madonna L. Moss and Jon M. Erlandson

To many scholars, the possibility that humans migrated into the New World along the North Pacific coast near the end of the Pleistocene remains a tantalizing, if unconfirmed, possibility. Finding early coastal sites is compli-

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cated by rapid postglacial sea-level rise and subsequent coastal erosion. Along the convoluted coastlines of northwestern North America, however, late-Pleistocene and early-Holocene shorelines have been preserved by the isostatic rebound of paleoshorelines in protected marine settings (Fladmark 1990). To focus the search for early Northwest Coast archaeological sites, the paleogeography of the area must first be reconstructed through the study of the glacial, sea level, and biological histories of the region. An important aspect of those studies is documenting and dating paleoshoreline features, including raised shell beds. In this paper, we report on one such feature located in Kanalku Bay on Admiralty Island, Southeast Alaska.

The Kanalku Bay shell bed was identified during a 1987 reconnaissance by the authors. Kanalku Bay is one of three major bays located in the complex estuarine system that empties out Kootznahoo Inlet on the southwest shore of Admiralty Island. Several wood-stake fishing weirs have been investigated in this region (Moss et al. 1990). At the Kanalku Bay fish weir (49-SIT-311), located in the intertidal zone at the mouth of Kanalku Lake Creek, we found one spruce (*Picea sitchensis*) stake (<sup>14</sup>C dated to  $955 \pm 35$  yr B.P.; Pitt-131) driven into estuarine clay containing numerous articulated butter clam (*Saxidomus giganteus*) shells in growth position. On the south side of the creek opposite this sampling location, a 1.2-m-high stream-bank profile revealed a basal estuarine mud again containing articulated *Saxidomus* shells. This shell bed was overlain by 30-40 cm of estuarine mud containing wood and other vegetal debris; a fluvial stratum 30-40 cm thick of poorly sorted cobbles, gravels, and coarse sands; and 40 cm of finer sands and muds, capped by a mineral soil supporting salt-grass marsh vegetation.

From the north bank of the creek, a single Saxidomus shell was <sup>14</sup>C dated to  $10,035 \pm 70$  yr B.P. (Pitt-134). With the shell bed located about 1 m below the modern high-water mark, and based on the modern tidal range of Saxidomus giganteus (ca. +1 m to - 0.75 m; Nickerson 1977), we estimate that the terminal-Pleistocene sea level was roughly 4 to 6 m higher than present on this part of Admiralty Island. Due to the steep topography, however, the position of the shoreline probably changed only slightly. Today, the exposed shell bed is located as little as 20-25 m from the current shoreline.

In recent years, considerable amounts of data have accumulated on paleoshorelines from Southeast Alaska and British Columbia (e.g., Clague et al. 1982; Fedje et al. 1995; Mann 1983; Mobley 1988; Putnam and Fifield 1995). The data suggest that raised marine shorelines dating to the terminal Pleistocene and early Holocene are present along much of the northern Northwest Coast. The elevations of these features vary widely depending on local glacial, isostatic, and sedimentation regimes (see Mobley 1988). Nonetheless, the wide distribution of these features near or above modern sea level suggests that numerous coastal landforms dated between 13,000 and 7,500 yr B.P. are present along the northern Northwest Coast.

Many of these localities would have been suitable for settlement by early maritime peoples. The abundance of shellfish remains in these Flandrian beach deposits also suggests that intertidal productivity was relatively high in some locales by the early postglacial. For the northern Northwest Coast, therefore, the hypothesis that productive intertidal and marine communities attractive to humans did not develop until the middle Holocene (e.g., Yesner 1980:734) seems to be unfounded. To effectively search for the archaeological sites early maritime peoples may have left behind, however, much more research is needed to document the spatial and temporal distributions of paleoshoreline features and the productivity of marine and estuarine communities.

#### **References Cited**

Clague, J. J., R. W. Mathewes, and B. G. Warner 1982 Late Quaternary Geology of Eastern Graham Island, Queen Charlotte Islands, British Columbia. *Canadian Journal of Earth Sciences* 19:1700–1790.

Fedje, D. W., A. P. Mackie, J. B. McSporran, and B. Wilson 1995 Early Period Archaeology in Gwaii Haanas: Results of the 1993 Field Programme. In *Early Human Occupation in British Columbia*, edited by R. Carlson and L. Dal Bona, University of British Columbia Press, Vancouver (in press).

Fladmark. K. R. 1990 Possible Early Human Occupation of the Queen Charlotte Islands, British Columbia. *Canadian Journal of Archaeology* 14:183–197.

Mann, D. H. 1983 The Quaternary History of the Lituya Glacial Refugium. Ph.D. dissertation, University of Washington, Seattle.

Mobley, C. M. 1988 Holocene Sea Levels in Southeast Alaska: Preliminary Results. Arctic 41(4):261-266.

Moss, M. L. 1989 Archaeology and Cultural Ecology of the Prehistoric Angoon Tlingit. Ph.D. dissertation, University of California, Santa Barbara. University Microfilms International, Ann Arbor.

Moss, M. L., J. M. Erlandson, and R. Stuckenrath 1990 Wood Stake Weirs and Salmon Fishing on the Northwest Coast: Evidence from Southeast Alaska. *Canadian Journal of Archaeology* 14:143–58.

Nickerson, R. B. 1977 A Study of the Littleneck Clam (Protothaca staminea conrad) and the Butter Clam (Saxidomus giganteus Deshayes) in a Habitat Permitting Coexistence, Prince William Sound, Alaska. Proceedings of the National Shellfisheries Association 67:85-102.

Putnam, D. E., and T. Fifield 1995 Estuarine Archaeology and Holocene Sea-Level Change on Prince of Wales Island, Alaska. Paper presented at Hidden Dimensions: the Cultural Significance of Wetland Archaeology, Vancouver, British Columbia, April 1995.

Yesner, D. R. 1980 Maritime Hunter-Gatherers: Ecology and Prehistory. Current Anthropology 21:727-750.

## General Stratigraphy and Geochronology of the Arc Site, Genesee County, New York

Kenneth B. Tankersley

Geographically, Arc (A037-10-0009, New York State Museum site number) is the largest early-Paleoindian site in New York state. The presence of buried, organic-rich late-Pleistocene and Holocene stratigraphy, as well as the geographic extent of the Arc site, provides an unique opportunity to obtain a large

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suite of geochronological data. Radiocarbon dating of the late-Pleistocene and Holocene stratigraphy allows us to chronometrically date the early-Paleoindian habitation, a rare geologic situation and unprecedented in the eastern Great Lakes region (Deller and Ellis 1988:255, 1992:126; Haynes 1991:438).

A mosaic of buried and intact late-Pleistocene and Holocene strata was exposed in recent geoarchaeological excavations and solid-sediment coring. While we were unable to find a single location with a complete uninterrupted late-Pleistocene through Holocene stratigraphic sequence, we identified a number of stratigraphic inliers (i.e., a group of strata surrounded by sediments of younger age). When this mosaic is examined collectively, a complete depositional history of the Arc site can be reconstructed.

Each stratigraphic section is like a patch on a quilt, and when viewed together the combined sections form a pattern of aggradation and degradation over the past c. 12,500 years. For example, in the southern section of the site (surface elevation 201 m, or 660 ft), we found more than 3 m of lacustrine deposits and peat overlying a firm, calcareous, silty clay diamicton. The lacustrine deposits consist of alternating red and gray varves overlain by upwardly grading clay, silt, and sands. They, in turn, are overlain by a layer of peat that extends to the modern land surface.

Undoubtedly, the diamicton amassed during the last glacial advance, c. 12,500 B.P. (Muller and Calkin 1988:57). As the ice margin withdrew to the north, glacial meltwater filled the adjacent Lake Erie basin. Discharging water flowed eastward and over the Arc site. The inflows of glacial meltwater created the extensive but shallow glacial Lake Tonawanda (Lewis and Anderson 1989; Tinkler et al. 1992). At this time, lacustrine sediments were deposited over the eroded diamicton surface. A radiocarbon assay obtained on a wood sample from the base of alluvium in nearbyWhitneyCreek demonstrates that Tonawanda lake waters had drained from the Arc site by  $11,700 \pm 110$  yr B.P. (BETA-47308) (Monaghan and Hayes 1993:14). In other words, Tonawanda would have been a dry lake basin at the time early Paleoindians first entered the eastern Great Lakes region and occupied the Arc site. Indeed, lacustrine deposits are absent in the northern section of the site (surface elevation  $\leq 198$  m, or 650 ft). In the uncultivated portions of this area, the eroded and weathered diamicton surface (i.e., a paleosol) is overlain by sequences of peat, marl, and tufa.

Early-Paleoindian artifacts and features occur on the surface of the weathered diamicton. It forms the surface of a series of shallow, sloping, erosional steps above and within Oak Orchard Swamp. Near the base of the slopes, the paleosol is overlain by a fine silt slope wash. Two radiocarbon age determinations  $(10,360 \pm 400 \text{ yr B.P. [BGS-1794] and } 10,375 \pm 110 \text{ yr B.P. [BGS-1795]}, 10,370 \pm 108 \text{ yr B.P. [weighted average]}) were made on wood and peat samples from a possible forest floor at the base of the overlying strata. These statistically comparable assays are$ *terminous post quem*, that is, they postdate the Paleoindian habitation of the site.

In some places (surface elevation 195 m, or 640 ft), an erosional hiatus occurs beneath more recent peat accumulations. Three radiocarbon dates were obtained from successive overlying peat layers:  $8,260 \pm 1,060$  yr B.P. (BGS-1840); 7,600 \pm 200 yr B.P. (BGS-1633); and  $5,260 \pm 190$  yr B.P. (BGS-1667)

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(Monaghan and Hayes, 1993:15; Weir et al. 1992). These radiocarbon dates support Monaghan's and Hayes's (1993) earlier interpretation that Oak Orchard Swamp formed during the Holocene, that is, after the Paleoindian habitation.

The early-Paleoindian habitation is likely related to the abundant mineral springs (i.e., salt, carbonate, and sulfate) that discharge on the Arc site. The mineral-rich waters reach the surface through faults and bedrock fractures under high hydrostatic pressure. Consequently, the flow of water would not have been affected by changing late-Pleistocene climatic conditions or the availability of surface moisture. In this regard, the Arc site is reminiscent of other mineral-spring related early-Paleoindian sites such as Sandy Springs, Ohio (Seeman et al. 1994), Big Bone Lick, Kentucky (Tankersley 1996), and Kimmswick, Missouri (Graham and Kay, 1988).

#### **References Cited**

Deller, D. B., and C. J. Ellis 1988 Early Palaeo-Indian Complexes in Southwestern Ontario. In *Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region*, edited by R. Laub, N. Miller, and D. Steadman, pp. 251–263, Bulletin of the Buffalo Society of Natural Sciences, Buffalo.

Deller, D. B., and C. J. Ellis 1992 *Thedford II.* Memoirs of the Museum of Anthropology, University of Michigan, No. 24, Ann Arbor.

Graham, R. W., and M. Kay 1988 Taphonomic Comparisons of Cultural and Noncultural Faunal Deposits at the Kimmswick and Barnhart Sites, Jefferson County, Missouri. In *Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region*, edited by R. Laub, N. Miller, and D. Steadman, pp. 227–240, Bulletin of the Buffalo Society of Natural Sciences, Buffalo.

Haynes, C. V. 1991 Geoarchaeological and Paleohydrological Evidence for a Clovis-Age Drought in North America and its Bering on Extinction. *Quaternary Research* 35:438–450.

Lewis, C. F. M., and T. W. Anderson 1989 Oscillations of Levels and Cool Phases of the Laurentian Great Lakes Caused by Inflows from Glacial Lakes Agassiz and Barlow-Ojibway. *Journal of Paleolimnology* 2:99–146.

Monaghan, G. W., and D. R. Hayes 1993 Geoarchaeology. In Stage III Archaeological Investigations at the Arc Site (ANR-29; AO37100009), Oakfield, New York. Commonwealth Cultural Resources Group, Inc. Jackson, MI.

Muller, E. H., and P. E. Calkin 1988 Late Pleistocene and Holocene Geology of the Eastern Great Lakes Region. In *Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region*, edited by R. Laub, N. Miller, and D. Steadman, pp. 53–63, Bulletin of the Buffalo Society of Natural Sciences, Buffalo.

Seeman, M., G. Summers, E. Dowd, and L. Morris 1994 Fluted Point Characteristics at Three Large Sites: The Implications for Modeling Early Paleoindian Settlement Patterns in Ohio. In *The First Discovery of America*. edited by W. S. Dancey, pp. 77–94, The Ohio Archaeological Council, Columbus.

Tankersley, K. B. 1996 Ice Age Hunters and Gatherers. In, *The Prehistory of Kentucky*, edited by R. B. Lewis, University of Kentucky Press, Lexington.

Tinkler, K. J., J. W. Pengelly, W. G. Parkins, and J. Terasmae 1992 Evidence for High Water Levels in the Erie Basin During the Younger Dryas Chronozone. *Journal of Paleolimnology* 2:99–146.

Weir, D. J., J. Schuldenrein, G. W. Lantz 1992 Stage II Archaeological Investigations for the Empire State Pipeline Project New York State: Arc Site (ANR-29; AO37-100009). Commonwealth Cultural Resources Group, Inc. Jackson, MI.

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(or Paleoamerican), archaeology, ca. (circa), yrB.P. (years before present), early, mid-, late- (i.e., early-Holocene), <sup>14</sup>C (radiocarbon 14; <sup>16</sup>C, etc.), in situ, et al., pers. comm., CRM (cultural resource management), and AMS or TAMS (accelerator mass spectrometer technique of radiocarbon dating). Metric units should be used and abbreviated throughout: mm, cm, m, km, ha, m<sup>2</sup>, etc.

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