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Contents

Physical Anthropology

Lithic Studies

Paleoenvironments: Plants

Paleoenvironments: Vertebrates

Paleoenvironments: Geosciences

From the Editor

Social Justice, the Law, and Science

On August 30, 2002, Federal Magistrate John Jelderks issued a landmark decision in the Kennewick Man case. He determined that former Secretary of the Interior Bruce Babbit's decision to give the bones of Kennewick Man to a coalition of Native American tribes was about as wrong as it could be. According to Jelderks:

- "The Secretary erred in defining 'Native American' to automatically include all remains predating 1492 that are found in the United States";
- "The Secretary erred in assuming that the coalition [of Native American tribes] was a proper claimant and in failing to separately analyze the relationship of the particular Tribal Claimants to the remains";
- The Secretary erred in determining that the Native American Graves Protection and Repatriation Act (NAGPRA) allowed evidence of "aboriginal occupation" to substitute for a "final judgement" of the Indian Claims Commission in establishing aboriginal title to lands;
- And, the Secretary erred in his finding that the Tribal Claimants had satisfied the cultural affiliation requirement of NAGPRA.

To make matters worse for the government, Jelderks ruled that the Army Corps and the Department of the Interior "have not acted as the fair and neutral decision makers required by the [Administrative Procedure Act]." Indeed, their "procedures, actions, and decisions have consistently indicated a desire to reach a particular result"—which was, to give the remains of this Ancient One to the Tribal Claimants, regardless of the tenuousness of the alleged links of cultural affiliation, the scientific importance of the remains, and the legal niceties that are supposed to govern such repatriation claims.

In a decision that will have profound implications for the future of First Americans studies, Jelderks concluded, "NAGPRA does not apply to the remains of Kennewick Man," and he ordered that the scientists' "request for access to study be granted."

August 30 surely was a good day for science, but was it, therefore, a bad day for social justice as both Elaine Dewar, in her recent book *Bones: Discovering the First Americans*, and Jonathan Marks, author of *What It Means to Be 98% Chimpanzee*, would have us believe? Marks asserts that Kennewick Man's "importance as a symbol to Native Americans . . . outweighs his importance to the scientists as a basis for thoughtless and irresponsible speculation" (2002:239).

And Dewar, while acknowledging that Secretary Babbit's claim had no scientific merit, argues that he did well to reach "beyond the words of the law to try to grasp its underlying spirit" (2002:552).

I believe that Dewar and Marks are wrong. Jelderks's ruling is a victory for social justice as well as science. The sort of "justice" that hands over human remains of such antiquity to persons with no demonstrable cultural affiliation simply to mollify their religious sensibilities, while denying scientists the opportunity to study the remarkable discovery, is the same sort of justice that the Catholic Church imposed on Galileo. When representatives of the United States government elect to reach beyond the law in their efforts to champion an authoritarian religious worldview over the nonsectarian and egalitarian approach to understanding the world embodied in the principles of science, it is they who have become the purveyors of injustice.

The underlying spirit of NAGPRA is not about the primacy of religious views of the world over science. It is about balance. Robert Kelly, President of the Society for American Archaeology, offered his opinion that "Judge Jelderks' decision in the Kennewick case will go a long way toward restoring the balance between the interests of science and those of Native Americans that Congress mandated when it passed NAGPRA" (SAA 2002:5).

I salute Judge Jelderks for his thoughtful and thorough decision. Government officials, however well intentioned their motives, are not above the law. Hopefully, scientists soon can begin to study the remains of Kennewick Man and replace the "speculation" decried by Marks with a more informed understanding of the life and times of this visitor from an ancient past.

For a copy of the complete text of Jelderks's decision, see the Friends of America's Past Web site: http://www.friendsofpast.org/kennewick-man/

References Cited

Dewar, Elaine 2002 *Bones: Discovering the First Americans.* Carroll & Graf Publishers, New York.

Marks, Jonathan 2002 *What It Means to Be 98% Chimpanzee: Apes, People, and Their Genes.* University of California Press, Berkeley.

SAA 2002 SAA responds to the Kennewick Man court decision. *The SAA Archaeological Record* 2(5):5-6.

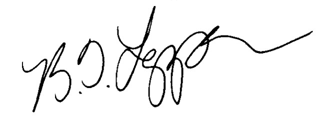
A Personal Note

For a variety of personal and professional reasons, I have decided to resign as editor of *Current Research in the Pleistocene.* It has been my honor and privilege to serve as editor for the past ten years. This has been an exciting decade for Pleistocene archaeology and its related disciplines, and editing *CRP* has kept me abreast of each new discovery. The job also has introduced me to many men and women whom I have come to know not just as fine scholars, but also as friends.

I extend my heartfelt thanks to all the associate and assistant editors for all their work over the years, to Jim and Char Chandler of C&C Wordsmiths for making *CRP* look so good, and to all the many contributors to and readers of

CRP. Finally, a special thanks to Rob Bonnichsen for entrusting this journal to me more than ten years ago and for the unfailing support and encouragement he provided.

I wish the new editor all the fun, excitement, and satisfaction I have experienced over the last decade. If the next ten years are anywhere near as fruitful as the last, we can all look forward to a cornucopia of current research in the Pleistocene!



CURRENT RESEARCH IN THE PLEISTOCENE Vol. 19, 2002

Archaeology

Final Field Report from the Hawk's Nest Clovis (Gainey) Site in Northeastern Illinois

Daniel S. Amick and Thomas J. Loebel

This abstract is the final synopsis of investigations between 1992 and 2002 at Hawk's Nest (11L344), a fluted-point occupation from a plowed field northwest of Chicago (Amick et al. 1997, 2000; Kullen et al. 1992; Loebel 2000). Although subdivision construction has now removed part of the site and limits access, we obtained 39 surface collections of artifacts scattered across 20,000 m^2, hand-excavated 143 m^2 (42 m^3), and recorded 330 m of backhoe trench cross section (Van Nest 1999). The accumulated assemblage contains 221 chipped-stone tools, 16 cores, 1,752 waste flakes (including 23 channel flakes), and 4 pecked stones. Over the past decade the surface yielded 1,202 artifacts (1 per 17 m^2), while 791 artifacts were produced from two seasons of subsurface excavations (19 per m^3). Many are plow-damaged (e.g., Mallouf 1981), reflecting the substantial history of tillage (approximately 150 years).

Most tools are technologically diagnostic of Gainey, a southern Great Lakes Clovis complex (Deller and Ellis 1988:255; Shott 1999; Simons et al. 1984; Storck 1991; Storck and Spiess 1994:125), while only 28 are diagnostic of Holocene occupations (early Archaic to late Woodland). Most of these Holocene bifaces are made from local cherts uncommon among the Clovis diagnostics and assemblage as a whole, implying the majority is attributable to Clovis. The entire assemblage and especially the Clovis tools are composed of raw materials found 100–300 km south and southwest of the site, especially the Avon variety of Burlington chert, with lesser use of cherts from Moline, Starved Rock (Oneota and Shakopee), and Indiana (Attica and Plummer).

Excluding the Holocene bifaces, the tool assemblage includes 47 fragmentary bifaces, 45 endscrapers, 41 sidescrapers, 17 combo end- and sidescrapers, 31 scraper fragments, 2 flake gravers, 2 flake knives, a perforator, a radial-break tool, 7 bifacial core fragments, 7 bipolar cores, 2 core fragments, 2 hammerstones, an abrader, and an anvil. Descriptions from Clovis biface manufacture (Bradley 1991; Callahan 1979; Morrow and Morrow 1995; Storck

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1997) can be used to classify 45 of these bifaces into production stages: 2 are Stage 1 (initial edging); 2 are Stage 2 (primary thinning); 11 are Stage 3 (secondary thinning and shaping); 6 with basal fluting platforms are Stage 4 (prepared for fluting); 20 with evidence of at least one flute removal are Stage 5 (fluted preforms); and only one can be classified as Stage 6 (finished fluted point with margin grinding).

These proportions indicate Stage 2 or Stage 3 Clovis bifaces were probably transported to the site where subsequent thinning and fluting operations took place, suggesting Clovis groups at Hawk's Nest may have been anticipating substantial needs for stone projectile points at a nearby hunting location. Furthermore, several activities related to processing a recent kill are implied by large numbers of sidescrapers, endscrapers, and other tools. Many current models suggest Gainey settlement-subsistence depends on caribou hunting (Deller and Ellis 1988:255; Jackson 1997; Simons 1997; Simons et al. 1984 Storck 1991; Storck and Spiess 1994:125). The overall assemblage content and environmental setting at Hawk's Nest are most consistent with proposed classification as a transient camp associated with caribou hunting. Tillage has expanded and blurred the original distribution of artifacts, but spatial analysis portrays patterning typical of differentiation expected in the organization of prehistoric activities at a hunting camp.

Unfortunately, no undisturbed Clovis deposits have been identified at Hawk's Nest. Most artifacts are confined to the active plowzone, with localized pockets sometimes found in root casts and animal burrows extending downward. Comparison of excavated versus surface assemblages confirms substantial size differences (Baker 1978; Odell and Cowan 1987), with smaller artifacts more common from excavated context. One effect of this process is that (larger) tools and cores account for 17 percent (n = 208) of the surface assemblage but only 4 percent (n = 29) of the excavated assemblage.

Hawk's Nest is situated on a gentle south-facing slope adjacent to an upland depression; radiocarbon dates from macrobotanical remains suggest a sizeable wetland existed in this depression from 14,000 to 8000 yr B.P. (Amick et al. 2000). At the base of the slope, adjacent to this former wetland, erosion and soil creep have buried an older plowzone containing prehistoric artifacts of various ages. Using ¼-inch dry screen augmented with 700-plus liters of flotation processing (collecting 1/16-inch heavy fraction), lithic artifacts were collected from 123 of the 143 (86 percent) active plowzone levels, 25 of the 52 (48 percent) levels excavated immediately below the active plowzone, and 1 of the 14 (7 percent) levels excavated into the buried plowzone. Although this declining success rate and size difference suggests downward movement from a surficial deposit, artifact density does not decrease with depth. The thicker levels excavated from the active (upper) plowzone average 18 artifacts per m^3 versus 19 artifacts per m^3 in thinner levels excavated below the active plowzone.

Low artifact density severely reduces the visibility of most plowzone Clovis sites. Adequate documentation of Hawk's Nest required repeated collections over several years (e.g., Shott 1995) and extensive excavations using fine-mesh recovery.

Don and Phyllis Simons deserve our greatest thanks for the special contributions they made in October and November of 2000, providing their time and expertise, and for supplying specialized heavy equipment used in tilling, excavating, and screening. We are grateful for the landowner's support and the 100-plus excavation volunteers from the local community; Midwestern Archaeological Research Services, Inc.; and the Sauk Trail, South Suburban, and Kenosha Archaeological Societies as well as students and faculty from Loyola and the University of Illinois at Chicago. Thanks to several dedicated Loyola students who helped with artifact cataloguing, analysis, and data entry during the past couple years, notably Christina Czerniawski, Julie Kostuj, Ramsey Senno, April Specht, and Kit Thurman.

References Cited

Amick, D. S., T. J. Loebel, T. A. Morrow, and J. E. Morrow 1997 Hawk's Nest: A New Gainey-Clovis Site in Northeastern Illinois. *Current Research in the Pleistocene* 14:4–6.

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* 17:1–3.

Baker, C. 1978 The Size Effect: An Explanation of Variability in Surface Artifact Assemblage Content. *American Antiquity* 43:288–293.

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

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

Deller, D. B., and C. J. Ellis 1988 Early Paleo-Indian Complexes in Southwestern Ontario. In *The Late Pleistocene and Early Holocene Paleoecology and Archaeology of the Eastern Great Lakes Region*, edited by R. S. Laub, N. G. Miller, and D. W. Steadman, pp. 251–263. Bulletin of the Buffalo Society of Natural Sciences, Vol. 33. Buffalo, NY.

Jackson, L. J. 1997 Caribou Range and Early Paleo-Indian Settlement Disposition in Southern Ontario, Canada. In *Caribou and Reindeer Hunters of the Northern Hemisphere*, edited by L. W. Jackson, and P. T. Thacker, pp. 132–164. Avebury, Brookfield.

Kullen, D., M. Garceau, and K. Adams 1992 *Phase I Archaeological Survey at Good Shepard Hospital, Lake County, Illinois.* Patrick Archaeology, Glen Ellyn, IL.

Loebel, T. J., D. Amick, and R. Lurie 2000 *Report on Phase II Excavations at the Hawk's Nest Site (11L344) in Lake County, Illinois.* Cultural Resource Management Report No. 844. Midwest Archaeological Research Services, Inc., Harvard, IL.

Mallouf, R. J. 1981 An Analysis of Plow-Damaged Chert Artifacts: The Brookeen Creek Cache (41HI86), Hill County, Texas. *Journal of Field Archaeology* 9:79–98.

Morrow, J. E., and T. A. Morrow 1995 Clovis Projectile Point Manufacture: A Perspective from the Ready/Lincoln Hills Site, 11JY46, Jersey County, Illinois. *Midcontinental Journal of Archaeology* 20:168–191.

Odell, G. H., and F. Cowan 1987 Estimating Tillage Effects on Artifact Distributions. *American Antiquity* 52:456–484.

Shott, M. J. 1995 Reliability of Archaeological Records on Cultivated Surfaces: A Michigan Case Study. *Journal of Field Archaeology* 22:475–490.

——— 1999 The Paleo-Indians: Michigan's First People. In *Retrieving Michigan's Buried Past: The Archaeology of the Great Lakes State*, edited by J. R. Halsey, pp. 59–70. Bulletin 64. Cranbrook Institute of Science, Bloomfield Hills, MI.

Simons, D. B. 1997 The Gainey and Butler Sites as Focal Points for Caribou and People. In *Caribou and Reindeer Hunters of the Northern Hemisphere*, edited by L. W. Jackson and P. T. Thacker, pp. 105–131. Avebury, Brookfield.

Simons, D. B., M. J. Shott, and H. T. Wright, Jr. 1984 The Gainey Site: Variability in a Great Lakes Paleo-Indian Assemblage. *Archaeology of Eastern North America* 12:266–270.

Storck, P. L. 1991 Imperialists without a State: The Cultural Dynamics of Early Paleoindian Colonization as Seen from the Great Lakes Region. In *Clovis: Origins and Adaptations*, edited by R. Bonnichsen and K. Turnmire, pp. 153–162. Center for the Study of the First Americans, Oregon State University, Corvallis.

——— 1997 *The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario.* Memoir No. 30. Museum of Anthropology, University of Michigan, Ann Arbor.

Storck, P. L., and A. E. Spiess 1994 The Significance of New Faunal Identifications Attributed to an Early Paleoindian (Gainey Complex) Occupation at the Udora Site, Ontario, Canada. *American Antiquity* 59:121–142.

Van Nest, J. 1999 *Geoarchaeological Reconnaissance of the Hawks Nest Paleoindian Site, Lake County, Illinois.* Report submitted to Midwest Archaeological Research Services, Harvard, IL.

Paleoindian Subsistence and Technology in Central Brazil: Results from New Excavations at Boleiras Rockshelter, Lagoa Santa

Astolfo G. M. Araújo, Walter A. Neves, and Luís B. Piló

In 1956, W. Hurt and O. Blasi excavated two small units near the back wall of Boleiras Rockshelter (Hurt and Blasi 1969) and found two burials, which we recently dated using AMS of bone collagen . The burials were found to have an age between 8000 and 7000 yr B.P. In 2001, we resumed excavations at the site, opening an area of 20 m^2.

The archaeological strata are generally dark (ranging from 10YR 3/3 to 7.5YR 4/3), with an average overall thickness of 1.5 m, directly placed over an "orangish" (7.5YR 5/6) archaeologically sterile sediment. We dated the archaeological/sterile interface at three different units, obtaining the dates for the first human occupations at the rockshelter: 8240 ± 50 yr B.P. (Beta-159232); 9210 ± 130 yr B.P. (Beta-159233); and 9600 ± 60 yr B.P. (Beta-159236).

Three discrete human burials were found at Boleiras, at units K10, K12, and O11, but almost every unit in the site contained sparse human bones within the stratigraphy. More information about human remains found at Boleiras can be found in the paper by Neves et al. (this volume).

The lithics found at Boleiras show almost no signs indicating a formal reduction strategy. Most of the artifacts consist of utilized flakes or flaked pebbles of quartz crystal and quartzite, chert flakes being very scarce.

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This is in agreement with the existing literature that describes the Paleoindian lithic technology in the Lagoa Santa region (e.g., Beltrão 1975; Hurt and Blasi 1969; Laming-Emperaire et al. 1975). However, the presence of a bifacial point in the lower strata of Boleiras suggests that greater technical expertise was involved in some of the knapping activities carried out by the Paleoindians.

Besides the flaked-stone industry, it is worth describing the presence of a polished wedge-shaped stone found at 80 cm depth. The place of this artifact in the stratigraphy strongly suggests it was part of the late-Paleoindian tool kit. In fact, many other polished artifacts were reported by other authors working in the area throughout the last decades (e.g., Beltrão 1975:127; Evans 1950:342; Hurt and Blasi 1969:41–42; Prous and Malta 1991:216–217; Walter 1948:29–33). The automatic, frequently axiomatic correlation between polished stone implements and agriculture led many Brazilian archaeologists to interpret these tools as being "intrusive" from later periods. Our findings in Boleiras do support this view. Favoring a more ample chrono-spatial distribution of Paleoindian polished artifacts, Veiga (1998) reported many instances where such tools were found in Pleistocene alluvial channels in the Amazon, mostly during mining activities.

Modified animal bones are not common at Boleiras. Other authors have described bone points in the region (Evans 1950:342; Hurt and Blasi 1969:48), and we also found two points that are similar to those previously described. Our discovery of a specific artifact, however, was a surprise to us: a bone hook found at Unit M17, between 90 and 100 cm depth, with an estimated age of about 9000 yr B.P. (as mentioned above, we dated the charcoal from Unit L17, about 1 m to the side and 10 cm lower than the artifact, at 9600 yr B.P.).

The faunal remains at Boleiras are mainly attributable to small-sized animals, and the only instance in which bones from a medium-sized animal (cervid) were found was within a presumably disturbed context, in the same layer where historical materials were found.

The rockshelters at Lagoa Santa do not appear to have been used as regular habitation sites. These sites were probably used for mortuary practices and eventually overnight camps. This raises a question regarding the relationship between humans and the megafauna, which were still present in the local ecosystem: Is the absence of the remains of large mammals within the rockshelters simply a function of the restricted activities carried out within the shelters, or does it suggest that these Paleoindians were nonspecialized hunter-gatherers whose main protein and caloric sources relied on acquiring small game and wild plants? Evidence from other sites suggests that the later possibility is more likely.

The presence of small game dominates at many sites from the Paleoindian period in Brazil (e.g., Kipnis 1998; Moreira 1981; Prous et al. 1997; Roosevelt et al. 1996). Besides that, Neves and Cornero (1997) detected a high incidence (9 percent) of dental caries among the Paleoindian population of Santana do Riacho compared with other hunter-gatherers in the world, suggesting a large consumption of vegetable items rich in carbohydrates.

There is no reason to expect that the Paleoindians of Lagoa Santa were specialized in hunting big-game animals, since species of megafauna, at least those large animals that inhabited the regions of the current Brazilian territory, did not live in herds, as was the case with the bison and mammoth of North America.

References Cited

Beltrão, M. C. 1975 Industries Lithiques Trouvees au Cours de La Prospection 1971. In *Grottes et Abris de la Region de Lagoa Santa, Minas Gerais, Brésil - Premier Rapport de la Mission Archéologique Franco-Brésilienne de Lagoa Santa*, edited by A. Laming-Emperaire, A. Prous, A. Vilhena de Moraes, and M. Beltrão, pp. 123–130. Cahiers D'Archeólogie d'Amerique du Sud, 1. École Pratique des Hautes Etudes VIe Section: Sciences Economiques et Sociales.

Evans, C. 1950 A Report on Recent Archaeological Investigations in the Lagoa Santa Region of Minas Gerais. *American Antiquity* 15: 341–343.

Hurt, W. R., and O. Blasi 1969 O Projeto Arqueológico "Lagoa Santa" - Minas Gerais, Brasil. *Arquivos do Museu Paranaense - Nova Série, Arqueologia*, 4:1–60.

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

Laming-Emperaire, A., A. Prous, A. Vilhena de Moraes, and M. Beltrão 1975 *Grottes et Abris de la Region de Lagoa Santa, Minas Gerais, Bresil - Premier Rapport de la Mission Archéologique Franco-Brésilienne de Lagoa Santa.* Cahiers D'Archeólogie d'Amerique du Sud, 1. École Pratique des Hautes Etudes VIe Section: Sciences Economiques et Sociales.

Moreira, L. E. 1981 Análise dos Restos de Alimentos de Origem Animal no Programa Arqueológico de Goiás. *Anuário de Divulgaçao Científica*, Universidade Católica de Goiás, 10: 98–112.

Neves, W. A., and S. Cornero 1997 What did South American Paleoindians Eat? *Current Research in the Pleistocene* 14:93–96.

Neves, W. A., M. O. Hübbe, and A. G. M. Araujo 2002 A Late-Paleoindian Secondary Ritualized Burial from Lagoa Santa, Minas Gerais, Brazil. *Current Research in the Pleistocene*, in press.

Prous, A., F. Costa, and M. Alonso 1997 Arqueologia da Lapa do Dragão. *Arquivos do Museu de História Natural.* Universidade Federal de Minas Gerais, 18:139–209.

Prous, A., and I. Malta (editors) 1991 Santana do Riacho - Tomo I. *Arquivos do Museu de História Natural.* Universidade Federal de Minas Gerais, 12.

Roosevelt, A., L. Costa, L. Machado, N. Michab, N. Mercier, H. Valladas, J. Feathers, W. Barnett, M. Silveira, H. Henderson, J. Silva, B. Chernoff, D. Rease, J. Homan, N. Toth, and K. Schick 1996 Paleoindian Cave Dwellers in the Amazon: The Peopling of the Americas. *Science*, 272: 373–384.

Veiga, T. 1998 Sinais Antigos de Ocupação Humana nos Aluviões Amazônicos. Paper presented at the symposium *O Patrimônio Cultural nos Países Amazônicos.* UNESCO/ICOMOS.

Walter, H. V. 1948 *A Pré-História da Região de Lagoa Santa (Minas Gerais).* Velloso & Cia. Ltda, Belo Horizonte.

The Kreisel Cache: Agate Basin Preforms from Jackson County, Wisconsin

Dillon Carr and Robert Boszhardt

The Kreisel Cache (47-Ja-336) was originally discovered in 1968 by David Kreisel while returning from the bottoms along the Black River in western Wisconsin. A sandstone outlier named Maiden Rock lies due south of the location. Initially walking by a piece of silicified sandstone that he noticed, Mr. Kreisel retraced his steps to pick up what proved to be a biface. Hearing it scrape on another stone, he dug and recovered 72 additional bifaces (Figure 1). The Kreisel Cache was recovered from a ravine cutting across a narrow terrace that possibly slumped from the main terrace top. Mr. Kreisel estimates the cache came from a spot 6 ft below the modern surface.

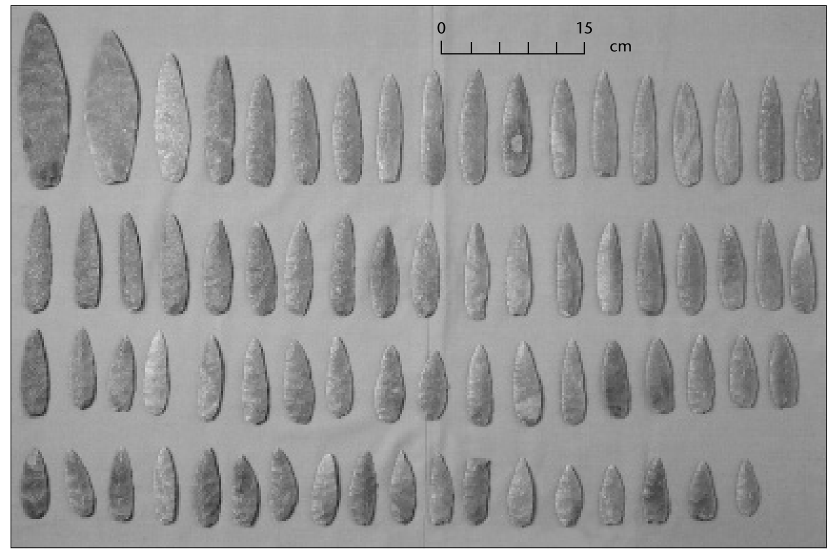

Figure 1. The Kreisel Cache.

All 73 bifaces are made from Cataract silicified sandstone (CSS), a recently discovered source of high-quality silicified sandstone within the unglaciated Driftless Area (Boszhardt 1998a, 1998b). Outcrops of CSS are found 20 km northeast of the find spot at the head of a tributary to the Black River. The range of color variation for CSS approaches that of Hixton silicified sandstone (HSS), which outcrops at Silver Mound 60 km to the north; several of the bifaces possess distinctive gray-green banding and reddish tint only found with CSS.

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The Kreisel Cache bifaces are interpreted as late-Paleoindian preforms, based on their general lanceolate shape, collateral flaking pattern, and apparent technological differences from earlier and later point types. All 73 bifaces conform to Callahan's (1979) Stage 5 bifaces. Lack of basal shaping on the bifaces prevents positive identification of point type, but they are thought to represent Agate Basin preforms.

The bifaces are crafted from flake blanks driven off a tabular core of CSS using soft hammer percussion as evidenced by wide striking platforms with little or no sign of crushing. Experiments with CSS have shown that the tabular form of the raw material lends itself to the production of numerous long, narrow flake blanks. Use of hard hammers creates considerable fracturing of striking platforms, which are noticeably narrower. The presence of original striking platforms on all the bifaces suggests that several of Callahan's early stages of thinning were not needed. The striking platforms display little sign of preparation. Bulbs of percussion and the original ventral surface of the flake blank are also visible on several of the bifaces.

Bifacial thinning was achieved using percussion flaking in a collateral pattern, though in several instances more random flaking is observed. One or two overshot flakes were used to remove the bulb of percussion near the base of several preforms. Pressure flaking was then used around the margins for general shaping of the convex sides of the bifaces.

There is a lack of working of both the bases and tips. Aside from the removal of the bulb of percussion, there is little other evidence of working on the basal portion of the bifaces. There is no basal grinding found on any of the bifaces, though some abrading is observed along the margins. This is likely related to the manufacturing process and not preparation for hafting. The tips possess only marginal pressure flaking, and are generally thick and blunt in appearance.

Five of the bifaces are asymmetrical and D-shaped. These appear to represent "backed bifaces" intended for use as knives and not projectile points. Their shape is similar to asymmetrical bifaces recovered from Agate Basin components at the type site (Frison and Stanford 1982:122), and Blackwater Draw (Boldurian and Cotter 1998:85). The degree of asymmetry was measured by the difference in width (mm) from either side of the midline at the widest part of the biface. The difference in width for the majority of bifaces ranges from 0–2 mm; all five identified backed bifaces possess differences in excess of 5 mm.

While caches have been found in both utilitarian and ceremonial contexts, the unfinished form of the bifaces and lack of association with a burial or cremation suggest that the Kreisel Cache is utilitarian in function. Paleoindian biface caches are typically associated with the early-Paleoindian stage (Anderson and Tiffany 1972; Gramly 1993; Stanford and Jodry 1988; Tankersley 1998), though late-Paleoindian–age caches have been found (Davis and Sisson 1998; Hartwell 1995). The large number of preforms in the Kreisel Cache makes it a valuable source of information on late-Paleoindian reduction strategies.

We would like to thank David Kreisel for allowing us the opportunity to study the cache.

References Cited

Anderson, A. D., and J. A. Tiffany 1972 Rummels Maske: A Clovis Find Spot in Iowa. *Plains Anthropologist* 17:56–59.

Boldurian, A. T., and J. L. Cotter 1998 *Clovis Revisited:ÊNew Perspectives on Paleoindian Adaptations from Blackwater Draw, New Mexico.* University Museum Monographs No. 103, University of Pennsylvania Museum, Philadelphia.

Boszhardt, R. F. 1998a *An Archaeological Survey of an Orthoquartzite District in West-Central Wisconsin.* Reports of Investigations No. 306. Mississippi Valley Archaeology Center at the University of Wisconsin—La Crosse.

——— 1998b Newly Discovered Lithic Resources in Western Wisconsin. *Minnesota Archaeologist* 57:87–96.

Callahan, E. 1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. *Archaeology of Eastern North America.* 7:1–181.

Davis, L. G., and D. A. Sisson 1998 An Early Stemmed Point Cache from the Lower Salmon River Canyon of West-Central Idaho. *Current Research in the Pleistocene* 15:12–14.

Frison, G. C., and D. J. Stanford, editors 1982 *The Agate Basin Site: A Record of Paleoindian Occupation of the Northwestern High Plains.* Academic Press, New York.Gramly, R. M. 1993 *The Richey Clovis Cache.* Persimmon Press, Buffalo.

Hartwell, W. T. 1995 The Ryan's Site Cache: Comparisons to Plainview. *Plains Anthropologist* 40:165–184.

Stanford, D. J., and M. A. Jodry 1988 The Drake Clovis Cache. *Current Research in the Pleistocene* 5:21–22.

Tankersley, K. B. 1998 The Crook County Clovis Cache. *Current Research in the Pleistocene* 15:86–88.

Early-Holocene Buried Soils and Archaic Cultural Materials from the Southern High Plains of the Oklahoma Panhandle

Brian J. Carter and Leland C. Bement

Four buried soils and Archaic cultural materials are found exposed on a bluff face along Sand Creek, a left bank tributary to Fulton Creek, in Beaver County, Okla. Fulton Creek is a moderately sized ephemeral (30 km) tributary of the Beaver (North Canadian) River. The bluff face occurs below a terrace, with the base of the exposure ending on the current Sand Creek floodplain. Total height of the exposure is 7.63 m and includes upper (unit 3, 84 cm) and lower (unit 1, 321 cm) alluvium separated by a middle unit 2 of loess (358

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cm). The bluff face extends laterally for approximately 0.5 km. Site 34BV161 contains Archaic cultural material including burned rock, flaking debris, and corner-notched dart points (Bement and Brosowske 2001). This cultural material erodes from the north edge of the bluff face from the modern surface soil and suggests a possible upper age limit of ca. 3000 yr B.P. for the exposure. Three buried soils are found in the lowest alluvium (unit 1). Organic matter extracted from the lowest buried soil (b4) yielded an early-Holocene age (Beta 155221;10,540 ± 150 yr B.P.) and suggests a maximum age for the exposure.

The soil profile description (Table 1A and 1B) indicates the Sand Creek basin aggraded during the early Holocene and the aggradation stopped several times as indicated by four distinct buried soils. This aggradation was punctuated by eolian material (unit 2, loess) after at least 9860 ± 120 yr B.P. (Beta 155220; 3Ak1b3 soil horizon) and may represent the middle-Holocene eolian activity found in west-central Kansas (Olson et al. 1997). The loess (unit 2) contains a well-formed soil (clay coatings and pedogenic calcite in the Btkb1 soil horizon). The loess (unit 2) is covered by the upper alluvium (unit 3) which contains a modern well-formed soil (clay coatings and pedogenic calcite; Bt2 and Btk soil horizons). Unit 3 extends to the ground surface.

The Sand Creek bluff soil profile description is the first to identify an early- and possibly middle-Holocene sequence of sedimentation and soil formation for the Southern High Plains in the Oklahoma Panhandle. Depending on future age determinations of the artifacts, the middle eolian unit (2) may represent a middle-Holocene dry period (Altithermal). The source area for unit 2 is likely the reworking of High Plains eolian sediments possibly correlating to the Blackwater Draw formation (Holliday 1989). Future work at the site will possibly reveal the exact age of the upper alluvium (unit 3) by further investigation of artifacts and an age from the buried soil that caps unit 2. Future work at this site may also serve to extrapolate extensive geoarchaeological work from similar High Plains settings (Holliday 1985; Mandel 1992).

References Cited

Bement, L. C., and S. D. Brosowske 2001 Streams in No Man's Land: A Cultural Resource Survey in Beaver and Texas Counties, Oklahoma. Oklahoma Archeological Survey, University of Oklahoma, Archeological Resource Survey Report No. 43.

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

——— 1989 The Blackwater Draw Formation (Quaternary): A 1.4-plus-m.y. Record of Eolian Sedimentation and Soil Formation on the Southern High Plains. Geological Society of America Bulletin, 101:1598–1607.

Mandel, R. D. 1992 Soils and Holocene Landscape Evolution in Central and Southwestern Kansas: Implications for Archaeologist Research. In *Soils in Archaeology: Landscape Evolution and Human Occupation,* edited by V. T. Holliday, pp. 41–100. Smithsonian Institution Press, Washington.

Olson, C. G., W. D. Nettleton, D. A. Porter, and B. R. Brasher 1997 Middle Holocene Aeolian Activity on the High Plains of West-central Kansas. *The Holocene* 7(3):255–261.

Table 1A. Soil profile description along Sand Creek, Beaver Co., OK (T1N, R20E, SEC. 8), March 30, 2001.

Horizon	Depth (cm)	Color and Moisture	Structure●	Texture■	Consistency▲	Boundary◆	Effervescence▼	Special Features
A	0–7	10YR3/3	1fGR	VFSL	vfr	c,s	sle	common medium and fine roots; alluvium-unit 3.
Bw	7–19	10YR3/4	2fSBK/2fGR	SCL	vfr	g,s	sle	common fine and few medium roots; alluvium-unit 3.
Bt	19–41	7.5YR4/3	2mPR	SCL	fr	g,s	sle	common fine and few medium roots; alluvium-unit 3.
Btk1	41–72	7.5YR4/4	2mPR	SCL	fr	g,s	ste	common fine and few medium roots; common distinct continuous clay coating on ped faces; alluvium-unit 3.
Btk2	72–84	7.5YR4/6	2mPR	SCL	fr	c,s	ste	common fine and few medium roots; few fine $CaCO_3$ masses; common distinct continuous clay coatings on ped faces; alluvium-unit 3.
2Btk1b1	84–108	10YR4/4	2mPR	SiL	fi	g,s	ve	few fine roots; common fine $CaCO_3$ masses; few strata 1mm or less thick (silt and very fine sand); few distinct continuous clay coatings on ped faces loess-unit 2.
2Btk2b1	108–183	10YR4/4	2mPR	SiL	fi	c,s	ve	few fine roots; many fine $CaCO_3$ masses; common distinct continuous clay coatings on ped faces; loess-unit 2.
2Bkb1	183–219	10YR4/3	1mPR/2mSBK	SiL	fi	g,s	sle	common fine $CaCO_3$ masses; few and common strata 1mm or very fine sand); few distinct continuous clay coatings on ped faces; loess-unit 2.
2Ckb1	219–405	10YR3/3	MA	SiCL	fi	c,s	sle	common fine $CaCO_3$ masses; many strata 1mm or less thick (silt and very fine sand); loess-unit 2.
3Bkb2	405–486	10YR3/4	1coPR/1mSBK	SiCL	fi	c,s	sle	common fine $CaCO_3$ masses; alluvium-unit 1.

Structure●
1 weak
2 moderate
3 strong
f fine
m medium
co coarse
GR granular
SBK subangular blocky
PR prismatic
MA massive

Texture■
VF very fine
S sand
Si silt
L loam
C clay

Consistency▲
v very
fr friable
fi firm

Boundary◆
c clear
g gradual
s smooth

Effervescence▼
sle slight
ste strong
ve violent

Table 1B. Soil profile description along Fulton Creek, Beaver Co., OK (T1N, R20E, SEC. 8), March 30, 2001.

Horizon	Depth (cm)	Color and Moisture	Structure●	Texture■	Consistency▲	Boundary◆	Effervescence▼	Special Features
3Ak1b3	486–548	10YR3/2	2mSBK	SiCL	fi	c,s	—	Common fine $CaCO_3$ masses; alluvium-unit 1; radiocarbon age 9,860 ± 120 yr B.P. (Beta 155220).
3Ak2b3	548–592	10YR3/3	1mSBK	SiCL	fi	g,s	—	Common fine $CaCO_3$ masses; alluvium-unit 1.
3Cb3	592–612	10YR3/4	MA	L	fi	c,s	sle	Few angular Permian shale and Ogallala quartzite and caliche gravels; alluvium-unit 1.
3Btkb4	612–638	10YR3/4	2mSBK	L	fi	g,s	ve	Common fine $CaCO_3$ masses; few faint continuous clay coatings on ped faces; alluvium-unit 1; radiocarbon age 10,540 ± 150 yr B.P. (Beta 155221).
3BCkb4	638–653	10YR5/3	1mSBK	SL	fr	c,s	sle	Fine few $CaCO_3$ masses; alluvium-unit 1.
3Cb4	653–763	10YR5/4	MA	LS	vfr	—	—	Common strata of 7.5YR3/1 and 4/2 silt loam A horizon material with slight effervescence (5–20 cm thick with regular interstratification); alluvium-unit 1.

Structure●		Texture■	Consistency▲	Boundary◆	Effervescence▼
1 weak	**co** coarse	**VF** very fine	**v** very	**c** clear	**sle** slight
2 moderate	**GR** granular	**S** sand	**fr** friable	**g** gradual	**ste** strong
3 strong	**SBK** subangular blocky	**Si** silt	**fi** firm	**s** smooth	**ve** violent
f fine	**PR** prismatic	**L** loam			
m medium	**MA** massive	**C** clay			

Late-Pleistocene/Holocene Paleogeography and Coastal Evolution at the Mouth of the Río de la Plata: Implications for Dispersal of Paleoindian People in South America

José Luis Cavallotto, Roberto Antonio Violante, and Hugo Gabriel Nami

For many years, discovery of "fishtail" (Fell's Cave or Fell) projectile points was reported in many places across South America. Since the 19th century, more than 100 specimens of these particular projectile points were reported in Argentina and Uruguay. Beyond technical similarities characterizing the projectile point patterns from both areas, recent investigations show that some Paleoindian artifacts from the Pampean region were probably made with raw materials coming from sources located in Uruguay (Flegenheimer et al. 2000).

At present, both regions are separated by the Río de la Plata, a great mass of water 50 to 200 km wide that covers almost 35,000 km^2, which behaves as a biogeographical barrier.

But at the end of the Pleistocene and the beginning of the Holocene, the outer area at the Río de la Plata and its outlet into the Atlantic ocean were significantly different from today's characteristics. At that time the area had significant changes in its geomorphologic configuration, related to the transition from ancient fluvial to modern estuarine and littoral environments open to the sea in response to glacial-eustatic fluctuations. This situation produced important variations in the distribution of submerged and emerged lands.

At the beginning of the last transgressive event (18 ky B.P., during the LGM), the geomorphologic configuration showed a conspicuous emerged feature (headland) separating two fluvial environments. The one located north of the headland included the primitive Río de la Plata, significantly narrower than today (reaching perhaps only a few kilometers wide) but still characterized by an enormous flow of water draining the tropical regions of Brazil, Paraguay, and northeastern Argentina (Cavallotto et al. 1999; Cavallotto in press). The other one, to the south, corresponded to the Salado river, which drained the Argentinean western regions but with progressively diminishing flows through time as a consequence of the onset of semiarid conditions in the pampean regions, between the cordillera and the sea (Violante and Parker 1999).

As the last transgression occurred, the above mentioned environments

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were affected in different ways. While the headland (Punta Piedras–Alto Marítimo watershed, Cavallotto et al. 1999; Cavallotto in press) remained as a subaerial feature, although significantly reduced in size, sea waters entered the primitive Río de la Plata, forming at its mouth and lower areas a long and narrow estuarine environment, which progressively widened and migrated landwards as the transgression progressed (Cavallotto et al. 1999; Cavallotto in press; Parker 1990; Parker and Violante 1993; Parker et al. 1999). At the same time, the depressed region around the lower Salado River was inundated owing to its very low relief, and it became an enormous shallow bay (Parker et al. 1999).

When sea level reached around 15 m below present level (10–8 ky B.P.), the headland, elongated in a west-east direction, acted as a front exposed to littoral agents such as waves, tides, and littoral currents (Figure 1). As a consequence, their open-to-the-sea southern margins developed extensive beaches associated with coastal barrier systems, whose relicts are today represented by the submerged La Plata Bank, which extends northeastwards at the east and southeast of the Punta Piedras–Alto Marítimo watershed (Parker 1979; Parker and Violante 1993; Urien 1967). On the other hand, the protected areas located behind the coastal barriers developed swamp and lagoon environments.

As a result, it is believed that before 10–8 ky B.P. those environments (subaerial at that time) reached the proximity of the present Uruguayan coasts near Punta del Este, staying separated from it only by the narrow outlet of that ancient Río de la Plata.

Between 8 ky B.P. and the present, sea level fluctuations are best documented in the region (Cavallotto et al. 1995). Since 8 ky B.P., the transgression caused the flowing of the Punta Piedras–Alto Marítimo watershed, which was definitely submerged (Cavallotto et al. 1999; Cavallotto in press; Parker et al. 1999; Violante et al. 2001). It is possible that relict sandy and shelly beach deposits documenting the passage of the transgressive process could still exist on the top of the watershed.

The last stage of the transgression, between 8 and 6 ky B.P., induced the final retreat of the coastline to its higher position about 6 m above present. When the sea reached that level, beach ridge systems were built in opposite directions attached to the most prominent point of the headland (the place known today as Punta Piedras), one towards the northwest in the direction of La Plata City (Cavallotto in press), and another one towards the southwest bordering the primitive Samborombón Bay (Codignotto and Aguirre 1993; Violante et al. 2001).

The final evolutionary stage, initiated at 6 ky B.P. with the lowering of sea level to its present position, was characterized by an intense coastal progradation. During this event, coastal plains formed (Cavallotto 1996; Parker and Violante 1993; Violante et al. 2001) and the delta of the Río de la Plata developed (Cavallotto in press; Parker and Marcolini 1992) with prodelta facies finally covering the western portion of the Punta Piedras–Alto Marítimo watershed.

In accordance with this paleogeographic outline, it is inferred that the peopling and dispersion of Paleoindian hunter-gatherers, as well as the raw

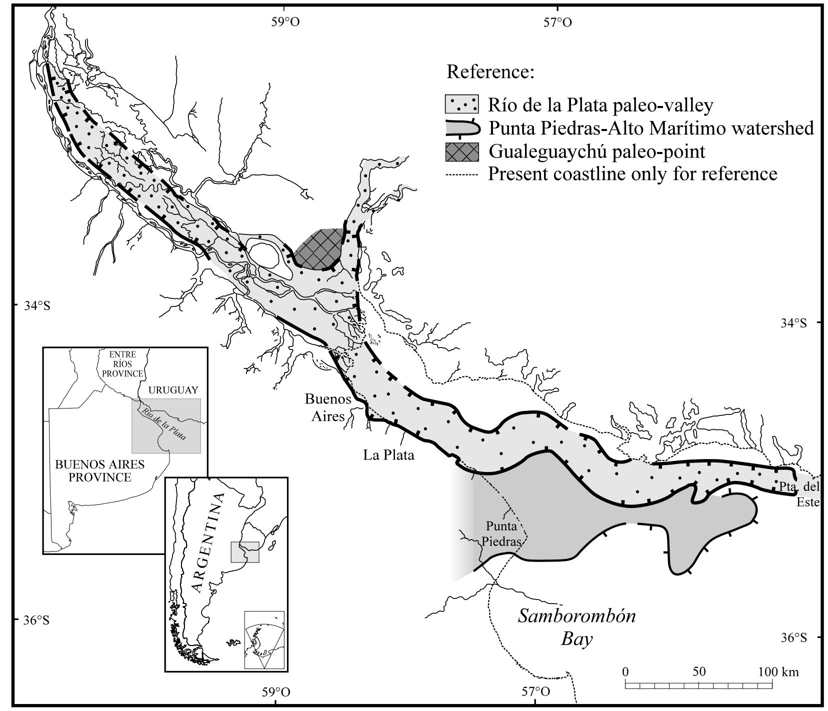

Figure 1. Paleogeography of the Río de la Plata mouth when the sea was below 15 m (adapted from Cavallotto et al. 1999).

materials, might have occurred before the flowing of the Punta Piedras–Alto Maritimo watershed (around 10–8 ky B.P.), when the sea was 15 m below present level and the Río de la Plata mouth was a narrow course.

References Cited

Cavallotto, J. L. 1996 Estratigrafía del Holoceno de la Llanura Costera del margen sur del Río la Plata. *Actas del XIII Congreso Geológico Argentino y III Congreso de Exploración de Hidrocarburos* IV:51–68, Buenos Aires.

——— in press Evolución holocena de la llanura costera del margen sur del Río de la Plata. *Revista de la Asociación Geológica Argentina.*

Cavallotto, J. L., G. Parker, and R. A. Violante 1995 Relative sea-level changes in the Río de la Plata during the Holocene. IGCP Project 375, Late Quaternary coastal records of rapid change: Application to present and future conditions. *Abstracts. IInd Annual Meeting*, pp. 19–20, Antofagasta.

Cavallotto, J. L., R. A. Violante, and G. Parker 1999 Historia evolutiva del Río de la Plata durante el Holoceno. *Actas del XIV Congreso Geológico Argentino* I:508–511, Salta.

Codignotto, J. O., and M. Aguirre 1993 Coastal evolution, changes in sea level and molluscan fauna in northeastern Argentina during the Late Quaternary. *Marine Geology* 110 (1/2):163–176.

Flegenheimer, N., C. Barón, M. Valente, J. Baeza, J. Femenías 2000 Traslado de rocas a grandes distancias. Taller "La Colonización del sur de América durante la transición Pleistoceno/Holoceno", *Libro de Resúmenes*, pp. 17, La Plata.

Parker, G. 1979 Geología de la planicie costera entre Pinamar y Mar de Ajó, Provincia de Buenos Aires. *Revista de la Asociación Geológica Argentina* 34 (3):167–183, Buenos Aires.

——— 1990 Estratigrafía del Río de la Plata. *Revista de la Asociación Geológica Argentina* 45 (3-4):193–204, Buenos Aires.

Parker, G., and S. Marcolini 1992 Geomorfología del Delta del Paraná y su extensión hacia el Río de la Plata. *Revista de la Asociación Geológica Argentina*, 47 (2):243–250, Buenos Aires.

Parker, G., C. M. Paterlini, R. A. Violante, I. P. Costa, S. Marcolini, and J. L. Cavallotto 1999 Descripción geológica de la Terraza Rioplatense (Plataforma Interior del noreste bonaerense). *Boletín del Servicio Geológico y Minero Argentino*, No 273, Buenos Aires.

Parker, G., and R. A. Violante 1993 Río de la Plata y regiones adyacentes. In *El Holoceno en la Argentina* M. Iriondo (Ed.), *CADINQUA* 2:163–230.

Violante, R. A., and G. Parker 1999 Historia evolutiva del Río de la Plata durante el Cenozoico superior. *Actas del Congreso XIV Geológico Argentino* 1:504–507, Salta.

Violante, R. A., G. Parker, and J. L. Cavallotto 2001 Evolución de las llanuras costeras del este bonaerense entre la Bahía Samborombón y la laguna Mar Chiquita. *Revista de la Asociación Geológica Argentina* 56 (1):51–66.

Urien, C. M. 1967 Los sedimentos modernos del Río de la Plata exterior, Argentina. *Boletín del Servicio de Hidrografía Naval* 4 (2):113–213, Buenos Aires.

A Middle-Pleistocene Marine Transgression in Central-eastern Argentina

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Several Pleistocene and Holocene marginal marine transgressions have been studied in the eastern Pampean area (Isla et al. 2000 and references cited therein; Figure 1). All have been considered as old as the last interglacial or the Hypsithermal. Recently we found a thin marine bed in a continental sequence in the Santa Clara del Mar marine cliffs (37°50′56″ S, 57°30′18″ W), near the city of Mar del Plata that is here considered older. This bed is characterized by the occurrence of marine bivalves *Glycimeris longior* and *Amiantis purpurata* and strong bioturbation of the underlying beds. Actually, Ameghino (1889) had described a bed in the area as supposedly assignable to the "Piso Belgranense." However, there were no marine indicators.

The stratigraphic position of the Santa Clara del Mar bed is the same as that of the marine "Piso Belgranense" (Belgranan Stage) in its stratotype at the Belgrano quarter (34°33′30″ S, 58°28′00″ W) of the city of Buenos Aires. The "Piso Belgranense" was considered a wedge intercalated between the Ensenadan and Bonaerean stages (Ameghino 1889). Ameghino (1889) and other authors described this unit in other locations east of the Province of Buenos Aires. Later, the sediments of the "Piso Belgranense" were included in the

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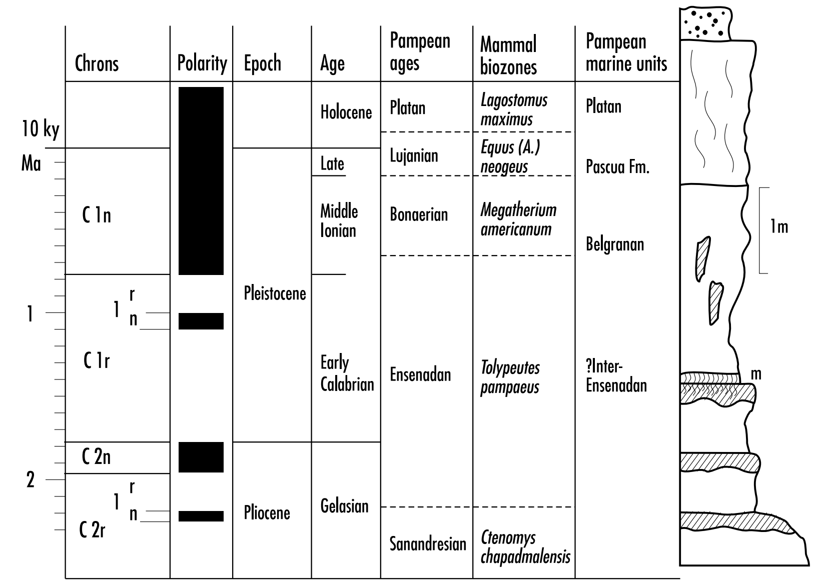

Figure 1. The Santa Clara del Mar section; m = marine bed. Pleistocene to Holocene chronology of southern South America is according to Cione and Tonni 1999). The Holocene is not drawn to scale.

Pascua formation, with stratotype in the Canal 15, eastern Provincia de Buenos Aires (Fidalgo et al. 1973). The Pascua formation is presently considered correlative with the Illinoian/Wisconsin interglacial (Pardiñas et al. 1996). Recently detected significant differences in mineralogical content and magnetic polarity directions suggest that sediments assigned to the Pascua formation in the Canal 15 do not correlate with those of Belgrano (Etchichury et al. 1998; Nabel et al. 1998). We agree with this view, because the marine unit at Belgrano is certainly intercalated between Ensenadan (about 2.0 Ma to younger than 0.78 Ma) and Bonaerean (younger than 0.78 Ma to 130 Kyr) and the Pascua formation is intercalated between Bonaerean beds (even including some terrestrial Lujanian mammals in the marine beds).

In Santa Clara del Mar, the marine bed is stratigraphically located 5–7 inches below a stratum with vertebrates assigned to the last interglacial, which has been correlated with a dated marine bed of this age at Centinela del Mar (38°26′29″ S, 58°13′20″ W; Isla et al. 2000). Consequently, we consider that the marine beds of Belgrano and Santa Clara del Mar correspond to a pre-Illinoian/Wisconsin interglacial, younger than 0.78 Ma.

References Cited

Ameghino, F. 1889 Contribución at conocimiento de los mamíferos fósiles de la República Argentina. *Actas de la Academia Nacional de Ciencias de Córdoba* 32:1–1027.

Cione, A. L., and E. P. Tonni 1999 Biostratigraphy and chronological scale of the uppermost Cenozoic of the Pampean area, Argentina. In Quaternary vertebrates of South America, edited by E. P. Tonni, and A. L. Cione. *Quaternary of South America and Antarctic Peninsula* 12:23–51.

Etchichury, M., P. Nabel, R. Tófalo, and D. Vargas 1998 Semejanzas y diferencias sedimentológicas y magnetoestratigráficas del "Belgranense" y de la Formación Pascua. In *Actas de las V Jornadas Geológicas y Geofisicas Bonaerenses,* Bahía Blanca:95–104.

Fidalgo, F., U. Colado, and F. d. Francesco 1973 Sobre ingresiones marinas cuaternrias en los partidos de Castelli, Chascomús y Magdalena (Provincia de Buenos Aires). In *Actas del Quinto Congreso Geológico Argentino,* Buenos Aires:227–240.

Isla, F., N. Rutter, E. Schnack, and M. Zárate 2000 La trangresi6n belgranense en Buenos Aires. Una revisión a cien años de su definición. *Asociación Geológica Argentina.Serie D.Publicación especial* 4:3–14.

Nabel, P., M. C. Etchichury, O. R. Tofalo, and D. Vargas 1998 La Formación Pascua no corresponde a la misma ingresión que el "Belgranense". In *Actas del X Congreso Latinoamericano de Geologia y VI Congreso Nacional de Geologia Económica,* Buenos Aires:143–143.

Pardiñas, U., J. Gelfo, J. San Cristóbal, A. L. Cione, and E. P. Tonni 1996 Una asociación de organismos marinos y continentales en el Pleistoceno superior en el sur de la provincia de Buenos Aires, Argentina. In *Actas del XIII Congreso Geológico Argentino y III Congreso de Exploración de Hidrocarburos,* Buenos Aires: 95–111.

Radiocarbon Dates for Paleoindian Components (Folsom, Scottsbluff) at the MacHaffie Site, West-Central Montana Rockies

Leslie B. Davis, Christopher L. Hill, and John W. Fisher, Jr.

Stratified Folsom and Scottsbluff components were documented by Forbis (1952) and Forbis and Sperry (1951) at the MacHaffie (24JF4) occupation site, which is situated on an ephemeral tributary of Prickly Pear Creek on the northwest flank of the Elkhorn Mountains south of Helena, Montana. Fifteen radiocarbon measurements are available for Paleoindian components at the site. Here we present information pertaining to two radiocarbon measurements, which indicate an age of ca. 10,400–10,100 RCYBP for the site's Folsom components, and compare those data with the remaining radiocarbon inventory.

The excavations conducted in 1951 by Forbis and Sperry documented a 2.7-m-thick stratigraphic sequence. The bottom 1.5 m consisted of a series of alluvial sands. No artifacts were found in these lower sands (Forbis and Sperry 1952). The sands were overlain by a "black soil" containing Folsom artifacts. The Folsom-bearing deposit graded upward into 60 cm of gray clays containing Scottsbluff artifacts. These clays were overlain by ca. 58 cm of alluvium and other deposits.

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Excavations in 1990, ca. 6 m upstream (east) from the Forbis-Sperry excavations, distinguished two Folsom components (*f1, f2*) and two overlying Scottsbluff components (*s1, s2*). These were assigned to the following archaeological strata: stratum I (Folsom?), stratum II (Folsom), stratum III (Scottsbluff?), and stratum IV (Scottsbluff) (Davis et al. 1991). Radiocarbon measurements for a stratigraphic sequence exposed at the south end of Trench A, which contained these Paleoindian components, on various materials—including bone gelatin, apatite, and charcoal—yielded seven dates ranging from ca. 9130 to 7905 RCYBP. Subsequent measurements of bone apatite, organic sediment, and bulk soil samples associated with the Scottsbluff components yielded dates ranging from ca. 9340 to 8019 RCYBP, while a date of ca. 9730 RCYBP was obtained from a bulk soil sample associated with Folsom.

Excavations in 2001 exposed a stratigraphic profile adjacent to the east side of the Forbis-Sperry excavation area. The lower set of deposits consist of ca. 1 m of muddy sands. It is overlain by a 10- to 20-cm-thick dark sandy mud, which can be correlated to the Folsom artifact-bearing "black soil" reported by Forbis and Sperry (1952). Above the sandy mud is ca. 1.2 m of alluvial and colluvial muds and silts. The muddy sands under the Folsom "black soil" appear to be alluvium that reflects terminal-Pleistocene/early-Holocene braided-stream environments (cf. Albanese 1991, 2000). Bone collagen (cf. *Bison* sp.) collected from sands directly below the dark mud was dated to 10,390 ± 40 RCYBP (Beta-159167; CAMS); this date appears to be associated with the oldest Folsom component (*f1*) at the site (= stratum I in Davis et al. 1991). A sample collected nearby from an organic-rich deposit, which seems to correlate with the Folsom "black soil" and the younger Folsom component (*f2*; stratum 2 in Davis et al. 1991), provided a date of 10,090 ± 50 RCYBP (Beta-159058).

Utilized fauna recovered from the respective Paleoindian components in 2001 are: *f1,* large mammal rib fragment, cf. *Bison* sp.; *f2,* large canid (*Canis* spp., cf. *C. lupus*), deer-sized artiodactyl (cf. *Odocoileus* spp.), rabbit (*Sylvilagus* sp.), and *Bison* spp.; and *s2, Bison* spp. Large canid remains are predominant in *f2*.

Elsewhere on the Great Plains, Folsom appears to range from ca. 10,900 to 10,300 RCYBP (Haynes 1992, 1993; Haynes et al. 1992). The Folsom-type site, for example, yielded a radiocarbon age of ca. 10,500 RCYBP (Meltzer, Todd, and Holliday 2002). A Folsom-affiliated assemblage at Indian Creek, south of MacHaffie, also in the Elkhorn Mountains, dates within the range of ca. 10,700–10,400 RCYBP (Baumler and Davis 2000; Davis and Baumler 2000). There are some indications that Folsom may extend to ca. 10,200 RCYBP on the Northern Plains and 10,100 RCYBP on the Southern Plains (Holliday 2000). The Alberta and Cody (Eden-Scottsbluff) continuum ranges from ca. 10,000 to 8000 RCYBP (cf. Holliday 2000; Stanford 1999). Radiocarbon dates reported here appear to indicate that Folsom artifacts at the MacHaffie site are contained within muddy sands and sandy mud (the "black soil") that range in age from ca. 10,390 to 10,100 RCYBP.

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References Cited

Albanese, J. P. 1991 Geologic Investigation of the MacHaffie Site (24JF4), Jefferson County, Montana. Report to the Department of Sociology and Anthropology, Montana State University-Bozeman.

——— 2000 Resume of Geoarchaeological Research on the Northwest Plains. In *Geoarchaeology in the Great Plains,* edited by R. Mandel, pp. 199–249. University of Oklahoma Press, Norman.

Baumler, M. F., and L. B. Davis 2000 Upon Closer Examination: Paleoindian Behavioral Inferences from a Folsom Feature Lithic Assemblage at the Indian Creek Occupation Site, West-Central Montana Rockies. *Archaeology in Montana* 41(2):17–62.

Davis, L. B., J. P. Albanese, L. S. Cummings, and J. W. Fisher, Jr. 1991 Reappraisal of the MacHaffie Site Paleoindian Occupational Sequence. *Current Research in the Pleistocene* 8:17–20.

Davis, L. B., and M. F. Baumler 2000 The Clovis and Folsom Occupations at Indian Creek. *Current Research in the Pleistocene* 17:17–19.

Forbis, R. G. 1951 *The MacHaffie Site.* Ph.D. Dissertation, Department of Anthropology, Columbia University, New York.

Forbis, R. G., and J. D. Sperry 1952 An Early Man Site in Montana. *American Antiquity* 18:127–133.

Haynes, C. V., Jr. 1992 Contributions of Radiocarbon Dating to a Geochronology of the Peopling of the New World. In *Radiocarbon After Four Decades: An Interdisciplinary Perspective,* edited by R. E. Taylor, A. Long, and R. S. Kra, pp. 355–374. Springer-Verlag, New York.

——— 1993 Clovis-Folsom Geochronology and Climatic Change. In *From Kostenki to Clovis: Upper Paleolithic-PaleoIndian Adaptations,* edited by O. Soffer and N. D. Praslov, pp. 219–236. Plenum Press, New York.

Haynes, C. V., Jr., R. Beukens, A. T. Jull, and O. K. Davis 1992 New Radiocarbon Dates for Some Old Folsom Sites: Accelerator Technology. In *Ice Age Hunters of the Rockies,* edited by D. J. Stanford and J. S. Day, pp. 83–100. University Press of Colorado and the Denver Museum of Natural History, Niwot.

Holliday, V. T. 2000 The Evolution of Paleoindian Geochronology and Typology on the Great Plains. *Geoarchaeology: An International Journal* 15(3):227–290.

Meltzer, D. J. , L. C. Todd, and V. T. Holliday 2002 The Folsom (Paleoindian) Type Site: Past Investigations, Current Studies. *American Antiquity* 67:5–36.

Stanford, D. J. 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 of the First Americans,* edited by R. Bonnichsen and K. L. Turnmire, pp. 281-339.

Early-Holocene Site Kuznetsovo-3 in Northeastern Primoriye

Olga Dyakova

In 2001, the Amur-Primoriye Archaeological Expedition investigated the northeastern territory of Primorski Krai (or Primoriye, the Maritime Region in southern Far East Russia) within the basin of rivers Kuznetsovo, Amgu, and Soyon. The research team discovered a remarkable early-Holocene site named Kuznetsovo-3. The data from the site seem promising for preliminarily reconstructing the dynamics of this late-Pleistocene culture and establishing its northern limits.

The Kuznetsovo-3 site is 0.5 km northeast of the village of Kuznetsovo, Terney District, Primoski Krai. It occupies an area on a gentle slope abruptly ending as an escarpment facing the Sea of Japan. Site dimensions are 180 m east to west, 120 m north to south. The altitude is 20 m above sea level. The slope is grassy, without trees or bushes. A country road passes across the site and damages it. Several small, intermittent streams dissect the landform; we have closely studied one of these cuts. The stratigraphic profile showed diluvial deposits in the form of light-brown loam with inclusions of detritus. The test pit and damaged ground surface yielded 28 artifacts with retouched edges, two microblades with trapezoidal cross-section (2.5 by 0.8 cm and 1.8 by 0.5 cm), one fragment of a retouched biface tip, one endscraper on a flaked blade, seven small and medium-sized flakes, and a microcore (Figure 1). All the stone artifacts except the microcore are made from ivory-colored siliceous stone. The microcore is black obsidian (Dyakova 2001). The collection proves singular in that it represents primarily pressure, rather than percussion, flaking technology.

Currently our data are insufficient to justify any correlations or far-flung conclusions. Yet we must note that similar technology is characteristic of the Novopetrovka settlement (the Novopetrovka Blade Culture) in Priamuriye (Amur Basin Region), while in Primoriye such a technology occurs in the lower layer of the Ulyss settlement (Dyakov 2000). We cannot exclude the possibility that the Kuznetsovo-3 exemplifies a transitional stage between the late-Paleolithic Ustinovka culture and Neolithic cultures. However, there is one evident fact, that the Kuznetsovo-3 is the northernmost occurrence of this type of site in Primoriye.

Reference Cited

Dyakov, V. I. 2000 *Primoriye v rannem golotsene. Mezoliticheskoe poselenie Ustinovka-IV (Primoriye in the Early Holocene. Mesolithic Settlement Ustinovka-4). In Russian.* Dalnauka, Vladivostok.

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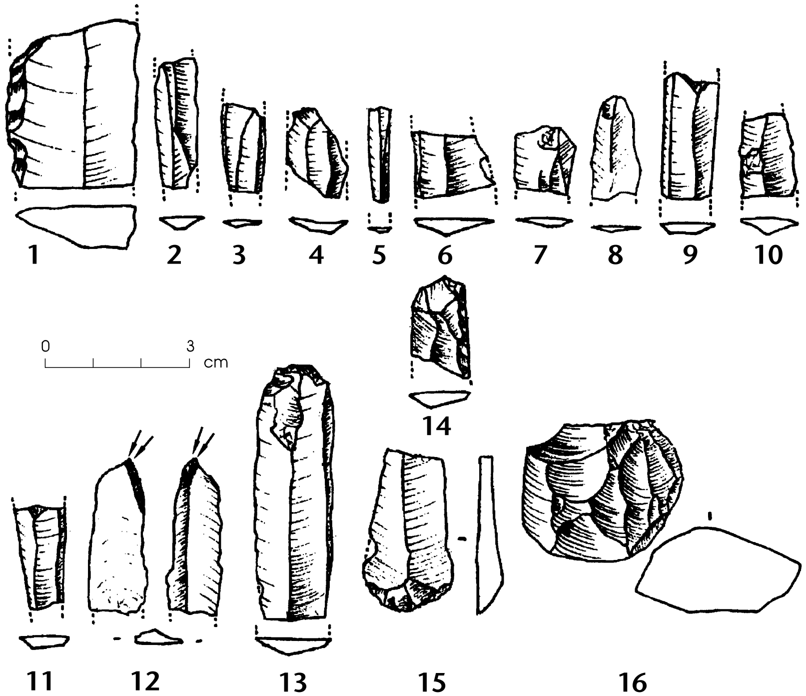

Figure 1. Stone artifacts from the site of Kuznetsovo-3 (found in 2001): **1–14,** blades and blade fragments; **15,** scraper; **16,** micro-core.

Two Moon, a Folsom Rockshelter Occupation in the Bighorn Mountains, Wyoming

Judson B. Finley, Brian N. Andrews, Marcel Kornfeld, and George C. Frison

Rockshelters are important to notions of North America's Paleoindian settlement. In most areas of the world, early rockshelter occupations are ubiquitous; however, minimal evidence exists in North America for such occupations dating between 12,000 and 10,000 yr B.P. Furthermore, one must ask why, in the colonization of the Western Hemisphere, South American Paleoindians utilized rockshelters, yet in North America rockshelters went virtually unnoticed. Collins (1991) attributed this fact to preservation and to the standard practice of excavating shelter interiors only; Kelly and Todd (1988) suggested unfamiliarity with ancient landscapes and highly mobile lifestyles are plausible explanations. Regardless, few documented Folsom rockshelter occupations exist (e.g., Dibble and Lorrain 1968; Hibben 1941; Miller 1982). This report presents the additional finding of a Folsom rockshelter occupation in the Bighorn Mountains of north-central Wyoming.

Both rockshelters and early-Paleoindian sites are widespread in the Bighorn region. Until now, no rockshelter occupations dated earlier than ca. 9500 yr B.P. (Frison 1991). Most rockshelters here are found at high elevations (ca. 2,000 m), raising questions of Paleoindian montane adaptations, a lifestyle thought to contrast significantly with Plains-oriented big-game hunters (Frison 1973, 1992, 1997). Clovis, Goshen, and Folsom artifacts found in the Bighorn Mountains indicate that early Plains Paleoindians probably collected toolstone there (Frison 1991:69). The Black Mountain Archaeological District (BMAD) is one such place.

BMAD is a major source of Phosphoria chert, an important raw material first utilized by Clovis hunters (Frison and Todd 1986). Diagnostic surface artifacts indicate that people used BMAD from early-Paleoindian through late-Prehistoric times (Kornfeld et al. 1998). Many limestone rockshelters also lie along Spring Creek, the district's major drainage; of these, Two Moon Shelter (48BH1827) and BA Cave (48BH1065) are currently under investigation. Here we focus on Two Moon Shelter and its role in western North America's early-Paleoindian prehistory.

The Two Moon Shelter archaeological deposit is a dense, chipped-stone debris midden—over 14,000 pieces came from a 1-by-2-m excavation unit. Of that, 99 percent is Phosphoria; the few formal and informal tools recovered indicate its function as a workshop. Datable ^{14}C or bone is minimal, and diagnostic artifacts are limited to two specimens. In 1999, we found in situ a large Morrison quartzite bi-beveled, bifacial knife (Finley et al. 2000). The knife resembles those recovered from a Pryor Stemmed component (ca. 8000 yr B.P.) at Medicine Lodge Creek (Frison 1976), located approximately 30 km from BMAD. In 2001, we recovered a small fragment of a Folsom projectile point base from a context approximately 3 cm below the Pryor Stemmed knife. Charcoal associated with the Folsom point returned an age estimate of 10,060 ± 60 yr B.P. (Beta-164002). This find provides significant new evidence of early-Paleoindian rockshelter utilization in western North America.

With dimensions of approximately 15-by-7-by-4 mm, the Two Moon Folsom fragment is made of gray quartzite, possibly from a source 5 km to the southeast. A complete channel covers most of one face; its maker apparently made two attempts to remove the other flute. The artifact has a radial break (not suggested to be intentional) and is sheared along one medial margin, preserving a single ear and part of the channel-flake platform. Classic Folsom

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post-fluting retouch is evident along both faces of the one intact lateral margin; however, its maker performed no final retouching along the proximal margin. Thus the specimen probably broke during final retouching or post-manufacture utilization, most likely the latter owing to its presence in a primary-reduction workshop. Since we recovered only a small portion of the base, it is not possible to verify post-manufacture utilization through microscopic use-wear analysis.

The Two Moon specimen is similar to points from the Hanson site (Frison and Bradley 1980:Figure 31; Ingbar 1992), a Folsom workshop located less than 20 km northwest of BMAD at the basin/foothills margin. Mountain raw material sources like Phosphoria were important to the Hanson site occupants. Since most Hanson projectile points and channel flakes were made of Phosphoria, those ancient flintknappers may have preferred it for their weaponry (Ingbar 1992:182). Furthermore, unfluted Phosphoria preforms were apparently brought to Hanson for final manufacture. Given the previous Folsom surface finds at BMAD, early Paleoindians were certainly familiar with it as a reliable source. BMAD is the closest (and largest) known Phosphoria source to Hanson; conceivably, BMAD was the source area and Two Moon the workshop utilized by Hanson's Folsom occupants.

While this find does not dramatically alter our notions of Paleoindian landscape use, it does demonstrate that early inhabitants were familiar enough with ancient landscapes to utilize rockshelters. It should come as no surprise that Folsom people, deliberately using BMAD to collect and prepare Phosphoria tools and preforms, made use of the area's many rockshelters to carry out these activities.

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References Cited

Collins, M. B. 1991 Rockshelters and the Early Archaeological Record in North America. In *The First Americans: Search and Research*, edited by T. D. Dillehay and D. J. Meltzer, pp. 157–182. CRC Press, Boca Raton, Florida.

Dibble, D. S., and D. Lorrain 1968 Bonfire Shelter: A Stratified Bison Kill Site, Val Verde County, Texas. Texas Memorial Museum Miscellaneous Papers No. 1. University of Texas, Austin.

Finley, J. B., M. Kornfeld, and G. C. Frison 2000 Black Mountain Archaeological District: Preliminary Report for the 1999 Season. Technical Report No. 18b, Department of Anthropology, University of Wyoming, Laramie.

Frison, G. C. 1973 Early Period Marginal Cultural Groups in Northern Wyoming. *Plains Anthropologist* 18:300–312.

——— 1976 The Chronology of Paleoindian and Altithermal Period Groups in the Bighorn Basin, Wyoming. In *Culture Change and Continuity: Essays in Honor of James Bennett Griffin,* edited by C. E. Cleland, pp. 147–173. Academic Press, New York.

——— 1991 *Prehistoric Hunters of the High Plains.* 2nd ed. Academic Press, San Diego.

——— 1992 The Foothills-Mountains and the Open Plains: The Dichotomy in Paleoindian Subsistence Strategies Between Two Ecosystems. In *Ice Age Hunters of the Rockies*, edited by D. J. Stanford and J. S. Day, pp. 323–342. Denver Museum of Natural History and University of Colorado Press, Niwot, Colorado.

——— 1997 The Foothill-Mountain Late Paleoindian and Early Plains Archaic Chronology and Subsistence. In *Changing Perspectives of the Archaic on the Northwest Plains and Rocky Mountains*, edited by M. L. Larson and J. E. Francis, pp. 84–105. The University of South Dakota Press, Vermillion.

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

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

Hibben, F. C. 1941 Evidences of Early Occupation in Sandia Cave, New Mexico, and other Sites in the Sandia-Manzano Region. *Smithsonian Miscellaneous Collections* 99:1–44. Washington, D.C.

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 and University of Colorado Press, Niwot.

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

Kornfeld, M., J. B. Finley, J. Kennedy, J. Durr, and G. C. Frison 1998 *Black Mountain Archaeological District: 1997 Field Study and Summary of Current Investigations.* Technical Report No. 16a, Department of Anthropology, University of Wyoming, Laramie.

Miller, S. J. 1982 The Archaeology and Geology of an Extinct Megafauna/Fluted Point Association at Owl Cave, the Wasden Site, Idaho. In *Peopling of the New World*, edited by J. E. Ericson, R. E. Taylor, and R. Berger. Ballena Press Anthropological Papers No. 23. Los Altos, California.

Early-Paleoindian Projectile Point Distribution in Alberta, Canada

Jason Gillespie, Andrea Freeman, and Eugene Gryba

Although the distribution of early-Paleoindian (fluted and basally thinned) projectile points from the United States has recently been published (e.g., Anderson and Faught 2000), these surveys do not include Alberta. This is problematic given that the Alberta region comprises a large portion of the classically conceived "Ice-Free Corridor" and may have provided the route by which Paleoindians entered the lower 48 states. Exclusion of the Alberta sample limits our ability to model early-Paleoindian migrations (e.g., Anderson and Gillam 2000).

The distribution of early-Paleoindian projectile points in Alberta (n = 156) (Figure 1) provides information on both past and present cultural behaviors. There are two clusters within the province, a small one in the Grande Prairie region and a large one in the south. Early projectile points are found only in

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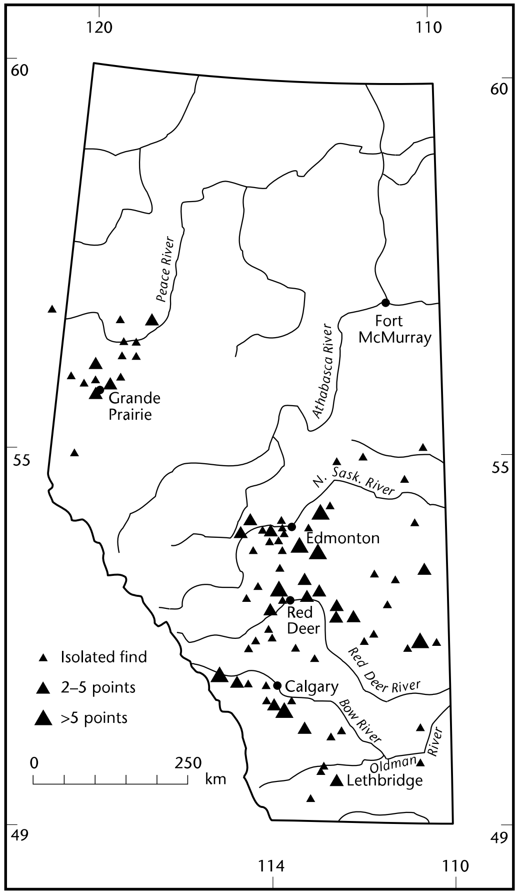

Figure 1. The Distribution of Early-Paleoindian Projectile Points. Source *Gryba 1988.*

the southern prairie/plains and montane ecozones and not in the northern boreal forest. Modern processes that have contributed to this pattern include the concentration of urban development, agricultural practices, locations of amateur archaeological societies, and intensity of archaeological reconnaissance in the southern portions of the province. These processes are much less active in the northern boreal forest.

Although modern practices partly explain the distribution of early points, past processes were also important. It is likely that the concentration of surface finds, in the south rather than the north, is partly explained by late-Pleistocene migrations and settlement patterns. The radiocarbon chronology from Alberta suggests that people carrying fluted and basally thinned projectile points did not move into Alberta until after ca. 11,000 RCYBP (Gillespie 2002). This suggests a late *northern* migration of people in Alberta rather than an early (pre-11,500 yr B.P.) *southern* migration, as has been historically conceived. Settlement patterns for these projectile points, derived from isolated surface finds, suggest affinities with High Plains groups rather than Alaskan groups (Gillespie 2002).

The Alberta fluted-point assemblage is dissimilar to its counterparts from the United States in size, style, and lithic materials used (Gryba 2001). Dissimilarity in size is partly due to extensive reworking of several samples. Style differences are accentuated by the poor quality of lithic resources available in Alberta (Gillespie 2002). In conclusion, the large size of the assemblage, combined with its apparent dissimilarity to the American sample and location within the late-opening deglacial corridor, indicates that late-Pleistocene colonization models that do not include this information may be problematic.

References Cited

Anderson, D. G., and M. K. Faught 2000 Paleoindian Artefact Distributions: Evidence and Implications. *Antiquity* 74:507–513.

Anderson, D. G., and J. C. Gillam 2000 Paleoindian Colonization of the Americas: Implications from an Examination of Physiography, Demography, and Artifact Distribution. *American Antiquity* 65(1):43–66.

Gillespie, J. 2002 Archaeological and Geological Evidence for the First Peopling of Alberta. Unpublished M.A. Thesis. University of Calgary.

Gryba, E. M. 1988 An Inventory of the Fluted Point Occurrences in Alberta. On File with the Archaeological Survey of Alberta.

——— 2001 Evidence of the Fluted Point Tradition in Western Canada. In *On Being First: Cultural Innovations and Environmental Consequences of First Peopling*, edited by J. Gillespie, S. Tupakka, and C. de Mille, pp. 251–284. Chacmool, Calgary.

Bone Technology at the Sentinel Gap Site

Stan Gough and Jerry R. Galm

A significant number of bone implements and ornaments are present in the large artifact assemblage recovered from the ca. 10,200 yr B.P. occupation at the Sentinel Gap site (45KT1362) in central Washington (Galm and Gough 2000). This sample and associated bone technological system are consistent with reported elements of Folsom bone technology (Hofman et al. 2000). Both bone and antler appear to be represented in this sample although exact identifications are difficult since most of these artifacts are coated and infused with carbonate salts ($CaCO_3$). The size and diversity of this sample are especially noteworthy as they imply a technological richness suggestive of companion industries in wood and twisted/woven fibers (i.e., “soft” technologies).

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The distal fragment of a clothespin-style bone/antler foreshaft in this sample has a large notch capable of accommodating a large (ca. 10 cm) point form (Figure 1L). The length and thickness of this piece suggest an affiliation with a large composite weapon system.

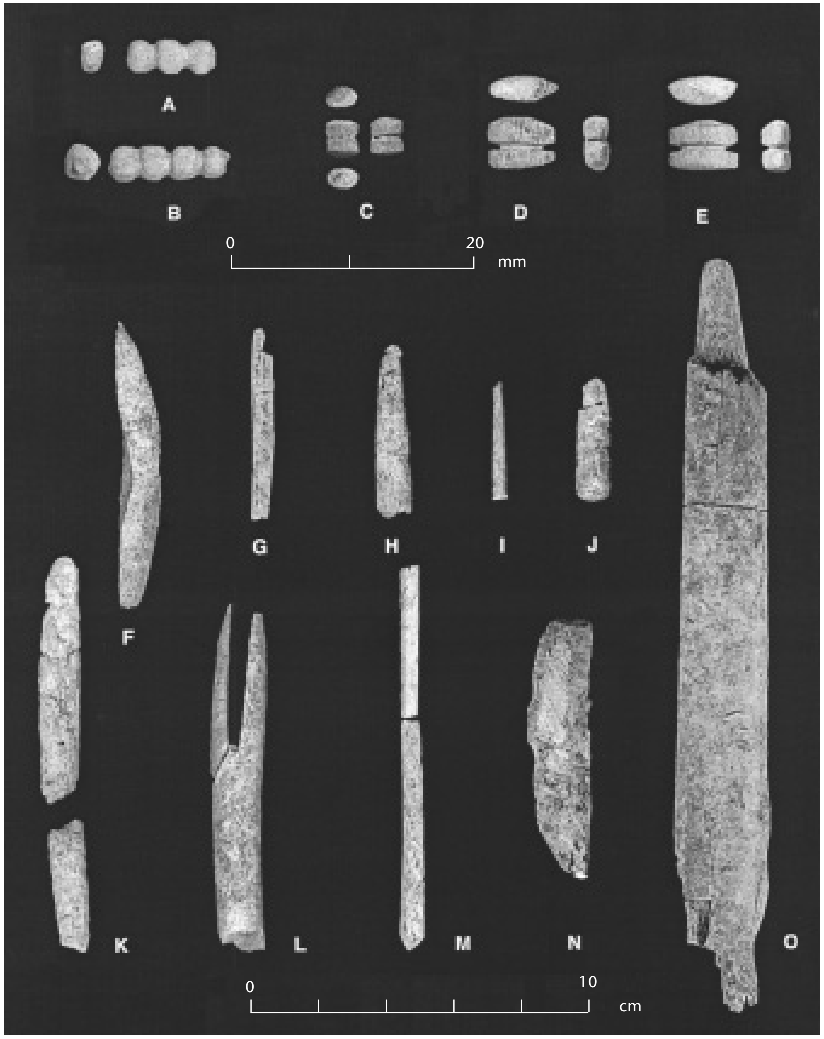

Figure 1. Selected Sentinel Gap site bone or antler beads/ornaments (A–E) and implements (F–O).

Two needle segments are present, the first of which is similar in shape and size to a form recovered at Marmes Rockshelter (Rice 1972:121–123). A second specimen (not illustrated) is a circular midsection fragment comparable in size and shape to eyed needles from the Lind Coulee site (Irwin and Moody 1978).

A significant sample of bone shaft implements (Figure 1F, G, H, K, M) and two specimens with wedge-shaped configurations (Figure 1J) were recovered from the occupation surface. Inferred uses of these pieces as pressure flakers, awls, and possibly even items of adornment reflect the variability in the overall shape and mass of included specimens. This sample also includes a spatulate-end bone implement (Figure 1O).

A 36.4-cm-long bone rod (not illustrated) was recovered as a series of articulated pieces in the field. One end is tapered and rounded to produce a blunt end configuration. The other end of the rod exhibits a single bevel and a rounded outer margin.

Very small ornaments were recovered from flotation and fine-fraction samples. Two examples (Figure 1A, B; Figure 1D, E) constitute a bead or ornament manufacturing stage. Final forms presumably would have been drilled and snapped off for use. A second category (Figure 1A–E), including a smaller version of this style (Figure 1C), exhibits a central groove around the circumference and remnant protrusions on either end consistent with manufacture as a connected series of forms.

References Cited

Galm, J. R., and S. Gough 2000 Site 45KT1362, a ca. 10,000 yr B.P. Occupation in Central Washington. *Current Research in the Pleistocene* 17:29–31.

Hofman, J. L., R. O. Rose, L. D. Martin, and D. S. Amick 2000 Folsom Adornment and Bone Technology. *Current Research in the Pleistocene* 17:42–45.

Irwin, A. M., and U. Moody 1978 The Lind Coulee Site (45GR97). Washington Archaeological Research Center, Washington State University, Project Report 56.

Rice, D. G. 1972 The Windust Phase in Lower Snake River Region Prehistory. Laboratory of Anthropology, Washington State University, Report of Investigations 50.

More Conjoined Fluted Projectile Points from the Vail Site, Maine

Richard Michael Gramly

Archaeological fieldwork in the Magalloway River valley of the northwestern Maine highlands since 1979 has led to the discovery of 10 sites of fluted-point-using Paleoamericans. Judging by shared use of raw materials and flaked toolforms, all these sites are related and undoubtedly close in age. Three of the 10 sites appear to be outliers or task areas belonging to the largest site in the valley, the Vail site (Gramly 1982).

All three task areas were explored in 1980–84. The one nearest the Vail site yielded 10 fluted points; the other two, nearly a kilometer upwind, produced

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only fluted points and butchering tools (Gramly 1984). The outlier closest to the encampment has been dubbed "Vail kill site #1" in harmony with the belief that herd animals, likely caribou, were intercepted there seasonally (Gramly, in Gibbon 1998).

Four of the fluted points at Vail kill site #1 were intact, but the remainder were represented only by tips and midsections. We were able to fit five of the six point fragments to bases unearthed at the encampment, 200–250 m to the east.

In 2001, an unusually snowless late fall, coupled with an earlier drought in New England, prevented man-made Aziscohos Lake from covering the Magalloway valley and its several Paleoamerican sites. Amateur archaeologist John Halunen of Farmington, Maine, was able to search the windswept lakebed and discovered two fragmentary fluted points at Vail kill site #1. These specimens are medial fragments of large points in excellent, nearly unweathered condition. Judging by his report, the fragments had eroded from sand and gravel near the bank of the ancient Magalloway River, 15–20 m east of the find-spots of the 10 fluted points recovered earlier.

In March 2002 the writer visited the Maine State Museum, where the Vail site collection is housed, and was able to match Halunen's points to basal fragments excavated in 1980. Although the conjoined fluted points are incomplete, enough is present to indicate that both were once deeply concave weapon tips of impressive size (Figure 1). Although the more complete fluted point had undergone resharpening in ancient times and the extreme tip is missing, its length when freshly made is estimated at 12–13 cm.

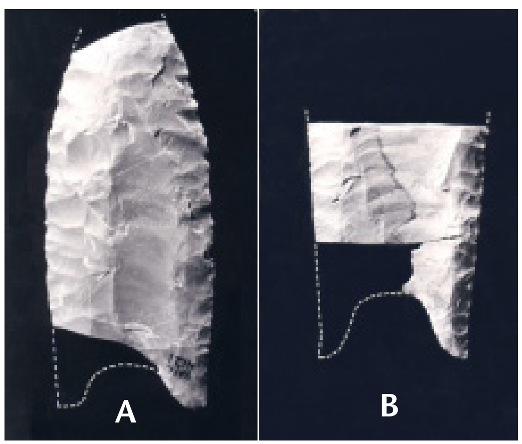

Figure 1. Newly conjoined fluted points from the Vail site. **A,** heavily resharpened fluted point of gray chert from kill site #1 and Locus E (catalogue #4121). Surviving length is 84 mm; estimated length when freshly made is 120-130 mm. **B,** elegant fragmentary fluted point of greenish-gray and tan chert with an exaggerated basal concavity (depth, 14 mm) from kill site #1 and Locus F (catalogue #7419). The fragment is 50 mm long; the complete, unresharpened point may have approached 150 mm in length.

The newly conjoined specimens are derived from Loci E and F at the Vail site. These loci and six others (A–D, G, and H) are separate habitation areas where we hypothesize tents made of hides once stood. Discoveries at the nearby Adkins fluted-point site (Gramly 1988) suggest that tents used by the Magalloway River Paleoamerican band may have accommodated six to eight adults.

It is important to note that the conjoined fluted points link six of the eight Vail habitation loci (A-F) with Kill Site #1. One is inclined to argue that all the

Vail site loci were occupied during any single visit to the valley by hunters.

A band of 35–50 Paleoamericans would require a large kill of caribou to satisfy their annual demand for clothing, sleeping skins, tent-skins, antler, and sinew. Hundreds of animals may have been taken each year during the migration from calving grounds towards their winter quarters in the south.

Judging by the mass of flaked-stone artifacts tallied from the Vail site since its discovery in 1972 (approximately 13,500 catalogued specimens; see Gramly 1995) and the amount of debris deposited during one occupational episode, the six tents may have been occupied by hunters only nine or ten times.

If the Magalloway Valley caribou herd was small, predation by 35–50 people over 9 or 10 years may have reduced the herd dramatically and caused it to abandon the region. Were it so, the Paleoamerican band would have been forced to decamp in search of virgin grounds.

Spiess (1984) has argued for relatively short periods of occupancy of fluted point sites in northeastern North America, and recent discoveries at the Vail site suggest that his hypothesis is not wide of the mark.

The help of ASAA member Greg Lott of Plymouth, Massachusetts, in bringing the newly found fluted points to my attention is deeply appreciated.

References Cited

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

——— 1984 Kill Sites, Killing Ground and Fluted Points at the Vail Site. *Archaeology of Eastern North America* 12:110–121.

——— 1988 The Adkins Site: A Palaeo-Indian Habitation and Associated Stone Structure. Persimmon Press, Buffalo, New York.

——— 1995 The Vail Palaeo-Indian Site, Maine: Fifteen Years After the Excavation. *The Amateur Archaeologist* 1(2):46–64.

——— 1998 Vail Site. In *Archaeology of Prehistoric Native America: An Encyclopaedia*, edited by G. Gibbon, pp. 863–864. Garland Press, New York.

Speiss, A. E. 1984 Arctic Garbage and New England Paleo-Indians: The Single Occupation Option. *Archaeology of Eastern North America* 12:280–285.

2001 Investigations at the Clary Ranch Site, Nebraska

Matthew Glenn Hill, Matthew E. Hill, Jr., David W. May, Thomas P. Myers, David J. Rapson, Frédéric Sellet, James L. Theler, and Lawrence C. Todd

The Clary Ranch (25GD106) site is located ca. 130 km west of the confluence of the north and south forks of the Platte River at North Platte, Nebraska, along the south bank of Ash Hollow Creek, ca. 5.5 km south of the point where the stream intermittently flows into the North Platte River. In 1970, Oren Clary reported to the University of Nebraska State Museum (UNSM) that late-Paleoindian (ca. 8500–9000 yr B.P.) lithic artifacts and flakes, charcoal, and bison remains were eroding from a deeply buried horizon along Ash Hollow Creek. In 1979, Thomas P. Myers supervised the first of four consecutive field seasons at the site in which 194 m^2 of the archaeological component was excavated by the end of the 1982 season.

Over the past several years, we have been analyzing archaeological materials recovered from the UNSM excavations with intentions of preparing a monograph on the site. To date, only examination of the bison archaeofauna has been completed (Hill 2001). Study of other data sets is ongoing; however, several problems have frustrated analysis and interpretation. In June 2001, we conducted a 10-day field session at the site as a first step towards future excavations to address several questions that cannot be resolved with the existing information, including aspects of the site's geoarchaeological and paleoenvironmental context, the intensity and duration of the occupation, and differences in Paleoindian activities across the site. The accomplished objectives and preliminary results of the 2001 field investigations are summarized below.

Five permanent datums were set to serve as control points in the UTM grid system that was subsequently established for the site and surrounding landscape using GPS and total station survey equipment. The UTM grid will be used for provenience control in all future work at the site, including topographic mapping, excavation, and various off-site specialist activities.

Intact early-Holocene sediment was exposed in two areas of Area A of the UNSM excavations that had been identified beforehand as having good potential to initiate future excavations, which we intend to do. "Area A East" is a 1-by-7-m block of intact sediment separating two UNSM blocks near the eastern end of excavations. "Area A West" is a 6-m^2 L-shaped block of intact sediment flanking previously excavated units at the western end of Area A.

The site's geoarchaeological and paleoenvironmental context was evaluated and enhanced. Stratigraphically, the Paleoindian component lies near the base of Terrace-2 alluvium (cf. Tanner 1982), ca. 1 m above a stratum tentatively interpreted as the Brady soil (Johnson and Park 1996; Johnson and Willey 2000). Across most of the site, archaeological remains occur slightly above a 1- to 3-cm-thick organic-rich horizon interpreted as "remnants of an old bog containing charred wood and hackberry seeds" (Myers et al. 1981:2). In some areas, however, items have been displaced vertically and are now encased within or lie several centimeters below the organic-rich stratum. The sediments immediately above the Paleoindian component and the organic-rich stratum are silt. These deposits are unconformably overlain by probable late-Holocene channel and overbank deposits. Thus the Paleoindian archaeological remains are within the basal deposits of early-Holocene Terrace-2 fill. This fill was deeply trenched and laterally eroded during the late Holocene, destroying, redepositing, or rearranging areas of the archaeological component, but Paleoindian deposits still exist in primary depositional context across much of the site.

Significantly, the earlier suggestion that the organic-rich stratum is a "remnant of an old bog" is not in accordance with preliminary results from the 2001 fieldwork. While the archaeological remains are encased in fine-grained alluvial sediments, there are no obvious signs of soft sediment deformation by trampling herbivores, for example, that may have led to vertical displacement of specimens. Moreover, although the level was not sampled for gastropods, samples bracketing it are dominated by terrestrial species that today inhabit relatively dry substrates. Three ideas regarding the origin of the stratum will be examined with additional field data. First, it may represent a small flood that redistributed charcoal from hearths at the site. Second, it could be from a flood, and the charcoal was produced by a prairie fire and concentrated in slackwater associated with a flood of Ash Hollow Creek or one of its tributaries. Third, it might be part of a lake deposit that reached the site area as the result of damming of the North Platte River by sand dunes (Muhs et al. 2000; Swinehart and Loope 1992) or by dunes damming the mouths of north-flowing tributaries to the North Platte River (Swinehart, pers. comm. 2001).

Subfossil terrestrial gastropods extracted from four bulk sediment samples add important new data on the early-Holocene environment of the Ash Hollow drainage. These samples, referred to as the Lower Brady Soil (LBS), Upper Brady Soil (UBS), Above Brady Soil (ABS), and Above Black Carbonaceous Stratum (ABC), collectively produced 2,955 terrestrial gastropods representing 14 taxa. The Paleoindian component is bracketed by the ABS and ABC samples. Briefly, the LBS assemblage indicates a cool, moist meadow with standing water and/or perennial spring seeps. The overlying assemblages suggest a shift to a somewhat drier setting, with no immediate standing

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water, but still relatively well vegetated and moist during the warm season.

Special thanks is extended to Mrs. Naomi Clary, Robert and Dee Clary, Warren and Jeanne Clary, and Vern and Vivian Kallsen for their support and tolerance of this project. The field crew was comprised of participants in the 2001 CSU field school, as well as volunteers P. Burnett, C. Egeland, M. Burns, B. Thomas, and N. May. Thanks to all the field crew for their outstanding field attitude and hard work!

References Cited

Hill, M. G. 2001 Paleoindian Diet and Subsistence Behavior on the Northwestern Great Plains of North America. Unpublished Ph. D. dissertation, Department of Anthropology, University of Wisconsin, Madison.

Johnson, W. C., and K. Park 1996 Late Wisconsinan and Holocene Environmental History. In *Archeology and Paleoecology of the Central Great Plains,* edited by J. L. Hofman, pp. 3–28. Arkansas Archeological Survey Research Series No. 48, Fayetteville.

Johnson, W. C., and K. L. Willey 2000 Isotopic and Rock Magnetic Expression of Environmental Change at the Pleistocene-Holocene Transition in the Central Great Plains. *Quaternary International* 67:89–106.

Muhs, D. R., J. B. Swinehart, D. B. Loope, J. Been, S. A. Mahan, and C. A. Bush 2000 Geochemical Evidence for an Eolian Sand Dam across the North and South Platte Rivers in Nebraska. *Quaternary Research* 53:214–222.

Myers, T. P., R. G. Corner, and L. G. Tanner 1981 Preliminary Report on the 1979 Excavations at the Clary Ranch Site. *Transactions of the Nebraska Academy of Sciences* 9:1–7.

Swinehart, J. B., and D. B. Loope 1992 A Giant Dune-Dammed Lake on the North Platte River, Nebraska. *Geological Society of America Annual Meeting Abstracts* 24:51.

Tanner, L. G. 1982 Geologic Relations at the Clary Ranch Site, Ash Hollow, Garden County, Nebraska (Abstract). *Proceedings of the Nebraska Academy of Sciences* 92:52.

A Folsom Camp in the Black Forest Area of Colorado

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A Folsom camp in upper Bijou Creek, Elbert County, Colorado, is located near sources of Black Forest silicified wood. Production of Folsom artifacts from this stone is evidenced by fluted preforms, channel flakes, and many retouch flakes. The assemblage includes over 1,500 pieces, with point fragments, scrapers, gravers, notches, and varied flake tools well represented. Discrete artifact concentrations recognized at the site represent either activity areas or differential deflation and exposure. Discovered by Grayson Westfall in 1999 (Westfall 2001), systematic site mapping and recording began in May 2001 (Hofman et al. 2001).

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Black Forest silicified wood occurs as cobbles and residual pieces within 1 km of the site. Westfall is one of several sites in the region, including Hahn (5EP1) (Greiser 1985; Stanford 1999), where Folsom people produced preforms and other artifacts from this distinctive, typically yellow and brown mottled silicified wood (Figure 1). Folsom artifacts of this material usually occur in small numbers in assemblages throughout the central High Plains of eastern Colorado, southwestern Nebraska, western Kansas, and the San Luis Valley of southern Colorado (Hofman 2002; Hofman and Toft n.d.; Jodry 1999a, 1999b).

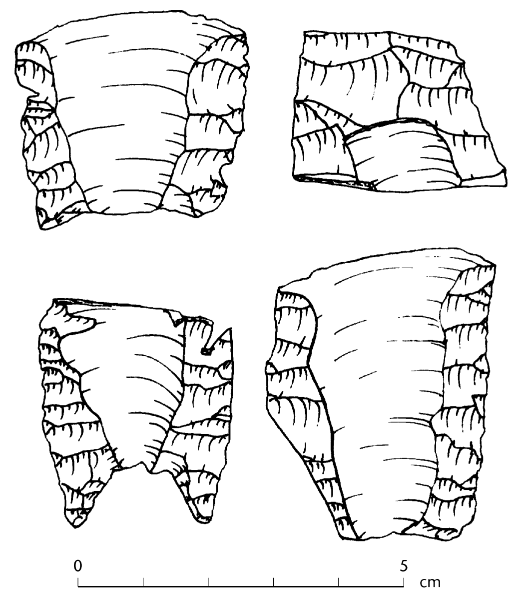

Figure 1. Four fluted Folsom preforms from the Westfall site. All are manufactured from Black Forest silicified wood.

The total area of the Westfall site can be estimated by exposures that have yielded artifacts. Intermittent wind erosion has exposed artifacts over a maximum area of 170 m east-west by 80 m north-south, or approximately 13,600 m^2. Within this space, however, are extensive areas that as yet have not yielded artifacts. Five concentrations of artifacts have been defined, but these may reflect erosional history rather than discrete prehistoric activity areas. Future investigations will help evaluate the probability that activity areas are preserved.

Area A, the most productive, yielded materials from an area of 50 by 30 m (1,500 m^2). The majority of small flakes have come from this area as well as numerous burned flakes and tools, broken (discarded) tools, flake tools, scrapers, point fragments, broken performs, and channel flakes. In addition, pieces of hematite were found, including one large ground piece, and several large sandstone pieces, which may be part of an anvil. A variety of mostly late-stage stone tool fabrication and tool retouch is evident in Area A, and one or more hearths are suspected. Other areas located 20–100 m from Area A, mostly smaller in size, are less productive. Burned artifacts and a cobble tool were found in Area B, while Area D yielded several pieces of Flattop chalcedony including two tools (200 km to source area). Area E artifacts include Alibates flakes and tools (450 km to source area). It is assumed at present that these areas represent more or less contemporaneous activities, but the refit pieces have not yet provided direct links between the areas. All the diagnostic prehistoric materials from these areas are Folsom.

The dominant artifacts are small (< 2 cm) flakes of Black Forest silicified wood (51 percent of the chipped stone [CS]). More than half of these have intact platforms, as is true for the larger (> 2 cm) flakes (11 percent of the CS). This may reflect minimal post-removal breakage due to factors such as trampling, the small size of pieces, and the soft substrate. Few pieces (5 percent of the CS, a third of these > 2 cm) exhibit cortex, suggesting that most flint working presently sampled pertained to final shaping, finishing, and maintenance of tools. Burned lithic pieces (13 percent of the CS) are mostly small and concentrated, suggesting the presence of hearths rather than general range fire or other total-area burning events.

Manufacturing activities are evidenced by early-stage biface failures (n = 7) and Folsom preforms (n = 11), which failed during the first or second fluting attempt (Figure 1). In addition, numerous channel flakes (n = 41, 13 with platforms) are represented. Six finished Folsom points are represented by basal and edge fragments. One is made from dendritic jasper, possibly from the Hartville Uplift region.

Informal modified flakes are common, exhibiting patterned damage along one or more edges. Notched flakes are abundant (n = 34) and deserve detailed study. Endscrapers are less common than preforms, and none exhibit the rounded polish usually associated with dry-hide wear (Keeley 1980). Non-chipped-stone artifacts include an edge-trimmed cobble with heavily pecked edges and abraded surfaces from Area B and a quartz cobble hammerstone from Area A.

A spring/marsh area located near the Westfall site is protected from most directions by low hills. Wooded ridges occur within several kilometers as does extensive open range. Folsom people would have had access to such key resources in this locality as water, wood, protected camp settings, diverse plants, quality lithics, and overlooks to monitor game movements.

Our thanks are extended to Myra Westfall, Jack Westfall, Erin Westfall, Dan Busse, Steve Juranek, Jeannette Blackmar, Brent Buenger, and Jen Wheeler. Also, our sincere appreciation to the tenants and land owners for facilitating this research.

References Cited.

Greiser, S. T. 1985 Predictive Models of Hunter-Gatherer Subsistence and Settlement Strategies on the Central High Plains. Plains Anthropologist Memoir 20.

Hofman, J. L. 2002 Tethered to Stone or Freedom to Move: Folsom Biface Technology in Regional Perspective. In *From 'Coups de Poing' to Clovis: Multiple Approaches to Biface Variability*, edited by M. Soressi and H. L. Dibble. Univeristy of Pennsylvania Museum. In press.

Hofman, J. L., and M. Toft. n.d. The Luft Site and Folsom Use of Flattop Chalcedony in Northeastern Colorado. Unpublished manuscript (1999).

Hofman, J. L., G. Westfall, and T. Westfall 2001 Westfall: A Folsom Campsite in the Black Forest Area of Colorado. Presented at the 2001 Plains Anthropological Society Meeting, Lincoln, NE.

Jodry, M. A. 1999a Paleoindian Stage. In *Colorado Prehistory: A Context for the Rio Grande Basin*, by M. A. Martorano, T. Hoefer, III, M. A. Jodry, V. Spero, and M. L. Taylor, pp. 45–114. Colorado Council of Professional Archaeologists. Denver.

——— 1999b Folsom Technological and Socioeconomic Strategies: Views from Stewart's Cattle Guard and the Upper Rio Grande Basin, Colorado. Ph. D. Dissertation. American University, Washington, D. C.

Keeley, L. H. 1980 *Experimental Determination of Stone Tool Use: A Microwear Analysis.* University of Chicago Press, Chicago.

Stanford, D. J. 1999 Paleoindian Archaeology and Late Pleistocene Environments in the Plains and Southwestern United States. In, *Ice Age Peoples of North America*, edited by R. Bonnichsen and K. Turnmire, pp. 281–339. Oregon State University Press, Corvallis.

Westfall, G. 2001 The Westfall Folsom Site. *Indian Artifact Magazine* 29(2):46–47,72.

Edwards Chert Clovis Bifaces from Nebraska

Steven R. Holen

Two bifaces were found in 1939 by fishermen at a hydroelectric plant construction area at the edge of the Platte River valley in south-central Nebraska (Figure 1). The artifacts were found "40 ft. below surface in water and gravel" and mammoth bones were found nearby, according to field notes (Blue n.d.). The artifacts are made of a high-quality Edwards chert from central Texas (Banks 1990). Lithic identification is based on macroscopic examination, confirmed using a short-wave ultraviolet light under which the artifacts ex-

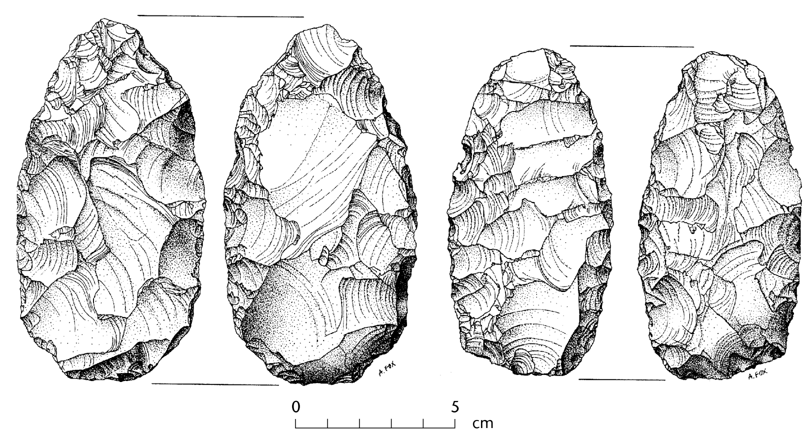

Figure 1. Clovis bifaces. Left, Cat. # Ft7431; right, Cat. #Ft7432.

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hibit an amber/orange fluorescence (Hofman et al. 1991:299–302). Edwards chert outcrops a minimum of 930 km south of the site (Holen 2001).

Measurements (in centimeters and grams) of biface Cat. # Ft7431 are length, 11.17; width, 5.95; basal width, 3.35; thickness, 1.47; weight, 120.8; for biface Cat. # Ft7432, length, 10.17; width, 5.13; basal width, 3.79; thickness, 1.42; weight, 89.1. The bifaces are ovate with squared bases and have convex lateral edges. Numerous short thick flakes were removed from lateral edges; some appear to be the result of use. An early-stage basal thinning flake that terminates in a hinge fracture is present on the smaller biface. These basal thinning flakes are common on point blanks from the Fenn Clovis Cache (Frison and Bradley 1999). Early- and later-stage percussion flaking is evident on both faces; some flakes extend over center, including one partially obscured overpass flake scar near the base of the larger artifact.

Lithic source data, contextual evidence, and technology suggest these two artifacts are part of the Clovis technocomplex. Clovis and Folsom artifacts made of Edwards chert have been recorded in the Central Plains (Hofman et al. 1991; Holen 2001:144–145), but later Edwards chert artifacts are rare. The presence of mammoth bones, indicating the artifacts were found in Pleistocene deposits, also supports a Clovis identification. These two artifacts appear to be Clovis projectile point blanks based on overall morphology; however, they are relatively thick compared with their width at this stage of reduction, in contrast with point blanks from the Anzick site (Wilke et al. 1991:249–254) and the Fenn Cache (Frison and Bradley 1999). The overpass flake scar also suggests Clovis bifacial reduction technology.

These two bifaces were probably part of a Clovis cache. If additional artifacts were present they were no doubt removed during construction activities. The bifaces may have been cached because their relative thickness and battered edges would have made projectile point production difficult. Caching lower-utility lithic tools at a mammoth kill site is a possibility, although there is no evidence that the mammoth and the artifacts were associated.

I thank Angie Fox, University of Nebraska State Museum Artist, for the excellent illustration. The bifaces are curated at the University of Nebraska State Museum.

References Cited

Banks, L. 1990 From Mountain Peaks to Alligator Stomachs: A Review of Lithic Sources in the Trans-Mississippi South, the Southern Plains, and Adjacent Southwest. Oklahoma Anthropological Society, Memoir 4.

Blue, E. L. n.d. Fieldnotes of E. L. Blue, July 24, 1939. Notes on file at the University of Nebraska State Museum, Division of Vertebrate Paleontology.

Frison, G., and B. Bradley 1999 The Fenn Cache: Clovis Weapons and Tools. One Horse Land and Cattle CO., Santa Fe, NM.

Hofman, J. L., L. C. Todd, and M. B. Collins 1991 Identification of Central Texas Edwards Chert at the Folsom and Lindenmeier Sites. *Plains Anthropologist* 36-137:297–308.

Holen, S. R. 2001 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.

2001 Excavations at the Boca Negra Wash Folsom Site, North-central New Mexico

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The Boca Negra Wash Folsom site was the scene of the University of New Mexico Southwestern Archaeological Field School from June 4 to July 13, 2001. Located about 25 km northwest of downtown Albuquerque on the east side of the Albuquerque Volcanoes, the Boca Negra Wash site was discovered in 1998 and tested in 1999–2000 (Huckell and Kilby 2000). Two discrete loci were identified from surface-exposed artifacts; they are approximately 60 m apart and lie around the margins of a small playa. Locus A is east of the playa, and testing showed it contained buried artifacts in a shallow pedogenically modified eolian sand resting atop basalt flows. Locus B, south of the playa, had been surface collected but not tested prior to 2001. The 13 field school students were split between the two loci; Kilby and Hamilton supervised work in Locus A while Buchanan and Ruth were responsible for Locus B. A system of 1-m grid squares was constructed for the site, and excavations were initiated with random (Locus A) and systematic (Locus B) sampling designs. All units were excavated by troweling in arbitrary 5-cm levels; sediments were passed through 1/4-in and 1/16-in screens.

In Locus A, 43 units excavated produced 174 pieces of flaked stone, 5 pieces of charcoal, 4 pieces of fire-cracked rocks, and 6 potsherds. Among the flaked stone artifacts were a small fragment of a uniface, a burned piece of a core, and small portions of two channel flakes (one obsidian and one Chuska chert). We also recovered several pieces of leporid and small mammal bone and four tiny fragments of tooth enamel from medium-to-large mammals. The sherds represent a gray plainware vessel broken near the north-central part of the locus; along with the fire-cracked rocks, they may represent a minor later occupation. We also determined that a dirt road and gas pipeline had removed a portion of the western end of the locus, leaving a small area of it west of the road. By chance a reworked obsidian Folsom point blade fragment, presumably derived from Locus A, was discovered on the road.

In Locus B, we dug 32 units. As in Locus A, the artifacts were concentrated in the upper part of the Bt horizon of a strong soil developed on a thick accumulation of eolian sand. The units produced 209 pieces of flaked stone, including one small basal edge fragment of a completed Pedernal chert Folsom point, an obsidian Folsom point preform broken during fluting of the second face, and seven channel flake fragments. The channel flakes were of

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Pedernal chert (n = 5), Chuska chert (n = 1), and obsidian (n = 1). Six small bone fragments and two pieces of medium-large mammal tooth enamel were also recovered, along with three pieces of charcoal. The Locus B units revealed an area approximately 10 m in diameter, within which 9 units produced 5–9 artifacts each, 6 contained 10–20, and one had 36. This is the highest artifact density yet seen at the site, and its fuller exploration will be a priority in 2002. No evidence of any younger occupations was observed at Locus B.

We also discovered what may be a third locus about 35 m west of Locus B. A Folsom point tip fragment of chert from an unknown source turned up on rodent burrow backdirt. On the surface within 4 m of it were an obsidian flake fragment and the proximal end of a petrified wood channel flake. Testing this area is a priority.

Field observations suggest that debitage raw materials from both loci are very consistent. In terms of known sources, Pedernal chert predominates by a wide margin, followed by obsidian and much more distantly by Chuska and Zuni spotted chert (Banks 1990; LeTourneau 1997, 2000). Assuming direct procurement of stone, we suggest that prior to reaching Boca Negra Wash, the Folsom group had visited the Jemez Mountains some 70 km to the north and restocked their lithic material supply with Pedernal chert and Valle Grande obsidian (identified by M. S. Shackley 2000 pers. comm.). The Chuska and Zuni spotted chert imply that the group had moved eastward from the Arizona–New Mexico border, probably visiting the Zuni Mountains before turning northeast into the Jemez.

References Cited

Banks, L. D. 1990 From Mountain Peaks to Alligator Stomachs: A Review of Lithic Sources in the Trans-Mississippi South, the Southern Plains, and Adjacent Southwest. Memoir No. 4, Oklahoma Anthropological Society, Norman.

Huckell, B. B., and J. D. Kilby 2000 Boca Negra Wash, a New Folsom Site in the Middle Rio Grande Valley, New Mexico. *Current Research in the Pleistocene* 17:45–47.

LeTourneau, P. D. 1997 Sources and Prehistoric Use of Yellowish Brown Spotted Chert in West-Central New Mexico. Paper presented at the 62nd Annual Meeting of the Society for American Archaeology, Nashville.

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

The Frazier Site: Preliminary Report on a Clovis/Gainey Site in Southeastern Wisconsin

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Recorded Clovis points in southeastern Wisconsin are rare (Harrison et al. 1977; Hill et al. 1998; Markman 1991; Mason 1997; Stoltman 1993, 1998; Stoltman and Workman 1969). Reported Clovis-Gainey sites in Wisconsin number fewer than a dozen, of which few are sizable and none in their primary context (Mason 1997; Stoltman 1993; Stoltman and Workman 1969). The nearest sizable Clovis-Gainey site to southeastern Wisconsin is Hawk's Nest, 40 km southwest (Amick et al. 1997) in Illinois.

The Frazier site (47KN 390) is on a riverside rise 16.5 km west of Kenosha on a Woodfordian substage moraine (12,500–20,000 yr B.P., Schneider 1983). The amateur collection consists of tools (Figure 1) and debitage in a plowed

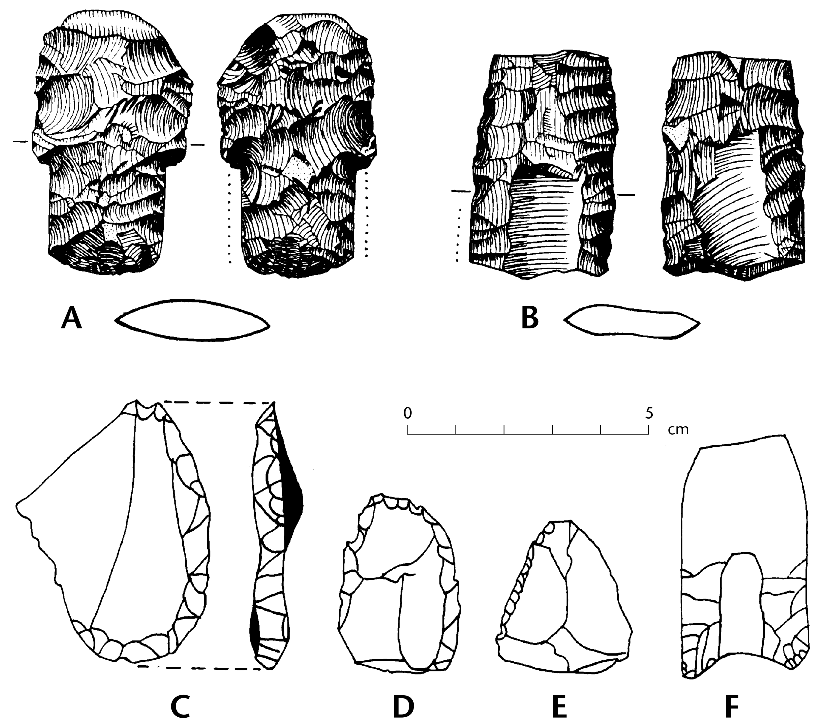

Figure 1. Frazier site tools. **A,** Alberta point, tan Burlington chert; **B,** midsection of a Clovis/Gainey point, Hixton orthoquartzite; **C,** side/endscraper, Hixton orthoquartzite; **D,** combination side/endscraper, Hixton orthoquartzite; **E,** retouched expedient tool, Hixton orthoquartzite; **F,** Clovis point, possibly Prairie du Chien chert.

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context covering approximately 167 m^2. The predominant raw material is Hixton orthoquartzite; the artifacts consist of the midsection of one fluted Clovis/Gainey point, two scrapers, a retouched flake, three tertiary flakes, and seven small bifacial thinning flakes. A fluted point of white-and-gray chert was collected but was not available for analysis. One bifacial thinning flake is made of a similar material. Six tertiary flakes are of a local Silurian chert. The base and midsection of an Alberta point are of tan Burlington chert.

Tertiary flakes and finished tools indicate that cores and bifaces were brought into the site (Binford 1979; Kelly and Todd 1988). Most Clovis tools are based on the reduction of bifaces or are made from bifacial reduction flakes (Bradley 1991). The small assemblage presented here tentatively suggests this was a short-term occupation involving expedient tool manufacture and hide processing. Toolstone largely consists of imported Hixton orthoquartzite whose source is 330 km northwest.

The Frazier site undermines the proposed association between the Chesrow complex and butchered mammoth sites in southeastern Wisconsin (Overstreet 1998). Evidence of human interaction from two mammoth sites containing associated non-diagnostic lithics in Kenosha County, Wisconsin, is interpreted as unequivocal (Dixon 1999; Johnson 2002a, 2002b; Overstreet 1996, 1998; Overstreet et al. 1993, 1995). Owing to a paucity of diagnostic Clovis/Gainey lithics on the glacial Lake Michigan lobe in Kenosha County, it has been posited that the Chesrow complex is associated with these mammoth sites (Overstreet 1996, 1998; Overstreet et al. 1993, 1995.). The Chesrow complex consists of undated thick, basally thinned lanceolate projectile points made from local chert cobbles; individual specimens have been classified as late Paleoindian by others (Mason 1997; Stoltman 1998). The Frazier site is a Clovis/Gainey-complex site and has a higher probability of association with the somewhat earlier-dated mammoth butchering locales in Kenosha County than does the undated Chesrow complex.

References Cited:

Amick, D. S., T. J. Loebel, T. A. Morrow and J. E. Morrow 1997 Hawk's Nest: A New Gainey-Clovis Site in Northeastern Illinois. *Current Research in the Pleistocene* 14:4–6

Binford, L. R. 1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35:255–273.

Bradley, B. A. 1991 Lithic Technology. In *Prehistoric Hunters of the High Plains*, 2nd edition, edited by G. C. Frison. pp. 369–396. Academic Press, New York.

Dixon, E. J. 1999 *Bones, Boats and Bison*. University of New Mexico Press, Albuquerque.

Harrison, W. F., C. Karch, and J. W. Springer 1977 Morphology and Distribution of Paleo-Indian Points from the Kishwaukee Basin, DeKalb County, Illinois. *The Wisconsin Archaeologist* 58:33–58.

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.

Johnson, E. 2002a Taphonomy of Late Pleistocene Mammoth in Southeastern Wisconsin. Report submitted to Great Lakes Archaeological Research Center, Milwaukee, Wisconsin.

——— 2002b Late Wisconsin Mammoth Procurment in the North American Grasslands. In *Clovis and Beyond*, edited by R. Bonnichsen. Center for the Study of the First Americans, Oregon State University, Corvallis (in press)

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

Markman, C. W. 1991 *Chicago Before History: The Prehistoric Archaeology of a Modern Metropolitan Area*. Studies in Illinois Archaeology No. 7 Illinois Historic Preservation Agency, Springfield.

Mason, R. J. 1997 The Paleoindian Tradition, *The Wisconsin Archaeologist*, 78(1/2):78–110.

Overstreet, D. F. 1996 Still More on Cultural Contexts of Mammoth and Mastodont in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene* 13:36–38

——— 1998 Late Pleistocene Geochronology and the Paleoindian Penetration of the Southwestern Lake Michigan Basin, *The Wisconsin Archaeologist*.

Overstreet, D. F., D. J. Joyce, K. Hallin, and D. Wasion 1993 Cultural Contexts of Mammoths and Mastodont in the Southwest Lake Michigan Basin. *Current Research in the Pleistocene* 10:75-77.

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

Schneider, A. F. 1983 Wisconsin Stratigraphy and Glacial Sequence in Southeastern Wisconsin. In D.M. Mickelson and L. Clayon (eds.) *Late Pleistocene History of Southeastern Wisconsin*. Geoscience Wisconsin 7:59–85.

Stoltman, J. B. 1993 A Reconsideration of Fluted Point Diversity in Wisconsin. In *Archaeology of Eastern North America*: Papers in Honor of Stephen Williams, edited by J. B. Stoltman, pp. 61–72. Mississippi Department of Archives and History, Archaeology Report 25.

——— 1998 Paleoindian Adaptive Strategies in Wisconsin During Late Pleistocene Times, *The Wisconsin Archaeologist* 79(1):53–67.

Stoltman, J. B., and K. Workman 1969 A Preliminary Study of Wisconsin Fluted Points. *The Wisconsin Archaeologist* 50:189–214.

A Chronological Assessment of the Schaefer Mammoth Site, Southeastern Wisconsin

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The Schaefer Mammoth (47KN252) was discovered in 1964 during tiling operations in Kenosha County, Wisconsin, when a partial femur and tusk fragments were recovered. The Kenosha Public Museum excavated the site in 1992–93 (Overstreet et al. 1993, 1995). Eighty percent of an adult male woolly mammoth (*Mammuthus primigenius*) was recovered. The bones were recovered from fine gray-tan lacustrine clay overlain by peat, oxygen-degraded peat, and an Ap horizon. The bones contain scoring, lineations, and indentations that are interpreted by the authors as human caused rather than natural breakage. E. Johnson's taphonomic study (Johnson 2002a, 2002b; Johnson et al. 2000) also interprets the marks as the result of human agencies and random bone orientation indicative of primary deposition. Stone tools from immediately below the pelvis and a disarticulated bone pile also indicate human interaction (Blazina-Joyce and Joyce 1993; Overstreet 1998; Over-

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street et al. 1993, 1995). Placement of the tools below the pelvis precludes any possibility of introduction from above. Given the low-energy primary depositional context, there is no reason to believe bone modification or recovered lithics are a result of noncultural processes (Dixon 1999).

Chronological placement of mammoth-human interaction should be rigorous using multiple dates (Dallman et al. 1997) and multiple lines of evidence. Table 1 lists 10 previously unreported ^{14}C measurements in radiocarbon years B.P. Four of these are AMS measurements from purified bone collagen; six are from spruce. A previously reported radiocarbon date of 10,960 ± 100 yr B.P. on an unpurified collagen fraction has been shown to be in error by ca. 1300 years. (Dallman et al. 1997; Overstreet and Stafford 1997). The present AMS measurements are on a highly purified chemical fraction "XAD-purified gelatin hydrolyzate" (Overstreet and Stafford 1997; Stafford, 1990; Stafford et al. 1991). These dates place the site at no younger than 12,220 ± 80 yr B.P.

Table 1. Radiocarbon assays in radiocarbon yr B.P., Schaefer Mammoth site (47KN252)

Specimen	Standard radiocarbon date	Specimen	AMS XAD-Gelatin (KOH collagen) date
femur▲	10,960 ± 100 (Beta-62822)	mandible	12,290 ± 60 (CAMS 72140)
spruce #4▲	12,220 ± 80 (Beta-62823)	pelvis▲	12,310 ± 60 (CAMS 30171)
spruce #10	12,280 ± 80 (Beta-137413)	rib	12,310 ± 50 (CAMS 61135)
spruce #16	12,300 ± 70 (Beta-141277)	femur	12,390 ± 40 (CAMS 61143)
wood #2	12,350 ± 70 (Beta-140776)	cranium	12,440 ± 40 (CAMS 72141)
spruce #8▲	12,480 ± 130 (Beta-62824)		
spruce #1	12,610 ± 80 (Beta-137412)		
wood #20	12,700 ± 70 (Beta-141278)		
hardwood #11	12,790 ± 70 (Beta-140777)		

▲Previously reported date

(Beta-62823). Dated wood specimens (Table 1) were intimately associated (often in contact) with the bones but are not considered cultural in origin. Samples were collected from a broad stratigraphic range below, within, and on top of the bone pile in order to give the maximum possible ^{14}C range. As a result of this approach, some of the wood specimens predate and postdate bone deposition while others are contemporaneous, thereby bracketing the bone deposition. One specimen lying atop the bone pile in direct contact with bone yielded a date of 12,300 ± 70 yr B.P. (Beta-141277). This could be considered a minimum date of deposition for the bone pile and is contemporaneous with the results on bone assays.

Ten pieces of wood submitted to the U.S.D.A. Forest Products Laboratory were identified as *Picea* (n = 5), *Picea/Larix* (n = 2), probably *Picea/Larix* (n = 2), and unidentified hardwood (n = 1). A pollen study of the site by Johnson (1997) finds *Picea* averaged 62.82 percent and *Larix* less than 1 percent, indicating that the recovered wood is more likely *Picea*. R. Johnson (1997) also finds the bones were deposited during the *Picea* pollen spike and before *Pinus* and *Betula* became dominant. R. Johnson correlates Schaefer's *Picea* spike with the nearby (16.6 km) Wisbog's (Huber and Rapp 1992; Johnson 1997) *Picea* spike at 12,300 yr B.P. The Hebior mammoth, 1.7 km away, was deposited during the same *Picea* spike (Fredlund et al. 1996). Hebior's radiocarbon dates are also contemporaneous with Schaefer

(Overstreet and Stafford 1997). Both direct and indirect lines of evidence indicate that the Schaefer Mammoth site is late Pleistocene in age and predates the accepted Clovis time frame.

References Cited

Blazina-Joyce, R. A., and D. J. Joyce 1993 Survey Report. In: Overstreet, D.F. (Ed.) *FY 1992 Historic Preservation Survey and Planning Grant - Early Holocene Megafauna Exploitation, Kenosha County, Wisconsin,* pp 1–14. Great Lakes Archaeological Research Center, Inc., Reports of Investigations No. 325.

Dallman, J. E., D. F. Overstreet, and T. W. Stafford, Jr. 1997 A Revised Chronology for Cultural and Non-Cultural Mammoths and Mastodon Fossils in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene* 13:10–13.

Fredlund, G. G., R. B. Johnson, G. S. Porter, T. A. Revane, H. K. Schmidt, D. F. Overstreet, and M. Kolb 1996 Late Pleistocene Vegetation of Hebior Mammoth Site, Southeastern Wisconsin. *Current Research in the Pleistocene* 13:87–89.

Dixon, E. J. 1999 *Bones, Boats and Bison*. University of New Mexico Press, Albuquerque.

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

Johnson, E. 2002a *Taphonomy of Late Pleistocene Mammoth in Southeastern Wisconsin.* Report submitted to Great Lakes Archaeological Research Center, Milwaukee, Wisconsin.

Johnson, E. 2002b Late Wisconsin Mammoth Procurment in the North American Grasslands. In *Clovis and Beyond*, edited by R. Bonnichsen. Center for the Study of the First Americans, Oregon State University, Corvallis (in press).

Johnson, E., P. J. Lewis, and R. Strauss 2000 A Measured Approach to Marks on Bones. Paper presented at the annual meeting of the American Association of Physical Anthropologists, San Antonio.

Johnson, R. B. F. 1997 Pre-Clovis Possibilities in Southeastern Wisconsin. Master of Science, University of Wisconsin Milwaukee.

Overstreet, D. F. 1998 Late Pleistocene Geochronology and the Paleoindian Penetration of the Southwestern Lake Michigan Basin. *The Wisconsin Archaeologist* 79(1), 28–52.

Overstreet, D. F., and T. W. Stafford, Jr. 1997 Additions to a Revised Chronology for Cultural and Non-Cultural Mammoth and Mastodon Fossils in the Southwestern Lake Michigan Basin. *Current Research in the Pleistocene*. 14:70–71.

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

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

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

Stafford, T. W., Jr., P. E. Harc, L. A. Currie, A. J. T. Jull, and D. Donahue 1991 Accelerator Radiocarbon Dating at the Molecular Level. *Journal of Archaeological Sciences* 70:515–525.

Japan's Early-Palaeolithic Hoax and Two Sites

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On 5 November 2000, Mainichi Shimbun (a newspaper company) revealed that Fujimura Shin'ichi had admitted planting artifacts on two early- (or early- and middle-) Palaeolithic sites in Japan that summer (Kyusekki 2000). He denied planting artifacts on any other sites or on earlier excavations of these two sites (Kuzureta 2000). Immediately, the entire Japanese nation began to question the validity of all the sites Fujimura had ever worked on.

The Cultural Affairs Agency reported on 10 November 2000 that Fujimura had worked on 33 excavated sites, beginning in 1976, and that he had been involved in survey work that found another 153 sites (Fujimura-shi Kanyo 2000). Two of the excavated sites, Ohira and Takamori, were published in *Current Research in the Pleistocene* (Kamata et al. 1993; Yanagida 1992).

Several of the affected prefectures and municipalities have conducted various kinds of validation work during the year since Fujimura's hoax was exposed. On 19 May 2001, after more than six months of preparatory meetings, the Japanese Archaeological Association established a "Special Committee for the Investigation of the Early and Middle Palaeolithic Problem" (Japanese Archaeological Association 2001:20–21). And various organizations have held symposiums or forums dedicated wholly or partly to understanding the "Japanese Early Palaeolithic Hoax."

This validation work has produced evidence of planted artifacts at several of the suspect sites and evidence that many of the excavated artifacts from other suspect sites had recently been on the surface of agricultural fields rather than buried in deep geological strata ("Fujimura Iseki" 2001; Nokosareta 2001).

In September 2001, Fujimura gave the head of the Japanese Archaeological Association's Special Committee a list of sites he had planted artifacts on and a written response to 10 questions from the head of the Special Committee (Tozawa 2001:26–27). On 7 October 2001, the head of the Special Committee reported to the Association members on the Special Committee's activities and, for the first time, on the content of Fujimura's "memos" (Tozawa 2001).

This report said that Fujimura admitted fabricating 42 sites, and it gave a simple list of those sites (Tozawa 2001:27). This report implied that Fujimura had admitted fabricating all the early-Palaeolithic materials found on those sites. The Takamori site was on that list, but the Ohira site was not.

However, the press acquired and reported information from Fujimura's memos on 29 September 2001, before the Association had reported the contents to the affected prefectures and municipalities and to its own members ("Netsuzo 30 Iseki ijo" 2001). This caused an angry outcry from several sides. This in turn necessitated a letter of apology from the Association to the affected prefectures, municipalities and organizations (Tozawa 2001:26). This apology appended copies of Fujimura's memos, censored to remove any

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information that did not concern that prefecture or that might indicate Fujimura's mental state. The press reported details from this apology and appended memos on 6 October 2001, again before any report had been given to the Association's members (Fujimura-shi, 40 Iseki 2001; Kenkyoi 2001; Kieta 2001; Netsuzo Iseki 2001; Takamori 2001). A copy of one of these sets is in my hands. The content of Fujimura's memos is considerably more complicated and detailed than the Association has reported publicly.

Takamori Site In the memo, Fujimura says he planted the three artifacts unearthed from Loc. O at the Takamori site in 1988, but not the artifacts unearthed from Loc. A that year. He says he does not think he planted any of the artifacts found in the subsequent three seasons (1991, 1992 and 1994). The Tohoku History Museum, which conducted those three excavations, reviewed its records and reported it was unlikely the artifacts from the second, third, and fourth seasons were planted, and especially unlikely the artifacts from the fourth season were planted (Tohoku 2000). But another report made about the same time shows a very close relationship between Fujimura and the unearthing of artifacts on the first three excavations (Yamada 2001:30–31), the excavations published in *Current Research in the Pleistocene* (Kamata et al. 1993).

Ohira Site From the censored copy of the memo in my hands, I cannot determine whether Fujimura said anything about the Ohira site, but a news article says that representatives from the Japanese Archaeological Association visited Fukushima Prefecture on 17 October 2001, and told the prefecture that Fujimura had denied planting artifacts at Ohira (Fujimura-shi "Netsuzo de nai" 2001). However, the work diary published in the final excavation report on Ohira shows that Fujimura was directly involved in discovering the site, and his presence during the subsequent two seasons of excavation correlates completely with the unearthing of artifacts (Yanagida 1997:4, 7–9).

Neither Takamori nor Ohira has been re-excavated, and apparently the artifacts have not been restudied in the light of recent experience in validating sites associated with Fujimura. The circumstantial and scientific evidence is largely against the validity of all early-Palaeolithic sites associated with Fujimura, including Takamori and Ohira, but there is no conclusive evidence against either of these two sites, yet.

More information on Japan's early-Palaeolithic hoax can be found on the Internet by searching with the keywords "Keally" and "hoax." The Japanese Archaeological Association is also making brief summaries of its activities available on its Web site www.avenue.co.jp/~kouko/ The Japanese version can be accessed directly at www.avenue.co.jp/~kouko/o_3_2.html The English version can be accessed directly at www.avenue.co.jp/~kouko/o_3_2_e.html

Addendum Yanagida Toshio contacted me on 19 March 2002 to report that a reexamination of the Ohira artifacts found clear evidence that as many as half of them had characteristics of artifacts that had been on the surface of modern cultivated fields, strongly suggesting that these artifacts were planted in the Ohira site. He reported this formally at the General Meeting of the Fukushima Prefectural Archaeological Association, held on 16–17 March

2002, and at the General Meeting of the Japanese Archaeological Association, held on 26 May 2002. At that same meeting, the Japanese Archaeological Association reported its conclusions after its first intensive year of reexamining the sites and artifacts from sites associated with Fujimura—none of these materials can be used for academic purposes. This would include the materials from both the Ohira site and the Takamori site.

At the General Meeting of the Japanese Archaeological Association on 26 May 2002, the Sendai City Board of Education reported the results of its reexamination of the artifacts from sites in that city that Fujimura had worked on. One of those sites was the late-Palaeolithic Tomizawa site, published in *Current Research in the Pleistocene,* no. 10 (Ota & Saino 1993). Sendai City found evidence strongly suggesting that the 10 artifacts reported from Stratum 25 and the 2 from Stratum 26 were planted; Fujimura worked on the site when those strata were excavated. But Fujimura was not on the site when the main late-Palaeolithic occupation in Stratum 27 was excavated, and none of the artifacts from that stratum shows traits characteristic of planted artifacts.

The authors of the articles on the Ohira and Takamori sites, published in *Current Research in the Pleistocene,* all have cooperated fully in providing me with the information for this article.

References Cited

"Fujimura Iseki" Uso Tsugi Tsugi (Lies One after Another on the "Fujimura Sites"). *Yomiuri Shimbun,* Oct. 16, 2001, p. 17 (in Japanese).

Fujimura-shi Kanyo Zenkoku 186 Iseki: Bunka-cho Chosa (Fujimura Associated with 186 Sites Nationwide: Cultural Affairs Agency Report). *Yomiuri Shimbun,* Nov. 11, 2000, p. 34 (in Japanese).

Fujimura-shi, 40 Iseki "Netsuzo" (Fujimura: 40 Sites "Fabricated"). *Yomiuri Shimbun,* Oct. 6, 2001, p. 38 (in Japanese).

Fujimura-shi "Netsuzo de nai" (Fujimura Says "Not Planted"). *Asahi Shimbun* (Fukushima edition), Oct. 18, 2001 (in Japanese).

Japanese Archaeological Association 2001 Zen-Chuki Kyusekki Mondai Chosa Kenkyu Tokubetsu Iinkai Katsudo Hokoku (Report on the Activities of the Special Committee for the Investigation of the Early and Middle Palaeolithic Problem). *Nihon Kokogaku Kyokai Kaiho* (Bulletin of the Japanese Archaeological Association) 144:19–23 (in Japanese).

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.

Kenkyoi, Iseki Toroku Massho (Prefectural Board of Education Erases Site Registrations). *Asahi Shimbun* (Miyagi edition), Oct. 6, 2001 (in Japanese).

Kieta "Seiki no Hakkutsu" (The "Excavations of the Century" Disappear). *Asahi Shimbun* (Fukushima edition), Oct. 6, 2001 (in Japanese).

Kyusekki Hakkutsu Netsuzo (Palaeolithic Excavation Fabrication). *Mainichi Shimbun,* Nov. 5, 2000, p. 1 (in Japanese).

Kuzureta Taiko no Roman (The Romance of Antiquity Collapsed). *Mainichi Shimbun,* Nov. 5, 2000, p. 27 (in Japanese).

"Netsuzo 30 Iseki ijo" ("More than 30 Sites Fabricated"). Yukan *Yomiuri Shimbun,* Sept. 29, 2001, p. 18 (in Japanese).

Netsuzo Iseki, 40-kasho ni (Fabricated Sites Increased to 40). *Asahi Shimbun* (Sapporo edition), Oct. 6, 2001 (in Japanese).

Nokosareta "Chi no Furyo Saiken" ("Useless Knowledge" Is All That's Left). *Asahi Shimbun* (Tokyo edition), Oct. 7, 2001 (in Japanese).

Ota, A., and H. Saino 1993 The Tomizawa Site: A Small Late Paleolithic Encampment on an Alluvial Plain in Northeastern Japan. *Current Research in the Pleistocene* 10:34–35.

Takamori, Aobayama E mo Netsuzo (Takamori and Aobayama E Sites Also Fabricated). *Mainichi Shimbun* (Miyagi edition), Oct. 6, 2001 (in Japanese).

Tohoku Rekishi Hakubutsukan 2000 Zen-Chuki Kyusekki Jidai Iseki no Chosa Kekka (Gaiyo) (Summary Report on the Investigation of the Early and Middle Palaeolithic Sites), dated Dec. 28,2000. Available on the Tohoku History Museum's web page: http://www.thm.pref.miyagi.jp/IO4/iseki_S.htm, consulted February 26, 2002 (in Japanese).

Tozawa, M. 2001 Nihon Kokogaku Kyokai 2001 Nendo Morioka Daikai de no Hokoku Zenbun (Full Text of the Report to the Japanese Archaeological Association's Fiscal Year 2001 Meeting in Morioka). *Nihon Kokogaku Kyokai Kaiho* (Bulletin of the Japanese Archaeological Association) 144:24–27 (in Japanese).

Yamada, A. 2001 Zen-Chuki Kyusekki no Kento — Miyagi-ken Zazaragi, Babadan A, Takamori Iseki (Examination of the Early and Middle Palaeolithic Sites — The Zazaragi, Babadan A and Takamori Sites in Miyagi Prefecture). *Dai-14-kai Tohoku Nihon no Kyusekki Bunka o Katarukai — Zen-Chuki Kyusekki no Kento Happyo, Toron Kiroku* (Record of the Presentations and Discussions of the Early and Middle Palaeolithic at the 14th Meeting of the Northeastern Japan Palaeolithic Discussion Conference, held Dec. 23-24, 2000, at the Fukushima Prefectural Museum), pp. 28-31 (in Japanese).

Yanagida, T. 1992 The Ohira Site: A Probable "Early Palaeolithic" Site in Fukushima Prefecture, Eastern Japan. *Current Research in the Pleistocene* 9:50–53.

——— 1997 *Abukuma-gawa Ryuiki no Zen-Chuki Kyusekki Jidai Niiseki no Chosa: Ohira, Takenomori Iseki no Kenkyu* (Research of the Early and Middle Palaeolithic Industry at Two Sites along Abukuma River Drainage — Study of Ohira Site and Takenomori Site [sic]). Koriyama Joshi Daigaku Tanki Daigaku-bu Bunka-ka Kokogaku Kenkyu Hokoku, Dai-1-satsu (Cultural Course, Koriyama Women's Junior College, Reports of Archaeological Study, no. 1). Koriyama, Japan (in Japanese with English summary).

The Cody-complex Component at Locality V of the Hell Gap Site, Wyoming

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Locality V of the Hell Gap site (48GO305) is one of five archaeological localities excavated by Harvard University and the University of Wyoming between 1959 and 1966 (Irwin-Williams et al. 1973). A final report on the Harvard-Wyoming investigations at this important site was never prepared,

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prompting University of Wyoming researchers to reassemble and analyze the Hell Gap collections as part of a long-term project to rectify the situation (Byers 2001; Camp 2000; Knell 1999; Rapson and Niven 1999; Sellet 1999). Our paper describes the Cody Complex component at Locality V and then summarizes analytical results for the recovered chipped stone and faunal remains (Knell 1999; Knell et al. 2000).

Researchers discovered Locality V (Irwin-Williams et al. 1973; previously designated Locality III South and Locality IV; Agogino and Irwin-Williams 1971) in 1964 when Paleoindian archaeological deposits were exposed during geologic trenching (Irwin 1969). Field notes and photographs from the 1964 and 1965 field seasons clearly depict large quantities of chipped-stone artifacts and fragmentary, disarticulated, and scattered faunal remains (predominantly bison) in direct association with Cody-complex points. The recovered materials are from a 47-m^2 area and are encased in a 7.5- to 10-cm-thick black paleosol, arguably representing one of the most discrete Paleoindian geocultural components at Hell Gap. Three ^{14}C assays are available for the Cody component, two on bone from the original excavations (8890 ± 110 and 9050 ± 160 RCYBP; [A-753A, A-753C_3]) (Haynes 1968) and a bulk sediment date (8685 ± 70 RCYBP, A-35655) obtained in 1999. All three dates fit comfortably within the generally accepted date range for the Cody Complex (Holliday 2000).

The lithic assemblage contains a total of 9,712 items, including 218 tools, 29 cores, 264 utilized flakes, and 9,201 unmodified flakes. Predominant tool types include bifaces (n = 23), Eden projectile points (n = 22) and preforms (n = 26), gravers (n = 38), scrapers (n = 24), and retouched flakes (n = 68). Other tool types include Cody knives (n = 2), multipurpose tools (n = 9), spokeshaves (n = 3), and hammerstones (n = 3). The core assemblage contains bifacial (n = 8) and multidirectional (n = 21) cores. Technological analyses indicate the Cody occupants manufactured a variety of tools for on-site activities and geared up with bifacial implements (including projectile points) for activities conducted away from the site (Knell 1999, 2001).

Preliminary raw material identifications indicate most lithic items consist of chert (93 percent) and quartzite (6 percent) local to the Hartville Uplift. Nonlocal raw materials (< 1 percent) include 11 unmodified flakes made of White River–group chalcedony. Three White River–group source locations are commonly recognized: Flattop chalcedony from Flattop Butte in northeast Colorado; Scenic chalcedony from the White River Badlands of South Dakota and Nebraska; and West Horse chert from the Table Mountain area of southeast Wyoming and southwestern Nebraska. Unfortunately, these three silicates are difficult to distinguish macroscopically (Hoard et al. 1992, 1993).

The archaeofauna contains 1,382 (NISP) specimens, of which 333 are bison. Another 913 specimens are Class IV artiodactyls and are also probably bison. The bison/Class IV sample is poorly preserved, completely disarticulated, and entirely fragmentary, except for the small, compact elements (e.g., carpals). The abundance of small, compact elements and long-bone articular ends likely reflects the field recovery protocol employed during the excavation. Nonetheless, at least seven (MNI) bison are represented by right radial

carpals and left fused central and fourth tarsals. Eruption and wear analyses of the maxillary and mandibular dentitions suggest a late-spring to early-winter season of occupation (Rapson and Niven 1999). Only three specimens show traces of Paleoindian carcass utilization. Although not unusual for a Paleoindian bison archaeofauna (Hill 2001), the paucity of butchery damage almost certainly reflects the poor cortical surface condition of most specimens and the excavators' use of varnish as a preservative. Other archaeofauna remains include Class IV artiodactyl fetal (NISP = 8), canid (NISP = 7), Class III artiodactyl (NISP = 2), mule deer (NISP = 1), lagomorph (NISP = 1), and unidentifiable bone fragments (NISP = 117).

Two spatially distinct concentrations of chipped stone and faunal remains occur in the Cody Complex component (Knell 1999). Concentration 1 is a depression containing 22 percent (n = 2,136) of the chipped-stone artifacts and 5 percent (n = 68) of the faunal remains. Forty-five percent of the analyzed chipped stone in Concentration 1 is heat altered, suggesting the depression is a hearth and/or a dump-type area. Concentration 2 contains 63 percent (n = 6,142) of the chipped-stone assemblage and 58 percent (n = 805) of the faunal assemblage, indicating it was a primary activity area. Only 7 percent of the analyzed artifacts in Concentration 2 are heat altered.

In summary, Cody Complex hunter-gatherers used Locality V as a campsite to conduct and stage a variety of tasks, including quarrying locally available lithic raw materials, manufacturing tools for on- and off-site activities, and procuring bison and possibly other prey species for subsistence.

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References Cited

Agogino, G. A., and C. Irwin-Williams 1971 Archaeological Investigations at the Hell Gap Site Near Guernsey, Wyoming, 1965. *National Geographic Society Research Reports, 1965 Projects*, pp. 11–13. Washington, D.C.

Byers, D. 2001 The Hell Gap Site Locality II Agate Basin Faunal Assemblage: A Study of Paleoindian Faunal Resource Exploitation. Unpublished Master's thesis, Department of Anthropology, University of Wyoming, Laramie.

Camp, B. A. 2000 The Paleoindian Core Assemblage from the Hell Gap Site, Wyoming. Unpublished Master's thesis, Department of Anthropology, University of Wyoming, Laramie.

Haynes, C. V., Jr. 1968 Radiocarbon: Analysis of Inorganic Carbon of Fossil Bone and Enamel. *Science* 161:687–688.

Hill, M. G. 2001 Paleoindian Diet and Subsistence Behavior on the Northwestern Great Plains of North America. Unpublished Ph.D. dissertation, Department of Anthropology, University of Wisconsin, Madison.

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

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

Holliday, V. T. 2000 The Evolution of Paleoindian Geochronology and Typology on the Great Plains. *Geoarchaeology* 15:227–290.

Irwin, H. T. 1969 Archaeological Investigations at the Hell Gap Site, Guernsey, Wyoming, 1964. *National Geographic Society Research Reports*, 1964 Projects, pp. 113–116. Washington, D.C.

Irwin-Williams, C., H. Irwin, G. Agogino, and C. V. Haynes 1973 Hell Gap: Paleo-Indian Occupation on the High Plains. *Plains Anthropologist* 18:40–53.

Knell, E. J. 1999 Late Paleoindian Cody Period Mobility Patterns: An Example from the Locality V Cody Component at the Hell Gap Site, Wyoming. Unpublished Master's thesis, Department of Anthropology, University of Wyoming, Laramie.

——— 2001 Coarse-Grained Nodules and Technological Organization Strategies at the Hell Gap Locality V Cody Component, Wyoming. Ms. on file, Department of Anthropology, Washington State University, Pullman.

Knell, E. J., M. G. Hill, and A. Izeta 2000 Hell Gap, Locality V, Cody Component. Paper presented at the 65th Annual Meeting of the Society for American Archaeology, Philadelphia.

Rapson, D. J., and L. B. Niven 1999 Analysis of Bison Dentitions from 1960s Excavations at the Hell Gap Site, Wyoming. Ms. on file, Department of Anthropology, University of Wyoming, Laramie.

Sellet, F. 1999 A Dynamic View of Paleoindian Assemblages at the Hell Gap Site, Wyoming: Reconstructing Lithic Technological Systems. Unpublished Ph.D. dissertation, Department of Anthropology, Southern Methodist University, Dallas.

Slim Arrow, the Long-forgotten Yuma-type Site in Eastern Colorado

Jason M. LaBelle

Harold Cook and E. B. Renaud (among others) rushed to Yuma County, Colorado, when amateur archaeologists Perry and Harold Andersen discovered artifacts in apparent association with Pleistocene fauna (Anonymous 1930; Cook 1931; Mountain 1953; Myers 1989; Picou 2000a,b). Survey of their vast artifact collection (66-plus Paleoindian localities) helped Renaud formulate his initial Paleoindian typology, giving science the infamous Yuma point (Figgins 1934, 1935; Renaud 1931, 1932, 1934). Although a type-site was never defined for the "Yuma complex," the Andersens believed specimens from the Slim Arrow site represented the archetypal Yuma form (Andersen 1988, 1990). Slim Arrow is located in the Wray dune field, between the Arikaree and the North Fork of the Republican River. Surface collected by the Andersens between 1927 and 1934, the site yielded 83 tools and 97 unmodified flakes. The site likely represents a large bison kill where preliminary butchery took place.

The tool assemblage contains 65 projectile points, including 27 complete or nearly complete specimens, 9 bases, 9 midsections, and 20 tips. The majority of the specimens fit comfortably within the Allen/Frederick complex

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(Hofman 1989), although a Scottsbluff and a thick Hell Gap point were also recovered. The points served two functions at the site, as projectiles (48 percent of the tips exhibit impact damage) and as butchery tools. The complete points display varying degrees of resharpening, with most exhibiting either slight (42 percent) or more extensive resharpening (53 percent), including beveling of the blade.

Several other tools are present, including two drills, a complete biface/knife, a Cody knife, two small biface fragments, and two utilized flakes. The complete biface is resharpened along the upper portion of the blade and is likely a skinning knife. Ten scrapers were recovered, including four endscrapers, two spurred endscrapers, and four end/sidescraper forms. The temporal relationship between the Allen assemblage and the Cody/Hell Gap materials is unknown, although all three types occurred in or near the bone bed (Andersen n.d.). As well, several specimens contain attributes of both the Allen and Eden forms and finishing flaking techniques (Figure 1).

A diverse group of raw materials are present, with Niobrara jasper the most common. Local fossilized woods and quartzites are also present. Other materials include Flattop chalcedony, Hartsville Uplift cherts, possibly Knife River flint, and Alibates silicified dolomite. The mobility of these late-Paleoindian foragers was likely oriented along river valleys; Niobrara jasper is available ca. 225 km to the east following local rivers downstream.

During the summer of 2001, the site was relocated, mapped, and tested. Surface mapping yielded 412 bone fragments and 2 flakes. Limited test excavations (6 m^2) recovered 4,731 small bone and tooth fragments (0.96 kg) and 3 flakes. Portions of the bone bed may remain intact under overlying sediment, though most of it was probably exposed and eroded during the 1930s.

The bulk of the collection and archival research was completed at the University of Nebraska State Museum, where Tom Myers and Beth Wilkins cheerfully aided access to the Andersen materials. Forrest Fenn deserves thanks for the opportunity to examine the Russell collection, and making available (with Pete Bostrom) the cast of the Slim Arrow specimen. Kenneth Mitchell kindly permitted our fieldwork on his property. Many thanks are due to the Tom Westfall family for their hospitality, expertise, and enthusiasm for the project. The field crew deserves special thanks, including Brian Andrews, Liv Fetterman, David Meltzer, John Seebach, Joanna Roberson, and Jeff Rose. Brian Andrews and John Seebach provided helpful editing, and Brian graciously sorted and summarized the faunal data. The collection and archival research was sponsored by a grant from the Greiner Endowment for Colorado Archaeology and two dissertation research grants from the Institute for the Study of Earth and Man at Southern Methodist University. The Quest Archaeological Research Fund sponsored the excavations.

References Cited

Andersen, H. V. 1988 History of the Yuma Type Artifacts and the Andersen Collection. *Indian Artifact Magazine* 7(4):13,45.

——— 1990 The Andersen Artifact Collection. *Indian Artifact Magazine* 9(3):12–15.

——— n.d. Assorted papers regarding the Andersen family collection. Department of Anthropology, University of Nebraska State Museum, Lincoln, NE.

Anonymous 1930 Archaeological Reconnaisance (sic). *El Palacio* 29(4-10):154.

Cook, H. J. 1931 More Evidence of the "Folsom Culture" Race. *Scientific American* 144(2):102–103.

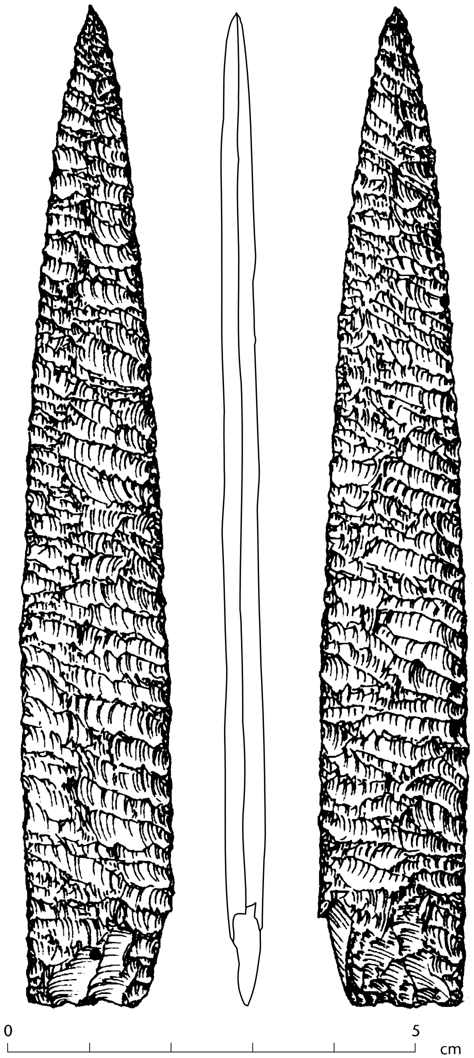

Figure 1. Projectile point discovered by Perry Andersen at the Slim Arrow site in 1928 (see Cook 1931:103 for photograph). Katherine Monigal illustrated the specimen.

Figgins, J. D. 1934 Folsom and Yuma Artifacts. *Proceedings of the Colorado Museum of Natural History* 13(2).

——— 1935 Folsom and Yuma Artifacts, Part II. *Proceedings of the Colorado Museum of Natural History* 14(2).

Hofman, J. L. 1989 Prehistoric Culture-history: Hunters and Gatherers in the Southern Great Plains. In *From Clovis to Comanchero: Archeological Overview of the Southern Great Plains*, by J. L. Hofman, R. L. Brooks, J. S. Hays, D. W. Owsley, R. L. Jantz, M. K. Marks, and M. H. Manhein, pp.25–60. Arkansas Archeological Survey Research Series No. 35, Fayetteville, AR.

Mountain, B. 1953 Perry Andersen, 1884–1953 (obituary). *Southwestern Lore* 19(3):14–15.

Myers, T. P. 1989 Nehawka Flint in the Paleoindian Occupation of the High Plains. *Central Plains Archaeology* 1:37–48.

Picou, E., Jr. 2000a Dr. H. V. "Andy" Andersen Dies. *Geology Department Newsletter,* pp. 7–8, Louisiana State University, Baton Rouge, LA.

——— 2000b In Memory of Harold Veral Andersen 1907-2000 (obituary). Available at http://www.gcssepm.org

Renaud, E. B. 1931 Prehistoric Flaked Points from Colorado and Neighboring Districts. *Proceedings of the Colorado Museum of Natural History* 10(2).

——— 1932 Yuma and Folsom Artifacts, New Material. *Proceedings of the Colorado Museum of Natural History* 11(2).

——— 1934 The First Thousand Folsom-Yuma Artifacts. *Archaeological Series*, first paper, Department of Anthropology, University of Denver, Denver, CO.

Early-Holocene Charmstone Assemblage from the Skyrocket Site (CA-Cal-629/630)

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Ten charmstones were recovered from a sealed deposit at the Skyrocket site (CA-CAL-629/630). Located on Littlejohns Creek 40 miles east of Stockton, California, in the first tier of the Sierran foothills, Skyrocket has a number of well-dated strata representing the early and middle Holocene. The deposit in which we recovered the above artifacts was dated between 9410 ± 250 (WSU 4929) and 7000 ± 70 yr RCYBP (WSU 4616). Charmstones are well known in the early, middle, and late periods of California prehistory, representing the timespan between 5000 and 500 RCYBP (Elsasser and Rhode 1996:14–23). What is important here is that these charmstones were found in a well-dated early-Holocene deposit and that their discovery provides sound evidence of the significant antiquity of these artifacts in California prehistory. This discovery also corroborates reports of charmstones occurring at a few other early-Holocene sites in California, some of which are not as well dated as Skyrocket (Elsasser and Rhode 1996:14–23; Erlandson 1994; Harrington 1948:92–95).

The Skyrocket charmstone assemblage (Figure 1) shows a significant degree of variability, including types that have been labeled "spindles" (artifacts 1E–I), "grooved" (artifacts 1C, D), "plummet" (artifact 1J), and two "exotics" (artifacts 1A, B) that do not fit any existing classifications (Elasser and Rhode 1996).

The two exotics (artifacts 1A, B), weighing 220.7 and 222.5 g, are made from greenstone. Measuring 3.1 and 3.2 cm. in maximum thickness, these artifacts have T-shaped designs pecked on their faces, which are duplicated completely on the obverse of 1B and only partially on the obverse of 1A. Both ends of 1B were battered; only one end of 1A shows similar wear. Function and classification are unknown to the writers.

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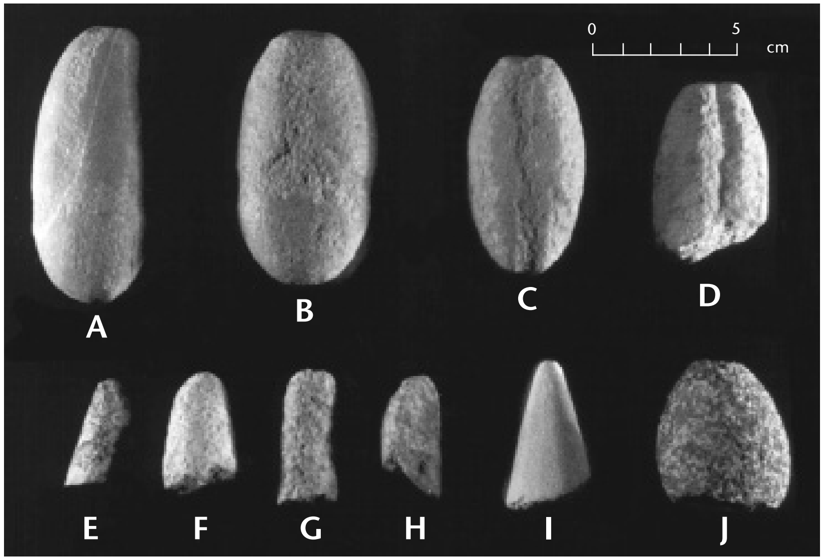

Figure 1. Charmstones, sinker weights, and exotics.

Artifacts 1C and 1D have been referred to as "longitudinally grooved" or Type T (Elsasser and Rhode 1996:101, and it has been suggested that these charmstones functioned as sinker weights for nets or as bolas used to ensnare birds (Elsasser and Rhode 1996:101). Artifact 1C weighs 159.3 g and its maximum thickness is 3.5 cm. This sinker weight was made from greenstone; its circumferential longitudinal groove and overall shape were the result of pecking. The other sinker weight in this collection, 1D, weighs 85.2 g, has a maximum thickness of 2.7 cm. and was made from a tuff. Although broken, this artifact has the same style of longitudinal groove and shape, also the result of pecking.

Charmstones 1E–I, all of which are broken, have been referred to as Type S or "symmetric spindles" (Elsasser and Rhode 1996:93–94); other researchers have called them "cigar-shaped" (Bickel 1981:251). Whatever their name, they occasionally occur in archaeological deposits of coastal sites in southwestern California (Erlandson 1994:264) and seem to be associated with the millingstone complex, dated between 9000 and 5000 RCYBP.

Artifact 1E weighs 17.6 g, is made from granite, and has a maximum thickness of 1.8 cm. Artifact 1F weighs 27.9 g, is made from greenstone, and has a maximum thickness of 2.4 cm. Artifact 1G weighs 29.2 g, is made from granite, and has a maximum thickness of 1.9 cm. Artifact 1H is made from greenstone, weighs 21.4 g, and has a maximum thickness of 1.8 cm.. The last spindle, artifact 1I, weighs 29 g, is made from greenstone, and has a maximum thickness of 2.2 cm. Of particular note here is the fact that its surface is extremely smooth, indicating that some grinding was necessary in its manufacture.

The last charmstone in our assemblage, artifact 1J, has been classified as Type Pt or "plummet-shaped" (Elsasser and Rhode 1996:81–82). It weighs

129.2 grams, has a maximum thickness of 3.7 cm, and is broken at both ends.

References Cited

Bickel, P. 1981 San Francisco Bay Archaeology: Sites Ala-328, Ala-13, and Ala-12. *Contributions of the University of California Archaeological Research Facility*, University of California, Berkeley.

Elsasser, A. B., and P. T. Rhode 1996 Further Notes on California Charmstones. *Coyote Press Archives of California Prehistory, 38.* Coyote Press: Salinas, California.

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

Harrington, M. R. 1948 An Ancient Site at Borax Lake, California. *Southwest Museum Papers, 16.*

Field Investigations at a Likely Source for New Mexico Obsidian Folsom Artifacts

Philippe D. LeTourneau and Anastasia Steffen

In a previous issue of this journal, LeTourneau et al. (1996) reported a previously undocumented semi-translucent mahogany variety of Valle Grande Member obsidian glass that appears in an unusually large proportion of Albuquerque Basin Folsom artifacts. This variety is chemically the same as the well-known translucent gray variety from that source in the Jemez Mountains. LeTourneau et al. (1996) speculated that Folsom point knappers in central New Mexico exploited a small primary source of this material in the Jemez Mountains to the north of the sites, rather than secondary gravel sources closer to the sites. Additional work determined that Valle Grande Member obsidian is not present in secondary gravel sources outside of the Jemez Mountains (LeTourneau 2000:501–503; LeTourneau and Baker nd; LeTourneau et al. 1998, 1999).

The Valle Grande Member of the Pleistocene Valles rhyolite consists of several volcanic domes within the Valles Caldera. In the literature, obsidian has been documented at almost all the domes (Baugh and Nelson 1987; Eck 1980; Winter 1981:19; Wolfman 1994:49). This obsidian is also known as Cerro del Medio obsidian for the best-known geographic source at one of these domes.

Until recently, access to this area has been limited. In July 2000, Cerro del Medio and the surrounding land became the Valles Caldera National Preserve (VCNP). As part of cultural resource management survey with the VCNP archaeology program in 2001, we had the opportunity to examine roads throughout the caldera including roads around the base of Cerro del Medio. During this work, we identified one source location of a mahogany variety on

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the western slope of Cerro del Medio. There the mahogany obsidian is found scattered as small angular clasts (up to 15 cm) with primary cortex and as smaller angular fragments in massive blocks of crystalline rhyolite in the same deposits. While we have not yet found a true bedrock setting, we have clearly isolated a source for the mahogany glass at Cerro del Medio.

Across the Cerro del Medio dome deposits examined that summer, obsidian is found as small and large angular clasts up to 30 cm long with primary cortex. Alluvial and colluvial deposits observed below the base of the dome also contain angular obsidian nodules with weakly developed secondary cortex. The most common colors observed include translucent black, translucent gray, flow-banded gray-black, and gray with a "shimmery" appearance. Vierra (1993:161) has characterized the latter variety as pleochroic, or exhibiting a black color when viewed at one angle and a silvery sheen at another. Whereas these color varieties are found in a broad area around the mountain, the mahogany variety appears to be much more restricted.

Cores and debitage of the mahogany obsidian are common in the immediate vicinity, but we located no temporally diagnostic artifacts of this obsidian. Within a few hundred meters of this source are retouched flake tools of Chuska, Edwards, and Cumbres Pass cherts—all represented in Folsom assemblages in the Albuquerque Basin to the south in unusually high numbers compared with other periods.

At a regional scale, the identification of the precise location of the source of the mahogany obsidian on the west slope of Cerro del Medio is not particularly important. However, because of the alluvial intra-caldera setting of the source deposits, the potential for a buried "pure" Folsom quarry workshop is high. Given that most other documented Folsom sites in central and northern New Mexico are both in deflated surface contexts and are dominated by toolstone from local gravel sources, the opportunity to find and document Folsom quarry/workshop activity is an exciting one.

Many thanks to the 2001 VCNP field crew (Tod Roberts, Kathy Helton, and Scott Worman) who assisted in identification of this source.

References Cited

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

Eck, D. C. 1980 *An Archaeological Survey of the Baca Geothermal 115 KV Transmission Line.* Office of Contract Archaeology, University of New Mexico, Albuquerque.

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

LeTourneau, P. D., and T. Baker nd The Role of Obsidian in Folsom Lithic Technology. Submitted for publication in *Lithic Technology.*

LeTourneau, P. D., R. K. Kunselman, and T. Baker 1999 Results of Additional XRF Analysis of New Mexico Folsom Obsidian Artifacts. *Current Research in the Pleistocene* 16:99–101.

LeTourneau, P. D., M. S. Shackley, and T. Baker 1998 Folsom Period Obsidian Use in New Mexico. Paper presented at the 63rd Annual Meeting of the Society for American Archaeology. Seattle, March 28.

LeTourneau, P. D., M. S. Shackley, J. M. Warnica, and J. Cummings 1996 Analysis of Folsom Obsidian Artifacts from New Mexico. *Current Research in the Pleistocene* 13:59–61.

Vierra, B. J. 1993 Lithic Resource Variation Across the Colorado Plateau. In *Across the Colorado Plateau: Anthropological Studies for the Transwestern Pipeline Expansion Project, Volume 17: Architectural Studies, Lithic Analyses, and Ancillary Studies*, edited by B. J. Vierra, T. W. Burchett, K. L. Brown, M. E. Brown, and C. J. Phagan, pp. 157–167. Office of Contract Archaeology and Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

Winter, J. C. 1981 Energy and Environment Along Redondo Creek: I - The Effective Environment. In *High Altitude Adaptations Along Redondo Creek, The Baca Geothermal Anthropological Project*, edited by C. Baker and J. C. Winter, pp. 15–24. Office of Contract Archeology, University of New Mexico, Albuquerque.

Wolfman, D. 1994 Jemez Mountains Chronology Study. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Late-Pleistocene Lake Otero, Tularosa Basin, Southern New Mexico

Spencer G. Lucas, Gary S. Morgan, John W. Hawley, and Mark E. Gordon

Recent stratigraphic and paleontologic research on the White Sands Missile Range has produced a greater understanding of the late-Pleistocene environments and biota in the Tularosa Basin of Socorro, Sierra, Lincoln, Doña Ana, and Otero Counties in southern New Mexico. Herrick (1904) first suggested the presence of a large ancient lake in the Tularosa Basin, which he named Lake Otero. The sedimentary fill of Lake Otero is the Otero formation (Herrick 1904), as much as 30 m of gypsiferous clay and sand and gypsite of lake basinal and shoreline facies, and volcaniclastic sand and gravel of fluvial-deltaic facies. The Otero formation forms much of the surficial fill of the Tularosa Basin at elevations below 1,220 m (Hawley 1993), and its areal extent is at least 2,100 km^2 (Seager et al. 1987), which we estimate to be the approximate maximum size of Pleistocene Lake Otero.

Fossil mammals from the Otero formation indicate its upper, exposed portion is of late-Pleistocene age. The Camp Rice formation, which is regionally no younger than about 0.73 Ma (Mack et al. 1993), underlies the Otero formation (Seager et al. 1987). The Otero formation is older than the ca. 5000 CALYBP age of the Carrizozo lava flows (Dunbar 1999) that overlie it. The possibility that at least the upper part of the Otero formation was deposited during a single glacial-pluvial cycle (Pinedale-Tahoka: late Wisconsinan) has been suggested (Gile et al. 1981, Hawley et al. 1976, Kottlowski et al. 1965). Recent work by Hall (2001) in the type area of the Tahoka formation docu-

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ments a middle- to late-Wisconsinan age (< 40,000 CALYBP) for the bulk of that unit; and he also demonstrates a close correlation of late-Pleistocene lacustrine cycles in a region extending from the Texas High Plains to the Estancia Basin of central New Mexico (Allen and Anderson 2000). Considering the proximity of the Estancia and Tularosa basins (about 80 km separation), synchrony of late-Pleistocene lacustrine deposition in both basins is probable. A late-Wisconsinan age for much of the exposed Otero formation is therefore consistent with all available chronologic and paleoclimatic information on pluvial lakes of this region.

The Otero formation is very fossiliferous. Twenty-five species of freshwater and terrestrial mollusks document lacustrine environments with shallow, nearshore freshwater habitats. Large populations of planorbids indicate nearshore macrophyte beds, and the *Stagnicola* spp. are diagnostic of cool-water habitats. Muddy lake margins without salt or gypsum and with grassy shores are indicated by the large numbers of succineids and some pupillids (e.g., *Pupilla blandi*). Local species richness and the occurrence of slugs (*Deroceras* sp.) reflect a relatively mesic environment. The presence of *Gastrocopta cristata* suggests the presence of floodplain and stands of cottonwood (Metcalf and Smartt 1997). Other species (e.g., *Vertigo ovata*) confirm the existence of woody, broadleaf plant communities and the presence of damp soil. Thus Lake Otero appears to have existed during a cool, mesic period as a large lake surrounded by low-profile shores with muddy, grassy margins interspersed with stands of cottonwood and other communities of woody, broadleafed vegetation.

Fossil footprints from a site in the Otero formation were made by proboscidean (mammoth) and camelid trackmakers. Oriented trackways suggest these large ungulates walked to and from the waters of Lake Otero, probably to drink. Although human artifacts (chipped stone) have been found at the tracksite, there are no human tracks and there is no demonstrable human association.

The largest and best-documented vertebrate fossil assemblages from the Otero formation encompass 11 localities 5–25 km north of the White Sands National Monument. The richest site yielded the freshwater frog *Rana*, a small colubrid snake, a lizard, a bird, the rabbit *Sylvilagus*, and four rodents—an unidentified sciurid, the vole *Microtus*, the muskrat *Ondatra*, and the mouse *Peromyscus*. The horse *Equus* occurs at two sites, and the mammoth *Mammuthus* is represented by several molar records referable to *M. columbi* on the basis of their complicated and very thin enamel. A complete scapula represents the large camel *Camelops hesternus*. At the present time, all four species of voles of the genus *Microtus* known from New Mexico occur primarily in the mountains at much higher elevations than the Tularosa Basin floor. The voles and other mammals from the Otero formation are consistent with cooler late-Pleistocene climates, and they also resemble mammal assemblages from other late-Pleistocene lakes in New Mexico, such as Lake Estancia and Lake San Agustín. However, more study of the Otero formation, particularly to recover subsurface data, is needed to decipher further the late-Pleistocene climatic and tectonic history of the Tularosa Basin.

We thank the U.S. Army, and Robert Myers for access to the White Sands Missile Range.

References Cited

Allen, B. D., and R.Y. Anderson 2000 A Continuous, High-Resolution Record of Late Pleistocene Climate Variability From the Estancia Basin, New Mexico. *Geological Society of America Bulletin* 112:1444–1458.

Dunbar, N. W. 1999 Cosmogenic ^{36}Cl-Determined Age of the Carrizozo Lava Flows, South-Central New Mexico. *New Mexico Geology* 21:25–29.

Gile, L. H., J. W. Hawley, and R. B. Grossman 1981 Soils and Geomorphology in the Basin Range Area of Southern New Mexico—Guidebook to the Desert Project. *New Mexico Bureau of Mines and Mineral Resources Memoir* 39:1–222.

Hall, S. A. 2001 Geochronology and Paleoenvironments of the Glacial-Age Tahoka Formation, Texas and New Mexico High Plains. *New Mexico Geology* 23:71–77.

Hawley, J. W. 1993 Geomorphic Setting and Late Quaternary History of Pluvial-Lake Basins in the Southern New Mexico Region. *New Mexico Bureau of Mines and Mineral Resource, Open-file Report* 391:1–28.

Hawley, J. W., G. O. Bachman, and K. Manley 1976 Quaternary Stratigraphy in the Basin and Range and Great Plains Provinces, New Mexico and Western Texas. In *Quaternary Stratigraphy of North America,* edited by W. C. Mahaney, pp. 235–274. Dowden, Hutchinson, and Ross, Inc., Stroudsburg, Pennsylvania.

Herrick, C. L. 1904 Lake Otero, an Ancient Salt Lake in Southeastern New Mexico. *The American Geologist* 34:174–189.

Kottlowski, F. E., M. E. Cooley, and R. V. Ruhe 1965 Quaternary Geology of the Southwest. In *The Quaternary of the United States*, edited by H. E. Wright Jr. and D. G. Frey, pp. 287–298. Princeton University Press, Princeton.

Mack, G. H., S. L. Salyards, and W. C. James 1993 Magnetostratigraphy of the Plio-Pleistocene Camp Rice and Palomas Formations in the Rio Grande Rift of Southern New Mexico. *American Journal of Science* 293:49–77.

Metcalf, A. L., and R. A. Smartt 1997 Land Snails of New Mexico. *New Mexico Museum of Natural History and Science Bulletin* 10:1–145.

Seager, W. R., J. W. Hawley, F. E. Kottlowski, and S. A.Kelley 1987 Geology of the East Half of the Las Cruces and Northeast El Paso 1 Degree x 2 Degree Sheets, New Mexico. *New Mexico Bureau of Mines and Mineral Resources Geologic Map* 57, scale 1:125,000, 5 sheets.

Geoarchaeology of the Winger Site (14ST401), a Late-Paleoindian Bison Bonebed in Southwestern Kansas

Rolfe D. Mandel and Jack L. Hofman

The Winger site (14ST401) is a deeply buried late-Paleoindian bison bonebed located in Stanton County in southwestern Kansas. In 1970, Virginia Buckner, an avocational archaeologist, discovered the bonebed eroding out along Bear Creek, a tributary of the Arkansas River. Buckner excavated two trenches and

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four contiguous 5-by-5-ft squares to the bonebed, leaving the bones in place and covering the exposed bone with plastic before closing the excavation in 1972 (Buckner 1970, 1973). From the first trench, she reported remains of at least seven bison with articulated units, vertebrae, rib cages, limbs, and teeth in place. Also, two "flakes of flint" were found at the bone level in the eastern trench.

Winger is at the thalweg of a meander loop of Bear Creek, and a playa is on the outside of the loop. Recent construction of an access road leading to the dry bed of Bear Creek exposed part of the bonebed in the area of Buckner's excavation. We visited the site in June 2001 and observed hundreds of bone fragments in the stream bed exposed by road maintenance and sand quarrying. A dense 36-m-long bison bonebed averaging about 25 cm thick was recorded at a depth of 265–290 cm in the cutbank.

A portion of the bank was cleaned from top to bottom just west of what we believe was Buckner's excavation, and a 1.5-m-wide profile was described (Figure 1). The upper 35 cm of the profile is a unit of eolian sand that has been slightly modified by pedogenesis (Ap-C soil horizonation). This unit rapidly thickens to the west of the site and forms a small sand dune. Barbed wire near the bottom of the dune indicates that the dune was active during modern time. The eolian sands overlie a 130-cm-thick unit of stratified silty, loamy, sandy, and fine-gravelly alluvium that has not been modified by pedogenesis (C horizons). The stratified alluvium mantles a buried soil with a weakly expressed AB-Bw-Bk profile developed in an 87-cm-thick unit of silty alluvium. Decalcified organic carbon from the upper 10 cm of this buried soil yielded a δ^{13}C-corrected ^{14}C age of 8570 ± 60 yr B.P. (ISGS-5192). The unit of silty alluvium overlies a dark gray soil with an Ak-Btk-BCk profile developed in clay-rich playa deposits (Figure 1). The bison bonebed is in the 3Btkb2

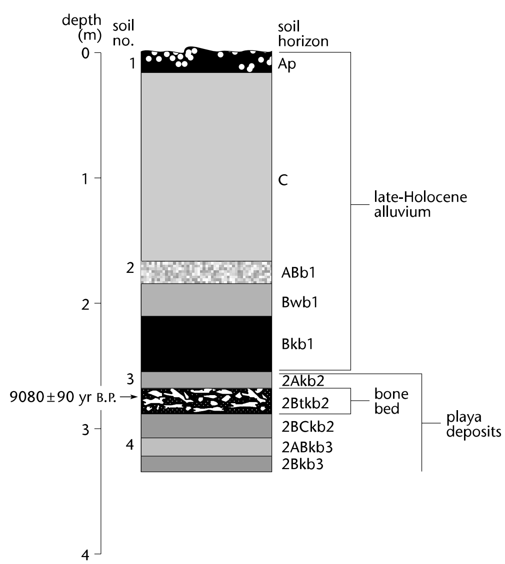

Figure 1. Stratigraphy of the cutbank profile at Winger site 14ST401.

horizon of this buried soil. A playa soil with an ABk-Bk profile underlies the bone-bearing soil.

The collagen fraction from a sample of cleaned rib blade fragments collected in June 2001 yielded a δ^{13}C-corrected ^{14}C age of 9080 ± 90 yr B.P. (SGS-4934). Based on this age, the buried playa deposits are at least 9,000 years old.

Cleaning small portions of the in situ bonebed in 2001 revealed a wide range of elements, both in size and density, including limb bones, vertebrae, ribs, crania, and small, dense elements (carpals and tarsals). Some articulated elements were also noted. Bones are commonly fractured in place, apparently by pressure and mechanical weathering, but bone surfaces are in generally good condition with minimal root etching and rare carnivore gnawing. These factors suggest rapid and fairly deep burial of at least parts of the bonebed. Potential impact of water transport and trampling remain to be assessed.

A sample of bones collected in 2001 from spoil piles at the base of the cutbank and from the bonebed has been studied, enabling some preliminary observations. This sample is highly fragmented due to recent and ancient mechanical factors, but it appears most bones can be preserved intact with careful excavation. All major skeletal portions are present, including crania, vertebrae, ribs, and limb elements. At least five bison are represented in this sample, based on ulnar carpals, and several elements indicate at least three or four animals. We estimate that several dozen animals are probably represented in this bonebed deposit. The majority of elements represent immature or small-sized (female) adults. A cow-and-calf herd is suggested, but a few elements appear to be from one or more large males. No clear seasonal estimate is possible from the current sample; a single M3 is in full wear.

At least two humeri exhibit carnivore damage, but when this occurred is unclear. All inspected fracture surfaces are rectilinear and appear to have occurred on dry bone. Breakage of long bones for marrow extraction is not indicated by the available sample. No prehistoric cut or butchering marks have been noted, but detailed inspection of bone surfaces has not been completed. A few small pieces of burned bone were found just west of the stratigraphic profile, but no discrete cultural features have been identified.

In the summer of 2002, approximately 9 m^2 of the bonebed was excavated. Also, most of the loose sediment at the foot of the cutbank was wet screened. Two Allen projectile points, one complete and the other a basal segment, were found in the bonebed. The basal corner of a third Allen point was recovered from loose sediment at the foot of the cutbank. A biface and many flakes were also found. Radiocarbon ages date the Allen/Frederick artifact assemblage to 7800–9400 yr B.P. (see Holliday, 2000:270). Hence, the radiocarbon age of 9080 ± 90 yr B.P. determined on bone from Winger is consistent with the chronology of the diagnostic artifacts associated with the bonebed.

In sum, current evidence indicates that the Winger site is a late-Paleoindian bonebed that represents a bison kill where partial butchery or a gourmet butchering strategy may be represented (cf. Todd 1987). Archaeological and geomorphic investigations will continue at the site to gain a better understanding of the origin, taphonomy, size, and geologic context of the bonebed.

We thank Martin Stein, Will Banks, Virginia Wulfkuhle, and Todd Bevitt of the Kansas State Historical

Society for their many efforts and contributions to this research. Also, the Winger family, particularly Tom, Kent and Travis Winger, are thanked for their interest and support. We also acknowledge the efforts of Virginia Buckner toward the study and documentation of this site. Thanks also goes to Jeff Trotman and the people of Grant and Stanton counties who provided assistance.

References Cited

Buckner, V. 1970 Kansas Anthropological Association Archeological Site Report for Site 14ST401. On file at the Kansas State Historical Society, Topeka.

——— 1973 Letter to Thomas Witty (dated November 12, 1973). On file at the Kansas State Historical Society, Topeka.

Holliday, V. T. 2000 The Evolution of Paleoindian Geochronology and Typology on the Great Plains. *Geoarchaeology: An International Journal* 15:227–290.

Todd, L. C. 1987 Analysis of Kill-Butchery Bonebeds and Interpretation of Paleoindian Hunting. In *The Evolution of Human Hunting,* edited by M. H. Nitecki and D. V. Nitecki, pp. 225–266. Plenum Press, New York.

Beyond 12 Mile Creek: Other Paleoamerican Evidence from Logan and Wallace Counties, Kansas

Janice A. McLean

Discovered in 1895, 12 Mile Creek has long been the only Paleoamerican site recorded in the Smoky Hill drainage of Logan and Wallace County, Kansas (Brown and Logan 1987; Hill 1996; Hofman 1994, 1996; Rogers 1984; Rogers and Martin 1984; Williston 1902, 1905; Yaple 1968). Ongoing research based on the Fort Wallace Dornic Club (FWDC) 1954–59 surface collections (Bussen 1958; McLean 1996:31) and the University of Kansas Great Plains Paleoindian Point Survey (GPPPS) data is finally producing new Paleoamerican evidence from this region.

Figure 1 illustrates 10 diagnostic bifaces from 8 sites in the study area. Another Clovis point (14LOTEMP-135, basalt, not illustrated) brings the extant artifact sample to a total of 11 Paleoamerican artifacts from 9 sites in the two counties. The artifacts illustrated in Figures 1A, 1B, and 1H have been included in various projectile point distribution studies based on GPPPS data (e.g., Blackmar 2001; Hofman 1994; Hofman and Hesse 1997; Holen 2001), but only the Folsom point illustrated in Figure 1B has ever been fully documented in a published context (Hofman 1994: Figure 3H).

In addition to a fluted point from the 12 Mile Creek site that was stolen from the University of Kansas (Rogers 1984:96–98), various sources indicate that a minimum of nine additional Paleoamerican finds from six sites in

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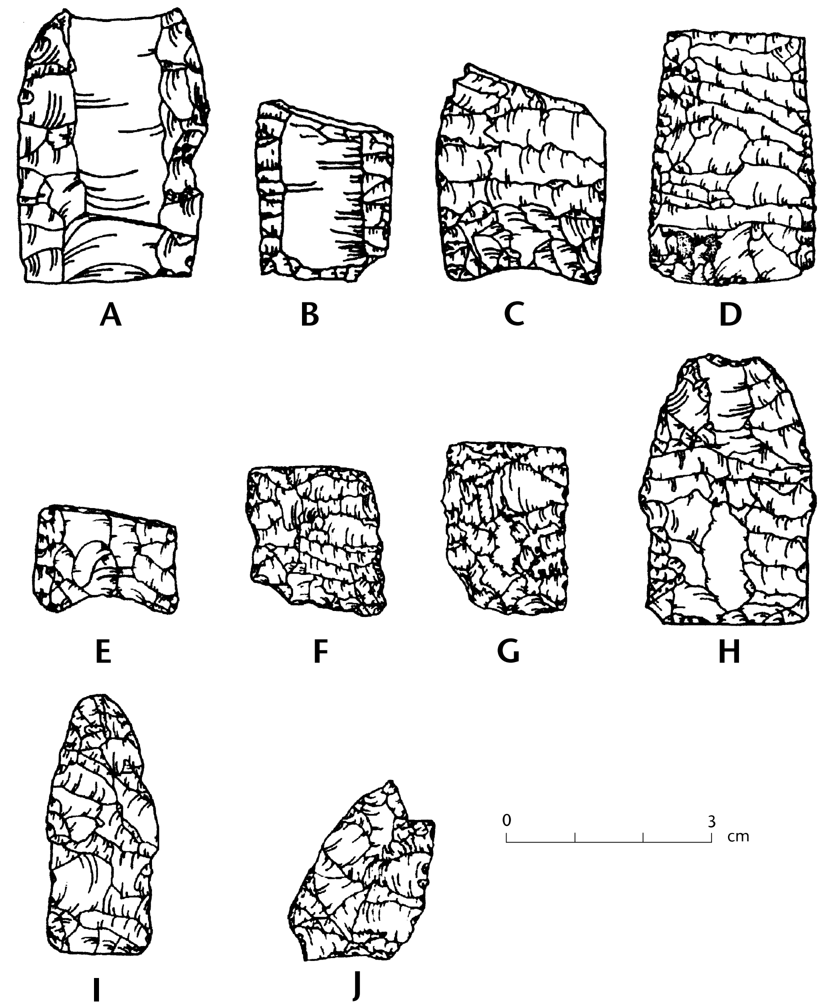

Figure 1. Extant Paleoamerican diagnostics from documented locations in Wallace and Logan counties, Kansas. **A,** Clovis preform reject made of Niobrara jasper (Smoky Hill silicified chalk) from 14WCTEMP-133; **B,** Folsom point base made of Alibates agatized dolomite from 14WC13; **C,** Goshen point base made of an unidentified reddish brown jasper from 14WCTTEMP-134; **D,** Frederick-Allen midsection made of yellowish brown quartzite from 14WC1; **E,** Plainview base fragment made of a distinctive dark reddish purple quartzite also from 14WC1; F-G, Cody-complex/Firstview–like base fragments from 14WC12. **F,** is made from an unidentified light grayish tan chert with pinkish orange inclusions. **G,** is made of a basalt common in the Smoky Hill River gravels; **H,** reworked Scottsbluff point made of Flattop chalcedony from 14WC14; **I,** reworked Scottsbluff point made of Flattop chalcedony from 14LO15; **J,** Cody knife midsection made of a mottled vivid yellowish orange and salmon pink chert/chalcedony from 14LO14. The Cody knife material closely resembles comparative samples of Narbona Pass chert from the Chuska Mountains in New Mexico, although Paleoamerican use of a similar lithic material has been documented in eastern Colorado and tentatively attributed to an undiscovered White River–group formation quarry or lag deposit (Jack Hofman, pers. comm. 2002).

Wallace and Logan Counties are inexplicably missing from archaeological collections curated in both public and private facilities in Kansas. The evidence for the existence of these artifacts includes unpublished FWDC collection notes, unpublished field notes (Fredericksen 1961a, 1961b), unpublished conference papers (Fredericksen n.d.), published reports (Smith and Fredericksen 1962; Yaple 1968), and state archaeological site file records. This material, including an inventory of the missing artifacts, is presented in detail in McLean (2002). No information is available that specifically explains the loss of any particular artifact, but several factors likely played a part, including, but not limited to, attrition caused by the FWDC's erratically enforced "finders, keepers" policy, inadequate or nonexistent curation facilities and/or collections management personnel, and possibly even theft. Since the level of collection documentation is generally insufficient to provide secure identifications even if the artifacts were to be found, there is little reason to hope that the artifacts will ever be available for study.

Two additional sites, 14LO16 and 14WC15, provide circumstantial evidence of Paleoamerican occupations (McLean 2002:11). Chipped-stone artifacts, but no diagnostics, were found at 14LO16, a fossil draw that yielded a *Bison occidentalis* skull—the same species present at the 12 Mile Creek bison kill (McClung 1908; Williston 1902, 1905). No diagnostic artifacts were found at 14WC15 either, but it is located approximately 1 mile northwest of 14WC13, where a Folsom point base fragment (Figure 1B) and mammoth mandible were recovered. Both 14WC13 and 14WC15 are located on a high terrace, presumably Pleistocene in age, at the same elevation and on the same side of North Ladder Creek. A relationship between the two sites is supported by the recovery of eight pieces of debitage from a hearth at 14WC15 that are macroscopically identical to an atypical Alibates chert variant used to manufacture the 14WC13 Folsom point.

Road construction and erosion destroyed at least two Paleoamerican sites in the study area, 14WC1 and 14WC14, and the present whereabouts of at least 10 documented Paleoamerican projectile points (n = 21 total) is unknown. However, 11 Paleoamerican artifacts and 15 sites, including 14LO16 and 14WC15, still retain their research potential (McLean 2002:9-12). After more than a century of geographic and temporal isolation, the 12 Mile Creek site finally has neighbors.

Jerome S. "Pete" Bussen of Wallace, Kansas gave me access to the FWDC collections in his possession for my MA thesis research at the University of Kansas, and even loaned the collections to the University of Kansas Museum of Anthropology when my financial situation almost made it too difficult for me to continue my research on location in Wallace. Finally, Pete has been the primary informant for all my FWDC research: without his active participation and encouragement, none of it would have been possible. Special thanks to Robert Conard, Jack Hofman, Jeannette Blackmar and Virginia Hatfield for their assistance with FWDC collection documentation and projectile point type assignments, and to Stacey Lengel for providing figure preparation instructions. Robert Conard also drew the illustrations. Errors of interpretation are the sole responsibility of the author.

References Cited

Blackmar, J. M 2001 Regional Variability in Clovis, Folsom, and Cody Land Use. *Plains Anthropologist* 46(175):65-94.

Brown, K. L., and B. Logan 1987 The Distribution of Paleoindian Sites in Kansas. In: *Quaternary Environments of Kansas*, edited by W. C. Johnson, pp. 189–195. *Kansas Geological Survey Guide Book Series* 5. Lawrence.

Bussen, J. S. 1958 Some Aspects of the Environment of Wallace County, Kansas. MS. on file at the University of Kansas Museum of Anthropology, Lawrence.

Fredericksen, W. M. n.d. An Outline of the Results of the University of Kansas Archaeological Field Survey to Logan County Kansas, May, 1961. MS. on file at the University of Kansas Museum of Anthropology, Lawrence.

——— 1961a May, 1961 Field Survey to Logan County, Kansas. Ms. on file at the University of Kansas Museum of Anthropology, Lawrence.

——— 1961b Field Catalog, May 1961, KU Survey — Logan Co. Ms. on file at the University of Kansas Museum of Anthropology, Lawrence.

Hill, M. E., Jr. 1996 Paleoindian Bison Remains from the 12 Mile Creek Site in Western Kansas. *Plains Anthropologist* 41(158):359–372.

Hofman, J. L. 1994 The Kansas Folsom Evidence. *The Kansas Anthropologist* 15:31–43.

——— 1996 Early Hunter-Gatherers of the Central Great Plains: Paleoindian and Mesoindian (Archaic) Cultures. In *Archeology and Paleoecology of the Central Great Plains*, edited by J. L. Hofman, pp. 41–100. Arkansas Archeological Survey Research Series, No. 48, Fayetteville.

Hofman, J. L., and I. Hesse 1997 Kansas Clovis. *Current Research in the Pleistocene* 13:23–25.

Holen, S. R. 2001 Clovis Mobility and Lithic Procurement on the Central Great Plains of North America. Unpublished Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

McClung, C. E. 1908 Restoration of the Skeleton of *Bison occidentalis*. *Kansas University Bulletin* 4:249-252.

McLean, J. A. 1996 Coal-Oil Canyon Revisited: History of Investigations, 1955–1996. *The Kansas Anthropologist* 17(2):1–32.

——— 2002 Summary of Paleoindian Artifact Documentation: Wallace & Logan Counties, Kansas. Ms. on file at the University of Kansas Department of Anthropology, Lawrence.

Rogers, R. A. 1984 Kansas Prehistory: An Alluvial Geomorphological Perspective. Unpublished Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

Rogers, R. A., and L. D. Martin 1984 12 Mile Creek Site—A Reinvestigation. *American Antiquity* 49:757–764.

Smith, C. S., and W. M. Fredericksen 1962 Field Work in Logan County, Kansas. *Plains Anthropologist* 17:91–92.

Williston, S. W. 1902 An Arrow-Head Found with Bones of *Bison occidentalis lucas*, in Western Kansas. *The American Geologist* 30:313–315.

——— 1905 On the Occurrence of an Arrow-Head with Bones of an Extinct Bison. *Proceedings of the International Congress of Americanists* 13:335–337.

Yaple, D. 1968 Preliminary Research on the Paleo-Indian Occupation of Kansas. *Kansas Anthropological Association Newsletter* 13(7):1–9.

A Folsom Site in Northeastern Minnesota

Susan C. Mulholland and Stephen L. Mulholland

The Jim Regan site (21SL875, 09-09-09-345) is a small Folsom campsite located in northeastern Minnesota. It was discovered in November 2000 during Phase I survey for the Minnesota Department of Transportation; two shovel tests yielded five quartz flakes and a base of a Folsom point (Figure 1). Phase II evaluation identified a small lithic concentration dominated by quartz. Additional excavation was conducted over the following year by the University of Minnesota Duluth and the Heritage Resources Program of the Superior National Forest, U.S.D.A. Forest Service. Sixteen units have removed most of the site in advance of proposed highway construction.

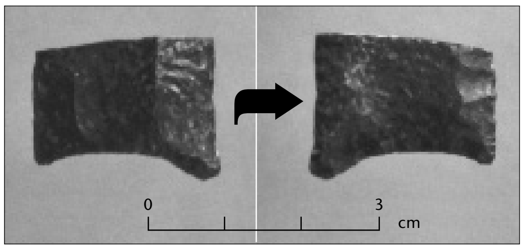

Figure 1. Front and back of base of Folsom point from the Jim Regan site.

Most materials were recovered in a concentration of 4 m^2, including 191 pieces of quartz, 3 of Knife River flint, and one of Gunflint silica; all are flakes or shatter. The materials are mostly 5 to 15 cm in depth. The quartz occurs in two loci about 1 m apart with additional scatter spread over a diameter of 2 m. A granite hammerstone was recovered near a large flat rock between the two loci. The amount of quartz debitage suggests reduction of one or two cobbles, perhaps for expedient tools. Quartz is the only naturally occurring lithic material in the area.

The non-quartz flakes occur in adjacent quadrants of two units south of the quartz loci. All four flakes are small, suggesting tool retouch. The Gunflint silica flake has dorsal flake scars, further supporting the probability of tool resharpening as an activity. Knife River flint is derived from North Dakota; Gunflint silica is present as bedrock outcrops in the Gunflint formation northeast of the site. It also occurs in Superior lobe till, with smaller amounts in Rainy Lobe till; deposits are to the north and east.

The Folsom point base is made of jasper-taconite, which is also part of the Gunflint formation and found in tills to the east of the site. It was recovered about 5 m south of the quartz concentration. The point base was found about 10 cm below surface; although the exact depth is unknown, it was below 5 cm and in the dark sediment of the A horizon. This depth and sediment characterize the context of the quartz concentration farther north. Two flakes, one quartz and one jasper taconite, were recovered between the concentration and the point.

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The Jim Regan site appears to be a small single-component campsite. The soil profile is undisturbed, showing a dark A horizon overlying a lighter B horizon; the interface is mottled and indistinct, reflecting an in situ development without disturbance. Ongoing sediment analyses are expected to add information on site formation. All cultural materials indicate lithic reduction activities, both primary reduction of quartz and retouching of non-quartz tools. The small size of the site and lack of features suggest a short-term occupation. However, several aspects of the site are unusual.

First, the recovery of a Folsom point from northeastern Minnesota represents the northernmost occurrence of (as well as the only known) in situ Folsom site in Minnesota. Folsom points are generally associated with prairie environments, either on the Plains or in the Prairie Peninsula (Munson 1990). Previously recorded Folsom points in Minnesota are from the western prairies and southern mixed forest areas (Higgenbottom 1996). In contrast, the area around the site has always been forest (Huber 1987).

Second, the majority of the cultural materials are quartz debitage (flakes and shatter), here interpreted as primary reduction of local material. Quartz is not commonly associated with Paleoindian technologies, although fluted points of crystal quartz are documented (Curran and Grimes 1989:50). Vein quartz or quartz cobbles, however, may be used for expedient tools. Given that the area within 20 miles of the site has a paucity of flakable material except for quartz, the reduction of quartz is not unreasonable at the site.

The site may be explained in two ways. It could represent a short-term excursion by an individual or small group from the plains into a forest environment. Alternatively, it may represent a previously unknown Folsom manifestation within the area. Fluted points of jasper-taconite are reported from western Wisconsin (Wendt 2001) and perhaps western New York (Tankersley et al. 1996:103). Given that the bedrock source of jasper-taconite is in northeastern Minnesota, additional sites of Folsom and Clovis age should be expected.

References Cited

Curran, M. L., and J. R. Grimes 1989 Ecological Implications for Paleoindian Lithic Procurement Economy in New England. In *Eastern Paleoindian Lithic Resource Use,* edited by C. J. Ellis and J. C. Lothrop, pp. 41–74. Westview Press.

Higgenbottom, D. K. 1996 An Inventory of Fluted Projectile Points from Minnesota. Manuscript. Presented at the 54th Annual Plains Conference, Iowa City.

Huber, J. K. 1987 A Vegetational Reconstruction from Big Rice Lake, St. Louis County, Minnesota. *Current Research in the Pleistocene* 4:91–93.

Jones, B. D. 1997 The Late Paleoindian Hidden Creek Site in Southeastern Connecticut. *Archaeology of Eastern North America* 25:45–80.

Munson, P. J. 1990 Folsom Fluted Projectile Points East of the Great Plains and Their Biogeographical Correlates. *North American Archaeologist* 11 (3):255–272.

Tankersley, K. B., J. D. Holland, and R. L. Kilmer 1996 Geoarchaeology of the Kilmer Site: A Paleoindian Habitation in the Appalachian Uplands. *North American Archaeologist* 17 (2):93-111.

Wendt, D. 2001 A Jasper Taconite Fluted Point from Dunn County, Wisconsin. Institute for Minnesota Archaeology, Report of Investigation No. 607. St. Paul.

An AMS ^{14}C Date from a Late-Pleistocene Deposit in the Ilaló Region, Ecuador: Implications for Highland Paleoindian Occupation

Hugo G. Nami

The Ilaló region in the highlands of Ecuador is a significant locale for "early man" studies in South America. There, a number of archaeological sites with "fishtail" or Fell projectile points were discovered, especially at El Inga (Bell 1965; Mayer-Oakes 1966, 1986; Mayer-Oakes and Bell 1960). Most of the archaeological remains at these sites occur on a dark layer of sediment overlying regional deposits of *cangagua,* a volcanic tuff presently exposed in the lower slopes of the Ilaló hill (Mayer-Oakes 1966). The *cangagua* is a very fine volcanic material similar to loess, but with a different mineralogical composition. Although this geological unit is widely believed to have been deposited during a glacial episode in the Pleistocene (Sauer 1965), no detailed chronological studies have been conducted (Salazar pers. comm. 1999).

To investigate the age of geological deposits during the terminal Pleistocene and Holocene, soil and sediment may be dated using the radiocarbon technique. Although radiocarbon dates obtained from sediments occasionally show some discrepancies relative to dates on other materials (e.g., Head et al. 1989; Martin and Johnson 1995; Nakamura et al. 1990), many seem reliable for determining the age of sedimentary deposits (Head et al. 1989; Willey et al. 1998).

During the spring of 1999, several investigations were conducted in the Republic of Ecuador, among them sampling sedimentary sections from diverse environments. The main goal was to explore the validity of a possible geomagnetic excursion that occurred during the late Pleistocene/Holocene and has been observed in several places in the Americas (e.g., Nami 1999a, 1999b, 2001). One set of samples was taken at El Tingo (00°17.43′ S, 78° 26.88′ W), located in the Los Chillos valley, southeast of Quito city. Sampling was carried out in the upper part of a large section of *cangagua* showing different colors. Considering the stratigraphic occurrence of the Paleoindian discoveries at El Inga, as well as the Pleistocene age of the deposit, only the upper part of this section underlying the recent soil (presumably of late-Pleistocene/early-Holocene age) was sampled. At this stratigraphic position

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the *cangagua* is the parent material of the present vegetal soil. The sampled unit consisted of three levels: I, the recent soil with vegetation; II, a dark sediment; and III, a gray-colored *cangagua*; The second one is transitional between levels I and III.

A sediment sample from 50–55 cm below the surface, within level II, was submitted to the INSTAAR Laboratory for AMS radiocarbon dating (Colorado University at Boulder). A conventional date of 10,550 ± 55 yr B.P. (CURL-5504) was obtained from the humic-acid fraction of the sediment, which tends to provide more reliable ages for this kind of material (Turnbull pers. comm. 2000).

In the Ilaló region, several sites have yielded Fell projectile points. However, there are many problems of chronology that have to be solved (Mayer-Oakes 1982, 1986). The stratigraphic sequence at El Tingo seems to be very similar to that at Paleoindian site at El Inga, 12 km distant. There, according to Mayer-Oakes (1963), the stratigraphy consists of a top level of soil 20–25 cm deep, periodically disturbed by plowing. Below that is a darker band of unplowed soil, in which most of the obsidian tools and debitage occurred. This level extends to 45–50 cm below the surface and is underlain by a yellow hardpan of consolidated volcanic tuff that contained no archaeological materials.

Although El Tingo is not an archaeological site, the radiometric date is significant because the dated level is in a stratigraphic position similar to that at sites in the general area that have produced Paleoindian material. The oldest radiocarbon date at El Inga on soil samples is 9030 ± 144 yr B.P. (R-1070/2), which is considered too late for Paleoindian occupation (Mayer-Oakes 1986). This date may be considered a minimum age because the apparent mean residence time of organic components is a significant factor that must be considered in dating sediments (Scharpenseel 1971; Stein 1992). However, the date from El Tingo is consistent with the expected age of the upper part of the *cangagua* stratum. If so, it also provides a basis for discussing the possible age of Paleoindian material buried in stratigraphically comparable deposits. Elsewhere in South America, most dates fall between 11,000 and 10,000 yr B.P. in central Chile (Nuñez et al. 1992), Pampean region (Flegenheimer and Zarate 1997; Martínez 2001; Mazzanti 1997) and Patagonia (Nami 1994, 1996, Miotti 2000). Thus, the date from El Tingo agrees well with what is known elsewhere about the age of Fell projectile points in South America.

I am deeply indebted to Ernesto Salazar and W. Mayer-Oakes for their continuous support of my work in the El Ilaló region and to Byron Camino for his friendship and invaluable help during the fieldwork. The AMS date was kindly provided by the NSF and IAI program for Latin American Quaternary research and global change studies; and by NSF grant ATM-9809285 to the University of Colorado INSTAAR Laboratory for AMS Radiocarbon Preparation and Research. Jocelyn Turnbull was very helpful during the AMS date processing. Peter Storck and an anonymous reviewer kindly provided assistance during the editing of this paper.

References cited.

Bell, R. E. 1965 *Investigaciones arqueológicas en el sitio de El Inga, Ecuador.* Casa de Cultura Ecuatoriana, Quito, 330 pp.

Flegenhemier, N., and M. Zarate 1997 Considerations on radiocarbon and calibrated dates from Cerro La China and Cerro El Sombero, Argentina. *Current Research in the Pleistocene* 14:27–28.

Head, M. J., W. Zhou, and M. Zhou 1989 Evaluation of ^{14}C Ages of Organic Fractions of Paleosols from Loess-Paleosol Sequences near Xian, China. *Radiocarbon* 31:680–696.

Martin, C. W., and W. C. Johnson 1995 Variation in Radiocarbon Ages of Soil Organic Matter Fractions from Late Quaternary Buried Soils. *Quaternary Research* 43:232–237.

Martínez, G. A. 2001 'Fish-tail' Projectile Points and Megamammals: New Evidence from Paso Otero 5 (Argentina). *Antiquity* 75:523–528.

Mayer-Oakes, W. J. 1963 Early Man in the Andes. *Scientific American* 208(5):117–128.

——— 1966 El Inga Projectile Points-Surface Collections. *American Antiquity* 31(5):644–661.

——— 1982 Early Man in Northern Andes: Problems and Possibilities. *Peopling of the New World,* edited by J. E. Ericson, R. E. Taylor, and R. Berger, pp. 269–285, Ballena Press Anthropological Papers, Los Altos.

——— 1986 *El Inga. A Paleoindian site in the Sierra of Northern Ecuador. Transactions of the American Philosophical Society*, 76(4), pp. 235, Philadelphia.

Mayer-Oakes, W. J., and R. Bell 1960 Early Man Site Found Highland Ecuador. *Science* 131:1805–1806.

Mazzanti, D. L. 1997 Excavaciones arqueológicas en el sitio Cueva Tixi, Buenos Aires, Argentina. *Latin American Antiquity* 8(1):55–62.

Nakamura, T., S. Tsunemasa, and N. Nakai 1990 Variations in ^{14}C of Various Organic Fractions in a Turbidite Sediment Core from Soruga Trough. *Geochemical Journal* 24:47–56.

Nami, H. G. 1994 Reseña sobre los avances de la arqueología finipleistocénica del extremo sur de Sudamérica. *Chungara* 26(2):145–163.

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

——— 1999a Possible Holocene Excursion of the Earth's Magnetic Field in Southern South America: New Records from Archaeological Sites in Argentina. *Earth, Planets and Space* 51:175–191.

——— 1999b Probable Middle Holocene Geomagnetic Excursion at the Red rock Archaeological Site, California. *Geofísica Internacional* 18(4):239–250.

——— 2001 A Latest Pleistocene/Holocene large secular variation detailed record from Northeastern Buenos Aires (Argentina), submitted for publication.

Nuñez, L., J. Varela, R. Casamiquela, V. Schiappaccasse, H. Niemeyer y C. Villagrán 1992 Mastodon Kill in Central Chile. *Prehistoric Mongoloid Dispersals Abstracts* pp. 27, Tokyo.

Sauer, W. 1965 *Geología del Ecuador*, Editorial del Ministerio de Educación, Quito.

Scharpenseel, H. W. 1971 Radiocarbon Dating of Soils-Problems, Troubles, Hopes. *Paleopedology. Origin, Nature and Dating,* edited by D. H. Yaalon, pp. 77–88, International Society of Soil Scientists and Israel University Press, Jerusalem.

Stein, J. K. 1992 Organic Matter in Arcaheological Contexts. *Soils in Archaeology*, edited by V. T. Holliday, pp. 193–216, Smithsonian Institution Press, Washington D. C.

Willey, K. L., W. C. Johnson, and J. S. Isaacson 1998 Preservation of the Paleoindian record in Alluvial Fill, Northeastern Kansas. *Current Research in the Pleistocene* 15:68–70.

The Haskey Area, a Cody-complex Site from the Quill Lakes Region, Saskatchewan, Canada

Brad Novecosky

A large Cody complex has been documented while recording private artifact collections from the Quill Lakes region in east-central Saskatchewan. Although large Cody sites are common, they have only been described in the southern portion of the province (e.g. Corbeil 1995; Ebell 1988; Joyes 1999, 2000; Meyer 1985). This site is unique because it is one of the largest recorded Cody sites in central Saskatchewan. The majority of the Cody-complex artifacts have been designated as Haskey Area 6 (ElMw-7), but a few diagnostic materials found across a small ephemeral creek were recorded as Haskey Area 5 (ElMw-6). The two areas are described together.

Thirty-one Cody-complex artifacts were recorded from an area along Milligan Creek, 6.4 km south of Wadena. Twenty-three Scottsbluff points and fragments, four Eden point fragments, a Cody knife, and a drill were identified. Other tools such as scrapers, bifaces, retouched flakes, fire-cracked rock, and debitage were also recorded for this area, but their association with the Cody-complex materials remains unclear because cultivation has disturbed the site.

Basal portions represent the majority of Scottsbluff points. Six points are complete but extensively reworked. The majority are fashioned from Swan River chert (60.9 percent), followed by chert (21.7 percent) and Knife River flint (17.4 percent). The dominance of Swan River chert, locally available in glacial till (Low 1996), in this assemblage differs from other large recorded sites in Saskatchewan such as the McLeod site (Joyes 2000) and Dunn site (Ebell 1988), where Knife River flint dominates. The four Eden mid-shaft fragments are fashioned from chert.

A single Cody knife was identified from this site (Figure 1A). The specimen

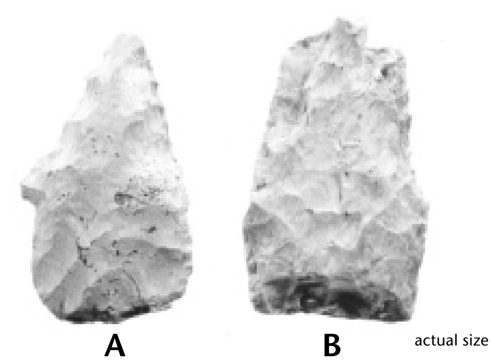

Figure 1. Cody knife (**A**) and drill (**B**) from the Haskey Area.

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is complete, but the lithic material is unknown because of heavy patination. The blade has been reworked to a point where it likely was no longer functional. This Cody knife brings the published total for Saskatchewan to 13 (Blackmar 1998; Joyes 2000). In addition, the basal portion of a drill is likely associated with the Cody materials from this site (Figure 1B). This drill base is similar to those associated with Cody-complex materials from the MacLeod (Joyes 2000:48) and Niska (Meyer and Liboiron 1990:301) sites. It is made from Knife River flint and is heavily patinated on one surface.

The Haskey area has been disturbed by cultivation but is important because the large collection that has been recorded represents one of the largest Cody-complex sites in central Saskatchewan.

References Cited

Blackmar, J. M. 1998 The Distribution of Cody Knives: A Distinctive Trait of the Cody Complex. *Current Research in the Pleistocene* 15:6–9.

Corbeil, M. 1995 The Archaeology and Taphonomy of the Heron Eden Site, Southwestern Saskatchewan. M.A. Thesis. University of Saskatchewan.

Ebell, B. 1988 The Dunn Site. *Plains Anthropologist* 33(122):505–530.

Joyes, D. C. 1997 New Paleo-Indian Finds from Southern Saskatchewan. *Saskatchewan Archaeological Society Newsletter* 18(6):107–112.

——— 2000 Cody Complex Technology at the McLeod Site, Saskatchewan, Canada. *Current Research in the Pleistocene* 17:47–49.

Low, B. 1996 Swan River Chert. *Plains Anthropologist* 41(156):165–174.

Meyer, D. 1985 A Component in the Scottsbluff Tradition: Excavations at the Niska Site. *Canadian Journal of Archaeology* 9(1):1–37.

Meyer, D., and H. Liboiron 1990 A Paleoindian Drill from the Niska Site in Southern Saskatchewan. *Plains Anthropologist* 35(129):299–302.

The Chance Gulch Late-Paleoindian Site, Gunnison Basin, Colorado

Bonnie L. Pitblado

The Chance Gulch site (5GN817) is located 4 km southeast of Gunnison, Colorado, in a sagebrush parkland, 2420–2460 m asl. The site is multicomponent, with stratified deposits ranging in age ca. 8000–3600 RCYBP. This paper describes features, radiocarbon dates, and diagnostic artifacts associated with the earliest of the site's occupations.

First recorded in 1979 (Coe et al. 1980) and rerecorded in 1998 (Coleman-Fike 1998), the Chance Gulch site has yielded 17 surface late-Paleoindian projectile points. Subsurface testing and excavation from 1999–2001

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(Pitblado 2001a, 2001b) produced an additional seven late-Paleoindian projectile points, numerous non-projectile point tools, a large hearth feature, and a possible storage pit on an occupation surface 30–40 cm below the ground surface.

The hearth consisted of 96 pieces of fire-cracked rock, including one piece of recycled groundstone. Fill associated with the feature contained little charcoal, probably because the sometimes ferocious Chance Gulch winds scoured it away. Fortunately, a few charcoal flecks remained in the protected nooks of the hearth rocks. One of them yielded a radiocarbon date of 7990 ± 50 RCYBP (Beta-145380).

Excavators exposed a possible storage pit in cross section in 2001. Measuring 50 by 60 cm, the pit contained a groundstone fragment and charcoal dated to 8090 ± 50 RCYBP (Beta-158247), the same age as the fire-cracked rock feature. Evidence suggests humans excavated the pit; however, animals could also have been responsible. Future excavations will address this issue.

In addition to the fire-cracked rock and pit features, the Paleoindian surface yielded over 1,400 point-plotted lithic artifacts, including primarily quartzite flakes, gravers, scrapers, bifaces, and the seven aforementioned projectile points. Six of the projectile points exhibit a lanceolate form, convergent and well-ground basal sides, and an oblique flaking pattern, and can be classified as Angostura (*sensu* Pitblado 1999) (Figure 1A, B). The seventh specimen (Figure 1C) is stemmed, has well-ground, straight basal sides, and a chevron flaking pattern. It is best (if imperfectly) compared with the Eden type (Wormington 1957).

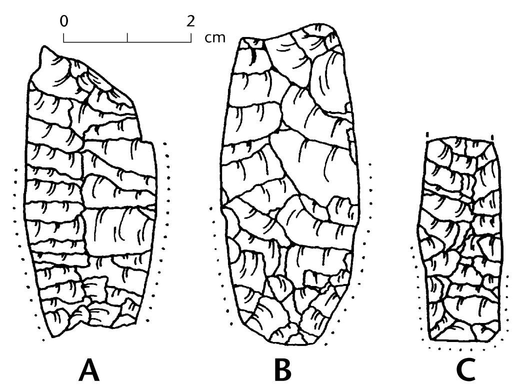

Figure 1. In situ late-Paleoindian projectile points from the Chance Gulch site: **A, B,** Angostura type (Pitblado 1999); **C,** Stemmed point (cf. Eden). Specimen **A** reworked at tip to create a graver. Specimen **B** reworked at both base and tip.

The late-Paleoindian component at Chance Gulch represents one of only a handful of early-Holocene open campsites in the Rocky Mountains. Such sites undoubtedly constituted an important element of the settlement strategy of people inhabiting the mountains at this time (Pitblado 1999). Future work at Chance Gulch will attempt to define the site's position within the broader land use system of its occupants.

The Bureau of Land Management, Colorado Historical Society, and Western State College provided funding for the Chance Gulch excavation. I thank them, field director Beth Ann Camp, BLM partner

Julie Coleman-Fike, and the many wonderful volunteers who have contributed and continue to contribute to the project.

References Cited

Coe, C., D. Markoff, and C. W. Wheeler 1980 An Assessment of Cultural Resources in the Vicinity of Chance Gulch, Gunnison County, Colorado. Prepared for Camp Dresser and McKee, Inc., Wheatridge, CO. Ms. on file, Colorado Historical Society, Denver.

Coleman-Fike, J. 1998 Class III Cultural Resource Inventory of Tomichi Fence Project, Gunnison County, Colorado. Ms. on file, Bureau of Land Management, Gunnison Resource Area, Gunnison, CO.

Pitblado, B. L. 1999 Late Paleoindian Occupation of the Southern Rocky Mountains: Projectile Points and Land Use in the High Country. University Microfilm Dissertation Services, Ann Arbor, MI.

——— 2001a Final Report: Test Excavations at Sites 5HN510, 5GN411, 5GN2151 and Interim Results of Test Excavations at 5GN817. Ms. on file, Bureau of Land Management, Gunnison Resource Area, Gunnison, CO.

——— 2001b Final Report: 2000 Test Excavations at the Chance Gulch Site (5GN817). Ms. on file, Bureau of Land Management, Gunnison Resource Area, Gunnison, CO.

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

The Spatial Component of the Western Clovis Chronology

Donna C. Roper and Brian T. Wygal

The origin of the Clovis tradition is an important problem in North American prehistory and one to which analysis of spatial trends within chronological data sets can contribute. Spatial trends have been evaluated on a pan-continental level as the relative ages of North American Clovis and early South American complexes are compared, and some attention has been directed toward comparing the relative ages of Western and Eastern Clovis sites. Little attention, though, has been given to evaluating spatial trends within the Clovis chronometric data set for western North America. In light of competing propositions regarding Clovis origins, it would seem important to do so.

Radiocarbon age determinations are available for nearly a dozen sites throughout the Plains and Southwest. Average dates for each site, with site location by state, are Lehner (Ariz.), 10.9 kya; Murray Springs (Ariz.), 10.9 kya; Blackwater Draw (N.M.), 10.9 kya; Lubbock Lake (Tex.), 11.1 kya; Aubrey (Tex.), 11.5 kya; Midland (Tex.), bracketed 11.4–10.8 kya (Holliday 1997); Domebo (Okla.), 11.1 kya; Dent (Colo.), 10.7 kya; Sheaman (Wyo.), 10.7 kya;

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Colby (Wyo.), 10.9 kya; and Anzick (Mont.), 10.8 kya. (Individual age determinations are listed in Frison 1991, Holliday 1997, Taylor et al. 1996, and other sources.) Two other sites have dates in the same general range but are not conclusively shown to be Clovis: the UP Mammoth (Wyo.), where the date is 11.3 kya but the artifacts are not diagnostic (McGrew 1961); and Lange-Ferguson (S.D.), where the question lingers as to whether the dated mammoth is associated with the nearby Clovis campsite (Hannus 1990).

Simple inspection of these dates shows that the earliest Western Clovis sites are in the Southern Plains. Younger sites also appear in the Southern Plains and adjacent Southwest, but all Northern Plains sites with verified Clovis association are younger. This is consistent with suggestions that Clovis originated in and expanded from the Southeast. The 12.2 kya date for the Johnson site near Nashville (Tenn.) is provocative and supportive (Broster et al. 1991), but the very large standard deviations of the individual determinations make it necessary to confirm this date. Additional dates from Clovis context in the Southeast are eagerly awaited. Furthermore, reported Clovis-point densities are considerably higher in the Southern Plains than in the Northern Plains, and still higher in the Southeast (Meltzer 1988), possibly reflecting (among other factors) a longer period over which Clovis points accumulated in the south.

To the north, the lack of Clovis material in the Ice-free Corridor in Canada and Alaska, where it would be expected if Clovis came from the north, is further consistent with a Southern origin for Clovis. Of the small amount of evidence of Clovis that actually occurs in Canada or Alaska, the Charlie Lake Clovis assemblage from central Canada dates to 10.5 kya (Driver 1998). Otherwise, Mesa is the nearest equivalent to a fluted-point assemblage. Lithics from Mesa, however, resemble Agate Basin, not Clovis, from the Great Plains. The originally announced Mesa site dates (11,660 ± 80 yr B.P. and 11,190 ± 70 yr B.P.) are from a single hearth (Kunz and Reanier 1995) and very likely attributed to "old wood." Closer inspection of Mesa provides strong evidence that the site was occupied between 10.2 and 9.9 kya (Hamilton and Goebel 1999). Other early fluted-point sites have also been reevaluated. Fluted-point technology from Putu in the Brooks Range was originally considered the earliest such material in Alaska and believed to date to 11.5 kya (Clark 1991), but now is considered to date around 8.45 kya (Reanier 1994).

James Dixon has proposed that Paleoamerican technologies began in the South and spread into Alaska approximately 10.5 kya (Dixon 1999). Spatial trends within the chronological data from the North American continent appear to support this. The trend within the dates from the Plains and Southwest Clovis sites, particularly in combination with the Canadian and Alaska dates and possibly also with the Southeastern dates, does not necessarily prefer one or another proposed model for the peopling of the Western Hemisphere or the origins of the Clovis tradition, save that it does not comport well with implications of the Clovis-first model. Faced with mounting evidence regarding the peopling of the Americas, we are on the threshold of new explanations. The image of big-game hunters traveling at breakneck pace through an Ice-Free Corridor is giving way to a much more complicated scenario (Bonnichsen and Turnmire 1999).

References Cited

Bonnichsen, R., and K. L. Turnmire (editors) 1999 *Ice Age Peoples of North America: Environments, Origins, and Adaptations of the First Americans.* Oregon State University Press, Corvallis.

Broster, J. B., D. P. Johnson, and M. R. Norton 1991 The Johnson Site: A Dated Clovis-Cumberland Occupation in Tennessee. *Current Research in the Pleistocene* 8:8–10.

Clark, D. W. 1991 The Northern (Alaska-Yukon) Fluted Points. In *Clovis Origins and Adaptations,* edited by R. Bonnichsen and K. L. Turnmire, pp. 35–48. Center for the Study of the First Americans, Corvallis, Oregon.

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

Driver, J. C. 1998 Human Adaptation at the Pleistocene/Holocene Boundary in Western Canada, 11,000 to 9000 BP. *Quaternary International* 49/50:141–150.

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

Hamilton, T. D., and T. Goebel 1999 Late Pleistocene Peopling of Alaska. In *Ice Age Peoples of North America: Environments, Origins and Adaptations of the First Americans,* edited by R. Bonnichsen and K. L. Turnmire, pp. 156–199. Oregon State University Press, Corvallis.

Hannus, L. A. 1990 The Lange-Ferguson Site: A Case for Mammoth Bone-Butchering Tools. In *Megafauna and Man: Discovery of America's Heartland,* edited by L. D. Agenbroad, J. I. Mead, and L. W. Nelson, pp. 86–99. Scientific Papers, Volume 1. The Mammoth Site of Hot Springs, South Dakota, Inc., Hot Springs, South Dakota.

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

Kunz, M. L., and R. E. Reanier 1995 The Mesa Site: A Paleoindian Hunting Lookout in Arctic Alaska. *Arctic Anthropology* 32(1):5–30.

McGrew, P. O. 1961 The Rawlins Mammoth. In *Guidebook: Sixteenth Annual Field Conference,* pp. 315-317. Wyoming Geological Association.

Meltzer, D. J. 1988 Late Pleistocene Human Adaptations in Eastern North America. *Journal of World Prehistory* 2(1):1–52.

Reanier, R. E. 1994 The Putu Site: Pleistocene or Holocene? *Current Research in the Pleistocene* 11:148–150.

Taylor, R. E., C. V. Haynes, Jr., and M. Stuiver 1996 Clovis and Folsom Age Estimates: Stratigraphic Context and Radiocarbon Calibration. *Antiquity* 70:515–525.

Late-Pleistocene Terrace in the Middle Yukon River Region at Eagle, Alaska

Robert A. Sattler and Robin O. Mills

The middle Yukon River Valley is a bedrock-constricted river corridor with a diverse sequence of late-Cenozoic terraces, landslides, alluvial fans, and alluvium in the international border area between Canada and Alaska. Radiocarbon ages on late-Pleistocene fauna in Eagle, Alaska, demonstrate a dated horizon of the last glacial–interglacial transition (ca. 14,000–10,000 yr B.P.) in east-central Alaska. The dated faunal elements are from the general area of a several-meter-high alluvial terrace overlooking the Yukon River around a formally designated site named the Eagle Bluff (EAG-070). The wolf remains are from Ft. Egbert paleontological site (EAG-335).

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The dated faunal elements are stratigraphically placed in the upper portion of late-Pleistocene outwash gravel situated below a younger, upward-fining sequence of eolian deposits. A bison (*Bison antiquus)* horn core (Eagle museum no. 941916) found embedded in the upper portion of the gravel produced an AMS age of 12,270 ± 50 RCYBP, 14,325 to 14,125 CALYBP (Beta-128757); a portion of a wolf (*Canis lupus*) mandible (UA2000-P-06) found in a finer gravel deposit immediately below the eolian sequence yielded an AMS age of 11,660 ± 80 RCYBP, 13,990 to 13,940 CALYBP (Beta-147161). The latter age falls within the period of initial human colonization of Interior Alaska greater than 11,600 yr B.P. (Dixon, 2001).

The initial report on the *Bison* find suggested that some bison elements were culturally modified (Armine, 1994), but a more thorough analysis indicates that the dated horn core is carnivore gnawed (Saleeby, 1999; and personal observation by RAS). Stephenson et al. (2001) have shown that bison survived the Holocene in interior Alaska nearly up to Euroamerican contact in the middle of the 19th century. Based on available data, the dated bison and wolf remains are found in paleontological contexts.

These faunal remains represent the only well-dated late-Pleistocene terrace with good stratigraphic context in east-central interior Alaska. The stratigraphic sequence indicates that these ages represent a terminal phase of aggradation of the Yukon River during late-Pleistocene deglaciation. The ages are in agreement with a regional phase of rapid sand deposition during the late glacial–early Holocene along the middle Yukon River between central Yukon and Alaska (Froese, 2001). This late-Pleistocene terrace will be useful for identifying other terrain features of similar age along the middle Yukon River to further understand the glacial-interglacial transition in the region.

We would like to thank Becky Saleeby (National Park Service) for helping with the identification of the bison materials. Wade Kaiser (National Park Service) found the wolf mandible during trenching operations at EAG-070. The National Park Service and the Bureau of Land Management paid for the radiocarbon ages.

References Cited

Armine, R. 1994 Archaeological Report of Front Street Eagle, Alaska. Report prepared for the Natural Resources Conservation Service, Anchorage, Alaska. Copy in possession of the authors.

Dixon, E. J. 2001 Human Colonization of the Americas: Timing, Technology and Process. *Quaternary Science Reviews* 20:277–299.

Froese, D. G. 2001 Eastern Beringian Paleoclimate from Fluvial Depsits: Plio-Pleistocene Middle Yukon River, Central Yukon and Aalska. Unpublished Ph.D. dissertation, University of Calgary.

Saleeby, B. 1999 Front Street Bank Stablization Project in Eagle, Alaska: Reexamination of Bones of Lithic Artifacts. Manuscript in possession of the authors.

Stephenson, R. O., S. C. Gerlach, R. D. Guthrie, C. R. Harington, R. O. Mills, and G.

Hare 2001 Wood Bison in Late Holocene Alaska and Adjacent Canada: Paleontological, Archaeological and Historical Records. *People and Wildlife in Northern North America. Essays in Honor of R. Dale Guthrie*, edited by S. C. Gerlach and M. S. Murray. British Archaeological Reports International Series 2001 – Volume 944, pp. 124–158. Oxford University Press, Oxford.

The Mountaineer Site, a Large Folsom Camp near Gunnison, Colorado

Mark Stiger

During the summer of 2001, Western State College began excavating a Folsom site 2 miles south of Gunnison, in western Colorado. The Mountaineer site sits atop a high mesa (elevation 8,600 ft/2,620 m), which overlooks the town and campus, offering spectacular views in all cardinal directions.

The shallow loess soils on the mesa top show evidence of little geological post-depositional disturbance. We conducted detailed surface mapping and also mapped alignments of cairns and rock-walled pits. On the surface we found Folsom points, preforms, channel flakes, or spurred scrapers on 14 of the approximately 35 artifact clusters found on the mesa. The Folsom clusters are all located in one area of the mesa, while all Archaic-age diagnostic artifacts are found in areas hundreds of meters away.

Our excavation was centered on one cluster of Folsom artifacts and opened a 73-m^2 block. Within the block area, we recovered parts of 40 Folsom points and preforms; 90 channel flakes; numerous bifacial, unifacial, and flake tools; two shallow hearths that may be centers of Folsom activities; 16,000 pieces of debitage; 150 bone fragments; and the edge of a middle-Archaic roasting pit (Figure 1). Detailed mapping of excavated artifacts and natural rocks shows what appear to be drop zones, toss zones, and cleaned zones around the features. Refit artifacts include several channel flake fragments that fit together and some that mate with preforms and points. However, most channel flakes appear to come from quartzite preforms not found and perhaps removed from the site by the prehistoric occupants.

Several aspects of this Folsom occupation, beyond its location on Colorado's Western Slope and its elevation, make Mountaineer highly unusual. Most of the debitage and projectile points found in the excavated area are made of local quartzite that could have been acquired within a mile of the site. The bone is well preserved but highly processed. Blades were manufactured on the site next to the hearths, as evidenced by refitting blades, blade core, and core tablet rejuvenation flake. The occupation doesn't seem to be integrated into a bison kill and processing site. The fires were built in slightly excavated pits. The spatial structure of the site showing cultural activities appears to be intact. There is surface evidence of at least another 13 Folsom

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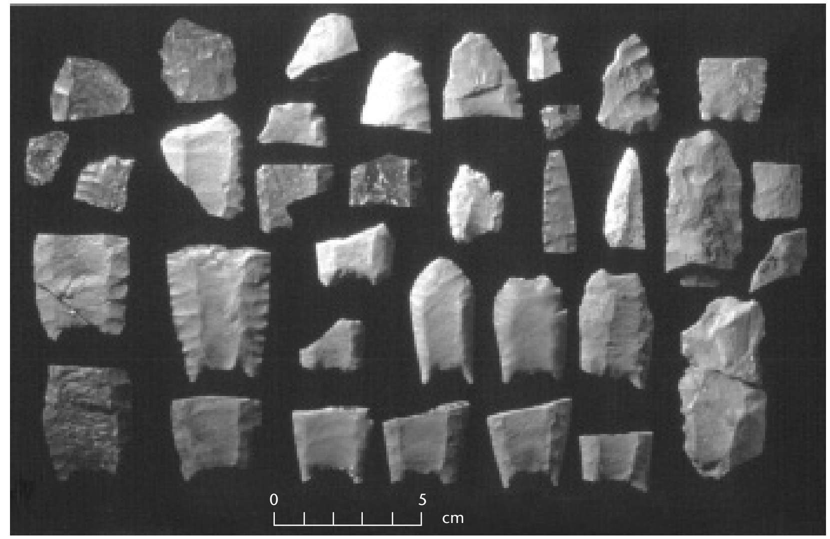

Figure 1. Representative point, preform, and channel fragments from the 73-m^2 excavation block at the Mountaineer site.

occupations nearby, and some of them appear to represent different kinds of activities and perhaps different aspects of the settlement system.

At the Mountaineer site, 80 to 90 percent of debitage and most of the tool classes are made of local quartzite. Scrapers are the only tool category in which the majority of specimens are made from chert, probably a non-local material type. This same pattern of raw material use is seen in during the early Archaic, which is well known from extensive excavations at the nearby Tenderfoot site (Stiger 2001). Furthermore, examination of surface-collected Paleoamerican artifacts and site records made by professionals and amateurs from 31 sites in the Basin show a preponderance of local quartzite projectile points of many different styles, including Clovis, Folsom, Goshen, Eden, and Jimmy Allen.

Reference Cited

Stiger, M. 2001 *Hunter-Gatherer Archaeology of the Colorado High Country*. University Press of Colorado: Boulder.

Physical Anthropology

A Late-Paleoindian Secondary Ritual Burial from Lagoa Santa, Minas Gerais, Brazil

Walter A. Neves, Mark O. R. Hübbe, and Astolfo G. M. Araújo

Since the pioneering paleontological work carried out by Peter Lund from 1833 to 1844 in several caves and rockshelters in Lagoa Santa, central Brazil, this region has become famous worldwide as an important area where the first Americans could be investigated. Since Lund's work, most research carried out in the region has been descriptive in nature, even that undertaken by professional archaeologists (see Kipnis 1998 for a review). Notwithstanding, by the early 1980s several points were already firmly established for the region (Prous and Fogaça 1999): (1) humans were present by the very end of the Pleistocene; (2) rockshelters were used as both camp sites and burial places; (3) local lithic industry was expedient; (4) subsistence was based primarily on small game and vegetable items, despite the probable presence of megafauna in the local ecosystem; and (5) most human bodies were deposited in the ground in highly flexed position and are often associated with blocks of stones.

From the beginning of the 1980s until very recently, there have been no major archaeological investigations carried out in Lagoa Santa. Most Paleoindian research in Minas Gerais has been focused in the north of the State, where many Pleistocene/early-Holocene sites are found that offer much better preservation (Prous 1986). In July 2001 we began a long-term paleoanthropological research project in the area with multiple objectives: (1) to test the hypothesis of a pre-Clovis occupation; (2) to understand the relationship between the local population and the megafauna; (3) to temporally contextualize the collections of human skeletal remains uncovered in the area in the last 150 years of research; (4) to search for new human skeletal material that could be precisely dated; (5) to more clearly understand the Paleoindian settlement-subsistence pattern; and (6) to reconstruct the landscape that existed at the time of the Paleoindians.

It has long been suspected that the Paleoindians at Lagoa Santa culturally

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manipulated human bones in complex fashions. Walter (1958), for instance, described the finding of a pipe fashioned from a human long-bone diaphysis at Sumidouro rockshelter. The lack of precise chronological context for this finding, however, prevents a clear association of this instrument with the Paleoindian horizon. Messias and Mello e Alvim (1961) noted that amongst the two "primary" burials found by Hurt and Blasi in 1956 in Boleiras Rockshelter (Hurt and Blasi 1969), which we have recently dated by AMS on collagen at 8000–9000 yr B.P., several cut marks are found on the tibias, femurs, and patellae of two of the individuals. In fact, remains of five individuals were found in the two "primary" burials described by the excavators.

During the curation (1995–99) of the Harold Walter collection of human skeletal material from several Lagoa Santa sites, one of us (WAN) noticed that the diaphyses of several tibias and femurs bore cutmarks suggesting their epiphyses had been intentionally removed by cutting. Although no absolute chronology exists for this material, all the epiphyses are heavily fossilized and are likely to represent Paleoindian material.

As part of our recent paleoanthropological research in the area (July 2001) we have undertaken re-excavations at the Boleiras rockshelter in Lagoa Santa. Boleiras, a major limestone rockshelter near the city of Matozinhos, is 60 m long and 12 m maximum width, with a sheltered area of 420 m^2. It is part of a limestone outcrop facing two dolines, one of them still active today as a swallet of an intermittent stream. Our re-excavations have yielded further evidence that complex manipulation of human bones was part of Paleoindian mortuary practices.

Three human burials were found during our excavations at the site. All burials are of unarticulated parts of human skeletons, but for two of them the possibility of bioturbation to explain their incompleteness and configuration could not be excluded. On the other hand, one of the burials (Burial 3) was clearly a secondary burial that had a very organized and formal configuration and also showed intensive manipulation of the bones.

General configuration Burial 3 was formed by several long bones of the arms and legs of an early adolescent individual displayed in roughly parallel position, with the cranial vault on top of them. The face was laid down separated from the cranial vault and occupied a kind of marginal position in the assemblage. Apparently the bundle of long bones was placed inside the cranial vault. The other parts of the skeleton were found below the first layer of bones or were organized around it. The entire assemblage occupied a circular area only 30 cm in diameter. Remains of a ceremonial hearth (charcoal and ashes) were present in the southernmost part of the burial, near the skull.

Chronology All burials found at Boleiras date between 8000 and 9000 yr B.P. This date is based on conventional C-14 dating on wood charcoal associated with three of the burials and on AMS dating on bone collagen from two of them. In particular, wood charcoal removed from the ritual hearth directly associated with Burial 3 generated an absolute date of 8360 ± 50 yr B.P. (Beta-159244). There is no evidence of funerary activity in the rockshelter after the late-Paleoindian horizon.

Bone manipulation Most of the skeleton of Burial 3 was painted with red ocher, but the intensity of this operation varied from bone to bone. The proximal epiphysis of the left ulna had been completely removed by cutting and was not found among the assemblage. Since red ocher was found covering the region of cutting, we assume the painting process was carried out during the reburial process. Further evidence for this view is that several fragments of both femurs are heavily painted externally and internally. In fact, the femurs seem to have been intentionally fragmented as part of this process, and the fragments used as sticks and spatulas to process the ocher.

Vast "functional" reburial has already been described by Prous (1980–81) as a feature of the Paleoindian settlement in the Lagoa Santa region, particularly for the site of Santana do Riacho, where 28 burials were found in a small area of 15 m^2. Because of the high density of interments in the site, emptying old burial pits to displace a new corpse seems to have been common in Santana do Riacho. The main parts of the removed skeletons were interred over the new burials (or by the side of them). However, a process of secondarization, done particularly for ritual reasons, was never proved for Santana do Riacho.

Boleiras Burial 3, therefore, provides the first direct evidence that late Paleoindians in Lagoa Santa practiced secondary funerary activities that seem to have been motivated by ritual reasons. This conclusion is reinforced by two other pieces of information. One, the low density of burials at Boleiras suggests there was little pressure to reutilize burial pits. Second, there was no primary interment found below or adjacent to Burial 3.

It is now clear that removal of body parts to be transformed into functional instruments and eventually adornments took place during the reburial procedure and that Lagoa Santa Paleoindians had a very elaborated funerary system.

References Cited

Hurt, W. R., and O. Blasi 1969 O Projeto Arqueológico "Lagoa Santa" – Minas Gerais, Brasil. *Arquivos do Museu Paranaense – Nova Série, Arqueologia*, 4:1–60.

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

Messias, T. T., and M. C. Mello e Alvim 1962 Material das escavações arqueológicas na região de Lagoa Santa, Minas Gerais, Brasil (1956). *Boletim do Museu Nacional, Nova Série, Antropologia* 20:1–55.

Prous, A. 1980–1981 Fouilles du grand abri de Santana do Riacho (MG), Brésil. *Journal de la Societé des Americanistes* 67:163–183.

——— 1986 L´archéologie au Brésil-300 siècles d´occupation humaine. *L´Anthropologie* 90:257–306.

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

Walter, H. V. 1958 *Archaeology of the Lagoa Santa region.* Sedegra, Rio de Janeiro.

Lithic Studies

Paleoindian Obsidian Procurement and Mobility in the Western Great Basin

Kelly E. Graf

Were early humans in the western Great Basin highly mobile foragers or generalized hunter-gatherers tethered to wetland patches? One way to address this question is by characterizing obsidian toolstone procurement. This paper presents results of X-ray fluorescence (XRF) element characterization analysis of 34 obsidian artifacts from the Sadmat and Coleman sites in western Nevada. Both sites are situated on fossil lake margin features of pluvial Lake Lahontan.

Based on typological comparisons, the Sadmat and Coleman lithic assemblages are assigned to the Paleoindian period, 11,000–8000 yr B.P. (Graf 2001; Rhode et al. 2000; Tuohy 1988; Warren and Ranere 1968). Both are characterized by stemmed projectile points (chiefly Haskett and Parman types), bifaces, sidescrapers, endscrapers, and gravers. Artifacts submitted for XRF analysis include 20 stemmed points, 3 biface fragments, 4 retouched flakes, 2 bipolar cores, and 5 debitage pieces (Graf 2001).

XRF results identified nine known sources ranging from 50 to 240 km from the Sadmat and Coleman sites, suggesting these hunter-gatherers traveled great distances to acquire obsidian toolstone (Figure 1). Eight sources are represented in the Sadmat collection. Northernmost of these is the extensive Massacre Lake/Guano Valley (Nev./Ore.) source, whose southern edge is 240 km north of Sadmat. The southernmost source, Casa Diablo/Sawmill Ridge (Calif.), is ca. 220 km south of Sadmat. Bodie Hills (Calif.) obsidian occurs most frequently among the sourced artifacts (25 percent); it is located in the Sierra Nevada ca. 165 km south of Sadmat. The closest identified obsidian source is Sutro Springs (Nev.), ca. 50 km southwest of the site. Other sources include Mt. Hicks (Nev.), ca. 150 km south; South Warners 2/Unknown B (Nev./Calif.), ca. 160–170 km northwest; Coyote Spring (Nev.), ca. 200 km north; and Bordwell Spring/Pinto Peak/Fox Mountain (Nev.), ca. 160 km north of Sadmat. The average distance between these sources and Sadmat is 158 km.

Five of the nine identified sources are present in the Coleman collection.

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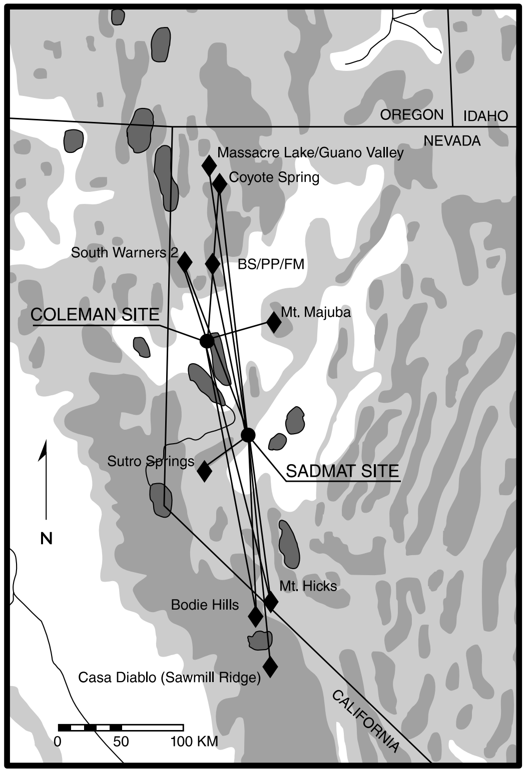

Figure 1. Location of the Sadmat and Coleman sites and obsidian sources.

The most distant source, Bodie Hills (Calif.), is ca. 240 km south of the site, while the furthest north source, Coyote Spring, is ca. 110 km away. The closest source, Mt. Majuba (Nev.), is ca. 50 km to the east. The other two sources are South Warners 2/Unknown B, ca. 70 km northwest, and Mt. Hicks, ca. 200 km southwest of Coleman. The average distance between sources and the Coleman site is 103 km.

Assuming that the obsidian in the Sadmat and Coleman assemblages was procured firsthand by the sites' occupants and that procurement was embedded within other economic activities, these data indicate that Paleoindians were far-ranging, traveling as much as 450 km. Furthermore, the geographical distribution of the obsidian suggests these Paleoindians ranged primarily in a north-south pattern, following the basin-and-range systems of the western Great Basin. Other studies from the central Great Basin have duplicated these patterns (Beck and Jones 2001), describing north-south distributions of obsidian stemmed points distancing 400 km. XRF source data from this project support the theory that Paleoindians in the Great Basin were highly mobile foragers who traveled great distances between productive resource patches.

Special thanks to C. Skinner for providing obsidian sourcing services, G. Hattori and the Nevada State Museum for providing access to the Sadmat and Coleman artifacts, and the University of Nevada Graduate Student Association for research funds.

References Cited

Beck, C., and G. T. Jones 2001 Lithic Source Use and Foraging Patterns in the Great Basin Paleoarchaic. 66th Annual Meeting of the Society for American Archaeology, New Orleans.

Graf, K. E. 2001 Paleoindian Technological Provisioning in the Western Great Basin. M.A. Thesis, Department of Anthropology, University of Nevada, Las Vegas.

Rhode, D., K. D. Adams, and R. G. Elston 2000 Geoarchaeology and Holocene Landscape History of the Carson Desert, Western Nevada. In *Great Basin and Sierra Nevada*, edited by D. R. Lageson, S. G. Peters, and M. M. Lahren, pp. 45–74. Geological Society of Americas Field Guide 2, Boulder.

Tuohy, D. 1988 Paleoindian and Early Archaic Cultural Complexes from Three Nevada Localities. In *Early Human Occupation in Far Western North America: The Clovis-Archaic Interface,* edited by J. A. Willig, C. M. Aikens, and J. L. Fagan, pp. 217–230. Nevada State Museum Anthropological Papers Number 21. Nevada State Museum, Carson City.

Warren, C. N., and A. J. Ranere 1968 Outside Danger Cave: A View of Early Man in the Great Basin. In *Early Man in Western North America,* edited by C. Irwin-Williams, pp. 6–18. Eastern New Mexico University Contributions in Anthropology, Vol. 1(4). Eastern New Mexico University Paleo-Indian Institute, Portales.

Pleistocene Faunas and Lithic Industries in the Antonião Rockshelter (Coronel José Dias, Piaui, Brazil): Studying Their Association

F. Parenti, M. Faure, F. Da Luz, and C. Guérin

From 1986 to 1988, the rockshelter of Antonião was excavated to a total depth of 5 m. The site is cut into one of many pre-Cambrian limestone outcrops in the São Raimundo Nonato archaeological area, just 15 km east of the Pedra Furada site (Parenti 2001). The fine-grained deposit was first explored because of the presence of rock paintings and evidence of prehistoric campfires, and it was carefully inspected for association between man and Pleistocene megafauna. An almost complete female human skeleton was recovered and dated at 9670 ± 140 yr B.P. (Figure 1) (GIF 8712) (Peyre 1993).

In moist periods of final Pleistocene and lower Holocene, Antonião was a temporary marsh that was visited by prehistoric groups and supported a very rich fauna. Large mammals were *Catonyx cuvieri, Eremotherium rusconii, E. laurillardi, Xenocnus cearensis, Dasypus, Euphractus, Tolypeutes, Pampatherium humboldti, Hoplophorus euphractus, Panochthus greslebini, Glyptodon clavipes, Agouti paca, Protocyon troglodytes, Cerdocyonthous, Speothos, Conepatus, Felis yagouaroundi, F. pardalis, Smilodon populator, Macrauchenia patachonica, Toxodon*

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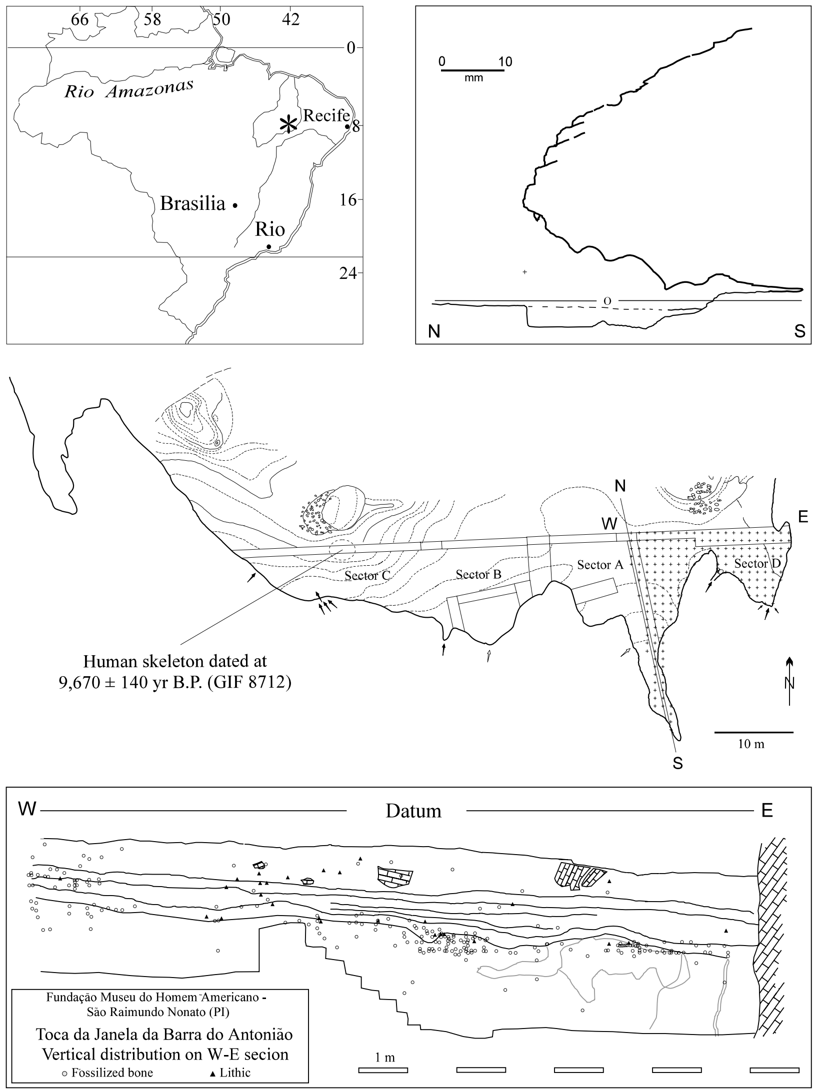

Figure 1. Geographic location, plan view, and stratigraphic profile of the Antonião Rockshelter.

platensis, Mixotoxodon, Haplomastodon waringi, Hippidion bonaerense, Equus neogaeus, Dicotyles tajacu, Tayassu pecari, Palaeolama niedae, Mazama gouazoubira, M. americana, and *Cervus* sp. Also found were about 20 micromammal species, 30 bird species, and some reptiles and amphibians (Guérin et al. 1993).

Such a fossil community gives evidence of a mixed landscape with large open expanses (savannas, chaparral) interrupted by forested areas, under a much wetter climate than exists today.

Lithic artifacts have been recovered from all sectors of the excavations, but

mainly in the uppermost 2 m. The 1,850-plus artifacts are made of quartz, quartzite, and chert, and include hammers (0.86 percent), core tools (22.18 percent), unretouched flakes and fragments (67.68 percent), and retouched tools (9.10 percent). Rare formally defined pieces can be compared with the Serra Talhada 1 industry from the Pedra Furada sequence (lower Holocene).

The association between artifacts and faunas is currently under study using GIS techniques. The ca. 6,700 pieces from sectors A and D plotted prior to 2001 suggest contemporary deposition for the middle and upper parts of the fossiliferous layer, which is documented here for the first time. The spatial distribution of lithics and fossil material in the entire site will clarify the taphonomy of the faunal assemblage and the relationship between man and extinct megafauna in the terminal Pleistocene of northeastern Brazil.

References Cited

Parenti F. 2001 *Le gisement quaternaire de la Pedra Furada (Piaui, Brésil). Stratigraphie, chronologie, evolution culturelle.* Editions Recherches sur les Civilisations, Ministère des Affaires Etrangères, Paris.

Peyre E. 1993 Nouvelle découverte d'un Homme préhistorique américain: une femme de 9700 ans au Brésil, *Comptes Rendus de l'Académie des Sciences de Paris*, 316, Série II:839–842.

Guérin C., M. A.Curvello, M. Faure, M. Hugueney and C. Mourer-Chauviré 1993 La faune pléistocène du Piaui (Nordeste du Brésil): implications paléoécologiques et biochronologiques, *Quaternaria nova* 3:303–341.

Paleoenvironments: Plants

Pollen and Algae from Late-Wisconsin Glacial Lake Great Falls Sediments, Holter Lake, Montana

James K. Huber and Christopher L. Hill

A stratigraphic sequence situated along the east side of Holter Lake contains silts and muds from glacial Lake Great Falls and overlying sands. The glacial lake was formed when a lobe of the Laurentide ice sheet blocked the Missouri River east of Great Falls, Montana (cf. Hill 2000). Immediately downstream from Holter Lake, deposits of glacial Lake Great Falls exposed along the Missouri River and Little Prickly Pear Creek have been assigned to the Wisconsin (Schmidt 1972).

Several localities on the east side of Holter Lake (U.S.G.S. Beartooth Mountain 7.5-minute quadrangle) were studied. At Holter Locality 1, sediment samples from the top part of the glacial Lake Great Falls sequence were collected for lithostratigraphic and paleoenvironmental studies (Hill and Valppu 1997). Nearby at Holter Lake Locality 2, preliminary luminescence measurements of the lake sediments and overlying sands indicate that the top of the sequence reflects conditions associated with the Last Glacial or late-Wisconsin Episode (Feathers and Hill 2001; Hill 2001).

The lake deposits at Holter Lake Locality 1 are laminated, calcareous (ca. 13–16 percent carbonate) silts and muds and contain ostracods (*Candona* sp., Hill and Valppu 1997) as well as pollen and algae. The Holter Lake pollen sample was treated with a modified Faegri and Iverson (1975) technique (addition of KOH, HCl, HF, and acetolysis), sieved through seven Fm Nitex screens (Cwynar, Burden, and McAndrews 1979), stained with safranin, and stored in silicone oil for counting. In addition, one standard *Eucalyptus* tablet was added to the sample in order to estimate pollen concentration values (Maher 1972).

The pollen sample from Holter Lake yielded 12 pollen types and 6 taxa of green algae (Chlorophyceae). The Holter Lake pollen spectrum is slightly dominated by nonarboreal pollen (NAP). Total NAP (57.0 percent) is composed of 27.4 percent Cyperaceae (sedge), 16.2 percent *Artemisia* (sage/wormwood), 7.7 percent Poaceae (grass), 4.2 percent *Pteridium*-type (bracken

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fern), and 1.5 percent *Ambrosia*-type (ragweed). Arboreal pollen types consist of 23.9 percent *Pinus* (pine), 13.3 percent *Salix* (willow), 2.1 percent *Quercus* (oak), 1.4 percent *Betula* (birch), and 0.8 percent each of *Picea* (spruce), *Acer* (maple), and *Alnus* (alder). The dominance of *Pinus* and *Salix* and open-ground herbaceous plants suggests the presence of an open conifer parkland.

The pollen spectrum from Holter Lake can be compared with pollen recovered from glacial lake sediments near Cascade and in the Benton Lake basin. Silty clay deposited in glacial Lake Great Falls near Cascade contained *Pinus*, *Juniperus* (cedar), *Pseudotsuga taxifolia* (Douglas fir), *Artemisia*, and Asteraceae (composites) (Hill and Valppu 1997; Lemke et al. 1975; Leopold 1958b; Leopold pers. comm. to CLH 1997). A coniferous assemblage with *Pinus* and forbs and grass was obtained from glacial Lake Great Falls sediments in the Benton Lake basin (Leopold 1958a; Leopold pers. comm. to CLH 1997). The pollen spectrum from Holter Lake appears to be more similar to the pollen from the Benton Lake basin than to the pollen from near Cascade. The lack of *Juniperus* and *Pseudotsuga taxifolia* pollen in the Holter Lake pollen spectrum may indicate the lack or low abundance of these taxa in the catchment basin or may be the result of degradation. Pollen preservation in the Holter Lake sample is poor and pollen concentration is low (930 grains/gram of dry sediment). Many of the indeterminable grains were degraded (22.1 percent).

Green algae are abundant in the sediment sample analyzed from Holter Lake Locality 1. The most prominent green algae is *Pediastrum simplex* (32.8). Other green algae recovered include *Pediastrum Kawraiskyi* (15.3 percent), *Pediastrum Boryanum* (10.6 percent), *Pediastrum araneosum* (1.1 percent), *Pediastrum integrum* (0.4 percent), and *Scenedesmus* (0.2 percent). The abundance of several *Pediastrum* species and *Scenedesmus* indicate that the ice dam that created glacial Lake Great Falls existed long enough for algae to become established in the lake and that the lake had relatively high values of productivity.

The pollen and algae recovered from glacial lake sediments at Holter Lake Locality 1 appear to provide an indication of both local environmental contexts and the regional drainage catchment during the Last Glacial (late Wisconsin Episode). The regional late-Wisconsin vegetational landscape appears to have included open conifer parkland settings.

References Cited

Cwynar, L. C., E. Burden, and J. H. McAndrews 1979 An Inexpensive Sieving Method for Concentrating Pollen and Spores from Fine-grained Sediments. *Canadian Journal of Earth Science* 16:1116–1120.

Faegri, K., and J. Iverson 1975 *Textbook of Pollen Analysis* (third edition). New York Hafner Press, 295 p.

Feathers, J. K., and C. Hill 2001 Dating Middle and Late Wisconsin Episode Stratigraphic Sequences in the Rockies and Missouri Plateau: Luminescence and Radiocarbon Chronologies. *Geological Society of America Abstracts with Programs* 33(6):A287.

Hill, C. L. 2000 Pleistocene Lakes Along the Southwest Margin of the Laurentide Ice Sheet. *Current Research in the Pleistocene* 17:145–147.

——— 2001 Pleistocene Mammals of Montana and Their Geologic Context. In *Mesozoic and

Cenozoic Vertebrate Paleontology in the Western Plains and Rocky Mountains, Guidebook for the Field Trips, Society of Vertebrate Paleontology, 61st Annual Meeting, edited by C. L. Hill, pp. 127–143. Occasional Paper No. 3, Museum of the Rockies, Bozeman.

Hill, C., and S. H. Valppu 1997 Geomorphic Relationships and Paleoenvironmental Context of Glaciers, Fluvial Deposits, and Glacial Lake Great Falls, Montana. *Current Research in the Pleistocene* 14:159–161.

Lemke, R. W., M. R. Mudge, R. E. Wilcox, and H. A. Powers 1975 Geologic Setting of the Glacier Peak and Mazama Ash-Bed Markers in West-Central Montana. United States Geological Survey Bulletin 1395-H.

Leopold, E. B. 1958a Report on Referred Fossils (Shipment No. E.G.-57-4D, Pollen analyses of Lake Benton Sediments), on file at United States Geological Survey Field Records Library, Denver, Colorado.

——— 1958b Report on Referred Fossils (Shipment No. E.G.-12D, Pollen Analyses Samples from *Bison antiquus* Site, Cascade Quadrangle, Montana), on file at United States Geological Survey Field Records Library, Denver, Colorado.

Maher, L. J., Jr. 1972 Absolute Pollen Diagram of Redrock Lake, Boulder County, Colorado. *Quaternary Research* 2:531–553.

Schmidt, R. G. 1972 Geologic Map of the Wolf Creek Quadrangle, Lewis and Clark County, Montana. United States Geological Survey, Map GQ-974.

Paleoenvironments: Vertebrates

Late-Pleistocene Horse (*Equus* sp.) from the Wilson-Leonard Archaeological Site, Central Texas

Barry W. Baker, Michael B. Collins, and C. Britt Bousman

The Wilson-Leonard site (41WM235) near Austin represents one of the best-preserved and -dated long-term archaeological sequences in the Southern Plains. Occupations are pre-Clovis through late-Prehistoric in age (Collins 1998; Collins et al. 1993). The site is located on Brushy Creek in Williamson County, on the eastern edge of the Edwards Plateau along an ecotone with the Black Prairie. The Wilson-Leonard site has received wide attention for the recovery of a late-Paleoindian human female skeleton (Wilson Component), as well as for the generalized human diet inferred for the late-Pleistocene/early-Holocene transition (Bousman 1998; Bousman et al. 2002). Extensive subsistence and environmental data have been reported, including a well-preserved vertebrate faunal assemblage (Baker 1994, 1998a, 1998b, 1998c; Balinsky 1997, 1998; Decker 1998; Winkler 1990).

Within the faunal assemblage is a single horse bone (*Equus* sp.). Following the nomenclature of Driesch (1976:91) and Peters (1987), the bone is a complete left central tarsal (*os tarsi centrale* [navicular]). Archaeological provenience is Excavation square E28/S78, Level 39A&B, Stratigraphic Unit Isi/Icl. The bone is not burned, and no cutmarks or other forms of potential cultural modification were observed. This bone was recovered from an area of the site referred to as the Bone Bed Component. The Texas Department of Transportation (TxDOT) recovered the bone during 1982–84 excavations at the site. Subsequent excavations by the Texas Archeological Research Laboratory at the University of Texas at Austin yielded no additional horse remains.

The Bone Bed Component, which overlies a Clovis component, dates to ca. 11,400–11,000 yr B.P. (Collins 1998). Stylistically, the artifact assemblage from the bone bed is difficult to interpret. Artifacts include an unfluted projectile point, 26 bifaces, an engraved stone, chipped stone tools, a mano, sandstone

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and hematite, and more than 3,000 debitage fragments. Associated faunal remains include the horse bone, the partial remains of at least two bison (*Bison* sp.), along with low frequencies of other taxa such as snake (Colubridae), musk turtle (*Sternotherus* sp.), bird (Phasianidae), woodrat (*Neotoma* sp.), gopher (*Geomys* sp.), muskrat (*Ondatra zibethicus*), rabbit (*Sylvilagus* sp.), canid (*Canis* sp.), and deer (*Odocoileus* sp.).

The horse bone was identified based on comparison with skeletal material in the Zooarchaeological Research Collection at Texas A&M University and the Vertebrate Paleontology Laboratory at the University of Texas at Austin. Following the measurements of Driesch (1976:91), its greatest breadth is 4.56 cm. Late-Pleistocene and early-Holocene records of horse in Texas, along with paleoenvironmental implications, are reviewed by Toomey (1993:407–413) and Toomey et al. (1992). Kurtén and Anderson (1980:291) noted that terminal dates for native *Equus* in North America may extend to ca. 8000 yr B.P. However, Meltzer and Mead (1983) reported the youngest reliable age for North American *Equus* at 10,370 ± 350 yr B.P. from Jaguar Cave in Idaho. More recently, Toomey (1993:409) reported *Equus* from Hall's Cave on the western Edwards Plateau of central Texas dating to 8700–9200 yr B.P. He stated, however, that "until more radiocarbon dating . . . can be done, it would be premature to claim late horse survival in central Texas" (Toomey 1993:409).

Toomey (1993:109) noted that all late-Pleistocene equids were cursorial grazers and that their presence suggests the presence of open grasslands. The bison remains from the Wilson-Leonard bone bed also reflect open grasslands at this ecotonal setting. A taxonomic assessment of the Wilson-Leonard horse remains difficult. Small late-Pleistocene equids may be of either the *E. francisci* group (stilt-legged), or the *E. alaskae* group (stout-legged) (Lundelius and Stevens 1970; Toomey 1993:408; Winans 1985, 1989). The *E. alaskae* group of Winans (1985, 1989) includes what is most commonly identified as *E. conversidens*. Distinction between the small stilt- and stout-legged forms is based on cranial and metapodial characters and morphometrics. Since the Wilson-Leonard sample produced only a single equid central tarsal, a more detailed assignment beyond *Equus* sp. could not be made. For more recent discussions of fossil horse taxonomy, the reader is referred to Azzaroli (1992, 1995), Azzaroli and Voorhies (1993), Eisenmann and Baylac (2000), and Pichardo (2000).

Grayson (1984) determined that *Equus* is second only to *Mammuthus* in terms of the number of radiocarbon-dated North American late-Pleistocene sites with human associations and extinct mammals. Pichardo (2000:275) stated that horse remains are ubiquitous in Paleoindian sites. However, *Equus* is typically represented by very few individuals at any given site. Kooyman et al. (2001) provided a recent review of such associations. This contrasts with European sites such as Solutré, in which large numbers of horses were exploited in single events (Olsen 1989). Woodward (1991) suggested this is because Pleistocene North American equids lived in smaller and more widely distributed social units than European horses. Overall, while the single horse bone from Wilson-Leonard is not unequivocally associated with Paleoindian hunting, it adds to the known late-Pleistocene geographic distribution of the genus in the United States.

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References Cited

Azzaroli, A. 1992 Ascent and Decline of Monodactyl Equids: A Case for Prehistoric Overkill. *Annales Zoologici Fennici* 28:151–163.

——— 1995 A Synopsis of the Quaternary Species of *Equus* in North America. *Bollettino della Società Paleontologica Italiana* 34(2):205–221.

Azzaroli, A., and M. R. Voorhies 1993 The Genus *Equus* in North America. The Blancan Species. *Palaeontographia Italica* 80:175–798.

Baker, B. W. 1994 Vertebrate Remains from the Wilson-Leonard Site (41WM235), Williamson County, Texas: Holocene Animal Exploitation in Central Texas Prehistory. Unpublished Master's thesis, Department of Anthropology, Texas A&M University, College Station.

——— 1998a Chapter 33: Vertebrate Faunal Remains from the 1/4-inch and 1/8-inch Screens. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Volume 5: Special Studies*, edited by M. B. Collins, pp. 1463–1509. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

——— 1998b Appendix 9: Faunal Taxa Descriptions. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Volume 5: Special Studies*, edited by M. B. Collins, pp. 1685–1696. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

——— 1998c Appendix 10: Provenience of Faunal Remains. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Vol. 5: Special Studies*, edited by M. B. Collins, pp. 1697–1853. Studies in Archeology No. 31. Texas Archeological Research Laboratory, The University of Texas at Austin. Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division, Austin.

Balinsky, R. L. 1997 Revision of the Pleistocene to Holocene Wilson-Leonard Microvertebrate Fauna and Its Paleoenvironmental Significance. Unpublished Master's thesis, Department of Geological Sciences, The University of Texas at Austin.

——— 1998 Pleistocene to Holocene Wilson-Leonard Microvertebrate Fauna and Its Paleoenvironmental Significance. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Volume 5: Special Studies*, edited by M. B. Collins, pp. 1515–1542. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

Bousman, C. B. 1998 The Late Paleoindian Archeology at the Wilson-Leonard Site. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Volume 1: Introduction, Background and Synthesis*, edited by M. B. Collins, pp. 161–210. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

Bousman, C. B., M. B. Collins, P. Goldberg, T. Stafford, J. Guy, B. W. Baker, D. G. Steele, M. Kay, A. Kerr, G. Fredlund, P. Dering, V. Holliday, D. Wilson, W. Gose, S. Dial, P. Takac, R. Balinsky, M. Masson, and J. F. Powell 2002 The Palaeoindian-Archaic Transition in North America: New Evidence from Texas. *Antiquity* 76(294):980–990.

Collins, M. B. (editor) 1998 *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas*, Volumes 1-5. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

Collins, M. B., C. B. Bousman, P. Goldberg, P. R. Takac, J. C. Guy, J. L. Lanata, T. W. Stafford, and

V. T. Holliday 1993 The Paleoindian Sequence at the Wilson-Leonard Site, Texas. *Current Research in the Pleistocene* 10:10–12.

Decker, S. 1998 Chapter 36: Eggshell Analysis. In *Wilson-Leonard: An 11,000-Year Archeological Record of Hunter-Gatherers in Central Texas, Volume 5: Special Studies*, edited by M. B. Collins, pp. 1543–1551. Studies in Archeology No. 31, Texas Archeological Research Laboratory, The University of Texas at Austin; and Archeology Studies Program, Report No. 10, Texas Department of Transportation, Environmental Affairs Division.

Driesch, A. von den 1976 A Guide to the Measurement of Animal Bones from Archaeological Sites. Bulletin No. 1. Peabody Museum of Archaeology and Ethnology, Harvard University. Cambridge, Massachusetts.

Eisenmann, V., and M. Baylac 2000 Extant and Fossil *Equus* (Mammalia, Perissodactyla) Skulls: A Morphometric Definition of the Subgenus *Equus*. *Zoologica Scripta* 29:89–100.

Grayson, D. K. 1984 Archaeological Associations with Extinct Pleistocene Mammals in North America. *Journal of Archaeological Science* 11:213–221.

Kooyman, B., M. E. Newman, C. Cluney, M. Lobb, S. Tolman, P. McNeil, and L. V. Hills 2001 Identification of Horse Exploitation of Clovis Hunters Based on Protein Analysis. *American Antiquity* 66(4):686–691.

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

Lundelius, E. L., and M. S. Stevens 1970 *Equus francisci* Hay, a Small Stilt-Legged Horse, Middle Pleistocene of Texas. *Journal of Paleontology* 44(1):148–153.

Meltzer, D. J., and J. I. Mead 1983 The Timing of Late Pleistocene Mammalian Extinctions in North America. *Quaternary Research* 19:130–135.

Olsen, S. L. 1989 Solutré: A Theoretical Approach to the Reconstruction of Upper Palaeolithic Hunting Strategies. *Journal of Human Evolution* 18:295–327.

Peters, J. 1987 Cuboscaphoids, Naviculo-Cuboids, Language Barriers and the Use of Standardised Osteological Nomenclatures in Archaeozoological Studies. *Archaeozoologia* 1(2):43–46.

Pichardo, M. 2000 Valsequillo Biostratigraphy III: Equid Ecospecies in Paleoindian Sites. *Anthropologischer Anzeiger* 58(3):275–298.

Toomey, R. S., III 1993 Late Pleistocene and Holocene Faunal and Environmental Changes at Hall's Cave, Kerr County, Texas. Unpublished Ph.D. dissertation, Department of Geological Sciences, The University of Texas at Austin.

Toomey, R. S., J. A. Huebner, and T. W. Boutton 1992 Stable Carbon Isotope Ratios of *Equus* sp. and *Bison antiquus* from the Late Pleistocene Deposits at Hall's Cave, Kerr County, Texas. *Current Research in the Pleistocene* 9:112–114.

Winans, M. C. 1985 Revision of North American Fossil Species of the Genus *Equus* (Mammalia: Perissodactyla: Equidae). Unpublished Ph.D. dissertation, Department of Geological Sciences, The University of Texas at Austin.

——— 1989 A Quantitative Study of North American Fossil Species of the Genus *Equus*. In *The Evolution of Perissodactyls*, edited by D. R. Prothero, and R. M. Schoch, pp. 262–297. Clarendon Press, New York.

Winkler, A. J. 1990 Small Mammals from a Holocene Sequence in Central Texas and Their Paleoenvironmental Implications. *The Southwestern Naturalist* 35:199–205.

Woodward, S. L. 1991 Late Pleistocene North American Equids: Why a Widespread Large Mammal May be Sparsely Represented in Early Archaeological Sites. In *Beamers, Bobwhites, and Blue-Points: Tributes to the Career of Paul W. Parmalee*, edited by J. R. Purdue, W. E. Klippel, and B. W. Styles, pp. 261–272. Illinois State Museum Scientific Papers Vol. 23. Springfield, Illinois.

A Giant American Lion (*Panthera atrox*) from the Kansas River, Late Pleistocene, Kansas

Katrina E. Gobetz and Larry D. Martin

The extensive collections of Pleistocene bones from sandbars on the Kansas River near Bonner Springs, Kansas, include the fragmentary right femur of a large felid, KUVP (University of Kansas Division of Vertebrate Paleontology) 127201. The elongate shaft of this femur rules out identification as one of the short-legged saber-toothed cats *(Xenosmilus, Smilodon)* (Martin et al. 1999) or the jaguar, *Panthera onca*. Although Pleistocene *P. onca* subspecies may reach the size of the living African lion (*Panthera leo*), none attains the size indicated by the Bonner Springs femur. Transverse shaft diameter measures 47.5 mm at the nutrient foramen (approximately the midpoint of the shaft) and about 62.1 mm (estimated due to abrasion) at the level of the midpoint of the lesser trochanter. These values exceed those of the largest femur from the late Pleistocene of Rancho La Brea (Merriam and Stock 1932).

Eliminating *P. onca* and Rancho La Brea species leaves the long-legged scimitar cat, *Homotherium,* and American lion, *Panthera atrox,* for comparison. The Bonner Springs femur differs from the femur of *Homotherium* (University of Idaho specimen 11861) in the position of the lesser trochanter and in the presence of a thin external ridge on the relatively robust shaft. In contrast, left and right femora from a *P. atrox* from Natural Trap Cave, Wyoming (KUVP 44409), are similar in general morphology to what is preserved of the Bonner Springs femur. Transverse shaft diameter at the nutrient foramen and at the midpoint of the lesser trochanter for the right Natural Trap femur are 36.8 mm and 54.2 mm, respectively. These values, although less than those for the Bonner Springs femur, are closer than values recorded for *Homotherium.* Based on these observations, we identify the Bonner Springs femur as a large *P. atrox.*

P. atrox is commonly associated with *Arctodus simus, Canis dirus,* and *Smilodon fatalis,* all of which occur on Kansas River sandbars. The only other record of *P. atrox* from Kansas is that of Hibbard (1939) from Harvey County, which we now believe to be *Homotherium* (Martin and Gobetz 2002).

Kansas River faunas are entirely redeposited, and as with other sandbar faunas, dating is problematic. Thus far, individually dated mammalian fossils appear to form two groups: bones with excellent collagen preservation representing a cool-climate fauna from 15,000–10,000 CALYBP; and bones with little or no collagen representing an older, warm-climate fauna (tapir, armadillo, llamine camel). We have not attempted to date the Bonner Springs femur, but preservation suggests it contains collagen and belongs to the younger

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fauna. Its giant size raises the possibility that large cats, like the extinct canid *Canis dirus,* may have had large-bodied Eastern populations. Other occurrences of large felids in eastern portions of their geographic range include a *P. atrox* from the late-Pleistocene Red Willow Sandpit fauna in south-central Nebraska (Corner 1977), and an unusually large, indeterminate felid reported by Hay (1917) from the late Pleistocene of Meade County, Kansas. Along with the Bonner Springs femur, these reports raise the possibility that large size characterized the Eastern populations of great cats in the Pleistocene.

References Cited

Corner, R. B. 1977 A Late Pleistocene-Holocene Vertebrate Fauna from Red Willow County, Nebraska. *Transactions of the Nebraska Academy of Science* 4:77–94.

Hay, O. P. 1917 On a Collection of Fossil Vertebrates Made by Dr. F. W. Cragin from the Equus Beds of Kansas. *The Kansas University of Science Bulletin* 10(4):39–51.

Hibbard, C. W. 1939 Notes on some mammals from the Pleistocene of Kansas. *Transactions of the Kansas Academy of Science* 42:463–479.

Martin, L. D., J. P. Babiarz, V. L. Naples, and J. Hearst 1999 Three Ways to be a Saber-toothed Cat. *Naturwissenschaften* 87:41–44.

Martin, L. D., and K. E. Gobetz 2002 Possible New Record of a Homothere (Felidae: Homotherini) from the Late Pleistocene of Kansas. *Current Research in the Pleistocene* 19, in press.

Meade, G. E. 1961 The Saber-toothed Cat, *Dinobastus serus. Bulletin of the Texas Memorial Museum*, Part I, No. 2:23–60.

Merriam, J. C., and C. Stock 1932 The Felidae of Rancho LaBrea. *Carnegie Institute Publication* 422:1–231.

Late-Quaternary Vertebrate Fossils from the Outer Islands of Southern Southeast Alaska

Timothy H. Heaton

The Alexander Archipelago consists of hundreds of offshore islands along the southern Alaska coast, separated by 5- to 20-km-wide channels. The southern section is dominated by Prince of Wales Island, where caves containing an extensive late-Pleistocene and Holocene fossil and archaeological record have been excavated (Dixon et al. 1997; Heaton and Grady 2002). Farther west are a series of smaller islands that are directly exposed to the northern Pacific Ocean. These are of special interest because they appear to have contained ice-free refugia during the Last Glacial Maximum. Several have extensive karstlands where caves containing fossil vertebrates have been discovered.

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Dall Island is the longest and southernmost of the islands west of Prince of Wales Island. At the northwestern corner, in a coastal cave called Enigma, a skeleton of *Ursus arctos* (brown bear) was discovered in 1994 and radiocarbon dated at 11,715 ± 120 yr B.P. (AA-15226). Brown bears no longer live in the southern Alexander Archipelago, and this is the southernmost record of this species in the islands (Heaton et al. 1996). Another promising coastal site on Dall Island is Kit 'n' Kaboodle Cave, which contains marine carnivore remains and beds of fish bone (from otter scat) that are interspersed with cultural shell middens (Erlandson and Moss 2001).

Farther north is a series of small, closely spaced islands. On Noyes Island a whale vertebra dating to 5115 ± 100 yr B.P. (AA-21563) was discovered in a raised sea cave called Puffin Grotto (Heaton 2001). Many raised sea caves were formed during the early Holocene prior to postglacial isostatic rebound of the area. The karst of Heceta Island has been extensively explored, and Nautilus Cave contains the oldest *Odocoileus hemionus* (deer) dated from southeast Alaska (8180 ± 70 yr B.P., AA-10574) and the only dated specimen of *Castor canadensis* (beaver), 1580 ± 60 yr B.P., AA-36642. An archaeological site on Heceta Island called Chuck Lake dates to 8200 yr B.P. and contains marine and terrestrial faunal remains (Dixon et al. 1997).

Coronation Island, farther offshore and more isolated than the other islands, is a wilderness area within Tongass National Forest. Today it has a restricted fauna of only six species of land mammals (Conroy et al. 1999; MacDonald and Cook 1996). The karst of this island was searched for caves in the summer of 2001. In Colander Cave, at the bottom of a 20-m-deep pit, a skeleton of *Ursus arctos* was found dating to 11,630 ± 120 yr B.P. (AA-44450), along with an *Odocoileus hemionus* skeleton dating to 3310 ± 50 yr B.P. (AA-44451) and several bird bones, including *Cyclorrhynchus psittacula* (parakeet auklet) and a passerine. Two otter den caves were also discovered containing thick bone accumulations. Species recovered in small surface samples included *Odocoileus hemionus*, *Lutra canadensis* (river otter), *Microtus coronarius* (Coronation Island vole), *Sorex* sp. (shrew), *Uria aalge* (common murre) and other birds, many fishes, and fragments of invertebrates.

Preliminary investigations indicate that these remote offshore islands have great potential for revealing the Ice Age history and early archaeology of coastal Alaska. Plans are currently underway to explore more fully and excavate the caves and fossil resources of Dall and Coronation Islands over the next two years.

I thank Jim Baichtal and cavers of the Tongass Cave Project for making collections on my behalf on Dall and Heceta Islands. I also thank Pete Smith, Steve Lewis, Cat Woods, and Terry Fifield for their help on Coronation Island. Funding was provided by Tongass National Forest, the National Science Foundation (EAR-9870343), the National Geographic Society (6212-98), and the University of South Dakota.

References Cited

Conroy, C. J., J. R. Demboski, and J. A. Cook 1999 Mammalian Biogeography of the Alexander Archipelago of Alaska: A North Temperate Nested Fauna. *Journal of Biogeography* 26:343–352.

Dixon, E. J., T. H. Heaton, T. E. Fifield, T. D. Hamilton, D. E. Putnam, and F. Grady 1997 Late

Quaternary Regional Geoarchaeology of Southeast Alaska Karst: A Progress Report. *Geoarchaeology* 12:689–712.

Erlandson, J. M., and M. L. Moss 2001 Shellfish Feeders, Carrion Eaters, and the Archaeology of Aquatic Adaptations. *American Antiquity* 66:413–432.

Heaton, T. H. 2001 Whale Remains from Puffin Grotto, A Raised Sea Cave on Noyes Island, Southeast Alaska. *Proceedings of the South Dakota Academy of Science* 80:409–410.

Heaton, T. H., and F. Grady 2002 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.

Season of Bison Mortality at the Jurgens Site, Weld County, Colorado

Matthew E. Hill, Jr. and Matthew G. Hill

During the summers of 1968 and 1970, Joe Ben Wheat directed excavations at the Jurgens site (5WL53) in Weld County, Colorado (Scott 1984; Wheat 1979). The site consists of three separate Paleoamerican activity areas, including a habitation area (Area 1), short-term camp (Area 2), and a butchering locus (Area 3) (Wheat 1979:146). Cultural material was recovered from a roughly 9000-year-old gleyed horizon in the upper portion of the Kersey Terrace (Holliday 1987). Nearly 5,800 bison bones, representing approximately 68 animals, were recorded with a large lithic assemblage including 61 Kersey points. We analyzed dentaries recovered from Areas 1 and 3 to determine the season of bison mortality and whether more than one kill event is represented at Jurgens.

We followed the general procedure outlined by Todd et al. (1996) and Niven and Hill (1998) for defining young bison (age groups 1–5) according to known annual stages of mandibular tooth eruption and occlusal wear. The age of older individuals was determined from measurements of tooth wear. This paper describes the mandibular tooth eruption and wear patterns for the 37 dentaries and fragments from bison less than 5 years old (Age Group 1–4). The patterns for Areas 1 and 3 are identical, so data from both areas are combined, and the key patterns are described below.

Group 1. A total of 11 dentaries, representing four bison from Area 1 and two bison from Area 3, constitute the Group 1 age cohort. All have first molars (m1s) erupted to the level of the premolars with either no occlusal wear or only slight damage to facets I–II. Todd et al. (1996:170) report identical patterns for yearlings from the Folsom site, and Reher and Frison (1980:65) suggest this pattern of wear occurs on modern bison by 0.5 years old. This suggests an age of 0.4–0.5 years for the Jurgens 1 cohort.

Group 2. Group 2 has 12 specimens (representing 4 bison from Area 1 and 3 bison from Area 3). In this group, the occlusal surfaces for the m1s are in full wear (wear code 9e) (see Payne 1985 and Todd et al. 1996), although their ectostylids are more than 6 mm below the occlusal surface. All second molars (m2s) in this group have either no occlusal wear damage or slight wear damage to facets I–II. This pattern suggests an age of 1.4–1.5 years for this cohort.

Group 3. There are 11 Group 3 specimens (representing two bison from Area 1 and three bison from Area 3) all with heavily worn deciduous premolars that are being replaced by permanent teeth. In this group, the m1s are in full wear (wear codes 9e to 10a) with their ectostylids in wear or immediately below the occlusal surface. The m2s vary from having moderately to heavily worn occlusal surfaces (wear codes 7d to 9e) with ectostylids more than 10 mm below the occlusal surface. First and second cusps of m3s have erupted, although there is usually no or just slight to moderate occlusal wear on facet I–II. This pattern suggests an age of 2.4–2.5 years for this cohort.

Group 4. Group 4 contains three specimens (representing two bison) from Area 1. In this group, the permanent second and third premolars are erupted and in wear, but the fourth premolar is only partially erupted. M1s and m2s for this group are in full wear, whereas m3s have light to moderate wear on facets I–IV. Although the M3 hypoconulids have erupted above the alveolar margin, none shows evidence of wear. This pattern suggests an age of 3.4–3.5 years for this cohort.

Although the current assemblage is just a small sample of teeth from Jurgens (field notes indicate heavily damaged pieces were discarded during the excavation; see also Wheat 1979:71), the patterns recorded for this study represent a tight clustering of dental ages from N + 0.4 to N + 0.5, which suggests the bison in Areas 1 and 3 were killed during the fall. However, it is not possible to determine the exact number of mortality events at Jurgens or whether the bison remains from Areas 1 and 3 originated from the same kill event(s).

Fred Lange and Diana Leonard are thanked for providing much assistance during the analysis of the Jurgens collection. Margaret Beck and Chad Jones helped in the analysis of these materials. The Carroll D. Clark Fund of the University of Kansas supported portions of this research.

References Cited

Holliday, V. T. 1987 Geoarchaeology and Late Quaternary Geomorphology of the Middle South Platte River, Northeastern Colorado. *Geoarchaeology* 2:317–329.

Niven, L. B., and M. G. Hill 1998 Season of Bison Mortality at Three Plains Archaic Kill Sites in Wyoming. *Plains Anthropologist* 43:1–26.

Payne, S. 1985 Reference Codes for Wear States in the Mandibular Cheek Teeth of Sheep and Goats. *Journal of Archaeological Science* 14:609–614.

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Reher, C. A., and G. C. Frison 1980 The Vore Site, 48CK302, a Stratified Buffalo Jump in Wyoming Black Hills. *Plains Anthropologist Memoir* 16, Lincoln.

Scott, D. S. 1984 Archaeology of the Jurgens Site. In *Paleo-Indian Sites of the Colorado Piedmont,* edited by A. B. Anderson, pp. 13–16. American Quaternary Association Field Trip Guidebook, Boulder.

Todd, L. C., D. J. Rapson, and J. L. Hofman 1996 Dentition Studies of the Mill Iron and Other Early Paleoindian Bison Bonebed Sites. In *Mill Iron Site*, edited by G. C. Frison, pp. 145–175. University of New Mexico Press, Albuquerque.

Wheat, J. B. 1979 The Jurgens Site. *Plains Anthropologist Memoir* 15, Lincoln.

Mandibular Tusks in Mature Mastodons (*Mammut americanum*): Communication with the Mandibular Canal

Richard S. Laub

Earlier, the author described communication between the mandibular tusk alveoli and the mandibular canals in an immature inferred male mastodon (Laub, 1999). He also showed that a mature inferred female, while lacking these tusks, yet had alveoli in the same position that similarly communicated with the mandibular canals. The present paper concerns this relationship in mature inferred males that bear mandibular tusks.

Mandibles of two mastodons were studied. The Sugar Loaf mastodon (Dumont and Ehlers 1973) is represented by a complete skeleton from Orange Co., southeast New York, on display at Orange County Community College, Middletown, New York. This is a male, aged about 36 African elephant years using the system of Laws (1966). It has a single large mandibular tusk, the mate having apparently been lost earlier in the animal's life. Specimen 270-JS-75 in the Illinois State Museum is from the Jones Spring site in southwest Missouri (Saunders 1988). It appears to be a male, based on the mandibular tusks, approximately 28 African elephant years at time of death. (The M_3 is missing, but its root sockets are present. There is no significant attrition at the distal end of the M_2.) It bears a pair of mandibular tusks that are remarkably long for their diameter, suggesting relatively little attrition during the animal's life. Figure 1 is based on CAT-scans (Computer-Aided Tomography) of these two mandibles.

In the earlier study, the mandibular canal of a yearling communicated with the mandibular tusk alveoli via a 1-cm-wide lingual branch (Laub, 1999, Figure 1A). On the other hand, in a female, 32–38 A.E. years old, the mandibular canal communicated with the tuskless alveoli via a lingual branch only 0.5 cm in diameter (*ibid.*, Figure 1C).

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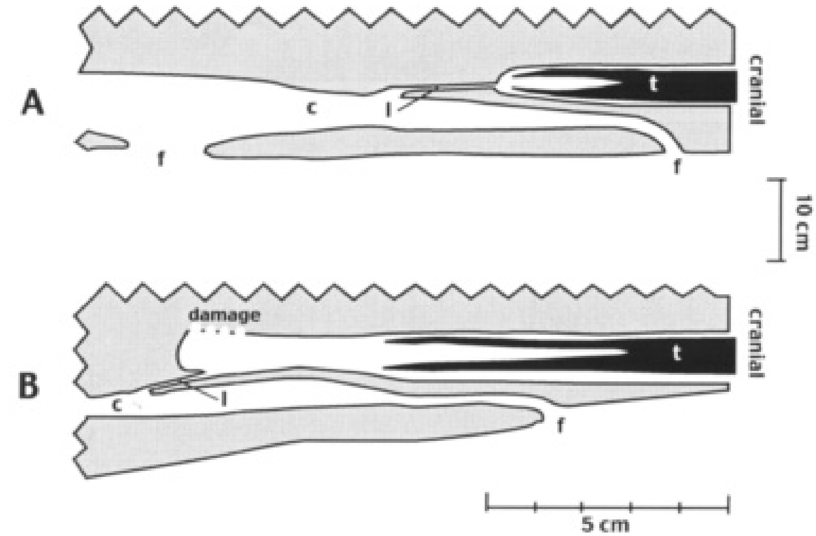

Figure 1. Anatomical features of mastodon mandibular symphyses, shown in dorsal view, based on transaxial Computer-Aided Tomography. **A,** Illinois State Museum specimen 270-JS-75. **B,** Sugar Loaf mastodon. **c,** mandibular canal; **f,** mental foramen; **l,** lingual branch from mandibular canal; **t,** mandibular tusk. Damage in **B** is post-mortem.

Transaxial tomographs in the symphyseal area of the two mature male mandibles (Figure 1) show a narrow canal, about 0.5 cm or less in diameter and 1–2 cm long, connecting the alveoli with the mandibular canal. At the longitudinal positions of these side canals, the mandibular canal is 3 to 3.5 cm wide. These dimensions are about equal to those in the mature female mandible.

The vascular supply to the mandibular tusk alveoli of mature males that retain these tusks, then, appears to have been significantly smaller, in proportion to the tusk size, than it was in very young mastodons. This, and the common absence of one or both of these tusks in mature males, suggests they were not critical to the animal's survival as it grew beyond maturity (though they may have been important earlier in life). Also, the vascular supply appears to have been no greater than it was in mature females that lacked these tusks. This latter observation raises the question of why females, who presumably lacked tusks, developed and nourished alveoli at the mandibular symphysis.

The CAT-scans were provided by Robert Kufchak through the courtesy of the Radiology Department, Children's Hospital of Buffalo. Norman D. Mohl of the School of Dental Medicine, State University of New York at Buffalo, provided valuable insights into the significance of the anatomy displayed by the mandibles described here.

References Cited

Dumont, E. K., and W. F. Ehlers 1973 The Sugar Loaf Mastodon. *Bulletin of the New York State Archaeological Association* 59:1–6.

Laub, R. S. 1999 Did Female Mastodons Have Mandibular Tusks? *Current Research in the Pleistocene* 16:124–125.

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

Saunders, J. J. 1988 Fossiliferous Spring Sites in Southwestern Missouri. 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. 127–149. Bulletin of the Buffalo Society of Natural Sciences 33.

Size Variation in Southern Plains *Bison antiquus* from Lubbock Lake and Cooper

Patrick J. Lewis, Eileen Johnson, Briggs Buchanan, Leland Bement, and Laura Gruss

While bison are integral to the study of late-Pleistocene environments and cultures, research on the populations from the Southern Plains (SP) has been limited (Wyckoff et al. 1997). The large samples of bison metatarsals from the SP sites of Lubbock Lake and Cooper, however, allow questions related to biogeographic variation to be addressed. *Bison antiquus* metatarsals dating to the late Pleistocene and early Holocene from Lubbock Lake (n = 59) and early Holocene from Cooper (n = 34) were analyzed for differences in size.

Lubbock Lake (41LU1) is a well-stratified archaeological site located in a meander of Yellowhouse Draw on the Southern High Plains of northwestern Texas (Holliday 1985; Johnson 1987). *Bison antiquus* remains are found in the lowermost deposits, stratum 1 (S1) and stratum 2 (S2). Stratum 1 dates to 11,100 RCYBP; deposition of S2 began about 11,000 RCYBP, with aggradation ending around 8500 RCYBP (Holliday et al. 1983, 1985).

Cooper (34HP45) is located on the floodplain margin of the Beaver River in northwestern Oklahoma (Bement 1997, 1999). Three Folsom-age kills occur within the confines of a narrow arroyo. The Cooper bison sample postdates the Lubbock Lake S1 population and is contemporary with the lower S2 (substratum 2A) population.

To test whether bison populations from the late Pleistocene to early Holocene varied in size, metatarsal lengths were compared and tested for significant differences using parametric analysis of variance (ANOVA) and nonparametric Kruskal-Wallace tests. Female sample sizes were S1 = 6, Cooper = 23, S2 = 16. Male sample sizes were S1 = 2, Cooper = 11, S2 = 35.

Results of both tests were the same. The ANOVA found significant variation between the populations of female bison metatarsals (p = 0.007). A post hoc Bonferroni/Dunn test found that the significant result was due to the difference between the S2 and Cooper specimens (p = 0.03). No significant differences, however, were found among the male metatarsals (Figure 1). While the Southern High Plains plateau separates it from the rest of the Southern Plains and gives it a distinctive environment, the plateau likely did not limit gene flow between bison herds. These results suggest rather the possibility of a large-scale north/south morphocline or the adaptation of slightly smaller size in the bison on the Southern High Plains. The time depth of the S2 sample vs. the restricted time of the Cooper sample may play a role. Additional work utilizing multiple measurements and both metapodials is under way to address further the evolution of Southern Plains bison through the late Pleistocene and Holocene.

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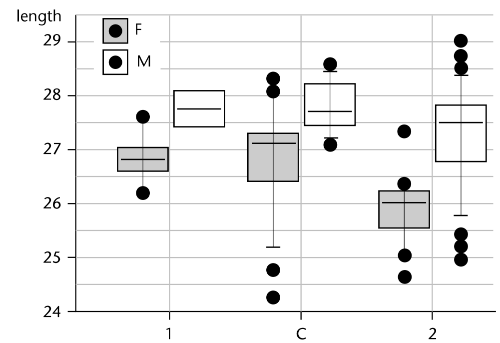

Figure 1. Boxplot of male and female metatarsal lengths (cm) for Lubbock Lake stratum 1 (**1**) and stratum 2 (**2**), and the Cooper site (**C**). Means, 50th percentiles, and 95th percentiles are shown with outliers.

Thanks are due to the VP Lab of the Texas Memorial Museum (Austin) for the loan of Lubbock Lake strata 1 and 2 bison metatarsals recovered during the Evans and Meade explorations in the late 1940s to early 1950s. The additional Lubbock Lake strata 1 and 2 bison metatarsals were recovered under TAC permit #36 to the Museum of Texas Tech University. They are housed at the Museum of Texas Tech University and held-in-trust for the people of the State of Texas. The Cooper material is housed at the Oklahoma Archeological Survey. Research was funded by the Museum of Texas Tech University as part of the ongoing Lubbock Lake Landmark regional research program into late-Quaternary climate and paleoecology of the Southern Plains.

References Cited

Bement, L. C. 1997 The Cooper Site: A Stratified Folsom Kill in Oklahoma. *Plains Anthropologist Memoir* 29:85–100.

——— 1999 *Bison Hunting at Cooper Site: Where Lightening Bolts Drew Thundering Herds*. University of Oklahoma Press, Norman.

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., 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):277–291.

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

Wyckoff, D. G., and W. W. Dalquest 1997 From Whence they Came: The Paleontology of Southern Plains Bison. *Plains Anthropologist Memoir* 29:3–32.

Possible New Record of a Homothere (Felidae: *Homotherini*) from the Late Pleistocene of Kansas

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Description of a *Panthera atrox* femur KUVP (University of Kansas Division of Vertebrate Paleontology) 127201 from the Kansas River (Gobetz and Martin 2002) prompted a reexamination of the only Kansas record directly assigned to that species. This is a left femur (KUVP 4646) from University of Kansas Harvey County Locality 1, collected by Hibbard (1939). Associated fauna includes a long-horned bison (*B. alleni*?), indicating a late-Illinoian to early-Wisconsinian age. We believe Hibbard's femur is probably not from *P. atrox*. Hibbard noted several differences from lion (*Panthera leo*) and tiger (*Felis tigris*) femora, e.g., dorso-ventrally bowed shaft, long distance between head and neck, and narrow intercondyloid fossa. As Hibbard had no postcranial material of *Homotherium* and the femur is lion-like in size and proportions, we compare it with the lion-like scimitar cat from the late Pleistocene, *H. serum,* and Pliocene *H.* cf. *crenatidens,* as well as *P. atrox* (Table 1).

Hibbard's femur shares several features with *Homotherium* femora, aside from those noted above: 1) side of lateral epicondyle depressed, and side of medial condyle deeply pocketed; 2) distal condyles short and broad, with lateral condyle tapering antero-posteriorly; 3) knob-like adductor insertion above lateral condyle on lateral edge of distal side; 4) patellar surface narrow; 5) greater trochanter narrow (Rawn-Schatzinger (1992) describes the *H. serum* greater trochanter as "rounded in dorsal profile"); 6) gluteal line/linea aspera not sharply defined or crest-like as in lions; 7) fovea capitis forming a deep pocket. A relatively short trochanteric fossa and intertrochanteric crest differ from other *Homotherium* and from *P. atrox*.

Both *Homotherium* and *P. atrox* occur in the late Pleistocene of Nebraska. Their hunting behavior was probably similar, and it would not be surprising if their ranges overlapped. *Smilodon* does not usually occur with *Homotherium*, and the two genera may have hunted in very different habitats. In conclusion, Hibbard's femur is not identical to that of compared homotheres, but shares at least seven characters with the genus *Homotherium* that differ from *P. atrox*.

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Table 1. Comparison of measurements from ?*Homotherium* femur with other *Homotherium* and *Panthera atrox* femora. All measurements in mm.

side	**?Homotherium** KUVP 4646 Harvey County, Kan. left	**H. serum [=Dinobastus serus]** TMM 933-3231 Friesenhahn Cave, Tex. right	**H. cf. crenatiden** UI 11861 Pliocene, Idaho right	**Panthera atrox** KUVP 44409 Natural Trap Cave, Wyo. right
greatest length	384.5	353.0	—	391.0
width, distal end	74.1	73.5	74.5	81.3
transverse shaft diameter at nutrient foramen (midpoint)	34.0	31.3	31.9	36.8
antero-posterior diameter, proximal end	91.8	92.0	—	95.3
antero-posterior diameter, head	44.2	42.8	42.2	44.6
width, intercondyloid fossa along postero-dorsal border	16.9	15.5	16.6	25.1
distance from base lesser trochanter to postero-ventral border of head	64.1	—	54.3	57.8
distance from base lesser trochanter to dorsal-most edge head	93.1	—	83.3	84.0
antero-posterior width, greater trochanter	46.6	—	—	52.2

KUVP University of Kansas Division of Vertebrate Paleontology
UI University of Idaho
TMM Texas Memorial Museum. Measurements of TMM 933-3231 from Meade (1961) and Rawn-Schatzinger (1992).

The only other possible Pleistocene *Homotherium* record from Kansas is a cranium from McPherson County, presently under re-study by the authors.

References Cited

Gobetz, K. E., and L. D. Martin 2002 A Giant American Lion (*Panthera atrox*) from the Kansas River, Late Pleistocene, Kansas. *Current Research in the Pleistocene* 19, in press.

Hibbard, C. W. 1939 Notes on some mammals from the Pleistocene of Kansas. *Transactions of the Kansas Academy of Science* 42:463–479.

Meade, E. 1961 The Saber-toothed Cat, *Dinobastus serus. Bulletin of the Texas Memorial Museum,* Part I, No. 2:23–60.

Rawn-Schatzinger, V. 1992 The Scimitar Cat *Homotherium serum* Cope: Osteology, Functional Morphology, and Hunting Behavior. *Illinois State Museum Reports of Investigations* 47, 80 pp.

Quaternary Mammals from the Axamilpa River, Puebla, México

Marisol Montellano-Ballesteros

In the southeastern part of the State of Puebla, 3 km north of the well-known fossiliferous Albian fish and reptile locality of Tlayua Quarry, runs the Axamilpa river. Along its margins are a sequence of ca. 30 m of late-Cenozoic sand, silt, and gravel outcrops. Small concentrations of fossils are found in these sediments. During recent years some sites have been extensively collected and Pleistocene mammals have been recovered.

In the site named Rancho Gerardo (Figure 1), fossil material was recovered from two different stratigraphic units. From the lower horizon, gomphothere, edentate, and glyptodont material was collected. The gomphothere material, which includes postcranial elements, lower jaws and upper tusks, is referred to *Cuvieronius* sp. (Montellano-Ballesteros 2002). The history of the genus is complex; discoveries of gomphotheres in México date from the middle of the 19th century. Despite the long history of discovery, the diversity and stratigraphic ranges of component taxa are practically unknown. In this same layer ossicles and an upper tooth of a mylodont were recovered and are referred to *Glossotherium* (*Paramylodon*) sp. The tooth size is similar to that of the species *G.* (*P.*) *harlani* present in Irvingtonian and Rancholabrean faunas of North America. A glyptodont right femur was also recovered and referred to *Glyptotherium* sp.

From the upper horizon, lower jaws of the equid *Equus conversidens* and isolated teeth and postcranial remains of *Mammuthus columbi* were collected. Recently, sediment for screen-washing for microvertebrates and samples for paleomagnetism were collected from this site.

In another site, Glyptodon's Hill, remains of a carapace of a glyptodont were recovered. The glyptodont material includes articulated scutes from different regions of the body: anterior aperture, anterolateral, lateral, posterolateral, posterior aperture, and dorsal region. Unfortunately, no cranial material was found. Characteristics such as the diameter of the central figures, number of peripherical figures per scute, shape of scutes, and the lack of overlapping of the scutes of the second row of the cephalic aperture suggest the material can be referred to *Glyptotherium* cf. *G. cylindricum* (Montellano and Castro, 1996). This taxon was originally described after discovery in Ameca, Jalisco (Brown, 1912), and has been recorded at Valsequillo (Puebla). The record of glyptodonts in México is quite poor. In this same layer remains of *Equus conversidens*, *Mammuthus columbi,* and antilocaprid were recovered.

The presence of two faunal assemblages is clear; the lower is characterized by the association of gomphothere and mylodont, and the upper by the

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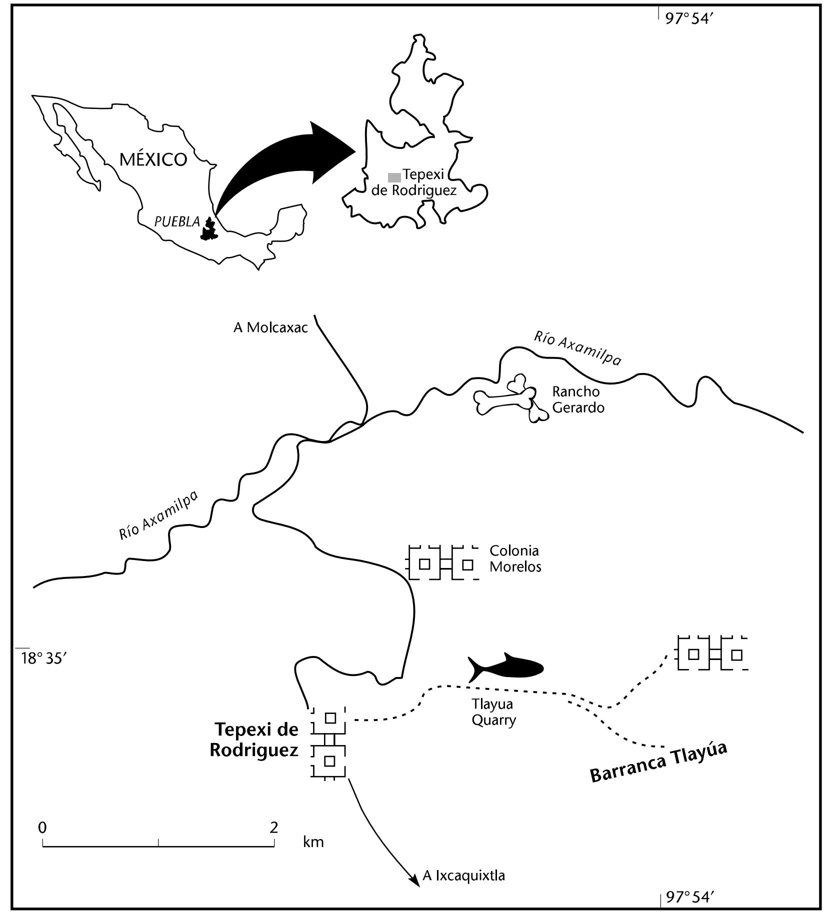

Figure 1. Location of Rancho Gerardo and other sites in Puebla, México.

presence of mammoth, horse, and glyptodont. The known stratigraphic ranges of the identified species extend through the whole Pleistocene. Thus far, no *Bison* remains have been recovered in the study area that would suggest a Rancholabrean age for the fauna, although the species of glyptodont, *G. cylindricum,* was reported from faunas considered Rancholabrean in age (Gillete and Ray, 1981). Thus the upper assemblage may be Rancholabrean.

The information presented here offers a more detailed taxonomic determination and establishes a preliminary vertical distribution of the taxa reported by previous authors (Torres and Agenbroad, 1991).

References Cited

Brown, B. 1912 *Brachyostracon,* A New Genus of Glyptodont from Mexico. *American Museum of Natural History Bulletin* 31(17):167–177.

Gillete, D. D., and C. E. Ray 1981 Glyptodonts of North America. Smithsonian Contributions to *Paleobiology* 40:1–255.

Montellano-Ballesteros, M. New *Cuvieronius* Finds from the Pleistocene of Central Mexico. *Journal of Paleontology* 76(3):578–583.

Montellano-Ballesteros, M., and H. Castro-Azuara 1996 A Glyptodont (Mammalia: Xenarthra) from the Pleistocene of the Mixteca, Puebla, México. *Journal of Vertebrate Paleontology* 16(2):54A.

Torres-Martínez, A., and L. D. Agenbroad 1991 Preliminary Report of the Pleistocene Mammals of the Valley of the Axamilpa River, Near Tepeji de Rodríguez, Puebla. *Current Research in the Pleistocene* 8:99–102.

Defects on Woolly Mammoth Molars from Pleistocene Central Europe and Their Paleoecological Implications

Laura Niven and Piotr Wojtal

Defects in the form of cementum furrows were recognized on molars of *Mammuthus primigenius* from the archaeological sites of Spadzista Street (B) in Poland (Gravettian) and Vogelherd Cave in Germany (Aurignacian). Such an arrest in tooth development, known as hypoplasia, might be a visual record of systemic stress and nutritional status of an individual caused by such factors as disease, vitamin/mineral deficiency, or nutritional stress (Goodman and Armelagos 1985). Although it is not clear whether these furrows in *cementum* represent hypoplasia similar to what is seen in *enamel* of many mammalian teeth, such developmental defects reveal information on the life histories of mammoths.

Furrows were recorded on 50 percent of the Spadzista molars (n = 259) and 74 percent of the Vogelherd specimens (n = 61). Exhibited in the cementum on the upper crown of one or both aspects (Figure 1) and in some cases the entire circumference of the tooth, hypoplasias are found in single or double bands ranging from thin, well-formed grooves (ca. 1.5–4 mm) to wider, more subtle bands (ca. 4.5–8 mm). The defect is primarily found on both upper and lower adult teeth and occasionally on juvenile molars. Hypoplasias do not appear to favor any particular tooth (e.g., M3), although the lingual aspect exhibits them twice as often on the Vogelherd molars.

Systemic stress from nutritional or vitamin/mineral deficiency might have influenced the location of mammoth herds. If mammoths were concentrated near patches of water, vegetation, or needed minerals such as calcium or sodium, this would have presented prehistoric groups with possibilities for opportunistic hunting and access to natural death sites where bones could be collected. The number of individuals (Spadzista = 71, Vogelherd = 28), age profiles, and skeletal element frequencies suggest a combination of these scenarios took place at these sites; it appears that the Spadzista mammoths died in the place of their deposition, while at Vogelherd, mammoth parts were acquired elsewhere and transported to the site.

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Figure 1. Hypoplasias on woolly mammoth molars from Pleistocene Central Europe.

German paleontologist Ekke Guenther (1955, 1956) observed hypoplasias on the molars of several fossil proboscidean species and explored the possible relationship between hypoplasias and paleoenvironment. Guenther (1956:46) speculated that mammoths underwent periodic nutritional stress as the result of fluctuating environmental conditions during the Pleistocene, which is visible in higher frequencies of hypoplasias in some herds. The assemblages from Spadzista Street (B) and Vogelherd support this hypothesis. Tooth defects in mammoths represent a unique approach for evaluating factors that could have influenced large mammoth accumulations.

Study of the Spadzista Street (B) mammoths was partly supported by Grant No. 6 P04C 064 18 of the State Committee for Scientific Research, Poland; the Vogelherd analysis was partly supported by the Sondersforschungsbereich 275 under the Deutsche Forschungsgemeinschaft. The authors would like to thank Drs. Gary Haynes, Reinhard Ziegler, Nicholas Conard, and Hans-Peter Uerpmann for their help in this research.

References Cited

Goodman, A. H., and G. J. Armelagos 1985 Factors Affecting the Distribution of Enamel Hypoplasias Within the Human Permanent Dentition. *American Journal of Physical Anthropology* 68:479–493.

Guenther, E. W. 1955 Mißbildungen an den Backenzähnen Diluvialer Elefanten. *Meyniana* 4:12–36.

——— 1956 Zahnmissbildungen und die Frage des Aussterbens der Diluvialen Elefanten in Mitteleuropa. *Geologische Rundschau*:46–51.

Fossil *Arctodus* from the Doeden Local Fauna (Illinoian/Sangamonian?), Eastern Montana

Michael C. Wilson and Christopher L. Hill

The Doeden gravel pit near Miles City, Montana, has yielded an extensive fauna of large vertebrates including ground sloths *Megalonyx jeffersonii* and *Glossotherium (Paramylodon) harlani*, mammoth (*Mammuthus columbi*), mastodon (*Mammut americanum*), several ungulates (*Equus* spp., *Camelops* sp., *Bootherium* sp., a cervid, and an antilocaprid), and a single specimen of the giant short-faced bear, *Arctodus* (Hill 1998, 2001; Hill and Schweitzer 1999; Wilson, in Kurtén and Anderson 1980:71; Wilson and Hill 2001). Material collected from the pit between 1976 and 1984 is in the collections of the Museum of the Rockies (MOR) and is the subject of continuing studies. Given the scarcity of *Arctodus* finds, the present note is addressed to describing this important specimen (MOR PL-084:B0007).

The specimen is the distal half of a left humerus, freshly broken at midshaft in recovery. It is gray to blue-gray in color and heavily mineralized. Abrasion of all eminences and particularly of the lateral and medial epicondyles indicates transport before deposition in the gravels. The specimen is ruggedly built, with rugose deltoid crest. In overall form it compares well with the humerus of "*Arctotherium*" *californicum* illustrated by Merriam and Stock (1925: Plate 7), with similarly expanded lateral supracondylar ridge and a robust bar roofing the entepicondylar foramen.

Because of the degree of abrasion, few measurements of the specimen can be taken at face value; most are minima. However, they do allow comparison with other specimens to give an idea of the relative size of this individual (Table 1). Its breadth measurements fall within the range for two La Brea, California, "species" described by Merriam and Stock (1925:23), both now subsumed within the species *Arctodus simus* (Kurtén and Anderson 1980:180–182). Considerably larger specimens are known from elsewhere, including "*Dinarctotherium merriami*" from Nebraska (Barbour 1916) and an immature specimen from the Arctic Slope of Alaska (Churcher et al. 1993). Comparison with the Merriam and Stock illustration indicates that almost exactly one-half of the bone is present, allowing a rough estimate of overall length at about 550 mm.

Table 1. Measurements of Doeden *Arctodus simus* humerus, compared with subspecies as defined by Richards et al. (1996:242). All measurements in mm.

	Doeden, MOR PL-084:B0007	Range for *A. s. simus*	Range for *A. s. yukonensis*
Transverse diameter at midshaft	(60)		
Greatest distal breadth across epicondyles	(137++)	113.5–156.0	123.2–178.0
Width of distal articular facet	(112)		
Overall length	(ca. 550)	436.0–497.0	555.0–633.0

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Richards et al. (1996) reviewed North American *Arctodus* finds and concluded that two subspecies of *A. simus* were differentiable on the basis of linear dimensions of the skull and limb bones. These were not the two "species" of the La Brea sample; those are now taken to signal sexual dimorphism within a single population (Cox 1991; Scott and Cox 1993). The northern *A. s. yukonensis* had significantly longer limbs than the more southerly *A. s. simus.* Length distributions are non-overlapping: the largest femur of the former is nearly 50 percent longer than the smallest femur of the latter. *A. s. yukonensis* was widespread in the West during Irvingtonian times and then differentiated during Rancholabrean times into two geographically overlapping groups, *A. s. yukonensis* in the Northwest and *A. s. simus* exclusively south of the region covered by Wisconsinan ice (Richards et al. 1996:212). The La Brea sample is referred to *A. s. simus.* There is evidence for late survival of very large *Arctodus* on the central Plains, so the geographical overlap was extensive (Gobetz and Martin 2002).

The age of the Doeden fauna is less than that of the Lava Creek B tephra (ca. 600 kyr) and based on terrace correlations would be greater than the 160 to 124 kyr dates on calcrete reported from the 30-m and 24-m terraces along creeks in the Tongue River drainage, which is tributary to the Yellowstone (Hinrichs 1988; Wilson and Hill 2001). This still leaves open the possibility of either an Irvingtonian (Yarmouthian to Early Illinoian) or early-Rancholabrean (Illinoian/Sangamonian) age; in the former instance one would expect *A. s. yukonensis,* whereas in the latter instance both that subspecies and *A. s. simus* would emerge as possibilities in the model proposed by Richards et al. (1996) and amended by Gobetz and Martin (2002). Absence of *Bison* sp. from the Doeden fauna despite the extensive sample is consistent with an Irvingtonian age, because the arrival of *Bison* in the midcontinent marks the start of the Rancholabrean. Breadth measurements of the Doeden specimen fall within the large zone of overlap between the two subspecies (Table 1), but the length estimate strongly suggests *A. s. yukonensis,* consistent with (though not definitive of) an Irvingtonian age. The proximal proportions of the specimen would necessarily have been highly atypical for the element to be as short as even the longest *A. s. simus.*

A late-Irvingtonian (Early Illinoian) age would make the Doeden Local Fauna roughly coeval with such faunas as Berends, Oklahoma; Sandahl and Adams, Kansas; and Angus and Mullen II, Nebraska. *Mammuthus columbi* appears in the record during the middle Irvingtonian, and *Bootherium* (= *Symbos*) by late Irvingtonian (Mullen II) (Kurtén and Anderson 1980:23, 332, 351). If this assignment is correct, the fauna could date to as much as 500 ka, but such a conclusion remains highly tentative.

References Cited

Barbour, E. H. 1916 A Giant Nebraska Bear, *Dinarctotherium merriami. Nebraska Geological Survey Bulletin* 4:349–353.

Churcher, C. S., A. V. Morgan, and L. D. Carter 1993 *Arctodus simus* from the Alaskan Arctic Slope. *Canadian Journal of Earth Sciences* 30:1007–1013.

Cox, S. M. 1991 Size Range or Sexual Dimorphism in *Arctodus simus* from Rancho La Brea. *1991 Annual Meeting, Southern California Academy of Sciences, Abstracts*, #20.

Gobetz, K. E., and L. D. Martin 2002 An Exceptionally Large Short-faced Bear (*Arctodus simus*) from the Late Pleistocene(?)/Early Holocene of Kansas. *Current Research in the Pleistocene* 18:97–99.

Hill, C. L. 1998 American Mastodon (*Mammut americanus*) from the Doeden gravels, No. 2 Terrace, Lower Yellowstone River (abstract). *American Quaternary Association Program and Abstracts, 15th Biennial Meeting, Puerto Vallarta, Mexico*:180.

——— 2001 Pleistocene Mammals of Montana and Their Geologic Context. In *Guidebook for the Field Trips, Society of Vertebrate Paleontology 61st Annual Meeting, Mesozoic and Cenozoic Paleontology in the Western Plains and Rocky Mountains*, edited by C. L. Hill, pp. 127–144. Museum of the Rockies Occasional Paper no. 3, Bozeman, MT.

Hill, C. L., and M. Schweitzer 1999 Mammoth (*Mammuthus*) from the Doeden Gravels, Eastern Montana: Biometric and Molecular Analyses. *Current Research in the Pleistocene* 16:120–123.

Hinrichs, E. N. 1988 Surficial Geology of the Sheridan 30'X60' Quadrangle, Wyoming and Montana. U.S. Geological Survey Bulletin 1816.

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

Merriam, J. C., and C. Stock 1925 Relationships and Structure of the Short-faced Bear, *Arctotherium*, from the Pleistocene of California. In *Contributions to Palaeontology: Papers Concerning the Palaeontology of the Pleistocene of California and the Tertiary of Oregon*, pp. 1–35. Carnegie Institution of Washington, Washington, DC.

Richards, R. L., C. S. Churcher, and W. D. Turnbull 1996 Distribution and Size Variation in North American Short-faced Bears, *Arctodus simus*. In *Palaeoecology and Palaeoenvironments 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, ON.

Scott, E., and S. M. Cox 1993 *Arctodus simus* (Cope 1879) from Riverside County, California. *PaleoBios* 15:27–36.

Wilson, M. C., and C. L. Hill 2001 Doeden Local Fauna (Illinoian/Sangamonian?), Eastern Montana. *Current Research in the Pleistocene* 17:140–142.

Paleoenvironments: Geosciences

Glacial Lake Great Falls and the Late-Wisconsin-Episode Laurentide Ice Margin

Christopher L. Hill and James K. Feathers

Stratigraphic sequences containing sediments related to glacial Lake Great Falls are exposed within the Missouri River valley in the region extending from around Helena to east of Great Falls, in west-central Montana (cf. Alden 1932; Calhoun 1906; Feathers and Hill 2001; Hill 2001; Hill and Valppu 1997; Lemke 1977; Lemke and Maughan 1977; Maughan 1961; Maughan and Lemke 1991; Montagne 1972; Robinson et al. 1969; Schmidt 1972, 1977, 1986; Stickney 1987; Vuke et al. 1995). The sediments were deposited in a lake formed when the Missouri River was blocked by a lobe of the Laurentide Ice Sheet (LIS). Direct dating of sediments using luminescence measurements appears to support a late-Wisconsin age for these stratigraphic sequences. This implies that a lobe of the LIS advanced into northern Montana and reached the present-day location of the Missouri Valley during the Last Glacial.

Two areas containing deposits of glacial Lake Great Falls were studied. At Holter Lake, near Wolf Creek, samples were obtained from an exposure adjacent to Beartooth Road immediately above present-day Holter Lake (U.S.G.S. Beartooth Mountain 7.5-minute quadrangle). Near Hower Coulee east of Great Falls, luminescence samples were collected from several localities containing sediments from glacial Lake Great Falls (U.S.G.S. Morony Dam 7.5-minute quadrangle).

At the Holter Lake exposure, luminescence samples were collected from laminated silts (UW355) from glacial Lake Great Falls and from overlying sands (UW356). Fine grains from UW355 were dated by infrared-stimulated luminescence (IRSL) and gave an age of 13,200 ± 900 CALYBP, but anomalous fading, or loss of a thermally stable signal through time, is evident, so this age can only be taken as a minimum. Preliminary optically stimulated luminescence (OSL), using the single-aliquot SAR method (Murray and Wintle 2000), gave an age on coarse quartz extracts from the same sample of 16,900 ± 3100

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CALYBP. Multi-aliquot OSL analysis of quartz grains from UW356 gave an age of 14,800 ± 1200 CALYBP. Thus, preliminary IRSL and OSL measurements both appear to indicate that the lake silts and overlying sands were deposited during the late-Wisconsin Episode.

Near Hower Coulee the stratigraphic sequence consists of fluvial gravels and sands overlain by laminated lake silts (the "lower lake"). The gravels appear to be correlative with alluvial deposits with an age of 125,000 ± 9000 CALYBP, based on U-series of shells of *Sphaerium striatinum*, *Lampsilis ovata*, and *Quadrula quadrula* (Maughan and Lemke 1991). The lower lake sediments are probably correlative with the "early deposits of glacial Lake Great Falls" (Maughan and Lemke 1991). The lower lake silts lie below a till, which in turn is overlain by several lithofacies of the "upper lake." The upper lake deposits can probably be correlated with the "late deposits of glacial Lake Great Falls" (Maughan and Lemke 1991). There are two preliminary single-aliquot OSL ages on sandy and silty deposits of the upper lake sequence at Locality B. A sandy facies yielded an age of 19,000 ± 2100 CALYBP, while silts provided an age of 14,200 ± 1200 CALYBP. The preliminary OSL measurements of sediments from the Hower Coulee area appear to indicate that these deposits of glacial Lake Great Falls also date to the late-Wisconsin Episode.

Estimating the age (or ages) of deposits of glacial Lake Great Falls may assist in determining the timing and extent of late-Wisconsin glaciation along the southwest margin of the LIS. For instance, the Lethbridge moraine in Alberta has been proposed as the limit of late-Wisconsin glaciation, implying that drift south of the Lethbridge moraine is middle Wisconsin or older (cf. Jackson 1983; Jackson and Pawson 1984). As an alternative, the Lethbridge moraine may represent an advance after late-Wisconsin deglaciation on the Montana Plains (cf. Fullerton and Colton 1986). In the vicinity of Holter Lake, glacial Lake Great Falls deposits in the Wolf Creek and Craig Quadrangles (Schmidt 1972, 1977) were assigned to the Wisconsin. The luminescence ages from near Holter Lake and Hower Coulee appear to indicate a late-Wisconsin age for the youngest deposits associated with glacial Lake Great Falls, implying a deglaciation chronology similar to that proposed by Dyke and Prest (1987).

References Cited

Alden, W. C. 1932 Physiography and Glacial Geology of Eastern Montana and Adjacent Areas. United States Geological Survey Professional Paper 174.

Calhoun, F. H. H. 1906 The Montana Lobe of the Keewatin Ice Sheet. United States Geological Survey Professional Paper 50.

Dyke, A. S., and V. K. Prest 1987 Late Wisconsinan and Holocene Retreat of the Laurentide Ice Sheet. Geological Survey of Canada, Map 1702A.

Feathers, J. K., and C. L. Hill 2001 Dating Middle and Late Wisconsin Episode Stratigraphic Sequences in the Rockies and Missouri Plateau: Luminescence and Radiocarbon Chronologies. *Geological Society of America Abstracts with Programs* 33(6):A287.

Fullerton, D. S., and R. B. Colton 1986 Stratigraphy and Correlation of the Glacial Deposits on the Montana Plains. *Quaternary Science Reviews* 5:69–82.

Hill, C. L. 2000 Pleistocene Lakes Along the Southwest Margin of the Laurentide Ice Sheet. *Current Research in the Pleistocene* 17:145–147.

——— 2001 Pleistocene Mammals of Montana and Their Geologic Context. In *Mesozoic and Cenozoic Vertebrate Paleontology in the Western Plains and Rocky Mountains, Guidebook for the Field Trips, Society of Vertebrate Paleontology, 61st Annual Meeting*, edited by C. L. Hill, pp. 127–143. Occasional Paper No. 3, Museum of the Rockies, Bozeman.

Hill, C. L., and S. H. Valppu 1997 Geomorphic Relationships and Paleoenvironmental Context of Glaciers, Fluvial Deposits, and Glacial Lake Great Falls, Montana. *Current Research in the Pleistocene* 14:159–161.

Jackson, L. E., Jr. 1983 Comments on Chronology of Late Wisconsinan Glaciation in Middle North America. *Quaternary Science Reviews* 1(4):vii–xiv.

Jackson, L. E., Jr., and M. Pawson 1984 Alberta Radiocarbon Dates. Geological Survey of Canada Paper 83-25.

Lemke, R. W. 1977 Geologic Map of the Great Falls Quadrangle, Montana. United States Geological Survey, Map GQ-1414.

Lemke, R. W., and E. K. Maughn 1977 Engineering Geology of the City of Great Falls and Vicinity, Montana. United States Geological Survey Miscellaneous Investigations Series Map I-1025.

Maughn, E. K. 1961 Geology of the Vaughn Quadrangle, Montana. United States Geological Survey, Map GQ-135.

Maughn, E. K., and R. W. Lemke 1991 Geologic Map of the Portage Quadrangle, Cascade and Choteau Counties, Montana. United States Geological Survey, Miscellaneous Investigation Series, Map I-2196.

Montagne, J. M. 1972 Quaternary System, Wisconsin Glaciation. In *Geologic Atlas of the Rocky Mountain Region.* Rocky Mountain Association of Geologists, Denver, Colorado, p. 257–260.

Murray, A. S., and A. G. Wintle 2000 Dating Quartz Using an Improved Single-Aliquot Regenerative-Dose (SAR) Protocol. *Radiocarbon Measurements* 32:57–73.

Robinson, G. D., M. E. McCallum, and W. H. Hays 1969 Geologic Map of the Upper Holter Lake Quadrangle, Lewis and Clark County, Montana. United States Geological Survey, Map GQ-840.

Schmidt, R. G. 1972 Geologic Map of the Wolf Creek Quadrangle, Lewis and Clark County, Montana. United States Geological Survey, Map GQ-974.

——— 1977 Geologic Map of the Craig Quadrangle, Lewis and Clark and Cascade Counties, Montana. United States Geological Survey, Map GQ-1411.

——— 1986 Geology, Earthquake Hazards and Land Use in the Helena Area, Montana–A Review. United States Geological Survey Professional Paper 1316.

Stickney, M. C. 1987 Quaternary Geologic Map of the Helena Valley, Montana. Montana Bureau of Mines and Geology. Geology Map Series No. 46.

Vuke, S. M., R. B. Berg, R. B. Colton, and H. E. O'Brien 1995 Geologic Map of the Belt 30X60-Minute Quadrangle, Central Montana. Montana Bureau of Mines and Geology, Geologic Map Series No. 54.

Isotopic and Biosilicate Records from Playa-Lunette Systems of the High Plains in Kansas

William C. Johnson, Steven R. Bozarth, and Joshua S. Campbell

Playa basins and associated lunettes, which dot the High Plains of the central continent, represent a major source of long-term environmental information. In Kansas, playas have developed on the loess-mantled uplands in the western half of the state; they range in diameter from 5 km to 10 m or less. Of more than 10,000 playas, fewer than 100 have recognizable lunettes. Without exception, lunettes are located on the south to southeast side of playa basins. Lunettes presumably reflect the influence of strong prevailing north-northwesterly winds of the Last Glacial Maximum (LGM), in contrast to the southerly flow of the Holocene. Notably, playas featuring lunettes appear to have the necessary antiquity to potentially contain traces of Paleoamerican and early-Archaic activity. Several of these playa basin–lunette landform assemblages have been cored and backhoe-trenched to explore the stratigraphy and to sample for radiocarbon dating and for rock magnetic, isotopic, sedimentological, biosilicate, and other analyses (Johnson et al. 2000; Mandel 2000). Lunettes contain a quasi-continuous depositional record to about 30,000 RCYBP, whereas the basin deposits appear thus far to be limited to the Holocene.

Stable isotope ratio analyses of bulk organic carbon from lunette cores indicate that from about 30,000 to 26,000 RCYBP (last interstadial), a mix of warm-season (C_4) and cool-season (C_3) grasses prevailed. From about 22,000 RCYBP, through the LGM, until about 11,000 RCYBP, cool-season grasses were dominant (Figure 1A). The isotopic shift at the Pleistocene-Holocene boundary is relatively abrupt and coincident with pronounced soil development. The soil is presumed to be the playa facies of the regionally expressed Brady soil (Johnson and Willey 2000; Schultz and Stout 1948). The low-resolution Holocene record indicates a prevalence of warm-season grasses throughout.

The lunette-derived phytolith record corroborates and amplifies the isotopic record and contributes additional detail to the environmental reconstructions. A mix of both Chloridoideae (C_4) and Pooideae (C_3) phytoliths prevailed until sometime after 22,000 RCYBP (Figure 1B). Pooideae phytoliths then increased during the LGM until about 16,000 RCYBP; a savanna environment (arboreal component) is suggested by the presence of other biosilicate types such as spinulose spheres and opaque bodies. Panicoideae (C_4 tall grasses, e.g., big bluestem) and Chloridoideae phytoliths clearly dominate the Holocene. Cores from basins typically exhibit discontinuities due to periodic desiccation, but they contain other biosilicates that reflect periodic flooding of the basin, e.g., algal statospores, diatoms, and sponge spicules.

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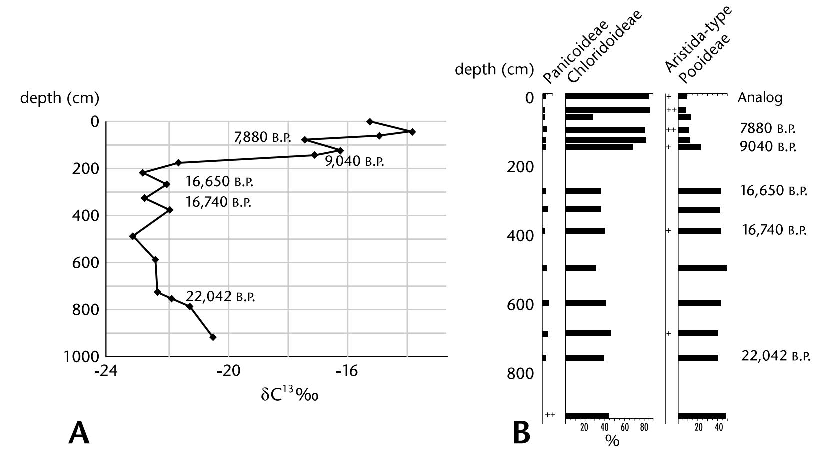

Figure 1. Core-derived stratigraphic data from the lunette at the Heitschmidt Playa in Scott County, Kansas. This core record begins about 23,000 RCLYBP. **A,** Carbon isotope trend ($\delta^{13}C$ wrt PDB). **B,** Frequencies of Panicoideae (C_4), Chloridoideae (C_4), and Pooideae (C_3) phytoliths. (+ denotes a single observation)

References Cited

Johnson, W. C., S. A. Bozarth, J. S. Campbell, and K. L. Willey 2000 Biostratigraphy, Magnetostratigraphy and the Environmental History of Playas on the High Plains of Western Kansas. *Geological Society of America Abstracts with Programs* 32(7):A223.

Johnson, W. C., and K. L. Willey 2000 Isotopic and Rock Magnetic Expression of Environmental Change at the Pleistocene/Holocene Transition in the Central Great Plains. *Quaternary International* 67:89–106.

Mandel, R. D. 2000 Lithostratigraphy and Geochronology of Playas on the High Plains of Western Kansas. *Geological Society of America Abstracts with Programs* 32(7):A223.

Schultz, C. B., and T. M. Stout 1948 Pleistocene Mammals and Terraces in the Great Plains. *Geological Society of America Bulletin* 59:553–591.

The Method of Multiple Working Hypotheses: An Application to Near-Surface Sediments in Northern Lower Michigan

Paul R. Rindfleisch

The method of multiple working hypotheses (MWH) involves developing, testing, modifying, and rejecting a number of different hypotheses, with the

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ultimate goal being acceptance of a single hypothesis, and hence, the explanation of an observed phenomenon (Chamberlin 1890; Gilbert 1886). Using MWH increases the robustness of one's conclusions by demonstrating that competing hypotheses have been considered and rejected. Despite this advantage, the use of MWH is seldom explicit in recent geoscience literature. The polygenetic nature of Quaternary sediments and landforms makes the use of MWH in their study particularly relevant. The objective of this paper is to demonstrate how MWH was used to determine the origin of lithologic discontinuities and sediments in a Michigan drumlin field.

Fieldwork and laboratory analysis of upland soils on drumlins of the Northport drumlin field, Leelanau County, Michigan, revealed that the soils typically formed in two parent materials separated by a lithologic discontinuity (Rindfleisch and Schaetzl in press). The material above the discontinuity typically contains more fine sand and has fewer coarse fragments (1–7 percent by volume) than the lower material (12–35 percent). The discontinuity is generally marked by an abrupt increase in gravel. Based on the coarse-fragment content, unsorted nature, and similarity in color to glacial till found in the region, the lower material was assumed to be till. The origin of the upper "cap" material was not as obvious, and a number of hypotheses were developed to elicit the process or processes responsible for this sediment. Below, I describe these hypotheses and outline the evidence considered for each and the reasons the hypotheses were rejected or accepted; see Rindfleisch (1999) for an exhaustive description of hypotheses.

Hypotheses concerning bioturbation and chemical and physical weathering were developed and tested using particle size and clay mineral analyses and soil pH. A biogenic origin was eliminated when particle-size analysis of worm casts showed that earthworms are bringing materials coarser than the cap to the surface. Clay mineral suites and soil pHs were similar to other weathering profiles observed in the region, suggesting that the cap was not formed through excessive chemical weathering. Comminution of the lower till to form the finer textured cap was eliminated as an agent, given the low number of freeze-thaw cycles occurring in the area (Isard and Schaetzl 1998) and the high permeability of the lower till.

An eolian origin for the cap was deemed possible, given the proximity of the drumlin field to eolian source areas (outwash and lake plains). This hypothesis was rejected, however, given the poor sorting, coarse texture, and presence of gravel in the cap, which are inconsistent with eolian sediments.

Several hypotheses were developed that involved ice-contact processes: (1) the cap represents till deposited by a separate ice advance, (2) the cap represents an ablation or supraglacial deposit, and (3) the cap is the deformation layer formed simultaneously with deposition of the lower till. The idea of a discrete till unit seems unlikely, given the thickness of the deposit (ca. 1 m). Additionally, if the cap were a supraglacial deposit, it would be expected to be coarser than the underlying material (Dreimanis 1990). Finally, the sandy texture and accompanying high permeability of the glacial till likely preclude the formation of a deforming upper layer (Boulton 1996).

Lastly, it was hypothesized that the cap and gravelly zone were the product

of submergence of the drumlin field. This lacustrine-origin hypothesis is supported by the occurrence of varved clay in some interdrumlin areas. In this situation, the cap and clays are the product of lacustrine deposition, whereas the gravelly zone represents an erosion lag formed through wave action. Based on similarities to analogs in the literature and as a result of rejecting alternate hypotheses, it was concluded that submergence was the product of the formation of an ice-dammed proglacial lake (Rindfleisch and Schaetzl in press). A proglacial lake scenario was favored over inundation by Glacial Lakes Glenwood and/or Calumet because the elevations of the observed deposits were higher than the estimated water planes for these lakes, and because of disagreement with the existing local glacial chronology.

Although the MWH method requires a thorough knowledge of the literature and rigorous testing and data analysis, the conclusions attained have a higher probability of explaining the observations because, ideally, "no stone is left unturned." In most publications, it is assumed that the concept of MWH was applied, but it is typically not elucidated owing to space constraints. Nevertheless, MWH is a powerful tool and should be considered by all geoscientists.

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References Cited

Boulton, G. S. 1996 The Origin of Till Sequences by Subglacial Sediment Deformation Beneath Mid-Latitude Ice Sheets. *Annals of Glaciology* 22:75–84.

Chamberlin, T. C. 1890 The Method of Multiple Working Hypotheses (reprinted in 1965). *Science* 148:754–759.

Dreimanis, A. 1990 Formation, Deposition, and Identification of Subglacial and Supraglacial Tills. In: *Glacial Indicator Tracing*, edited by R. Kujansuu and M. Saarnisto, pp. 35–59. A.A. Balkema, Brookfield, VT, U.S.A.

Gilbert, G. K. 1886 The Inculcation of the Scientific Method by Example. *American Journal of Science* 31:284–299.

Isard, S. A., and R. J. Schaetzl 1998 Effects of Winter Weather Conditions on Soil Freezing in Southern Michigan. *Physical Geography* 19:71–94.

Rindfleisch, P. R. 1999 Lithologic Discontinuities and Multiple Parent Materials in Some Soils of the Northport Drumlin Field, Michigan. Unpublished Master's thesis, Department of Geography, Michigan State University, East Lansing.

Rindfleisch, P. R., and R.J. Schaetzl 2002 Soils and Geomorphic Evidence of a High Lake Stand in a Michigan Drumlin Field. *Physical Geography*: in press.

Errata

In last year's issue of *Current Research in the Pleistocene* (Volume 18, 2001), we published two articles by Frédéric Sellet, "The Chronology of the Goshen Bone Bed at the Jim Pitts site" (coauthor James Donohue) and "The Dalton Gang Strikes Up North: Dalton Points in South Dakota (coauthor Michael Fosha). By an unfortunate oversight we failed to print the figures that should have accompanied the articles (Figure 1 in each case).

The following pages are the articles with figures as they should have appeared. The text for both articles is complete and exactly the same as originally published except for F. Sellet 2001 in "References Cited," an article that was in press at the time Volume 18 was published.

We apologize to Frédéric Sellet and his coauthors, and we thank them for their patience.

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

James Donohue and Frédéric 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.

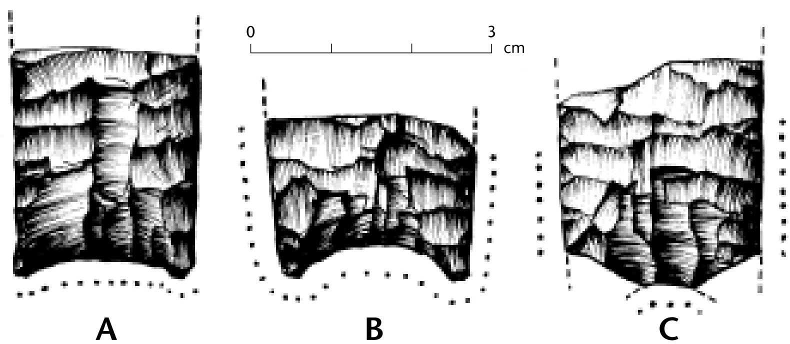

Figure 1. Three of the Goshen points from the Jim Pitts site.

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, 2001). 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. 2001 A Changing Perspective on Paleoindian Chronology and Typology: A View from the Northwestern Plains. *Arctic Anthropology* 38(2):48–63.

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

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

Frédéric 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 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

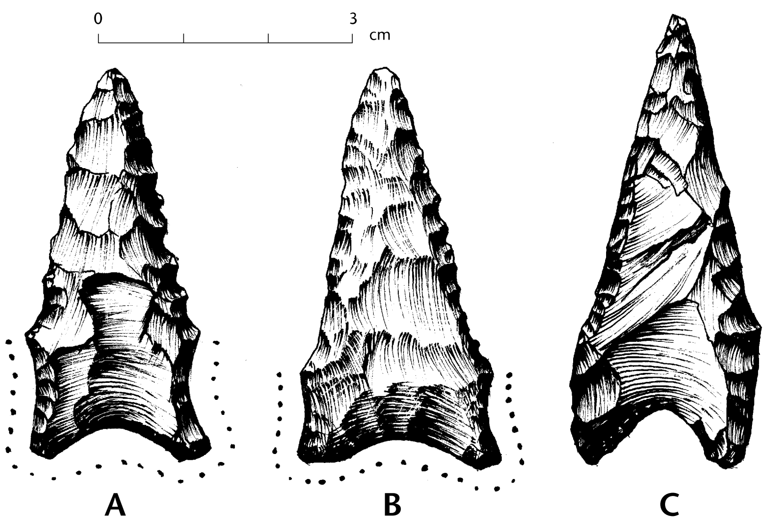

Figure 1. Dalton points from the South Dakota Badlands.

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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 2001).

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. Nebraska Academy of Science* IX:1–7.

Myers, T. P., and R. Lambert 1983 Meserve Points: Evidence of a Plains-ward 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. 2001 A Changing Perspective on Paleoindian Chronology and Typology: A View from the Northwestern Plains. *Arctic Anthropology* 38(2):48–63.

Wyckoff, D. G. 1999 Southern Plains Folsom Lithic Techn In Prehistory, Archaeological Series 12. Ann Arbor, MI.

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The following are some preferred abbreviations, words, and spellings: archaeology; Paleoamerican (Paleoindian implies a descent relationship); ca. (circa);

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Numbers of measurement, which are expressed as a decimal fraction, are written as Arabic numerals regardless of whether a decimal point appears or not (example: "3.5 m, 8 km, 1 kg, 52.34 cm, 3.0 ft").

Radiocarbon dates are expressed in ^{14}C years before present (RCYBP) and should include the standard error and the laboratory number (example: "11,000 ± 250 RCYBP (A-1026)"). Dates referring to geologic time, radiocarbon dates corrected for error, and dates inferred by other means such as TL and OSL dating are expressed in calendar years before present (CALYBP) (example: "85,000 CALYBP). Omit the comma when the year is less than 10,000 (examples: "8734 ± 90 RCYBP (A-1026)" "9770 CALYBP").

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References cited in the text must adhere to the style guide printed in *American Antiquity,* 48 (2):429–442 (the style guide can also be found on the Web site of the Society for American Archaeology, **www.saa.org**); this facilitates the editing for style used in *CRP*. Citations used in the text are as follows: ". . . according to Martin (1974a, 1974b)," ". . . as has been previously stated (Martin 1974; Thompson 1938)." Crosscheck all references with the original work—this is where most problems occur. *CRP* editors are not responsible for reference errors.

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