CURRENT RESEARCH IN THE PLEISTOCENE

Volume 18 2001

A Peopling of the Americas Publication

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From the Editor

Paleolithic Archaeological Frauds

Japanese archaeology was rocked last year by the disclosure of fraud by one of the most honored amateur archaeologists in that country. Shinichi Fujimura was caught red-handed planting artifacts at the Kamitakamori site (Normile 2001). Fujimura has been a major contributor to the discovery and study of the early Japanese Paleolithic. He was called "God's hand" or said to have a "divine hand" signifying his uncanny luck at finding ancient sites. It now appears that his success had nothing to do with either luck or supernatural guidance. He has confessed publicly to planting artifacts at two sites: Kamitakamori and a site in Hokkaido (Normile 2001). But it is widely suspected that his fraud goes much further—implicating, perhaps, the entire record of the early and middle Paleolithic in Japan (Keally 2000; cf. Bleed 2000). According to a review of the case in *Science*, "Fujimura's confession dealt a body blow to claims of a much older human settlement in Japan and casts doubt on dozens, if not hundreds of related findings" (Normile 2001:34).

Archaeologist Peter Bleed, a recent guest professor at Tohuku University in Sendai, has argued that Fujimura's confessed perfidy does not invalidate all his contributions to Japanese archaeology or those of his collaborators: "Early/Middle Paleolithic excavations have all been overseen by competent, responsible researchers. I simply cannot believe that all of them could have been duped and I will not dismiss their work as careless" (Bleed 2000). Bleed goes on to describe excavations in which he participated:

> I watched Fujimura excavate his pit and find a couple of flakes. These were deep in the feature he was removing and they were entirely surrounded by well-compacted soil that was just like the soil in the pit I was working on [which yielded no artifacts]. . . . I have to believe that the objects I saw him remove are legitimate, ancient artifacts (Bleed 2000).

In response to Bleed's confidence in the abilities of himself and his Japanese colleagues to detect a clever hoax (one they did not suspect at the time), I offer the following trenchant remarks by James Randi, renowned magician and debunker of self-proclaimed psychics:

> Many 'men of science' stupidly assume that because they have been trained in the physical sciences or the medical arts, they are capable of flawless judgement in the investigation of alleged psychics. Nothing could be further from the truth. In fact, the more scientifically trained a person's mind, the more he or she is apt to be duped by an enterprising performer. A scientist's test tube will not lie; another human

> being will. Scientists are all the more easily deceived because they think in a logical manner. All my efforts as a professional magician are based on the assumption that my audience thinks logically and can therefore be fooled by me if I work on that assumption (Randi 1982:7).

Fujimura, in spite of the supernatural pretensions of his nickname, was no psychic, but Randi's observations (though harsh) are still relevant. Scientists do not normally expect other scientists to lie to them. Fujimura's colleagues may have been duped, not through carelessness, but because they were too trusting and too ready to accept evidence for what they already believed to be true (see Feder 2002:81).

Fujimura was a contributor to an article published in *CRP* in 1993, "The Takamori Site: A Possible > 300,000-Year-Old Site in Japan" (Kamata et al. 1993). This site is closely associated with the site at which Fujimura was caught planting artifacts. As of this writing, no retraction has been submitted to *CRP* by Fujimura or his coauthors. I hope they will consider whether doing so would not be in the best interests of Japanese archaeology—and world prehistory. The archaeology of the western Pacific rim is of fundamental importance for our understanding of the peopling of the Americas (see, for example, the Special Focus on Hokkaido archaeology in *CRP* 7). The intimacy of that connection is highlighted by recent studies suggesting Kennewick Man's closest affinities lie with the Ainu of Japan (Chatters 2001:220–223).

Archaeological frauds are not, of course, restricted to Japan. There have been several examples in the recent literature that relate directly to Paleoamericana: the apparently fraudulent fluted point found with the Angus mammoth in Nebraska (Howard 2001; see also Wormington 1957:43), the "cache" of spectacular fluted points supposedly from near Greeley, Colorado now known to have been made by a modern flintknapper (Preston 1999), and the troubling allegations of fraud at Sandia Cave (Preston 1995).

Sadly, frauds are not rare and isolated occurrences in science (Broad and Wade 1982) and archaeology seems an especially attractive arena for hoaxers (Feder 2002). Efforts to understand what motivates the perpetrators of frauds—and why certain frauds are exposed immediately while others gain widespread acceptance and misdirect scientists for years—are hampered by the complexity of the problem and by the understandable reluctance of the perpetrators and others directly involved to discuss what they did wrong. If Fujimura is truly repentant he should cooperate in a detailed study of why and how he did what he did. His collaborators and coauthors should frankly discuss what went wrong in this case and how such missteps might be avoided in the future. We have not seen the last fraud, and Fujimura and his colleagues have much they could teach us that might mitigate the effects of the next one. I hope they are able to overcome their personal shame and embarrassment in order to make this contribution. It could be Fujimura's last—and his most enduring—legacy.

References Cited

Bleed, P. 2000 Special Report: Digging Out of the Scandal. The Ancient East Asia Website, http://www.ancienteastasia.org/special/japanarchscandal2.htm; site viewed on 4 September 2001.

Broad, W., and N. Wade 1982 *Betrayers of the Truth: Fraud and Deceit in the Halls of Science.* Simon & Schuster, New York.

Chatters, J. C. 2001 *Ancient Encounters: Kennewick Man and the First Americans.* Simon & Schuster, New York.

Feder, K. L. 2002 *Frauds, Myths, and Mysteries: Science and Pseudoscience in Archaeology,* Fourth edition. McGraw-Hill, Boston.

Howard, C. D. 2001 Authentication Analysis of the Angus Nebraska Fluted Point. *Plains Anthropologist* 46:323–325.

Kamata, T., S. Fujimura, H. Kajiwara, and A. Yamada 1993 The Takamori Site: A Possible >300,000-Year-Old Site in Japan. *Current Research in the Pleistocene* 10:28–30.

Keally, C. T. 2000 Special Report: Japanese Scandals—This Time It's Archaeology. The Ancient East Asia Website, http://www.ancienteastasia.org/special/japanarchscandal.htm; site viewed on 4 September 2001.

Normile, D. 2001 Japanese Fraud Highlights Media-driven Research Ethic. *Science* 291:34–35.

Preston, D. 1995 The Mystery of Sandia Cave. *New Yorker,* 12 June 1995, pp. 66–83.

——— 1999 Woody's Dream. *New Yorker,* 15 June 1999, pp. 80–87.

Randi, J. 1982 *FlimFlam: Psychics, ESP, Unicorns and Other Delusions.* Prometheus, Buffalo, New York.

Wormington, H. M. 1957 *Ancient Man in North America,* Fourth Edition. Denver Museum of Natural History, Denver.

Important Editorial Note

Please note the changes to the "Information for Contributors" section in this issue. These are effective immediately and will be enforced for all future submissions. For the most part, the changes concern graphic images that we will accept. We will now accept photographs, but all photographs must be at least 5″ in height and width and must be submitted as black-and-white glossy prints—photocopies of photographs are not acceptable for publication. Drawn figures (ink, PMTs, or laser-printed computer graphics) should be submitted larger than final size; they will be reduced to the appropriate size for publication. Pencil drawings are not acceptable for publication. It is our hope that these changes will expedite the production process and that *CRP* will be coming out on a more timely schedule.

Archaeology

Agate Basin at Beacon Island, North Dakota

Stanley A. Ahler and Michael McGonigal

A significant Agate Basin site has been discovered in the Missouri River valley near New Town, North Dakota. The site is on a hill overlooking the former confluence of the Little Knife and Missouri rivers, now an island within artificial Lake Sakakawea. The site is on public land managed by the Omaha District of the U.S. Army Corps of Engineers. The site is presently documented by a collection of Agate Basin points discovered by fishermen and local residents in a restricted area of the eroding shoreline. Beacon Island and several nearby localities are well known for numerous Folsom finds in eroded contexts (Ahler et al. 1999; Schneider 1982).

At present, 23 complete and fragmentary Agate Basin points have been documented from the site and 20 have been examined in detail. The points conform in virtually all details of technology, precision, and symmetry (Figure 1) to the type of specimens from the Agate Basin site (Frison and Stanford 1982). Ten of 17 specimens with intact distal portions show distal resharpening; basal fractures are not reworked. Impact fractures on 14 specimens range from crushing to distal fluting (Figure 1C) and buckle breaks (Figure 1F). The character of the sample (about 50 percent are medial and distal fragments) is similar to the type in the Agate Basin site collection and suggests a kill site; one burned basal fragment also suggests hearth-centered activities.

In contrast to local Folsom assemblages dominated by Knife River flint (found locally and in quarries 75 km to the south), several toolstones are common. These include antelope chert (35 percent), porcellanite (15 percent), and Swan River chert (10 percent) (sources to the southwest, southwest, and northeast, respectively), as well as KRF (40 percent). Points in the sample describe a distinctly tri-modal size distribution (see caption, Figure 1); the reason for this is uncertain, but the variation contrasts markedly with uniform haft width in Folsom points (e.g., Judge 1973:171–172).

Despite widespread surface finds of Agate Basin and Agate Basin-like points over a large part of the northern Plains and adjacent Upper Midwest (e.g., Hill et al. 1998), very few in situ Agate Basin components have been

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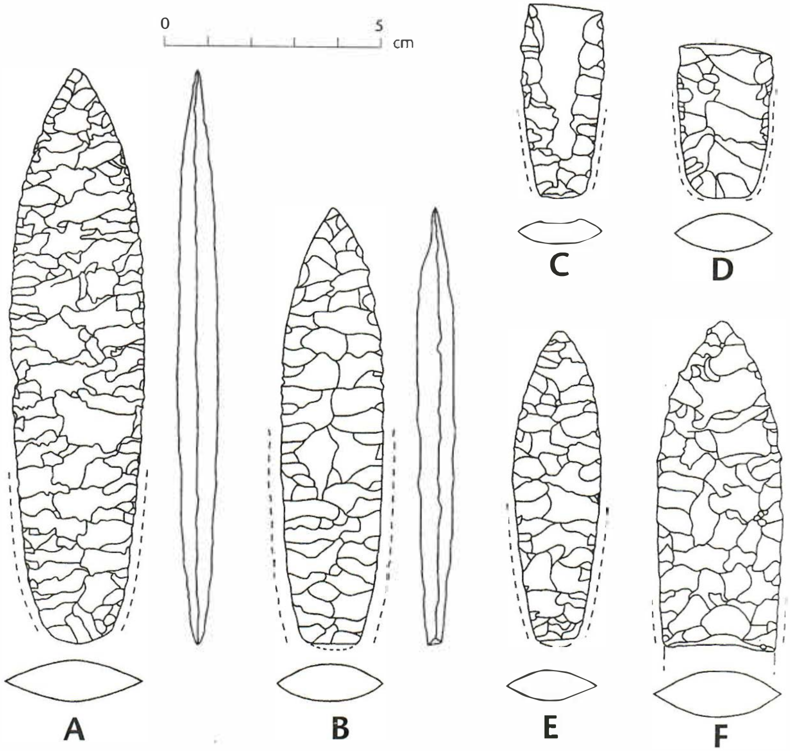

Figure 1. Agate Basin points from Beacon Island, North Dakota, in three distinct size variants. **A, F,** large; **B, D,** medium; **C, E,** small. Specimen **A** has not been reworked; all others have been distally resharpened.

investigated (e.g., Agate Basin, Wyo.; Hell Gap, Wyo.; and Frazier, Colo.). Thus, Beacon Island may prove one of the most significant discoveries in recent years. Pertinent research topics include technofunctional aspects of the point and haft assembly and the cultural relationship between Agate Basin and Folsom (Ahler and Geib 2000a, 2000b; Stanford 1998).

We thank Robert-George de Stolfe for preparation of Figure 1.

References Cited

Ahler, S. A., and P. R. Geib 2000a Why Flute? Folsom Point Design and Adaptation. *Journal of Archaeological Science.* 27:799–820.

——— 2000b Why the Folsom Point Was Fluted: Implications from a Particular Technofunctional Explanation. Manuscript submitted for publication in the Proceedings of the Folsom Workshops I and II, edited by J. E. Clark and M. B. Collins. Special edition of *Lithic Technology*, in press.

Ahler, S. A., G. C. Frison, and M. McGonigal 1999 Folsom and Other Paleoindian Artifacts in the Missouri River Valley, North Dakota. Manuscript submitted for publication in the Proceedings of the Folsom Workshops I and II, edited by J. E. Clark and M. B. Collins. Special edition of *Lithic Technology*, in press.

Frison, G. C., and D. J. Stanford 1982 Agate Basin Components. In *The Agate Basin Site,* by G. C. Frison and D. J. Stanford, pp. 76–134. Academic Press, New York, NY.

Hill, M. G., D. S. Amick, and T. J. Loebel 1998 An Inventory of Wisconsin Paleoindian Projectile Points at the Milwaukee Public Museum. *Current Research in the Pleistocene* 15:18–20.

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

Schneider, F. E. 1982 A Preliminary Investigation of Paleo-Indian Cultures in North Dakota. *Manitoba Archaeological Quarterly* 6:16–43.

Stanford, D. 1998 Discussant in a Symposium on Paleoindian Land Use of the Rocky Mountains from Canada to Colorado. 63rd Annual Meeting of the Society for American Archaeology. Seattle, WA.

Station E: An Early-Holocene Stratum 2 Bone Bed At the Lubbock Lake Landmark

Susan E. Baxevanis

Investigations of the stratum 2 bone bed at Station E were carried out in 1949 by Glen Evans and Grayson Meade for the Texas Memorial Museum (TMM), Austin (Holliday and Johnson 1990; Johnson 1987). However, few results of their work were published (Johnson 1987; Sellards 1952). Evans and Meade's work focused on the stratigraphy of the reservoir walls, around and including Station E. When bone beds were encountered, a portion was exposed by digging into the wall and bones were removed, sometimes in plaster jackets for later research. Several Folsom points were found in situ with *Bison antiquus* bones in stratum 2 near Stations 1 and D (Holliday and Johnson 1990). However, no points were found at Station E with the stratum 2 bison bone bed. The bones were compressed and poorly preserved; the quality of bone preservation was similar to that encountered at Stations I and D. The general stratigraphic setting in Station E also was similar to Stations I and D.

Station E is a rich but puzzling source of information. Evans (1949) identified stratum 2 in general as a massive diatomaceous earth unit and stratum 2 at Station E as the "massive diatomaceous member," without designating any subdivisions. At Station D, the bison bones and Folsom points are noted as coming from the basal banded and laminated deposits; at Station I, material is noted as coming from the lower part of stratum 2 (Evans 1949). Stratum 2 at Station E is composed of two subdivisions, the bottom being laminated diatomite (substratum 2A), the upper being silty clay loam (substratum 2B) (Holliday 1985; Holliday and Allen 1987). Substratum 2A dates between 10,800 and 10,000 yr B.P., substratum 2B between 10,000 and 8,500 yr B.P. (Holliday 1985; Holliday and Allen 1987; Johnson and Holliday 1989).

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Evans and Meade presumed the Station E stratum 2 bone bed to be Folsom, based on correlation with the stratigraphy and Folsom points at Stations D and I. However, geoarchaeological research at Lubbock Lake (Holliday 1985) has demonstrated that stratum 2 is more complex, with Folsom-age bone beds occurring in lower substratum 2A, Plainview-age bone beds at the contact of substrata 2A and 2B, and Firstview-age bone beds in mid to upper 2B. As it is unclear exactly from where the plaster jackets were taken, the exact age of the material is in question.

The Paleoindian assemblages differ in the treatment of bone piles, the variance between their tool assemblages, the distinctive types of projectile points, and their age (Johnson 1987). Therefore, for the Station E stratum 2 materials, the plaster jackets could be of utmost importance in yielding data on bone treatment and organic sediments for radiocarbon assay.

Upon examining the eight stratum 2 plaster jackets from Station E, two were selected to be opened first, based on their large size and potential for sediments. One contained a bison skull, the other a pelvis. Once opened, the very poor condition of the bone was apparent. The bones were highly fragmented, and the jackets had been plastered in close proximity to the surface of the bone. An organic sediment sample was sent to the Desert Research Institute for radiocarbon assay. However, insufficient organics were present to produce a reliable date. An AMS date of ca. 6300 RCYBP was also unreliable. Based on a number of radiocarbon ages, stratum 2 diatomite (substratum 2A) dates from ca. 10,800 to 10,000 RCYBP (Holliday et al. 1983, 1985; Johnson 1987). No lithic material or cultural modification to the bone was found within the two opened jackets. The remaining jackets were not opened, owing to the poor condition of the bone and the lack of sediment surrounding the specimens inside.

Based on information obtained from excavating the plaster jackets, neither the treatment of the bone nor the type of tool assemblages could be determined. However, the sediment was determined to be laminated diatomite. The diatomite places the bones in these two plaster jackets within substratum 2A, identifying them as Folsom age (Holliday 1985). However, the age and cultural affiliation of the material in the other six jackets are still unknown. Attempts at determining archaeological and chronological context for the early Holocene Station E stratum 2 bone bed at Lubbock Lake using the TMM collection are continuing. However, it is necessary to reinvestigate stratum 2 in order to resolve the geochronological complexities of Station E.

The author would like to thank the Vertebrate Paleontology Laboratory of Texas Memorial Museum, and Dr. Ernest Lundelius in particular, for permission to borrow and excavate the eight stratum 2 plaster jackets from Station E. Funding for this project was provided by the Graduate School Summer Research Award, Texas Tech University and the Museum of Texas Tech University. This work is part of the ongoing Lubbock Lake Landmark regional research program in late-Quaternary climatic and environmental change on the Southern High Plains.

References Cited

Evans, G. L. 1949 Field Notes and TMM Accession Records. Copy on File at the Museum of Texas Tech University, Lubbock, TX.

Holliday, V. T. 1985 Archaeological Geology of the Lubbock Lake Site, Southern High Plains of Texas. *Geological Society of America Bulletin*, 96:1483–1492.

Holliday, V. T., and B. L. Allen 1987 Geology and Soils in *Lubbock Lake: Late Quaternary Studies on the Southern High Plains*, edited by E. Johnson, pp. 14–21. Texas A&M University Press, College Station, TX.

Holliday, V. T., and E. Johnson 1990 Fifty Years of Discovery: The Lubbock Lake Landmark. In *Lubbock Lake Landmark Quaternary Research Center Series* 2, edited by V. T. Holliday and E. Johnson Museum of Texas Tech University.

Holliday, V. T., E. Johnson, H. Haas, and R. Stuckenrath 1983 Radiocarbon Ages from the Lubbock Lake Site, 1950–1980: Framework for Cultural and Ecological Change on the Southern High Plains. *Plains Anthropologist*, 28(101):165–182.

——— 1985 Radiocarbon Ages from the Lubbock Lake Site: 1981–1984. *Plains Anthropologist*, 30(110-1):277–291.

Johnson, E. 1985 Current Developments in Bone Technology. In *Advances in Archaeological Method and Theory*, edited by M. B. Schiffer, 8:157–235. Academic Press, New York, NY.

——— 1987 *Lubbock Lake: Late Quaternary Studies on the Southern High Plains*. Texas A&M University Press, College Station, TX.

Johnson, E., and V. T. Holliday 1989 Lubbock Lake: Late Quaternary Cultural and Environmental Change on the Southern High Plains. *Journal of Quaternary Science*. 4(2):145–165.

Sellards, E. H. 1952 *Early Man in America*. University of Texas Press, Austin, TX.

Cody Obsidian Use in the Southern Plains

Jeannette M. Blackmar, Jack L. Hofman, and Ray Kunselman

Cody evidence in Oklahoma is limited primarily to surface evidence and isolated finds. We have recorded 97 Cody artifacts (Blackmar and Hofman 1997), although no Cody assemblages have been documented. One such surface lithic collection is the Flaming site that was discovered in a wheat field by Steve Flaming in 1972. The site is strategically situated along a narrow divide defined by the Washita River and Cobb Creek drainages in Washita County, Oklahoma. This divide would have provided a natural northwest-southeast corridor of movement for bison herds and other animals. The site position is similar to a number of other bison kills in the region including the Lipscomb, Waugh, and Certain sites.

Our best evidence of site function at Flaming comes from the limited artifact inventory. This includes an Edwards chert Cody point (tip broken by farm implements), a nearly complete obsidian Cody point found a few meters away, two small retouch flakes, and the distal end of an endscraper. Typologically, the Edwards point is comparable to the Firstview points from Olsen-Chubbuck (Wheat 1972) and Seminole Rose (Collins et al. 1997). This point is 6.36 (broken) cm long, 2.27 cm wide, and 86 cm thick. The Flaming

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obsidian point fits easily within the Scottsbluff I type (Wormington 1957). It is 10.12 cm long, 3.41 cm wide, and 1.01 cm thick, with a stem length of 2.01 cm and basal width of 2.21 cm. The obsidian point has slight impact damage on the tip and one basal corner; the second Cody point has prehistoric damage on the base. Both points are large and are assumed to have been lost or cached. The damage suggests they were lost during use; such loss of complete or nearly complete points commonly occurs during kill events (Wheat 1972). The lack of bone at the site may be a reflection of site formational history and lack of preservation due to the shallow context. Excavation at the find spot could provide additional information. Our preferred explanation is that the site represents a small kill that simply lacks faunal preservation. The endscraper fragment and retouch flakes support the interpretation of activities associated with a kill/butchery site.

In an effort to source the obsidian point from Flaming, Ray Kunselman conducted a nondestructive X-ray fluorescence analysis on an ORTEC TEFA energy-dispersion XRF spectrometer (Kunselman 1994, 1996). The analysis revealed that the closest elemental comparison for the Flaming point is with the Wright Creek obsidian source near Malad, Idaho. While this source determination is not absolute, it is clear that the obsidian is *not* from the much closer source areas in the Jemez Mountains of northern New Mexico. The straight-line distance of the Flaming site from the Wright Creek, Idaho, obsidian source is approximately 1,375 km (Figure 1).

The only known Oklahoma obsidian Cody artifact is the Flaming point. Other occurrences of obsidian in Cody assemblages are widespread but limited. Satterthwaite (1957) reports a broken Scottsbluff point of obsidian from the Finley site, and Frison (1987:275) reports one from Horner, both in Wyoming. Cannon and Hughes (1993) report an Alberta point of Idaho obsidian (Bear Gulch source area) from Yellowstone Park, and Davis (1972) reports less than 3 percent Alberta-Cody obsidian points from the Montana area (Davis et al. 1995). Dick and Mountain (1960) report a broken Cody knife of obsidian from the Claypool site in Colorado. McNeish et al. (1967) report an obsidian Scottsbluff point from site Tc50 in the Tehuacan Valley. Western Stemmed points from the Great Basin are more commonly made of obsidian (e.g., Amick 2000; Green et al. 1998). This tentative link between Southern Plains Cody and the Great Basin, provided by the Flaming site point, indicates long-distance movement of lithic material, and probably people and ideas as well.

References Cited

Amick, D. S. 2000 The McNine Collection: A Possible Cache of Early Stemmed Bifaces from Northwestern Nevada. Paper presented at the 27th Great Basin Anthropological Conference, Ogden. UT.

Blackmar, J. M., and J. L. Hofman 1997 Cody Complex Artifacts in Oklahoma. *Current Research in the Pleistocene* 14:9–11.

Cannon, K., and R. E. Hughes 1993 Obsidian Source Characterization of Paleoindian Projectile Points from Yellowstone National Park, Wyoming. *Current Research in the Pleistocene* 10:54–56.

Collins, M. B., D. J. Stanford, J. L. Hofman, M. A. Jodry, R. O. Rose, K. Kibler, and J. M. Blackmar

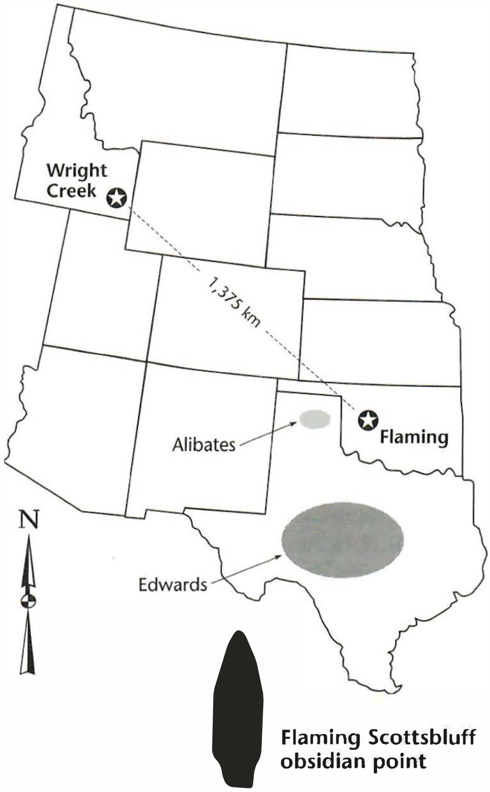

Figure 1. Flaming site, relative to lithic sources.

1997 Cody Down South: The Seminole-Rose Site in West Texas. *Current Research in the Pleistocene* 14:15–18.

Davis, L. B. 1972 *The Prehistoric Use of Obsidian in the Northwestern Plains.* Ph.D. dissertation, Department of Anthropology, University of Calgary.

Davis, L. B., S. A. Aaberg, J. G. Schmitt, and A. M. Johnson 1995 *The Obsidian Cliff Plateau Prehistoric Lithic Source, Yellowstone National Park, Wyoming.* Selections from the Division of Cultural Resources No. 6, Rocky Mountain Region, National Park Service, Denver, CO.

Dick, H., and B. Mountain 1960 The Claypool Site: A Cody Complex Site in Northeastern Colorado. *American Antiquity* 26:223–235.

Frison, G. C. 1987 The Tool Assemblage, Unifinished Bifaces, and Stone Flaking Material Sources for the Horner Site. In *The Horner Site, The Type Site of the Cody Cultural Complex,* edited by G. C. Frison and L. C. Todd, pp.233–278. Academic Press, Orlando, FL.

Green, T. J., B. Cochran, T. W. Fenton, J. C. Woods, G. L. Titmus, L. Tieszen, M. A. Davis, S. J. Miller 1998 The Buhl Burial: A Paleoindian Woman from Southern Idaho. *American Antiquity* 63(3):437–456.

Kunselman, R. 1994 Prehistoric Obsidian Utilization in the Central Rocky Mountains: The Lookingbill Site 48FR308. *The Wyoming Archaeologist* 34(1-2):15–25.

——— 1996 UWXRF Letter Report 96.8. Department of Physics, University of Wyoming, Laramie, WY.

MacNeish, R. S., A. Nelken-Terner, and I. W. Johnson 1967 *The Prehistory of the Tehuacan Valley: Volume 2, Nonceramic Artifacts.* University of Texas Press, Austin, TX.

Satterthwaite, L. 1957 *Stone Artifacts at and Near the Finley Site Near Eden, Wyoming.* Museum Monographs 4. University Museum, University of Pennsylvania, Philadelphia, PA.

Wheat, J. B. 1972 *The Olsen-Chubbuck Site: A Paleoindian Bison Kill.* Memoir of the Society for American Archaeology 25.

Wormington, H. M. 1957 *Ancient Man in North America.* Denver Museum of Natural History. Popular Series 4. Denver, CO.

The Jefferson IV Site (27-CO-45), Jefferson, New Hampshire

Richard A. Boisvert and Kathryn Puseman

The chance discovery of a fluted-point fragment in 1995 led to the identification of a Paleoindian site in Jefferson, N.H., and subsequent investigations documented two more Paleoindian sites and the definition of the Israel River Complex (Boisvert 1998). In June 2000, the senior author was apprised of a possible new site abutting the Complex. In July and October five 1-by-1-m test pits and a 50-by-50-cm test pit documented another Paleoindian site. The artifact inventory consists of 46 waste flakes and 2 unifacially worked lithics, besides one complete and one fragmentary fluted point.

Although the artifact count and density are low, the site has yielded significant information. The fluted points represent two distinctively different styles of points. The complete point (Figure 1A) is most similar to the

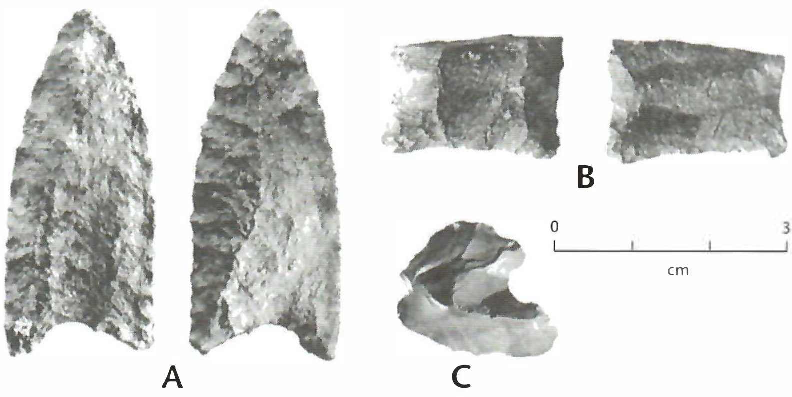

Figure 1 Fluted point, fluted point fragment, and Munsungun chert flake from the Jefferson IV site.

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Gainey and Bull Brook varieties (Spiess, Wilson and Bradley 1998:235), exhibiting ground parallel sides and a base indented 5 mm. The basal fragment (Figure 1B) most closely resembles the Barnes or Michaud/Neponset style (Carty and Spiess 1992:27–30), with slightly flared basal corners and shallow concave base. Both points were found in undisturbed strata and are the only diagnostic artifacts recovered from the site.

A Munsungun chert flake (Figure 1C) was discovered in situ in undisturbed context. Upon recovery, we recognized that the arrises were extremely worn, indicating the flake had been struck from a relatively large biface that had been used for strenuous cutting or scraping. Also, the flake had a concavity created by the hinge termination of a previous flake removal; organic material would have been trapped in this concavity. Consequently we considered the specimen to be a prime candidate for the retention of animal protein. Residues removed from the flake and the complete point were subjected to a cross-over immunoelectrophoresis (CIEP) analysis at Paleo Research Laboratories (Puseman 2001) and tested against antisera from 18 different animal species. The complete point yielded negative results to all antisera tested. The flake, however, yielded a positive result to deer antiserum, indicating the presence of protein from a member of the Cervid family such as deer, moose, elk, or caribou. Given the context of the find, we feel that caribou is the most likely source, although the other possibilities cannot be dismissed. This identification is important because there is scant evidence of specific fauna from New England Paleoindian sites. Caribou bone or antler has been reported from Bull Brook and the Whipple sites (Spiess, Curran, and Grimes 1985:147). Cervid antler is reported from the Neal Garrison site in Eliot, Maine (Spiess 2000), and from the Michaud site (Spiess and Wilson 1987:84–85). Beaver was also reported from Bull Brook (Spiess, Curran & Grimes 1985:148). The identifiable faunal database from New England Paleoindian sites is sorely limited.

The site is clearly Paleoindian and has been added to the Israel River Complex. More importantly, the identification of cervid protein significantly adds to our body of knowledge at both the site and regional levels. This finding strongly suggests that more such specimens may be present at the site. It is also regionally important because it represents a large step forward in expanding our corpus of faunal data associated with Paleoindians of the Northeast.

References Cited

Boisvert, R. A. 1998 The Israel River Complex: A Paleoindian Manifestation in Jefferson, New Hampshire. *Archaeology of Eastern North America* 26:97–106.

Carty, F. M., and A. E. Spiess 1992 The Neponset Paleoindian Site in Massachusetts. *Archaeology of Eastern North America* 20:19–38.

Puseman, K. 2000 Protein Residue of Artifacts from Site 27CO45, New Hampshire. *Paleo Research Labs Technical Report* 00-97. Unpublished technical report prepared for the NH Division of Historical Resources.

Spiess, A. E. 2000 Notes on Identification of Calcined Bone Pieces. In *Phase III Data Recovery Excavations at the Neal Garrison Paleoindian Site (1.8 ME), Eliot, York County, Maine,* Douglas C. Kellogg and Kevin Simmons, Appendix XII. Report prepared for Portland Natural Gas Transmission System, Portsmouth, New Hampshire. Copies on file at the Maine Historic Preservation Commission, Augusta, ME.

Spiess, A. E., M. L. Curran, and J. R. Grimes 1985 Caribou (*Rangifer Tarandus L.*) Bones from New England Paleoindian Sites. *North American Archaeologist* 6(2):145–159.

Spiess, A. E., and D. B. Wilson 1987 Michaud: A Paleoindian Site in the New England–Maritimes Region. *Occasional Publications in Maine Archaeology* 6. The Maine Historic Preservation Commission and the Maine Archaeological Society, Inc. Augusta, ME.

Spiess, A. E., D. B. Wilson, and J. W. Bradley 1998 Paleoindian Occupation in the New England–Maritimes Region: Beyond Cultural Ecology. *Archaeology of Eastern North America* 26:201–264.

New Evidence of Paleoindian Occupations in Rocky Mountain National Park, North-Central Colorado

Robert H. Brunswig, Jr.

High-altitude archaeology in the Rockies of north-central Colorado until recently has been confined to relatively small-scale survey and testing programs. Only in the past decade have larger-scale multidisciplinary research programs emerged (e.g., Kornfeld and Frison 2000). One such program is the University of Northern Colorado (UNC) 5-year National Park Service–funded Systemwide Archeological Inventory Program (SAIP). The UNC research project by late 2000 had completed a survey of 15,000+ acres, documented 500 new sites and isolated finds, and re-recorded 30 previously known sites.

Of that number, only seven produced evidence of Paleoindian occupations. Even so, they provide the basis for important new understanding of the region's earliest peoples. The project's most significant Paleoindian evidence came from testing of the Lawn Lake (5LR318-3365 masl) site with its 50-cm-thick cultural deposits embedded in a terrace of Roaring River, immediately below a glacial col valley lake (Brunswig 2001). Its lowest of three cultural units (unit 3) contained a Paleoindian deposit with associated lithic tools, flaking debris, and a late-Paleoindian projectile point base (Figure 1A), the latter similar to ones recovered from Caribou Lake by Benedict (1974: Figure 2a) and Pitblado (1999b: Figure 1) and radiocarbon-dated at Caribou Lake between 9000 and 7900 RCYBP. The Lawn Lake point base supplemented an earlier surface find of an indented Allen point base (Figure 1B). Lawn Lake Paleoindian radiocarbon dates were 8000 ± 170 RCYBP (Beta-144867) at the base of the deposit and 7160 ± 40 RCYBP (Beta-144869) in its

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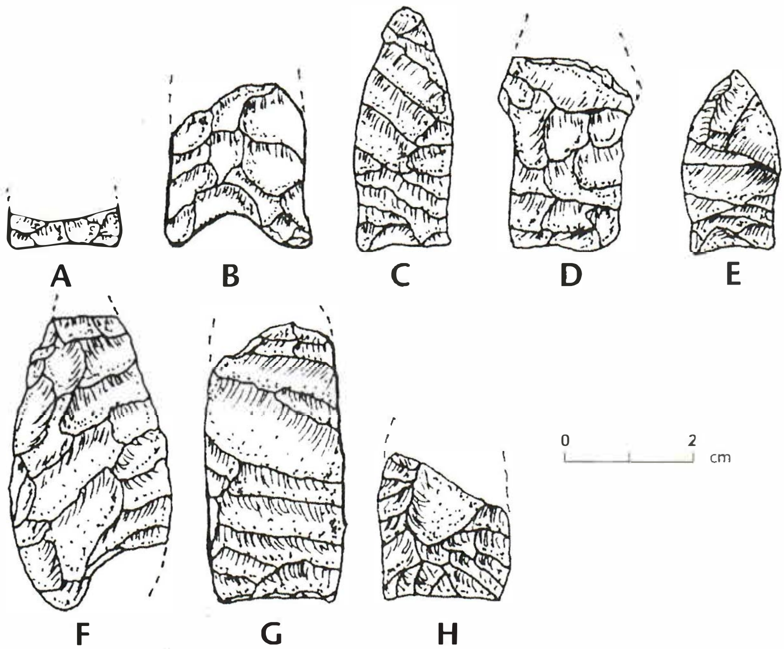

Figure 1. Paleoindian projectile points recovered during UNC archeological inventory surveys, 1998–2000.

upper area. Source material analysis of Paleoindian lithic artifacts showed a nearly complete preponderance of cherts, jaspers, and quartzites from Middle Park quarries immediately west of the continental divide (Kremmling and Table Mountain cherts and jaspers) and from central Wyoming (Hartville Formation sources).

Along with Lawn Lake, six other Paleoindian sites were identified. Three are located on or near major or secondary passes, two on lower elevation stream valleys, and one on a mountain slope, all in the northern half of RMNP. One, 5LR7075 (3536 masl), is a small open alpine bench camp near a minor pass. It yielded a complete parallel-oblique-flaked Pryor Stem point (Figure 1C) dated at ca. 8450–7800 RCYBP (see Pitblado 1999a: Table 4.6, Figure 4.14b,c and d), made of very fine reddish (heat-treated) Hartville Formation (Wyoming) quartzite. A second site, 5LR7075 (3536 masl), occupies a tundra ridge camp overlooking Fall River valley, a major route to Fall River Pass, where several prehistoric trails intersect and descend on both sides of the continental divide. The site contained a lower-Paleoindian point base (Figure 1D) dated at 8450–7800 RCYBP, possibly belonging to the Cody Complex but more likely a Pryor Stem/Lovell Constricted–type variant (Pitblado 1999a: Figure 4.16b), made of Kremmling chert. The third high-altitude Paleoindian find was 5GA2537 (3272 masl). The small Kremmling chert point (Figure 1E) was found immediately below (southwest) Milner

Pass where it descends into the Kawuneeche (Colorado River) valley. The Milner Pass point is strongly reminiscent of Goshen finds in nearby Middle Park, dated between ca. 11,000 and 9000 RCYBP (cf. Pitblado 1999a: Figure 4.23a, b and c; Kornfeld and Frison 2000: Figure 3-9).

The final three sites are located in lower-elevation (upper and middle montane forest) zones. The most extensive was 5LR9826 (3109 masl), a multicomponent stream confluence camp with a partial parallel-oblique-flaked late-Paleoindian (Fredrick/Lusk/Angostura variant) point (Figure 1G) dated at 9700–7550 RCYBP (Pitblado 1999a: Table 4.11, Figure 4.32a and c, Figure 6.14a and b), made of Windy Ridge quartzite. A second valley terrace camp (5LR4552-2498 masl) in Moraine Park (eastern RMNP) yielded a Pryor Stem/Lovell Constricted variant point (Figure 1E) dated at ca. 8450–7800 RCYBP (see Pitblado 1999a). The final Paleoindian site of note is 5LR7074 (2843 masl), which yielded an isolated find of a lanceolate point (Figure 1F) made of Hartville quartzite with a hint of basal flake thinning (a base corner is broken) and provisionally identified as a Clovis variant, dated at ca. 11,250–11,000 RCYBP (compare Frison and Todd 1986: Figure 3.2). The point was found on a forested mountain slope immediately above the Ute Trail near where it exits into the RMNP Beaver Meadows valley.

References Cited

Benedict, J. B. 1974 Early Occupation of the Caribou Lake Site, Colorado Front Range. *Plains Anthropologist* 19(63):1–4.

Brunswig, R. H., Jr. 2001 *Lawn Lake (5LR318): Results of an Archeological Mitigation Research Project at a High Altitude Site in Rocky Mountain National Park.* Greeley, Colorado, Department of Anthropology, University of Northern Colorado.

Pitblado, B. L. 1999a *Late Paleoindian Occupation of the Southern Rocky Mountains: Projectile Points and Land Use in the High Country.* P.D. Dissertation, Department of Anthropology, University of Arizona, Tucson, AZ.

—— 1999b New ^{14}C Dates and Obliquely Flaked Projectile Points from a High-Altitude Paleoindian Site, Colorado Rocky Mountains. *Current Research in the Pleistocene* 16:65–66.

Frison, G. C., and L. C. Todd 1986 *The Colby Mammoth Site.* University of Mexico Press, Albuquerque, NM.

Kornfeld, M., and G. C. Frison 2000 Paleoindian Occupation of the High Country: The Case of Middle Park, Colorado. *Plains Anthropologist* 45 (172):129–153.

The 1948 and 1999 Excavations of Stratum 2 Paleoindian Bone Beds in Station E (Area 18) at Lubbock Lake

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Glen Evans and Grayson Meade, working at Lubbock Lake (41LU1) on the Southern High Plains of Texas in 1948, 1949, and 1951 for Texas Memorial Museum (TMM), uncovered numerous Paleoindian occupations situated along the walls of the reservoir that constituted the then known areal extent of the site. The reservoir, excavated by the W.P.A. in 1936 along Yellowhouse Draw to reactivate local springs, exposed Paleoindian artifacts at the base of the valley fill (strata 1 and 2). The TMM work was carried out along the walls of the reservoir at a series of stations (A–O and Q). Most of the excavations concentrated on Stratum 2 containing Paleoindian materials (Johnson and Holliday 1987:7). When bone beds were encountered, a portion was exposed by digging into the reservoir wall, and bones were removed; occasionally sections were plaster-jacketed for future research. Several Folsom points were found in situ among *Bison antiquus* bone beds in stratum 2 near Stations I and D (Johnson and Holliday 1987:7). Bison bones also were recovered from stratum 2 at Station E (now designated Area 18 at Lubbock Lake) in a layer 18 inches thick (Evans 1949). Although "a few small, non-definitive flint spalls" were recovered (Johnson and Holliday 1987:9), the bone could not be associated with a particular Paleoindian cultural affiliation. However, based on stratigraphic correlation, Evans and Meade assumed the bone uncovered in Station E was the result of a Folsom kill (Evans 1949).

Information regarding the excavations at Station E is limited. Little of the TMM work at Lubbock Lake was published; most of what is known of Station E comes from analyzing removed loose bone and the plaster jackets. However, questions regarding the number of kills present, their microstratigraphic placement, and their ages prompted renewed archaeological and geoarchaeological investigations in the area.

In order to facilitate work in Station E, mechanical trenching equipment was used to remove overburden that had accumulated over the past 25 years. Cleaning of the area exposed over 7 m laterally of stratum 2 with well-defined microstratigraphy that was sampled for phytoliths, diatoms, stable-carbon isotopes, and radiocarbon analysis. Bison bone was exposed in the profile in distinct layers (top to bottom): middle substratum 2B, lower 2B, and 2A. This 3-tiered exposure was about 18 inches thick. TMM excavations collected bone from all three bone layers. Test excavations concentrated on a remnant shelf of substratum 2A, left protected at the base of the profile. A bison bone bed feature (FA18-1) was exposed within a thick layer of diatomite at the base of substratum 2A.

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Substratum 2A has been dated in other contexts at Lubbock Lake between 10,800 and 10,300 RCYBP (Holliday et al. 1983, 1985; Johnson 1987). That affiliation was confirmed with the recovery of a Folsom point. The point is complete and fluted on both faces, with a typical concave base and two protruding basal ears. The point is 52.4 mm long and 23.2 mm at its greatest width, with edge grinding to approximately 30 mm from the base. The point is made of gray Edwards Formation chert. The closest source of Edwards Formation chert to Lubbock Lake is in central Texas over 180 km to the southeast (Holliday and Welty 1981). The tip of the point appears to have been resharpened at least once. The point was recovered among numerous bison bone elements, most of which were naturally deteriorated and fragmented.

Two sediment samples, corresponding to the upper two bone layers in the Area 18 profile, were radiocarbon dated. The sample from middle 2B, at the same elevation as the upper bone layer, yielded an age of 9600 ± 55 RCYBP (NSRL-10973; humic acid), probably affiliated with Firstview. The sample from the base of 2B and at the same elevation as the middle bone bed yielded an age 9810 ± 50 RCYBP (NSRL-10974; humic acid) probably affiliated with Plainview (Johnson and Holliday 1995).

The reinvestigation of Area 18 has answered some of the questions left from the TMM work. Investigations have revealed at least three bone layers in stratum 2 corresponding in age to the known regional Paleoindian sequence and exposed a portion of the lowermost bone bed. However, Evans and Meade did not differentiate between the three bone beds within the 18-inch-thick bone deposit. Although the lowermost bone bed is Folsom, the assumption cannot be made that all the stratum 2 bone recovered by Evans and Meade are from this lowermost layer and represent a Folsom bison kill.

Reinvestigation of Station E at Lubbock Lake was funded by the Museum of Texas Tech University and in part by NSF Earth System History Program grant EAR-9807347 (to VTH) and conducted as part of the research at the Lubbock Lake Landmark under Texas Antiquities permit #1515. This work is part of the ongoing Lubbock Lake Landmark regional research program into late Quaternary cultural adaptations to changing grassland ecosystem on the Southern Plains.

References Cited

Evans, G. L. 1949 Field Notes and TMM accession records. Copy on file at the Museum of Texas Tech University, Lubbock, TX.

Holliday, V. T., and C. M. Welty 1981 Lithic Tool Resources of the Eastern Llano Estacado. *Bulletin of the Texas Archeological Society* 52:201–214.

Holliday, V. T., E. Johnson, H. Haas, and R. Stuckenrath 1983 Radiocarbon Ages from the Lubbock Lake Site, 1950–1980: Framework for Cultural and Ecological Change on the Southern High Plains. *Plains Anthropologist* 28(101):165–182.

——— 1985 Radiocarbon Ages from Lubbock Lake Site, 1981–1984. *Plains Anthropologist* 30(110):1227–1291.

Johnson, E. 1987 *Lubbock Lake. Late Quaternary Studies on the Southern High Plains.* Texas A&M University Press, College Station, TX.

Johnson, E., and V.T. Holliday 1987 Introduction. In *Lubbock Lake. Late Quaternary Studies on the Southern High Plains,* edited by E. Johnson, pp. 3–13. Texas A&M University Press, College Station, TX.

——— 1995 Archeology and Late Quaternary Environments of the Southern High Plains. *Bulletin of the Texas Archeological Society* 66:519–540.

Six Paleoindian Projectile Points from West-Central New Mexico

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This paper presents previously unpublished descriptions of six Paleoindian projectile points documented as surface finds during cultural resource management studies in west-central New Mexico between 1987 and 1997.

At site LA113997 near Socorro, New Mexico, Dello-Russo (1997) reported the base of a Folsom point (Figure 1A). The tan-and-blue chert point appears

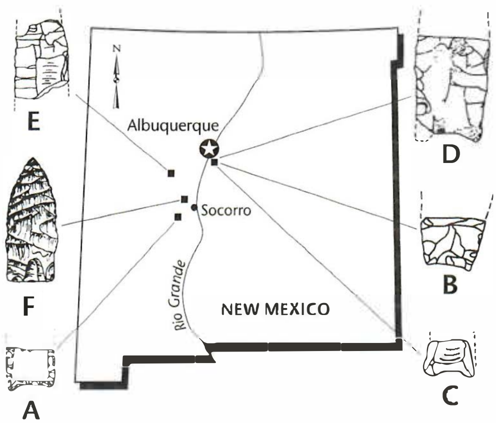

Figure 1. Locations of six Paleoindian projectile points: **A,** Folsom; **B,** Folsom/Midland; **C,** Clovis; **D,** Plainview; **E,** Folsom; **F,** Scottsbluff.

similar to materials from the Edwards Plateau in Texas. The artifact has a basal width of 19.0 mm, a flute width of 15.0 mm, a maximum thickness of 4.0 mm, a flute thickness of 3.0 mm, and a concavity depth of 3.0 mm. Grinding is evident on both lateral edges but not within the concavity of the base.

At site LA2334 on Sandia National Laboratories lands, Hoagland and Dello-Russo (1995) reported the bases of a gray-tan chert Folsom/Midland point and a dark gray basalt Clovis point (Figures 1B and 1C). The Folsom/Midland point has a maximum width of 25.0 mm, a basal width of 17.0 mm, and a thickness of 5.0 mm. While the relatively small Clovis point base (maximum width 22.0 mm; thickness 6.0 mm) was originally described as a Folsom point, it is more similar to Clovis point bases documented at the Mockingbird Gap site (Weber and Agogino 1968). The same researchers also

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found an isolated dark gray basalt Plainview point (Figure 1D) uphill of site LA 2334. This point has a maximum width of 32.0 mm, a basal width of 27.0 mm, and a thickness of 6.0 mm.

At site LA115313, in a broad alluvial basin about 63 km north of Magdalena, N.M., Dello-Russo (1998) recovered the midsection of a blue-gray and brown chert Folsom point (Figure 1E). The artifact has a width of 22.3 mm and a thickness of 5.2 mm.

Finally, in the Socorro Mountains west of Socorro, N.M., Gossett and Gossett (1990) found an isolated complete Scottsbluff projectile point (Figure 1F) made of light gray chert with darker gray veins. It has a length of 55.0 mm, a maximum width of 23.0 mm, a basal width of 21.0 mm, and a thickness of 6.0 mm. The point base is thinned and its lateral edges are ground.

The period of occupation represented by these six points ranges from approximately 11,500 yr B.P. for the Clovis point to 8,000 yr B.P. for the Scottsbluff point (Cordell 1984:136).

Permission to reproduce point descriptions and illustrations was graciously granted by Sandia National Laboratories, Albuquerque, N.M.; EMRTC New Mexico Institute of Mining and Technology; and the Navajo Nation Historic Preservation Department, Window Rock, Ariz.

References Cited

Cordell, L. S. 1984 Prehistory of the Southwest. Academic Press, Inc., New York, NY.

Dello-Russo, R. D. 1997 A Cultural Resources Inventory for a 7.5 Mile Section of the American Telephone and Telegraph Communications Cable Near Socorro, New Mexico. Report No. ERG-1996–7 submitted by Escondida Research Group, Socorro, N.M. to Peak and Associates, Inc., El Dorado Hills, CA.

——— 1998 Results of Test Excavations at Five Archaeological Sites in the Navajo Route N55(2) Project Area, Cibola County, New Mexico. Report No. ZCRE-566 prepared by Zuni Cultural Resource Enterprise, Zuni, N.M. for Navajo Nation Historic Preservation Department and Bureau of Indian Affairs, Gallup, NM.

Gossett, C. W., and W. J. Gossett 1990 Cultural Resource Inventory of 13.48 Sections Above 5000 Ft in the Socorro Mountain Range, Central New Mexico. Report submitted by Rio Abajo Archaeological Services to T.E.R.A. Group, New Mexico Institute of Mining and Technology.

Hoagland, S., and R. D. Dello-Russo 1995 Cultural Resource Investigation for Sandia National Laboratories, New Mexico / Environmental Restoration Program, Kirtland Air Force Base, New Mexico. Prepared by Butler Service Group for Sandia National Laboratories, Albuquerque, NM.

Weber, R. H., and G. A. Agogino 1968 The Mockingbird Gap Paleo-Indian Site: Excavations in 1967. Paper presented at the 33rd Annual Meeting of the Society for American Archaeology, Santa Fe, NM.

The Antiquity of the Peopling of Southern Brazil

Adriana Schmidt Dias and André Luiz Jacobus

Summaries of the peopling of the Brazilian territory in the Pleistocene-Holocene transition rarely address the first settlements in the south of Brazil. There is little discussion about their connection with available data from other regions; sometimes erroneous dates are given for sites, thus creating problems in interpreting data (Bombin and Bryan 1978; Borrero 1996; Dillehay 2000; Dillehay et al. 1992; Kipnis 1998; Prous and Fogaça 1999; Roosevelt et al 1996; Schmitz 1987a, 1987b). Our purpose here is to evaluate this information and integrate it in this discussion.

In Rio Grande do Sul State, in the mid-Uruguay River region, there are 11 sites with 19 dates between 12,770 and 8,585 RCYBP. These data are derived from the Paleoindian Program (PROPA), the only project developed specifically to study contexts of this period in the area (Miller 1987). At the Lajeado dos Fósseis site, a date of 12,770 ± 220 RCYBP (SI-801) was obtained on a *Glossotherium* sp. cranium fragment. Studies of sedimentation processes in the area indicate that this cranium, found without other anatomical elements, may have been originally enclosed in earlier strata and was subsequently redeposited. The characteristics of the lithic assemblage are also ambiguous. Its dispersion and chipping patterns, typical of fluvial drag, reinforce the idea of a natural phenomenon (Jacobus 1991; Milder 1995, 1999). Dates of 12,690 ± 100 RCYBP (SI-2351) and 11,010 ± 190 RCYBP (SI-9628), erroneously attributed to that site, apply to vegetable remains and not to cultural association (Bombin 1976; Bombin and Bryan 1978; Miller 1987).

Ten other sites in the area feature 18 radiocarbon dates that span the period between 11,555 and 8585 RCYBP. The artifactual assemblage, which includes bifacial projectile points, does not have a proven connection with megafauna. (Miller 1987). Only two of these sites were extensively investigated. Milton Almeida dated one site to 10,810 ± 275 RCYBP (SI-2622); Laranjito obtained six dates between 9620 ± 110 RCYBP (SI-2631) and 10,985 ± 100 RCYBP (SI-2630). Both scientists demonstrate associations between dated structures and artifactual assemblages. Their work shows the need for further research on the early peopling of the area. In the valley of the Taquari River, three dates between 9430 ± 360 RCYBP (Beta-44739) and 8020 ± 150 RCYBP (Beta-33458) are associated with the Garivaldino rockshelter. The lithic assemblage is typologically similar to ones in the mid-Uruguay river region and is associated with archeofauna of small and midsize species (Ribeiro and Ribeiro 1999). In the valley of the Sinos River, we recently obtained a calibrated date of 8180 ± 40 RCYBP (Beta-154353) and two more recent dates (Beta-154351 and Beta-154352), associated with the

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Sangão rockshelter. The lithic assemblage and archeofauna are similar to those of the Garivaldino site.

In Santa Catarina State, the SC-U-6 site, in the high Uruguay River region, yielded dates of 8640 ± 95 RCYBP (SI-995) and 8095 ± 90 RCYBP (SI-994) on carbonized vegetable material with no cultural association (Rohr 1966, 1973, 1984; Schmitz and Becker 1968). In Paraná State, the PR-NL-8 site in the high Paraná River region, yielded evidence of a bifacial lithic industry for producing projectile points. A date of 8115 ± 80 RCYBP (SI 6401) was obtained; however, stratigraphic disturbances caused by earth extraction must be taken into consideration in evaluating the date (Chmyz 1984; Chmyz and Chmyz 1986).

In São Paulo State, in the high Paraná River valley, the Alice Böer site yielded evidence of a bifacial projectile point industry in its third occupational layer, with two ^{14}C dates on charcoal in the range of 6000 RCYBP and a date of 14,200 ± 1150 RCYBP (SI-1208), considered uncorrected (Beltrão 1974; Bryan and Beltrão 1978). Burned chert samples from the same layer when TL dated yielded seven dates in the range of 6000 yr B.P., a date of 10,950 ± 1020 yr B.P., and a date of 10,970 ± 1620 yr B.P., again showing a considerable margin of error (Beltrão et al 1986). In the valley of Ribeira do Iguape River, old dates associated with the Maximiano rockshelter and the Capelinha fluvial shell mound are questionable. The Maximiano rockshelter yielded a date of 9810 ± 150 RCYBP (Gif-7493) on human bones of unknown depositional context. The Capelinha shell mound yielded dates of 9890 and 10,500 ± 1500 RCYBP on gastropod samples with no cultural association (Collet 1978, 1979, 1985).

The available data for southern Brazil seem to point to a dispersion of populations engaged in bifacial industries in the south-north direction, whose limit would be the state of São Paulo. However, we seek to demonstrate that this scenario is the result of differences in the intensity and goals of the investigations. Models of the peopling process in this area demand new data from regional projects focused specifically on studying this problem.

References Cited

Beltrão, M. C. M. C. 1974 Datações Arqueológicas Mais Antigas do Brasil. *Anais da Academia Brasileira de Ciência* 46 (2):211–251.

Beltrão, M. C. M. C., C. R. Enriquez, J. Danon, E. Zuleta, and G. Poupeau 1986 Thermoluminescence Dating of Burned Cherts from Alice Böer Site (Brazil). In *New Evidence for the Pleistocene Peopling of the Americas*, edited by A. L. Bryan, pp.203–219. University of Maine, Orono, ME.

Bombin, M. 1976 Modelo Paleoecológico Evolutivo para o Neoquaternário da Região da Campanha-Oeste do Rio Grande do Sul (Brasil): a Formação Touro Passo, seu Conteúdo Fossilífero e a Pedogênese Pós-deposicional. *Comunicações do Museu de Ciências da PUCRS* 15:1–190.

Bombin, M., and A. L. Bryan 1978 New Perspectives on Early Man in Southwestern Rio Grande do Sul, Brazil. In *Early Man in America from a Circum-Pacific Perspective*, edited by A. L. Bryan, pp. 301–302. University of Alberta, Edmonton, AB.

Borrero, L. A. 1996 The Pleistocene-Holocene Transition in Southern South America. In *Humans at the End of the Ice Age: the Archaeology of the Pleistocene-Holocene Transition*, edited by L. G. Straus, B. V. Eriksen, J. M. Erlandson, and D. R. Yesner, pp. 339–354. Plenum Press, New York, NY.

Bryan, A. L., and M. C. M. C. Beltrão 1978 An Early Stratified Sequence Near Rio Claro, East Central São Paulo State, Brazil. In *Early Man in America from a Circum-Pacific Perspective*, edited by A. L. Bryan, pp. 303–305. University of Alberta, Edmonton, AB.

Chmyz, I. 1984 *Projeto Arqueológico Rosana-Taquaruçu*. UFPR-CESP, São Paulo, Brazil.

Chmyz, I., and J. Chmyz 1986 Datações Radiométricas em Áreas de Salvamento Arqueológico no Estado do Paraná. *Arqueologia - Revista do Centro de Estudos e Pesquisas Arqueológicas da UFPR* 5:69–77.

Collet, G. C. 1978 *Notas Prévias Sobre Sondagens Efetuadas num Abrigo Sob Rocha no Vale do Rio Maximiano, Iporanga, São Paulo*. Sociedade Brasileira de Espeleologia, São Paulo, Brazil.

——— 1979 *Notas Prévias Sobre Sondagens em Abrigos Sob Rocha—2ª Parte*. Sociedade Brasileira de Espeleologia, São Paulo, Brazil.

——— 1985 Novas Informações Sobre Os Sambaquis Fluviais do Estado de São Paulo. *Arquivos do Museu de História Natural da UFMG* 10:311–324.

Dillehay, T. D. 2000 *The Settlement of the Americas: A New Prehistory*. Basic Books, New York,NY.

Dillehay, T. D., G. Ardila Calderon, G.. Politis, and M. C. M. C. Beltrão 1992 Earliest Hunters and Gatherers of South America. *Journal of World Prehistory* 6(2):145–204.

Jacobus, A. L. 1991 Os Homens e a Fauna Extinta. *Clio* 4:29–30.

Kipnis, R. 1998 Early Hunter-gatherers in the Americas: Perspectives from Central Brazil. *Antiquity* 72 (277):581–592.

Milder, S. E. S. 1995 Uma Breve Análise da Fase Arqueológica Ibicuí. *Revista do CEPA* 19(22):41–63.

——— 1999 Caçadores-coletores: A Problemática Arqueológica sobre os Primeiros Povoadores do Rio Grande do Sul. In *Rio Grande do Sul: Quatro Séculos de História*, edited by J. QUEVEDO, pp. 5–60. Martins Livreiro, Porto Alegre.

Miller, E. T. 1987 Pesquisas Arqueológicas Paleoindígenas no Brasil Ocidental. *Estudios Atacameños* 8:37-61.

Prous, A., and E. Fogaça 1999 Archaeology of the Pleistocene-Holocene Boundary in Brazil. *Quaternary International* 53/54:21–41.

Ribeiro, P. A. M., and C. T. Ribeiro 1999 Escavações Arqueológicas no Sítio RS-TQ-58, Montenegro, RS, Brasil. *Série Documento da FURG* 10:1–86.

Rohr, J. A. 1966 Os Sítios Arqueológicos do Município de Itapiranga às Margens do Rio Uruguai, Fronteira com a Argentina. *Pesquisas-Antropologia* 15:21–60.

——— 1973 A Pesquisa Arqueológica no Estado de Santa Catarina. *Dédalo* 17/18:49–65.

——— 1984 Sítios Arqueológicos de Santa Catarina. *Anais do Museu de Antropologia da UFSC* 17:77–167.

Roosevelt, A. C., da C. M. Lima, M. Michab, N. Mercier, J. B. Feathers, A. S. Henderson, D. S. Reese, and J. A. Holman 1996 Paleoindian Cave Dwellers in the Amazon: The Peopling of the Americas. *Science* 272:373–384

Schmitz, P. I 1987a Caçadores Antigos no Sudoeste de Goiás, Brasil. *Estudios Atacameños* 8:16–35.

——— 1987b Prehistoric Hunters and Gatherers of Brazil. *Journal of World Prehistory* 1(1):53–126.

Schmitz, P. I., and Becker I. I. B. 1968 Uma Indústria Lítica de Tipo Alto-Paranaense, Itapiranga, Santa Catarina. *Pesquisas-Antropologia* 18:21–48.

The Chronology of the Goshen Bone Bed at the Jim Pitts Site

James Donohue and Frederic Sellet

The Jim Pitts site is a multicomponent site located in the southwestern Black Hills of South Dakota. In 1993, the entirety of the site was excavated (476 m^2) under the direction of the senior author, with funding from the South Dakota Department of Transportation. Two artifact-bearing strata were defined. Stratum I, the upper one, is a late- to middle-Holocene colluvium; Stratum II is an early-Holocene to late-Pleistocene paleomollisol. A total of 7,312 individual artifacts and bones were mapped, mostly in Stratum II, which yielded evidence for Cody, Mountain/Foothill, Agate Basin, Folsom, and Goshen components.

The base of Stratum II included a bison bone bed with some elements of pronghorn, elk, small mammals, and possibly a large bird (pers. comm. Gilbert 2000; Hill 2000). Associated with the bone bed were five Goshen points (Figure 1), several preforms, unifacial knives, scrapers, gravers, bifaces, expedient tools, modified flakes, and debitage. The tool kit is weighted towards meat processing and weapon replacement activities. All but one of the Goshen points are basal fragments. These data, in conjunction with the heavily processed condition of the bone, suggest that the oldest Goshen occupation at the site was a camp/processing area where *Bison antiquus* were butchered, hides and bones processed, and tools manufactured, repaired, or replaced.

Sixteen wood charcoal samples from the lower part of Stratum II have undergone AMS radiocarbon analysis. Of these, six non-intrusive samples are directly associated with the bone bed. The six bone bed ^{14}C dates (all in RCYBP) are: 10,240 ± 70 (AA-23777), 10,110 ± 70 (AA23767), 10,170 ± 60 (Beta-65398), 9855 ± 245 (AA20295), 10,280 ± 200 (AA-20291), and 10,115 ± 230 (AA-20294). The dates are statistically identical at the 95-percent level (Stuiver and Reimer 1993). The weighted mean of the samples is 10,160 ± 50 RCYBP. This date is considered a minimum age for the occupation, since at this stage of site analysis it has not been established whether the dated charcoal was derived from a contemporaneous cultural event or from a post-occupation fire.

The distribution of dates, bone, and artifacts indicates that the Goshen bone bed most likely represents a single event or at least very closely spaced events. A preliminary analysis of the stratigraphy and of the distribution of Folsom, Agate Basin, and Goshen points suggests two Goshen components at the site (Sellet, in press). The upper component is penecontemporaneous with Folsom and Agate Basin diagnostics. Capping these two levels is a small Cody occupation.

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References Cited

Sellet, F. in press A Changing Perspective on Paleoindian Chronology and Typology. A View from the Northwestern Plains. In "Between Two Worlds: Late Pleistocene Cultural and Technological Diversity in Eastern Beringia," edited by M. Kunz and M. Bever. *Arctic Anthropology*.

Stuiver, M., and P. J. Reimer 1993 Extended ^{14}C Database and Revised CALIB Radiocarbon Calibration Program. *Radiocarbon* 35:215–230.

Biface Transport in the Pampean Region, Argentina

Nora Flegenheimer

The form in which lithic artifacts were transported is critical when dealing with the technological organization and mobility of early societies. In the early assemblages under study in the Argentine pampean region, Cerro la China (S1, 2, and 3) and Cerro El Sombrero (A1 and Cima), the tool kit includes both unifacial and bifacial artifacts in varying frequencies at the different sites (Flegenheimer 1991). It is mainly manufactured of orthoquartzites of the Sierras Bayas Group (S.B.), transported from about 50 km distance.

S.B. toolstone has been transported mostly as flake blanks and tools. Discarded cores on S.B. are small and worn out; larger ones probably were taken away for further use. Here we present evidence for a type of core which has not yet been found in the assemblages. The existence of bifaces used as cores is inferred through the presence of biface thinning flakes, which were used as blanks for unifacial tools. Medium- or large-sized flakes are especially relevant for this discussion.

The largest bifacial tools are some especially large Fell's Cave Stemmed (FCS) projectile points (Flegenheimer and Zárate 1989). Bifacial scrapers, knives, bifacial blanks, and preforms have also been recovered (Figure 1E and 1F), which are smaller than the largest points. The flake scars on these points have a maximum length of 3.5 cm (the only larger scar is a channel flake on point No. S12/105/1). Although most biface thinning flakes are small (Figure 1D), several are 4 cm long, and some exceptional specimens are even longer. The size of these flakes indicates they were not obtained from the bifacial tools, blanks, or preforms present in the assemblages, but from larger bifaces instead.

Also, all these large bifacial thinning flakes were used as blanks for tools, and all exhibit retouch along their edges (Figure 1A–1C). The occasional transport of bifaces used as cores is therefore inferred for early societies occupying the Pampean region.

The bifaces themselves could have served as blanks for the largest FCS

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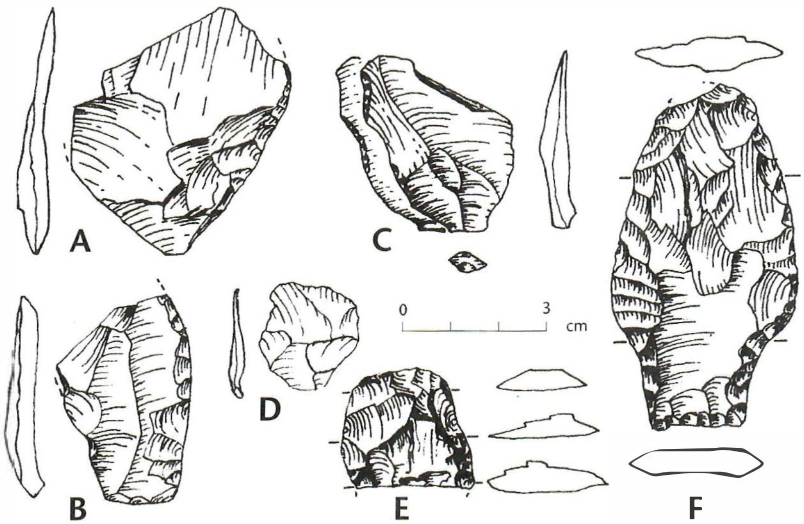

Figure 1 **A,** Knife on large biface thinning flake (Cima S7/102/1); **B,** side scraper on biface thinning flake (Cima S12/106/6); **C,** biface thinning flake with alternate retouch (La China S3/695); **D,** small thinning flake (A1/133); **E,** bifacial blank (Cima S12/402/3); **F,** large FCS projectile point (Cima S19/101/1).

points for which blanks have not yet been recovered. These points are scarce (2 complete points out of 13, and probably 17 fragmented points out of 93) and represent a complete bifacial reduction. Medium-sized FCS points manufactured of flake blanks of approximately the same thickness as the finished product are more abundant. Their manufacture is similar to that described for other FCS points in the Southern Cone (Bird 1969; Nami 1997). So, in the Pampean region, different *chaînes operatoires* involving several transport options could have as an end product the artifacts we recognize as FCS points.

I wish to thank Cristina Bayón for sharing our eternal discussions.

References Cited

Bird, J. 1969 A Comparison of South Chilean and Ecuadorian "Fishtail" Projectile Points. *The Kroeber Anthropological Society Papers,* 40:52–71. 20th Anniversary Issue. Papers in Honor of John Howland Rowe. Kroeber Anthropological Society, Berkeley, CA.

Flegenheimer, N. 1991 Bifacialidad y Piedra Pulida en Sitios Pampeanos Tempranos. *Shincal* 3 (2):64–78, Universidad Nacional de Catamarca, Catamarca, Argentina.

Flegenheimer, N., and M. Zárate 1989 Paleoindian Occupation at Cerro El Sombrero Locality, Buenos Aires Province, Argentina. *Current Research in the Pleistocene* 6:12–13. Orono, ME.

Nami, H. 1997 Aspectos Técnicos de los Cazadores-recolectores del Tardiglacial. *Anales del Instituto de la Patagonia* 25:151–186. Punta Arenas, Chile.

Central Plains Folsom Mobility: Clues from the Nolan Site in Southwestern Nebraska

Jack L. Hofman

The Nolan site (25CH4) was discovered in the early 1930s and reported to C. B. Schultz of the University of Nebraska State Museum (UNSM) by Cornelius Gardner. Intensive artifact collecting occurred during the following decade. Fortunately, Gardner's collection was donated to the UNSM and remains one of the few extant collections from the site. Nolan was a large erosional blowout in a dune field, located near the Nebraska-Colorado border. The site is situated between the Republican River and the Frenchman Fork of the Republican, both of which originate in eastern Colorado. In 1946 minimal stratigraphic testing was conducted at the site by C. Bertrand Schultz's crew. This work, in the deflated portion of the blowout, identified no in situ deposits of Folsom age.

Other cultural components represented in the Nolan site surface collection include non-Folsom Paleoindian, some mid-Holocene, and late-prehistoric diagnostics. Folsom and Paleoindian artifacts from the site must therefore be segregated on typological and technological criteria. The Folsom assemblage from Nolan suggests hunting, processing, and retooling activities, perhaps associated with bison procurement in a dune or pond margin setting. The identified Folsom assemblage from Nolan (Figure 1) includes Folsom points (n = 13), Folsom preforms (n = 9), channel flakes (n = 5), gravers (n = 8), tips or perforators (n = 2), endscrapers, many of which are spurred (n = 44), spokeshaves and notches (n = 4), other scrapers (n = 44), flake knives (n = 44), wedges (n = 4), burins (n = 2), denticulate (n = 1), bifaces (n = 3), flakes and spalls (n = 27), and one abrader. Some of these artifacts are probably derived from Cody and other Paleoindian components at the site.

A striking characteristic of the Nolan artifact assemblage is the dominance of White River Group Silicates (WRGS), probably Flattop chalcedony. Most of the Folsom points (69 percent), preforms (89 percent), and channel flakes (80 percent) are of this material. The Flattop source is 150 km to the west in Logan County, Colorado (Greiser 1983; Hoard et al. 1992, 1993; Jensen 1973). Additional sources occur to the north in eastern Wyoming (Koch and Miller 1996), southwestern South Dakota (Nowak and Hannus 1984), and as secondary deposits (Ahler 1977). Some of the Nolan pieces exhibit matrix cortex and are presumed to be from a primary source area.

Other lithic materials represented by Paleoindian and probable Folsom artifacts include Hartville Uplift materials from eastern Wyoming (Miller 1991), Black Forest silicified wood from east-central Colorado, and rare artifacts of more distant materials including Alibates flint, Edwards chert,

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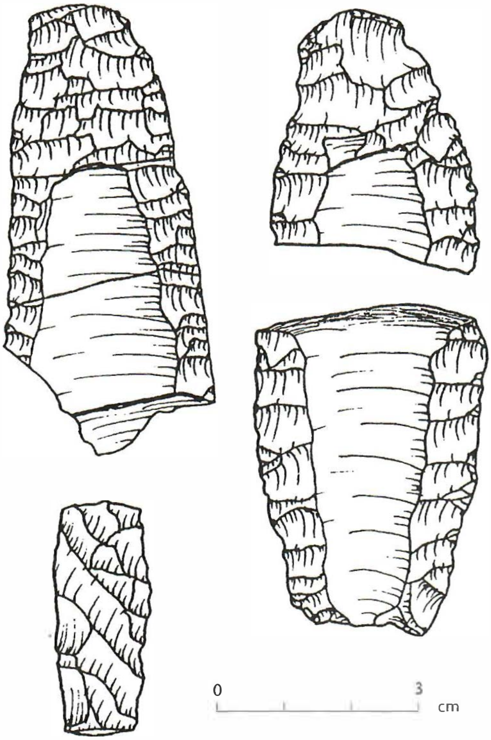

Figure 1. Folsom fluted preforms and channel flake made of Flattop chalcedony from the Nolan site (25CH4).

Knife River Flint, and Permian Florence chert. A significant minor proportion of the collection (15 percent of Folsom points; 11 percent of Folsom preforms) represents Niobrara or Republican River jasper (NJ). Sources include the Medicine Creek area in Frontier County, Nebraska, about 125 km east of Nolan and extend south beyond the Saline River in northwestern Kansas (Hofman 1990; O'Brien 1984; Wedel 1986). Use of NJ at Nolan was more intensive in post-Folsom Paleoindian time. Among the 26 non-Folsom Paleoindian projectile points from Nolan are 10 (38 percent) made of NJ. This is consistent with the evidence for intensive use of this jasper in post-Folsom Paleoindian components at Medicine Creek sites (Bamforth 1991; Davis 1953, 1962).

Despite the fact that Nolan is slightly closer to the NJ source area than to Flattop, the assemblage is dominated by Flattop materials, with limited evidence for Folsom use of NJ at the site or in the region. This is not simply a site-specific pattern, as indicated by the total available Folsom evidence from Chase and adjacent Dundy counties. A total of 43 Folsom-age artifacts (24 Folsom points, 14 Folsom preforms, and 5 Midland points) from Chase and Dundy counties in Nebraska (including the Nolan sample) include only 6 (14 percent) made of NJ. For Nebraska as a whole, a total of 257 Folsom points, preforms, and Midland points have been recorded, and only 26 (10 percent) of these are manufactured from NJ, occurring mostly east of the source area.

During Folsom time we see a strong directional pattern in the movement of WRGS from the Flattop Butte source area to the east and southeast, but lack evidence for comparable movement of lithic materials such as NJ to the west during the same period (Hofman and Toft n.d.). This is despite the fact that Folsom groups repeatedly used NJ. Folsom groups probably did not move in one direction more than the other, but the procurement, transport, and use of lithic components of their technology were typically embedded into directional movements. On return trips west, lithics were apparently of much less concern than other resources such as bison products. Predominantly unidirectional movement of lithics obviously need not imply unidirectional movement of people. In the case of Folsom on the Great Plains, this pattern probably reflects long-term recurrent movements from lithic source staging areas to bison hunting areas (cf. Hofman 1999; Root et al. 1999).

Study of the Nolan collection was enabled by a sabbatical supported by the University of Kansas. Special thanks to Steve Holen, Jeannette Blackmar, and Carolyn Waters. Work with the collections and records at the University of Nebraska State Museum was facilitated by George Corner, Steve Holen, Beth Wilkins, and Tom Myers. Access to documents at the Nebraska State Historical Society and information about the Nolan site were provided by Jeannette Blackmar and Gayle Carlson.

References Cited

Ahler, S. A. 1977 Lithic Resource Utilization Patterns in the Middle Missouri Sub-Area. In, *Trends in Middle Missouri Prehistory*, edited by W. R. Wood, pp.132–150. *Plains Anthropologist* Memoir 13.

Bamforth, D. B. 1991 Population Dispersion and Paleoindian Technology at the Allen Site. In, Raw Material Economies Among Prehistoric Hunter-Gatherers, edited by A Montet-White and S. R. Holen, pp.357–374. *Publications in Anthropology* 19. University of Kansas, Lawrence, KS.

Davis, E. M. 1953 Recent Data from Two Paleo-Indian Sites on Medicine Creek, Nebraska. *American Antiquity* 18(4):380–386

——— 1962 Archaeology of the Lime Creek Site in Southwestern Nebraska. Special Publication 3. University of Nebraska State Museum, Lincoln, NE.

Greiser, S. T. 1983 A Preliminary Statement about Quarrying Activity at Flattop Mesa. *Southwestern Lore* 49(4):6–14.

——— 1985 Predictive Models of Hunter-Gatherer Subsistence and Settlement Strategies on the Central High Plains. *Plains Anthropologist* Memoir 20.

Hoard, R. J., S. R. Holen, M. D. Glascock, H. Neff. and J. M. Elam 1992 Neutron Activation Analysis of Stone from the Chadron Formation of a Clovis Site on the Great Plains. *Journal of Archaeological Science* 19:655–665.

Hoard, R. J., J. R. Bozell, S. R. Holen, M. D. Glascock, H. Neff, and J. M. Elam 1993 Source Determination of White River Group Silicates from Two Archaeological Sites in the Great Plains. *American Antiquity* 58:698–710.

Hofman, J. L. 1990 Paleoindian Mobility and Utilization of Niobrara or Smoky Hill Jasper on the Southern Plains. *The Kansas Anthropologist* 9(2):1–13.

——— 1999 Unbounded Hunters: Folsom Bison Hunting on the Southern Plains Circa 10,500 B.p., the Lithic Evidence. In, *Le Bison: Gibier et Moyen de Subsistance des Hommes du Paleolithique aux Paleoindiens des Grandes Plaines*, edited by J.-PH. Burgal, F. David, J. G. Enloe, and J. Jaubert, pp.383–415. Editions APDCA, Antibes, France.

Hofman, J. L., and M. Toft n.d. The Luft Site and Folsom Use of Flattop Chalcedony in Northeastern Colorado. manuscript in possession of authors.

Jensen, R. E. 1973 A Preliminary Report on the Point of Rocks Archeological Survey, 1971. Publications in Anthropology 5, Part II, pp. 157–233. Nebraska State Historical Society, Lincoln, NE.

Koch, A., and J. Miller 1996 Geoarcheological Investigations at the Lyman Site (25SF53) and Other Cultural Resources Related to Table Mountain Quarry Near the Nebraska/Wyoming Border. Report for Nebraska Department of Roads, Project HES-92-1(113), Lincoln, NE.

Miller, J. C. 1991 Lithic Resources. In, *Prehistoric Hunters of the High Plains*, 2nd edition edited by G. C. Frison, pp.449–478. Academic Press, San Diego, CA.

Nowak, T. R., and A. L. Hannus 1985 Lithic Raw Materials from the West Horse Creek Quarry Site (39SH37). *South Dakota Archaeology* (8 and 9):98–114.

O'Brien, P. J. 1984 The Tim Adrian Site (14NT604): A Hell Gap Quarry Site in Norton County, Kansas. *Plains Anthropologist* 29:41–56.

Root, M. J., J. Taylor, J. D. William, and L. K. Shifrin 1999 Gearing Up and Moving Out: Folsom Settlement in Western North Dakota. *Current Research in the Pleistocene* 16:67–69

Wedel, W. R. 1986 *Central Plains Prehistory: Holocene Environments and Culture Change in the Republican River Basin.* University of Nebraska Press, Lincoln, NE.

The Fuller Biface: A Probable Clovis Bifacial Flake Core from the Central Great Plains

Steven R. Holen

The Fuller biface produced from high-quality White River Group chalcedony, a.k.a. Flattop chalcedony, was found by a collector in the Sand Hills of northwestern Lincoln County, Nebraska. Flattop Butte in northeastern Colorado is the nearest source of this material, and the biface was found 200 km east of this source area (Holen 2001).

The asymmetrical biface weighs 830.5 grams and is 20.1 cm long and 14.78 cm wide. Thickness is 1.6–1.9 cm, and 2.34 cm thick where a flake terminated prematurely. A flat scar on the proximal right lateral edge of face A (Figure 1) may be the result of a perverse fracture that occurred while reducing a larger biface (Wilke et al. 1991:247 and 249, Figure 4).

Both faces exhibit long, broad percussion flake scars. Face B has one flake scar 14.58 cm long by 7.76 cm wide and 3.68 cm wide at the point of initiation (Figure 1). Deep rippling marks the distal end of the scar. A 9.17-cm-long overshot flake scar originates on the right lateral margin of face A near the proximal end. It may have been intended to remove part of the perverse fracture scar on the opposite margin. Face B exhibits a diving flake scar 10.73 cm long by 5.12 cm maximum width.

A yellow pigment, possibly yellow ocher, occurs in three areas only on face B. Presence of this pigment is reminiscent of red ocher found on artifacts in Clovis caches including Anzick, Richey-Roberts, Fenn, and Simon.

Brown patination and black mineral staining are present over the entire surface of the artifact (except where modern flake scars, that appear to have

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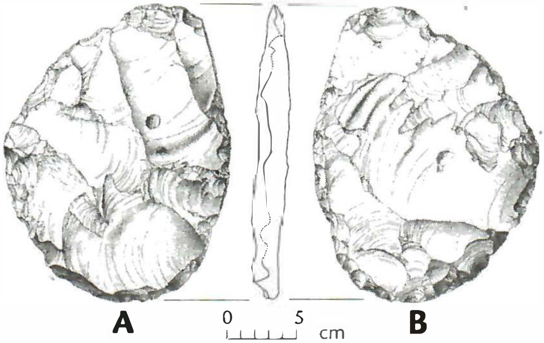

Figure 1. The Fuller biface.

been produced post-discovery, have removed it). This patination suggests great antiquity.

Phil Wilke studied the biface and suggested it is technologically identical to the large bifacial flake cores present in the Anzick assemblage from Montana (Wilke et al. 1991; Wilke, pers. comm. 1999). The biface is tentatively attributed to Clovis, based on technological attributes. Long-distance movement of this chalcedony during the Clovis occupation of the central Great Plains has previously been documented by Hoard et al. (1991, 1993) and Holen (2001). Evidence for the reduction of at least one large White River Group chalcedony bifacial core is present at the Eckles Clovis site in north-central Kansas, 450 km east southeast of the Flattop Butte source area (Holen 2001).

I thank Angie Fox, University of Nebraska State Museum artist, for the biface illustration, and Phil Wilke and Kathe Decker for editorial assistance.

References Cited

Hoard, R. J., S. R. Holen, M. D. Glascock, H. Neff, and J. M. Elam 1992 Neutron Activation of Stone from the Chadron Formation and a Clovis Site on the Great Plains. *Journal of Archaeological Science* 19(6):655–668.

Hoard, R. J., J. R. Bozell, S. R. Holen, M. D. Glascock, H. Neff, and J. M. Elam 1993 Source Determination of White River Group Silicates from Two Archaeological Sites in the Great Plains. *American Antiquity* 58(4):698–710.

Holen, S. R. 2001 Climate Change and Human Adaptation at the Pleistocene-Holocene Boundary: Clovis Mobility and Lithic Procurement on the Central Great Plains of North America. Ph.D. dissertation, University of Kansas.

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.

Geoarchaeological Investigations at the Rio Rancho Folsom Site, New Mexico

Bruce B. Huckell, Leslie D. McFadden, James P. Holmlund, and Lisa W. Huckell

During the fall of 1999 and spring of 2000, field research was conducted at the Rio Rancho Folsom site, located 25 km northwest of downtown Albuquerque at an elevation of 1814 m on the Llano de Albuquerque (West Mesa) geomorphic surface. Present vegetation is a mixed grassland and desert scrub developed on eolian sand. First investigated by the late Jerry Dawson between 1965 and 1967 (Dawson and Judge 1969; Hibben 1966, 1968; Hillerman 1973; Judge and Dawson 1972), the site consists of five spatially discrete, shallowly buried loci dispersed along 300 m of an east-west-trending ridge. Three loci represent campsites; each yielded a few thousand artifacts including Folsom point basal fragments, endscrapers, gravers, and other unifaces, Folsom point preform and channel flake fragments, miscellaneous biface fragments, and debitage (Figure 1). The easternmost locus also yielded Cody Complex, Archaic, ancestral Pueblo, and historic artifacts. The two smaller loci produced only a few specimens. Unfortunately, Dawson never fully published on Rio Rancho; remedying this situation has been a priority since 1995.

The collection, housed at the Maxwell Museum, consists of approximately 7,400 artifacts. Original excavations consisted of shovel stripping within 10-by-10-ft grids; all sediment was sifted through ¼-in mesh screens. Several dozen 35 mm slides and black-and-white photographs of the work have survived, but no excavation notes or overall site map exists. New field work devoted to mapping and analyzing local geomorphology, on- and off-site depositional and soil stratigraphy, and the stratigraphic context of Folsom artifacts within these deposits was deemed vital.

A complete topographic map of the site area, covering 340 m E-W by 170 m N-S, was prepared using GPS. Previously excavated areas of the three large loci were located, using wooden grid stakes placed 30 years earlier and microtopography of the loci. Contour maps in intervals of 2.5 to 20 cm were generated. We found no trace of the two smaller loci.

Geomorphic, sedimentological, and pedological studies, aided by backhoe trenches, provided details of the landscape as it existed during Folsom time.

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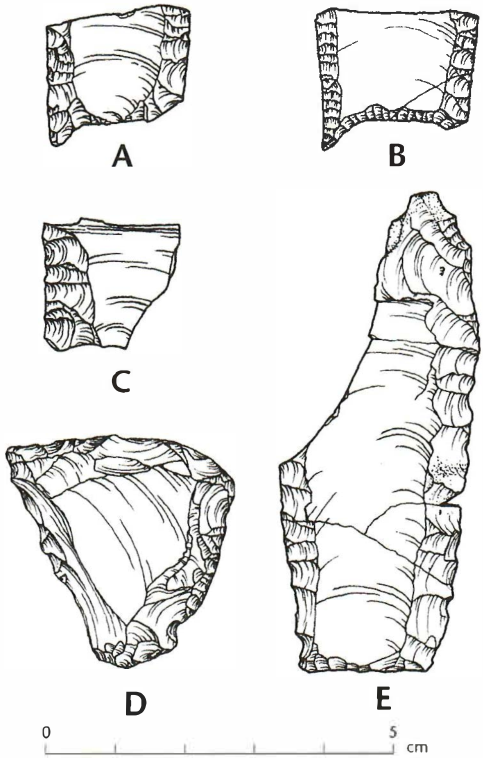

Figure 1. Artifacts from the 1965–67 excavations at Rio Rancho. **A, B,** Folsom point bases; **C, E,** Folsom point preforms broken in manufacture; **D,** endscraper.

At all three major loci, a well-developed soil with a moderate to strong argillic Bt and a stage 2 calcic (Btk) horizon was exposed in the upper 75 cm of an eolian sand. Based on correlations with regional soil chronosequences, its age is estimated at tens of thousands of years. This suggests that the present-day local topography on and near the site has changed little since Folsom occupation. Also, trenches excavated into what Dawson identified as a playa southwest of the site (Dawson and Judge 1969: Figure 4) revealed no lacustrine deposits, but rather fluvially reworked eolian, clayey sand exhibiting moderate pedogenic modification. The origin of this large feature may be erosional.

We excavated 1-by-1-m test pits in 5-cm levels at the three major loci. Our goal was to recover artifacts in situ or, by passing excavated sediment through 1/16-in screens, to recover them from a narrowly bounded vertical space. At the easternmost multicomponent locus, two pits were excavated, each of which produced artifacts from unconsolidated sand atop an erosional surface developed on the upper part of the argillic horizon. Each pit yielded 14 to 60 artifacts; although impressive, the latter total consists largely of flakes smaller than 5 mm recovered from a buried eroded ant hill. At the next locus to the west, two test pits failed to produce artifacts.

At the westernmost locus, we discovered a 20-by-20-m area of unexcavated

Folsom camp debris. In all, 29 artifacts—debitage and one broken graver—were recovered from 11 test pits scattered judgmentally east of the 1965–67 excavations. All but three specimens were recovered from 5–20 cm below surface from the uppermost part of the argillic horizon. We observed no evidence of an erosional hiatus, nor did we encounter spatially discrete, high-density clusters of flakes of single materials. This implies that artifacts were subjected to minor eolian and fluvial transport before burial, and potentially by bioturbation subsequent to burial. Debitage raw materials included Chuska and Pedernal chert and Jemez obsidian.

This research provides more detailed understanding of the role of natural site formation processes at the Rio Rancho site, which will inform ongoing studies of the spatial distribution of artifacts and activity areas within the loci. The work has demonstrated that an additional area of Folsom occupation remains to be excavated at one locus, further underscoring the importance of this site for understanding Folsom habitation sites.

We are most grateful to the National Geographic Society for support of the project (NGS Grant No. 6576-99). Dennis Stanford and Jim Judge provided valuable information on the late Jerry Dawson's excavations; Dennis also passed along what he had of Jerry's notes, photographs, and artifacts. Dick Bice of the Albuquerque Archaeological Society gave us artifacts and notes from the Society's 1967 excavations at one of the loci, along with an invaluable aerial photograph he took of the entire site area shortly after excavation. The excellent drawings of Rio Rancho artifacts accompanying this report are the work of J. David Kilby.

References Cited

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

Hibben, F. C. 1966 Following the Trail of the First Americans. *New Mexico Magazine* 6-9, 34.

——— 1968 *The Lost Americans* (revised edition). Thomas Y Crowell Co., New York, NY.

Hillerman, T. 1973 The Hunt for the Lost American. In *The Great Taos Bank Robbery and Other Indian Country Affairs*, pp. 52–75. University of New Mexico Press, Albuquerque, NM.

Judge, W. J., and J. Dawson 1972 Paleoindian Settlement Technology in New Mexico. *Science* 176: 1210–1216.

The Moore Site (BjGx-1), Hagerman Township, Parry Sound District, Ontario

Lawrence Jackson

In 1999, an isolated spear point was located in Hagerman Township of Parry Sound District by Mr. William Allen, an amateur archaeologist. Allen interviewed property owner Mr. Neil Moore as part of a general regional survey

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and recognized this artifact in Moore's possession as of possible significance. Moore had kept a large red quartzite spear point found near the barn on his property in 1965. There is good reason to believe the locational information is accurate, since Moore had written the legal location on the artifact in black India ink at the time it was found. The site is just north of Highway 124 and southwest of the town of Dunchurch, Ontario, in an area crossed by proglacial Lake Algonquin strandlines. Dunchurch is about 25 km east of the Georgian Bay shoreline of Lake Huron (Figure 1). The point, examined by Lawrence Jackson, possesses a number of characteristics sug-

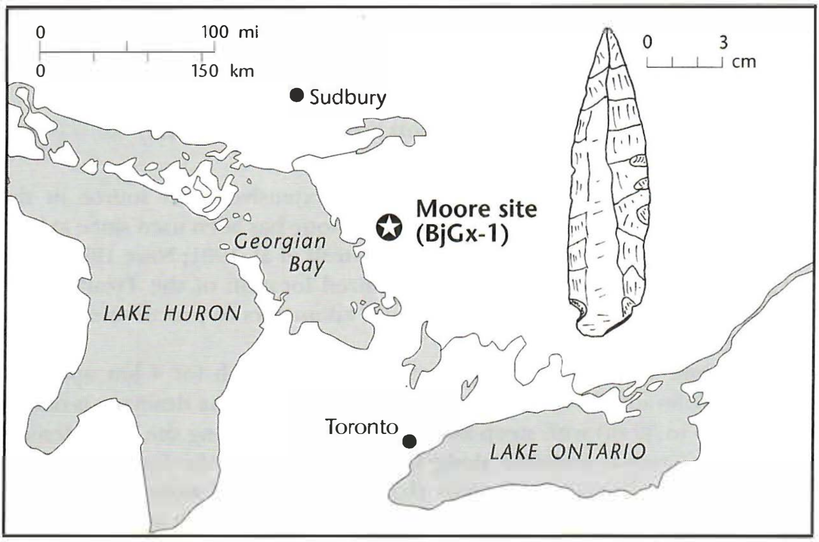

Figure 1. Location of late-Paleoindian point in Parry Sound District, Ontario.

gesting a late-Paleoindian/early-Archaic age. It is 122.0 mm long, elongated lanceolate in outline, markedly biconvex, with ground basal edges, straight base, narrow and deep basal edge notches; maximum width is 31.5 mm, maximum thickness is 9.6 mm, and weight is 42.78 grams. Overall flaking is parallel to collateral; the body is parallel-sided and slightly excurvate, and the base has rounded corners. The style and notching of the point are similar to large side-notched early-Archaic types in southern Ontario, which are themselves quite similar to the Thebes and St. Charles types of eastern North America (see Jackson and Morrison 1997). Heavy grinding of base and notches is typical, as are deep but wide side notches. The early-Archaic side-notched horizon in southern Ontario is believed to date just after late Paleoindian and before the early-Archaic corner-notched horizon, or ca. 10,000–9700 yr B.P. (see Ellis et al. 1990). However, the overall length and configuration of the Moore site point are more in keeping with un-notched late-Paleoindian lanceolate forms found north of Lake Huron and Lake Superior. This suggests the possibility of a point type either transitional to or predating early-Archaic side-notched.

References Cited

Ellis, C. J., I. Kenyon, and M. Spence 1990 The Archaic. In *The Archaeology of Southern Ontario to 1650*, edited by C. Ellis and N. Ferris, Occasional Publications of the London Chapter, Ontario Archaeological Society, Publication No. 5, pp. 65–124.

Jackson, L. J., and D. Morrison 1997 The Early Archaic of Ancaster: Meadowbrook Knoll, A Haldimand Chert *Preform Reduction Site*. In *Preceramic Southern Ontario*, edited by P. J. Woodley and P. Ramsden, Occasional Papers in Northeastern Archaeology No. 9, pp. 29–46, Copetown Press.

Paleoindian Occupation of Barger Gulch and the Use of Troublesome Formation Chert

Marcel Kornfeld, George C. Frison, and Patrice White

Troublesome Formation (Izett 1975) is an extensive chert source in the Middle Park of north-central Colorado. The stone has been used since at least the Goshen times (Kornfeld et al. 1999; Metcalf et al. 1991; Naze 1986). The Barger Gulch site is the most heavily utilized location of the Troublesome exposures, with evidence of several square kilometers of procurement activities (White 1999).

The Barger Gulch Site stretches along Barger Gulch for 4 km upstream from the Colorado River floodplain (Kornfeld 1998). The drainage is deeply incised (up to 50 m) with steep-sided talus slopes exposing the Troublesome Formation. Chert is available along the steep slopes in the form of primary beds and slabs. Procurement tools (hammerstones and stone picks), early-stage debitage, and cores litter the slopes. The relatively flat ancient terraces between the incised drainages contain patches of various sizes and densities of later-stage debitage, cores, and tools.

Six localities have been recognized at Barger Gulch (A–F). Locality A, the largest and densest with a surface deposit of over 1 km^2, contains Folsom, Cody, Hell Gap or Western Stemmed tradition, and James Allan (these may have been identified as Goshen in some earlier studies; Kornfeld and Frison 2000; White 1999) artifacts. Approximately 500 m to the southeast is locality B with fewer artifacts, but with a buried Folsom component (see Waguespack and Surovell this volume). Locality C, a few hundred meters to the northeast of Locality B, consists of one Folsom projectile point base and a few artifacts. Locality D, 2 km southeast of locality A, has yielded one complete Goshen projectile point and no other artifacts. Locality E, across Barger Gulch Drainage from localities A and B, contains only one late-Paleoindian projectile point fragment. Locality F, a chipped-stone stratum of unknown cultural affiliation buried in the upper terrace system of the Barger Gulch (dating to 8510 ± 50 RCYBP, Beta 110406; Kornfeld 1998:54), is at a spring 1.5 km

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upstream from locality A. Localities A, B, and C also contain spurred scrapers and gravers likely of Paleoindian age.

The earliest use of Barger Gulch is during the Goshen period, followed by Folsom, Cody, Hell Gap or Western Stemmed tradition, James Allan, and late-Paleoindian periods (Figure 1). The longer post-Paleoindian occupation is less well represented by one out of three diagnostic artifacts. The commonest

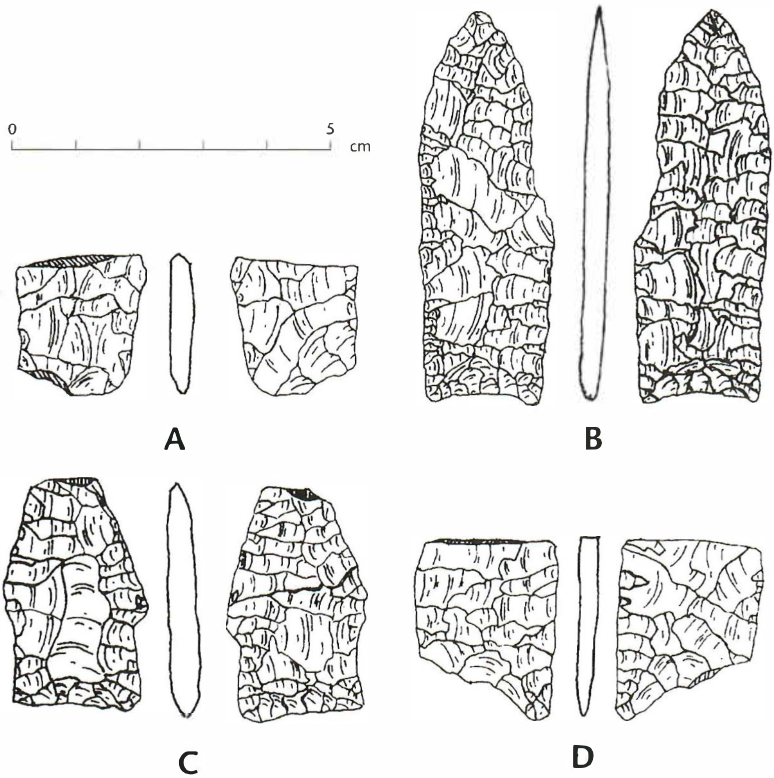

Figure 1. Selected chronologically diagnostic points of Paleoindian age from Middle Park. **A,** Western Stemmed tradition base from locality A; **B,** complete Goshen point from locality D; **C,** complete Cody Complex point from locality A; **D,** James Allen base from locality a.

Paleoindian component is represented by Folsom artifacts (n = 14), followed by late-Paleoindian artifacts (n = 11), Western Stemmed tradition (4 artifacts), Cody (2 artifacts), and Goshen (1 artifact). All these diagnostic artifacts are projectile points except Folsom (of the 14 Folsom artifacts, 6 are channel flakes and 4 are preforms). All the projectile points, except one complete point at Locality D, are broken or exhausted specimens. All the broken specimens are bases except six late-Paleoindian midsections, and all are from the site surface.

The presence of procurement tools and hammerstones, broken and exhausted projectile points, and manufacturing debris as well as maintenance tools suggests that Barger Gulch represents a toolstone procurement site, workshop, and campsite, used since the earliest Paleoindian occupation of the Rocky Mountains.

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References Cited

Izett, G. A. 1975 Late Cenozoic Sedimentation and Deformation in Northern Colorado and Adjoining Areas. *Geological Society of America*, Memoir 144.

Kornfeld, M. (editor) 1998 *Early Prehistory of Middle Park: The 1997 Project and Summary of Paleoindian Archeology*. Technical Report 15a. Department of Anthropology, University of Wyoming.

Kornfeld, M., and G. C. Frison 2000 Paleoindian Occupation of the High Country: The Case of the Middle Park, Colorado. *Plains Anthropologist* 45(172):129–153.

Kornfeld, M., G. C. Frison, M. L. Larson, J. C. Miller, and J. Saysette 1999 Paleoindian Bison Procurement and Paleoenvironments in the Middle Park of Colorado. *Geoarcheology* 14:655–674.

Metcalf, M. D., R. J. Rood, P. K. O'Brien, and B. R. Overturf 1991 *Kremmling Chert Procurement in the Middle Park Area: 5GA1144 and 5GA1172*. Report prepared by Metcalf Archeological Consultants, Inc. (MAC), Eagle, Colorado. Prepared for Sato Associates, Golden, CO.

Naze, B. 1986 The Folsom Occupation of Middle Park, Colorado. *Southwestern Lore* 53:1–32.

White, P. M. 1999 *Getting the High Altitude Stone: Lithic Technology at the Barger Gulch Site (5GA195), Middle Park, Colorado*. Unpublished Master's thesis, department of Anthropology, University of Wyoming, Laramie, WY.

Bifacial Blanks and the Paleoindian Archaic Transition

Roger Marks La Jeunesse and John Howard Pryor

Percussion-flaked bifacial blanks were a significant feature of many of the artifact exhibits shown at the 1999 Clovis and Beyond Conference held in Santa Fe, New Mexico. This artifact type, produced by freehand percussion, is often large, in some cases exceeding 20 cm in length, with a very high width-to-thickness ratio. It represents an intermediate stage in the biface reduction sequence leading to the production of Clovis points. It has also been suggested that these blanks could have served as a readily available source of medium- to large-size flakes for butchering (Wilke et al. 1991:245).

What is of interest to us is the fact that this artifact type (Flenniken 2001 pers. comm.) occurs in large numbers in the biface assemblages from the oldest components of the Skyrocket site (CA-Cal 629/630), an early-Holocene deposit from central California dating between 9,410 ± 50 (WSU

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4929) and 7,000 ± 70 RCYBP (WSU 4616). Their occurrence at this well-dated stratified site is further evidence, in our opinion, of the continuation of Paleoindian technology into the transitional period before the Archaic (LaJeunesse and Pryor 1998:29–32).

The Skyrocket site is situated on Littlejohns Creek, 40 miles east of Stockton, California, in the first tier of the Sierran foothills. A sealed deposit, located approximately 1.5–2.0 m below the surface, contained the oldest components as well as a large stone platform measuring 10 x 10 x 0.5 m. Stratigraphic analysis of the deposits associated with this feature (LaJeunesse and Pryor 1999:50–52) has revealed the presence of two distinct components. The first, from the lower part of the platform, dates between 9,410 ± 250 (WSU 4929) and 8,550 ± 150 RCYBP (WSU 4614); the more recent one, from the upper portions of this feature, dates between 8,550 ± 150 (WSU 4614) and 7,000 ± 70 RCYBP (WSU 4616).

In both components these percussion-flaked blanks (Figure 1) represent a significant percentage of the biface assemblages. They are mostly teardrop

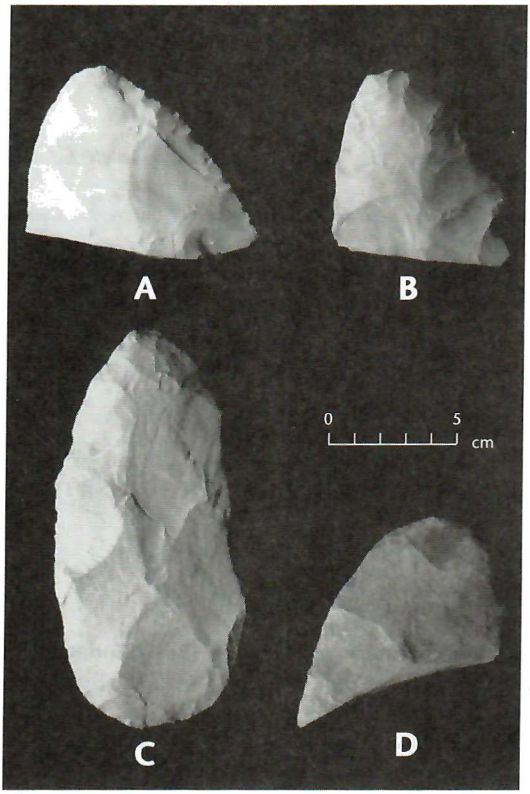

Figure 1. Early-Holocene percussion-flaked bifacial blanks (fine-grained greenstone).

shaped with rounded bases, excurvate sides, and a cross-sectional profile between bi-plano and plano-convex. Their average dimensions are 120.5 mm long, 62.8 mm wide, and 12.9 mm thick, with a width-to-thickness ratio of 5:1.

The flake scars on their surfaces are large, some removed by overshot flaking, and many specimens still have their original platforms. The majority of them were produced from a heat-treated fine-grained greenstone, with a few specimens made from basalt.

In the oldest of the components, the flake blanks, which represent 33 percent of the bifaces, are associated with an assemblage characterized by large stemmed points. In the more recent component, however, these blanks persist (24 percent), even though the assemblage is characterized by Pinto points. There is no evidence the latter were related to the reduction sequence associated with the blanks, since these points were made from different raw materials.

The fact that this pre-Altithermal component still showed evidence of a Paleoindian stone-working technology is further indication of the conservation of past life ways as these cultures encountered new environmental conditions. It is quite possible that these blanks, although no longer intended to serve as a stage in the production of large points, did continue to be used in the manufacture of large bifacial flakes, possibly utilized as cutting tools.

References Cited

Flenniken, J. J. 2001 Personal Communication.

La Jeunesse, R. M., and J. H. Pryor 1998 Romer's Rule and the Paleoindian/Archaic Transition. *Current Research in the Pleistocene*, 15:29–32.

—— 1999 Early-Holocene Cultural Sequence in the Central Sierra of California. *Current Research in the Pleistocene*, 16:50–52.

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

Evidence of the Role of Bifacial Cores in Folsom Lithic Technology

Philippe D. LeTourneau

Many researchers argue that large bifacial cores were the foundation of Folsom lithic technology (e.g., Amick 1999:2; Bement 1999:149; Boldurian 1991; Collins 1999:23; Hofman 1992:197–208; Hofman et al. 1990:226; Ingbar 1992:169; Kelly and Todd 1988:237; Stanford 1999:303; Wyckoff 1996, 1999:346). If bifacial cores did play such a role, then Folsom lithic assemblages should show abundant evidence of bifacial core reduction both in the form of large bifacial cores and in the form of tools (retouched and/or

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used flakes) made on bifacial reduction flakes (BRFs). Very few studies have been directed at evaluating the role of bifacial cores in Folsom technology (see Bamforth [in press], Boldurian [1991:291–292], and Bradley [1982:183–184] for exceptions). In order to examine the role of bifacial cores, I analyzed lithic assemblages excavated from reliable Folsom contexts at Blackwater Draw, Lindenmeier, and Lubbock Lake to determine the presence, frequency, and size of bifacial cores and tools made on BRFs (LeTourneau 1997, 2000).

Of the cores from the three sites, 88 percent are bifacial cores; the remaining 12 percent are generalized cores (Table 1). No blade or bipolar cores were identified. Mean dimensions for the Blackwater Draw bifacial cores are 48 mm long, 35 mm wide, and 13 mm thick; mean width-to-thickness ratio is 4.9:1. Mean dimensions for the Lindenmeier bifacial cores are 50 mm long, 34 mm wide, and 8.6 mm thick; mean width-to-thickness ratio is 4.4:1.

Table 1. Reduction technology of cores and flakes from three Folsom sites.

	cores (n = 24)		flake tools (n = 267)			
Site	**bifacial**	**generalized**	**on BRFs**	**on channel flakes**	**on blades**	**on other flakes**
Blackwater Draw	6	1	15	7	0	44
Lindenmeier	15	1	56	14	5	125
Lubbock Lake	0	1	0	0	0	1
Totals	21	3	71	21	5	175

Note: Most of the cores and flake tools that Hester (1972) and Stevens (1973) report from Folsom contexts at Blackwater Draw are not in fact from secure Folsom contexts and are therefore excluded from this analysis; the remainder are included here. The Lindenmeier artifacts are those from Cotter's (1978) excavations. The Lubbock Lake artifacts are from Texas Tech University excavations at FA6-8 (Johnson and Holliday 1987a, 1987b). Cores include many artifacts traditionally termed "bifaces," but exclude all projectile points, point preforms, and ultrathins. "Other flakes" comprise flakes from generalized core reduction (i.e., not blade, bipolar, or late-stage bifacial core reduction).

Only 23 percent of Blackwater Draw flake tools and 28 percent of Lindenmeier flake tools are made on BRFs; flakes from generalized core reduction make up approximately two-thirds of all flake tools. Mean length for the Blackwater Draw BRF tools is 38 mm, and mean width is 28 mm. Mean length for the Lindenmeier BRF tools is 36 mm, and mean width is 25 mm. BRFs were most frequently used for gravers: over half of gravers are made on BRFs. Endscrapers are much less commonly made on BRFs, while not quite a third of other flake tools are made on BRFs.

Based on my analysis, I suggest that bifacial cores played only a limited role in Folsom lithic technology. Small bifacial cores dominate the core assemblages from Blackwater Draw (86 percent) and Lindenmeier (94 percent); but because of their small size, they may not have served primarily as cores for the manufacture of flake tool blanks. The other cores at Blackwater Draw and Lindenmeier are generalized cores. At both sites mostly flake tools were produced from generalized cores, with small proportions of channel flake and blade tools. The paucity of evidence at Lubbock Lake makes it impossible to draw conclusions about bifacial cores—the single core is a generalized core, and the single flake tool is from a generalized core. In general, BRF tools at Blackwater Draw and Lindenmeier were made on flakes that came from cores larger than those found at the same sites.

It appears that there were at least two Folsom flake production strategies and that bifacial cores played a much smaller role than generalized cores. Relatively small bifacial cores may have been carried for use as knives and to produce relatively small flake blanks for gravers and other small flake tools. The majority of flake tools and perhaps even projectile points were made on flakes produced by generalized core reduction at quarries. The presence of some relatively large BRF tools at Blackwater Draw and Lindenmeier suggests that some BRFs were produced at or near quarry sites, where earlier stages of bifacial core reduction took place.

References Cited

Amick, D. S. 1999 New Approaches to Understanding Folsom Lithic Technology. In *Folsom Lithic Technology: Explorations in Structure and Variation,* edited by D. S. Amick, pp. 1–11. Archaeological Series 12. International Monographs in Prehistory, Ann Arbor, MI.

Bamforth, D. B. in press Rethinking the Role of Bifacial Technology in Paleoindian Adaptations on the Great Plains. In *From Coups de Poing to Clovis: Multiple Approaches to Biface Variability,* edited by H. Dibble and M. Soressi. University of Pennsylvania Press, Philadelphia, PA.

Bement, L. C. 1999 *Bison Hunting at the Cooper Site: Where Lightning Bolts Drew Thundering Herds.* University of Oklahoma Press, Norman, OK.

Boldurian, A. T. 1991 Folsom Mobility and Organization of Lithic Technology: A View from Blackwater Draw, New Mexico. *Plains Anthropologist* 36(137):281–295.

Bradley, B. A. 1982 Flaked Stone Technology and Typology. In *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains,* edited by G. C. Frison and D. J. Stanford, pp. 181–208. Academic Press, New York, NY.

Collins, M. B. 1999 Clovis and Folsom Lithic Technology on and Near the Southern Plains: Similar Ends, Different Means. In *Folsom Lithic Technology: Explorations in Structure and Variation,* edited by D. S. Amick, pp. 12–38. Archaeological Series 12. International Monographs in Prehistory, Ann Arbor, MI.

Cotter, J. L. 1978 Appendix: A Report of Field Work of the Colorado Museum of Natural History at the Lindenmeier Folsom Campsite, 1935. In *Lindenmeier, 1934–1974: Concluding Report on Investigations,* edited by E. N. Wilmsen and F. H. H. Roberts, Jr., pp. 181–184. Smithsonian Contributions to Anthropology Number 24. Smithsonian Institution Press, Washington, D.C.

Hester, J. J. 1972 *Blackwater Locality No. 1.* Publication Number 8. Fort Burgwin Research Center, Ranchos de Taos, NM.

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, Denver, CO.

Hofman, J. L., D. S. Amick, and R. O. Rose 1990 Shifting Sands: A Folsom - Midland Assemblage from a Campsite in Western Texas. *Plains Anthropologist* 35(129):221–253.

Ingbar, E. E. 1992 The Hanson Site and Folsom on the Northwestern Plains. In *Ice Age Hunters of the Rockies,* edited by D. J. Stanford and J. S. Day, pp. 169–192. Denver Museum of Natural History, Denver, CO.

Johnson, E., and V. T. Holliday 1987a Introduction. In *Lubbock Lake: Late Quaternary Studies on the Southern High Plains,* edited by E. Johnson, pp. 3–13. Texas A&M University Press, College Station, TX.

——— 1987b Lubbock Lake Artifact Assemblages. In *Lubbock Lake: Late Quaternary Studies on the Southern High Plains,* edited by E. Johnson, pp. 100–119. Texas A&M University Press, College Station, TX.

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

LeTourneau, P. D. 1997 The Role of Bifacial Cores in Folsom Technology. Paper presented at the 1st Folsom Workshop/Conference, Austin, TX March 18.

——— 2000 *Folsom Toolstone Procurement in the Southwest and Southern Plains.* Unpublished Ph.D. dissertation, Department of Anthropology, University of New Mexico, Albuquerque, NM.

Stanford, D. 1999 Paleoindian Archaeology and Late Pleistocene Environments in the Plains and Southwestern United States. In *Ice Age Peoples of North America: Environments, Origins, and Adaptations,* edited by R. Bonnichsen and K. L. Turnmire, pp. 281–339. Center for the Study of the First Americans/Oregon State University Press, Corvallis, OR.

Stevens, D. 1973 Blackwater Locality No. 1, 1963–1972, and Its Relevance to the Firstview Complex. Unpublished Master's Thesis. Department of Anthropology, Eastern New Mexico University, Portales, NM.

Wyckoff, D. G. 1996 The Westfahl and Engle Bifaces: Isolated Finds of Large Bifaces on the Southern Plains. *Plains Anthropologist* 41(157):287–296.

——— 1999 Southern Plains Lithic Technology: A View from the Edge. In *Folsom Lithic Technology: Explorations in Structure and Variation,* edited by D. S. Amick, pp.39–64. Archaeological Series 12. International Monographs in Prehistory, Ann Arbor, MI.

Early Paleoindian Materials at the Field Museum of Natural History

Thomas J. Loebel

This paper presents preliminary results from the analysis of early-Paleoindian materials curated at the Field Museum of Natural History (FMNH). This study was conducted as part of an ongoing project designed to create a database concerning early-Paleoindian occupations of the western Great Lakes through research and excavation (Amick et al. 2000; Hill et al. 1998; Loebel 1999).

Examination of FMNH accession records indicated 52 diagnostic early-Paleoindian items within the collections. The majority of these represent individual finds of fluted points from locations throughout the Midwest, although items from known sites at Kimmswick, Missouri, and the Blackwater Draw localities in New Mexico are also present.

In light of the advances that have been made in eastern U.S. and Great Lakes Paleoindian studies in the past 20 years, it is important that existing collections be reanalyzed. Although the FMNH holdings constitute an important part of the early North American archaeological record, the specimens within the museum's collection have not been adequately analyzed or published and remain largely unknown to researchers.

In 1931–33, 24 fluted points were acquired from Byron Knoblock, a promi-

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nent collector. Typologically, these items are similar to Clovis/Gainey (n = 21), Folsom (n = 1), and Cumberland (n = 2) fluted-point forms. Items acquired from Knoblock lean towards large and complete pieces, reflecting a collector bias for "attractive" specimens. Typical of these is the distal fragment of a large fluted biface that has had a prehistoric break "repaired" by steep, crude retouch along the proximal end to create a new tip. That most of the Knoblock specimens also appear to be isolated finds may be a result of collection bias, as no preforms or associated items are present. Because preforms are usually broken or discarded during manufacture, they are frequently overlooked by collectors. It is likely that some of the points in the FMNH collections came from sites that contained other portions of the lithic tool kit, but have since been separated by selective collecting. Although it is unfortunate that much of the collection includes pieces only provenienced to state and county level, this lack of site-specific information is less significant when viewed at scales of regional comparison, especially when examining patterns of Paleoindian lithic raw material movement.

In 1946, the FMNH acquired four lithic items, including one fluted point, collected by Dr. W. F. Parks in 1908 from the well-known bone beds at Kimmswick, Mo. Illinois State Museum excavations in 1979 at this site recovered several fluted points and chipped-stone tools in direct association with extinct Pleistocene fauna (Graham et al. 1981). Three items are Holocene biface fragments; the fourth is a fluted point that has sustained a heavy impact fracture. Since the raw material of this piece matches that of a fluted-point fragment recovered during the ISM excavations, it likely was also derived from the Clovis deposits.

In 1941, the Field Museum acquired 22 items from the University of Pennsylvania E. B. Howard Blackwater Draw collections. Eleven items are casts; the rest consist of projectile-point fragments and scrapers technologically diagnostic of Clovis- and Folsom-age occupations of the area. Starting in 1933, Howard collected at several localities in the Blackwater Draw area. Fieldwork in 1936–37 focused almost exclusively on the gravel pit, where in situ deposits of Clovis material were found in association with extinct fauna. Unfortunately, Howard's original catalog numbers are no longer present on most of the items in the FMNH collection, and I have been unable to locate records at either institution of which items were involved in the trade, making their exact collection provenience difficult to determine. One item has been traced to surface contexts at Beck Forest Lake; another item is thought to have come from the 1937 excavations at the gravel pit. Attempts are underway to obtain information that may determine more precise information on the remaining items. In total, four Clovis and one Folsom point fragments, five endscrapers, one of which appears to have been made from the base of a blade-like core fragment, and one sidescraper are represented.

The remaining five items present in the FMNH collection are other fluted points acquired over the years. Of particular interest is a fluted biface collected in 1901 from the Ojo Caliente, N.M., area that is technologically and stylistically identical to bifaces from the Fenn Cache (Frison and Bradley 1999). This piece (FMNH #74482) exhibits parallel oblique overshot flaking and is manufactured on translucent chalcedonic material that may retain evidence of red ocher staining.

I would like to thank Steve Nash and the Anthropology Department of the FMNH and Lawrence Keeley for facilitating examination of the holdings, as well as comments and input from Russ Graham, Anthony Boldurian, and Dan Amick concerning the Kimmswick and Blackwater Draw materials.

References Cited

Amick, D. S., T. J. Loebel, R. Lurie, and J. Van Nest 2000 Results of Continued Surface Collection and Phase II Testing at the Hawk's Nest Clovis (Gainey) Site in Northeastern Illinois. *Current Research in the Pleistocene*. Vol. 17:1.

Frison, G., and B. Bradley 1998 The Fenn Cache Clovis Tools and Weapons. One Horse Land and Cattle Co. Santa Fe, NM.

Graham, R. W., C. V. Haynes, D. Johnson, and M. Kay 1981 Kimmswick: A Clovis-Mastodon Association in Eastern Missouri. *Science*. Vol. 213:1115–1116.

Hill, M. G., D. S. Amick, and T. J. Loebel 1998 An Inventory of Wisconsin Paleoindian Projectile Points at the Milwaukee Public Museum. *Current Research in the Pleistocene*. Vol 15:18–20.

Loebel, T. J. 1999 David Wenner's Documentation of Fluted Points in the Chicago Region. *Current Research in the Pleistocene*. Vol 16:53–55.

Fell Evidence: Explorations and New Data on Late-Pleistocene Landscape from Canelones, Uruguay

Federico López, Jorge Femenías, and Hugo G. Nami

In an effort to look for Paleoindian sites, the Antonio Taddei Museum in Canelones city, Republic of Uruguay, started a long-term survey and exploration in the Santa Lucía river basin. This fluvial system is 230 km long, extending from Cerro Pelado (Minas, Lavalleja department) to the Río de la Plata river (Figure 1A).

The explorations, which were carried out by pedestrian survey and boat travel to more remote locations, cover the lower and middle parts of the river basin. A number of significant geological, paleontological, and archaeological discoveries have been made over the ten years of the survey. A geological discovery of archaeological interest is a bedrock formation near Picada Berget and Rancho Verde, which outcrops along a series of Cretaceous shorelines and contains exposures of chert. These rocks occur in extensive deposits of tabular nodules ranging from 5 to 40 cm thick. Replicative experiments conducted by the third author showed that it has excellent flaking qualities, ranking at 3.5 in Callahan's lithic grade scale (Callahan

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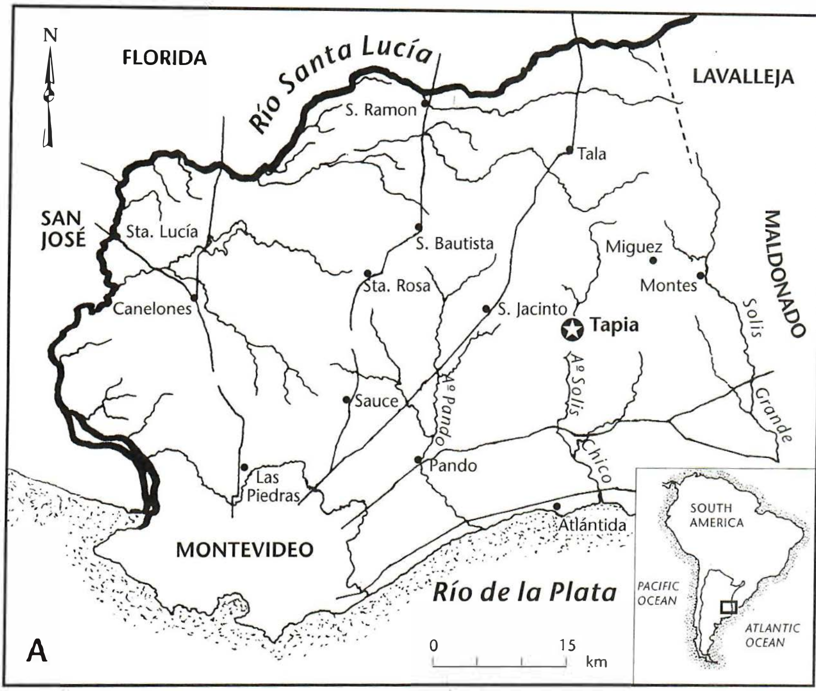
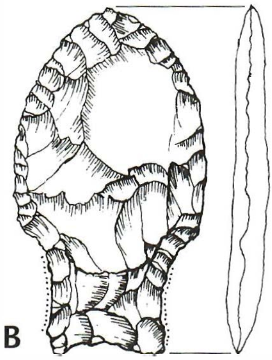


Figure 1. **A,** Map of the Canelones department showing the Santa Lucía River Basin; **B,** Fell projectile point found at Tapia. (Drawing taken from Meneghin 1988 and slightly modified.)



1979: 16). This rock is comparable with the excellent flints and cherts of the world, such as chalcedonies from Lindenmeier (U.S.A.) or Guadalupe chert from Mexico.

Considering they date to late-Pleistocene times, the findings were remarkable. For example, the so-called "Dolores Formation" produced abundant new data that expand our knowledge of Pleistocene—and possibly earlier—fauna in Canelones (e.g., Teisseire 1930, Mones and Francis 1973). These include skeletons of several ground sloths (*Glossotherium robustum, Megatherium americanum, Megatheridae* sp., *Scelidotherium* sp., *Lestodon* sp.) and glyptodons and armadillos (*Doedicurus* sp., *Glyptodon* sp., and undetermined *Glypto-*

dontidae), bear (*Ursidae* sp.), mastodon (probably *Stegomastodon* sp.), horse (*Equus* sp.), cervus (*Antifer* sp., *Morenelaphus*), rodents (*Lagostomus* sp.), and undetermined extinct camelids and canids. Currently these remains are the subject of several paleontological studies.

The paleontological discoveries indicate late-Pleistocene faunas in Uruguay were characterized by a great diversity of species. As in the Pampean-Patagonian region in Argentina, many of these species may have been contemporaneous with late-Pleistocene hunter-gatherers (cf. Menegaz and Nami 1994; Politis et al. 1994).

Discoveries of great interest are six paleoecological sites along the Santa Lucía river, which contain buried trees still remaining in living position. Wood samples from Paso Cuello and Paso Pache sites yielded the following radiocarbon dates: 10,480 ± 100 RCYBP (LP-1110), 10,500 ± 110 RCYBP (LP-1143) and 11,650 ± 130 RCYBP (LP-509) (Ubilla 1999).

These data are highly significant for understanding the landscape of Fell hunter-gatherers in the area. Several surface finds of Paleoindian artifacts have been made in Canelones (Bosch et al. 1980). Near the Santa Lucía River at Tapia locality an excellent Fell projectile point (Figure 1B) was discovered. This artifact, made on a very fine white chert, is 59 mm long and has a maximum width of 33 mm and maximum thickness of 7.1 mm. The artifact exhibits very uniform transverse and longitudinal sections. The flake scars on both faces indicate that before final shaping the artifact was made by very careful bifacial flaking with soft percussion. After that, it was finished by pressure flaking that left short retouch flake scars that extend less than 1 cm from the edges. The stem is 16 mm long and 19 mm wide at the base, which was carefully abraded along both edges (shown with a dashed line in Figure 1B). This attribute is a common feature of South American Fell projectile points (Flegenheimer 1991; Nami 1997, 2000a). In southern South America, Fell projectile points were used by late-Pleistocene/early-Holocene hunter-gatherers between ca. 9500 and 11,000 year B.P. (Nami 1996; Nami and Nakamura 1995).

Like Clovis people in North America, hunter-gatherers who used Fell points in their weaponry lived in diverse environments. To cope with these environments, Fell people probably developed different adaptive strategies. However, all these early peoples probably shared similar material culture with respect to their lithic technology (Nami 2000b). Thus, the Santa Lucía river basin findings are helping to expand the picture of the environmental biodiversity surrounding the Paleoindian people in South America.

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References Cited

Bosch, A., J. Femenías, and A. J. Oliva 1980 Dispersión de las Puntas de Proyectil Líticas Pisciformes en el Uruguay. *Anales. III congreso Nacional de Arqueología (1974)*, Montevideo, Uruguay.

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

Flegenheimer, N. 1991 Bifacialidad y Piedra Pulida en Sitios Pampeanos Tempranos. *Shincal* 3: 64–78.

Meneghin, U. 1988 Arqueología en la Región Centro-Oriental del Departamenteo de Canelones, Uruguay. *Comunicaciones Antropológicas del Museo de Historia Natural de Montevideo* II (14), 14 pp.

Menegaz, A., and H. G. Nami 1994 Late Pleistocene Faunal Diversity in Ultima Esperanza (Chile): Further Data from Cueva del Medio. *Current Research in the Pleistocene* 11:93–95.

Mones, A., and J. C. Francis 1973 Lista de Vertebrados Fósiles del Uruguay. II. *Comunicaciones Paleontógicas del Museo de Historia Natural del Uruguay* I (4):39–97, Montevideo, Uruguay.

Nami, H. G. 1996 New Assessments of Early Human Occupations in the Southern Cone. In *Prehistoric Mongoloid Dispersals,* edited by T. Akazawa and E. J. E. Szathmáry, pp. 254–269. Oxford University Press.

——— 1997 Investigaciones Actualísticas para Discutir Aspectos Técnicos de los Cazadores-recolectores del Tardiglacial: El Problema Clovis-Cueva Fell. *Anales del Instituto de la Patagonia (Serie Ciencias Sociales)* 25:152–186.

——— 2000a Experiments to Understand North and South American Late Pleistocene Lithic Reduction Sequences: An Actualistic and Comparative Study. In *Late Pleistocene Lithic Technology: An Hemispheric Perspective,* edited by J. Morrow and C. Gnecco, (in press).

——— 2000b Technological Comments on Some Paleoindian Lithic Artifacts from Ilaló, Ecuador. *Current Research in the Pleistocene,* 17:104–107.

Nami, H. G., and T. Nakamura 1995 Cronología Radiocarbónica con AMS Sobre Muestras de Hueso Procedentes del Sitio Cueva del Medio (Ultima Esperanza, Chile). *Anales del Instituto de la Patagonia (Serie Ciencias Humanas)* 23:125–133.

Politis, G., J. L. Prado, and R. P. Beukens 1994 The Human Impact in Pleistocene-Holocene Extinctions in South America. The Pampean Case. In *Ancient Peoples and Landscapes,* edited by E. Johnson, pp.187–205, Texas Tech University, Lubbock, TX.

Teisseire, A. 1930 *Contribución al Estudio de la Geología y de la Paleontología de la República Oriental del Uruguay.* Peña Hnos., Montevideo, Uruguay.

Ubilla, M. 1999 Dataciones Radiocarbónicas (^{14}C) para la Fm. Dolores (Río Santa Lucía, dpto. de Canelones y A° Gutierrez Chico, dpto. de Río Negro) y Comentarios sobre la Fauna de Vertebrados Asociada. *Revista de la Sociedad Uruguaya de Geología,* III Epoca, 6:48–54.

The Role of Sediment Analyses in Establishing Human Presence at Early Archaeological Sites

Lucinda J. McWeeney

It has long proved difficult to validate the many claims for pre-Clovis human occupation in the New World. However, several methods recently employed at the Cactus Hill site in southeastern Virginia hold significant potential to document stratigraphic integrity along with human presence at an archaeological site (McWeeney 2000). A hearth-like feature containing white pine (*Pinus strobus*) charcoal radiocarbon dated to 15,070 ± 70 RCYBP (Beta Ana-

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lytic 81590), along with quartzite trim flakes and blade flakes excavated 7.5 cm below the Clovis-like fluted points (McAvoy et al. 2000), opened the site to speculation that people lived at Cactus Hill long before previously accepted dates for prehistoric occupation of North America.

Knowing that the date and its association with humans would be questioned, the Nottoway River Survey (NRS) research team determined that rigorous methods must be employed to evaluate the evidence. What indicators could be assessed further to correlate the botanical, radiometric, and lithic evidence? The research team produced evidence documenting a pre-Clovis component at the Cactus Hill site based on criteria established by noted archaeologists (Dincauze 1984; Griffin 1979; Waters cited in Hall 2000). The criteria require 1) a clearly identifiable intact geologic context, 2) verified human artifacts, and 3) that the site be dated by reliable dating methods.

Innovative methods were deemed to be essential for correlating stratigraphic integrity and human presence in the dated pre-Clovis level at Cactus Hill. In their study of the sand dunes in northwest Britain, Powers et al. (1989:27) concluded that the quantity of phytoliths found in areas occupied by humans were orders of magnitude greater than those in natural sand dunes, non-grazed grasslands, woodlands, shrub layers, or herbaceous landscapes. While botanical remains from a Bronze Age site vary considerably from the imprint left by Paleoindians, NRS believes the phytolith method holds potential to resolve debated issues for Cactus Hill.

McWeeney hypothesized that if the dune sediments had been disturbed, post-depositional processes would produce a homogenous phytolith and phosphates record in every level of the site. A 60-cm column of sediment was excavated in 2.5-cm increments, providing high-resolution sampling. Phytolith extraction methods followed Zhao and Pearsall (1998) and Mulholland (1989). Phytolith quantification is based on weight of the extracted material. Samples were also analyzed for phosphates (Baker and Hodges 2000) based on established association between phosphates and human presence (Vizcaino and Canabate 1999). The results of these analyses indicate that the quantity of phytoliths, phosphates, and lithics co-varied throughout the column, indicating the integrity of the strata (Figure 1). Moreover, the nearly parallel relationship between the three types of human-related components strongly supports the presence of humans in the layer associated with the 15,070 RCYBP date on charcoal.

Based upon botanical analysis, pedological analysis, soil chemistry, lithic studies, and faunal analysis, supplemented by OSL and ^{14}C dating (McAvoy et al. 2000), we believe Cactus Hill satisfies all the criteria required to document a pre-Clovis site. Future work will include analysis of a second column from a cultural unit at Cactus Hill, along with an adjacent off-site column to evaluate our initial results and further test our hypothesis. We encourage other archaeologists working on Paleoindian and potentially earlier habitations to employ this series of tests for evaluating stratigraphic integrity and associated human occupation at other sites.

The Virginia Department of Historic Resources funded the initiation of this phytolith study. The National Geographic Society grant #6345-98 funded several other analyses referenced in this paper.

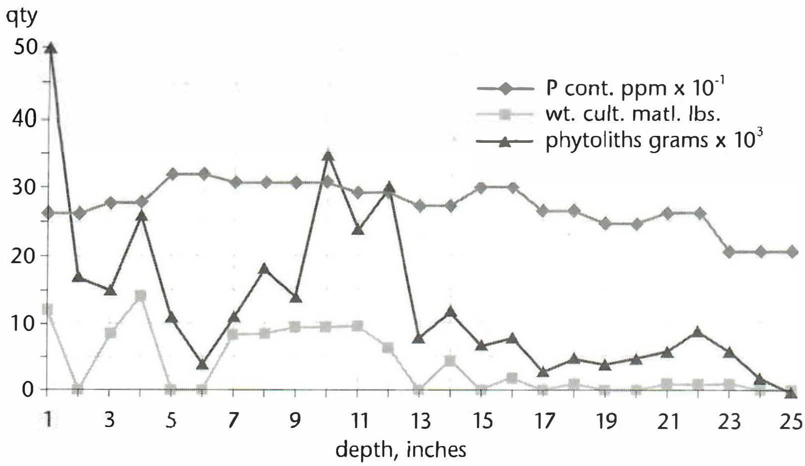

Figure 1. Human habitation levels determined by lithics, herein based on weight, compared with the stratigraphic analyses of phosphates and phytoliths from Cactus Hill. Depths on the X-axis based on artifacts represent: 1″ came from the plow zone; middle-Archaic period begins at 3″ and goes through 8″, early-Archaic in 10–12″, Hardaway at 14″, Clovis at 16″, pre-Clovis at 21″. Graph by L. McAvoy. (McAvoy et al. 2000.)

References Cited

Baker, J. C., and R. L. Hodges 2000 Pedologic Analyses and Stratigraphy of Surficial Sand Deposits at Cactus Hill. Paper presented at the Society for American Archaeology, Philadelphia, PA.

Dincauze, D. 1984 An Archaeological Evaluation of the Case for Pre-Clovis Occupations. *Advances in World Archaeology* 3:275–323.

Griffin, J. B. 1979 The Origin and Dispersion of American Indians in North America. In *The First American: Origins, Affinities, and Adaptations*, edited by W. S. Laughlin and A. B. Harper, pp. 43–55. Gustav Fischer, NY.

Hall, D. A. 2000 Geoarchaeological Methods Crucial for Finding Pre-Clovis. *Mammoth Trumpet* 15(2):9–15.

McAvoy, J. M., J. C. Baker, J. K. Feathers, R. L. Hodges, L. J. McWeeney, and T. R. Whyte 2000 *Summary of Research at the Cactus Hill Archaeological Site, 44SX202, Sussex County, Virginia: Report to the National Geographic Society in Compliance with Stipulations of Grant #6345-98.*

McWeeney, L. J. 2000 Determining Human Presence Using Multiple Lines of Evidence for the Cactus Hill Site, Virginia. Paper presented at the Society for American Archaeology, Philadelphia, PA.

Mulholland, S. C. 1989 Procedures for Phytolith Analysis. Unpublished manuscript, Archaeometry Laboratory, University of Minnesota Duluth, Duluth, MN.

Powers, A. H., J. Padmore, and D. D. Gilbertson 1989 Studies of Late Prehistoric and Modern Opal Phytoliths from Coastal Sand Dunes and Machair in Northwest Britain. *Journal of Archaeological Science* 16:27–45.

Vizcaino. A. S., and M. L. Canabate 1999 Identification of Activity Areas by Soil Phosphorus and Organic Matter Analysis in Two Rooms of the Iberian Sanctuary "Cerro El Pajarillo." *Geoarchaeology: An International Journal* 14(1):47–62.

Zhao, A., and D. M. Pearsall 1998 Experiments for Improving Phytolith Extraction from Soils. *Journal of Archaeological Science* 25:587–598.

New Data on Fell Lithic Technology from Paso del Puerto, Río Negro Basin, Uruguay

Hugo G. Nami

Antonio Taddei was one of the pioneers in Uruguayan archaeology. His collection, which includes more than 60,000 artifacts, is curated at the museum named after him in Canelones city, Uruguay Republic. The lithic collection consists of diverse cores and both finished and unfinished artifacts from different areas of the country. The collection has considerable potential for informing us about lithic technology in Uruguay during the late Pleistocene and Holocene.

One of the sites that yielded a remarkable number of stone artifacts is Paso del Puerto (33° 07′ S 57° 12′ W). It is located in the Río Negro basin in the central part of the country, an area noteworthy for the discovery (Baeza and Femenías 1999; Bosch et al. 1980) of a large number of Paleoindian projectile points known as "fishtail," Fell's cave (Mayer-Oakes 1986), or just Fell (Nuñez et al. 1994). At the Paso del Puerto site, Taddei collected diverse kinds of lithic artifacts since 1948; among them are more than 500 bifaces in early stages of manufacture, preforms, and projectile points (Taddei 1980). Most of the points are stemmed and comparable with those produced by the Holocene hunter-gatherers in southern Brazil, Uruguay (Schmitz 1987), and northeast Argentina (Rodriguez and Cerutti 1999). However, one "typical" example of a fluted Fell Paleoindian projectile point was obtained from the site and reported many years ago by Bosch et al. (1980, plate 2 #13).

Recently, detailed studies by the author on bifacial and unifacial artifacts from Paso del Puerto resulted in the identification of new Paleoindian specimens: at least two unfluted pieces that fall into the range of variation of Fell projectile points (Figure 1A, 1B) and six preforms that reveal distinctive attributes of the manufacturing process. Also present is a lateral scraper with morphological and technological attributes of the Paleoindian artifacts of this type in southern South America; it exhibits the delicacy in manufacture characteristic of Paleoindian unifacial stone tools (see Cardich 1987, Figures 6, 7 and 9; Nami 1994, Figures 4 and 7). This type of tool is not commonly found in Holocene Uruguayan assemblages and might be attributed to Fell hunter-gatherers. Lateral scrapers were made of highly selected flint-like material with similar colors that Fell knappers used to produce their projectile points in Uruguay (Baeza, pers. comm. 1999).

Although there is variation in the basal treatment of Fell projectile points (Nami 1997, Figure 3), including the fact that many are not fluted (e.g., Bird 1969; Bosch et al. 1980; Mayer-Oakes 1986, etc.), the preforms from Paso del Puerto are interesting because they show the manner in which Paleoindian

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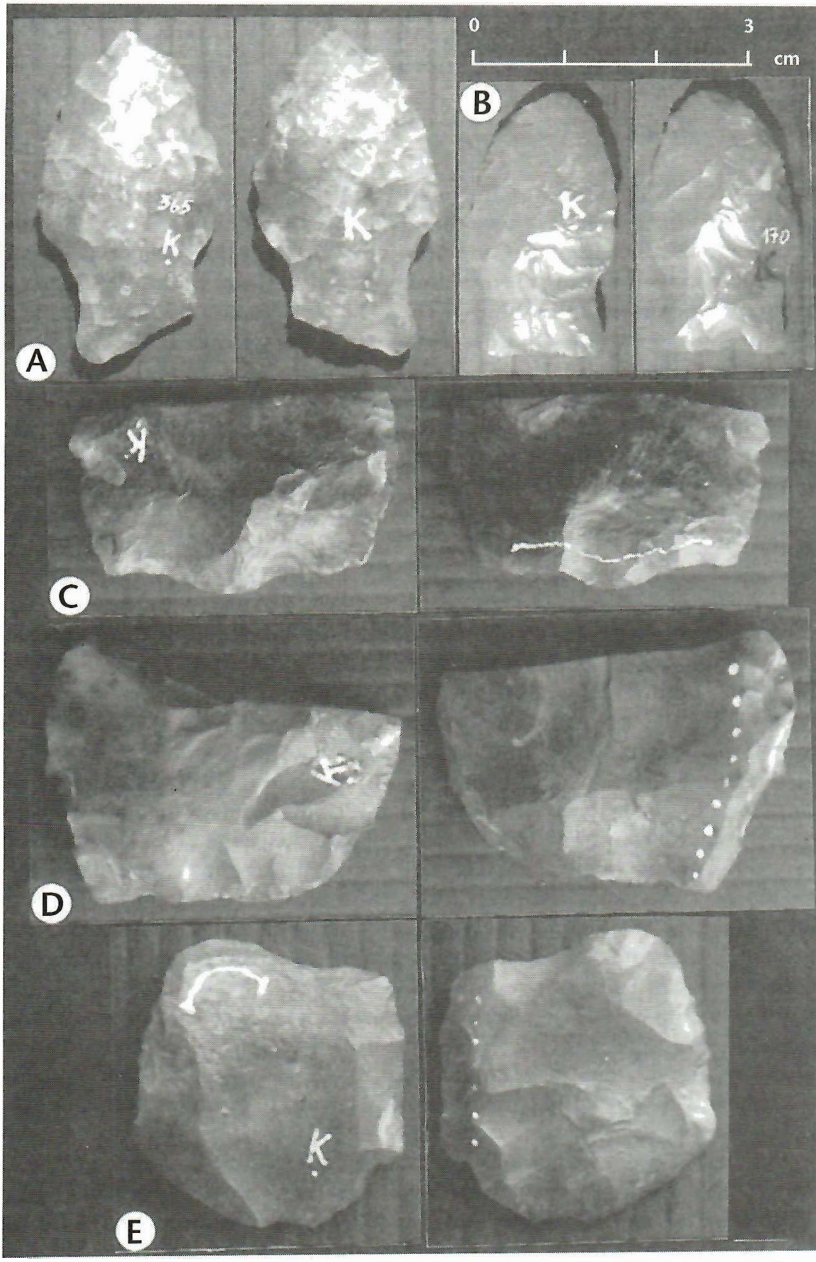

Figure 1. **A, B,** Fell projectile points; **C, D,** platform preparation by isolated nipples; **E,** fluted preform broken by a bending fracture. The lines and dots were originally marked by A. Taddei.

knappers prepared the platforms for fluting. In fact, five preforms from Paso del Puerto were fluted on one face and broken during this activity. This kind of evidence is rare in South America, and the Paso del Puerto artifacts may provide the first clues about how Fell points from Uruguay were fluted. In fact, as illustrated in Figure 1C and 1D, some preforms show that the flute scar was created by removing a flake from a carefully prepared and isolated nipple. Other preforms were fluted simply by beveling the basal portion with a few retouch flakes to create a platform, but without carefully isolating a nipple. One preform is an exceptional example of unsuccessful fluting due to a bending fracture (see also Chauchat et al. 1998, 53 right; Mayer-Oakes 1986, Figures 102d, 108c, 113c-e, 114), but from an abraded beveled platform (Figure 1E). These artifacts are evidence of excellent fluted Fell specimens in Uruguay. Other excellent examples are those found at Rincón del Bonete (middle Río Negro) and illustrated by Schobinger (1992: 161). These specimens are comparable to North American fluting.

At other sites in South America, nipple preparation is also observed on some Fell preforms from the Ilaló region in Ecuador (Mayer-Oakes 1986, Figure 103e; Nami 2000), from Peru (Chauchat et al. 1998, Figure 53 right), and from the Buenos Aires province in the Argentinean pampas (Flegenheimer et al. 2000). Thus, there is no doubt that the South American Paleoindians used nipple isolation in preparation for fluting.

In summary, recent observations on the Paso del Puerto lithic collection provide evidence of additional Paleoindian artifacts from Uruguay. Remarkable are the preforms showing preparation for fluting, which is a technical attribute that until recently was not very well known in South American Paleoindian lithic assemblages.

I am indebted to J. Femenías, director of the Antonio A. Taddei Museum, for allowing and stimulating my studies of the Paso del Puerto collection; J. Baeza for his invaluable help and enthusiasm for studying the Uruguayan collections; F. López, J. E. Gutierrez and F. Montini for their hospitality, help and support during my stay in Canelones; M. de las Mercedes Cuadrado Woroszylo, who was very helpful and supportive in diverse aspects of my investigations in Uruguay; and finally P. Storck, for his invaluable help during the editing of this paper.

References Cited

Bird, J. 1969 A Comparison of South Chilean and Ecuatorial "Fishtail" Projectile Points. *The Kroeber Anthropological Society Papers* 40:52–71, Berkeley, CA.

Baeza, J., and J. Femenías 1999 Nuevas Observaciones Sobre Puntas Colas de Pescado del Uruguay. Paper presented at Primeras Jornadas de arqueología Pampeana, Rosario.

Bosch, A., J. Femenías, and A. J. Oliva 1980 Dispersión de las Puntas de Proyectil Líticas Pisciformes en el Uruguay. *Anales. III congreso Nacional de Arqueología (1974)*, Montevideo, Uruguay.

Cardich, A. 1987 Arqueología de Los Toldos y El Ceibo (Provincia de Santa Cruz, Argentina). *Estudios Atacameños* 8:98–117.

Chauchat, C., C. Galvez, J. Briceño R., and S. Uceda C. 1998 Stios Arqueológicos de la Zona de Cupisnique y Margen Derecha del Valle de Chicama. *Travau de L'Institut Francais d'Etudes Andines*, p. 113, Lima, Peru.

Flegenheimer, N., D. Amick, and C. Bayón 2000 Early Strategies of Raw Material Acquisition and Use in the Southern Cone. In *Late Pleistocene Lithic Technology: An Hemispheric Perspective*, edited by J. Morrow and C. Gnecco.

Mayer-Oakes, W. 1986 *El Inga. A Paleoindian Site in the Sierra of Northern Ecuador. Transactions of the American Philosophical Society,* 76 (4), 235 pp., Philadelphia, PA.

Nami, H. G. 1994 Reseña Sobre los Avances de la Arqueología Finipleistocénica del Extremo sur. *Chungará* 26 (2):145–163, Arica.

1997 Investigaciones Actualísticas para Discutir Aspectos Técnicos de los Cazadores-Recolectores del Tardiglacial: El Problema Clovis-Cueva Fell. *Anales del Instituto de la Patagonia (Serie Ciencias Sociales),* 25:152–186, Punta Arenas.

2000 Technological Comments on Some Paleoindian Lithic Artifacts from Ilaló, Ecuador. *Current Research in the Pleistocene* 17:104–107.

Nuñez, L., J. Varela, R. Casamiquela, V. Schiappaccasse, H. Niemeyer, and C. Villagrán 1994 Cuenca de Taguatagua en Chile: El Ambiente del Pleistoceno Superior y Ocupaciones Humanas. *Revista Chilena de Historia Natural* 67:503–519, Santiago, Chile.

Rodriguez, J., and C. Cerutti 1999 Las Tierras Bajas del Nordeste y Litoral Mesopotámico. In *Nueva Historia de la Nación Argentina,* I, pp. 109–122. Editorial Planeta, Buenos Aires, Argentina.

Schmitz, P. I. 1987 Prehistoric Hunter and Gatherers of Brazil. *Journal of World Prehistory* 1:53–126.

Schobinger, J. 1992 La Patagonia en el Marco de la Más Antigua Prehistoria Americana. In *Culturas Indígenas de la Patagonia,* edited by R. Bárcena, pp. 151–168. Sociedad Estatal del Quinto Centenario, Turner, Madrid, Spain.

Taddei, A. 1980 Un Yacimiento de Cazadores Superiores en el Río Negro (Paso del Puerto) (Uruguay). *Anales. III Congreso Nacional de Arqueología (1974).* Montevideo, Uruguay.

Three Anzick-Style Bifaces

Kristen M. Parsons and William L. Parsons

During the summer of 1996, the principal investigators, while conducting their continuing field survey of the area, were shown the lithic collection of a rancher in Cascade County, Montana. This collection contains approximately 500 pieces, all surface collected. The rancher confirmed that all were collected from within his 6,000-acre ranch, which is located 7 km east of the Smith River. Approximately 1 km from the site, three large bifaces and an Anzick-style fluted-point basal fragment were discovered (Parsons and Parsons, 1998).

The discovery location of at least two of the bifaces is known within 100 ft. There were no lithic materials or distinguishing features associated with their discovery. These two bifaces are of almost identical construction and size and are made of the same chert material. When the principal investigators compared these bifaces with specimens of the Anzick assemblage (Wilke et al. 1991, and casts at the Clovis and Beyond Conference in Santa Fe, New Mexico, 2000), they found remarkable similarities.

These bifaces can be described as bifacial cores or discoidal cores (Gramly 2000). They are almost circular, with prepared striking platforms, relatively flat-faced with large converging flake scars. In at least three instances on one

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biface (Figure 1C) and in one instance on another (Figure 1A), some of the flake scars extend past the midline of the long axis of the biface. They may have been used to yield flakes, or may be exhausted blade cores. One biface (Figure 1B) is made of opaque yellow ochre-like lithic material. The larger bifaces (Figure 1A and 1C) are made of greenish brown translucent chalcedony. The nearest source for these lithic materials is the "gastrolith" cobbles that are an identifying characteristic of the local Kootenai geologic formation "badlands" (Ross et al., 1955).

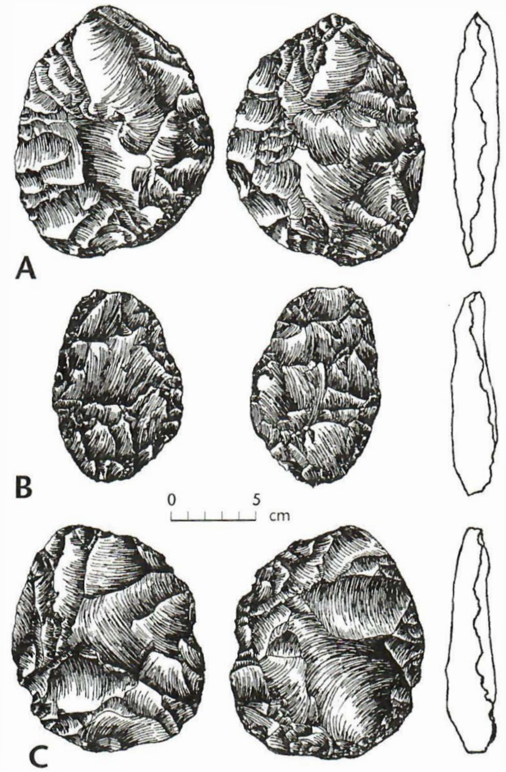

Figure 1. Three Anzick-style bifaces found in Cascade County, Montana. Illustration by William L. Parsons.

Dimensions of the bifaces: Figure 1A, short axis 10.5 cm, long axis 14.7 cm, width 2.7 cm; Figure 1B, short axis 7.4 cm, long axis 10.9 cm, width 2.4 cm; Figure 1C, short axis 10.9 cm, long axis 13 cm, width 2.9 cm.

References Cited

Gramly, R. M. 2000 *Guide to the Palaeo-American Artifacts of North America*, Persimmon Press Monographs in Archaeology, Buffalo, NY.

Parsons, W. L., and K. M. Parsons 1998 Anzick-Style Fluted Projectile Point, *Current Research In The Pleistocene*, 15:53–54.

Ross, C. P., D. A. Andrews, and I. J. Witkind 1955 *Geologic Map of Montana*, Prepared in cooperation with the Montana Bureau of Mines and Geology.

Wilke, P. J., J. J. Flenniken, and T. L. Ozbun 1991 Clovis Technology at the Anzick Site, Montana. *Journal of California and the Great Basin Anthropology* 13(2):242–27.

Recent Investigations at the Gerstle River Site, a Multicomponent Site in Central Alaska

Ben A. Potter

The Gerstle River Site (49XMH-246) is located 1 mile from a braided river on a south-facing bench on a loess-mantled bedrock outcrop in the Tanana Basin, central Alaska. The site consists of two areas 30 m apart, the Upper Locus and Lower Locus. Previous researchers tested and excavated the Upper Locus in 1976, 1977, 1983, 1985, and 1996 (Holmes 1998; Holmes and Dilliplane 1976; Kimura et al. 1989; Rabich and Reger 1978), and briefly tested the Lower Locus (Holmes 1998). The author excavated 48 m^2 at the Lower Locus in 1999 and 2000 (Potter 1999, 2000; Potter and Holmes 2000). To date, we have excavated 133 m^2, obtained 21 ^{14}C dates, and recovered over 6,000 artifacts in 6 components spanning the entire Holocene at both loci. The 2000 excavation was designed to connect various activity areas relating to hearths and articulated and unarticulated faunal remains uncovered in 1999, excavate the southern edge of the bluff prior to collapse, determine the extent of artifact presence, and retrieve ^{14}C-datable material. The stratigraphy at the site consists of a series of eolian sediments up to 4 m thick, with five buried Bw horizons and two paleosol complexes.

Component I, associated with a paleosol dated to 9740 ± 50 RCYBP (B-133751), consists of flaking debris, a few scattered unidentifiable bone fragments, and 72 cobbles/boulders that may represent a feature. Since no diagnostic artifacts were recovered, its cultural historical placement is unknown. Component II consists of 2 modified flakes, 102 microblades, 1 microblade core tablet, and 2 facet rejuvenation flakes from wedge-shaped cores, together with flaking debris, all associated with a hearth dated to 9510 ± 50 RCYBP (B-134098). Component III, the largest component at the site, consists of over 4,000 artifacts, including 434 microblades, 2 wedge-shaped microblade cores, 2 burins, 10 burin spalls, 1 endscraper, 1 sidescraper, 4 boulder spall scrapers, and flaking debris, associated with 3 hearths, one dating to 8860 ± 70 RCYBP (B-133750). Numerous faunal elements were associated with the hearths and lithics, including multiple individuals of elk and bison, and a single worked mammoth ivory tusk. Gastroliths have been found in the 1996 and 2000 excavations for this component. The assemblages from Components II and III are most similar to clusters A–

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C, G, and N at Dry Creek site CII (Powers et al. 1983), and fall within Denali Complex parameters (West 1967). Component IV consists of eight microblades, a side scraper, an endscraper, and flaking debris. Component V consists of a single notched pebble, and Component VI contains two endscrapers, a projectile point, and flaking debris, with a stratigraphic date of 3800 ± 65 RCYBP (N-4959).

The worked mammoth ivory rod or point (Figure 1) was found 50 cm south of a hearth dated to 8860 ± 70 RCYBP (B-133750). This point, approximately 25 cm long and less than 1 cm diameter, has a near-circular cross section near

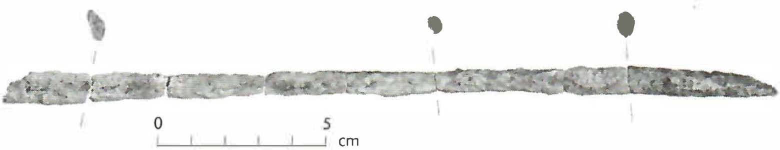

Figure 1. Mammoth ivory point (UA99-062-284).

the tip and becomes flattened near the base. Similar points, made of bone and found in the muck deposits near Fairbanks, were recently dated by Jim Dixon to about 8500 RCYBP (Dixon 1999:53). The presence of this non-slotted point in association with microblades is intriguing.

The 1999 faunal assemblage of Component III is composed primarily of low-yield axial and lower limb elements. Such an assemblage is highly suggestive of a field-butchering site, where recently killed animals were processed and low-value meat units extracted from the carcasses. The fragmented nature of the bones tends to support this interpretation, suggesting use of marginal-value bones for marrow extraction. The 2000 faunal assemblage of Component III and fauna from previous excavations are currently being analyzed.

There is potential for earlier occupations at the site. Several horse bones were recovered in 1996, including a radius dating to 15,090 ± 70 RCYBP (B-109267) (Holmes 1998) and a molar found in 2000. A saiga antelope humerus was also recovered. These remains were recovered in the eroding slope debris; no artifacts were found in association. Due to safety and time constraints, only one test (a pit 1 m square) has been conducted in the lower sediments. Further excavations are scheduled for the summer of 2001. It is hoped that small, discrete components such as those found at the Gerstle River site can begin to address early-Holocene site structural questions and help elucidate Denali Complex subsistence and settlement patterns.

References Cited

Dixon, E. J. 1999 Bones, Boats, and Bison: Archeology and the First Colonization of Western North America. University of New Mexico Press, Albuquerque, NM.

Holmes, C. E. 1998 Archaeological Testing and Evaluation of the Gerstle River Quarry, East-central Alaska, 1996. Office of History and Archaeology Report Number 65.

Holmes, C. E., and T. Dilliplane 1976 Report of archaeological survey along the Alaska highway including a brief history of the highway. In Archaeological Survey Projects, 1976, pp. VIII-18, Miscellaneous Publications, History and Archaeology Series No. 16, Alaska Division of Parks.

Kimura, Y., T. Nishimoto, and Y. Kotani 1989 Three-dimensional and Attribute Debitage Analyses of Stone Chips. Bulletin National Museum of Japanese History and Ethnology 21:207–238.

Potter, B. A. 1999 Gerstle River Quarry Site (XMH-246) Archaeological Excavation Preliminary Report. Report prepared for Delta-Greely School District.

——— 2000 Gerstle River Quarry Site (XMH-246) Archaeological Excavation Preliminary Report. Report prepared for the Alaska Office of History and Archaeology, Department of Natural Resources, Anchorage, AK.

Potter, B, A., and C. E. Holmes 2000 Gerstle River Quarry Site, an Early Holocene Multicomponent Site in the Tanana Basin. Paper presented at the Twenty-seventh annual Alaska Anthropological Association conference, Anchorage, AK.

Powers, W. R., R. D. Guthrie, and J. F. Hoffecker 1983 Dry Creek: Archeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp. Report submitted to the National Park Service. Contract CX-9000-7-0047.

Rabich, J. C., and D. R. Reger 1978 Archaeological Excavations at the Gerstle River Quarry Site. In, Archaeological Survey Projects, 1977, pp. 11-37, Miscellaneous Publications, History and Archaeology Series No. 18, Alaska Division of Parks.

West, F. H. 1967 The Donnelly Ridge Site and the Definition of an Early Core and Blade Complex in Central Alaska. *American Antiquity* 32:360–382.

The Dalton Gang Strikes Up North: Dalton Points in South Dakota

Frederic Sellet and Michael Fosha

In a recent reevaluation of the long-forgotten Meserve point type, Myers and Lambert (1983) suggest that Meserve points belong to the greater Dalton cultural horizon. This conclusion is based on the typological resemblance of the projectile points discovered at the Meserve site (Schultz 1932), the Red Smoke site (Davis 1953, 1962) and the Clary Ranch site (Myers et al. 1981, 1983) to typical Dalton points described by Goodyear (1974:24–32). The common morphological characteristics of these artifacts are a well-formed basal concavity, a stem with incurvated sides, and evidence of beveling (Myers and Lambert 1983: 110).

The purpose of this paper is to bring attention to a series of artifacts fitting the typological definition of Dalton points (including fluting) that have been recorded as part of an exhaustive survey of Paleoindian points in South Dakota (Sellet and Fosha 2000). Myers and Lambert's description of Dalton-Meserve points does not mention fluting; nevertheless, fluting is commonly found on Dalton points from Missouri and Arkansas, the core area of the

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Dalton complex (e.g., Wyckoff 1999: Figure 7a,c,d,f,h). To date, a total of 21 Dalton points have been found in 3 separate private collections. These points include 8 fluted (Figure lA, 1C), 4 serrated (Figure lA, 1B) and 13 beveled specimens (Figure lA, 1C). All artifacts are surface finds from the same general area in the South Dakota Badlands. At least six came from a single locality (Figure lB, 1C). To the best of our knowledge, those finds represent the northernmost extension of the Dalton type.

In their discussion of the chronological overlap between Folsom, Agate Basin, Hell Gap, and Dalton, Myers and Lambert noticed that the former point types are poorly represented in south-central Nebraska. They propose that "the manufacturers of Dalton-Meserve points were living in an area that was, at best, thinly populated by people with a High Plains technology" (Myers and Lambert 1983:112). The South Dakota finds challenge this interpretation, since all Dalton points were recovered in a region that has the densest concentration of Paleoindian points in South Dakota. In the same vein, Wyckoff (1999) contrasted Dalton and Folsom technologies on the southern Plains and argued in favor of restricted mobility for Dalton. Our preliminary analysis of raw material types does not support this dichotomy. Finally, although the data presented here provide additional information for evaluating a northern expansion of the Dalton complex, we caution against attempting to directly correlate distribution of point types with movements of human population (see Sellet i.p.).

References Cited

Davis, E. M. 1953 Recent Data from Two Paleoindian Sites on Medicine Creek, Nebraska. *American Antiquity* 18(4):380–386.

——— 1962 The Archaeology of the Lime Creek Site in Southwestern Nebraska. *Bulletin of the Nebraska State Museum, Special Publication Series* 3.

Goodyear, A. 1974 *The Brand Site: A Techno-functional Study of a Dalton Site in Northeast Arkansas.* Research Series 7. Arkansas Archaeological Survey. Fayetteville, AR.

Myers T. P., R. G. Corner, and L. Tanner 1981 Preliminary Report on the 1979 Excavations at the Clary Ranch Site. *Transactions. Nebrăska Academy of Science* IX:1–7.

Myers, T. P., and R. Lambert 1983 Meserve Points: Evidence of a Plainsward Extension of the Dalton Horizon. *Plains Anthropologist* 28:109–114.

Schultz, B. 1932 Association of Artifacts and Extinct Mammals in Nebraska. *Bulletin of the Nebraska State Museum* 33(1):271–282.

Sellet, F., and M. Fosha 2000 Distribution of Folsom and Goshen Artifacts In South Dakota. *Current Research in the Pleistocene 17.*

Sellet, F. in press A Changing Perspective on Paleoindian Chronology and Typology. A View from the Northwestern Plains. In "Between Two Worlds: Late Pleistocene Cultural and Technological Diversity in Eastern Beringia," edited by M. Kunz and M. Bever. *Arctic Anthropology.*

Wyckoff, D. G. 1999 Southern Plains Folsom Lithic Technology: A View From The Edge. In *Folsom Lithic Technology,* edited by D. Amick, pp. 39–64. International Monographs In Prehistory, Archaeological Series 12. Ann Arbor, MI.

Archaeology

Technomorphological Observations on Fishtail Projectile Points and Bifacial Artifacts from Northern Uruguay

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Archaeological evidence shows that the Uruguay and Negro rivers were the main access routes into Uruguay, in southeast South America, for early humans during the late Pleistocene (ca. 11,000–10,500 yr B.P.). On their banks, as well as on those of their tributaries, have been found the largest number of early sites and also great concentrations of lithic resources used by early people in Uruguay (jasper, agate, chalcedony, opal, quartzite and silicified limestone) (Suárez 1999, 2000a).

Great variability in design, manufacturing technique and size of Fishtail Projectile Points (FPPs) is common in archaeological contexts at the end of the Pleistocene in the Southern Cone of South America (Flegenheimer 1999; Flegenheimer and Zárate 1989; Politis 1991). My comments are based on observations of FPPs (n = 23) from northern and central Uruguay, which were most probably used for hunting (some of them show impact damage). All of them show bifacial thinning and technological similarities with FPPs recovered in stratigraphic contexts of South America; some are also fluted (n = 6). However, some morphological differences among the specimens can be noticed, mainly in their stems and shoulders (Figure 1). Those variations could be explained by the following hypotheses. Hypothesis 1: the knappers belonged to different human groups, diachronic or synchronic. Hypothesis 2: variation is due to specific techno-functional designs. Hypothesis 3: variation reflects patterns of design with cultural significance. Hypothesis 4:

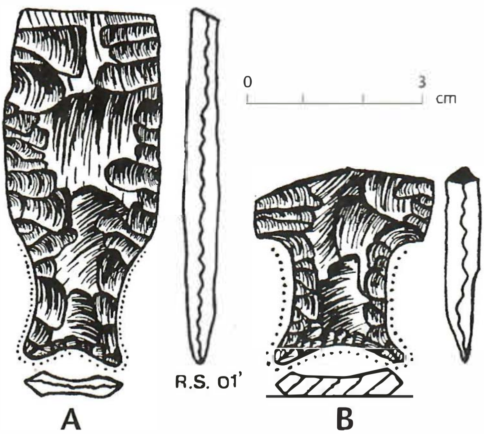

Figure 1. Fishtail projectile points of northern Uruguay, Los Pinos site (Uruguay River). **A**, jasper; **B**, chaledony.

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variation is the result of a long use life, resharpening, and recycling. Although the first three hypotheses cannot be ignored, I am inclined to choose the fourth. The long use life of the FPP, with consequent resharpening and recycling (Flegenheimer 1999, Flegenheimer pers. comm. 2001 Politis 1991), can be expected to have altered the original primary morphological design, characterized by very pronounced shoulders (shoulder angle of 90°–110°; see Figure 1B). Constant resharpening of the blade and shoulders can lead to morphological secondary designs with insinuated shoulders (shoulder angle of 140°–160°; see Figure 1A).

In the collections of early archaeological sites (Arroyo del Tigre, ca. 10,500 yr B.P., and Pay Paso site 1, ca. 9900–9100 yr B.P.), I have recorded several bifaces (n = 15) similar in shape and size to the ones described by Callahan (1979:127–128, Figure 54 C and Figure 55 G -Stage 4-). In some cases they are fluted (Suárez 2000a). These bifaces are 98.5–130.1 mm long and can be technologically defined as preforms of fishtail points. In Pay Paso site 4, three specialized bifaces were recovered at the bottom of a ravine 23–30 m from where bones of *Stegomastodon* sp. were recovered. One of them, classified as Stage 5 (fluted preform), is made of red chalcedony; it exhibits basal fluting and nipple isolation-preparation with pressure-flaked fluting on the reverse face. It is 78.8 mm long, 41.3 mm wide, 9.8 mm thick, and weighs 38.52 gr. The other biface is 93.1 mm long, 52 mm wide, 11 mm thick, and weighs 57.66 gr.; it is made of silicified gray-greenish sandstone and classified Stage 4 (secondary thinning). Another large biface classified Stage 4 (secondary thinning) is made with extraordinary flaking technique and excellent flake scar spacing; it shows very good control of flaking in both faces. It is made of yellow translucent agate of the Arapey formation. It is 110 mm long, 47.4 mm wide, 11.9 mm thick, and weighs 76.13 gr. This biface was probably used as a knife, indicated by use-wear on the edges.

Finally, the north of Uruguay was explored and colonized in the late Pleistocene/early Holocene by Paleoindian groups that possessed among their material culture fluted and unfluted bifacial preforms, bifacial knifes longer than 100 mm, and the classical FPP. The morphological variations of these complex bifacial artifacts are probably due more to long use and resharpening than to stylistic differences.

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References Cited

Callahan, E. 1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flint Knappers and Lithic Analysis. *Archaeology of Eastern North America* 7(1):1–180.

Flegenheimer, N. 1999 Vista Una, Vistas Todas? Las "Cola de Pescado" de la Cima del Cerro del Sombrero. *XIII Congreso Nacional de Arqueología Argentina,* Abstract :353–354. Córdoba, Argentina.

Flegenheimer, N., and M. Zárate 1989 Paleoindian Occupations at Cerro El Sombrero Locality, Buenos Aires province, Argentina. *Current Research in the Pleistocene* 6:12–13.

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

Suárez, R. 1999 Cazadores-Recolectores en la Transición Pleistoceno-Holoceno del Norte Uruguayo: Fuentes de Abastecimiento de Materias Primas y Tecnología Lítica. *Primeras Jornadas del Cenozoico en Urguay* :27–28 Facultad de Ciencias, Montevideo, Uruguay.

——— 2000a Evidence of Human Occupattion During the Transition Pleistocene-Holocene in the North of Uruguay: Paleoindian Sites, Fishtail Projetile Points and New Radiocarbon Dates for the Archaeological Region of Uruguay-Cuareim Riveres. Absract:35 *International Workshop of INQUA, The Colonization of South America During the Plesitocene/Holoecene Transition.* La Plata 4-9 December. Argentine.

——— 2000b Paleoindian Occupations in Uruguay. *Current Research in the Pleistocene* 17:78–80.

Barger Gulch Locality B: A Folsom Site in Middle Park, Colorado

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The intermontane basin of Middle Park, Colorado, is known to contain a high density of Folsom archaeology (Kornfeld 1998; Naze 1986). Although abundant surface finds have been reported, only two Folsom sites have been identified as containing buried archaeological deposits, Crying Woman (Naze 1994) and Barger Gulch, Locality B (Kennedy et al. 1998; Kornfeld and Frison 2000; Surovell et al. 2000). This paper briefly summarizes recent fieldwork (during 1997, 1999, and 2000) at Locality B of the Barger Gulch site (5GA195). As discussed by Kornfeld et al. (this volume), Locality B is one of at least six Paleoindian sites that flank Barger Gulch, a small southern tributary of the Colorado River. The site lies adjacent to a small intermittent stream on a high ridge east of Barger Gulch proper.

To date, subsurface deposits have yielded only Folsom artifacts. The depth of cultural materials is highly variable across the site, exposed on the surface in some areas, buried by as much as 50 cm of sediment in others. Where not eroded, however, cultural material is consistently associated with a buried paleosol. The stratigraphy is somewhat obscured by bioturbation, but is generally straightforward for a shallow site. The uppermost stratum is a light brown to orange silty loam, unconsolidated in its upper portions. This is underlain by a moderately organic paleosol A-horizon. Gleying is associated with the paleosol in low-lying areas, implying high water tables at the time of soil formation and possibly the presence of a spring locally (Reider 1998). A

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single radiocarbon date of 9,420 ± 50 RCYBP (Beta-109464) was obtained on soil organic matter from the paleosol. This date should be considered a minimum age of soil formation, since it has likely suffered some contamination by younger humic acids. The paleosol B-horizon appears to be a modified bedrock surface and exhibits weak secondary carbonates in its lower portions. It is believed that the carbonates postdate soil formation, since the paleosol formed under rather acidic conditions. The B-horizon sits directly on Miocene bedrock (Troublesome Formation). Although some vertical dispersion of the Folsom component is evident, artifacts tend to be concentrated at the contact of the paleosol A- and B-horizons.

From 16 excavation units, 5,265 artifacts have since been recovered. Artifact densities vary dramatically, ranging from fewer than 10 to more than 600 pieces per m^2. The excavated assemblage is overwhelmingly represented by debitage (n = 5,206). The remainder of the assemblage is composed of 3 preforms, 1 finished projectile point, 14 channel flakes, 8 endscrapers, 5 gravers, 3 bifaces, 9 cores, and 16 miscellaneous retouched tools and tool fragments. Also recovered was a sandstone abrader, approximately 3 cm long, with red ocher preserved on one surface. Small pieces of red ocher have been recovered from a number of excavation units. One large core is an excellent example of a centripetal Levallois core similar to those described from the Hanson site (Frison and Bradley 1980). The remaining cores exhibit informal use of large tabular nodules of chert. Locally available Troublesome Formation chert constitutes more than 99 percent of the assemblage. Other raw materials represented include dendritic orange chert (possibly Trout Creek chert from South Park, Colo.), brown dendritic chert, petrified wood, and quartz. No faunal remains have been recovered, likely owing to acidic conditions associated with the paleosol that buried the archaeological materials.

In addition to excavated material, more than 2,500 surface artifacts have been collected and mapped from an area approaching 10,000 m^2. It is not known what percentage of the artifacts are of Folsom age, but only a single non-Folsom diagnostic has been recovered, an isolated side-notched projectile point. Numerous channel flakes and spurred endscrapers have been recovered across this area in addition to Folsom projectile point performs.

Although the site was initially thought to be primarily a quarry location, there are numerous reasons to suggest it represents a Folsom residential occupation or an occupation associated with quarrying activities (Kornfeld et al. this volume). Unlike Locality A (Kornfeld et al. this volume; White 1999), Locality B does not sit immediately adjacent to a primary outcrop of chert, although raw material is available within a kilometer. Also, unlike Locality A, the site location was not periodically reused from the late Pleistocene onward. Finally, a large diversity of tool forms suggests numerous activities occurred in addition to raw material procurement. If indeed Barger Gulch Locality B represents a large residential campsite, it may have tremendous potential for furthering studies of late-Pleistocene hunter-gatherer lifeways in the Rocky Mountain region.

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References Cited

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

Kennedy, J., V. MacMillan, and J. Durr 1998 The Barger Gulch Troublesome Procurement Site (5GA195). In *Early Prehistory of Middle Park: The 1997 Project and Summary of Paleoindian Archaeology*, edited by M. Kornfeld, pp. 34–48. Technical Report No. 15a, Department of Anthropology, University of Wyoming, Laramie, WY.

Kornfeld, M. 1998 Folsom Technology and Subsistence. In *Early Prehistory of Middle Park: The 1997 Project and Summary of Paleoindian Archaeology*, edited by M. Kornfeld, pp. 56–62. Technical Report, No. 15a, Department of Anthropology, University of Wyoming, Laramie, WY.

Kornfeld, M., and G. C. Frison 2000 Paleoindian Occupation of the High Country: The Case of Middle Park, Colorado. *Plains Anthropologist* 45:655–674.

Kornfeld, M., G. C. Frison, and P. White 2001 Paleoindian Occupation of Barger Gulch and the Use OF Troublesome Formation Chert. This volume.

Naze, B. S. 1986 The Folsom Occupation of Middle Park, Colorado. *Southwestern Lore* 52(4):1–32.

——— 1994 *The Crying Woman site: a Record of Prehistoric Human Habitation in the Colorado Rockies.* Unpublished M.A. thesis , Department of Anthropology, Colorado State University, Fort Collins, CO.

Reider, R. G. 1998 Soil Investigations at Archaeological Sites, Middle Park, Colorado. In *Early Prehistory of Middle Park: The 1997 Project and Summary of Paleoindian Archaeology*, edited by M. Kornfeld, pp. 63–69. Technical Report No. 15a, Department of Anthropology, University of Wyoming, Laramie, WY.

Surovell, T. A., N. M. Waguespack, S. Richings-Germain, M. Kornfeld, and G. C. Frison 2000 *1999 Investigations at the Barger Gulch and Jerry Craig Sites, Middle Park, Colorado.* Technical Report No. 18a, George C. Frison Institute of Archaeology and Anthropology, University of Wyoming, Laramie, WY.

White, P. M. 1999 *Getting the High Altitude Stone: Lithic Technology at the Barger Gulch Site (5GA195), Middle Park, Colorado.* Unpublished M.A. thesis, Department of Anthropology, University of Wyoming, Laramie, WY.

Site Distribution in the Zerkal'naya River Valley, Russian Far East

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Archaeologists have long recognized the Primorye Territory of the Russian Far East as a region where important human migration, cultural diffusion,

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and regional adaptations occurred. Nearly a century of archaeological investigations (Derevianko 1998; Okladnikov 1959; Vasilievsky et al. 1997) provides the background for current research by both Russian and cooperative international research teams. In order to contribute to that research, to focus future work, and to describe the material record of this region, this paper summarizes the spatial and temporal patterning of archaeological sites in the Zerkal'naya River valley.

The Zerkal'naya is one of several rivers that flow across southeastern Primorye. It originates on the eastern slope of the Sikhote-Alin Range and flows eastward for some 70 km, where it empties into the Sea of Japan. Although a complete geomorphologic assessment of the valley has yet to be conducted, Pleistocene terrace remnants are recognizable along the length of the valley. The terraces range 10–30 m above the modern floodplain, but most occur at elevations of 12–16 m. Although there is evidence of ancient human occupation on the terraces and valley bottom, the spatial and temporal distribution is not uniform, and sites of different ages appear to have distinctive terrace associations.

Over the past 15 years, archaeologists working in the Zerkal'naya River valley have discovered some 20 archaeological sites and identified three major periods of archaeological occupation. Late-Paleolithic groups occupied the Zerkal'naya River valley by at least 15,000 yr B.P. (Tabarev et al. 1999) and left behind distinct assemblages of small bifaces, burins, percussion blades, and wedge-shaped microcores. Sites of this age constitute the bulk of known archaeological deposits in the valley and have been the major focus of research because they are very similar in content to assemblages from Siberia, north China, and Japan. The possibility of a much earlier Paleolithic occupation is very real, but not securely documented. All known late-Paleolithic sites are located on terraces 12–16 m high, almost invariably on promontories that overlook a tributary confluence.

Early-Holocene (9500–6000 yr B.P.) Neolithic remains are known from other portions of the Primorye, where they are associated with embellished ceramics, stone projectile tips, and a mixed economy that relied on hunting, gathering, and domesticated plants and animals. Until recently, however, *no* Neolithic sites were known in the Zerkal'naya River valley. During the 2000 field season, limited testing at a site located on the 14-m terrace did yield Neolithic pottery from a layer above a Paleolithic deposit. This site certainly deserves more research, since it represents some of the only evidence of early-Holocene human occupation in the valley.

Bronze Age sites are the second most common category of sites in the Zerkal'naya River valley. These sites, loosely dated at 2000–3000 yr B.P., are marked by a cultural assemblage that includes unembellished cooking pots, spindle whorls, polished and chipped stone tools and—very rarely—metal artifacts. All known Bronze Age sites occur on terraces 12–16 m high and are commonly found overlying Paleolithic deposits.

Only a few Medieval sites dating from early in the second millennium A.D. have been located in the Zerkal'naya River valley. Archaeologists know little about these sites, but they include substantial farmsteads and at least one stone-walled "castle." All known Medieval sites are located on the valley floor and are commonly found on land currently cultivated by Russian farmers who have occupied the Basin for the past century.

We offer three potential explanations for the apparent spatial and temporal pattern of archaeological sites within the Zerkal'naya River valley. First, it is possible that the patterns reflect past cultural and economic practices. Second, archaeological research has emphasized Paleolithic sites and focused on areas where they are known to occur, and therefore the distribution may reflect survey bias. Finally, geomorphologic processes may have destroyed many early-Holocene surfaces, older portions of the valley floor, and several thousand years of the Zerkal'naya River's past. These explanations raise separate implications about the antiquity of the Primorye, but can be used as the basic for future research plans and funding applications that will focus on (1) clarifying past economic patterns, (2) regionally based systematic survey, and (3) geomorphic investigations of the Zerkal'naya River valley.

References Cited

Derevianko, A. P. 1998 The Paleolithic of the Russian Far East. In, *The Paleolithic of Siberia: New Discoveries and Interpretations,* edited by A. P. Derevianko, pp. 274–328. University of Illinois Press, Champaign, IL.

Okladnikov, A. P. 1959 Daliokoe Proshloe Primoria. Vladivostok. (in Russian)

Tabarev A. V., A. A. Krup'anko, L. B. Niven, and C. M. Lee 1999 The Final-Paleolithic Sites of Suvorovo III and IV in the Maritime Region, Russian Far East. *Current Research in the Pleistocene* 16:73–75.

Vasilievsky, R. S., A. A. Kryp'anko, and A. V. Tabarev 1997 Genesis of Neolithic in the South of the Russian Far East. Fareastern State University, Vladivostok, p.155.

Radiocarbon Dates Associated with a Single-beveled Bone Projectile Point from Sheriden Cave, Ohio

Kenneth B. Tankersley, Brian G. Redmond, and Thomas E. Grove

A single-beveled, crosshatched bone projectile point (Figure 1) was discovered in late-Pleistocene geological contexts during the 2000 archaeological excavation of Sheriden Cave, Wyandot County, Ohio (Tankersley and Redmond 2000). The artifact was discovered 17 cm below the Holocene-

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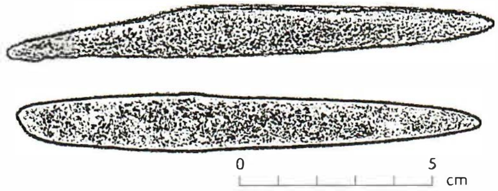

Figure 1. Single-beveled bone point from Sheriden Cave, Wyandot County, Ohio.

Pleistocene boundary and approximately 10 m below the surface in 1-m excavation square N0W3. The western and northern walls of the cave bound this unit. The artifact was found near the reported find-spot of a large Wyandotte chert sidescraper, in an ash-like matrix that contained masses of wood charcoal and burned peccary bone (*Platygonus compressus*). The bone point was found within a meter of a cervical vertebra of a snapping turtle (*Chelydra serpentina*) bearing distinctive chopping marks, a fluted projectile point, another single-beveled crosshatched bone point, and the perforated fragment of a left peccary ilium (Tankersley 1999; Tankersley and Redmond 1999). Although the puncture wound on the ilium approximates the size and shape of the bone points, their relationship remains uncertain.

Stylistically and metrically (length 134.2 and 119.4 mm, maximum width 13.8 and 14.2 mm, minimum diameter 10.6 and 11.6 mm, bevel length 46.0 and 46.9 mm, and weight 16.0 and 12.8 g), the two bone points are nearly identical, and they are unmistakably similar to artifacts recovered from Paleoindian sites in Alaska, Saskatchewan, Washington, Oregon, Montana, Wyoming, New Mexico, and Florida. They are also strikingly similar to some Eurasian upper-Paleolithic single-bevel bone and antler points that date between 11,000 and 23,000 yr B.P.

The bases of the bone points are long and straight, with angular bevels covered with crosshatched patterns of incised lines. On each point, the incising of the beveled end most likely represents an attempt to roughen this contact surface prior to attaching to a shaft. The distal end of each point is tapered to a point, and one specimen displays impact damage typical of its use as a projectile. The surfaces of both bone points are covered with marks from carving, grinding, scoring, incising, and polishing, demonstrating that they were manufactured while the bones were fresh and resilient. Radiography of the points revealed that they were produced from thick (> 11.6 mm diameter) splinters of dense mega-mammal cortical bone.

Eleven uncalibrated AMS radiocarbon dates were obtained on wood charcoal from the artifact-bearing late-Pleistocene strata (all RCYBP): 10,470 ± 70 (AA-21712), 10,550 ± 70 (Beta-117604), 10,570 ± 70 (Beta-117605), 10,600 ± 60 (Beta-117603), 10,620 ± 70 (Beta-117606), 10,680 ± 80 (AA-21710), 10,840 ± 80 (Beta-127909), 10,850 ± 70 (Beta-117602), 10,940 ± 70 (Beta-117601), 10,960 ± 60 (Beta-127910), and 10,970 ± 70 (Beta-117607).

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References Cited

Tankersley, K. B. 1999 Sheriden: A Stratified Pleistocene-Holocene Cave Site in the Great Lakes Region of North America. *BAR International Series* 800:67–75.

Tankersley, K. B., and B. Redmond 1999 Radiocarbon Dating of a Projectile Point from Sheriden Cave, Ohio. *Current Research in the Pleistocene* 16:76–77.

——— 2000 Ice Age Ohio. *Archaeology* 53:6:42–46.

The Gravettian Reindeer Hunter Site, Moravany Lopata II

Piotr Wojtal, Janusz K. Kozłowski, and Grzegorz Lipecki

Moravany-Lopata II is probably one of the latest Gravettian shouldered-point sites in western Slovakia, preceding the final disappearance of this horizon and the transition to the Epigravettian in the rest of Central Europe. Archaeological investigations from 1993 through 1996 were conducted at the site by the Institute of Archaeology of the Slovak Academy of Sciences at Nitra, Slovakia, and the Institute of Archaeology of the Jagiellonian University in Kraków, Poland.

The site is located on the left bank of the Vah River, on the western slope of the Považsky Inovec Mountains, near Moravany in western Slovakia. Buried and stratified cultural materials rest on the surface of a thick layer of interpleniglacial loess. The lower horizon is represented by clustered cultural materials and black organic patches. This horizon is truncated by an older generation of ice wedges filled before the next occupational phase, which occurs in the lower portion of a thin layer of brown loess. The brown loess underlies a younger generation of ice wedges. They are filled with typical loamy loess of the Last Glacial Maximum (LGM), which has eroded from the site, but is still preserved on the slopes and in gullies. A radiocarbon date from the older cultural horizon of 21,400 ± 610 RCYBP (Gd-9246) indicates the occupation occurred just before the LGM. Based on stratigraphy and the distribution of the lithic and faunal finds, three spatial units were recognized at the site. Unit A corresponds to an older phase, and Unit B to the younger period of the occupation. Unit C is probably a dumping zone or corridor between units A and B.

The site yielded 4,669 stone artifacts and 16 bone tools, besides bones with

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traces of working and decoration (Kazior et al. 1998). The remains of two hearths and a storage pit were also found. In all, 1,522 bones and teeth of large mammals were recovered from Units A–C. A total of 1,446 cranial and postcranial elements are from reindeer (*Rangifer tarandus*), 18 from fox (*Vulpes vulpes*), 14 from wolf (*Canis lupus*), 12 from woolly mammoth (*Mammuthus primigenius*), 11 from brown bear (*Ursus arctos*), 11 from hare (*Lepus* sp.), 7 from wolverine (*Gulo gulo*), and one from horse (*Equus* sp.). The faunal remains reflect a specialized human hunting economy focused especially on reindeer. All parts of the *Rangifer tarandus* skeleton are present. The reindeer MNI is 18 in unit A, 10 in unit B, and 17 in unit C. All age categories are present in the reindeer age profile; there was no selection of prime-age adults. The oldest individual was about 10 years old; the youngest animals were killed at age 5–8 months, yearlings at around 17–20 months (Lipecki and Wojtal 1998).

About 90 percent of the bones show no weathering modification and are in stage 0, with only a few bones in stage 1–2. Most of the bones (over 70 percent) exhibit extensive rootlet etching, covering 50–90 percent of their surfaces. Many bone fragments are covered by a calcitic precipitate. Bones from the assemblage show no trampling marks and no gnawing marks from carnivores and rodents (Lipecki and Wojtal 1998).

Nine cutmarks on reindeer bones have been identified. The cuts are located on non-meat-bearing bones, specifically metapodials, carpals, "reduced" phalanges of the forelimb, and some of the distal parts of humeri. The locations and characteristics of these marks are typical of dismembering or skinning. Only one cutmark located on a proximal ulna could be interpreted as a filleting mark (Binford 1981). Most of the long bones and all mandibles show green bone fractures, suggesting marrow extraction (Lyman 1978).

The wear patterns on deciduous and permanent reindeer teeth indicate the site was occupied during the autumn-winter season. Marrow extraction from limb bones and mandibles supports an occupation in the cold part of year, when the people would have needed all available food resources. Moravany-Lopata II is interpreted as a butchering locus created by hunters who killed reindeer in the Vah River valley during the autumn-winter season.

References Cited

Binford, L. R. 1981 *Bones: Ancient Men and Modern Myths*. Academic Press, New York, NY.

Kazior B., J. K. Kozłowski, and K. Sobczyk 1998 Lithic Inventories. In *Complex of Upper Palaeolithic Sites Near Moravany, Western Slovakia. Vol. 2: Moravany-Lopata (Excavations 1993–1996)*, edited by J. K. Kozłowski, pp. 43–83. Institute of Archaeology, Jagellonian University, Cracow/Archaeological Institute, Slovak Academy of Sciences, Nitra.

Lipecki G., and P. Wojtal 1998 Mammal Remains. In *Complex of Upper Palaeolithic Sites Near Moravany, Western Slovakia. Vol. 2: Moravany-Lopata (Excavations 1993–1996)*, edited by J. K. Kozłowski, pp. 103–126. Institute of Archaeology, Jagellonian University, Cracow/Archaeological Institute, Slovak Academy of Sciences, Nitra.

Lyman, R. L. 1978 Prehistoric Butchering Techniques in the Lower Granite Reservoir, Southeastern Washington. *Tebiwa, Miscellaneous Papers of the Idaho State University Museum of Natural History* 13:1–25.

From Beringia to Chile in Less Than 250 years? Note on the Rapid Traversal of Continents

Dawn Youngblood

How viable is the concept of rapid traversal of the Americas by humans? This paper first considers the historically documented traversal of a continent by another omnivorous species and then offers a simple model for rapid traversal. The red fox was introduced on the east coast of Australia and within 50 years was documented on the opposite side of the continent (Lines 1999). British settlers along the coast of Victoria introduced foxes in the early 1870s for the purpose of sport. By 1917, they had reached the opposite side of the continent in Western Australia. Within the first ten years of their introduction, foxes ranged an estimated area of 13,000 km^2. By 1893, some 20 years later, they had extended their range beyond the Murray River less than 500 km beyond their point of origin. Foxes had reached southern Queensland, ca. 1,300 km north of their origin, by 1911, and were reported west of the Kalgoorlie River in Western Australia by 1917 (Lines 1999). Thus, in less than 50 years, the fox had traversed the continent at a net rate of ca. 60 km/year.

The case of the fox in Australia demonstrates that, under certain conditions, a hunting omnivore not only can but actually *did* traverse a continent at a net rate of ca. 60 km/year. The distance from Melbourne to Perth is 2,720 km; from Fairbanks to Santiago is 12,737 km, or 4.7 times further. Thus, any entity traversing continents at the same net rate as the fox in Australia would cover the ground between Fairbanks and Santiago in 235 years. Emphasis should be placed on the overall *net* rate calculated. Not only would species migration vary through time due to population increase, as clearly occurred with the accelerated dispersal of the fox in Australia; the rate of migration would speed up and slow down as a function of available water and food, predation, climate, and physical barriers.

Under what conditions would an omnivorous species rapidly traverse a new domain? A brief model is presented for consideration: Resources (R) act as an attractor not only by their presence, but also by their abundance. A new environment with little or no competition would offer resources at abundance level (*a*). Over time (*t*), resources will drop to a level of *a-n*. Thus, simple abundance drop-off could account for rapid traversal of a landmass wherein the species encounters a viable and unoccupied niche, according to the simple formula:

$$R_t = R_a - R_n$$

Stated again, when the present area of occupation offers resources at an abundance level $R_a - R_n$ and an adjacent area offers resources at abundance level R_a, or potentially R_{a+n}, the adjacent area acts as an attractor for the

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newly arrived species. Once the species has occupied all new areas where R_a exists, the rapid infiltration strategy will be replaced as equilibrium changes to the extent where not moving is more attractive than moving. When conditions approximate the conditions described in this model, rapid traversal will occur.

Thanks to paleontologist Kent D. Newman for his review and valued comments.

Reference Cited

Lines, W. J. 1999 *Taming the Great South Land: A History of the Conquest of Nature in Australia.* University of Georgia Press, Athens, GA.

Physical Anthropology

The Long and Winding Road of the First Americans

M. Blum, W. A. Neves and M. M. Lahr

Until recently, the proposal of an Asian Mongoloid origin for all Native Americans (Greenberg 1987; Greenberg et al. 1986; Turner 1983; Williams et al. 1985) was the most accepted model for the origins of New World populations. But since the late 1980s, various authors have been generating evidence questioning this view. The Paleoindian cranial morphology in South America, and partially in North America, differs significantly from that of late Native American Indians and Asian Mongoloids, instead showing affinities with modern Africans and Australians (Chatters et al. 1999; Lahr 1995, 1996, 1997; Munford 1999; Munford et al. 1995; Neves & Blum 1999; Neves and Pucciarelli 1989, 1991; Neves et al. 1996a, 1996b, 1997, 1998, 1999a, 1999b; Powell 1993, 1995; Powell and Steele 1992; Powell et al. 1998; Steele and Powell 1992, 1993, 1994). But how should these findings be interpreted?

Almost all scholars agree that the New World was colonized by Asian populations by way of the Bering Land Bridge (Bellwood 1975, 1978, 1985; Fagan 1998; Serjeantson 1984). In addition to the evidence supporting this view, a number of studies (Brothwell 1960; Cornell and Jantz 1997; Kamminga and Wright 1988; Lahr 1995; Macintosh 1978; Matsumura and Zuraina 1999; Neves and Pucciarelli 1998; Wright 1995) have demonstrated unexpected morphological affinities among some late-Pleistocene hominids from Southeast Asia and recent non-Mongoloid peoples.

In the present work, we show a strong similarity among what is supposed to be the oldest known human skeleton of the Americas, Lapa Vermelha IV–Hominid 1 ("Luzia") (Neves et al. 1998, 1999c, 1999d), recent Africans and Australians, and two early modern hominids from Qafzeh, dated to ca. 92Kyr old (Schwarcz et al. 1988; Valladas et al. 1988; Vandermeersch 1981).

This paper aims to provide further evidence illustrating the distinctive character of the Paleoindian morphology in relation to recent Amerindians.

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Cranial measurements of the two early modern *Homo sapiens* from the Levant were taken by MML, while the LV-IV was metrically characterized by WAN (both researchers following Howells (1973) recommendations). For the morphological comparison, 19 modern populations from Howells data set (1973, 1989) were used. We performed a Principal Component Analysis (PCA) using the SPSS software program. Data were size-corrected using the method proposed by Darroch & Mosimann (1985).

The results are depicted in Figure 1. The population scores along PC1 clearly separate the samples into two clusters: LV-IV, recent Africans, recent Australians, and the mean of Qafzeh; all apart from the rest of the recent

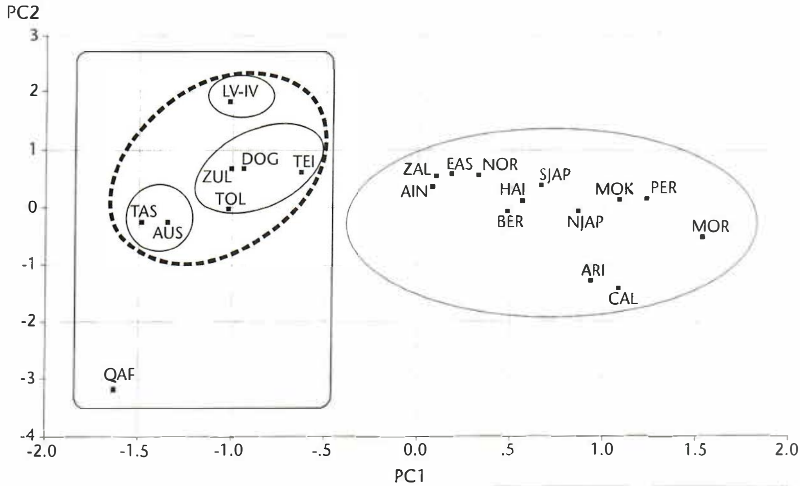

Figure 1. Plot of the first two Principal Components (PC1 and PC2) obtained in the analysis. The most influential variables and the amount of information retained by each PC are indicated. The 24 metric variables (Howells, 1973) used in the analysis were ASB, AUB, FMB, FRC, FRF, FRS, GOL, MAB, MDH, NLB, NLH, NPH, OBB, OBH, OCC, OCF, OCS, PAC, PAF, PAS, SOS, STB, WCB, and WMH. The populations used in the analysis are LV-IV (Lapa Vermelha IV hominid 1); QAF (the mean of Qafzeh VI and Qafzeh IX); ZUL (Zulu); DOG (Dogon); TEI (Teita); TOL (Tolai); AUS (Australians); TAS (Tasmania); ZAL (Zalavar); AIN (Ainu); EAS (Eastern Island); NOR (Norse); HAI (Hainan); BER (Berg); SJAP (South Japan); NJAP (North Japan); MOK (Mokapu); MOR (Moriori); PER (Peru); ARI (Arikara); CAL (California–Santa Cruz).

populations. This pattern is defined by a broad upper face and small nasal and malar heights. PC2 defines a shape dimension that separates the recent populations, including the Paleoindian fossil LV-IV, from the early modern mean. The Qafzeh crania have a flatter frontal bone and overall longer face than any of the recent crania.

The increasing knowledge about the first Americans tells us that a much more complicated history was involved in the colonization of the New World: our results suggest that a nonspecialized human cranial morphology existed in the Americas, clearly distinguishing the Paleoindian population from recent Amerindians and Asians. The morphological similarities presented here suggest that the settlement of the New World was an extension of the initial dispersion of anatomically modern humans out of Africa (before the differentiation of the Mongoloids). How and why this morphological pattern found in the early Americans remained little changed over a time span of more than 100,000 years are questions for further research.

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References Cited

Bellwood, P. S. 1975 The Prehistory of Oceania. *Current Anthropology* 16:9–28.

——— 1978 Man's Conquest of the Pacific. Collins, Aukland, New Zealand.

——— 1985 The Prehistory of the Indo-Malaysian Archipelago. Academic Press, Sydney, Australia.

Brothwell, D. 1960 Upper Pleistocene Human Skull from Niah Caves, Sarawak. *Sarawak Museum Journal* 9:323–349.

Chatters, J. J., W. A. Neves, and M. Blum 1999 The Kennewick Man: A First Multivariate Analysis. *Current Research on the Pleistocene* 16:87–89.

Cornell, D. C., and Jantz, R. L. 1997 The Morphometric Relationship of Upper Cave 101 to Modern Homo Sapiens. *American Journal of Physical Anthropology Supplement* 24:95.

Darroch, J. N., and J. E. Mosimann 1985 Canonical and Principal Components of Shape. *Biometrika* 72:241–252.

Fagan, B. M. 1998 The First Americans. In People of the Earth: an Introduction to World Prehistory, edited by A. McClare pp. 177–206. Longman, NY.

Greenberg, J. H. 1987 Language in the Americas. Stanford University Press, Stanford, CA.

Greenberg, J. H., C. G. Turner, and S. L. Zegura 1986 The Settlement of the Americas: a Comparison of Linguistic, Dental and Genetic Evidence. *Current Anthropology* 27:477–497.

Howells, W. W. 1973 Cranial Variation in Man. A Study by Multivariate Analysis of Patterns of Difference Among Recent Populations. Papers of the Peabody Museum of Archaeology and Ethnology, vol. 67. Harvard University Press, Cambridge, MA.

——— 1989 Skull Shapes and the Map. Papers of the Peabody Museum of Archaeology and Ethnology, vol. 79. Harvard University Press, Cambridge, MA.

Kamminga, J., and R. V. S. Wright 1988 The Upper Cave at Zhoukoudian and the Origins of the Mongoloids. *Journal of Human Evolution* 17:739–767.

Lahr, M. M. 1996 The Evolution of Modern Human Diversity. A Study of Cranial Variation. Cambridge University Press, Cambridge, UK.

——— 1997 History in the Bones. *Evolutionary Anthropology* 38:163–198.

Macintosh, N. W. G. 1978 The Tabon Cave Mandible. *Archaeology and Physical Anthropology in Oceania* 13:143–159.

Matsumura, H., and M. Zuraina 1999 Metric Analyses of an Early Holocene Human Skeleton from Gua Gunung Runtuh, Malaysia. *American Journal of Physical Anthropology* 109:327–340.

Munford, D. 1999 Estudo Comparado da Morfologia das Populações Pré-históricas da America do Sul: Implicações para a Questão do Povoamento do Novo Mundo. Ph.D. Dissertation, Universidade de São Paulo.

Munford, D., M. C. Zanini, and W. A. Neves 1995 Human Cranial Variation in South America: Implications for the Settlement of the New World. *Brazilian Journal of Genetics* 18:673–688.

Neves, W. A., and M. Blum 1999 The Buhl Burial: A Comment on Green et al. *American Antiquity* 65:191–193.

Neves, W. A., D. Meyer, and H, M. Pucciarelli 1996b Early Skeletal Remains and the Peopling of the Americas. *Revista de Antropologia* 39:121–139.

Neves, W. A., D. Munford, and M. C. Zanini 1996a Cranial Morphological Variation and the Colonization of the New World: Towards a Four Migration Model. *American Journal of Physical Anthropology*, Supplement 22:176.

Neves, W. A., J. F. Powell, and E. G. Ozolins 1999a Modern Human Origins as Seen from the Peripheries. *Journal of Human Evolution* 37:129–133.

——— 1999b Extra-continental Morphological Affinities of Palli Aike, Southern Chile. *Interciencia* 24:258–263.

——— 1999c Extra-continental Morphological Affinities of Lapa Vermelha IV, Hominid 1: A Multivariate Analysis with Progressive Numbers of Variables. *Homo* 50:263–282.

Neves, W. A., J. F. Powell, A. Prous, and E. G. Ozolins 1998 Lapa Vermelha IV, Hominid 1–Morphological Affinities of the Earliest Known American. *American Journal of Physical Anthropology*, Supplement 26:169.

Neves, W. A., J. F. Powell, A. Prous, E. G. Ozolins, and M. Blum 1999d Lapa Vermelha IV Hominid 1: Morphological Affinities of the Earliest Known American. *Genetics and Molecular Biology* 22:1–5.

Neves, W. A., and H. M. Pucciarelli 1989 Extra-continental Biological Relationships of Early South Americans Human Remains: a Multivariate Analysis. *Ciência e Cultura* 41:566–575.

——— 1991 Morphological Affinities of the First Americans: an Exploratory Analysis Based on Early South American Human Remains. *Journal of Human Evolution* 21:261–273.

——— 1998 The Zhoukoudian Upper Cave Skull 101 as Seen from the Americas. *Journal of Human Evolution* 34:219–222.

Neves, W. A., M. C. Zanini, D. Munford, and H. M. Pucciarelli 1997 O Povoamento da América à Luz da Morfologia Craniana. *Revista Usp* 34:96–105.

Powell, J. F. 1993 Dental Evidence for the Peopling of the New World: Some Methodological Considerations. *Human Biology* 5:799–819.

——— 1995 Dental Variation and Biological Affinity Among Middle Holocene Human Populations in North America. Ph.D. Dissertation, Texas A&M University.

Powell, J. F., W. A. Neves, E. G. Ozolins, and H. M. Pucciarelli 1998 Afinidades Biologicas Extra-continentales de los Esqueletos Mas Antiguos de America: Implicaciones para el Poblamiento del Nuevo Mundo. *Antropologia Fisica Latinoamericana.*

Powell, J. F., and D. G. Steele 1992 A Multivariate Craniometric Analysis of North American Paleo-Indian Remains. *Current Research in the Pleistocene* 9:59–62.

Schwarcz, H. P., R. Grun, B. Vandermeersch, O. Bar-Yosef, H. Valladas, and E Tchernov 1988 ERS Dates for the Hominid Burial Site of Qafzeh in Israel. *Journal of Human Evolution* 17:733–737.

Serjeantson, S. W. 1984 Migration and Admixture in the Pacific. *Journal of the Pacific History* 19:160–171.

Steele, D. G., and J. F. Powell 1992 Peopling of the Americas: Paleobiological Evidence. *Human Biology* 64:303–336.

——— 1993 Paleobiology of the First Americans. *Evolutionary Anthropology* 2:138–146.

——— 1994 Paleobiological evidence of the peopling of the Americas: A morphometric view. In *Method and Theory for Investigating the Peopling of the Americas,* edited by R. Bonnichsen & D. G. Steele pp. 141–163. Center for the Study of the First Americans, Corvallis, OR.

Turner, C. G. II 1983 Dental Evidence for the Peopling of the Americas. In *Early Man in the New World,* edited by R. Shutler, Jr. pp. 147–157. Sage Publications, Beverly Hills, CA.

Valladas, H., J. L. Reyss, J. L. Joron, G. Valladas, O. Bar-Yosef, and B. Vandermeersch 1988 Thermoluminescence Dating of Mousterian 'Proto-Cro-Magnon' Remains from Israel and the Origin of Modern Man. *Nature* 331:614–616.

Vandermeersch, B. 1981 Les Hommes Fossiles de Qafzeh, Israel. CNRS, Paris, France.

Williams, R. C., A. G. Steinberg, H. G. Gershowitz, and C. G. Smith 1985 GM Allotypes in Native Americans: Evidence for Three Distinctive Migrations Across the Bering Land Bridge. *American Journal of Physical Anthropology* 66:1–19.

Wright, R. V. S. 1995 The Zhoukoudian Upper Cave Skull 101 and Multiregionalism. *Journal of Human Evolution* 29:181–183.

"Luzia" Is Not Alone: Further Evidence of a Non-mongoloid Settlement of the New World

Walter A. Neves and Max Blum

By the end of the 20th century, the scientific community witnessed an uproar regarding the pioneer colonization of the Americas. A pre-Clovis occupation of the continent was finally accepted by the majority of the archaeologists (Meltzer et al. 1997), and North and South American physical anthropologists have generated significant new information questioning the long-held version that only Mongolian/Siberian-like populations entered the New World (Chatters et al. 1999; Lahr 1995; Neves and Blum 2000; Neves and Pucciarelli 1989, 1990, 1991, 1998; Neves et al. 1993, 1996a, 1996b, 1997, 1998, 1999a, 1999b, 1999c; Powell and Neves 1999; Steele and Powell 1992, 1993, 1994).

Notoriously, a Brazilian female specimen (Lapa Vermelha IV Hominid 1–LPV), archaeologically dated to between 11,000 and 11,500 yr B.P., has received considerable worldwide attention. "Luzia" is supposed to be the oldest human skeleton found so far in the Americas; yet her cranial features demonstrate a clear biological affinity with recent Australian and African aborigines (Neves et al. 1998, 1999a, 1999b). However, some anthropologists preferred to treat this specimen as an aberrant individual (Holden 1999), undermining the importance of the discovery. This is due in part to the frenzy created by the mass media around this single Paleoindian cranium, and in part to the fact that these same anthropologists have been unaware of the mounting evidence we have been generating since 1989 showing that the first South Americans were very similar in terms of cranial metrics to present Africans and Australians.

In the present work, we explore the morphological affinities of the heavily fossilized female specimens from the Harold Walter collection (HWC), comparing them with Howells's (1973, 1989) reference populations. Luzia, the "aberrant," was also included in the analysis.

The Harold Walter collection was formed mainly during the 1930s and 1940s (Walter 1948, 1958). All the material comes from six different caves located in the famous Lagoa Santa area. Although some of the skeletons of the collection could be related to later times of the local prehistory, the bulk of the material is clearly associated with Paleoindian levels and is estimated to

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be bracketed between 11,000 and 8,000 yr B.P. In one of the caves explored by H. V. Walter and his research colleagues (Arnaldo Cathoud and Anibal Matos), known as "Lapa Mortuária de Confins," one male skull was found associated with extinct megafauna.

Most of the sites explored by H. V. Walter are now destroyed or completely damaged. The only possibility of dating the specimens is to submit them to AMS analysis. After several trials to do so, we discovered that the great majority of the specimens preserve too little collagen to permit exact dating. Beta-Analytic Inc. was able, however, to generate minimum dates based on organic material present in the acid washes of two heavy fossilized samples. These dates were 7250 ± 60 RCYBP (HW-12; Beta 108186) and 6660 ± 50 RCYBP (HW-15; Beta 108187).

Our experience with AMS dating in the Lagoa Santa region has shown that, in general, there is a difference of 2,000 or 3,000 years between minimum and exact dates (Neves et al. 1999a, 1999d). For this reason, and because of the heavy fossilized state of 11 adult specimens in the collection, we are led to believe that this material is of Paleoindian nature.

The morphological assessment of the four adult females (HW-003, HW-004, HW-016, HW-018) was carried out through principal components analysis applied to the mean vector of 26 variables (see Figure 1), and also by a cluster analysis (Ward's method) applied to a Euclidean Distance Matrix. The SPSS software program was used in the first case, and the STATISTICA software was used in the second case. All data were size-corrected using the method proposed by Darroch and Mosimann (1985).

The results of our multivariate analysis are shown in Figure 1. The two first Principal Components (PC) explain 53.6 percent of the original variation. PC1 is mainly influenced by GLS (with negative values), FRC, XFB, and ASB (showing positive values); while PC2 is determined by GOL, PAC, and FMB (with positive values).

Figure 1 shows that PC1 does not discriminate well among the samples analyzed. They are scattered all over this vector. The formation of loose regional clusters with Australians dominates the left area of the graph; Europeans, Asians, Polynesians and recent Native Americans dominate the center of it; and Africans dominate the right side. PC2 splits in two all the human variation represented in Howells's dataset: Africans and Australians occupy the upper part of the graph, while all other populations are scattered in the lower part of it. The pattern of segregation provided by PC2 is more similar to the original clustering obtained by Howells (1973, 1989) in his seminal works. Both Luzia and the mean of the five female specimens from the Harold Walter Collection (HWC) cluster with recent Africans if both principal components are taken into account, and with Africans and Australians if only PC2 is considered. The cluster analysis also shows a strong relationship among HWC, Luzia, and Africans.

These results show unequivocally that the morphological affinities of Luzia with recent Africans and Australians are not the result of an "aberrant" morphology. The first South Americans do show a cranial morphometric pattern completely different from that of today's Mongolians, Siberians, and

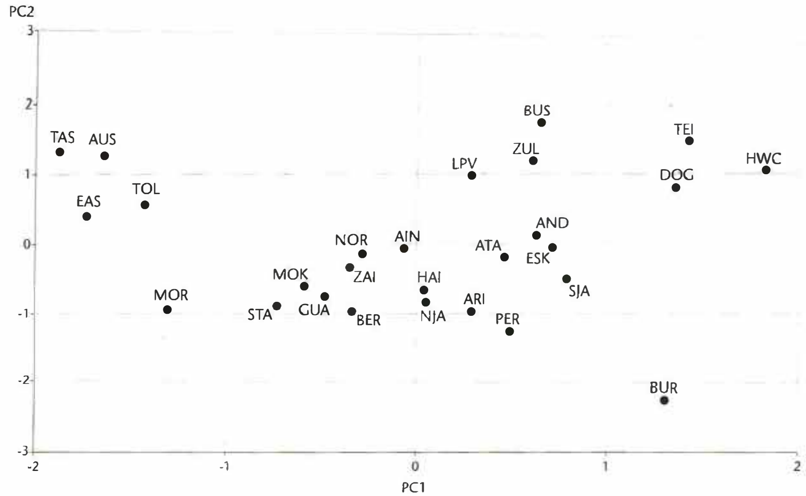

Figure 1A. Plot of the first two Principal Components obtained through a Multivariate Analysis. The variables used were ASB (Biasterionic Breadth); AUB (Biauricular Breadth); BBH (Basion-Bregma Height); BNL (Basion-Nasion Length); FMB (Bifrontal Breadth); FOL (Foramen Magnum Length); FRC (Nasion-Bregma Chord); GLS (Glabella Projection); GOL (Glabello-Occipital Length); MAB (Palate Breadth); MDB (Mastoid Width); MDH (Mastoid Height); NAS (Nasio-Frontal Subtense); NLB (Nasal Breadth); NLH (Nasal Height); OBB (Orbit Breadth Left); OBH (Orbit Height Left); OCC (Lambda-Opisthion Chord); PAC (Bregma-Lambda Chord); SOS (Supraorbital Projection); STB (Bistephanic Breadth); WCB (Minimum Cranial Breadth); WMH (Cheek Height); XCB (Maximum Cranial Breadth); XFB (Maximum Frontal Breadth); ZYB (Bizygomatic Breadth). The populations used in the analysis were AIN (Ainu); AND (Andaman); ARI (Arikara); ATA (Atayal); AUS (Australia); BER (Berg); BUR (Buriat); BUS (Bushman); DOG (Dogon); EAS (Eastern Island); ESK (Eskimo); GUA (Guam); HAI (Hainan); HWC (Harold Walter Collection); LPV (Lapa Vermelha IV Hominid 1); M●K (Mokapu); MOR (Moriori); NJA (North Japan); NOR (Norse); PER (Peru); SJA (South Japan); STA (Santa Cruz); TAS (Tasmania); TEI (Teita); TOL (Tolai); ZAL (Zalavar); and ZUL (Zulu).

Amerindians. Accordingly, we find it reasonable to keep our concept of a "Two Component Settlement Model" for the peopling of the New World, with non-Mongoloids arriving on the continent prior to the classical Mongoloid populations.

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References Cited

Chatters, J., W. A. Neves, and M. Blum 1999 The Kennewick Man: a First Multivariate Analysis. *Current Research in the Pleistocene* 16:87–90.

Darroch, J. N., and J. E. Mosimann 1985 Canonical and Principal Components of Shape. *Biometrika* 72:241–252.

Holden, C. 1999 Comment. *Science*. 286:1467.

Howells, W. W. 1973 Cranial Variation in Man. A Study of Multivariate of Patterns of Difference Among Recent Human Populations. Papers of the Peabody Museum of Archaeology and Ethnology. Harvard University Press, Cambridge, MA.

——— 1989 Skull Shapes and the Map. Craniometric Analysis in the Dispersion of Modern

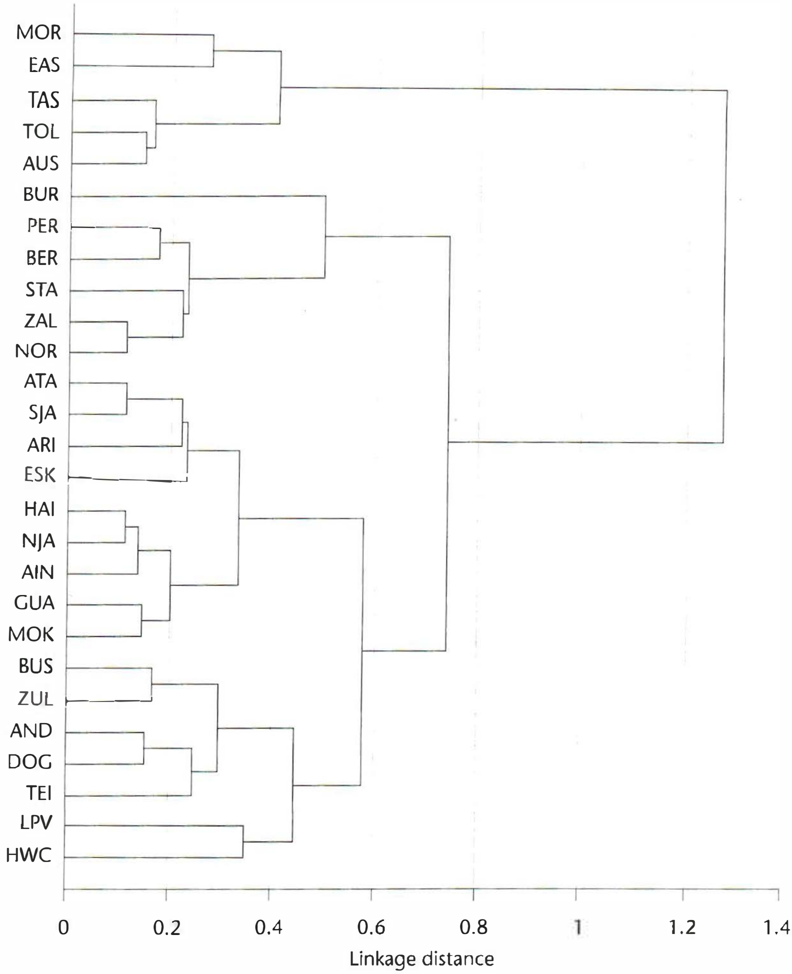

Figure 1B. Dendrogram showing relationships among populations analyzed in Figure 1A.

Homo. Papers of the Peabody Museum of Archaeology and Ethnology. Harvard University Press, Cambridge, MA.

Lahr, M. M. 1995 Patterns of Modern Human Diversification: Implications for Amerindian Origins. *Yearbook of Physical Anthropology* 38:163–198.

Meltzer, D. J., D. K. Grayson, G. Ardila, A. W. Barker, D. F. Dincauze, C. F. Haynes, F. Mena, L. Nuñez, and D. Stanford 1997 on the Pleistocene Antiquity of Monte Verde, Southern Chile. *American Antiquity*, 62:659–663.

Neves, W. A., and M. Blum 2000 The Buhl Burial: A Comment on Green et al. *American Antiquity* 65:191–193.

Neves, W. A., M. Blum, and L. Kozameh 1999c Were the Fuegians Relicts of a Paleoindian Non-Specialized Morphology in the Americas? *Current Research in the Pleistocene* 16:90–92.

Neves, W. A., D. Munford, and M. C. Zanini 1996b Cranial Morphological Variation and the Colonization of the New World: Towards a Four Migration Model. *American Journal of Physical Anthropology* Supplement 22:176.

Neves, W. A., D. Munford, M. C. Zanini, and H. M. Pucciarelli 1999b Cranial Morphological Variation in South America and the Colonization of the New World: Towards a Four Migration Model? *Ciência e Cultura* 151–165.

Neves, W. A., J. F. Powell, and E. G. Ozolins 1999d Extra-continental Morphological Affinities of Lapa Vermelha Iv, Hominid 1: a Multivariate Analysis with Progressive Numbers of Variables. *Homo* 50:263–282.

Neves, W. A., J. F. Powell, A. Prous, and E. G. Ozolins 1998 Lapa Vermelha IV Hominid 1: Morphological Affinities of the Earliest Known American. *American Journal of Physical Anthropology* Supplement 26:169.

Neves, W. A., J. F. Powell, A. Prous, E. G. Ozolins, and M. Blum 1999a Lapa Vermelha IV Hominid 1L: Morphological Affinities of the Earliest Known American. *Genetics and Molecular Biology* 22:461–460.

Neves, W. A., and H. M. Pucciarelli 1989 Extra-Continental Biological Relationships of Early South American Human Remains: a Multivariate Analysis. *Ciência e Cultura* 41:566–575.

——— 1990 The Origins of the First Americans: an Analysis Based on the Cranial Morphology of Early South American Human Remains. *American Journal of Physical Anthropology* 81:274.

——— 1991 Morphological Affinities of the First Americans: an Exploratory Analysis Based on Early South American Human Remains. *Journal of Human Evolution* 21:261-273.

——— 1998 The Zhoukoudian Upper Cave Skull 101 as seen from the Americas. *Journal of Human Evolution* 34:219-222.

Neves, W. A., H. M. Pucciarelli, and D. Meyer 1993 The Contribution of the Morphology of Early South and North American Skeletal Remains to the Understanding of the Peopling of the Americas. Toronto: *American Journal of Physical Anthropology* Supplement 16:15-151.

——— 1996a Early Skeletal Remains and the Peopling of the Americas. *Revista de Antropologia* 39:121–139.

Neves, W. A., M. C. Zanini, D. Munford, and H. M. Pucciarelli 1997 O Povoamento da América à Luz da Morfologia Craniana. *Revista Usp* 34:96–105.

Powell, J. F., and W. A. Neves 1999 Craniofacial Morphology of the First Americans: Pattern and Process in the Peopling of the New World. *Yearbook of Physical Anthropology* 42:153–188.

Steele, D. G., and J. F. Powell 1992 Peopling of the Americas: Paleobiological Evidence. *Human Biology* 64:303–336.

——— 1993 Paleobiology of the First Americans. *Evolutionary Anthropology* 2:138–146.

——— 1994 Paleobiological Evidence of the Peopling of the Americas: a Morphometric View. In Method and Theory for Investigating the Peopling of the Americas edited by R. Bonnichsen and D. G. Steele, Center for the Study of the First Americans, Corvallis, OR.

Walter, H. V. 1948 A Pré-História da Região de Lagoa Santa (Minas Gerais). Oficinas Gráficas da Papelaria e Tipografia Brasil de Velloso & Cia. Ltda. Guajajaras, Belo Horizonte.

——— 1958 Archaeology of the Lagoa Santa Region (Minas Gerais). Sedegra, Rio de Janeiro.

Lithic Studies

Source Analysis of Archaeological Obsidian on Sakhalin Island, Russian Far East

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Sakhalin Island is a large island located along the northeastern coast of Asia, stretching 950 km from south to north and varying up to 125 km wide. Sakhalin is separated from the Japanese island of Hokkaido by La Perouse (Soya) Strait, ca. 40 km wide. Because Sakhalin Island connected the Asian mainland with Japanese islands during the late Pleistocene (cf. Aikens and Higuchi 1982; Kuzmin 1997), the study of archaeology on Sakhalin Island is important for understanding prehistoric human migration and contact in the region.

Identifying the geological sources of obsidian artifacts is one of the best ways to document human contact and exchange (cf. Shackley 1998). Since 1992, we have been conducting geochemical studies of obsidian sources in the Russian Far East (Kuzmin et al. 1999). In 1999–2000, we collected 79 obsidian artifacts from 35 prehistoric sites on Sakhalin Island and determined their chemical compositions by Instrumental Neutron Activation Analysis (INAA) at the Missouri University Research Reactor (MURR). The Sakhalin artifacts are made from high-quality rhyolithic volcanic glass. However, no sources of volcanic glass have been located on Sakhalin Island. As a result, we also collected and analyzed 15 samples of volcanic glass from three major sources on Hokkaido named Oketo, Shirataki, and Tokachi-Mitsumara. The original INAA data are being published elsewhere (Kuzmin and Popov 2000). Statistical grouping of the analytical data was made using the approach described in Glascock et al. (1998).

The analysis indicates the existence of three geochemical groups for Sakhalin archaeological obsidian separated by significant differences in concentrations of the elements Ba, Cs, Hf, Rb, Mn, and Na. The artifacts closely match (with 95-percent probability) three major Hokkaido obsidian source groups,

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HK1, HK2, and HK3. Therefore we can conclude that the Hokkaido sources are the origin of archaeological obsidian found on Sakhalin.

The first source, HK1, is the Oketo volcano (43° 42′ N, 143° 32′ E). HK1 obsidian was recovered from 12 archaeological sites distributed from the southern end to the northern tip of Sakhalin. Site ages vary from final Paleolithic (ca. 12,000–10,000 yr B.P.) to early Iron Age (ca. 2000–1000 yr B.P.). The distance from sites to source ranges up to 1,000 km.

The second source, HK2, is located in the Shirataki area (43° 55′ N, 143° 09′ E) and includes two localities, Akaishiyama and Horokozawa. HK2 obsidian was recovered from 22 sites distributed throughout the entire length of Sakhalin. The sites correspond primarily to the upper Paleolithic (ca. 19,000–12,000 yr B.P.) and Neolithic (ca. 8500–2000 yr B.P.) The earliest sites are associated with early upper Paleolithic, ca. 19,000 yr B.P. (Ogonki 5, layer 2; Kuzmin et al. 1998), and possibly with pre-upper Paleolithic, at least ca. 30,000 yr B.P. (Sennaya 2; A. A. Vasilevsky, pers. comm. 1999). The distance from sites to source is up to 1,000 km.

The third source, HK3, is also from the Shirataki area, and includes the Horokozawa, Hachigozawa, and Ajisaitaki localities. HK3 obsidian was found on 18 sites located from the southern end to the central portion of Sakhalin Island. They correspond mostly to the upper Paleolithic and Neolithic. For the latter source, the distance from sites to source ranges up to 750 km.

As a result of this study, we can now securely establish the extensive use of the Oketo and Shirataki obsidian sources by prehistoric people living on Sakhalin. This confirms a preliminary conclusion made in the late 1970s (Vasilievsky et al. 1982:96) on the basis of limited INAA results. This conclusion was renewed in the late 1990s (Kimura 1998). In the southern part of Sakhalin, high-quality volcanic glass was transported from Hokkaido (Shirataki source) as early as ca. 19,000 yr B.P. Since ca. 12,000 yr B.P., volcanic glass from the more distant Shirataki and Oketo sources was transported to the northern part of Sakhalin Island.

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References Cited

Aikens, C. M., and T. Higuchi 1982 *Prehistory of Japan*. Academic Press, New York, NY.

Glascock, M. D., G. E. Braswell, and R. H. Cobean 1998 A Systematic Approach to Obsidian Source Characterization. In *Archaeological Obsidian Studies: Methods and Theory*, edited by M. S. Shackley, pp. 15–65. Plenum Press, New York, NY.

Kimura, H. 1998 Obsidian Human Technology. In *Paleoecology of the Pleistocene and Stone Age Cultures of Northern Asia and Adjacent Regions*, edited by A. P. Derevianko, vol. 2, pp. 302–314. Institute of Archaeology and Ethnography Press, Novosibirsk.

Kuzmin, Y. V. 1997 Pleistocene Geoarchaeology of the Russian Far East: Updated Results. *Anthropologie* (Brno) (Special Volume "Pleistocene Geoarchaeology," edited by J. Chlachula) 35(2):131–136.

Kuzmin, Y. V., and V. K. Popov (editors) 2000 *Volcanic Glasses of the Russian Far East: Geological* *and Archaeological Aspects.* Far Eastern Geological Institute, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok.

Kuzmin, Y. V., A. V. Tabarev, V. K. Popov, M. D. Glascock, and M. S. Shackley 1999 Geochemical Source Analysis of Archaeological Obsidian in Primorye (Russian Far East). *Current Research in the Pleistocene* 16:97–99.

Kuzmin, Y. V., A. A. Vasilevsky, J. M. O'Malley, and A. J. T. Jull 1998 The Age and Environment of the Paleolithic Occupation of Sakhalin Island, the Russian Far East. *Current Research in the Pleistocene* 15:134–136.

Shackley, M. S. (editor) 1998 *Archaeological Obsidian Studies: Methods and Theory.* Plenum Press, New York, NY.

Vasilievsky, R. S., E. L. Lavrov, and S. B. Chan 1982 *The Stone Age Cultures of Northern Japan.* Nauka, Novosibirsk (in Russian).

Taphonomy–Bone Modification

Late-Pleistocene Bone Technology at Tocuila, Basin of México

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Mammoth as a game animal was part of the late-Pleistocene meat-related subsistence base oriented around a wide diet breadth (Johnson 1991). Known mammoth sites were used for acquiring meat or quarrying bone or a combination of both. Mammoth bone quarrying was a fracture-based bone technology for producing tool blanks and cores (Johnson 1985). Mammoth bone quarrying was a North American grasslands-wide technological activity with a great time depth (Johnson in review). It depended on the cortical thickness of mammoth limb bones and disappeared from the grasslands hunter-gatherer technological repertoire when mammoth became extinct. Procuring mammoth for bone quarrying was not a subsistence activity but rather a technological one for securing raw material in transportable, usable form (Hannus 1989; Johnson 1985, 1989, 1991; Miller 1989). The activity is akin to that practiced at a lithic outcrop and for a similar purpose.

At the southern end of the North American grasslands, Tocuila (Morett et al. 1998a, 1998b) is located in the Basin of México that lies within a volcanic area (active now and during the late Pleistocene). The locality is in a mud flow at the edge of Lake Texcoco, one of several shallow paleo-lakes within the main basin. Remains of at least seven mammoths, ranging in age from young to adult, have been uncovered along with a few bones from ungulates, rabbits, and aquatic animals (Corona-M. and Arroyo-Cabrales 1997; Morett et al. 1998a, 1998b). A number of radiocarbon dates (charcoal, seeds, and bone) from samples taken throughout the mud flow unit yield an average age of ca. 11,188 RCYBP (Arroyo-Cabrales et al. 1999; Morett et al. 1998a).

The locality is stratified; the main unit (ca. 1.7 m thick) that contains the bones is a lahar (a mud flow caused by volcanic activity). Lahars form when heavy rains or melted snows wash loose volcanic debris down from higher to

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lower ground, usually flowing down a stream channel. Above this unit are deposits derived from lesser magnitude lahars. Below the mammoth-bearing unit is volcanic ash overlying lacustrine clays (Morett et al. 1998a). A late-Pleistocene channel was downcut prior to the mammoth-bearing event, and the lahar had flowed through and filled the channel (Arroyo-Cabrales et al. 1999).

Taphonomic analysis to date has focused on bone diagenesis (Johnson et al. 2000) and the potential role of people within the bone-bed assemblage. People are indicated by dynamic impact fracturing features on mammoth long bone segments and fracturing debris. The assemblage is small, consisting of five specimens, but significant. A triangular-shaped femoral radial segment (TOC-1-281) exhibits a helical fracture at the apex, crushing and small flake removal along the opposite edge (i.e., the "base" of the triangle), and a series of large facets along the cortical surface below the crushed and small flake removal area. This specimen is interpreted as a bone core with a prepared platform and scars from the removal of a number of large cortical flakes. Another specimen (TOC-1-534) has a number of facets on the cortical surface, an area of crushed bone and small flake removal at the top of the faceted area, and an undulating surface on the reverse side with a large diffuse bulge. This specimen is interpreted as a cortical bone flake with remnant platform preparation. The cortical flake conjoins with the central flake scar on the bone core.

The Tocuila cortical flakes are morphologically similar and share the same features as those from Lubbock Lake (Johnson in review), Lange-Ferguson (Hannus 1989, 1997), Duewall-Newberry (Steele and Carlson 1989), Owl Cave (Miller 1989), and the experimentally generated ones from Ginsberg (Stanford et al. 1981). The same relationship exists for the large cone flakes from Tocuila, Lubbock Lake (Johnson 1985), Sand Creek (Johnson et al. 1994), and Duewall-Newberry (Steele and Carlson 1989). While human involvement with mammoth at Tocuila is limited, it is focused on bone breakage and interpreted as bone quarrying to produce cores for transport elsewhere.

What the Tocuila mammoths represent is unclear, as information is not yet available on the age, gender, and carcass condition of the mammoths, nor on their relationship to the bone core and flakes recovered other than their presence in the same bone bed. A mud flow is a catastrophic event. The disarticulated nature of the remains suggests the mud flow did not kill the mammoths and other animals within the flow deposit. Whether the mammoth remains were already laid down in the channel (either as an accumulation or a catastrophic event) and the mud flow covered them, or whether they were brought in with the mud flow is being debated (Arroyo-Cabrales et al. 1999, 2000; Morett et al. 1998a; Siebe et al. 1999).

References Cited

Arroyo-Cabrales, J., S. González, L. A. Morett, O.J. Polaco, G.J. Sherwood, and A. Turner 1999

The Late Pleistocene Paleoenvironment of the Basin of Mexico—Evidence from the Tocuila Mammoth Site. *DEINSEA* Netherlands.

Corona-M., E., and J. Arroyo-Cabrales 1997 New Record for the Flamingo (*Phoenicopterus* cf. *P. ruber* Linnaeus) from Pleistocene- Holocene Transition Sediments in Mexico. *Current Research in the Pleistocene,* 14:137–139.

Hannus, L. A. 1989 Flaked Mammoth Bone from the Lange/Ferguson Site, White River Badlands Area, South Dakota. In *Bone Modification,* edited by R. Bonnichsen and M. Sorg, pp. 395–412. Center for the Study of the First Americans, University of Maine, Orono, ME.

——— 1997 Mammoth Bone Flake Tools from the Lange/Furguson Site, South Dakota. In Proceedings of the 1993 Bone Modification Conference, Hot Springs, South Dakota, edited by L. A. Hannus, L. Rossum, and R. P. Winham. Augustana College, Sioux Falls, Archeology Laboratory, *Occasional Publication,* 1:220–235.

Johnson, E. 1985 Current Developments in Bone Technology. In *Advances in Archaeological Method and Theory,* edited by M. B. Schiffer, 8:157–235. Academic Press, New York, NY.

——— 1989 Human Modified Bones from Early Southern Plains Sites. In *Bone Modification,* edited by R. Bonnichsen and M. Sorg, pp. 431–472. Center for the Study of the First Americans, University of Maine, Orono, ME.

——— 1991 Late Pleistocene Cultural Occupation on the Southern Plains. In *Clovis: Origins and Adaptations,* edited by R. Bonnichsen and K. L. Turnmire, pp. 215–236. Center for the Study of the First Americans, Oregon State University, Corvallis, OR.

——— in review Late Wisconsinan Mammoth Procurement in the North American Grasslands. Submitted to the Center for the Study of the First Americans, Oregon State University, Corvallis, OR.

Johnson, E., L. Litwinionek, and V. T. Holliday 1994 The Sand Creek Mammoth Site, Llano Estacado of Texas. *Current Research in the Pleistocene.* 11:70–72.

Johnson, E., C. Nielsen-Marsh, and M. Gutierrez 2000 Pilot Diagensis Program at Mammoth Localities on the North American Grasslands. Paper presented at the IV Bone Diagenesis Meeting, Albarracin, Spain.

Miller, S. J. 1989 Characteristics of Mammoth Bone Reduction at Owl Cave, the Wasden Site, Idaho. In *Bone Modification,* edited by R. Bonnichsen and M. Sorg, pp. 381–393. Center for the Study of the First Americans, University of Maine, Orono, ME.

Morett, L. A., J. Arroyo-Cabrales, and O. J. Polaco 1998a Tocuila, a Remarkable Mammoth Site in the Basin of Mexico. *Current Research in the Pleistocene,* 15:118–120.

——— 1998b El Sitio Paleontológico de Tocuila. *Arqueología Mexicana,* 5(30):57.

Siebe, C., P. Scháaf, and J. Urrutia-Fucugauchi 1999 Mammoth Bones Embedded in a Late Pleistocene Lahar from Popocatépetl Volcano, Near Tocuila, central México. *Geological Society of America Bulletin,* 111:1550–1562.

Stanford, S., R. Bonnichsen, and R. E Morlan 1981 The Ginsberg Experiment: Modern and Prehistoric Evidence of a Bone-Flaking Technology. *Science,* 212:438–440.

Steele, D. G., and D. L. Carlson 1989 Excavation and Taphonomy of Mammoth Remains from the Duewall-Newberry Site, Brazos County, Texas. In *Bone Modification,* edited by R. Bonnichsen and M. Sorg, pp. 413–430. Center for the Study of the First Americans, University of Maine, Orono, ME.

Observations on Damage to Mastodon Ribs at the Hiscock Site (Western New York State)

Richard S. Laub

At the Hiscock site (Laub et al., 1988), displacement of Pleistocene bones is extensive, with only about a half-dozen pairs (out of several hundred specimens) confidently matched. Known or suspected agents of this dispersion include depositional reworking, trampling, scavenging by carnivores, and manipulation by Paleoindians.

One area of the site is especially rich in complete or nearly complete mastodon ribs. It measures 49 m^2 and contains 12 such specimens, about half the number found in the total 688 m^2 that have been excavated. Of the ribs found in this small area, seven bear distinct crush or puncture marks (Figure 1A–E). These include specimens E8NE-148, E9NW-144, E9SE-205, F9SW-35, F9SW-71, F9SW-88, and F9NW-118/F9SW-113. In the case of the last specimen (Figure 1D), a puncture broke the rib in two pieces, found 3.5 m apart. The crush marks are both complete (the full perimeter depressed below the bone surface, Figure 1B) and hinged (a portion of the crushed area still reaching the bone surface, Figure 1C).

All these marks are on the anatomical anterior or posterior surfaces of the rib (none on the edges), and lie toward the proximal end. In fact, of 13 marks, 7 are proximal to the tubercular area, and 11 proximal to the angle (Figure 1G). No such marks were found outside this region until the distal end of the rib, where breakage (or erosion?) had occurred in six of the seven ribs.

The seven damaged ribs are all from the anterior half of the rib series, three from the right side and four from the left. It is possible that all are from a single animal. The left and right ribs cluster separately. While one lacks a capitulum epiphysis, at a certain age ribs may be in varied states of epiphyseal fusion (e.g., the Farview mastodon, male, Rochester Museum and Science Center, Laws [1966] age group XX). The fact that damage is on the anterior and posterior surfaces, while absent from the medial and lateral edges, suggests the ribs had been separated from the carcass before being damaged.

The precision and topological restriction of these marks seem to preclude trampling as a mechanism. Cultural activities are also an unlikely source for the marks, since ribs are easily rotated out of the vertebral demifacets once surrounding muscles have been cut (Laub, 1992). Scavenging by carnivores may be the cause. Three mastodon metatarsals within this limited area bear deep grooves gouged in their eroded distal ends (Figure 1F), suggestive of gnawing. In most instances, the ribs do not show damage marks in opposition to those observed. Perhaps this reflects adhering soft tissue. The limitation of

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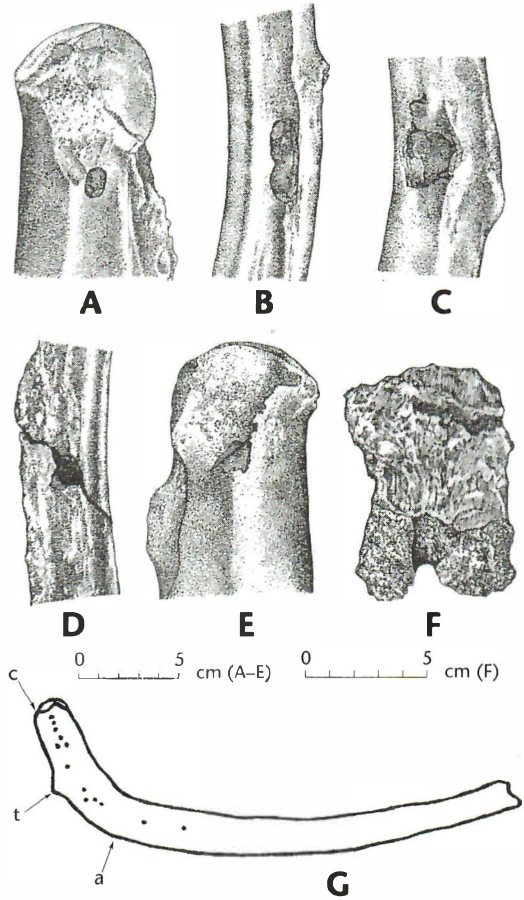

Figure 1. Hiscock mastodon ribs displaying damage. Anatomical proximal ends face top of page. **A**, E8NE-148 with puncture near capitulum; **B**, F9SW-113 with complete crush-mark just distal to angle; **C**, F9SW-71 with hinged crush-mark (hinged toward proximal end) near tuberculum; **D**, conjoined specimens F9NW-118 (above) and F9SW-113 (below), showing puncture and crushing along separation line; **E**, F9SW-35 with hack-like mark near capitulum. **F**, mastodon metatarsal E9NW-128 with heavily eroded distal end on which is superimposed a deep, U-shaped groove. **G**, generalized outline of mastodon rib on which are superimposed the projections of the 13 distinct damage marks (represented as dots) observed on seven ribs concentrated in a limited area of the Hiscock Site. The dots are placed without regard to the side of the rib on which they occur; only the longitudinal position is represented here. **c**, capitulum; **t**, tuberculum; **a**, angle. Illustrations by William L. Parsons.

damage to the proximal portions may reflect the larger and more accessible marrow cavity in this area than occurs distally, as shown by CAT-scans.

The author benefited from discussions with Gary Haynes (Department of Anthropology, University of Nevada, Reno). Paul Montgomery and Robert Kufchak (Department of Radiology, The Children's Hospital of Buffalo) respectively authorized and produced CAT-scans for this study. Illustrations are by William L. Parsons (Buffalo Museum of Science). Excavation of the Hiscock Site is funded by the George G. and Elizabeth G. Smith Foundation of Buffalo, New York.

References Cited

Laub, R. S. 1992 On Disassembling an Elephant: Anatomical Observations Bearing on

Paleoindian Exploitation of Proboscidea. In *Proboscidean and Paleoindian Interactions*, edited by J. W. Fox, C. B. Smith and K. T. Wilkins, pp. 99–109. Baylor University Press, Waco, TX.

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.

Laws, R. M. 1966 Age Criteria for the African Elephant, *Loxodonta a. africana*. *East African Wildlife Journal* 4:1–37.

Perimortem Bone Taphonomy of Late-Pleistocene Human and Hyena Refuse Deposits in Siberia

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From 1998 to 2001, with financial aid from the National Geographic Society and the Wenner-Gren Foundation, we carried out laboratory and field investigations on perimortem damage to bone and tooth fragments recovered from late-Pleistocene paleontological and archaeological cave and open sites in Siberia, principally in the Altai, Yenisei, and Lake Baikal regions. Our procedure involved scoring 26 variables for each bone or bone fragment, although only 7 variables were looked for in the 1998 pilot study. The variables include provenience, bone age, skeletal element, fragmentation type and form, end hollowing, tooth pits and scratches, pseudo-cuts, stomach acid erosion, polishing, edge notching, cut marks, burning, etc. (Turner et al. 2000; Turner et al. in press). Our objective was to define and distinguish between the bone damage signatures of large carnivores and humans. We are mainly interested in the sorts of damage that were likely done by hyenas, especially since early in this project we found what appeared to be cut marks on bones from an Altai cave (Razboinich'ya) used exclusively by carnivores, mainly hyenas. Caves used by Mousterian and more recent peoples in the general mountain taiga region of Razboinich'ya, such as Kaminnaya, Denisova, and Ust-Kan, are lower in

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elevation, nearer to valley floors and running water, have similar faunal inventories, and were used alternately by humans and hyenas. Altogether we have made 145,158 observations on 5,583 selected animal bone fragments from a grand total of more than 600,000 pieces of bone from 30 sites. Among these are an additional 214 pieces of human bone. Faunal selection was done by examining all excavated fragments more than 2.5 cm long and with minimal plant root damage to the fragment surface.

Preliminary analyses show that burned bone is very scarce; butchering, dismembering, and marrow extraction were common; and smaller carnivores such as wolves were not as destructive (Figure 1) as the bone-crushing seemingly cannibalistic hyenas (Ovodov and Martynovich 2000). In Yelenev Cave, overlooking the Yenisei upriver from Krasnoyarsk, some 65 pieces of

Figure 1. Examples of late-Pleistocene Siberian saiga antelope cranial bases with highly patterned chewing, polishing, and reduction of horn cores. This processing is thought to have been done by wolves rather than hyenas, since the damage is less than that attributable to the bone-crushing hyena. Proskuryakova Cave, 1974, Khakassia Autonomous Republic. Lower right specimen, 15 cm maximum diameter (CGT neg. 8-10-99:12).

Mesolithic and Neolithic human adult and subadult bone were recovered in various levels by N. D. Ovodov and associates. These show much damage by small and medium-sized carnivores. On the other hand, almost no human remains have been recovered from the Pleistocene caves, where hyena as well as human occupation is abundantly evident. To us, this suggests that hyenas may have had more of an influence on Pleistocene human life and skeletal preservation than did post-Pleistocene carnivores (Turner n.d.).

References Cited

Ovodov, N. D., and N. V. Martynovich 2000 Siberian Population's Cannibalism of Cave Hyena.

Program of International Scientific Conference: Paleogeography of the Stone Age. Correlation of Natural Events and Archaeological Cultures of Paleolithic Period of Northern Asia and Adjoining Territores, July 22–31, pp. 102–104. Krasnoyarsk. [in Russian]

Turner, C. G. II (translated by O.V. Pavlova) n.d. Perimortem Taphonomy and Dental Affinity Assessment of the Human Skeletal Remains from Yelenev Cave, Yenisei River, Krasnoyarsk Region, Southern Siberia. Institute of Archaeology and Ethnology, Siberian Branch, Russian Academy of Sciences. Submitted. [in Russian]

Turner, C. G. II, N. D. Ovodov, N. V. Martynovich, A. P. Derevianko, N. I. Drosdov, and O. V. Pavlova 2000 Perimortem Taphonomy of Late Pleistocene Siberian Faunal Assemblages from Natural and Cultural Settings. Program of International Scientific Conference: Paleogeography of the Stone Age. Correlation of Natural Events and Archaeological Cultures of Paleolithic Period of Northern Asia and Adjoining Territores, July 22–31, pp. 70–71. Krasnoyarsk.

Turner, C. G. II, N. D. Ovodov, N. V. Martynovich, A. Popov, A. P. Derevianko, N. I. Drosdov, and O. V. Pavlova 2001 Working Definitions for Perimortem Taphonomy of Natural and Anthropogenic Bone Damage in Late Pleistocene and Holocene Siberia and Primoria. *Archaeology, Ethnology & Anthropology of Eurasia.* In press.

Paleoenvironments: Plants

A Regional Compilation of Postglacial Paleoenvironmental Records from the Northern Plains for the SCAPE Project

Alwynne B. Beaudoin

The SCAPE (Study of Cultural Adaptations in the Canadian Prairie Ecozone) project seeks to understand human occupation and landscape characteristics at five specific Holocene time slices (9000, 6000, 3000, 1500, and 500 yr B.P.) across the Northern Plains, focused on south-central Canada (see http://scape.brandonu.ca). As part of this project, I have initiated a compilation and study of paleoenvironmental records from within the SCAPE study region (Figure 1). The objective of this component is to produce regional reconstructions of vegetation at each time slice, using primarily pollen records supplemented by data from other proxy indicators. This will extend the work I contributed to a similar analysis of the 6,000 yr B.P. interval (Vance et al. 1995). As the background for human occupation, the biophysical environment is a fundamental element in assessing resource distribution and availability. Pollen records are the basic data source for a glimpse at past vegetation and, by inference, climate and food resources.

The database builds on my previous compilation (Beaudoin 1993). Of the 149 records that occur within the study area, 102 are derived from pollen. The others comprise records focused on diatoms, pigments, sediment geochemistry, or plant macroremains. Spatial coverage is uneven, and not all records are continuous. Sixteen taxa characterize the pollen records, and eight vegetation types characterize the region through the postglacial. Evaluating the pollen records includes assessing variable chronologic control and differing taxonomic exactitude of the pollen identifications. Because publications use different pollen sums, I have made efforts to obtain raw count data so I can recompute pollen diagrams on a common basis. So far, raw data are available from 47 records.

Twenty-six records, located around the former margins of the Laurentide Ice Sheet, extend into the late Pleistocene (Figure 1). These will track the assembly of initial vegetation on the Northern Plains following deglaciation.

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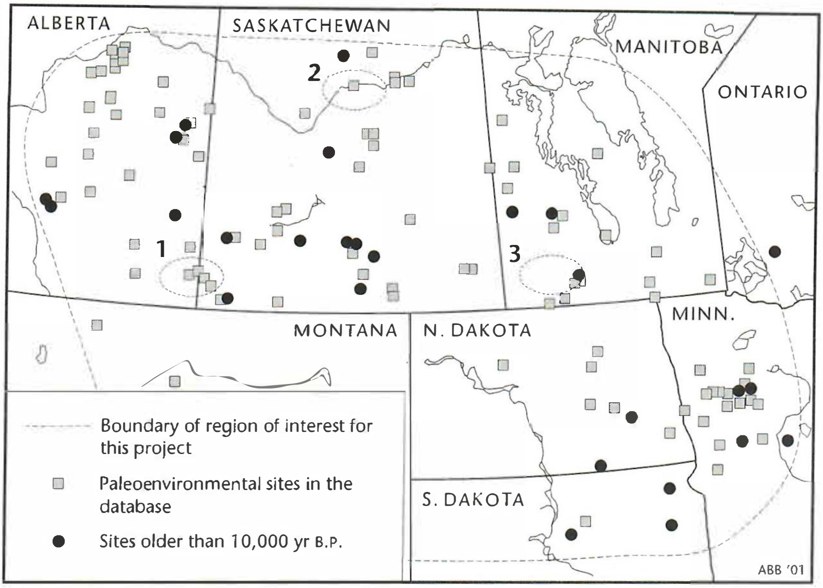

Figure 1. Postglacial paleoenvironmental records for the northern plains. Shaded areas show the three nodes of the SCAPE project: **1,** Cypress Hills, southeast Alberta and southwest Saskatchewan; **2,** the Forks area, central Saskatchewan; and **3,** Lauder Sandhills and Tiger Hills, southwest Manitoba.

Continuing into the Holocene, the 9000 yr B.P. reconstruction (based on 29 records) will provide regional context for Paleoindian occupation.

Vandy Bowyer and Tim Panas helped assemble this database. Partial funding for this project is provided by the Social Sciences and Humanities Research Council of Canada (SSHRC) through an MCRI Grant #412-99-1000. This is E-SCAPE Contribution 1.

References Cited

Beaudoin, A. B. 1993 A Compendium and Evaluation of Postglacial Pollen Records in Alberta. *Canadian Journal of Archaeology* 17:92–112.

Vance, R. E., A. B. Beaudoin, and B. H. Luckman 1995 The Paleoecological Record of 6 ka BP Climate in the Canadian Prairie Provinces. *Géographie Physique et Quaternaire* 49:8–98.

A Late Glacial Pollen Sequence from Wild Rice Lake Reservoir, St. Louis County, Minnesota

James K. Huber

A palynological investigation of the lowermost sediments of a 200-cm-long core from Wild Rice Lake Reservoir, St. Louis County, Minnesota, was undertaken as part of an investigation of the history of wild rice (*Zizania aquatica*) in northeast Minnesota and its availability to prehistoric Native Americans. Wild Rice Lake was modified in the 1920s when a dam was built at the north end of the lake, creating what is now known as Wild Rice Lake Reservoir to generate hydroelectric power (Rapp, 1995) and destroying the wild rice beds on the lake. Wild Rice Lake Reservoir is located approximately 15 km northwest of Duluth, Minnesota (UTM Zone 15: 562272, 5193200).

The upper 75 cm of sediment in the core is gyttja; below 75 cm, the sediment is minerogenic. Except for the lowermost 10 cm, pollen is poorly preserved in the mineral-rich sediment and well preserved above. Based on the abrupt sediment change and the preservation and composition of the pollen, it appears that a major hiatus occurs in the core at 75 cm. The hiatus is probably the result of the shallow Wild Rice Lake drying up during the Hypsithermal.

The most abundant arboreal pollen types are spruce (*Picea*) and birch (*Betula*). The dominant nonarboreal pollen types are sedge (*Cyperaceae*), grass (*Poaceae*), and wormwood (*Artemisia*). Cedar (*Cupressaceae*), jack/red pine (*Pinus banksiana/resinosa*), oak (*Quercus*), willow (*Salix*), alder (*Alnus*), and ragweed (*Ambrosia*-type) are important minor components (Figure 1). The

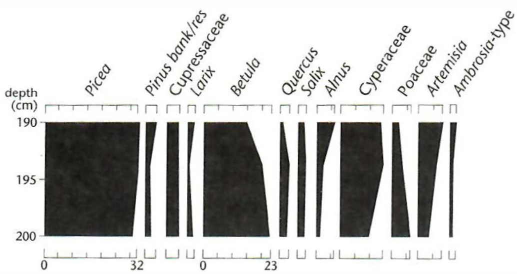

Figure 1. Pollen percentage diagram of selected taxa, Wild Rice Lake Reservoir, St. Louis County, Minnesota.

pollen spectra are interpreted as representing a shrub parkland or a forest-tundra of dwarf birch and willow with scattered black and white spruce and juniper.

The pollen sequence from Wild Rice Lake Reservoir is similar to the regional *Betula-Picea* assemblage zone of Cushing (1967), which dates from 10,500 to 10,200 yr B.P. at Weber Lake, Lake County, Minnesota (Fries

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1962), the type locality for this zone. Missing from the Wild Rice Lake Reservoir pollen sequence is the *Compositae-Cyperaceae* assemblage zone of Cushing (1967), which usually underlies the *Betula-Picea* assemblage zone. Apparently either sediments of this age were not recovered during core retrieval or the lake did not exist at this time. However, subsequent cores from the lake may yield older sediments. The results of this investigation provide additional information on the vegetational history of northeast Minnesota and may also aid in understanding Native American occupation of the area.

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, Jr., pp. 59–88. Yale University Press, New Haven, CT.

Fries, M. 1962 Pollen profiles of Late Pleistocene and Recent Sediments from Weber Lake, Minnesota. *Ecology*, 43:295–308.

Rapp, G. R., Jr. 1995 Introduction. In *The Paleo-Indian of Southern St. Louis County, Minnesota: The Reservoir Lakes Complex*, edited by C. Harrison, E. Redepenning, C. L. Hill, G. Rapp, Jr., S. E. Aschenbrenner, J. K. Huber, and S. C. Mulholland, pp. 1–5. University of Minnesota, Kendall/Hunt Publishing Company, Dubuque, IA.

Paleoenvironments: Vertebrates

Paleodiet of *Cavidae* Rodents in the Monte Desert of Argentina in the Last 30,000 Years

María A. Dacar, Carlos Borghi, Eduardo Martínez Carretero, Stella Giannoni, and Alejandro García

Systematic archaeological research since 1955 at Gruta del Indio (San Rafael, Mendoza) has yielded evidence of Pleistocene megafaunal remains related to probable human occupation (Lagiglia 1956). As part of a new program of interdisciplinary research at the site (García and Lagiglia 2000), the local paleoecological record has been enlarged through recovery of wood fragments and coprolites of extinct megafauna, mesofauna (*Lagidium viscacia*), and rodents of the family *Cavidae*. The new items correspond to the periods ca. 30,000–24,000 and ca. 12,000–9,000 yr B.P., thus allowing study of environmental conditions prior and subsequent to the Last Glacial Maximum (García and Lagiglia 1999). One of the approaches used in this research is analysis of rodent (*Cavidae*) excrement (Betancourt et al. 1990), for which preliminary results are given in this note.

Based on their morphological features, the coprolites analyzed are attributed to the extant species *Galea musteloides* of the family *Cavidae*. Standard microhistological methodology was improved with the modifications proposed by Dacar and Giannoni (2001) for analysis of hard tissue and seeds. Determination of vegetal species was done through comparison with local patterns of occurrence at the site and with regional patterns of occurrence recorded in the Ruiz Leal herbarium (MERL-IADIZA).

Samples were analyzed from four levels dating to ca. 9,000, ca. 24,000, ca. 28,500–30,000 and ca. 30,000 yr B.P. Seventeen vegetal components were determined (Table 1), though some were only determined to the familial level. The hemicryptophyte *Pappophorum caespitosum* appeared in all four levels; the presence of the phanerophyte *Prosopis flexuosa* and elements of the *Chloridea* family is also very important. Comparison between paleodiets and the present diet (Monge et al. 1994) does not show qualitative differences.

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Table 1. Composition of rodent (*Cavidae*) paleodiets.

Vegetal species	ca. 9000	ca. 24,000	ca. 24,000–28,600	ca. 30,000
Hyalis argentea	■			
Prosopis flexuosa depr.	■	■	■	
Chenopodiaceae	■	■		
Pappophorum caespitosum	■	■	■	■
Chloridea	■	■	■	
Poa ?	■	■		
Acantholippia seriphioides	■	■		
Capparis atamisquea			■	
Aristida adsc. ?	■			
Setaria sp.	■		■	
Hordeum sp.			■	■
Bromus sp.	■			
Boutelowa sp.	■			
Cercidium praecox			■	■
Stipa sp.			■	■
Digitaria californica			■	
Schinus fasciculatus				■

Note: All dates are yr B.P.

The vegetal species consumed are conspicuous in the present vegetation of the area. The species that constitute the paleodiet belong to the phytogeographic unit called "Monte desert," where they constitute definite floristic associations; therefore they exhibit an interesting environmental relationship in the late Pleistocene, suggesting that any changes in vegetation, and probably climate, were not pronounced. Nevertheless, the diet of caviomorph rodents (the group that includes *Galea musteloides*) is generally specialized; they do not consume resources according to their abundance, but actively select them (Campos et al. 1999). Consequently, taking into account that foraging strategies produce a profound bias on paleoenvironmental information (Dial and Czaplewski 1990), a more complete reconstruction of the environmental conditions of the period will only be obtained by combining data on meso- and megaherbivores diets from the same location.

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References Cited

Betancourt, J., T. Van Devender, and P. Martin (editors) 1990 *Packrat Middens: The Last 40,000 Years of Biotic Change.* The University of Arizona Press, Tucson, AZ.

Campos, C., R. Ojeda, S. Monge, and M. Dacar 1999 Utilization of Food Resources by Small and Medium- Sized Mammals in the Monte Desert Biome, Argentina. *Australian Journal of Ecology.*

Dacar, M., and S. Giannoni 2001 A Simple Method for Preparing Reference Slides of Seed. *Journal of Range Management* 54(2):191–193.

Dial, K., and N. Czaplewski 1990 Do Woodrat Middens Acurately Represent the Animals' Environments and Diets? The Woodhouse Mesa Study. In *Packrat Middens: The Last 40,000 Years of Biotic Change*, edited by J. Betancourt, T. Van Devender, and P. Martin, pp. 43–58. The University of Arizona Press, Tucson, AZ.

García, A., and H. Lagiglia 1999 A 30,000-Year-Old Megafauna Dung Layer from Gruta del Indio (Mendoza, Argentina). *Current Research in the Pleistocene* 16:116–118.

——— 2000 Avances en el Estudio del Registro Pleistocénico Tardío de la Gruta del Indio (Mendoza). *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano* 18:167–174.

Lagiglia, H. 1956 Estudios Arqueológicos en el Rincón del Atuel (Dpto. San Rafael, Mendoza). *Anales de Arqueología y Etnología* XII:227–287

Monge, S., M. Dacar, and V. Roig 1994 Comparación de Dietas de Cuises en la Reserva de la Biósfera de Ñacuñán (Santa Rosa, Mendoza, Argentina). *Vida Silvestre Neotropical* 3(2):115–117.

An Exceptionally Large Short-faced Bear (*Arctodus simus*) from the Late Pleistocene(?)/Early Holocene of Kansas

Katrina E. Gobetz and Larry D. Martin

Remarkably large *Arctodus simus* (short-faced bear) remains were recovered from Kansas River sand and gravel bars near Bonner Springs, Wyandotte County, Kansas. The disassociated bones include one complete right humerus (cast, KUVP C-2427), one left femur minus the distal end (KUVP 131586), one lumbar vertebra (KUVP 81230), one first caudal vertebra (KUVP 88320), and one left metatarsal (KUVP 126144), possibly representing several individuals. Stafford et al. (1996) dated KUVP 81230 to the early Holocene, approximately 9,630 ± 60 RCYBP (CAMS-20007).

Femoral measurements exceed values for large *Arctodus* from Lake Bonneville, Utah (Nelson and Madsen, 1983), and Hay Springs, Nebraska (Kurtén, 1967), by ca. 10.2 percent and 11.3 percent, respectively (Table 1). The humerus is somewhat larger than the type *Dinarctotherium merriami* (= *Arctodus simus*) from Cass County, Nebraska (Barbour, 1916) (Table 1). Least femoral shaft width exceeds that of the largest known *Arctodus* femur (Lake Bonneville) by ca. 2 mm (Table 1), suggesting a body weight estimation (after Kurtén (1967)) of 620–660 kg, as for the Lake Bonneville bear (Nelson and Madsen, 1983). The Kansas River specimens thus occupy the large end of the size spectrum for *A. s. yukonensis* Lambe, and are probably male if size indicates sex (Kurtén, 1967).

Kurtén and Anderson (1980) contended that *A. simus* decreased in size after the Irvingtonian, except in the northwestern United States. However, several Central Plains bears may support the suggestion of Richards et al.

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Table 1. Measurements of Kansas River *Arctodus* specimens, with values from relatively large, previously described *A. simus yukonensis* specimens for comparison where available. All measurements are in mm.

Specimen	Kansas River, Kansas	Lake Bonneville, Utah[A]	Cass County, Nebraska[B]	Hay Springs, Nebraska[C]
Humerus, KUVP C-2427				
Total length	646		633	
Greatest ant./postr. prox. width	134		158	
Least transv. shaft width	75		75	
Least ant./postr. shaft width	68		64	
Average width shaft	71.5		80	
Greatest transv. width distal end	185		180	
Ant./postr. caput diameter	114		115	
Femur, KUVP 131586				
Greatest ant./postr. prox. width	193.7	191		155
Least transv. shaft width	65.7	64		62.6
Ant./postr. caput diameter	83.2			77
Lumbar, KUVP 81230				
Ventral length centrum	66.8			
Greatest width postr. end centrum	104.6			
Depth centrum at midline postr. surface	69.5			
First Caudal, KUVP 88320				
Ventral length centrum	48.6			
Greatest width postr. end centrum	90.5			
Depth centrum at midline postr. surface	52.9			
Metatarsal (II?) KUVP 126144				
Total length	123.6			

Data from other sources:
[A] Nelson and Madsen (1983)
[B] Barbour (1916)
[C] Kurtén (1967)

(1996) that local populations remained large. Three other Kansas *Arctodus* specimens are known, all relatively small. Two are Irvingtonian, from near Arkalon, Seward County (Richards et al., 1996); the third is Rancholabrean (Sangamonian?) from the Jinglebob Fauna, Meade County (Rinker, 1949). These may represent the geologically older *A. s. simus* Cope and female *A. s. yukonensis*, respectively (Richards et al., 1996). Other Central Plains *Arctodus*, such as the Hay Springs and Cass County, Nebraska, specimens, are large (Kurtén, 1967), possibly larger than *A. s. yukonensis* from the Yukon.

Some Central Plains specimens are also geologically young. The Lake Bonneville and Kansas River bears—the largest described—are late Wisconsinan or younger, the Lake Bonneville bear being ca. 12,650 ± 70 yr B.P. (Richards et al., 1996). The Kansas River bears thus imply that large *Arctodus* may have survived into the early Holocene. They represent one of the youngest dates for extinct North American Pleistocene megafauna.

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References Cited

Barbour, E. H. 1916 A Giant Nebraska Bear, *Dinarctotherium merriami*. *Bulletin of the Nebraska Geological Survey* 4 (pt. 26):349–353.

Kurtén, B. 1967 Pleistocene Bears of North America, Part 2. Genus *Arctodus*, Short-faced Bears. *Acta Zoologica Fennica* 117:1–60.

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

Nelson, M. E., and J. H. Madsen, Jr. 1983 A Giant Short-faced Bear (*Arctodus simus*) from the Pleistocene of Northern Utah. *Transactions of the Kansas Academy of Science* 86(1):1–9.

Richards, R. L., C. S. Churcher, and W. D. Turnbull 1996 Distribution and Size Variation in North American Short-faced Bears, *Arctodus Simus*. In *Paleoecology and Paleoenvironments of Late Cenozoic Mammals: Tributes to the Career of C. S. (Rufus) Churcher*, edited by K. M. Stewart and K. L. Seymour, pp. 191–246. University of Toronto Press, Toronto, ONT, Canada.

Rinker, G. C. 1949 *Tremarctotherium* from the Pleistocene of Meade County, KS. *Contributions from the Museum of Paleontology, University of Michigan* 7(6):107–112.

Stafford, T. W., Jr., L. D. Martin, W. Dort, and J. L. Hofman 1996 Radiocarbon Dating of Extinct Pleistocene Megafauna from the Kansas River, Bonner Springs Locality, Kansas. *Current Research in the Pleistocene* 13:114–116.

Hibernation in a Pleistocene Ground Squirrel (*Spermophilus?*)

H. Thomas Goodwin and Daniel Gonzalez

Incremental deposition of mammalian dental tissues may be related to environment and physiology (Carlson 1990). Patterns and isotopic composition of increments have supported paleobiological inferences, especially in studies of ever-growing tusk dentine in proboscideans (e.g., Fisher 1996). Similar studies should be possible with ever-growing rodent incisors, which exhibit daily growth increments (Schour and Steadman 1935) but are constrained by high rates of tooth eruption and attrition. A given rodent incisor preserves at most a few months of increments.

We examined incremental dentine in fossil lower incisors of the Wyoming ground squirrel (*Spermophilus elegans*), an extant, obligate hibernator of the central Rocky Mountains and northern Great Basin (Zegers 1984). Fossils were from Porcupine Cave, Park Co., Colorado, which documents high-elevation, middle-Pleistocene and possibly younger vertebrate assemblages (Barnosky and Rasmussen 1988; Bell and Barnosky 2000). All incisors were present in lower jaws but loose enough to be removed. This allowed identification based on jaws and cheek teeth and qualitative categorization of specimens into wear classes of cheek teeth. Incremental dentine was visualized on

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the medial surface using low-angle light to highlight subtle topographic relief.

Of 104 incisors, 30 displayed a set of features documenting an interval of reduced growth (we refer to the feature-set as the reduced growth mark–RGM). Correlated features included: 1) a narrow band of poorly defined, closely spaced dentine increments bounded by more distinct, wider increments; 2) depression of the medial dentine surface in the region of poorly defined increments, indicating less outward growth during deposition; and 3) thickening of the enamel deposited synchronously with the poorly defined dentine increments, resulting in an enamel "sleeve." The latter may indicate that rate of enamel deposition was less depressed than that of dentine during the interval of reduced growth.

The RGM was never observed more than once per incisor, indicating a cause that did not repeat within two or three months (estimated period of incisor record based on counts of normal increments). The RGM was non-randomly distributed across dental wear classes (chi-square = 27.58, $p < 0.001$, df = 2)—absent on specimens with erupting or unworn adult cheek teeth ($n = 19$), likely juveniles in their first summer and fall; present on 19 of 61 specimens with light to moderate tooth wear; and most frequent on specimens with heavy tooth wear (present on 11 of 24), probably adults who lived through at least one full year. (Correlation between tooth wear and age is based on preliminary observations of modern museum collections.)

We suspect hibernation as the cause of the RGM. This accounts for the single RGM per tooth (hibernation occurs annually), its absence in juvenile specimens (they did not survive to first hibernation), and its presence in only some specimens presumed to have gone through hibernation (the RGM was lost to attrition on individuals living several months post-hibernation). It also is consistent with previous studies demonstrating reduced growth rates of incisors during hibernation in the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*; Sarnat and Hook 1942) and deposition of narrow dentine increments during hibernation in another ground-dwelling squirrel, the yellow-bellied marmot (*Marmota flaviventris*; Rinaldi 1999).

Many of these observations are explicable if another annual stress, such as lactation, were the cause. However, observations on two specimens of extant *Spermophilus parryii* (Arctic ground squirrel) favor hibernation. The RGM is absent on a male collected about 50–60 days after emergence, consistent with both models—either males never experience requisite metabolic stresses (e.g., lactation), or the RGM was lost to attrition after hibernation. In contrast, a clear RGM is present on a female collected about 30–40 days after emergence and is located about one-half of the way along the tooth—expected if hibernation were the cause; this location on the tooth is more distal than expected if the RGM is caused by parturition or lactation. (The male [Univ. of Michigan (UM) 158181] was collected 21 June 1975; the female [UM 158169] was collected 5 June 1975. Post-emergence estimates were based on two observations: males begin emerging from hibernation in middle to late April, with females delayed 1–2 weeks—Michener 1984.)

Work is ongoing to further test the association between life-history and the

RGM in modern ground squirrels. If the association is confirmed, RGM may serve as an "event anchor" for environmental, physiological, and taphonomic interpretations of incremental dentine in archaeological and paleontological samples.

Thanks to E. Anderson (Denver Museum of Natural History) and P. Myers (University of Michigan) for access to specimens.

References Cited

Barnosky, A. D., and D. L. Rasmussen 1988 Middle, South Park, Colorado. *Annals of the Carnegie Museum* 56:267–292.

Bell, C. J., and A. D. Barnosky 2000 The Microtine Rodents from the Pit Locality in Porcupine Cave, Park County, Colorado. *Annals of the Carnegie Museum* 69:93–134.

Carlson, S. J. 1990 Vertebrate Dental Structures in *Skeletal Biomineralization: Patterns, Processes, and Evolutionary Trends,* Vol. I, edited by J. G. Carter, pp. 531–556, Van Nostrand Reinhold, New York, NY.

Fisher, D. C. 1996 Extinction of Proboscideans in North America in *The Proboscidea: Evolution and Palaeoecology of Elephants and Their Relatives,* edited by J. Shoshoni and P. Tassy, pp. 296–315, Oxford University Press, Oxford, UK.

Michener, G. R. 1984 Age, Sex, and Species Differences in the Annual Cycles of Ground-Dwelling Sciurids: Implications for Sociality in *The Biology of Ground-Dwelling Squirrels,* edited by J. O. Murie and G. R. Michener, pp. 81–107, University of Nebraska Press, Lincoln, NE.

Rinaldi, C. 1999 A Record of Hibernation in the Incisor Teeth of Recent and Fossil Marmots (*Marmota flaviventris*) in *Proceedings of the 11th International Symposium on Dental Morphology,* edited by J. Mayhall, pp. 112–119, Oulu University Press, Oulu, Finland.

Sarnat, B. G., and W. E. Hook 1942 Effects of Hibernation on Tooth Development. *The Anatomical Record* 83:471–493.

Schour, I., and S. R. Steadman 1935 The Growth Pattern and Daily Rhythm of the Incisor of the Rat. *The Anatomical Record* 63:325–333.

Zegers, D. A. 1984 Spermophilus elegans. *Mammalian Species* 214:1–7.

Late-Pleistocene and Holocene Vertebrates from Cave Deposits near Wrangell, Alaska

Timothy H. Heaton

Extensive cave deposits with fossils spanning the last 50,000 years have been found on Prince of Wales Island (Heaton and Grady 2000, 2001; Heaton et al. 1996), but until now none have been reported from the nearby Alaska mainland. Two caves containing vertebrate fossils have been found in a thin band of marble located on the northeast side of Blake Channel near The Narrows, 20 km southeast of Wrangell and 70 km east of northern Prince of

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Wales Island. Blake Channel is a glacial fjord, and the caves were probably exposed and modified by late-Wisconsin glacial erosion.

Lawyers Cave (also known as Phalanges Phreatic Tube) is a 10-m-long horizontal tube with an entrance at each end located just 20 m above sea level. Several phalanges of black bear (*Ursus americanus*), wing bones of common loon (*Gavia immer*), fish bones, and quills and feces of modern porcupine (*Erethizon dorsatum*) were found on the surface. One of the bear phalanges was dated to 6,290 ± 50 RCYBP (SR-5265). Test pits revealed bone to a depth of at least 20 cm, and a bone of white-winged scoter (*Melanitta fusca*) from that depth dated to 8,880 ± 50 RCYBP (SR-5264). Teeth of Keen's mouse (*Peromyscus keeni*), long-tailed vole (*Microtus* cf. *longicaudus*), red-backed vole (*Clethrionomys* cf. *gapperi*), and bog lemming (cf. *Synaptomys borealis*) were also recovered. This cave was probably below sea level during the latest Pleistocene and earliest Holocene before isostatic rebound was complete, but must have been exposed by about 9,000 yr B.P. Several archaeological remains were also found in the cave and are under study by E. James Dixon.

Hole 52 is located in a sinkhole 55 m above sea level and contains several vertical pits separated by short horizontal crawlways (Allred 1999). A waterfall and stream are present in the cave, and most of the cave is wet during rainy periods. A large black bear cranium found near the entrance dated to 10,350 ± 100 RCYBP (AA-36636), and a modern porcupine skeleton was found nearby. Numerous remains of black bears and porcupines were found on ledges and at the bottom of a 20-m-deep pit. A porcupine skull from this pit dated to 4,395 ± 70 RCYBP (AA-36639), and two black bear skulls dated to 4,845 ± 60 and 10,930 ± 140 RCYBP (AA-36637, AA-36638). Shallow sediments below the pit were screened, and abundant remains of black bear, porcupine, Keen's mouse, long-tailed vole, red-backed vole, and shrew (*Sorex* sp.) were recovered as well as a single tooth of marmot (*Marmota caligata*), ermine (*Mustela* cf. *erminea*), and river otter (*Lontra canadensis*).

The oldest remains from Hole 52 were recovered from shallow sediments in a horizontal crawlway accessed from the bottom of the pit. Black bear remains dated to 10,080 ± 120, 10,420 ± 110, and 11,460 ± 130 RCYBP (AA-36641, AA-36640, AA-33202). A porcupine skeleton was found on the surface at the same location and appeared much younger. It is unclear how the bones reached this remote location, but there are several vertical pits through which animals or bones might fall.

The cave faunas appear to represent primarily cave-dwelling species, though the bird and fish remains in Lawyers Cave were probably brought in by otters. Hole 52 is not configured to act as a natural trap for surface animals such as deer, but the pits are effective traps for animals denning inside the cave (bears, porcupines, and micromammals). All the species found in these caves are present in the area today (MacDonald and Cook 1996), except that marmots are probably restricted to higher (less forested) elevations.

As in the caves of Prince of Wales Island, most bear remains date to the latest Pleistocene and early Holocene prior to extensive forest development. The Prince of Wales Island fauna lacks porcupines and postglacial marmots, apparently due to the difficulty of colonizing an island following deglaciation. (No rodents survived the Last Glacial Maximum on Prince of Wales Island; Heaton and Grady 2000, 2001.) Therefore these mainland caves provide an interesting contrast between colonization by land and sea.

I thank cavers Dave Love, Pete Smith, and Kevin Allred for bringing these caves to my attention and assisting with the excavation. Jackie DeMontigny, Mark McCollum, and Jim Baichtal of Tongass National Forest provided logistical support and funding. Grant funding was provided by the National Science Foundation (EAR-9870343), the National Geographic Society (6212-98), and the University of South Dakota.

References Cited

Allred, K. 1999 Hole 52 and Speleological Potential of the General Area, Wrangell, Alaska. Preliminary Report #S9, Tongass Cave Project, National Speleological Society, 4 pp.

Heaton, T. H., and F. Grady 2000 Vertebrate Biogeography, Climate Change, and an Ice Age Coastal Refugium in Southeastern Alaska. *Journal of Vertebrate Paleontology* 20:48A.

——— 2001 The Late Wisconsin Vertebrate History of Prince of Wales Island, Southeast Alaska. In *Vertebrate Paleontology of Late Cenozoic Cave Deposits in North America*, edited by B. W. Schubert, J. I. Mead, and R. W. Graham (in press).

Heaton, T. H., S. L. Talbot, and G. F. Shields 1996 An Ice Age Refugium for Large Mammals in the Alexander Archipelago, Southeastern Alaska. *Quaternary Research* 46:186–192.

MacDonald, S. O., and J. A. Cook 1996 The Land Mammal Fauna of Southeast Alaska. *Canadian Field-Naturalist* 110:571–598.

Proboscidean Remains near the Wichita River in North-central Texas

Kenneth C. Kraft, Timothy G. Baugh, and Frank Force

This note reports on archaeological investigations conducted at Truscott Brine Lake (TBL), Knox County, Texas. The goal of the research was to investigate the remains of a proboscidean and ascertain if Paleoindian hunters killed and/or butchered the animal. It was also a goal to establish if the bones were in primary context. If not, the research objective would shift to determining the extent to which the bones were scattered and damaged and identifying the agents responsible (Kraft 1997; Kraft and Force 1997). The information to follow will be useful to researchers in the region when added to the Pleistocene faunal distribution database.

TBL is one of many U.S. Army Corps of Engineers–created impoundments intended to control brine entering the Red River via its tributaries. The

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Wichita River in Cottle, Foard, King, and Knox counties, Texas, is one such tributary. Brine water emanating from springs is pumped overland to evaporative reservoirs such as TBL. Archaeologists performed initial investigations at TBL in 1972 and 1978. Forty-nine archaeological sites were recorded in the project area, as well as three paleontological sites (Etchieson et al. 1978:4–6). None of the archaeological sites were attributed to Paleoindian occupation of the area. Moreover, no Paleoindian sites are recorded in the surrounding counties and river systems (Biesaart et al. 1985).

In late 1996, a section of tusk was discovered north of TBL in a badlands setting characterized by high runoff and severe erosion (Rogers and Risinger 1979:24, 42). At the onset it was not known if the 50-cm-long section of exposed tusk belonged to a mammoth or mastodon. A previous report made note of two pieces of enamel from a mammoth tooth in the vicinity. Details were limited to a short paragraph with a reference point on the map (Etchieson et al. 1978:109, 234). Owing to the elapsed time since the first report (1978) and the high erosion rates typical of the area, it is not clear if the newly discovered remains correspond to the previous find.

Three backhoe trenches and a block of squares were excavated. Controlled archaeological excavation of 2.4 m^2 revealed a partial left mandible with an intact molar. Examination of the desiccated molar revealed that the animal was a mammoth (*Mammuthus* sp.). It was also apparent that the tusk and associated bones were not in primary context. The bones had been dislodged previously and redeposited in their present location. This conclusion is based on the marl surrounding the cranial elements. The same compact marl outlined the contour of a paleo-gully that is eroding once again. Farther down the wash a single, intact carpal was found as well as three indeterminate rib fragments. The ribs lay atop a gley deposit not associated with the tusk and mandible. The horizontal extent of the gley was not determined despite our efforts. No evidence of human involvement was detected. No stone tools were recovered around the skeletal remains, and no flakes or stone/bone/wood tools were recovered from the screened material. Evidence of cut marks or impact scars was absent. Other forms of human activity such as bone stacking or crushing were also absent.

The modern badlands setting at TBL is markedly different from that during the Pleistocene Epoch. There are no detailed pollen records for the TBL area. However, pollen records from the adjacent southern Plains indicate the presence of grassland vegetation (Hall and Valastro 1995). Four Paleoindian sites in the vicinity of TBL were studied well enough to reconstruct past environmental conditions. Two are post-Clovis sites (Lake Theo and Perry Ranch), and two are Clovis sites (Domebo and McLean). Geological, paleontological, and paleobotanical data from these sites reflect a woodland setting astride tall and short grasses with incised canyons slowly agrading (see Holliday 1997).

In sum, localities with faunal collections comparable to that at TBL have been identified in northern Texas (Dalquest and Schultz 1992) and southern Oklahoma (Force 1997; Hay and Cook 1930; Leonhardy 1966; Magilo 1973:63; Neal 1994, 1995; Neel 1985; Rohrbaugh 1971). Similar localities too numerous to cite here are recorded in southern Kansas, northern Oklahoma, and western Texas (see Kraft 1997:22–35). For a dated but thorough review of mammoth and mastodon bone locations for northwestern and southwestern Oklahoma, see Lintz (1980) and Northcutt (1984), respectively. A recent publication by Wyckoff and Czaplewski (1997) offers an in-depth overview of proboscidean research in Oklahoma, and Dalquest and Schultz (1997) do the same for north-central Texas.

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References Cited

Biesaart, L., W. Roberson, and L. Spotts 1985 *Prehistoric Archeological Sites in Texas: A Statistical Overview.* Texas Historical Commission, Office of the State Archeologist, Special Publication #28. Austin, TX.

Dalquest, W., and G. Schultz 1992 *Ice Age Mammals of Northwestern Texas.* Midwestern State University Press. Wichita Falls, TX.

Etchieson, M., R. Speer, and J. Hughes 1978 *Archaeological Investigations in the Truscott Reservoir Area, King and Knox Counties, Texas.* Report submitted to the U.S. Army Corps of Engineers, Tulsa District, contract # DACW56-77-C-0110. Kilgore Research Center, West Texas State University. Canyon, TX.

Force, F. 1997 The Domebo Site: A Taphonomic Reanalysis. Unpublished Master's thesis, Department of Anthropology, University of Oklahoma. Norman, OK.

Hall, S., and S. Valastro 1995 Grassland Vegetation in the Southern Great Plains during the last Glacial Maximum. *Quaternary Research* 44:237–245.

Hay, O., and H. Cook 1930 Fossil Vertebrates Collected near or in Association with Human Artifacts at Localities near Colorado, Texas; Frederick, Oklahoma; and Folsom, New Mexico. *Proceedings of the Colorado Museum of Natural History* 9(2):4–40.

Holiday, V. 1997 *Paleoindian Geoarchaeology of the Southern High Plains.* University of Texas Press. Austin, TX.

Kraft, K. C. 1997 *Paleontological Investigations at Truscott Brine Lake, Knox County, Texas.* Report submitted to U.S. Army Corps of Engineers, Tulsa District, contract # DACW56-96-M-1278. Wichita and Affiliated Tribes, Historic Preservation Office. Anadarko, OK.

Kraft, K. C., and F. Force 1997 Preliminary Investigations at the Truscott Brine Lake Proboscidean Site, Knox County, Texas. Paper presented at the 19th Annual Flint Hills Archaeological Conference. Manhattan, KS.

Leonhardy, F. 1964 *Domebo: A Paleoindian Mammoth Kill in the Prairie-Plains.* Museum of the Great Plains, Contributions to the Museum of the Great Plains #1. Lawton, OK.

Lintz, C. 1980 *Excavation of Mammoth Remains within Impoundment #36, Turkey Creek Watershed, Major County, Oklahoma.* Oklahoma Conservation Commission, Miscellaneous Reports #11. Oklahoma City, OK.

Magilo, V. 1973 Origin and Evolution of the Elephantidae. *Transactions of the American Philosophical Society* 63(3).

Neal, L. 1994 The Hill Mammoth in Garvin County. *Oklahoma Archeological Survey Newsletter* 14(1):1–2.

——— 1995 A Radiocarbon Date from the Hill Mammoth Site in Garvin County. *Oklahoma Archeological Survey Newsletter* 14(4):2

Neel, C. 1985 The Allison-Menifee Mammoth Excavations: Evidence for a Late Pleistocene Stream Course in Central Oklahoma. *Oklahoma Geology Notes* 45(5):188–204.

Northcutt, J. 1984 A Review of Mammoth and Mastodon Bone Locations in Southwestern

Oklahoma. Paper presented at the 42nd Annual Plains Anthropological Conference. Lincoln, NE.

Rogers, C., and W. Risinger 1979 *Soil Survey of Knox County, Texas.* U.S. Department of Agriculture, Soil Conservation Service.

Rohrbaugh, C. 1971 Mayesville Mammoth Investigations. *Oklahoma Anthropological Society Newsletter* 19(7):2.

Wyckoff, D., and N. Czaplewski 1997 Paleontological and Archeological Perspectives of Fossil Proboscideans in Oklahoma. *Oklahoma Geology Notes* 57(3):72–101.

Radiocarbon Chronology of the Pleistocene Fauna from Geographic Society Cave, Primorye (Russian Far East)

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Geographic Society Cave (42° 52′ N, 133° 00′ E) contains the most complete record of the late Pleistocene vertebrate fauna in the Russian Far East (Kuzmin 1997; Ovodov 1977; Vereshchagin and Baryshnikov 1984). The finding of stone and bone tools together with Pleistocene animal remains made this site unique in terms of Paleolithic archaeology of the area (Derevianko 1998:279–280). The importance of the site in study of both fauna history and human occupation in warm-temperate region of Northeastern Asia was underscored when a single ^{14}C value, 32,570 ± 1,510 RCYBP (IGAN-341) (Kuzmin et al. 1994), was obtained on bone collagen prior to 2000.

The remains of 36 mammal species were identified in the cave (Ovodov 1977). Among them, sika deer (*Cervus nippon* Temminck), roe deer (*Capreolus capreolus* L.), and common deer (*Cervus elaphus* L.) dominate in the assemblage. Bones of several extinct species, such as woolly mammoth (*Mammuthus primigenius* Blum.), woolly rhinoceros (*Coelodonta antiquitatis* Blum.), horse (*Equus caballus* L.), bison (*Bison priscus* Boj.), and cave hyena (*Crocuta spelaea* Goldfuss), were also excavated.

For ^{14}C dating, bones of tiger (*Panthera tigris* L.), cave hyena, and mammoth were selected. Collagen was extracted in Novosibirsk ^{14}C Lab by de-

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mineralizing bone pieces in cold hydrochloric acid solution (Kuzmin and Orlova 1998:3–5). The CO_2 gas was made and converted to graphite using routine procedure, and ^{14}C measurements were performed at the NSF-Arizona AMS Facility.

The results of AMS ^{14}C dating are shown in Table 1. For quality control, sample 10 (33,420 ± 460 RCYBP; AA-37183) was additionally dated at both

Table 1. AMS ^{14}C dates of animal bone collagen, Geographic Society Cave

Sample No.	Species	RCYBP	Date number	$\delta^{13}C$, ‰
1	*Panthera tigris*	> 39,000	AA-37068	-20.2
2	*P. tigris*	35,100 ± 1,900	AA-37069	-20.5
3	*P. tigris*	> 40,000	AA-37070	-20.0
4	*P. tigris*	34,300 ± 1,700	AA-38229	-22.8
5	*P. tigris*	> 38,000	AA-37071	-19.0
6	*Crocuta spelaea*	> 37,000	AA-37072	-18.6
7	*C. spelaea*	> 36,000	AA-37073	-19.1
8	*C. spelaea*	34,510 ± 1,800	AA-38230	-19.6
9	*C. spelaea*	> 39,000	AA-37074	-19.0
10	*Mammuthus primigenius*	33,420 ± 460	AA-37183	-21.7
		31,550 ± 600	GrA-16819	
		33,000 ± 1,000	GrA-16839	
		31,500 ± 980	SOAN-4067	

Groningen (AMS technique) and Novosibirsk (LSC technique) ^{14}C Labs and these results are also shown in Table 1. It appears that all the values are quite close to each other (within ±2 sigma), and this made our conclusions more reliable. Samples in the 30,000–40,000 RCYBP range have larger errors than typical of AMS measurements on samples of <5,000 RCYBP, where precisions of ± 30–40 yr are typical. At >30,000 RCYBP, the error is dominated by the blank correction, especially for bone samples, which, at Arizona, is taken to be 1.0 ± 0.3 percent modern carbon for a 1-mg sample of bone collagen.

New ^{14}C dates generally confirm the Karginian (mid-Wisconsin) age of the Geographic Society Cave fauna, which existed in the environment of coniferous and broad-leafed forests (Kuzmin 1996). Samples 3 and 5 were collected from stratigraphic layer 4, where a few upper-Paleolithic tools were also found. The age of human occupation of the cave may be established at least as early as ca. 38,000 RCYBP. This is older than Kuzmin (1996:143) previously suggested it, and agrees with earlier assumption by Vasilievsky (1987). Thus, the earliest firmly documented evidence of human existence on the Russian Far East may now be dated to ca. 38,000–40,000 RCYBP.

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References Cited

Derevianko, A. P. (editor) 1998 *The Paleolithic of Siberia: New Discoveries and Interpretations.* University of Illinois Press, Urbana and Chicago, IL.

Kuzmin, Y. V. 1996 Palaeoecology of the Palaeolithic of the Russian Far East. In *American*

Beginnings: The Prehistory and Palaeoecology of Beringia, edited by F. H. West, pp. 136–146. University of Chicago Press, Chicago and London.

——— 1997 Vertebrate Animal Remains from Prehistoric and Medieval Settlements in Primorye (Russian Far East). *International Journal of Osteoarchaeology*, 7(2):172–180.

Kuzmin, Y. V., and L. A. Orlova 1998 Radiocarbon Chronology of the Siberian Paleolithic. *Journal of World Prehistory*, 12(1):1–53.

Kuzmin, Y. V., L. A. Orlova, L. D. Sulerzhitsky, and A. J. T. Jull 1994 Radiocarbon Dating of the Stone and Bronze Age Sites in Primorye (Russian Far East). *Radiocarbon*, 36(3):359–366.

Ovodov, N. D. 1977 Late Anthropogene Fauna of Mammals (*Mammalia*) of South of the Ussuri Region. In *Fauna and Systematics of the Vertebrates in Siberia*, edited by B. S. Yudin, pp. 157–177. Nauka, Novosibirsk (in Russian).

Vasilievsky, R. S. 1987 Upper Paleolithic Cultures of South-Eastern Primorye. In *Antiquities of Siberia and Far East*, edited by R. S. Vasilievsky, pp. 103–106. Nauka, Novosibirsk (in Russian).

Vereshchagin, N. K., and G. F. Baryshnikov 1984 Quaternary Mammalian Extinction in Northern Eurasia. In *Quaternary Extinctions: A Prehistoric Revolution*, edited by P. S. Martin and R. G. Klein, pp. 483–516. University of Arizona Press, Tucson, AZ.

New Records for *Mammut americanum* in Northeastern México

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The American mastodon (*Mammut americanum*) is relatively scarce in the fossil record from México, since it is only known from seven localities in the Mexican Plateau, mainly from isolated molars (Polaco et al., 1998). In recent excavations in Sierra Alta, a home development in the town of La Estanzuela, 10 km south of Monterrey, Nuevo León (25° 34′ 35″ N, 100° 16′ 34″ W, altitude 601 m), mammal fossils were discovered. The most abundant remains were those of American mastodon.

The remains were found at the base of a clayish layer 3.10–3.95 m thick with a high content of organic matter. Prospecting was done by georadar in two transects, one oriented at 19° NNE with a total distance of 27 m, the other at 17° NNE with a total distance of 28 m. A single fragment of pelvis of a proboscidian was found in an anomaly at 5 m and a depth of 3.30 m from the second transect.

More than 100 bones were recovered. Most are well preserved. They include tusks, molars, mandibles with molars, mandible fragments, ribs, vertebrae, and scapulae from at least 14 individuals representing five taxa: *Mammuthus columbi*

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(n = 2), *Mammut americanum* (n = 7), *Camelops hesternus* (n = 1), *Bison* sp. (n = 3), and *Equus* sp. (n = 1).

Remains recovered from American mastodon include 15 molars or molar fragments, three mandible ramii, and unquantified postcranial material. At least seven individuals are represented. Identification and measurements of molars follow Laub (1992), Miller (1987), and Saunders (1977). The following molar data list indicates kind of tooth, number of elements (E), average length in mm (LA), minimum length in mm (LS), maximum length in mm (LM), average width in mm (WA), minimum width in mm (WS), and maximum width in mm (WM). Dp4, E = 1, LA = 70.6, WA = 55.1; M1, E = 1, LA = 50.5, WA = 68.6; M2, E = 3, LA = 113.6, LS = 108.2, LM = 116.6, WA = 88.6, WS = 80.2, WM = 94.4; M3, E = 3, LA = 175.7, LS = 163.6, LM = 187.9, WA = 104.0, WS = 100.9, WM = 107.2; m2, E = 3, LA = 116.3, LS = 104.5, LM = 131.5, WA = 87.8, WS = 83.0, WM = 95.2; m3, E = 5, LA = 183.1, LS = 162.8, LM = 200.5, WA = 97.7, WS = 88.1, WM = 108.6. These measurements are similar to those provided by Miller and Saunders.

The presence of *Bison* sp. indicates a Rancholabrean age for the fauna of La Estanzuela. This is the first documented association of *Mammuthus columbi* and *Mammut americanum* in México. It is also noteworthy that possible transversal butcher marks in one mammoth scapula suggest the presence of man in the deposit.

From a second locality at Iturbide, Nuevo León, were recovered five molars and one lower tusk belonging to a young adult mastodon approximately 10 years old (African age, following Saunders 1977). The measurements of the molars (length and width in mm) are: recently emerged left M2, L = 128.2, W = 100.5; unerupted left M3, L = 195.5, W = 105.7; worn left dp4, L = 69.0, W = 60.5W; right m1, L = 99.2, W = 74.5; recently emerged left m2, L = 131.2, W = 93.6W; recently emerged right m2, L = 128.6, W = 92.3; inferior tusk with enamel in the tip, L = 198.8, W = 24.5. These measurements are similar to those given by Saunders 1977.

The distribution of *Mammut americanum* in northeastern México is indicated by material from two localities in the state of San Luis Potosí. In El Cedral locality were found one second and one third lower molar of one individual and fragments of deciduous molars from another. In Laguna de la Media Luna a partial cranium was recovered, together with two molars and basal fragments of two tusks (left M2 measures 117.3L, 106.2W). Cabral-Perdomo (2000) provided a new locality record for the state of Hidalgo. All these records indicate that the American mastodon was relatively abundant in northeastern México.

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References Cited

Cabral-Perdomo, M. A. 2000 Presencia de *Mammut americanum* (Proboscidea: Mammutidae), en sedimentos del Pleistoceno Tardío del noreste de la Cuenca de México. In *VII Congreso Nacional de Paleontología y I Simposio Geológico en el Noreste de México. 22–28 de julio 2000. Libro de Resúmenes* edited by J. G. López-Oliva et al., pp.15–16, Universidad Autónoma de Nuevo León.

Laub, R. S. 1992 Positional and Ordinal Identification of the Teeth of *Mammut Americanum*. *Current Research in the Pleistocene,* 9:105–108.

Miller, W. E. 1987 *Mammut Americanum,* Utah's First Record of the American Mastodon. *Journal of Paleontology,* 61:168–183.

Polaco, O. J., J. Arroyo-Cabrales, and B. García-Uranga 1998 The American Mastodon in México. *Current Research in the Pleistocene,* 15:122–124.

Saunders, J. J. 1977 Late Pleistocene Vertebrates of the Western Ozark Highland, Missouri. *Illinois State Museum, Reports of Investigations,* 33:1–118.

Mammal Footprints in a Cave on the Eastern Edge of Tandilia Range, Late Pleistocene of Buenos Aires Province, Argentina

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The wide plain of Argentina, known as the Pampean region, is interrupted by two ranges of hills, Tandilia and Ventania. Tandilia is characterized by low elevations (no more than 300 masl) oriented NW-SE and separated by wide valleys, water gaps, and undulating plains. The area is covered by late-Tertiary and Quaternary loess-like sediments. In the study area, 17 archaeological sites have been recorded. Five of these correspond to the late Pleistocene (dated with ^{14}C AMS): Tixi cave, Amalia Site 2, La Brava cave, Los Pinos small shelter, and Burucuyá cave.

Burucuyá Cave is a rockshelter located in La Vigilancia Range about halfway up the slope. This archaeological site covers an area of 90 m^2. Of this area, 8 m^2 was excavated inside the cave, reaching a maximum depth of 55–64 cm before encountering bedrock. Four stratigraphic units were defined based on sedimentary characteristics (texture, color, types of contacts and structures) and pedogenetic features. The stratigraphic sequence of Burucuyá cave is composed of late-Pleistocene to Holocene sandy-clayed silts, diatomaceous silts, and a diatomite layer (Martínez et al. 1999). Four stratigraphic units were defined. Unit 3 was dated at 10,000 ± 120 RCYBP (LP 863). The three upper units correspond to the Holocene, and the lower one (Unit

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4) to the late Pleistocene. The ichnites consist of depressed features that are below the archaeological record in the upper part of Unit 4. This unit presents marked differences in color, texture, and grain size compared with the dated Unit 3, leading to clear three-dimensional traceable distinctions. Field precautions were taken to avoid modifying either the dimensions or the shape of the depressed features. These structures have a vertical to subvertical axis; in plan view they measure 10–25 cm in maximum diameter and are up to 17 cm deep. The density is high; there are up to 11 features in each excavation grid (1 m^2). The structures occupy the entire excavated area. Although the shape of these features is variable, most of them present a subcircular contour, with the largest diameter near the top and a relatively vertical axis. In some areas, more complex structures are characterized by the union of two or more features. These sedimentary structures in the upper portion of Unit 4 are interpreted as footprints of large mammals walking on silt substrate. They do not record a definite pattern of locomotion, but their collective effect was to generate an irregular surface. Because the silts were saturated with water, the footprints do not retain the precise form of the legs of the animal that made them. For this reason, taxonomic identification was impossible. Similar footprints were found in the icnologic locality of Pehuen-Có, Buenos Aires Province (Manera, pers. comm.). This site has a similar age of 12,000 ± 110 RCYBP (Aramayo and Manera 1996). In some parts of the study area, such as lagoon margins, intermittent ponds, or river banks, groups of footprints with a similar pattern to those seen in Burucuyá cave were observed, although they were of smaller dimensions. These modern footprints correspond to large domestic mammals such as cows and horses. Footprints of similar shape can also be found in wet caves of Tandilia (e.g., Gruta del Oro located in Cuchilla de las Aguilas Range); these footprints were also caused by the passage of large domestic animals. We reject the idea that features interpreted as footprints are burrows produced by mammals because their dimensions and morphology are not appropriate. These features also differ from burrows of amphibians, fossorial scarabs and rodents, armadillos, and lizards, whose populations have been documented in the area near the end of the Pleistocene (Quintana and Mazzanti 1996). Moreover, it is not probable that these features correspond to sedimentary structures such as load casts or other products of deformation of previously stratified material. Rather, features identified here as footprints are defined by a single, highly deformed contact, which represents a depositional unconformity.

References Cited

Aramayo S., and T. Manera 1996 *Edad y Nuevos Hallazgos de Icnitas de Mamíferos y Aves en el Yacimiento Paleoicnológico de Pehuen-Có (Pleistoceno tardío)*, Provincia de Buenos Aires, Argentina. Asoc. Pal. Arg., Pub. Esp. 4:47–57.

Martínez G., M. Osterrieth, and D. Mazzanti 1999 *Estratigrafía de Sitios Arqueológicos en Reparos Rocosos en las Sierras de la Vigilancia y Valdés, Sistema de Tandilia, Provincia de Buenos Aires. XII* Congreso Nacional de Arqueología Argentina, 3:139–144.

Quintana C., and D. Mazzanti 1996 *Secuencia Faunística del Sitio Arqueológico Cueva Tixi (Pleistoceno tardío- Holoceno), Provincia de Buenos Aires.* VI Journal. Pamp. de Cs. Nat., Actas pp.187–194.

The Second Occurrence of an Atypically Grooved Fossil Pocket Gopher Tooth

Dennis R. Ruez, Jr.

The Ichetucknee River flows through karstic north-central Florida and intersects several sinkhole deposits that contain abundant fossil vertebrates, now housed at the Florida Museum of Natural History. The fauna recovered from these deposits is latest Pleistocene in age and consists of both forest and open terrain taxa (Lambert and Holling 1998; Webb 1974). Included in the Ichetucknee River fauna is a pocket gopher (*Geomys pinetis*) upper incisor that has three grooves, rather than the typical two (Figure 1). This is only the second published record of an atypically grooved fossil pocket gopher incisor. Among extant pocket gophers, *Geomys pinetis* is the species that most commonly has extra grooves, though similar abnormalities also occur in species of *Thomomys, Pappogeomys,* and *Orthogeomys* (Akersten 1973).

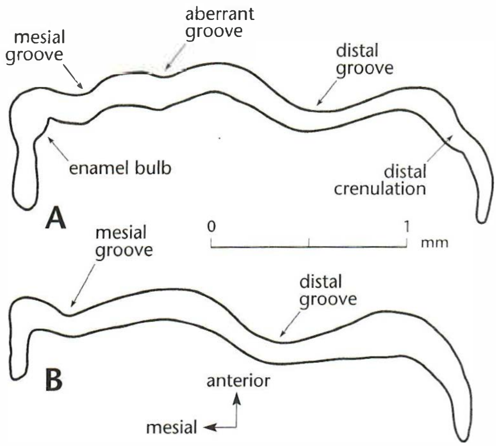

Figure 1. Upper left incisors of *Geomys pinetis* from the Ichetucknee River (Columbia County, Florida). The camera lucida drawings show the enamel at the occlusal surface. Mesial is to the left and anterior is to the top. **A**, tooth with anomolous third groove; **B**, incisor with the two grooves typical of *Geomys pinetis.* Both teeth are catalogued as UF 45745.

This three-grooved incisor (Figure 1A) has a deep distal groove and shallow mesial groove similar to those seen in normal *Geomys* (Figure 1B). The aberrant groove lies between these two and is nearly as pronounced as the normal mesial groove. There is also a slight crenulation at the distal edge of the incisor. An expanded bulb of enamel lies on the anteromesial corner of the tooth. The size of the tooth is similar to other *Geomys pinetis* incisors from the Ichetucknee River. Incisors from immature individuals may show extra folding (Akersten 1973), but the Ichetucknee River tooth has the same width at the occlusal surface and at the base, which indicates the tooth is from a mature animal.

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The number of grooves present on the upper incisor is a useful character for assigning pocket gophers to genera (Russell 1968), but no known taxa normally have three grooves. Functionally, these grooves may provide a serrated cutting edge, may aid in the extraction of the teeth from coarse fibrous materials, and may increase the strength of the teeth (Russell, 1968).

The only other published fossil record of an atypically grooved pocket gopher incisor is one from the middle-Pleistocene Tobin fauna associated with *Geomys tobinensis* and presumably assignable to that species (Russell 1968). As in the Ichetucknee River specimen, the Tobin *Geomys* incisor has the anomalous groove between the two normal ones.

I would like to thank C. Bell, C. Jass, and G. Bever for reading and improving a draft of this manuscript.

References Cited

Akersten, W. A. 1973 Upper Incisor Grooves in the Geomyinae. *Journal of Mammalogy* 54:349–355.

Lambert, W. D., and C. S. Holling 1998 Causes of Ecosystem Transformation at the End of the Pleistocene: Evidence from Mammal Body-mass Distribution. *Ecosystems* 1:157–175.

Russell, R. J. 1968 Evolution and Classification of the Pocket Gophers of the Subfamily Geomyinae. *University of Kansas Publications, Museum of Natural History* 16:473–579.

Webb, S. D. 1974 Chronology of Florida Pleistocene Mammals. In *Pleistocene Mammals of Florida*, edited by S. D. Webb, pp. 5–31. University of Florida Press, Gainesville, FL.

Late-Pleistocene Mammalian Fauna and Environments of the Sandia Mountains, New Mexico

Jessica C. Thompson and Gary S. Morgan

Late-Pleistocene (late Rancholabrean) vertebrate faunas from Sandia Cave and Marmot Cave in the Sandia Mountains of north-central New Mexico contain eight extant species of small mammals no longer found in this mountain range. Sandia Cave also has nine extinct species of large mammals. The two caves are located about 100 m apart (35° 15′ N, 106° 24′ W) at an elevation of 2,165 m. Faunal data and/or radiocarbon dates indicate a late-Wisconsinan age for these cave deposits.

Sandia Cave, a solution tunnel 140 m long and 2–4 m in diameter, is situated on a vertical cliff in Las Huertas Canyon. Frank Hibben (from 1936–1941), Vance Haynes and George Agogino (in 1961), and Richard Smartt

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and David Hafner (in 1984) conducted excavations at this site. Hibben (1937, 1941) reported seven species of extinct Pleistocene megafauna from Sandia Cave supposedly associated with Paleoindian artifacts: *Nothrotheriops shastensis* (Shasta ground sloth), two extinct species of *Equus* (horse), *Camelops hesternus* (Yesterday's camel), *Bison antiquus* (extinct bison), *Mammut americanum* (American mastodont), and *Mammuthus.*

Our study of the original Sandia Cave material confirms the presence of all seven large mammals reported by Hibben (1941) and adds at least two other species of extinct mammals, *Hemiauchenia macrocephala* (large-headed llama), *Capromeryx minor* (diminutive pronghorn), and possibly the large cervid *Navahoceros* (mountain deer). The fossils of extinct megafaunal mammals from Sandia Cave, primarily consisting of isolated teeth, toe bones, and carpal/tarsal elements, are heavily mineralized and many are rodent gnawed. They are similar in preservation to fossil teeth and bones of smaller mammals from Sandia Cave collected in 1984 and during Hibben's excavations. The association of extinct megafaunal mammals with Paleoindian artifacts in Sandia Cave is open to question because of sediment bioturbation by rodents (Haynes and Agogino, 1986).

A small sediment sample collected from Sandia Cave in 1984 yielded 29 species of vertebrates: salamander, toad, lizard, two birds, and 24 species of mammals. The mammalian fauna includes five megafaunal species (horse, camel, bison, mastodont, and mammoth) and six living species now extralimital to the Sandia Mountains: *Sylvilagus nuttalli* (Nuttall's cottontail), *Marmota flaviventris* (yellow-bellied marmot), *Thomomys talpoides* (northern pocket gopher), *Neotoma cinerea* (bushy-tailed woodrat), *Microtus montanus* (montane vole), and *M. pennsylvanicus* (meadow vole). Three radiocarbon dates on large mammal bones from Sandia Cave range from 11,850 to 13,700 RCYBP (Haynes and Agogino, 1986). These dates, the presence of at least nine extinct megafaunal mammals, and the occurrence of six mammals now restricted to higher elevations in mountain ranges north of the Sandias strongly indicate a late-Wisconsinan age for the Sandia Cave fauna.

Marmot Cave, located 100 m north of Sandia Cave, has a shelter-like entrance room 10 m long and 3 m wide. A small opening in the rear leads to a second room 12 m long and 3–5 m wide. In 2000, we excavated four test pits (two 1 m^2, two 0.5 m^2) to a maximum depth of 80 cm in this second chamber. We collected and screenwashed over 1 metric ton of sediment from Marmot Cave and are still in the process of sorting and identifying these samples. We identified 33 species of vertebrates from Marmot Cave: fish, toad, two lizards, two snakes, two birds, and 25 species of mammals. The most important difference from Sandia Cave is the absence of megafaunal mammals. Marmot Cave has an abundance of *Marmota flaviventris*, a species now found from ca. 3,000 m to well above timberline in New Mexico, and absent in the Sandia Mountains (Findley et al., 1975). Marmot Cave contains five of the six extralimital mammals present in Sandia Cave except *Neotoma cinerea*, and also has *Spermophilus lateralis* (golden-mantled ground squirrel) and *Phenacomys intermedius* (heather vole). Like Sandia Cave, the extensive fauna of montane mammals now absent from the Sandia Mountains suggests a late-Wisconsinan age for Marmot Cave. Forthcoming ^{14}C dates will help establish an absolute chronology for this site.

Because of their similarity in location, elevation, and small mammal faunas, data from Marmot Cave and Sandia Cave are combined to create a regional paleoenvironmental reconstruction of the Sandia Mountains during the late Wisconsinan. The current habitat near the caves is a piñon-juniper woodland, now found in New Mexico at elevations of 2000–2800 m. However, the eight species of extralimital small mammals identified from these two caves (*Sylvilagus nuttalli, Marmota flaviventris, Spermophilus lateralis, Thomomys talpoides Neotoma cinerea, Microtus montanus, M. pennsylvanicus,* and *Phenacomys intermedius*) typically inhabit montane coniferous forests and subalpine coniferous forests at elevations above 3000 m in the Sangre de Cristo, Jemez, and San Juan mountain ranges of northern New Mexico. These faunal data agree with the floral evidence, suggesting that during the late Wisconsinan, vegetation zones in the Southwest were displaced about 900–1200 m lower than at present (Dick-Peddie, 1993).

R. Smartt and D. Hafner collected fossils from Sandia Cave and Marmot Cave in 1984. B. Huckell and M. Lewis of the Maxwell Museum of Anthropology allowed us access to F. Hibben'sSandia Cave fossils. C. Bordegaray, S. Bruschini, S. Burger, P. Dow, S. Harris, S. Libed, K. Lucas, R. Montenegro, F. Sena, and J. Wilburn helped collect, wash, and sort fossils from Marmot Cave. L. Agpaoa and T. Cartledge of the US Forest Service gave us permission to excavate Marmot Cave.

References Cited

Dick-Peddie, W. A. 1993 *New Mexico Vegetation: Past, Present, and Future.* University of New Mexico Press, Albuquerque, NM.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones 1975 *Mammals of New Mexico.* University of New Mexico Press, Albuquerque, NM.

Haynes, C. V., Jr., and G. A. Agogino 1986 Geochronology of Sandia Cave. *Smithsonian Contributions to Anthropology,* 32:1–32.

Hibben, F. C. 1937 Association of Man with Pleistocene Mammals in the Sandia Mountains, New Mexico. *American Antiquity* 2(4):260–263.

——— 1941 Evidences of Early Occupation in Sandia Cave, New Mexico, and Other Sites in the Sandia-Manzano Region. *Smithsonian Miscellaneous Collections,* 99(23):1–44.

Mid-Wisconsinan Date Associated with *Eremotherium laurillardi* in Withlacoochee River, North Florida

David K. Thulman and S. David Webb

Associated elements of the giant ground sloth, *Eremotherium laurillardi,* were discovered in 1998 in organic clay matrix eroding from the south bank, about

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1 m below water level, in the Withlacoochee River of north Florida. The site, hereby named the Munroe Sloth site, lies in Madison Co., 0.6 km south of the Florida-Georgia line in the SE quarter of section 164. (This river in north Florida should not be confused with the other Withlacoochee River that arises in central Florida.) The only other vertebrate fossils from this site are one cheek tooth and a few other elements of *Mammut americanum.*

The stratum producing the teeth and bones of these two species of large extinct mammals is about 1 m thick. It consists of dark brown organic clay containing scattered clasts of blue-gray marl up to a few centimeters in diameter and cobbles of limestone and chert derived from adjacent exposures of Suwannee limestone. The limestone in the area includes abundant agatized coral, and large pieces of such coral were also deposited with the clay. The bone-bearing clay stratum is underlain by silts and sands, which form the river bank extending downward about 5 m to the river bed. The clay and other clastic sediments making up this site form a low break in the south bank of the Withlacoochee River, which otherwise is rimmed by more resistant limestone bluffs.

The material of *Eremotherium laurillardi* collected to date consists of a full set of upper and lower teeth, the lower jaw, two adjacent vertebrae, both humeri, and parts of the radius and ulna of the right side. A voucher specimen of this individual, a right upper intermediate molariform, is catalogued as UF 206885 in the Vertebrate Paleontology Collection of the Florida Museum of Natural History. The bone is very well preserved, and when first exposed, is light orange in color. Later it oxidizes to dark brown. A right upper third molar of *Mammut americanum,* UF 206884, probably eroded from this same clay, but was recovered in the river bottom about 1 m downstream.

Besides vertebrate fossils, the dark clay of this site contains numerous isolated pieces of wood predominantly of cypress. Five pieces of wood, each a few centimeters long, were selected from the same horizon and within 20 cm of the main concentration of sloth teeth. They were submitted to Beta Analytic Inc in Miami, Florida, for a bulk carbon date. The resulting radiocarbon date was 38,860 ± 1300 RCYBP (Beta 136874).

If this date is correct, the Withlacoochee site represents the youngest evidence of *Eremotherium* in North America, as far as we know. The geographic range of *Eremotherium laurillardi* extends from Brazil north throughout tropical America, whereas its sister taxon, *Megatherium americanum,* ranges south into Argentina and Uruguay. In North America *Eremotherium* extends around the Gulf Coastal Plain and up the Atlantic Coastal Plain to New Jersey.

The oldest record of *Eremotherium* presently known is from the late Blancan of Florida, but this occurrence is attributed to the more primitive species, *E. eomigrans.* Occurrences of *Eremotherium laurillardi* are remarkably rare, and to our knowledge no other carbon dates have been associated with this species. Two *Eremotherium* sites in southeastern United States, however, occur in sediments correlated with the last interglacial epoch (oxygen isotope stage 5). These are the Daytona Beach site in northeastern Florida and the Skidaway Island site in southeastern Georgia. This latter is the area from which

Dr. Joseph Leidy named *Megatherium mirabile*, now recognized as a synonym of *Eremotherium laurillardi*. In their recent excavations in coastal Georgia, Hulbert and Pratt (1998) found *Eremotherium* to be the commonest sloth in the area of Savannah, Georgia, where the terrestrial vertebrate assemblages occur in fluvio-estuarine deposits of last interglacial age. These records along the Atlantic coast of south Georgia and north Florida had led many to conclude that this genus had disappeared before the Wisconsinan. This view was reinforced by the absence of *Eremotherium* from latest Pleistocene faunas of this region and from all of North America.

The new date associated with *Eremotherium laurillardi* from the Withlacoochee River gives an intermediate result. While this carbon date is not infinite, it extends the range of this giant sloth into oxygen isotope stage 3, a full glacial cycle before the Wisconsinan. This preliminary date certainly does not place *Eremotherium laurillardi* within the Wisconsinan glacial. Its time range is still well removed from any association with humans in North America. We intend to conduct further excavations at the Withlacoochee River site. We hope to corroborate the present wood date with a bone date.

Reference Cited

Hulbert, R. C., Jr., and A. E. Pratt 1998 New Pleistocene (Rancholabrean) Vertebrate Faunas from Coastal Georgia. *Journal of Vertebrate Paleontology*: 18(2):412–429.

Confirmation of *Microtus montanus* (Mountain Vole) from the Late-Wisconsinan Jones Local Fauna, Meade County, Kansas

Steven C. Wallace

Davis (1987) observed statistically significant differences between expected and observed numbers of *Microtus* upper and lower molar morphotypes from the mid-Wisconsinan Jones l.f. (26,700 ± 1,500 to 29,000 ± 1,300 RCYBP, I-3461 and I-3462) of Meade Co., Kansas. These differences suggested an unidentified species of *Microtus* ("alpha") was present in addition to *M. pennsylvanicus* (meadow vole). To account for these differences, species alpha had to exhibit a *M. pennsylvanicus* "type" m1, and a *M. ochrogaster* (prairie vole) "type" M2. Recovery of a *M. montanus* (mountain vole) skull, which exhibits the above characters, from the Trapshoot l.f. (stratigraphically between 12,000 and 20,000 RCYBP), Rooks Co., Kansas (Stewart 1978, 1987) confirmed the presence of this species on the Great Plains during the late Wisconsinan. Although no skulls of *M. montanus* were recovered from the Jones l.f., Davis (1987)

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hypothesized that species alpha represented this taxon. This is significant because the closest modern population of this montane species is more than 300 miles west of Meade County (Figure 1).

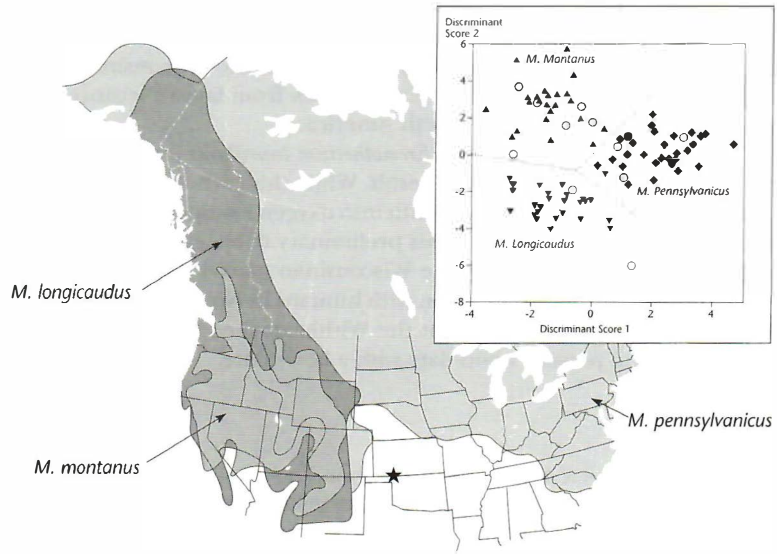

Figure 1. Map showing the modern distribution of *Microtus pennsylvanicus, M. montanus,* and *M. longicaudus*, and bi-variant plot showing the discriminant scores for specimens of these taxa (without *M. xanthognathus*). Note that the modern ranges of *M. montanus* and *M. longicaudus* are restricted to the Western mountain ranges. On the plot, Jones m1s are represented by open circles and the "knowns" are solid squares and triangles.

To confirm or reject the presence of *M. montanus* in the Jones l.f., 12 fossil m1s were subjected to a discriminant analysis of landmark (Bookstein 1991) data. Recent m1s of *M. pennsylvanicus, M. longicaudus* (long-tailed vole), *M. montanus*, and *M. xanthognathus* (yellow-cheeked vole), all possibly on the central Great Plains at that time, were used to establish several discriminant functions. Because this procedure is applicable to all *Microtus*, a detailed description and discussion will be published separately.

No m1s from the Jones l.f. are consistent with *M. xanthognathus* (Prob. = 0.00 for all), two are consistent with *M. longicaudus* (Prob. = 1.00 and 1.00), five with *M. montanus* (Prob. = 0.77, 1.00, 1.00, 1.00, and 0.65), and five with *M. pennsylvanicus* (Prob. = 1.00 for all).

I concur with Davis (1987) and Stewart (1978, 1987) that *M. pennsylvanicus* was not the only "five closed triangle" *Microtus* on the Great Plains during the late Wisconsinan and (likely) early Holocene, and that *M. montanus* also was present. Species alpha, however, includes *M. longicaudus* in addition to *M. montanus* (Figure 1). The existence of these two taxa in the Jones l.f. further supports the "non-analog" faunal concept (i.e., Semken 1988), with range retreat to the west (FAUNMAP 1996; Guilday and Parmalee 1972; Guilday et al. 1978; Semken 1983) as well as to the north (Dansereau 1957; Graham 1976; Guilday and Bender 1960; Martin 1958). Furthermore, either the specific ecological requirements of *M. montanus* and *M. longicaudus* have changed significantly since the late Wisconsinan, or environmental conditions on the western Great Plains at that time included pockets of the montane-like ("forested") habitats preferred by these taxa.

References Cited

Bookstein, F. L. 1991 *Morphometric Tools for Landmark Data, Geometry and Biology.* Cambridge University Press, New York, NY.

Dansereau, P. 1957 *Biogeography - an Ecological Perspective.* The Ronald Press Company, New York, NY.

Davis, L. 1987 Late Pleistocene/Holocene Environmental Change in the Central Great Plains of the United States: The Mammalian Record. In *Late Quaternary Mammalian Biogeography and Environments of the Great Plains and Prairies,* edited by R. Graham, H. A. Semken, and M. Graham, pp. 88–143. Illinois State Museum, Springfield, IL.

FAUNMAP Working Group 1996 Spatial Response of Mammals to Late Quaternary Environmental Fluctuations. *Science* 272:1601–1606.

Graham, R. W. 1976 Late Wisconsin Mammalian Faunas and Environmental Gradients of the Eastern United States. *Paleobiology* 2(4):343–350.

Guilday, J. E., and M. S. Bender 1960 Late Pleistocene Records of the Yellow-Cheeked Vole, *Microtus xanthognathus* (leach). *Annals of the Carnegie Museum* 35:315–330.

Guilday, J. E., H. W. Hamilton, E. Anderson, and P. W. Parmalee 1978 The Baker Bluff Cave Deposit, Tennessee, and the Late Pleistocene Faunal Gradient. *Bulletin of Carnegie Museum of Natural History* 11:1–67.

Guilday, J. E., and P. W. Parmalee 1972 Quaternary Periglacial Records of Voles of the Genus *Phenacomys* Merriam (Cricetidae: Rodentia). *Quaternary Research* 2(2):170–175.

Martin, P. S. 1958 Pleistocene Ecology and Biogeography of North America, In *Zoogeography* edited by C. L. Hubbs, pp. 375–420. American Association for the Advancement of Science, Publication 51, Washington DC.

Semken, H. A. 1983 Holocene Mammalian Biogeography and Climate Change in the Eastern and Central United States, In *Late- Quaternary Environments of the United States, volume 2—The Holocene* edited by H. E. Wright, Jr., pp. 182–207. University of Minnesota Press, Minneapolis, MN.

——— 1988 Environmental Interpretation of the "Disharmonious" Late Wisconsinan Biome of Southeastern North America, In *Late Pleistocene and Early Holocene Paleoecology and Archeology of the Eastern Great Lakes Region, Bulletin of the Buffalo Society of Natural Sciences* 33, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 185–194. Buffalo Society of Natural Sciences, Buffalo, NY.

Stewart, J. D. 1978 Mammals of the Trapshoot Local Fauna, Late Pleistocene of Rooks County, Kansas. *Proceedings of the Nebraska Academy of Science, 88th Annual Meeting* Abstracts:45–46.

——— 1987 Latitudinal Effects in Wisconsinan Mammalian Faunas of the Plains. *Kansas Geological Survey, Guidebook series* 5:153–158.

Paleoenvironments: Geosciences

Middle- and Late-Wisconsin (Late-Pleistocene) Paleoenvironmental Records from the Rocky Mountains: Lithostratigraphy and Geochronology of Blacktail Cave, Montana

Christopher L. Hill

Cave deposits provide both lithostratigraphic and paleobiotic evidence for middle- and late-Wisconsin paleoenvironmental conditions in the Rocky Mountain region of North America. Here, the fossil-bearing deposits from Blacktail Cave, Montana, are described and the geochronologic sequence is compared with other caves in the region that contain late-Pleistocene (Rancholabrean) vertebrate assemblages, typically composed mostly of small mammals.

Blacktail Cave is situated close to the South Fork of the Dearborn River, a tributary of the Missouri River on the eastern side of the Rocky Mountains in western Montana. The cave is formed in the middle-Cambrian–age Meagher Limestone and is bounded to the southwest by the Eldorado thrust fault and argillites ("shales") of the Proterzoic-age Greyson Formation (Whipple and Bregman 1981). The cave contains sedimentological and paleobiotic records dating from about 37,000 to 10,000 RCYBP and has been reported to contain Goshen-Plainview artifacts (Davis et al. 1996; Hill 2000; Melton 1979). The late-Pleistocene succession is in a part of the cave that seems to have had an entrance that was nearly closed ca. 10,000 RCYBP. At about this time, a travertine was deposited, which appears to have effectively sealed the underlying sediments until excavations were begun in the 1970s.

Near the pre-10,000 RCYBP entrance, the travertine overlies deposits composed of limestone bedrock scree and roof-fall, along with argillite fragments from bedrock sources outside the cave. A bear phalanx (specimen no. 95A6-FS512a) from near the top of this section was dated to 10,930 ± 80 RCYBP (GX-21559). Away from this old entrance, sediments containing higher amounts of fine clastics were covered by the travertine. The fine clastics contain fragments of an artiodactyl (95C3-FS17) dated to 10,270 ± 115 RCYBP

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(GX-21558) and a bovid (95F2/3-FS38) dated to 11,240 ± 80 RCYBP (GX-21557).

Erosional surfaces separate the upper fine-grained deposits from deposits of well-sorted sands and gravels composed of fragments of argillite. Because the cave is composed of limestone, these sediments were washed into the cave. An *Equus* (horse) phalanx (95B8-FS58) recovered slightly above the sands and gravels was dated to 27,200 ± 370 RCYBP (GX-21558). If the radiocarbon dates provide an indication of the age of sedimentation events in the cave, the coarser clastics composed of redeposited argillite may be separated from the ca. 11,000–10,000 RCYBP deposits by an erosion-induced or depositional-hiatus time gap centered on the Last Glacial Maximum (LGM). Direct dating of more faunal remains will help to test this idea.

The lowest sediments exposed during excavation and coring consist of muds and clays seemingly deposited in a cave pool, perhaps indicating higher groundwater levels ca. 37,400 ± 790 RCYBP (B-1060101), based on collagen from the jaw of a yellow-bellied marmot (*Marmota flaviventris*, 96R10-FS253).

From a geochronological point of view, Blacktail Cave contains late-Pleistocene deposits and fauna that can be separated into two groups. The oldest deposits, composed predominantly of muds and clays with some lenses of well-sorted argillite sands and gravels, have been dated from ca. 37,000 to 27,000 RCYBP. These sediments reflect paleoenvironmental conditions prior to the LGM. Fossil-bearing deposits dating to this same general time have been reported north of Blacktail Cave, including late mid-Wisconsin dates from the Rocky Mountains of Alberta (ca. 22,700 and > 33,000 RCYBP at Eagle Cave, and ca. 23,000–33,500 RCYBP at January Cave; Burns 1984, 1987, 1990:63), and south of Blacktail Cave at Wilson Butte Cave, Idaho (ca. 32,250 RCYBP, Gruhn 1995:16) and possibly at Natural Trap Cave in the Pryor Mountains near the Wyoming/Montana border (Gilbert and Martin 1985:143).

The younger group of dates from Blacktail Cave range from about ca. 11,200–10,000 RCYBP. This interval would include the known-age range for Goshen-Plainview artifact forms (e.g., Frison et al. 1996:212; Holliday 2000:251) and might provide an age estimate for the artifacts previously reported from Blacktail Cave (Melton 1979:420). Caves from the region that contain radiocarbon-dated deposits overlapping with this time interval include False Cougar Cave, Montana (ca. 14,590–10,530 RCYBP; Bonnichsen et al. 1986:279), Natural Trap Cave, Wyoming (ca. 20,250–10,930 RCYBP; Chomoko and Gilbert 1987:397), Jaguar Cave, Idaho (ca. 11,580–10,370 RCYBP; Sadek-Kooros 1966:58, 1972:7; Dort 1975), Wasden (Owl Cave), Idaho (ca. 10,640–10,920 RCYBP; Miller in Bryan and Tuohy 1999:255), and Wilson Butte Cave, Idaho (ca. 16,000–10,230 RCYBP; Gruhn 1995:16). Blacktail Cave thus provides a radiocarbon-dated lithostratigraphic sequence containing Pleistocene biotic remains that are comparable to other regional pre- and post-LGM paleoenvironmental sequences.

Geologic studies at Blacktail Cave were partially funded by an NSF MONTS EPSCOR grant and the Kokopelli Archaeological Research Fund. Sincere thanks to Tag Rittel for permission to conduct these studies at Blacktail Ranch, and to Dave Batten for supervising the excavations of the cave. Thanks to Cheryl Hill, who served as field assistant for part of this project.

References Cited

Bonnichsen, R., R. W. Graham, T. Geppert, J. S. Oliver, S. G. Oliver, D. Schnurrenberger, R. Stuckenrath, A. Tratebas, and D. E. Young 1986 False Cougar and Shield Trap Caves, Pryor Mountains, Montana. *National Geographic Research* 2(3):276–290.

Burns, J. A. 1984 *Late Quaternary Palaeoecology and Zoogeography of Southwest Alberta: Vertebrate and Palynological Evidence from Two Rocky Mountain Caves.* Unpublished Ph.D. Dissertation, University of Toronto.

——— 1987 Late Quaternary Zoogeography of the Northern Pocket Gopher, *Thomomys Talpoides*, in Southwestern Alberta. *Canadian Field-Naturalist* 101:419–422.

——— 1990 Paleontological Perspectives on the Ice-Free Corridor. In *Megafauna and Man: Discovery of America's Heartland*, edited by L. D. Agenbroad, J. I. Mead, L. W. Nelson, The Mammoth Site of Hot Springs, South Dakota, Inc. Scientific Papers, Vol. 1, pp. 61–66.

Bryan, A. L., and D. R. Tuohy 1999 Prehistory of the Great Basin/Snake River Plain to about 8,500 Years Ago. In *Ice Age People of North America: Environments, Origins, and Adaptations*, edited by R. Bonnichsen, and K. L. Turnmire. Oregon State University Press, Corvallis, OR.

Chomoko, S. A., and B. M. Gilbert 1987 The Late Pleistocene/Holocene Faunal Record in the Northern Bighorn Mountains, Wyoming. In *Late Quaternary Mammalian Biogeography and Environments of the Great Plains and Prairies*, edited by R. W. Graham, H. A. Semken, Jr., and M. A. Graham, pp. 394–408. Illinois State Museum Scientific Papers, Vol. XXII, Springfield, IL.

Davis, L. B., J. Saysette, D. C. Batten, and J. F. Rittel 1996 Blacktail Cave: A Late-Glacial to Post-Glacial Faunal Catchment at the Southern Outlet of the Ice-free Corridor, West-Central Montana Rockies. *Current Research in the Pleistocene* 13:101–102.

Dort, W., Jr. 1975 Archaeo-geology of Jaguar Cave, Upper Birch Creek, Idaho. *Tebiwa, the Journal of the Idaho State University Museum* 17(2):33–57.

Frison, G. C., C. V. Haynes, Jr., M. L. Larson 1996 Discussion and Conclusions. In *The Mill Iron Site*, edited by G. C. Frison, pp. 205–216. University of New Mexico Press, Albuquerque, NM.

Gilbert, B. M., and L. Martin 1984 Late Pleistocene Fossils of Natural Trap Cave, Wyoming, and the Climatic Model of Extinction. In *Quaternary Extinctions, a Prehistoric Revolution*, edited by P. S. Martin and R. G. Klein, pp.138–147. The University of Arizona Press, Tucson, AZ.

Gruhn, R. 1995 Results of New Excavations at Wilson Butte Cave, Idaho. *Current Research in the Pleistocene* 12:16–17.

Hill, C. L. 2000 Upper Pleistocene Stratigraphy and AMS Radiocarbon Chronology of Fossil-Bearing Cave Deposits, Dearborn Drainage, Montana. *Geological Society of America Abstracts with Programs* 32:4.

Holliday, V. 2000 The Evolution of Paleoindian Geochronology and Typology on the Great Plains. *Geoarchaeology: An International Journal* 15(3):227–290.

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

Sadeck-Kooros, H. 1966 *Jaguar Cave: An Early Man Site in the Beaverhead Mountains of Idaho.* Unpublished Ph.D. Dissertation, Harvard University.

——— 1972 The Sediments and Fauna of Jaguar Cave: I. The Sediments. *Tebiwa, the Journal of the Idaho State University Museum* 15(1):1–20.

Whipple, J. W., and M. L. Bergman 1981 *Geologic Map of the Rogers Pass Quadrangle, Lewis and Clark County, Montana.* United States Geological Survey Miscellaneous Field Studies Map, MF-1309.

Chronology of Holocene Pedogenetic Events in the Pampean Area of Argentina

Eduardo P. Tonni, Alberto L. Cione, and Anibal J. Figini

Paleosoils widely occur in the Pleistocene and Holocene sequence of the Pampean area of Argentina. During the last 30 years, Fidalgo and collaborators constructed a lithostratigraphic and pedostratigraphic scheme for the Pampean region from the latest Pleistocene to the present, calibrated by means of many ^{14}C dates (see Fidalgo 1992; Tonni et al. 1999). (See Table 1.) The stratigraphic sequence relied in part on a former sequence by Ameghino (1889), modified by Frenguelli (1957) and others. The stratigraphic Holocene scheme of Fidalgo and others (see Fidalgo 1992) involved two paleosoils (Puesto Callejón Viejo Geosol, close to the Pleistocene-Holocene boundary, and the Puesto Berrondo Geosol, at about 2000 yr B.P.), and the recent soil. Other workers (e.g., Carignano 1999; Iriondo and García 1993; Iriondo and Kröhling 1996) agreed only in the existence of a Holocene paleosoil and obviously the present soil. In this later scheme, the Holocene pedogenetic event was considered long-lasting and assignable to the Hypsithermal (see Carignano 1999).

Remarkably, there were no dates in the type area of the soil units of Fidalgo (1992; lower Río Salado basin). However, after the analysis of the numerous dates and additional field work in the Pampean area by workers of the Museo de La Plata, we consider that two middle- to late-Holocene pedogenetic events actually occurred: one at about 6000–5000 yr B.P. and the other about 2000 yr B.P. The Aimaran "Stage" of Frenguelli (1957 and previous papers) corresponds to the 2000 yr B.P. episode.

Besides, according to recent dating (Figini et al. 1999), in Punta Hermengo (southeastern Buenos Aires Province), a paleosoil in the position of Puesto Callejón Viejo Geosol, which was assigned to the boundary Pleistocene-Holocene by Fidalgo (1992) and others, would be more modern and actually correspond to the middle-Holocene event. The same pedogenetic event could correspond to the paleosoils with dates of 6500–4000 yr B.P. in Paso Otero, La Horqueta II, Arroyo Tapalqué, and Río Sauce Grande (Figure 1).

On the other hand, paleosoils in Paso Otero (Johnson et al. 1998), La Horqueta II (Zárate et al. 1995), and Arroyo Tapalqué (Figini et al. 1998) seem to correspond to an older pedogenetic event of early-Holocene age.

In short, we suggest that the main Holocene pedogenetic events in the Pampean area should correspond to the Early Holocene (10,000–7000 yr B.P.; unnamed paleosoil), middle Holocene (6500–4000 yr B.P.; Puesto Callejón Viejo Geosol), late Holocene (3000–2000 yr B.P.; Puesto Berrondo Geosol), and the present soil.

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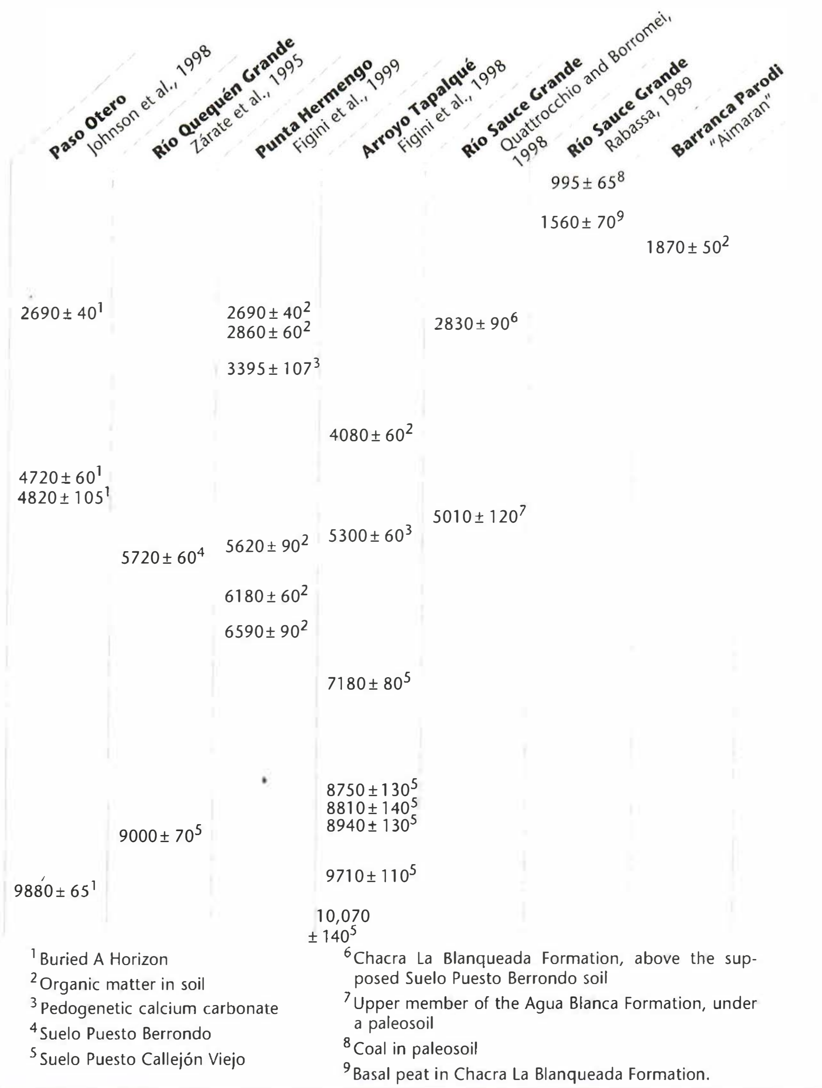

Figure 1A. Some Holocene dates in soils of the Pampean area.

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References Cited

Ameghino F. 1889 Contribución al Conocimiento de los Mamíferos Fósiles de la República Argentina. *Actas de la Academia Nacional de Ciencias, Córdoba,* 32:1–1027.

Carignano, C. 1999 Late Pleistocene to Recent Climate Change in Córdoba Province, Argentina: Geomorphological Evidence. *Quaternary International,* 57/58:117–134.

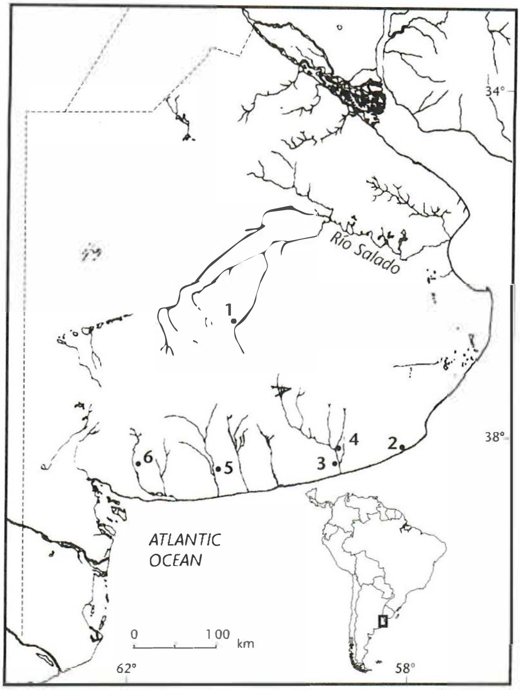

Figure 1B. Map of locations referenced in Figure 1A, Pampean area of Argentina.

Fidalgo, F. 1992 Provincia de Buenos Aires Continental. In *El Holoceno en la Argentina*, edited by M. Iriondo, pp.23–38. Cadinqua, Buenos Aires, Argentina.

Figini, A. J., J. Carbonari, R. Huarte, and E. P. Tonni 1999 Cronología Radiocarbónica del Holoceno de Punta Hermengo, Buenos Aires. *Actas del XIV Congreso Geológico Argentino*, 2:63–66.

Figini, A. J., R. Huarte, J. Carbonari, and E. P. Tonni 1998 Edades C 14 en un Perfil del Arroyo Tapalqué, Provincia de Buenos Aires, Argentina. Contribución a la Cronología de los Acontecimientos Faunístico Ambientales. *Actas del X Congreso Latinoamericano de Geología*, 1:27–31.

Frenguelli, J. 1957 Neozoico. In *Geografía de la República Argentina*. Soc. Arg. de Estudios Geográficos GAEA, tomo 2, Pt.3, pp.1–218. Buenos Aires, Argentina.

Jonhson, E., G. Politis, G. Martínez, W. Hartwell, M. Gutiérrez, and H. Haas 1998 Radiocarbon Chronology of Paso Otero I in the Pampean Region of Argentina In *Quaternary of South America and Antarctic Peninsula*, 11:15–25.

Iriondo, M. H., and N.O. García 1993 Climatic Variations in the Argentine Plains During the Last 18,000 Years. In *Palaeogeography, Palaeoclimatology, Palaeoecology*, 101:209–220.

Iriondo, M., and D. M. Kröhling 1996 Los Sedimentos Eólicos del Noreste de la Llanura Pampeana (Cuaternario superior). *Actas XIII Congreso Geológico Argentino*, 4:2747.

Rabassa, J. 1989 Geología de los Depósitos del Pleistoceno Superior y Holoceno en las Cabeceras del Río Sauce Grande, Provincia de Buenos Aires. *Actas Primeras Jornadas Geológicas Bonaerenses*, 1:765–789.

Quattrocchio, M., and A. M. Borromei 1998 Paleovegetational and Paleoclimatic Changes During the Late Quaternary in Southwestern Buenos Aires Province and Southern Tierra Del Fuego (Argentina). *Palynology*, 22:67–82.

Tonni, E. P., A. L. Cione, and A. J. Figini 1999 Predominance of Arid Climates Indicated by

Mammals in the Pampas of Argentina During the Late Pleistocene and Holocene. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 147:257–281.

Zárate, M., M. Espinosa, and L. Ferrero 1995 La Horqueta II, Río Quequén Grande: Ambientes Sedimentarios de la Transición Pleistoceno-Holoceno. *Actas de las IV Jornadas Geológicas y Geofísicas Bonaerenses,* pp.195–204.

Information for Contributors

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Categories of notes are: 1) Archaeology, 2) Physical Anthropology, 3) Lithic Studies, 4) Taphonomy–Bone Modification, 5) Methods, 6) Paleoenvironments (with subsections: Plants, Invertebrates, Vertebrates and Geosciences), and 7) Special Focus. The last category is reserved for a pre-selected topic for which CSFA solicits manuscripts. No more than 65 papers will be accepted for each issue. Each contributor will have no more than one paper as senior author.

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The following are some preferred abbreviations, words, and spellings: archaeology; Paleoamerican (Paleoindian implies a descent relationship); ca. (circa); RCYBP (radiocarbon years before present); CALYBP (calendar years before present); early, middle, late (e.g., early Holocene); ^{14}C (radiocarbon 14; ^{14}C, etc.); in situ; et al.; pers. comm. (e.g., "C. L. Brace pers. comm. 1998"); CRM (cultural resource management); and AMS or TAMS (accelerator mass spectrometer technique of radiocarbon dating). Metric units should be used and abbreviated throughout: mm, cm, m, km, ha, m^2, etc.

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