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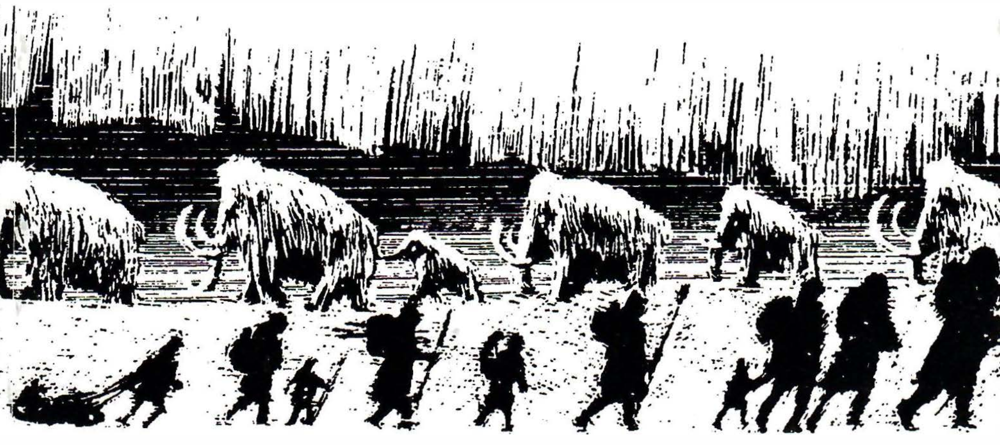

A Peopling of the Americas Publication

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Center for the Study of the First Americans
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From the Editor

This issue of *Current Research in the Pleistocene* includes a Special Focus section on the implications of repatriation and reburial of Native American human remains and associated funerary objects for Paleoindian research. Due to an overwhelming lack of response the section is limited to an invited review article by Alan Schneider and a submission from Clement Meighan. We had anticipated presenting a stimulating dialogue on various aspects of the controversy which would benefit the archaeological community generally. Perhaps, the majority of Paleoindian researchers believe that the Native American Graves Protection and Repatriation Act (NAGPRA) does not apply to them or their universe of research, since there are no extant tribal groups who can demonstrate biological or cultural continuity with any *particular* set of late-Pleistocene/ early-Holocene human remains. If that reflects your general opinion, then I refer you to Schneider's and Meighan's articles as well as to the new draft recommendations by the NAGPRA review committee on the disposition of culturally unidentifiable Native American remains. Paleoindian skeletons and artifacts have been reburied (though not, as yet, under NAGPRA), and the NAGPRA Review Committee is recommending that all Native American human remains and associated funerary objects—*regardless of age*—be repatriated.

The selection of the Special Focus section for this issue of *CRP* did have an impact. One archaeologist informed me that he had considered submitting an article on a new discovery of some significance—compelling evidence for Paleoindian ritual activity. However, the scholar decided that announcing it in a forum with such a contentious special focus might draw attention to the discovery from activists who would then seek to have the material reburied. So the scientific community is denied timely access to an important new discovery because of quite justifiable concerns that the discovery would thereby be threatened with destruction. Sadly, unless the archaeological community attends to the issues that this edition of *CRP* intended to address, the decision not to publicize the discovery may only serve as a temporary reprieve.

ERRATUM

An unfortunate error appeared in "Terminal Pleistocene of the Kheta Site, Upper Kolyma Region, Northeastern Russia" by Maureen L. King and Sergei B. Slobodin, which was published in *CRP* Volume 11, pp. 138–140. On page 138 the level designation for Ushki should read Level VI, not Level VII. I apologize to the authors for any confusion this has caused.

Archaeology

Fish Slough Side-notched Projectile Points: An Early-Holocene Time Marker in the Western Great Basin

Mark E. Basgall, Michael G. Delacorte and M. C. Hall

Notwithstanding some recent and ultimately unconvincing claims to the contrary, there is little doubt that chronologically sensitive variation in projectile-point morphology provides Great Basin archaeologists with an invaluable dating tool. Still, it is unlikely that the full extent of spatial-temporal variation among such artifacts is fully understood, a problem that is especially profound with respect to early- and middle-Holocene point forms, rarely recovered from demonstrably intact chronostratigraphic contexts. Fortunately, obsidian hydration makes it possible to determine the relative age of individual artifacts occurring in otherwise undatable situations. This note deals with one such case, recent research east of the Sierra Nevada disclosing a large side-notched projectile point type that likely predates 7,500 yr B.P. Though now recognized at a number of sites (Delacorte et al. 1995; Meighan 1955), these Fish Slough Side-notched points were found in some quantity at Fish Slough, a spring-fed wetland on the Volcanic Tableland north of Bishop, California, and around the perimeter of Deep Springs playa in the northern Inyo Mountains (Basgall and Giambastiani 1995; Delacorte 1990).

These dart point-size artifacts manifest broad, convex bases with shallow to deep notches on the lower margins; most extant specimens consist of proximal sections broken near the shoulders, making blade morphology difficult to characterize (Figure 1). Examples from Fish Slough have an average basal width (BW) of 24.6 mm, neck width (NW) of 17.9 mm, and proximal shoulder angle (PSA) of 155°; points from Deep Springs are slightly smaller, with a mean BW of 22.2 mm, NW of 14.5 mm, and PSA of 165°. Large side-notched forms are extremely uncommon in the southwestern Great Basin (cf. Hester 1973; Thomas 1981); though Heizer et al. (1968) defined a seemingly localized "Elko Side-

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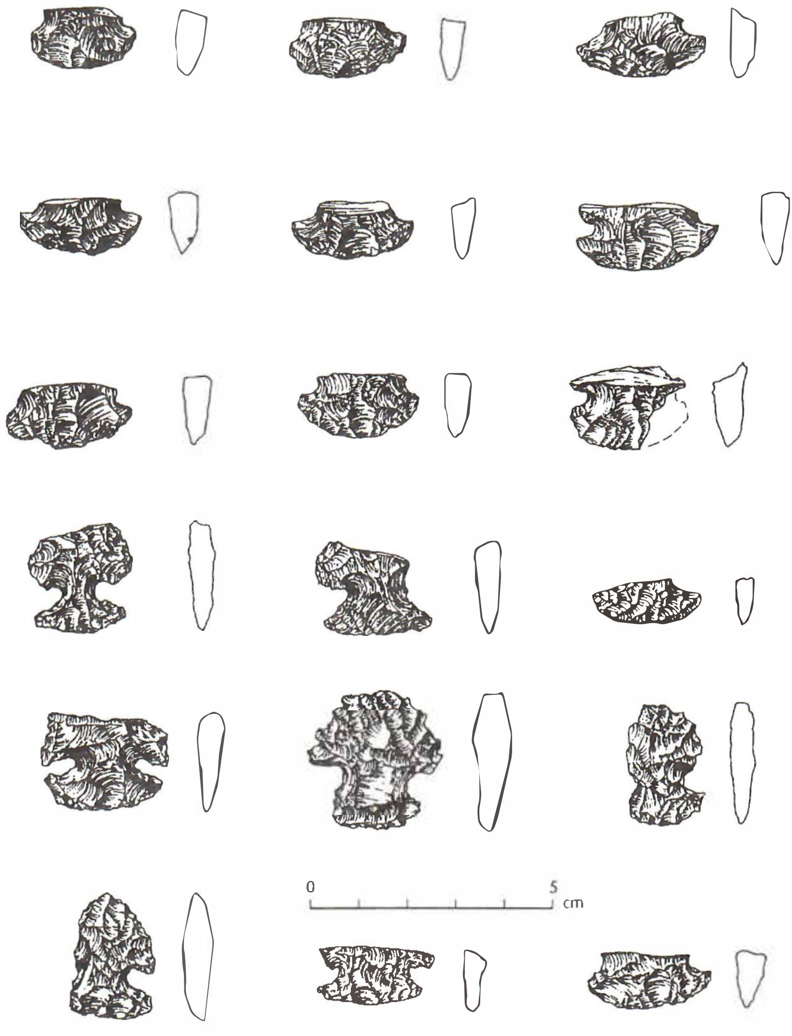

Figure 1. Fish Slough side-notched projectile points.

notched" type at South Fork Shelter, the category has been dropped by most subsequent workers. The Northern Side-notched type (Gruhn 1961) is confined to northern fringes of the Great Basin, and is morphologically distinct from the artifacts at issue here (having straight to concave bases, squared tangs, comma-shaped notches). Statistical comparison of Fish Slough points with the Elko assemblage from Gatecliff Shelter (Thomas 1983) reveals significant differences in stem form (BW—$t = 13.40$, $df = 160$, $p<0.0001$; NW—$t = 10.30$, $df = 219$, p<0.0001; PSA—t = 9.69, df = 226, p<0.0001). While many Fish Slough points lack intact shoulders, there seems little chance that they represent broken Elko or Northern Side-notched forms.

The distinctiveness of the Fish Slough type is further exemplified in hydration profiles. Data permit evaluation of obsidian artifacts attributable to the Casa Diablo and Truman/Queen geochemical types. Casa Diablo values from Long Valley (LV) average 7.2 and 9.3 μm, respectively, for Great Basin Stemmed and Concave-base points, fully 22–58% larger than mid-Holocene, Little Lake/Pinto series markers (5.9 μm). A smaller sample from the Volcanic Tableland (VT) implies slightly faster hydration (due to higher temperatures), but the side-notch mean of 10.0 μm is dearly of the same magnitude as early-Holocene artifacts in Long Valley (and 45% greater than the VT Little Lake/Pinto specimen [6.9 μm]). Adequate comparative data are not yet available for Deep Springs (DS), but two Casa Diablo side-notched pieces (8.7 μm) from this locality are again suggestive of great age. Truman/Queen source data derive from three localities (the Benton Range [BR], VT, and DS). Great Basin Stemmed points yield much larger hydration measurements than later Holocene series in the BR (9.3 vs. 3.8 μm for Elko), and despite higher temperatures, still shows marked differences between Fish Slough specimens (10.0 μm) and mid-Holocene markers (41–56% for Pinto/Elko [6.1/5.5 μm]) on the VT. The DS sample compares well with the other profiles, side-notched forms (7.1 μm), again producing dramatically larger (67%) readings than later Elko forms (4.3 μm).

The consistency of these data leaves little question that Fish Slough Side-notched points (1) appreciably predate Little Lake/Pinto types in the western Great Basin, (2) show no temporal overlap with the Elko series, and (3) have an antiquity comparable to more widespread early-Holocene forms (cf. Great Basin Stemmed and Concave-base). Variation in hydration across localities further indicates that the form persisted for some time within the region. In many parts of the Great Basin it has proven notoriously difficult to find evidence of early human occupation. Part of this undoubtedly relates to poor archaeological visibility/preservation, but researchers may well be overlooking signatures of ancient activities, ignoring diagnostic markers and construing them as statistical/morphological outliers of better substantiated assemblages.

We would like to thank the many individuals who volunteered on field projects in the Volcanic Tableland and Deep Springs Valley; Mark Giambastiani spent much time collecting and cataloguing artifacts employed in this study; Tom Origer performed much of the hydration analysis at reduced cost; the fine illustrations were prepared by J. Peter Mundwiller.

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The Clovis and Cumberland Projectile Points of Tennessee: Quantitative and Qualitative Attributes and Morphometric Affinities

Emanuel Breitburg and John B. Broster

This paper summarizes the results of a study designed to document the incidence of and quantitative and qualitative attributes for Tennessee Clovis and Cumberland projectile points. Records of 654 Clovis and 234 Cumberland points maintained by the Tennessee Division of Archaeology contain data on location, blade length, width, and thickness; base width and depth; flute length and width; grinding, and chert type. We have previously commented on the incidence of the points by physiographic occurrence (Breitburg and Broster 1994). In this article we present information on chert types, point dimensions, and the results of statistical tests designed to conceptualize the similarities and differences of samples grouped by physiographic occurrence.

Clovis points (n = 322) represent 15 types of chert. Ft. Payne (41%), Dover (37%), and Waverly (10%) were the primary cherts used, followed by a wide variety of other cherts: Buffalo River, St. Louis, Knox, cream, Flint Ridge, Horse Mountain, red agate, Ste. Genevieve, chalcedony, Burlington, banded and red cherts. Length ranges 30.7 to 182.4 and averages 71.0 mm. Blade width varies 14.0 to 48.9 and averages 27.9 mm. Base width ranges 14.0 to 42.4 and averages 25.7 mm. Blade thickness varies 2.00 to 9.9 and averages 6.5 mm. Flute length and width average 30.9 and 14.46 mm, and range 9.8 to 83.4 and 4.9 to 48.00 mm, respectively. Lateral grinding averages 27.8 and ranges 13.8 to 69.3 mm. Basal concavity appears on 90% of points and ranges 0.67 to 11.9 and averages 4.0 mm.

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Cumberland points (n = 181) sort to nine chert types. Ft. Payne (56%), Dover (31%), and Waverly (5%) are the main cherts present, followed by less commonly used Buffalo River, Knox, St. Louis, cream, waxy, and black cherts. Length ranges 37.6 to 167.9 and averages 77.6 mm. Blade width ranges 14.5 to 32.8 and averages 23.1 mm. Base width ranges 14.3 to 31.5 and averages 21.2 mm. Blade thickness varies 4.6 to 17.3 and averages 7.5 mm. About 63% (n = 114) display fluting. Flute length and width averages 1.9 and 14.0, and range 46.0 to 100.9 and 11.7 to 22.8 mm, respectively. Lateral grinding (n = 105, 81%) averages 25.8 and ranges 9.0 to 50.3 mm. Basal concavity is present in 73% (n = 148) of the cases and averages 3.4 and ranges 0.88 to 8.5 mm. Basal constriction averages 18.7 and ranges 15.2 to 27.5 mm in width.

Figure 1 summarizes the morphometric relationships of physiographically defined Clovis and Cumberland point assemblages. Plotted values represent the first two principal component scores obtained via the analysis of four variables (length, width, base width, and thickness). The results accentuate the strong morphometric dissimilarity between the two projectile points. The within-point-type clusters, confirmed by univariate analysis, reveal strong morphometric affinity between Western Valley and Western Highland Rim Clovis and Cumberland points. Central Basin, Coastal Plain, Eastern Highland Rim, and Valley and Ridge Clovis points do not differ significantly in size from each other, but they do differ significantly in size from the Western Valley and Western Highland Rim cluster. In contrast, Central Basin and Eastern Highland Rim

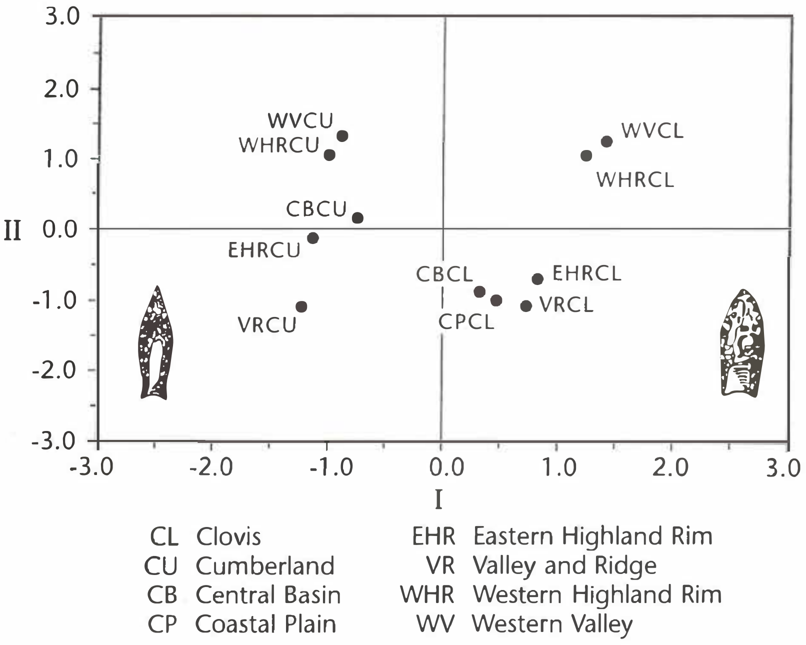

Figure 1. Plot of the first two principal components scores for four Clovis and Cumberland projectile point dimensions.

Cumberland points show strong morphometric affinity, but, although of smaller size, overall dimensions do not differ significantly from the Western Valley and Western Highland Rim. The Cumberland Valley and Ridge point is an even smaller version of that found in the latter regions.

The Clovis point was in use from about 11,500 to 10,900 yr B.P., and the succeeding Cumberland 11,000 to 10,500 yr B.P. The primary lithic source for both points included the Western Valley and Western Highland Rim Mississippian-period Ft. Payne and Dover cherts. In conjunction with our present view of early-Paleoindian base and ephemeral encampment settlement pattern, morphometric analysis implies that points are larger and show less maintenance and use wear closer to base camps with quarry sites than at progressively distant camp sites, where points are smaller and exhibit much greater wear or are worn out. The results of the study emphasize the unique nature of the Western Valley and Western Highland Rim and continue to identify these physiographic areas as primary corridors of Paleoindian activity.

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Disproof of Commonly Held Assumptions Relevant to the Peopling of the Americas

Alan L. Bryan

Recent work in Northeast Asia and northwestern North America has disproved certain long-held assumptions relevant to the initial peopling of the Americas. One pervasive assumption maintained by most North American archaeologists is that early people could not have occupied subarctic Siberia without an upper-Paleolithic level of technology. On this basis North American archaeologists expect to find in Siberia lanceolate projectile points that would be convenient predecessors for Clovis points, which are generally thought to be the most distinctive identifiable element of the earliest demonstrable tool kit in North America. Therefore, Yuri Mochanov's work in Dyuktai Cave on the Aldan River, a tributary of the Lena, has been hailed by North American archaeologists as very significant because several willow leaf-shaped points were found with a microblade and burin technology dated between 15,000 and 13,000 yr B.P. (Mochanov 1978: 58–9). The lack of thin broad lanceolate projectile points in Siberia in Pleistocene contexts has been ignored by Alaskan archaeologists who propose that they have recovered pre-Clovis broad lanceolate points, derived from Siberia by migration, in north central Alaska as early as 11,700 yr B.P., the

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oldest of several dates (Kunz and Reanier 1994). Clovis kill sites on the Great Plains, repeatedly dated between 11,200 and 10,900 yr B.P., would thereby be explained, although dates earlier than 12,000 yr B.P. on Clovis sites in the Eastern Woodlands (e.g., Brose and Barrish 1992; Wisner 1992) would not fit such a rapid migration model.

Also generally ignored is Mochanov's (1993) ongoing work at the Diring Yuriakh site on the 120-m terrace of the Lena River, where 39 clusters of lower-Paleolithic pebble and flake tools had been excavated through the 1994 field season from around boulders used as anvilstones beneath up to 40 m of banded sands and eolian silts. Mochanov maintains in the basis of paleomagnetic analyses that the site is more than 1.8 million years old; however, Mike Waters (pers. comm. 1995) of Texas A & M has obtained thermoluminescence dates suggesting the sands overlying the cultural zone are between 400,000 and 300,000 years old, and the loess capping part of the section is 250,000 years old. Whatever the date, Mochanov's recovery of a lower-Paleolithic artifact assemblage has clearly disproved the assumption that only people with an upper-Paleolithic level of technology could have survived subarctic winters in the coldest part of the northern hemisphere.

Another long-standing assumption is that an ice-free corridor appeared about 12,000 years ago east of the Canadian Rocky Mountains for migrating hunters to move southward in pursuit of mammoths. Recent research, including dating of some 40 large mammal bones, e.g., mammoths, indicates that the corridor opened from the south starting about 14,000, but did not reach central Alberta until about 11,600 yr B.P. (Young et al. 1994). Another 30 dates on bone and wood have been obtained from locally preglacial fluvial deposits. These dates range from off the counter (>45,000 yr B.P.) to 21,300 yr B.P., after which time the kilometer-thick Laurentide ice advancing from the north evidently blanketed central Alberta for nearly 10 millennia before it finally melted.

It has long been assumed that Laurentide ice covered Alberta east of the Rockies several times during the Pleistocene, as it did farther east, and that the advancing ice would have obliterated any earlier deposits near the surface, so archaeologists never looked below glacial deposits because it would be too old. However, this assumption has been disproved by the recent paleontological work in central Alberta, and by Jiri Chlachula (1994), a Moravian archaeologist trained in the east-European Paleolithic, who started collecting pebble and flake tools from a site buried by 23 m of Glacial Lake Calgary deposits. Glacial Lake Calgary was created by Laurentide ice that dammed the Bow River. An approximate time, about 21,000 years ago, can be extrapolated for the damming from the 21,300 date 200 miles farther north, if one assumes that the ice advanced rapidly. Limited excavation has yielded a core and flake assemblage, including flakes that refit onto a bifacially retouched quartzite pebble. Similar artifacts have been collected from a nearby site located beneath Cordilleran till which underlies the Glacial Lake Calgary beds.

Evidently people with an early-Paleolithic level of technology lived in the Bow River valley before a small Cordilleran glacier advanced down the valley from Banff and before the massive Laurentide glacier covered Alberta east of the mountains. There is no evidence that these early people made bifacially flaked projectile points, although the large biface suggests that the potential was inherent for further development of bifacial technology.

As in Alberta, pebble and flake tools are commonly found on many Holocene sites in North America. Their presence on the surface does not necessarily indicate great antiquity because these useful tools were easy to make and just as easy to discard. In other words, presence of a rudimentarily flaked artifact classifiable as early Paleolithic does not mean that it is very old. Many Paleolithic-looking bifaces are simply rejected preforms. Nevertheless, these omnipresent artifacts should not be ignored or explained away as simply "quarry blanks," especially when the lack of obviously more recent artifacts could be a clue that the site represents an occupation before bifacial points were innovated. However, it can be difficult to prove that possibility, especially if the artifacts lie on the surface. If desert varnish has developed on their surface, they might be directly datable by Ron Dorn's AMS radiocarbon method (Whitley and Dorn 1993). If artifacts can be located in geologically ancient sediments, such as below glacial or volcanic deposits, the artifacts might be geologically datable. The most important point to make is that it should be incumbent on all field archaeologists to look in "old dirt" for evidence of human presence, including simple pebble and flake tools, if we ever hope to resolve the perplexing question of when people first discovered America.

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Survey and Test Excavations at the Arc Site, Genesee County, New York

Rachel Ennis, Marc Hess, John D. Holland, Vivian Honsinger, Kevin P. Smith, Kenneth B. Tankersley and Stanley Vanderlaan

The Arc site is located in Genesee County, New York, on the southern margin of the Tonawanda basin, north of the Onondaga escarpment (Gramly 1988:272; Vanderlaan 1986:64). During the summer of 1994, the Department of Anthropology, State University of New York–Brockport and the Anthropology Division of the Buffalo Museum of Science conducted an archaeological survey, systematic solid-sediment coring, and test excavation at the Arc site. Our investigations exposed early-Paleoindian artifacts, features, late-Pleistocene and Holocene sediments, and ecofacts.

The early-Paleoindian artifact assemblage includes broken and exhausted fluted projectile points, aborted fluted-point preforms, worn and broken unifacially flaked chipped-stone tools, and debitage (Figure 1). Of the nine bifaces recovered, two are fragments of broken or exhausted fluted projectile points and seven are broken or aborted preforms. Most (i.e., 88%) of the fluted bifaces and associated debitage are manufactured from local Onondaga chert. Stylistically, the fluted bifaces are similar to Clovis and Gainey points from other Paleoindian sites in eastern North America (Tankersley 1994).

Worn and broken unifacially chipped stone tools were also recovered from the site (see Figure 1). These artifacts include nine spurred endscrapers, four sidescrapers, and two blade tools. Like the bifaces, most (i.e., 87%) of these tools are manufactured from local Onondaga chert. Non-local stone includes a Normanskill chert fluted point from eastern New York, a Hardyston chert spurred sidescraper from eastern Pennsylvania, and a Flint Ridge chert blade tool and fluted-point fragment from eastern Ohio (Holland 1994). Interestingly, the remains of an organic mastic are preserved on the haft elements of a fluted projectile point and a blade tool.

Early-Paleoindian artifacts and features appear directly on the surface of a firm calcareous reddish-brown diamicton. It forms a series of shallow, sloping erosional steps. The lowest step receives runoff and colluvium from the upper slope and is overlain by peat along the northern margin of the site. The site is adjacent to mineral spring and marl deposits. Excavations in the peat and spring deposits exposed a variety of macrobotanical fossils, large and small terrestrial animal paleo-feces, and gastropods. Cores from the marl contain a diversity of well-preserved gastropods and ostracods. The overlying peat, spring, and marl

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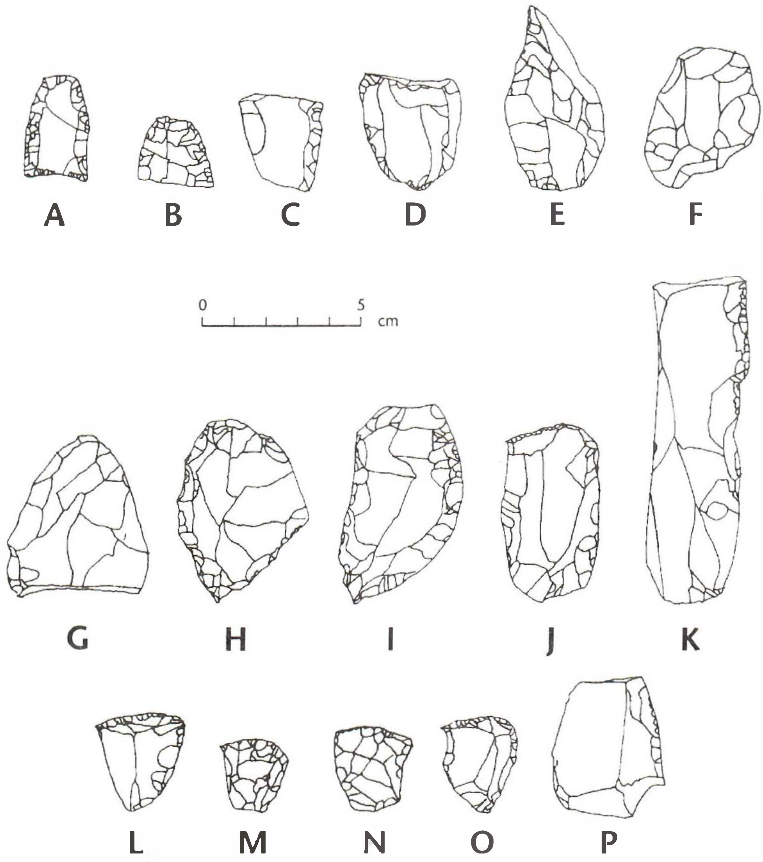

Figure 1. Early Paleoindian artifacts recovered from the Arc site during the 1994 investigations: (**A, B**) exhausted and broken fluted points; (**C–G**) fluted point preforms; (**H, I, K**) sidescrapers; (**J, P**) blade tools; (**L–O**) spurred endscrapers.

deposits correlate with a warming period, a rise in the water table, and possibly mark the end of the Younger Dryas chronozone (Haynes 1991).

This work was funded in part by a SUNY-Brockport Scholarly Incentive Grant.

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The Hilltop of Cerro el Sombrero, Argentina, Revisited

Nora Flegenheimer

Fieldwork at the summit of Cerro El Sombrero in the Argentine Pampas, has continued since findings were last reported (Flegenheimer 1991). Currently the excavated area of the site occupies 35 m², and surface remains were recovered from most of the 12,000-m² flat area at the hilltop of this butte. Previously reported excavations were situated where a concentration of surface materials had been registered (Sector 12); the more recent ones are distributed throughout the hilltop.

The occupation at this site has not been dated, as organic preservation is extremely poor and no adequate materials have been recovered. Yet, according to regional information, a late-Pleistocene/early-Holocene age is expected (Flegenheimer 1991). The Paleoindian occupation at Abrigo 1, a nearby shelter in the same hill, has been dated between 10,200 and 10,800 yr B.P. (Flegenheimer et al. 1994). Also, the earliest assemblages from Cerro La China and Cueva Tixi in neighboring hills present similar chronologies (Mazzanti 1993; Zárate and Flegenheimer 1991). Therefore a 10,000–11,000 yr B.P. date for an early occupation of the region is now firmly established. The hilltop of Cerro El Sombrero stands out as the largest among the early sites under study in the region .

In order to obtain a first sample to evaluate site extension and density, 12 pits, each measuring one square meter, were excavated. They are situated at 30-m intervals along the main longitudinal axis of the hill and along a transverse axis, which respectively measure about 300 m and 100 m. They have all yielded remains assigned to the Paleoindian assemblage. These remains are overlying a level of colluvium and covered by a thin layer of Holocene eolian sediments up to 50 cm thick, on which an A horizon is developed. This local stratigraphy can be correlated to the general regional stratigraphy. Artifact position is similar to that at Cerro La China S2 and S3, although at these sites the Holocene cover is thicker due to their lower topographic position (Zárate and Flegenheimer 1991).

Density of remains varies greatly among different pits. Some have yielded ca. 20 tools and more than 150 flakes, while at others, especially those near the hilltop limits, only 1 tool and fewer than 10 flakes have been registered. Two concentra-

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tion areas have also been observed for surface materials. Different explanations are being considered for this distribution: either post-depositional processes concentrated artifacts in certain situations, or these artifact concentrations reflect real activity loci. This second possibility is presently considered more probable, and geoarchaeological research is under way to study site-formation processes in detail. Several factors, which could have influenced the preference for certain areas are being considered: wind exposure, visibility and ground characteristics at the time of occupation.

Remains obtained from the 12 recently excavated pits include: one Fell´s Cave Stemmed or fishtail (FCS) point, 2 FCS stems, 3 whole tools, 28 bifacial fragments, 46 unifacial fragments, 865 flakes and 3 ocher fragments. That is, most of the discarded tools are fragmented and some of these fragments present worn-out edges. The majority of flakes (95%) are trimming flakes corresponding to the last stages of manufacture and measure less than 1.5 cm. Among these, bifacial reduction flakes presenting evidence of strong platform preparation are frequent. FCS stems are evidence that point rehafting took place at the site. The complete FCS point made from white quartzite is 7.3 cm long and is fluted on one face. Trends described for this collection are similar to those already observed both on the surface and in the previously excavated materials (Flegenheimer 1991).

The site has been considered as strategic due to its panoramic view (Flegenheimer 1991; Madrazo 1972). It has also been described as a re-equipment site where tool replacement activities were carried out (Flegenheimer 1991). Recent excavations confirm that this activity occurred throughout the summit. As the raw material for most of the artifacts can only be obtained from at least 30 km westward, this site function implies certain forethought in planning activities and a knowledge of the region. In this context, the hilltop of Cerro El Sombrero constitutes a large special-purpose locus and is unique among early sites found so far in the Southern Cone, which have been recently reviewed by Nami (1993). At present, it is difficult to propose whether the various artifact concentrations resulted from one prolonged or dense occupation or from several more discrete reoccupations. Yet, either possibility implies that these early groups were well established in the region and scheduled their activities in advance.

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Agua de la Cueva Rockshelter and its Relationship to the Early Peopling of Central West Argentina

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Until recently there were only two indications of the Pleistocene peopling of central-west Argentina subarea: some radiocarbon dates obtained by H. Lagiglia in the Gruta del Indio, from samples of charcoal and *Mylodontidae* and *Megatheridae* excrements (Lagiglia 1968, 1979) and a fishtail projectile point found on surface at La Crucesita site (Schobinger 1971). The excavation of Agua de la Cueva–Sector Sur rockshelter confirmed the presence of early human occupation in central-west Argentina ca. 10,350 yr B.P. (García 1992).

Recently, four more radiocarbon dates were obtained for Agua de la Cueva–Sector Sur's lowest archaeological levels, giving 10,950 ± 190 yr B.P. (Beta 61409), 10,240 ± 60 yr B.P. (Beta 61408 CAMS 5811), 9,760 ± 160 yr B.P. (Beta 61410) and 9,210 ± 70 yr B.P. (Beta 64539). This last date corresponds to a hearth located some 15 cm below a rock fall sealing the lowest strata. The other three are some 20–30 cm below it, almost at the beginning of site occupation. All samples were taken from charcoal lenses and concentrations (apparently hearths) associated with abundant faunal and lithic archaeological material. For the second date, AMS was utilized. These new dates both confirm the Pleistocene age of Agua de la Cueva–Sector Sur's earliest occupation, and show that its recurrent utilization during the Pleistocene-Holocene transition lasted at least over 1,000 years.

The importance of Agua de la Cueva–Sector Sur is due to its proximity to a spring, and its strategic situation in the pre-Cordilleran region. The site (latitude 69° 09′ 49″ W, longitude 32° 37′ 01″ S; 2,900 m a.s.l.) appears to have been seasonally occupied, during warm months (perhaps September–March) by groups strongly dependent on guanaco (*Lama glama guanicoe*) as primary food source. Winter sites probably ought to be sought in the eastern plain (50 km eastward), a much lower region (500 m a.s.l.). Unlike the mountain region where Agua de la Cueva–Sector Sur is located, it is not covered by snow in winter.

The climatic and geographical conditions of NW Mendoza would indicate that the first human groups settled in the region ought to have developed adaptive strategies which took into account the exploitation of ecologically different zones. The plain (600–800 m), the piedmont (800–1,500 m), the pre-Cordilleran region with mountain ranges up to 3,500 m, an extensive valley at 1,900 m and

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the Cordillera de los Andes ranges (3,000–7,000 m) are all registered in a 100-km E-W crosscut.

Settlements older than 8,500 yr B.P. have not been discovered in nearby areas to the north, which have been intensively surveyed (Gambier 1974, 1980). The present archaeological record seems to support Gambier's argument that ecological circumstances only allowed inhabitation and exploitation of that zone since 8,500 yr B.P. (Gambier 1979). If this is correct, it could be suggested that the early peopling ofcentral-west Argentina began ca. 11,000–10,500 yr B.P. from the west, through the Cordillera de los Andes and around 33° S. So, the first human settlements would have occurred in the southern half of central-west Argentina, between 33° and 34°. This scheme is also consistent with the presence of sites in Central Chile exhibiting dates older than those of Agua de la Cueva–Sector Sur, like Tagua Tagua and Quereo (Borrero 1994).

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San Isidro: A Late-Pleistocene/Early-Holocene Site in Colombia

Cristóbal Gnecco

The San Isidro site in southwestern Colombia is located at 2° 27′ N latitude, 76° 37′ W longitude at an altitude of 1,690 m a.s.l., 40 km north of the city of Popayán. The open-air archaeological site lies on the flat summit of a small structural hill, in an area of gently rolling hills.

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The site contains a single component dated to 9,530 ± 100 yr B.P. (B-65877) and 10,050 ± 100 yr B.P. (B-65878). All data obtained during the excavation of San Isidro indicate that the site was a lithic knapping station where hunter-gatherers made lithic artifacts and carried out their daily activities. While it is clear that they exploited a wide variety of forest resources, the evidence is biased toward plant gathering, especially palm fruits; information on hunting practices rests entirely on some of the lithic tools. More than 3,000 items of charred vegetal material were recovered from the archaeological deposit; the larger part corresponds to the cortical cover of the fruits of an undetermined palm species, very likely of the lowland genus *Acrocomia*, of which several fruit fragments were also found. Other genus represented with few seed fragments are *Persea*, likely a wild species; *Virola*, a group of plants currently used for their hallucinogenic power; and *Caryocar*, a lowland nut.

San Isidro was a lithic-knapping station; of the more than 58,000 lithic items recovered in the 20 m^2 excavated, only 514 (fewer than 1%) are artifacts; more than 99% of the material is knapping debris, of which most pieces (84%) are less than 1 cm long. Cores are virtually absent, suggesting that primary reduction took place elsewhere. Bifaces in different stages of manufacture, from slightly knapped flakes (still retaining percussion platforms and bulbar sections) to finished projectile points represent 22% of the artifacts. The seven whole and broken points found in San Isidro are lanceolate; these points are so far unique in the context of the northern Andes. The overwhelming majority of tools, however, represent ad hoc artifacts, and 3.5% are cobbles modified by use, primarily on the edges. This group comprises six edge-ground cobbles, an adze, and four flat grinding tools.

From the perspective of functional analysis, the lithic assemblage from San Isidro can be characterized as hunting gear supplemented by tools employed in the processing of game, wood and bone, and in the manufacturing of stone tools; outstanding for such an early site, the assemblage also contains equipment used in the processing of edible forest resources, evidence of which was also found in the form of macro-botanical remains.

The occupation at San Isidro represents a late-Pleistocene/early-Holocene human adaptation to a mountain tropical forest, evidence of which was obtained in the form of fossil pollen and macro-botanical remains; this evidence widens the spectrum of South American environments occupied by early hunter-gatherers. Even more, that occupation was made by individuals who already exploited forest resources with grinding tools; this kind of artifact was thought before to be much more recent. If to these considerations we add the great quantity of lithic and vegetal material recovered, San Isidro stands as a site of vital importance in the better understanding of the human side of the Pleistocene-Holocene frontier in the northern Andes.

Results of New Excavations at Wilson Butte Cave, Idaho

Ruth Gruhn

Wilson Butte Cave, a large lava blister situated in the central part of the Snake River Plain, was first excavated in 1959 and 1960 by Gruhn (1961), and produced a radiocarbon date of 14,500 ± 500 yr B.P. (M-1409) on small mammal bones from the lowest artifact-bearing level (in Stratum C, a gray/brown sand deposit), indicating a late-Pleistocene occupation (Gruhn 1965). In 1988 and 1989 new excavations, sponsored by the U.S. Bureau of Land Management and the Social Sciences and Humanities Research Council of Canada, uncovered lower deposits on the north side of the cave that were still undisturbed by relic hunters. These lower deposits included Stratum E, the basal yellow/brown clay; and the directly overlying lower part of Stratum C, the gray/brown sand deposit.

In 1988/89 Stratum E, a yellow/brown clay zone often mottled by coarse dark basalt grit or pumice, yielded fragments of bone of small and large mammals, the latter including a small camelid, a medium-large bovid, and artiodactyl. One fragment of a long bone was possibly modified; a nearly identical bone fragment found in the clay nearby produced an AMS radiocarbon date of 16,000 ± 140 yr B.P. (TO-1650). An AMS date of 33,250 ± 320 yr B.P. (TO-1467) was obtained on a marmot pelvis found deeper in Stratum E. Eight flakes of obsidian, ignimbrite, basalt, and chalcedony were recovered from Stratum E; but obsidian hydration analysis of two of the flakes indicates intrusion from the overlying gray/brown sand of Stratum C.

In the extensive 1988/89 excavations three major facies were identified within the preserved lower portion of Stratum C: a basal compact gray sand zone and a zone of coarse sand with abundant small angular basalt fragments, as well as the gray/brown sand. Artifacts, unmodified stone flakes, bone fragments, and small charcoal fragments were scattered throughout all facies. Bone fragments identified included remains of bison, camelid, and horse; and a single flake of proboscidian ivory, which yielded an AMS radiocarbon date of 10,700 ± 100 yr B.P. (TO-3300). A badly decayed large-mammal bone embedded in compact gray sand at the rear wall of the cave produced an AMS radiocarbon date of 16,030 ± 100 yr B.P. (TO-1647); but the bone was within 5–10 cm of the bedrock floor, and could have been derived from Stratum E by erosion and lag. The earliest date on charcoal in Stratum C was 10,230 ± 90 yr B.P. (TO-1485) from a level about 23 cm above the underlying Stratum E. Stratigraphically anomalous charcoal dates from the front and central areas of the cave indicate movement of small charcoal fragments within the gray/brown sand, most likely by animal activity. The complete series of radiocarbon dates will be presented and analyzed in the final site report, now nearing completion.

Most prominent in the 1988/89 artifact collection from the undisturbed lower part of Stratum C were fragmentary long, thick stemmed projectile points most

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closely comparable to the Haskett type of the Great Basin Stemmed Point tradition. One of these stemmed points produced an obsidian hydration date of 14,600 yr B.P. ± 402, and another stemmed point an obsidian hydration date of 13,657 yr B.P. ± 389; five other obsidian stemmed specimens produced dates ranging from 8391 yr B.P. ± 326 to 5949 yr B.P. ± 275. There were also several large shouldered Alberta-like points, and several concave-base points. Other artifacts recovered from undisturbed areas of Stratum C included bifaces, scrapers, utilized flakes, and burins.

It was hoped that the 1988/89 excavations would clearly resolve the question of whether or not there was a late-Pleistocene occupation of Wilson Butte Cave; but the evidence of human presence in Stratum E is still unclear; and the dating of the lower levels of Stratum C, in which there are numerous definite artifacts, remains ambiguous: bones of extinct fauna, radiocarbon dates on bone, and two obsidian hydration dates indicate a late-Pleistocene age; but no Pleistocene dates were obtained on the small charcoal fragments scattered in the deposit. The much larger artifact sample now available from undisturbed levels in the lower part of Stratum C indicates that the early Great Basin Stemmed Point technological tradition was manifested strongly at Wilson Butte Cave, a cultural feature which was not apparent from the very small artifact assemblage recovered in the much more limited earlier excavations on the south side of the cave.

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The Busse Cache: A Clovis-Age Find in Northwestern Kansas

Jack L. Hofman

The Busse site in Sherman County, northwestern Kansas (14SH1), is believed to represent a Clovis-age tool cache and activity site. The Busse cache was discovered in June 1968 by Dan Busse. It consists of 90 lithic artifacts, found 20–50 cm below the sloping surface. Dan Busse discovered the cache while checking a fence and walking in a cattle path eroded by heavy rains. A small piece of jasper in the path caught his attention, and on trying to pick it up he found it to be a large biface. On removing this biface another one was found, and so the cache was discovered. The pieces were lying flat and appeared to have been placed on an old surface.

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Excavation at the time extended around the initial find for an area of about two meters until the primary concentration of pieces was exposed.

The excavation of this area yielded one large cobble of jasper, which had a few flakes removed; one flat chalk-covered cobble used as an edge abrader; 13 large bifaces from 29.6 to 10 cm long (6 are refit from large fragments); 25 large blades and fragments (up to 11 cm long) including numerous scraping tools (4 are refit from broken pieces); 2 flake gravers on exotic flints possibly from southeastern Wyoming; and 48 flakes, flake tools, and fragments representing large biface reduction and tool making or maintenance (including 6 refit sets). Twenty-one flakes and pieces can be refit to bifaces, and nine flakes or flake tools are composed of multiple fragments. All the fractures appear to be prehistoric, as there is no evidence of modern or recent breakage. Several tools were retouched or reworked after they were broken. Subsequently, the tool parts were collected together and cached in this location.

Some of the artifacts (8 of the 13 large bifaces, the abrader, and some tools) have streaks of red ocher, usually on one surface only. All specimens except three are made from high-quality yellow to brown Niobrara jasper, with the closest quality sources about 100 km east of the site. The broad, flat flaking on the large bifaces is similar to that expressed on pieces from other Clovis caches, including the Anzick site in Montana (Wilke et al. 1991), and the Fenn cache from the Wyoming-Idaho border (Frison 1991). The unifacial blades include some with cortex or which are irregular in form as well as more standardized pieces, as was the case with the Sailor-Helton cache in southwest Kansas (Mallouf 1994). The platform technology and form of some pieces are much like the Clovis blades from Blackwater Draw and elsewhere (Green 1963; Young and Collins 1989). Both blade core and biface reduction are well represented in the assemblage. A spurred endscraper, gravers, and tools made on radial break pieces are also distinctive Paleoindian tool forms. The large biface thinning flakes, some of which refit to the large bifaces, are similar to specimens from the Sheaman site in eastern Wyoming (Frison 1982). The Busse Cache differs from most previously recorded Clovis caches in that it contains many heavily used tools, lacks final-stage preforms or finished projectile points, and many of the artifacts appear to represent the worn, damaged, or irregular pieces which we would expect to be abandoned first when transport decisions were being made.

Functional clues as to how the Busse Cache artifacts were used include high-polish and steep-edged tools, which might serve in hide processing; thick-edged tools with heavy edge damage, such as can occur in wood or bone working; thin-edged tools with polish and light fracture patterns indicative of butchering; and thick bifacial edges with heavy damage, such as can occur in initial butchering or dismembering activities. Also, tool maintenance and recycling are evident by the retouch flakes and refit pieces. This range of activities we might expect to occur in the context of butchering and processing carcasses and in repairing a damaged tool kit. Butchering a mammoth or numerous bison carcasses would result in new products, such as hides, meat, fat, marrow, bone and others, which people might wish to take with them and so necessitate the reevaluation of what was to be transported when the group moved on. This could result in the caching, with the possibility of future use, of excess, damaged, or second-quality lithic pieces. More than 7.3 kg (16.4 lbs) of stone are represented in the Busse Cache, and this durable material could be cached with confidence that it would remain useful should someone in the group need to return and claim it in the future. Further study of the Busse cache is ongoing, and detailed investigation of the site is planned.

Study of the Busse Cache would not have been possible without the long-term curation, interest, support and encouragement provided by Dan Busse and the Busse family. The work has also been supported by the University of Kansas General Research Fund and the Department of Anthropology's Carroll D. Clarke Fund.

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Norton: An Early-Holocene Bison Bone Bed in Western Kansas

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In 1992, field investigations began at the Norton Bone Bed site (14SC6) soon after learning that a lanceolate projectile point had been found eroding from this deposit, which contained abundant bison bone. The site was first exposed in the mid-1970s as a result of sand- and gravel-quarrying activities. Our attention focused on the site as a result of information and encouragement provided by Charlie Norton early in 1992. Testing was initiated in May of 1992 and followed by limited excavation in the summers of 1992 and 1993. Further investigations are planned, and the collections are currently the focus of continuing analyses. This note provides initial observations about the geochronology, faunal assemblage, and lithic materials that have been recovered.

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More than a decade of erosion has occurred on this exposure since the close of quarry activity resulting in an unknown amount of site loss. Bones and artifacts are located within an ancient gully, which apparently drained to the north toward Ladder Creek, but the head wall and most of the western margin of this gully have been removed by quarry activity. The west and north excavation areas are situated near the center of the paleo-gully, but the east excavation, only a few meters away, is on the gully margin. The gully was cut into Pleistocene sand and gravel. Subsequent infilling of the channel by brown silt has contained and covered the bones by two to five meters of fill. Mammoth, horse, turtle and other Pleistocene faunal remains have been found in the basal sand and gravel.

Three radiocarbon dates are now available for the Norton site; two are from the late-Holocene soil that caps the gully fill, and one is an AMS age on bison bone. The youngest date is a total humate sample from the topmost 4 cm of the uppermost Ab horizon (which is buried by quarry spoil and also apparently truncated by heavy equipment). This age, 410 ± 50 (TX-7815), provides a terminal date for the soil. The base of this 45-cm-thick soil is dated to 1,790 ± 60 (TX-7941), based on a total humate sample from the lowermost 5 cm of the Ab horizon. This provides a minimum age for termination of the gully filling, which occurred after the bison-kill event(s). Currently, only a single radiocarbon age is available for the bone bed. This bone sample of KOH-extracted collagen yielded an age of 9,080 ± 60 (CAMS-16032) (T. W. Stafford Oct. 17, 1994 letter to JLH). The sample was derived from a right humerus (specimen #M20-1-2) collected in place on June 28, 1992) at an elevation of 97.365 from the freshly eroded exposure between the east and west excavation units. This was also the approximate location where an Edwards chert spurred endscraper was collected after a rain and slump, and is in the immediate vicinity of the original projectile-point find.

Faunal remains are dominated by bison, but antelope is also represented in the bone bed by a few elements. Taphonomic study of more than 1,600 mapped pieces indicates a complex formational history for this deposit. Bone in the gully floor and fill is highly variable as to surface weathering, orientation, and dip. The most weathered surfaces are often on the down sides of bones when excavated. This reflects periods of weathering, movement, and reburial. Bones in the gully are highly fragmented and there are few articulations. Bones from the gully margin (east excavation grid) include several articulated limb units, with the most weathered bone surfaces oriented skyward. The number of bison represented is minimally eight, although the final MNI is expected to increase significantly. Very few intact teeth of young individuals have been recovered, and no seasonal estimate from eruption and wear has been made.

Lithic artifacts and debitage include a limited range of tools and several hundred flakes; the latter are primarily very small retouch flakes. Lithic material types include a variety of distinct sources, but the debitage is dominated (>70%) by Niobrara jasper. Other lithic types include unidentified cherts, quartzite, Edwards chert, basalt, opaline, Flattop, Florence, and Alibates in relative order of abundance. Artifacts (n = 9) include projectile points, scrapers, and flake tools, but are made of opaline, basalt, quartzite, fossil wood, Flattop, and Edwards chert, not Niobrara jasper. Diagnostic pieces include a complete quartzite lanceolate point with oblique parallel flaking, a concave base, and a reworked blade giving it a stemmed appearance. The specimen shares attributes with both the Allen and Dalton types. It is quite similar to a specimen from the Clary Ranch site in southwest Nebraska (Myers et al. 1981); to a point from the 34CI133 site in the Oklahoma Panhandle (Larry Neal, pers. comm.); and to a specimen from the Horace Rivers site near Canadian, Texas (Mallouf 1994). A square-stemmed point base with ground edges from a Cody complex type was also recovered. Whether these specimens reflect one or multiple episodes of site utilization remains to be determined. Other artifacts of note include a spurred endscraper of central Texas Edwards chert and a scraper of Flattop. The 9,080 yr B.P. radiocarbon date is appropriate for these point types, but the nature of the association is unclear at present.

Special thanks are extended to Charlie, Pat, Tanya, Tanner, and Carson Norton, who have been instrumental in making the research at the Norton site possible and in supporting our work there in numerous ways. Acknowledgment is also due to Chuck Kirk, Eleanor Kirk, Kathy and Gary Lawrence, Pete Bussen, George C. Frison, Pete Bostrom, Tom W. Stafford, Ken Tankersley, Jack Frick, Chuck Bonner, Charlie Duff, Gary Cutler, Galen Burgett, Larry Todd, Norman and Sigred Olsen, Karolyn Kinsey, Lee Walz, Rick Stevens, Tom Norman, Mary Warren, Gene Bertrand, Lou Evans, Joyce McGaughey, Denny Kuhn, Mark and Mildred Berry, Dan Busse, M. E. Hill, Bruce Zimmerman, Linda Greatorex, Shaun Bittikoffer, and the dedicated efforts of numerous field school students. Support was also provided by the University of Kansas General Research Fund, Dean Kathleen McClusky-Fawcett, Dave Frayer, and Glenn Kappelman.

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A Clovis Point from South Coastal Chile

Lawrence J. Jackson

In November of 1989, while researching collections from the Fell's Cave site of southernmost Chile, I recorded a fluted-point epoxy cast made by the late Junius Bird at the American Museum of Natural History in New York. Recorded as a surface find made by Americo Gordon, this obsidian projectile point (lacking only its tip) was recovered south of Puerto Saavedra on the Pacific Coast of Chile. The find location is listed only as 20 km south of Lago del Budi—a large, near-coastal freshwater lake about 60 km southwest of the inland city of Temuco (Figure 1). The Puerto Saavedra point is bifacially fluted and most closely resembles North American Clovis points in its style and execution. It shows little resemblance to fishtail fluted points, such as Fell's Cave type I, recorded from

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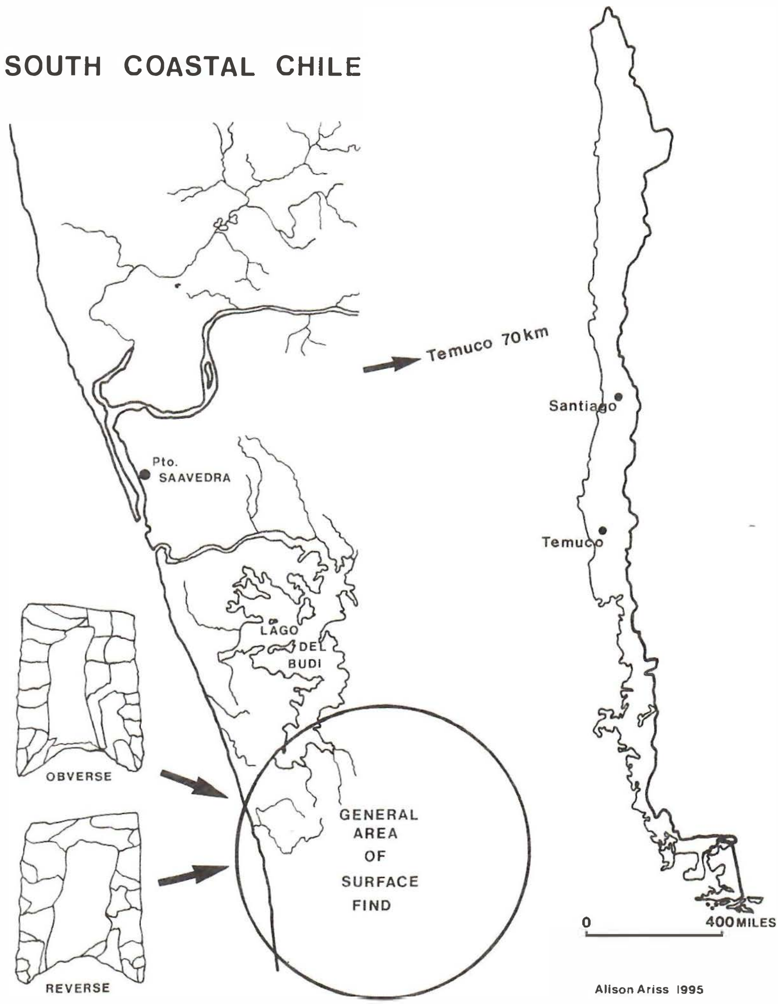

Figure 1. Find location, Puerto Saavedra point.

Tierra del Fuego and other sites in southern South America (Flegenheimer and Zorate 1989; Nami 1989).

The Puerto Saavedra "Clovis" point exhibits the following characteristics: pronounced basal concavity with distinct "ears" at the juncture of basal and lateral edges, straight and parallel sides, broad basal width of 28 mm, maximum body thickness of 7.2 mm and overall length of 50–60 mm (39.3 mm present with tip section missing). A single large fluted scar dominates each face of the artifact. On one face the flute scar is 27 mm long and varies between 8 and 12 mm in width. On the opposing face, the flute scar is 24 mm in length and 10 to 14 mm in width. The base of the longer of the two scars shows marginal retouch or basal finishing which obviously took place after the flute was manufactured. Roosa (1965) has noted the use of basal finishing on Clovis-age fluted points in the Great Lakes area of North America.

In its characteristics of marked basal concavity with pronounced basal ears, parallel-sidedness, overall width and thickness, and flute-scar length only one-third to one-half the length of the entire point, the Puerto Saavedra specimen shows clear correspondence with northern Clovis-type points and regional Clovis analogues such as Gainey in the Great Lakes region (see Ellis and Deller 1988). It is clearly different from anything which might be classified as Folsom, Folsom-like, or even Fell's Cave–like, with the implication that it may, in fact, be earlier than most fluted points known from southern South America.

The geographic location of the Puerto Saavedra specimen, near the Pacific Coast of southern Chile, raises some intriguing questions about coastal migration routes for Clovis, possible relationships to sites such as Monte Verde, and the age of earliest Paleoindian occupations. Vegetation in the coastal area south of Temuco is today mostly scrub, with areas of small trees, thin grass, bogs, and bare rock. The landscape is open, with abundant shoreline indentations around Lago del Budi, and shows pronounced scouring effects of Pleistocene glaciation. It is strongly reminiscent of the topography of Clovis-age sites in the Northeast of North America, as well as of Fell's Cave in Tierra del Fuego. Future research in this part of coastal Chile may well reveal hitherto unsuspected evidence of late glacial human occupation.

Anyone interested in examining the cast of the Puerto Saavedra fluted point should contact the American Museum of Natural History in New York. I am indebted to the late Dr. John Hyslop for his able assistance in researching the south Chilean collections of Junius Bird.

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The Martens Site (23SL222): A Clovis Occupation in St. Louis County, Missouri

Brad Koldehoff, Juliet E. Morrow, Toby A. Morrow, and Richard Martens

This article presents preliminary information about the Martens site (23SL222), a previously unreported Clovis habitation/workshop. The site is located on a cultivated ridge overlooking the Missouri River Valley in St. Louis County, Missouri, and also contains Archaic and Woodland components. Richard Martens has collected and monitored the site since he discovered it in 1969. Based on Martens's surface assemblage, the majority of diagnostic artifacts are of early-Paleoindian (Clovis) affiliation. The Clovis component is, in general, distributed across the site which occupies a broad upland ridge. However, a 450-m^2 "hot spot" has yielded a large number of Clovis artifacts over the years. This artifact concentration is located on a relatively level erosional step off the main ridge.

The Clovis biface assemblage contains 16 finished or nearly finished stage 5–6 Clovis points (see Morrow and Morrow 1993), ten fluted Clovis preforms in various stages of manufacture (Figure 1A–F), and two distal stage 4 biface fragments, which exhibit a Clovis-style flaking pattern; that is, large transverse percussion flakes with narrow flake initiations indicative of carefully prepared, isolated striking platforms (J. Morrow 1992). Thirteen endscrapers, 20 sidescrapers, 2 bifacial disk cores, 2 blade cores, and numerous blades have also been recovered (Figure 1G, H). The blade cores and blades are reminiscent of those from the Adams site in Kentucky (Gramly and Yahnig 1991; Sanders 1990). Both modified and unmodified blades are present. Blades were manufactured into endscrapers and sidescrapers or were used as is for cutting and scraping tasks. Also recovered from the Clovis concentration were more than 50 stage-2 to stage-3 unfluted biface production failures and rejects.

Based on macroscopic identification, five raw materials are represented in the Clovis assemblage. The majority of bifaces and blades are made of locally available Burlington chert. Represented by a stage 4 fluted biface proximal fragment (broken during removal of the second flute), two finished Clovis points (proximal fragments), and numerous stage-2 and stage-3 biface fragments, the second most common raw material is Salem/St. Louis chert, which is also locally available. Represented by a finished Clovis point, a fluted-point midsection, a bifacial disk core, and four stage-2 to stage-3 bifaces, the third most common raw material is chert from the Jefferson City Formation, which outcrops some 25 km southwest of the site. Represented by two sidescrapers, four utilized/retouched flakes, and one flake fragment, the fourth most common raw material is a greenish gray felsite, which outcrops in the St. François Mountains about 130 km

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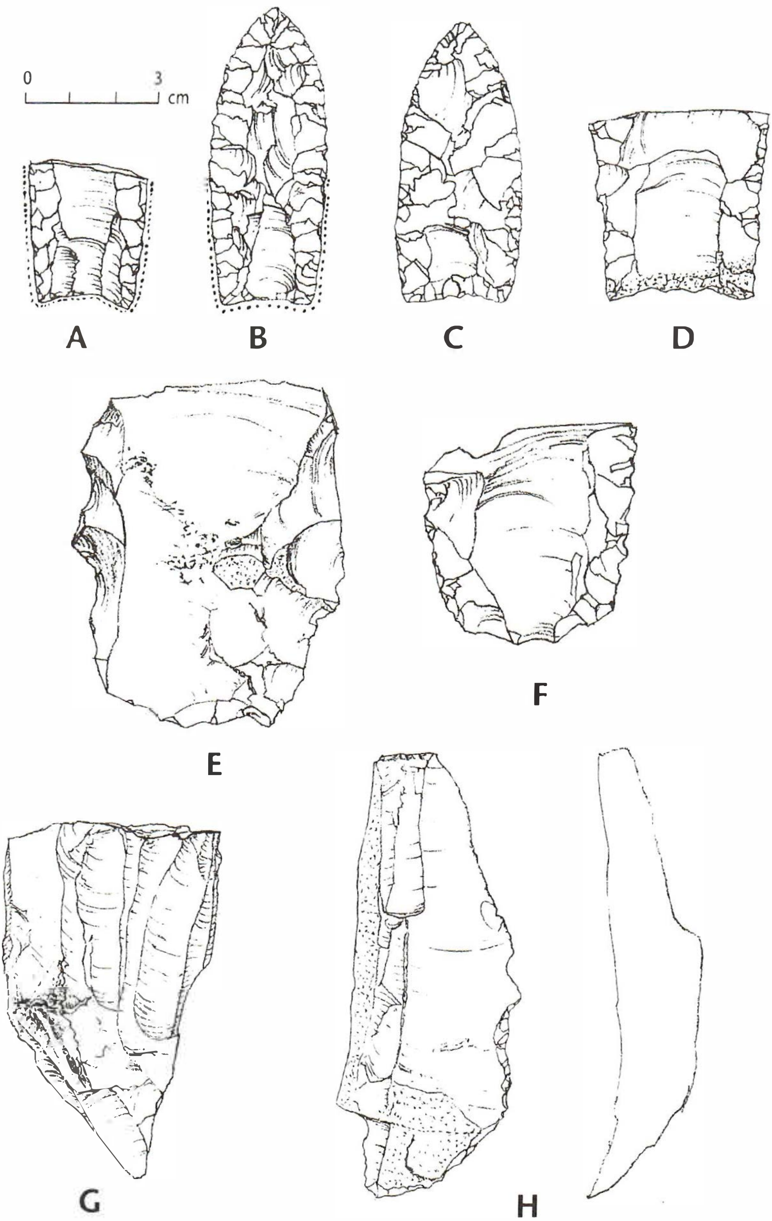

Figure 1. Selected artifacts from the Martens site. (**A**) Finished Clovis point base, Burlington chert; (**B**) finished Clovis point, Burlington chert; (**C**) nearly finished (stage 5) Clovis point, Burlington chert; (**D**) stage 4 Clovis biface, both faces fluted, Salem chert; (**E**) end-thinned stage 2.5 to 3 biface fragment, Salem chert; (**F**) stage 4 Clovis biface proximal fragment, overshot on first flute, Burlington chert; (**G**) blade core, Burlington chert; (**H**) utilized blade, felsite.

south of the site (Jack Ray, personal communication 1995). All seven felsite specimens appear to have been detached from one or two blade cores. Represented by a bipointed, steeply retouched uniface that resembles a limace, the fifth and final raw material is an unidentified, possibly non-local, chert that is cryptocrystalline, highly lustrous and streaked with gray, blue and brown.

The fluted biface technology represented by the Martens site assemblage parallels that of Ready/Lincoln Hills (J. Morrow 1992; T. Morrow 1992; Tankersley and Morrow 1993) and the Kimmswick (Tankersley and Morrow 1993) site assemblages. Possible relationships between these sites are currently under investigation, and the analysis of the Martens site assemblage is still ongoing.

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The Hiscock Site (Western New York): Recent Developments in the Study of the Late-Pleistocene Component

Richard S. Laub

Results of research at the Hiscock Site, Genesee Co., New York, through the 1991 field season were summarized by Laub (1994). Subsequent discoveries have deepened our understanding of this site and broadened the areas of inquiry. The present note describes some recent developments.

The fossiliferous Pleistocene unit, the "gravelly clay" (Laub et al. 1988), appears to have formed through in situ reworking of till and lake sediments of the underlying "cobble layer" (ibid.) by springs. Evidence includes: 1) poor sorting

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of the gravelly clay, indicating little transport; 2) the interface between the two units forming angles as high as 64°, too steep for stability under wet conditions as noted during excavation; 3) vertical and lateral penetration of the cobble layer by the gravelly clay, suggesting areas where spring water upwelled through and partly undercut the cobble layer.

Laub et al. (1994) proposed that abundant conifer twig segments within the fossiliferous Pleistocene unit are mastodon gastrointestinal material. Eight twigs from various parts of the site have been individually dated as follows (AMS method, years B.P., all ^{13}C adjusted): 10,945 ± 185 (AA-6970); 10,705 ± 80 (AA-6968); 10,545 ± 160 (AA-6971); 10,465 ± 110 (AA-4943); 10,240 ± 120 (NZA-1107); 10,220 ± 120 (NZA-1108); 9,475 ± 95 (AA-6969); and two dates from a single twig: 9,260 ± 70 (CAMS-6340) and 9,150 ± 80 (CAMS-6341). If the interpretation of these twig fragments is correct, *Mammut americanum* may have survived in this area beyond the generally accepted time of its extinction of approximately 10,850 yr B.P. (Thomas Stafford, pers. comm.). The discovery of mastodon bones significantly younger than that date is needed to confirm this hypothesis. Two relatively young mastodon bone dates from Hiscock, 10,515 ± 120 (Beta-24412) and 10,630 ± 80 (CAMS-17407), are suggestive but not conclusive.

The minimum number of mastodons at the site is now eight, but there are indications that the count will rise considerably. For example, at least 30 chin-tusks (thought to have been restricted to males) have been collected to date. They must, however, be assigned to deciduous and permanent categories before they can be useful for a census.

Gnaw marks at the proximal and distal ends of several mastodon ribs are the first evidence of large Pleistocene carnivores at Hiscock. One rib was in two pieces, lying about three meters apart. When fitted together, there was an oval puncture with crush marks along the joint, suggesting a powerful, possibly bear-sized animal.

Seven Pleistocene lithic artifacts, five of them fluted bifaces, have been excavated and identified to date. Six of the seven—all but BMS C29883, the most recently found—are illustrated by Laub (1994, Figure 8.4). One of these (ibid. Figure 8.4D-F) tested positive against Bovidae antiserum (analysis by Margaret Newman, 1992). It is noteworthy than no bovid remains have yet been identified from the Hiscock Site. AMS dates were obtained for a bone (probably a weathered fragment of mastodon scapula) and three conifer twigs found within 8 cm above the artifact. Unfortunately, though the twig dates overlapped (samples AA-4943, NZA-1107, and NZA-1108 above), the bone was discordantly older. This suggests stratigraphic mixing too great for confident dating of the artifact.

An unusual find is a bead (BMS C29884) made from granular rock, possibly sandstone (Figure 1). It measures 7.5 by 9.5 mm in width and 6 mm in thickness. A central cylindrical canal just under 2 mm in diameter penetrates its thickness. A concretionary fragment confirmed as pyrite by X-ray diffraction (field no. G8SW-679) was also found in the fossiliferous Pleistocene horizon. It is shaped roughly like the frustrum of a cone, 17 mm in length along its axis, and 5 and 10 mm in diameter respectively, at its two bases. The sides of this "frustrum" are extensively pitted (like the surface of a meteorite—potlidding?), with the topographically higher areas worn smooth. Because this is the only piece of pyrite

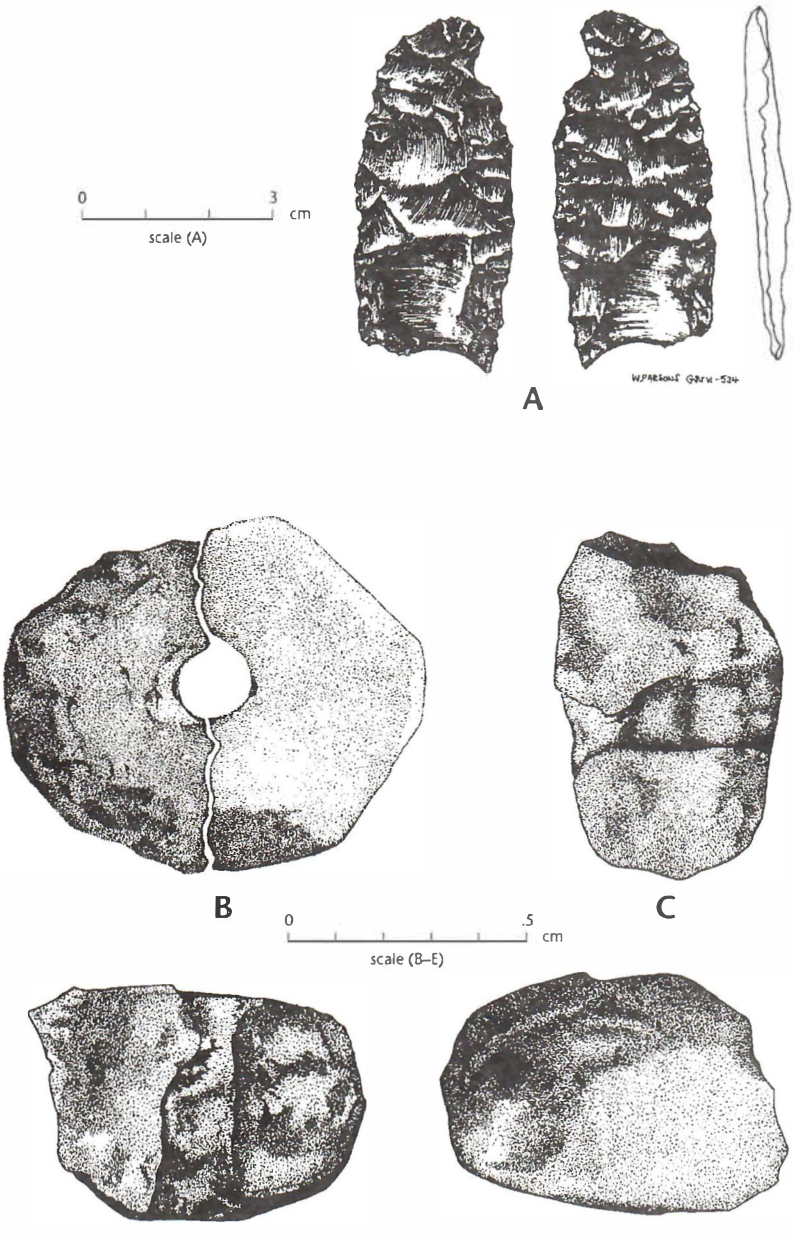

Figure 1. Hiscock site Pleistocene artifacts. **A,** fluted biface of undetermined function, Bflo. Mus. Sci. C29883; **B–E,** stone bead in two pieces, Bflo. Mus. Sci. C29884. Illustrations by William L. Parsons.

found at the site in 12 years of excavation, and because of its stratigraphic context, it is considered as potentially of cultural origin, and recorded here for future consideration.

A survey of about 20% of the Pleistocene Hiscock specimens revealed 13 expedient tools of mastodon bone and ivory, and of antler. One was illustrated by Laub (1994, Figure 8.5). These have been identified and analyzed by John Tomenchuk through a grant to the author from the George G. & Elizabeth G. Smith Foundation of Buffalo (see Tomenchuk & Laub, this issue).

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Quaternary Studies in Northern Chihuahua

Phil LeTourneau

During June and November of 1994, I conducted preliminary investigations into the late-Pleistocene archaeology of the region surrounding Villa Ahumada, Chihuahua. This field work was conducted under the auspices of Rafael Cruz Antillón, an archaeologist with the Instituto Nacional de Antropologia e Historia (INAH), and will be part of a larger interdisciplinary Quaternary study of northern Chihuahua to be proposed to INAH.

Chihuahua is well known for its Casas Grandes–period sites, but the earlier prehistory has received little attention. Especially absent is any substantial knowledge of an early-Paleoindian presence; this is true for northern Mexico in general. Clovis and Folsom sites are common to the north in the U.S. border states, and numerous early-Paleoindian sites have been documented farther south in the Basin of Mexico (Aveleyra 1955; Lorenzo and Mirambell 1986; Wormington 1957:91–99) and in southernmost Mexico and Central America (Ranere and Cooke 1991). However, only a few isolated fluted points have been reported from the northern Mexico states of Baja California (Aschmann 1952;

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Wormington 1957:84), Sonora (Di Peso 1955), and Chihuahua (Aveleyra 1961; Di Peso 1965; Krone 1978, 1980; Phelps 1990).

I assumed that this pattern of early point finds was due to a lack of attention to northern Mexico's early prehistory, and not to an actual absence of early sites. I therefore visited the Villa Ahumada area to assess the region's potential for early-Paleoindian sites. Villa Ahumada is a small town roughly 80 km south of Ciudad Juarez. As part of the Mexican Highlands section of the Basin and Range Province, this area is characterized by numerous pluvial lake basins and small mountain ranges. Villa Ahumada is situated between two of these pluvial lakes—Laguna Patos to the northeast and El Barreal to the west. A long Pleistocene sequence of fluctuating lake levels is expressed in numerous shorelines, but an absolute chronology for the area has not been developed (Hawley 1969, 1993; Reeves 1965, 1969).

I focused my investigations along one edge of El Barreal with the hope of finding lake-side sites. I identified three separate lake shorelines; on these were several sites of possible Paleoindian age. The artifacts were exclusively lithic and were dominated by small, high-quality chert bifacial thinning flakes. The only formal tool I recorded was a typical Paleoindian endscraper. These lithic assemblages differed sharply from those at sites in the region of later periods in terms of their raw materials and technology. I also identified a previously unknown secondary source of nodular obsidian in the dry bed of El Barreal (Steven Shackley, pers. comm. 1994).

There are numerous reported finds of Pleistocene fauna in the region (Scott Fitzpatrick, pers. comm. 1994). I visited two of these east of El Barreal with Spencer Lucas, Curator of Paleontology at the New Mexico Museum of Natural History. Both sites have been exposed by construction activities. One site consists of a 10-m-thick accumulation of mammoth (*Mammuthus columbi*) bones in a travertine spring deposit (Lucas, pers. comm. 1994). About 10 m of eolian sand overlies the travertine, which is well indurated and consists of sand and gravel cemented with calcium carbonate. The site's most outstanding feature is the very high density of skeletal remains in the travertine matrix. The bones are primarily molars and tusks with some postcranial elements; all are fragmentary and mineralized. This deposit probably predates the terminal Pleistocene, but is invaluable for the information it can shed on the region's late-Pleistocene environment. The other site consists of a 50-cm-thick accumulation of mammoth (*M. columbi* or *M. jeffersonii*) and horse (*Equus sp.*) bone fragments and teeth in an alluvial deposit covered by a meter of eolian sand (Lucas, pers. comm. 1994; Fitzpatrick, pers. comm. 1995). The bone here is fragmentary and not mineralized, and there are proportionally fewer teeth in this assemblage. These bones may date to the terminal Pleistocene. We made an intriguing find of a large chert flake (possibly Edwards Formation) in the backdirt at the second locality.

While I did not observe any fluted points in my survey, I believe that the potential for early-Paleoindian sites in this understudied region is high. By continuing my investigations I hope to better document the region's late-Pleistocene/early-Holocene environment and human occupation. Future research will target geology, geomorphology, paleoenvironment, lake chronology, soils, as well as archaeology.

This research was made possible by financial support from University of New Mexico (UNM) Graduate Student Association SRAC and RPT grants, and from Robert D. Leonard (through grants from UNM Department of Anthropology and UNM College of Arts and Sciences). Robert D. Leonard and Rafael Cruz Antillón provided initial logistical support for my research. Steve Shackley generously conducted the XRF analysis. I am also grateful to Spencer Lucas, Scott Fitzpatrick, and John Hawley for sharing their knowledge of the area's paleontology and geology.

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Three Fluted Points from South Central Louisiana

Thomas Anthony Marckese

Three fluted lanceolate-shaped points (Figure 1) recovered as surface finds from the south Louisiana Parishes of St. Landry (16SL167), St. Mary (16SMy79), and Lafayette (16Ly68) represent the southernmost occurrences of fluted points reported within this state and extend the known southern range to the present-day Gulf Coast (Dincauze 1993; Gagliano and Gregory 1965; Marckese 1993). The Lafayette Parish specimen was an isolated find, comparable to the pattern reported from results of the Texas Clovis Fluted Point Survey (Meltzer 1986). The St. Landry and St. Mary Parish specimens were found in multicomponent contexts, which included other Paleoindian tools and artifacts from later periods. All these points were recovered from Prairie Terrace margins adjacent to the Lafayette–Mississippi River floodplain (Gagliano 1990; Gibson 1990; Saucier 1981). This agrees favorably with other fluted-point finds reported in Louisiana where the majority have been found on various upland terrains that overlook floodplains, such as Maçon Ridge in northeastern Louisiana, some of the older terraces along the Red and Sabine river valleys, and certain older terraces in the southern part of the state (Gagliano 1990; Gibson 1982; Hillman 1985; Servello 1983; Webb 1948).

The longitudinal basal fluting, heavy basal and lateral grinding, slightly

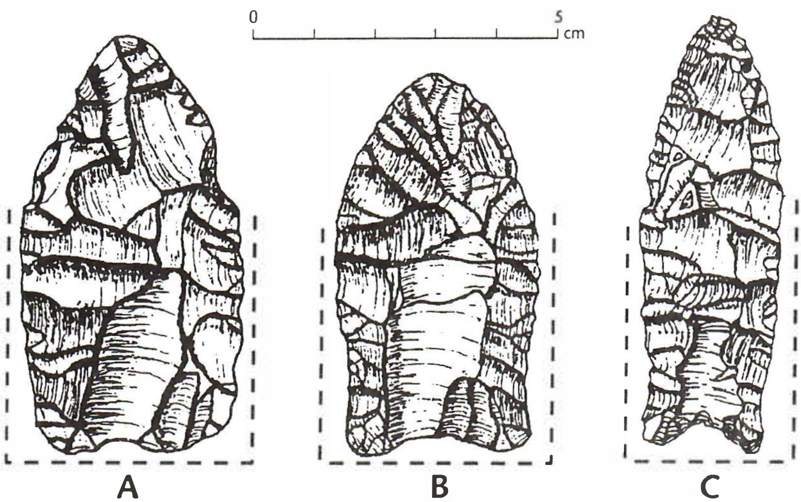

Figure 1. Fluted lanceolate-shaped points from South Central Louisiana: **A,** the St. Landry Parish specimen (16SL167); **B,** the St. Mary Parish specimen (16SMyy79); and **C,** the Lafayette Parish specimen (16Ly68). Dashed lines indicate edge grinding.

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parallel or convex margins, and concave bases exhibited on these points are similar to Clovis points (Wormington 1957). In the non-hafted portions, all three points exhibit impact fractures, reworked areas, refashioned tips, and damaged lateral edges. In this respect, they have similar multipurpose reduction/rejuvenation tool trajectories as Clovis points from sites in the Southwest and west-central Louisiana (Johnson 1991; Servello 1983). The Lafayette Parish specimen is made from blue Texas chert. The St. Landry and St. Mary Parish specimens are fashioned from local pebble chert and suggest local procurement of lithic resources.

The St. Mary Parish specimen was found at the Côte Blanche Island Salt Dome in a talus beach deposit containing Pleistocene megafaunal remains. This deposit is the product of wave action that is presently undercutting the base of the salt dome. Notably, this point found at Côte Blanche Island Salt Dome is the only fluted lanceolate point discovered at any of Louisiana's salt domes that closely resembles Clovis points of the Southwest. This latter relationship and the other two fluted point finds confirm that Paleoindian bands utilized an area that ranges from central Texas to the edge of Lafayette-Mississippi Alluvial Valley, as well as the adjoining Gulf Coast of Louisiana.

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The Texas Clovis Fluted Point Survey—1995

David J. Meltzer

In the years since the Texas Clovis Fluted Point Survey (TCFPS) was originally published (Meltzer 1987), data have continued to accumulate (for a complete summary, see Meltzer and Bever 1996). The TCFPS now includes 402 points, nearly twice the number originally reported; Clovis points are presently known from 126 counties (up from 95). Most counties have fewer than two Clovis points, though a few (Crosby, Gaines, and Jefferson), have more than 10 (the McFaddin Beach site in Jefferson County has yielded 70 points; Turner and Tanner 1994). The average density of Clovis points statewide is just over 15 per 10,000 square miles, but the points are not uniformly distributed. They are especially infrequent in the Trans-Pecos region of west Texas, despite some extensive surveys, and are nearly absent from the Lower Plains, perhaps a result of geomorphic processes that have deeply buried Clovis-age surfaces and/or poor-quality, highly saline water that discouraged Clovis occupation. Clovis points are more abundant on the High Plains (often occurring around freshwater sources), and along a crescent-shaped arc through central Texas that follows the Balcones Escarpment, along which high-quality chert and freshwater were readily available.

The Clovis distribution does not correlate with the distribution of later Paleoindian remains (including Folsom), except at a very coarse spatial scale (cf. Largent et al. 1991). This implies differences in land-use strategies over Paleoindian times, and is in keeping with other evidence (Meltzer 1993) that Clovis adaptations may be quite different from those of the Paleoindians who followed.

The majority of the points for which data are available were made of Edwards chert from central Texas (n = 93); a significant minority were fashioned of Alibates agatized dolomite and Tecovas jasper from the High Plains (n = 34). There are regional differences in raw material use: Edwards cherts are common throughout the state, but under-represented on the High Plains. Alibates and Tecovas tend to be less frequent east and off of the Plains, though stone from these same sources was routinely carried north (e.g., the Drake Cache in Colorado, Stanford and Jodry 1988). Such patterns, and the extreme scarcity of obsidian Clovis points in Texas (the closest outcrops of which were to the west), may indicate Clovis groups on the High Plains predominantly cycled north-south, more so than east-west (Meltzer 1989).

Texas Clovis fluted points average just over 6 cm in length, 2.75 cm in width, less than 0.73 cm in thickness, and generally taper in plan and longitudinal section (the thickest and widest portions of the points were on the blade beyond the haft). The points commonly were fluted once on each face, the flutes rarely extending beyond the haft area (marked by the extent of lateral grinding). They tend to have relatively shallow basal concavities.

These averages, however, should not mask the variation about the mean in certain dimensions—notably length and thickness. In the TCFPS sample, varia-

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tion in these dimensions is clearly attributable to reworking and breakage, not to differences in raw materials or technological strategies (cf. Tankersley 1994). In contrast, values for basal width and flute thickness cluster tightly about the mean. That clustering implies a high degree of standardization in point manufacture, likely related to the demands of fitting the basal portions of the points into preexisting hafts (e.g., Judge 1973; Odell 1994).

Most of the points in the TCFPS sample (n = 161) were complete or had incidental breaks that postdated their use-life (slightly broken corners, tips. etc.). Clovis preforms are extremely rare in the TCFPS sample (n = 2), which likely results from problems collectors may have recognizing early stage (possibly unfluted) forms and failures.

The most common signs of use-life attrition in this sample of Clovis points were reworking (n = 56) and lateral snaps (n = 58), both of which mostly occurred while the points were still mounted in their hafts. The incidence of reworking was highest on the High Plains, where raw material was scarcest and where, perhaps not coincidentally, four of the six points with impact fractures were recovered. Reworked points on the High Plains also tended to be smaller than those in more stone-rich areas of the state (notably central Texas), suggesting points were jettisoned from the tool kit sooner when there was an ample supply of replacement stone, and later when there was not.

The TCFPS could not have been accomplished without the cooperation of scores of individuals; I thank them collectively here, and separately in the forthcoming paper (Meltzer and Bever 1996). This brief note benefited from the help of Michael R. Bever and Vance T. Holliday.

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Piedra Museo Locality: A Special Place in the New World

Laura Miotti

During the last decade archaeological investigations in the Patagonian Region have focused on regional archaeology, and most of them were about the relationship between the hunter-gatherers and the megamammals of the late Pleistocene. In other words, paleoenvironments, human colonization and massive extinctions and the role of technology in this peopling process are considered the key concepts in the interpretation of dispersal and consolidation of human territoriality.

The aim of this paper is to present the archaeological results of our work at Piedra Museo locality (Santa Cruz province, Argentina) as evidence for the differential use of space by hunter-gatherer societies of the late Pleistocene as it relates to concepts of social network communication and landscape use. These investigations bring out reliable information about Pleistocene peopling and the need to formulate models of movement of people into regions such as Extra-Andean Patagonia, which are apparently homogeneous in terms of inhabitable areas and resources. Here, microenvironments suggest that in the past, as today, there were significant ecological differences.

The spatial analysis (intra- and intersite) developed in our work in the central plateau of Santa Cruz province (Miotti 1989; 1990; 1992; 1993a), is connected to ethno-archaeological studies. It attempts to address the interrelationships between the mobility, ecology, economy, social and communication network, symbolism and decision-making of the hunter-gatherers that explored and colonized the Americas' Southern Cone.

The principal archaeological investigation in the Central plateau since 1988 has focused in Piedra Museo and nearby localities that have very different environmental conditions: central basins and shallow valleys. The sites contain archaeological contexts between 11,000 and 7,500 yr B.P. AEP-1 rockshelter of Piedra Museo Locality is the first site in Extra-Andean Patagonia Region (Argentina) where fishtail projectile points were found in stratigraphic context. Likewise, this small rockshelter would have been a locus of primary procurement and dismemberment of big prey.

In the AEP-1 rockshelter, and nearby workshops and quarries, we recovered fishtail projectile points (Figure 1), and unifacially worked scrapers and knives, some heat treated. Bipolar techniques are present in bone raw material. This early occupation was dated by AMS to 10,400 ± 80 yr ^{14}C B.P. (AA-8428). Two fragments of fishtail points were recorded at a depth of 1–1.20 m. The large fishtail point is made of a red chert and of this excellent raw material was obtained from quarry-workshop "17 de Enero," 6 km southeast of AEP-1. Another fishtail

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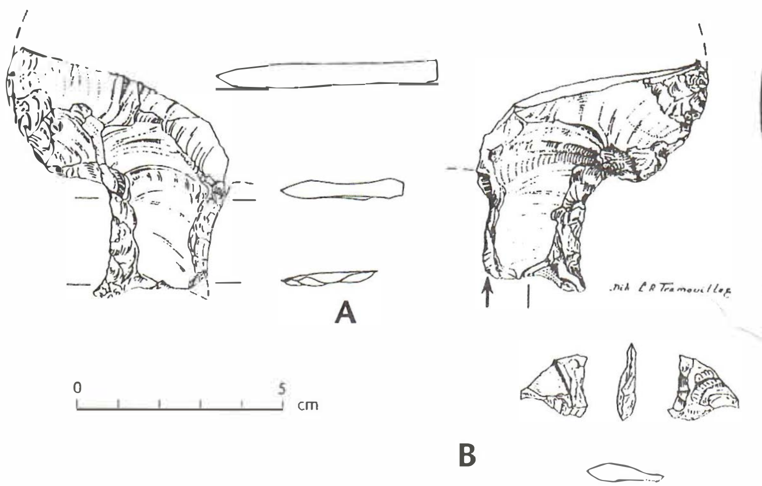

Figure 1. **A**) Fishtail projectile point of red chert; **B**) fishtail projectile point of rose chalcedony.

fragment is made of rose-colored chalcedony. The source of the latter has not been detected yet.

The faunal assemblage is very significant because it include remains of extinct megamammals and big flightless birds (cf. *Rhea americana*) that do not inhabit this region presently. The bones of one species of small extinct camelid, *Lama (Vicugna) gracilis,* could be identified through multivariate analysis (Miotti 1993b), and three vertebrae, metapodials and phalanges of horse, *Hippidion saldiasi,* were identified by morphometrical analysis.

Distributional, taphonomic and bone-modification analyses at the Piedra Museo locality suggest that the lower component of AEP1 rockshelter was a locus of confined activities related to primary butchering of large mammals and large ostrich that were hunted in a nearby paleo-lagoon (50 m southeast). The surrounding landscape suggests that these rockshelters were excellent locations for ambushing, killing, and butchering such prey. There is only one similar locus of killing and butchering in the South Cone associated with fishtail projectile points—Tagua-Tagua in central Chile (Lautaro Núñez, pers. comm. 1993). Also, it could be related to Nivel 11 and initial Toldense components of Los Toldos and El Ceibo localities, although these sites don't have fishtail points, and the radiocarbon date is earlier (Cardich et al. 1987). They seem to have similar lithic technology in all the other artifacts; likewise, extinct species of megammamals were associated in both contexts. The relationship with nearby and contemporaneous sites allows us to suggest that the procurement of raw materials was done within 6 to 10 km.

At 0.70 m above the oldest archaeological component of AEP-1, evidence for a later occupation was recovered, including lithic artifacts associated with remains of modern fauna (see Miotti 1993a). This occupation was radiocarbon dated in 7,670 ± 110 yr B.P. (LATYR). The lithic technology is similar to that of

Fell III, late Toldense at Los Toldos and La Martita Caves, and Regional level Rio Pinturas II—all assigned to early Holocene (Miotti, 1989).

At this time I think that the social landscape of the region was changing and that the relationship between groups of colonizer was maintained by alliances and trade. Items such as spear points and shells are likely candidates for trade among foragers because they can function to mark territoriality. The mobility of groups is as high as at the end of the Pleistocene.

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An Early Holocene Hand-dug Water Well in the Tehuacan Valley of Puebla, Mexico

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A hand-dug water well of apparent great antiquity was discovered in San Marcos Necoxtla (a village located about 7 km south-southeast of the city of Tehuacan) in 1993. The cross-section of the filled well was exposed in an east-facing vertical earthen wall cut above a flowing water-supply canal. Exposed deposits include a complex, 10-m-thick sequence of bedded, calcareous, palustrine (marsh) depos-

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its, with several organic-rich strata, capped with travertine from a Prehistoric canal. The corrected radiocarbon age of the lowest of these strata, 1.3 m above the base of the exposed section, is 14,960 ± 170 yr B.P. or cal. 15,927 B.C. (TX-7915). The well-preserved molar of an extinct camel, *Camelops* sp., was found 0.5 m higher in the section. This tooth was complete and showed no evidence of transport damage or adhering exotic sediment. Still higher, 3.4 m above the base of the section, is the lower contact of a bed containing numerous cobbles of chert, many of which had been worked for use as clearly recognizable, but nondiagnostic, scraping and chopping tools. A second radiocarbon sample collected from organic-rich laminae near the top of the bed containing the worked chert, 5.2 m above the base, yielded a corrected age of 8,709 ± 79 B.P. or cal. 7,829 B.C. (TX-7916). The age span indicated by the two radiocarbon samples is consistent with the known age of *Camelops*.

Bedding throughout the lower 5.4 m of the section was essentially regular, and interrupted at a few points by minor erosion surfaces. Above this stratum, the bedding sequence changes abruptly. From the top of this bed a steep, sharply defined, northward-dipping boundary cuts downward across all subjacent strata. These strata truncate laterally against the boundary, which forms the southern edge of a broadly U-shaped depression. The depression is more than 5 m deep and 10 m wide at the top, and is entirely filled with chert flakes, boulder-size blocks of tufa (porous travertine), and fragments of at least five diagnostic late-Paleoindian/early-Archaic projectile points (three Hidalgo and two Nogales types; see MacNeish, et. al 1967:60–61). There is no laminated sediment within the fill. Additional palustrine sediment with abundant aquatic snail shells and impressions of reeds overlies the fill and surrounding strata. A narrow canal was excavated into this bed immediately above the fill. A bed of travertine containing ceramic sherds dating to the Formative, Classic, and Post-Classic periods caps the entire section and occludes the canal. The section was partly exposed by the construction of a small aqueduct at this site during the Colonial Period. An existing water-supply canal for the community of San Marcos Necoxtla cuts through the entire section.

The broadly U-shaped depression filled with cultural material appears to have been a large hand-dug well. Stratigraphic, sedimentary, and micropaleontologic (diatom) data indicate that the beds through which the well was excavated consist of sediment deposited in a shallow-water marsh or pond. Yet there is no water-laid sediment within the depression, indicating that the water-table had dropped approximately 5 m and did not rise until the depression was essentially full. Probable ages of the diagnostic artifacts within the fill range from about 9,000 to 6,000 B.P. or c. 7,000 to 4,000 B.C., which are compatible with the c. 8,709 ± 79 B.P. or cal. 7,829 B.C. radiocarbon age of the last bed deposited at the site prior to the formation of the depression. Thus, the existing evidence shows that the depression came into being shortly after c. 8.709 B.P. (c. 7,829 B.C.), the age of the organic carbon in the sediment rimming the depression. These data indicate this to be one of the oldest, if not the oldest, chronometrically dated water-management features reported in the New World.

Although limited, data now available provide the basis for some preliminary interpretations. The water level appears to have declined abruptly and the flake scars on the remaining portion of the dorsal surface. Damage along the working edge of the implement is indicative of hard use, and a bulb of percussion is observed on the ventral face in immediate proximity to the edge damage. Figure 1b cannot be defined as a tool, but is certainly the result of cultural behavior. The dorsal face of this item has multiple flake scars, but it is not clear if the piece is a broken tool fragment or merely a by-product of tool maintenance. Broken facies occur on both ends thereby hindering more detailed interpretation. The raw-material sources of these implements are local chert cobbles from glacial till.

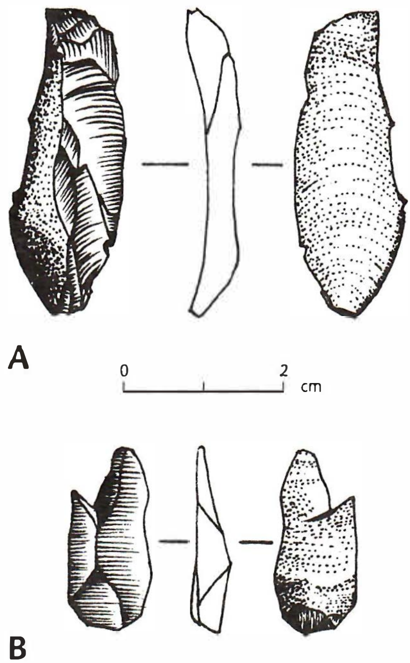

Figure 1. Lithic implements from the Schaefer mammoth site (47KN252). (**A**) biface fragment, (**B**) broken flake.

The association of chipped stone with the Schaefer mammoth, in consort with the bone-pile configuration and bone modification dispel any notions that the site reflects other than Paleoindian involvement. The demonstration of just whose culture this represents, however, remains elusive. Four years of biased and systematic survey in Kenosha and Racine Counties, Wisconsin, including exhaustive investigation of public and private collections has failed to yield any evidence of Clovis or Clovis-like material culture (Joyce and Joyce 1993; Overstreet 1993b, 1994). Chesrow Complex (Overstreet 1993a) sites, though, are numerous. More than 20 components are identified, and three excavated sites have yielded undisturbed subsurface contexts. At the Chesrow site a heat-treating oven was defined, and at the Lucas site a habitation floor with chipped stone tools and calcined bone was encountered (Overstreet 1993a, 1994).

Chesrow Complex sites occur on the lake plain of Glacial Lake Chicago and its associated Glenwood, Calumet, and Toleston (Algonquin) strands. Sites also are clustered on the flanks of postglacial lake basins which occur on the Valparaiso, Tinley, and Lake Border moraine systems (Hansel et al. 1985; Schneider 1983). It is in these latter contexts that mammoth and mastodon kill/scavenge sites occur. Mammoth and mastodon remains from the Schaefer (47KN252), Fenske (47KN240), Hebior (47KN265), Mud Lake (47KN246), and Oakes (47RA209) sites all bear butchering marks. From this we project three propositions testable by ongoing research: (1) exploitation of both mammoth and mastodon was a significant subsistence pursuit for Chesrow Complex peoples; (2) the remains may reflect scavenging and/or kill sites; and (3) predator/prey activities may have had a significant role in the extinction of mammoth and mastodon in the southwestern Lake Michigan basin region. Proposition 1, if correct, provides a means of assessing Chesrow Complex chronology. Bone collagen from the Schaefer mammoth yields an assay of 10,960 ± 100 yr B.P. (Beta-62822). This chronology would place the Chesrow Complex contemporaneous with late-Clovis manifestations (Haynes 1991, Stanford 1991). Regional site distributions (Overstreet 1994) indicate that in the southwestern Lake Michigan basin Clovis-related sites are clustered on landscapes associated with the Green Bay Lobe while Chesrow Complex sites occur on landscapes associated with the Lake Michigan lobe.

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Paleoindian Manifestations in the Spring Creek Drainage, Genesee County, New York.

Kevin P. Smith

In 1991, the Buffalo Museum of Science initiated a program of surface surveys to examine changing patterns of prehistoric land use in western New York. The program's first phase has focused on the drainage of Spring Creek, a small tributary of the Genesee River in eastern Genesee County, NY.

Spring Creek traverses a landscape characterized by Wisconsinan-age ground and recessional moraines, drumlin fields, and eskers. Relict strandlines and basins of late-Pleistocene lakes and ponds, now occupied by wetlands in various stages of succession, are the area's most significant hydrological and ecological features. Investigations at the Hiscock Site, which occupies one such basin in the southeastern portion of the study area, have documented the local co-occurrence of late-Pleistocene floral and faunal remains with early-Paleoindian cultural materials (Gramly 1988; Laub 1990, 1994; Laub et al. 1988; Miller 1988; Steadman 1988).

As 90% of the Spring Creek drainage is cultivated, an intensive pedestrian survey approach was adopted: in each surveyed area, we walked transects at 3-m intervals, instrumentally recorded the locations of all recovered artifacts and debitage, and generated isopach maps relating surface artifact density to modern and relict landforms. Coherent and isolated artifact clusters, as well as high-density artifact peaks within extensive, low-density (<3 artifacts/100 m^2), drainage-associated lithic scatters were defined as potentially separable sites, to which components were assigned on the basis of recovered diagnostics. All sites were revisited periodically to confirm their extent and age. Several sites were independently examined in 1990 during CRM investigations (Weir et al. 1992) and in 1991 and 1992 as part of the Hiscock site investigations. To date, more than 70 prehistoric components have been documented within a contiguous block covering only 2 km^2. Four loci (CF2: 1, CF3: 8, LB2: 1 and HK 2) produced evidence of Paleoindian activity.

Site CF2:1 occupies a low knoll overlooking an extensive wetland, in which wood from basal fluvial deposits overlying lacustrine sediments dates to 10,870 ± 120 yr B.P. (Beta-47576, Weir et al. 1992). CF2:1 is a small site (ca. 800 m^2) with a limited assemblage that consists of one notched and spurred trianguloid endscraper (Figure 1A), one thermally damaged graver, one backed biface (Figure 1B), one utilized channel flake with a heavily ground nipple-like striking platform, one thermally damaged core and two flake fragments. The proximal segment of a large alternately beveled biface (Figure 1C, Ellis and Deller 1988), recovered 120 m downslope at the edge of the wetland, may also relate to this component.

A small multicomponent lithic scatter (CF3:8), located 0.375 km across Spring

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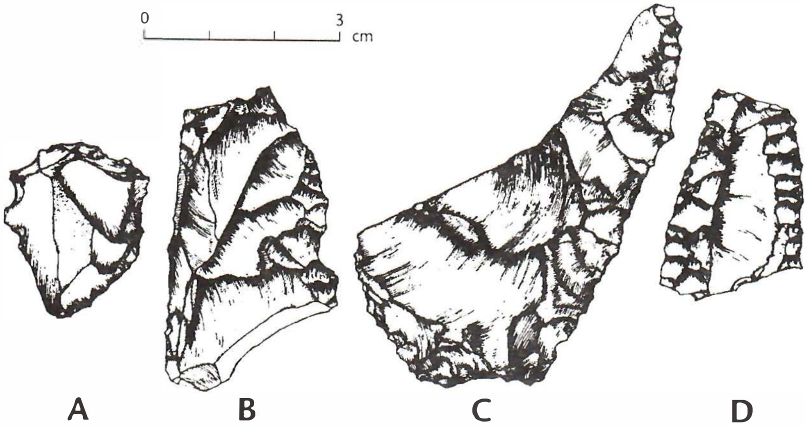

Figure 1. Selected Paleoindian artifacts from the Spring Creek drainage. (**A**) notched and spurred trianguloid endscraper [BMS C29614.003] from site CF2:1, (**B**) backed biface [BMS C29614.140] from site CF2:1, (**C**) large alternately beveled biface [BMS C29647.014], near site CF2:1, (**D**) Barnes point midsection [BMS C29882.001] from site LB2:1.

Creek from CF2:1 yielded a broad (4 cm) medial biface fragment with flute terminations on both faces. The breadth and thickness of the fragment recall the largest fluted bifaces from the Lamb site (Gramly 1988). Other diagnostics from the site, however, document mid-Holocene occupations.

A fluted-point medial fragment (Figure 1D) was recovered from LB2:1, an isolated find-spot 0.85 km from CF3:8 and 0.5 km from the Hiscock site. The point fragment is relatively narrow, with a high width/thickness ratio (3.06:1) and a single flute scar extending nearly to the tip on one face. On the opposite face, parallel-collateral thinning flakes originate from opposite margins to meet at the point's midline; fluting, if originally present, terminated proximally to the break. Marginal pressure retouch is present on both lateral edges. The apparent length of the single flute, the fragment's width/thickness ratio and the approach to facial preparation suggest attribution to the Barnes type (Deller and Ellis 1992).

HK2 is a small lithic scatter (ca. 800 m^2) on a low ridge near the Hiscock basin. One large combination end- and sidescraper (Deller and Ellis 1992), one medio-lateral fragment of a probable fluted point with a heavily ground lateral edge, and 17 biface-thinning flakes complete the assemblage. Attribution to the Paleoindian period is tentative and is based on morphological features of the scraper and the biface fragment, on the site's setting, and on its proximity to the Paleoindian component in the Hiscock basin.

High-quality Onondaga chert is accessible at outcrop sources less than 10 km from the survey area and was the only lithic material recovered from these sites. Fluted points from the Hiscock site and probably CF3:8 conform to the Gainey type, while material from two loci (CF2:1 and LB2:1) suggest affiliation with Parkhill complex assemblages (Deller and Ellis 1988, 1992). Paleoindian loci in the Spring Creek drainage are neither extensive nor unusually dense, but their distribution suggests that a potentially significant Gainey and Parkhill complex presence remains to be documented between the basins of postglacial lakes Tonawanda and Tckagowageh (Muller and Calkin 1988), in close proximity to the Hiscock site.

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The Kilmer Site: a Paleoindian Site in the Allegheny Plateau

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Kilmer is a multicomponent Paleoindian site located in Steuben County, New York. Physiographically, this area is known as the Allegheny Plateau, a dissected highland with wide, flat valley floors, sharply contrasted by steep-walled uplands and truncated ridge spurs (Van Diver 1992). Local relief exceeds 350 m (>1,100 ft). While a number of Paleoindian sites have been reported from the Erie-Ontario Plain of western New York (e.g., Calkin and Miller 1977; Gramly 1988; Laub et al. 1988; Tankersley 1994; Vanderlaan 1986), Kilmer is the first documented Paleoindian site in the Allegheny Plateau of New York state.

The Kilmer site overlooks the confluence of Purdy, Bennetts, and Colonel Bills creeks with the Canisteo River. It is situated immediately below a spring that discharges onto a gently sloping bedrock bench at the base of a 300-m-high valley wall. This landform was probably selected for short-term habitation because of its proximity to the spring head, confluence overlook, and sheltered position.

One of the most engaging aspects of the Kilmer site is that three successive Paleoindian cultural complexes are present: Clovis/Gainey; Parkhill; and Holcombe/Hi-Lo (after Deller and Ellis 1988, 1992a, 1992b). Each of these Paleoindian complexes is represented by stylistically distinct bifacial chipped-stone artifacts (Figure 1): four Clovis/Gainey points, two manufactured from Normanskill chert, one from Flint Ridge chert, and one possibly from Gun Flint Jasper (early Paleoindian); a Barnes point manufactured Onondaga chert (middle Paleoindian); a Holcombe point manufactured from Normanskill chert, and two Hi-Lo points manufactured from Onondaga chert (late Paleoindian).

Other Paleoindian artifacts recovered from the site include 10 Onondaga chert fluted-point preforms, a non-local chalcedony biface fragment, Normanskill and Onondaga chert side scrapers, 2 Onondaga chert endscrapers, an Onondaga chert graver, and 2 Flint Ridge chert bifacial thinning flakes. Even if we assume that Paleoindians obtained Onondaga chert from local secondary deposits, more than half of the Paleoindian artifact assemblage is manufactured from stone sources located more than 500 km away (Wray 1948).

Geographically, the Paleoindian components are sequentially spaced relative to the spring. For example, the Clovis/Gainey component occurs nearest the spring head and the Holcombe/Hi-Lo the furthest. In addition to chipped-stone artifacts, organic stains and hearth features are exposed in the plow zone of the site. The Kilmer site has significant potential to provide new information on Paleoindian land-use and subsistence patterns in the Allegheny Plateau region.

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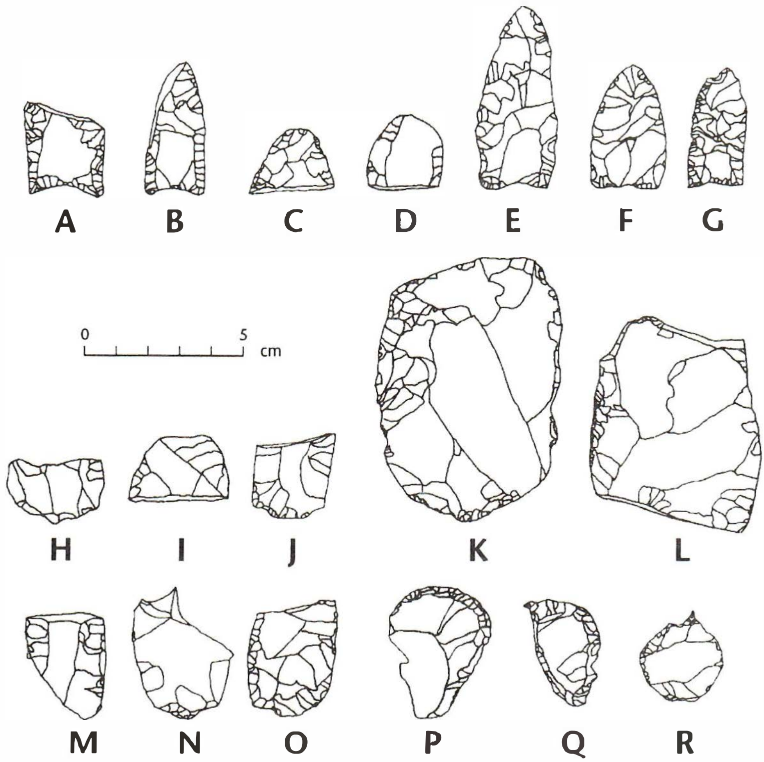

Figure 1. Early Paleoindian artifacts recovered from the Kilmer site: (**A–G**) fluted projectile points; (**K, H, I, J, M, N, O**) fluted-point preforms; (**L**) sidescraper; (**P, Q**) endscrapers; (**R**) graver.

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Physical Anthropology

Problems in Determining Continuity and Discontinuity in North American Native Populations: a Case Study

Roberta L. Hall

Anthropologists interested in determining migration history and continuity and discontinuity in cultures tend to focus on languages and biological features of descendant populations. Special problems that occur when this methodology is applied to North American populations include the fact that a minimum of 150 years of intensive acculturation into the English language has occurred everywhere in North America as well as intermarriage with people from Europe, but even if the project had begun before European populations arrived in North America the problems would have been immense.

The magnitude of the task is comparable to the current interest in reconstructing Indo-European migrations, also studied primarily by means of language and genetics (Barbujani et al. 1995; Bower 1995; Mallory 1989). The time frame assumed for the Indo-European spread is less than that of the post-Clovis North American expansion; there may be fewer distinct Indo-European languages than there are North American families of languages; and there is a long history of written language in Europe. Even so, many disagreements about Indo-European origins exist. The inescapable inference is that difficulties with reconstructing migrations and settlements in North America are likely to be even greater than for Indo-Europeans.

Rather than considering the earliest North American populations, this paper gives a case study of an Indian population that has its origins in people representing two very distinct language families. Well known through ethnohistoric, cultural, and biological data, this case provides a scenario for processes that may have occurred many times during the ten or twenty thousands of years of Native American occupation of North America. Drawing upon reconstructed cultural history and biological data, it illustrates the complex issues related to determination of continuity and discontinuity in the archaeological record.

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The Coquille Indian Tribe of southwestern Oregon consists of descendants of people whose ancestors lived in villages along what is now known as the Coquille River. In the 1850s, at the time of major Euro-American intrusion and conflict, villages of primarily Athapaskan-speaking Upper Coquille people resided near villages of primarily Penutian-speaking people. Athapaskan is considered a member of the Na-Dene language phylum, and Penutian is in the larger and more diverse Amerindian phylum. Physical anthropologists agree that speakers of Amerindian preceded Na-Dene populations in colonizing the Americas though they do not agree on precise dates (Szathmary 1993). The Athapaskan language has provided something of a marker for a hypothesized migration of people from the North into southern Oregon, northern California, and the Southwest. The migration is believed to have occurred no later than A.D. 1300 or perhaps a few centuries earlier (Moratto 1984). Because the Athapaskan and Penutian languages were so distinct, anthropologists and historians studying native cultures of southern Oregon have tended to categorize each geographical area as culturally Penutian *or* Athapaskan. They do so even though Athapaskan-speaking migrants adopted some technologies and social forms from their new neighbors. Culture-trait studies (Barnett 1937) show that a gradation existed among the groups of the southern Oregon coast; no sharp border between "Athapaskan" and "Penutian" populations existed either in technological items or in social practices. In addition, genealogies, ethnohistoric documents, and ethnographic data show that in pre-contact times marriages occurred regularly between members of these villages (Hall 1992); elders of the Coquille tribe (Wasson 1988) indicate that grandmothers, particularly, were fluent in several languages—they had to be, since they often crossed a language barrier at the time of their marriage. The dominant paradigm verges on being one of "cultural purity," an approach I have referred to as an "anthropological myth" (Hall 1984).

Biological studies support cultural studies that show population amalgamation. In the 1890s Franz Boas organized a massive anthropometric survey of North American populations, a data set that recently has been computerized (Boas 1891; Jantz et al. 1992). After sorting individuals into local populations and examining the data for evidence of geographical adaptations to particular climates, we found (Hall and Hall 1995) that populations of the far north tend to have longer, narrower noses as a climatic adaptation; this trait compares with generally shorter, wider noses found in southern areas. The Athapaskan-speaking Tututni sample of the southern Oregon coast matches Boas's northern-Athapaskan samples for this attribute, but the Coquille sample is intermediate between Penutian-speaking samples from southern Oregon and that of the Tututni. The Boas studies of living peoples are particularly important because individuals were able to self-identify by tribe and language family; in archaeological recovery—either of skeletal materials or of artifacts—categorization of a site either as Penutian or as Athapaskan is problematic if the site is less than 1,000 years old.

Two other types of biological analysis—skeletal studies and genetic analysis from archaeological remains or living descendants—may eventually provide additional insights. Tasa's study (1995) of a skeletal marker of northern

Athapaskans, the three-rooted mandibular molar, however, has so far *not* shown linkage between southern Oregon and northern populations. This could mean that the skeletal population studied was not genealogically descendant from northern Athapaskans, even though the sample was from a geographic area considered to be Athapaskan; it could indicate a population representing a biologically integrated village; or it could reflect the necessarily nonrandom nature of any archaeologically salvaged skeletal population. My point here is to illustrate that even when anthropologists are dealing with issues in the *recent past*, and even when the cultural identities of populations have a *solid* basis in observation and research, there may be anomalous outcomes. This points to problems inherent in a paradigm that specifies that sites within a particular area must be categorized as one culture *or* another.

What appears to have happened in southern Oregon is that over a period of approximately 500 years—from A.D. 1300 to 1800—the lines between one linguistically determined culture and another were blurred in terms of technologies, cultural patterns, and biological features. While it is possible that in some other areas in the country changes occurred more slowly than on Oregon's southwest coast, it is reasonable to assume that the same processes have occurred elsewhere in North America over the past 10,000 years. This case study suggests that the likelihood of accurately determining continuity or discontinuity—particularly in the absence of linguistic records, but even when they are present—must be challenged, even if technological replacements occur. Secondly, the likelihood that any cultural or linguistic discontinuities did not involve some biological integration of populations is abysmally small.

In summary, this paper challenges premises of the paradigm that accepts the concepts of cultural and biological continuity and discontinuity as mutually exclusive categories that can be determined empirically.

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Northeast China Fossil Human Localities and Reconstruction of Regional Environmental Conditions During the Middle and Late Pleistocene

Zuo Quan and Wang Hai Yian

Within the past few decades as many as 20 archaeological sites have been discovered in northeast China (north of 38 N and east of 118 E). Thirteen of these sites contain human remains of middle- and upper-Pleistocene age (Table 1), and these serve as documentation for the environmental conditions which humans had adapted to in this part of Asia.

Two localities are associated with the middle Pleistocene or earliest part of the last Pleistocene. Miaochoushan Man, dated to approximately 300,000 yr B.P., is associated with *Buballus* sp. (water buffalo), *Cervus unicolor Kerr* (deer/elk), *Macaca robustus Yong* (macaque), and *Pipistrelus* sp. (pipistrelle bat) among others. These taxa, their descendants still living in tropical and subtropical zones, are associated with warm weather and wet conditions. Floral remains recovered from this locality include remains of *Larix* (Larch) *Quercus* (oak) and other deciduous trees, and broad-leaf plants.

Jinniushan Man, whose cranial remains suggest an early *Homo sapiens* affiliation, is associated with the early late Pleistocene. Environmental indicators suggest a continuation of warm conditions during this time.

The climate in northeast China grew colder and drier in the late Pleistocene with the developing glacial conditions in the Arctic. During this generally cold period, three undulations in climate occurred. It was dry and cold during the early and late periods of the late Pleistocene, but warm and humid during the middle part of the late Pleistocene. These varying conditions led to different animal and plant fossil assemblages in different places and different periods in Northeast China.

Exemplary of the cold conditions of the early part of the late Pleistocene are

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Table 1. Middle- and late-Pleistocene fossil human localities of northeast China.

Table 1A Middle-Pleistocene geological age

Cultural age	Site	Human fossils	Culture	Age	Longitude & latitude
Early Paleolithic	Jinniushan	Skull, long bones	Jinniushan	270,000?	40° 34′ N/120° 30′ E
		Assorted bones		280,000	
	Miaohoushan	Mandibular molar teeth	Miaohoushan A	247,000	41° 14′ 9″ N/124° 7′ 50″ E

Table 1B Late-Pleistocene geological age

Cultural age	Site	Human fossils	Culture	Age	Longitude & latitude
Late Paleolithic	Dabushu	Capitate, frontal, mandible	Dabushu	10,000	44° 44′ N/123° 40′ E
	Qingshantou	Femur		10,940	47° 17′ 13″ N/124° 18′ 20″ E
	Qianyang	Capitate, mandible, incisor teeth	Qianyang	18,600	39° 35′ 5″ N/124° E
	Xuetian	Parietal, tibia	Xuetian	20,000	44° 47′ 30″ N/127° 33′ E
	Harbin	Parietal	Yanjia	20,000	45° 45′ 30″ N/126° 18′ 30″ E
	Antu	Premolar tooth	Antu	26,500	43° 5′ 17″ N/128° 55′ 35″ E
	Yushu	Parietal, tibia	Zhoujia	26,700	44° 43′ 55″ N/126° 21′ E
	Eastern Cave	2 pariet pieces, radius	Miaohoushan B	28,040 ±680	41° 14′ 18″ N/124° 7′ 50″ E
	Jianping	Humerus shaft		Relative	41° 25′ N/119° 41′ E
	Xiaogushan	Femur, teeth	Xiaogushan	40,000	40° 34′ 53″ N/122° 58′ 30″ E
Middle Paleolithic	Pigeon Cave	Parietal, patella, molar teeth	Pigeon Lake	100,000	41° 34′ N/120° 30′ E

the faunal remains found in and around Pigeon-Cave, dated at greater than 100,000 yr B.P. The animals are grassland-adapted grazers, and the temperature is inferred to have been cold and dry.

Between 50,000 and 30,000 yr B.P., cold conditions were over. At the Xiaogushan locality, a *Mammuthus-Coelodonta* (mammoth/woolly rhinoceros) fauna existed, and here, conditions are inferred to have been almost as they are today, perhaps a little more humid. Grassland and sparse forests may have been the natural environments then.

The second cold period fell onto the large area of northeast China from 30,000 to 10,000 yr B.P., the coldest time of the Quaternary and northeast China. A succession of sites have been discovered which are associated with this period and which contain human remains: Eastern-Cave Man, Qianyang Man, Antu Man, Yushu Man, Harbin Man and Qingshantou Man sites. Typically associated with these sites is the *Mammuthus-Coelodonta* fauna. Spore and pollen remains indicate that the environments were basically made up of pelophyte grasslands and dark coniferous forests, with the average annual temperature possibly being ten degrees cooler than today. Eastern-cave Man and Qianyang Man are in the southern part of Northeast China, and therefore their climate may not have been as cold as areas to the north.

Throughout the later Pleistocene, the global climate changed frequently and this led to the frequent advancing and retreating of the sea levels. The climate in northeast China, reflecting these global changes, developed a pattern of cold dry climate, to a mild cool and humid climate, and a return to a cold dry climate. Ice-edge vegetation communities were scattered over large areas and formed the plant community supporting the *Mammuthus-Coelodonta* fauna. These plant and animal communities in turn provided the favorable conditions for the late-Pleistocene humans in northeast China.

Summary

Based upon a review of the middle- and late-Pleistocene sites of northeast China containing fossil human remains, the following points can be made:

1. Comparatively, the human fossils in northeast China are widely dispersed and abundant (Table 1). These sites document that humans were living in the broad area of northeast China since the early Pleistocene. Due to the impact of the global glacial events in the late Pleistocene, there were two times when "continental bridges" developed inshore, which could have provided convenient routes of migration and distribution for the people of northeast China. Northeast China may very possibly be the passageway through which ancient peoples and their cultures spread to northeast Asia, based upon the analysis of the relationships between the middle- and late-Paleolithic cultures in northeast China and surrounding areas.

2. Four climatic stages can be documented for the late middle and late Pleistocene: warm and humid, cold and dry, cool and humid, and cold and dry. Plant communities changed with the changing climatic conditions: forest, forest-grassland, dry-grassland and sparse grassland, and forest grassland. Human inhabitants in northeast China survived throughout the above climatic and biotic environmental changes, creating the middle- and late-Paleolithic cultures of the region.

3. Judging from the cultural remains and the marks on the surface of animal fossils and the bone products that were recovered in association with human fossils, some types of animals were the intentional prey of the ancient people in northeast China throughout the early, middle and late periods of the Pleistocene. The existence of these animals enriched the lives and cultures of the ancient people.

This article was checked by Peng Jiang, Professor in Jilin Province, Institute of Archaeology Changchun, China. Thanks to Professor Peng Jiang.

Lithic Studies

Raw Material Selection Patterns among Paleoindian Tools from the Black Rock Desert, Nevada

Daniel S. Amick

The Black Rock Desert of northwestern Nevada has long been recognized for its prolific record of Paleoindian occupations (Clewlow 1968). Unfortunately, this record was largely erased and altered by private artifact collectors during the 1950s–70s. Recent efforts have been made to reconstruct the archaeological record of Paleoindian occupations in the Black Rock Desert from the documentation of private collections in conjunction with some field testing. This study is only beginning, but intriguing patterns are already emerging. Patterns of toolstone use among 275 artifacts associated with late-Pleistocene/early-Holocene occupations on the playa floor in the east arm of the Black Rock are discussed in this paper. The majority of these artifacts are concentrated in a 20-km^2 area associated with ancient delta and stream deposits of the ancestral Quinn River as it flowed into the Black Rock arm of Pluvial Lake Lahontan.

The sample assemblage consists of 81 projectile points of the Western Stemmed Tradition (Bryan 1980), 87 Great Basin Concave Base points (Pendleton 1979), and 109 crescents (Tadlock 1968). Two primary categories of toolstone are represented: microcrystalline quartz (chert and chalcedony) and obsidian. Abundant sources of chert and chalcedony, which correspond to the Black Rock artifact materials, are found in the alluvial fans and eroded hill slopes on the margins of the playa. These sources lie 5–30 km from the artifact concentration. In contrast, the nearest obsidian sources (pebbles and cobbles) lie about 50–70 km away near Mt. Majuba to the southeast and the High Rock country to the northwest. Hence, in the Black Rock Desert, chert and chalcedony are considered locally available while obsidian is non-local.

These data provide a useful test of the hypothesis proposed by Beck and Jones (1990:286–287) regarding Paleoindian toolstone selection in the Great Basin. Their hypothesis suggests a strong functional preference for microcrystalline quartz (regardless of source distance) among crescents, while lithic preference

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in projectile point manufacture is nonselective. A meaningful implication of this hypothesis is that projectile points should be made from local materials with little regard for the mechanical properties of the stone.

Crescents from the Black Rock Desert conform to the predictions of Beck and Jones (1990) with 89% (n = 94) made of chert/chalcedony and 11% (n = 12) of obsidian. Great Basin Concave Base points exhibit 34% (n = 30) made of chert/chalcedony and 66% (n = 57) of obsidian. Western Stemmed points are 1% (n = 1) chert/chalcedony and 99% (n = 81) obsidian. Chi-square tests demonstrate statistically significant differences at the 99% confidence level for all subsets and combinations of these data. A strong preference for (local) cherts and chalcedonies characterizes the crescents, while the projectile points (especially Western Stemmed) exhibit equally strong preference for (nonlocal) obsidian.

Raw-material selection patterns among 86 Western Stemmed points from southern Nevada (Amick 1993) provide a useful alternative viewpoint. Lithic resources are abundant and diverse in this region and include obsidian, microcrystalline quartz, opal, and welded tuff. The majority of points (n = 76) are made from local obsidians, but nonlocal (more than 200 km away) sources are also represented. Thus, these large assemblages of Western Stemmed points from the Black Rock Desert and southern Nevada assemblages exhibit similar reliance on obsidian despite different lithic-resource structures.

Abundant sources of microcrystalline quartz are locally available in the Black Rock Desert, yet Western Stemmed point technology appears highly selective for obsidian despite much greater source distances. This evidence suggests Western Stemmed point technology is clearly responsive to the mechanical properties of different stones with strong selection for obsidian, which is characterized by extremely sharp cutting edges and superior workability. The evidence that basalt characterizes Western Stemmed point technology in some regions (e.g., Beck and Jones 1990; Tuohy 1970) is notable because the mechanical properties of basalt provide an effective complement to obsidian. Basalt is more difficult to flake but usually produces sharp edges, although not as sharp as obsidian. In contrast to these two brittle materials, stone tools made of microcrystalline quartz are characterized primarily by exceptionally durable edges.

These results appear to contradict the hypothesis that toolstone selection among Great Basin Paleoindian projectile points is nonselective. This investigation suggests Western Stemmed point technology is generally selective for materials that produce sharp rather than durable edges. This pattern is contrary to the toolstone-selection criteria used for crescent manufacture.

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Obsidian Hydration Dating of Early-Holocene Assemblages in the Mojave Desert

Mark E. Basgall

It has proven difficult to obtain reliable radiometric dates on early- and middle-Holocene archaeological components across much of the Desert West. Many are surface or near-surface phenomena, and even buried deposits in open-air contexts typically harbor few organics of uncertain origin. The problem is well illustrated at Fort Irwin, north-central Mojave Desert, where more than a decade of concerted study involving major excavations at numerous sites has garnered only a handful of early radiocarbon dates. Any systematic dating program for these assemblages will, therefore, require use of alternative methods, among the more promising being the obsidian hydration technique. This paper reports on hundreds of hydration measurements from the northern Mojave Desert in an effort to corroborate relative occupational spans for several sites, and segregate assemblages containing shouldered, indented-base (cf. Pinto), Great Basin Stemmed (Stemmed [cf. Lake Mohave, Silver Lake]), and Great Basin Concave-base (cf. fluted) point forms within the region. The first form has generally been treated as a mid-Holocene marker, the last two groups as terminal-Pleistocene/early-Holocene artifacts (e.g., Hester 1973; Warren 1967; Willig and Aikens 1988). Recently, however, some researchers have argued that Pinto points date significantly earlier, Jenkins (1987) suggesting an appearance ca. 8,400 yr B.P. and Schroth (1994) an age of at least 10,000 years. This "earlier than you think" position has one of two implications: either Stemmed forms date substantially older than usually held (cf. Bryan 1988), extending well into the Pleistocene, or Stemmed and Pinto morphologies overlap for much of their history.

Hydration profiles for Coso obsidian artifacts from eight early- to middle-Holocene components in the northern Mojave Desert are summarized in Table 1; seven locations are at Fort Irwin and one is the Stahl site at Little Lake. Mean measurements of these samples range from 11.6 to 15.7 microns; by contrast, means for Gypsum period (ca. 4,000–1,500 yr B.P.) components containing Elko, Gypsum, and Humboldt series points are 6.0–8.1 microns (Basgall 1993a;

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Gilreath et al. 1988; Hall 1993). Feature-associated radiocarbon determinations from the subject sites also support their early- to mid-Holocene attributions: sites SBR-2348 and SBR-5251 produced assays of 5,540 ± 90 and 6,640 ± 65 yr B.P., respectively; five dates at SBR-4966 range from 4,360 ± 280 to 8,470 ± 370 yr B.P. (four <7,500 yr B.P.); seven at SBR-5250 from 4,040 ± 110 to 8,410 ± 210 yr B.P. (five >7,500 yr B.P.); and two dates from a hearth at the base of SBR-4562 were 9,410 ± 115 and 9,470 ± 115 yr B.P. (Basgall 1993b). Dates from what are complex depositional circumstances at SBR-4966 and SBR-5250 denote both middle- and early-Holocene occupations, but the former components appear predominantly younger than those at SBR-5250. Although consistent with early occupation, a hydration subsample correlated with the deeply buried SBR-4562 carbon samples averages 14.6 microns (Basgall and Hall 1993); notwithstanding some stratigraphic mixing, hydration profiles and point distributions from this site demarcate two clear components (ibid.). Finally, the single dates from SBR-2348 and SBR-5251 imply mid-Holocene occupations.

Spatially disjunct distributions of points, obsidian data, and ^{14}C assays preclude any direct association of the three, but general hydration profiles offer an independent check on the occupational histories indicated by radiocarbon (Table 1). Site modes fall into two distinct groups, one with most (73–90%) rims under 13.5 microns (Stahl, SBR-2348, SBR-5251, SBR-4562, SBR-4966), the other with values primarily (72–80%) above that threshold (SBR-4963, Nelson, SBR-5250); notably, 13.5 microns corresponds to a date of ca. 7,550 yr B.P. using a general, radiocarbon-calibrated hydration rate developed for Coso obsidian (Basgall n.d.). A Mann-Whitney rank sum analysis supports the integrity of these

Table 1A. Projectile point and hydration profiles for select sites.

Site	PIN	SLK	LMO	GEN	FLT	Number	Mean	St. Dev.	Median	Range
Stahl	40	2	1	1	-	61	11.8	2.9	11.3	5.0–18.9
SBR-2348	36	9	1	-	1	48	11.7	1.8	11.6	7.6–16.3
SBR-5251	31	-	1	-	-	15	11.6	2.2	11.7	8.3–16.0
SBR-4562	43	14	4	-	-	141	11.9	2.4	11.7	5.5–18.9
SBR-4966	16	15	11	3	3	66	12.2	3.2	12.1	5.6–20.3
SBR-4963	-	3	4	5	-	20	14.7	2.7	14.9	6.9–21.0
Nelson	4	23	21	19	7	50	14.7	2.1	14.5	10.7–20.0
SBR-5250	111	34	31	9	2	103	15.7	3.3	15.2	8.5–24.5

SBR-2348	SBR-5251	SBR-4562	SBR-4966	SBR-4963	Nelson	SBR-5250	
0.4386	0.9376	0.3539	0.3099	<0.0001	<0.0001	<0.0001	Stahl
	0.8308	0.9466	0.4903	<0.0001	<0.0001	<0.0001	SBR-2348
		0.6896	0.5458	<0.0001	<0.0001	<0.0001	SBR-5251
			0.4787	<0.0001	<0.0001	<0.0001	SBR-4562
				<0.0001	<0.0001	<0.0001	SBR-4966
					0.4083	0.5508	SBR-4963
						0.0579	Nelson

PIN = Pinto, SLK = Silver Lake, LMO = Lake Mohave, GEN = general Great Basin Stemmed, FLT = fluted

Note: Stahl data on points, values corrected for EHT differences between Rose Valley and Fort Irwin; all other hydration on Coso debitage; rejected measurements determined by Chauvenet's criterion (p[x] < 1/2n) were as follows: 5 values SBR-2348; 2 values SBR-5251; 8 values SBR-4562; 1 value SBR-4963; 3 values each Nelson and SBR-5250; Nelson data from four sites (SBR-2355, SBR-2356, SBR-5047, SBR-5263); data assembled from Basgall (1993a), Basgall and Hall (1993, 1994), Hall (1993), Meighan (1981), and Warren (1991).

site clusters, sample medians indistinguishable within groups but significantly different between groups (Table 1). These distributions suggest the lone ^{14}C dates from SBR-2348 and SBR-5251 reliably reflect a mid-Holocene occupation peak, that there is a general match between obsidian deposition and radiometric assays at SBR-4966 (mainly mid-Holocene) and SBR-5250 (mainly early Holocene), and only at SBR-4562 is there major discrepancy; the context of these last dates has been noted, and site-wide hydration data clearly indicate most site use occurred after ca. 7,500 yr B.P. Inclusive hydration profiles also portray more extended periods of reduced site use (earlier or later than peaks).

These data have important implications for the segregation of Pinto and Stemmed point forms in the northern Mojave Desert. Obsidian points are rare in Fort Irwin collections (13% of 252 Pinto, 11% of 259 Stemmed), evidence of reworking is common, and many are too weathered to permit hydration analysis. A small Coso sample does suggest that Stemmed forms (mean = 13.6, n = 10) tend to be older than Pinto forms (mean = 12.3, n = 8; note also the temperature [EHT] corrected mean of 11.8 microns on Pinto points at Stahl), but separation is less than anticipated. More compelling are projectile-point distributions at the subject sites (Table 1). Three assemblages (Stahl, SBR-2348, SBR-5251), two with mid-Holocene carbon dates, contained predominantly Pinto forms (88% combined), while two (SBR-4963, Nelson) produced almost none (4%). Two other sites in the later hydration cluster (SBR-4562, SBR-4966), both with substantiated early-Holocene components, have considerably reduced proportions of Pinto points (56%); the prevalence of Stemmed forms is most evident at SBR-4966, which has more hydration values >13.5 microns than other samples in this group (27% vs. 20% or less). The most problematic case is that of SBR-5250, where despite an early-Holocene occupation focus evidenced by radiocarbon and hydration measures, greater than half (60%) of the points are Pinto forms. This apparent discrepancy cannot be fully resolved with available data; however, it is notable that 80% of the points are surface finds, while hydration data and carbon dates derive mainly from buried contexts. Further, eolian erosion has severely compromised the SBR-5250 deposit, which abuts an isolated basaltic knob in the center of a vast flat valley, and much of the matrix has clearly been reworked (Hall 1993). It is not unthinkable that obsidian debitage from mid-Holocene occupations is more extremely weathered (hence, unmeasurable hydration) than deeper, generally earlier volcanic glass.

Even with SBR-5250, projectile-point distributions clearly indicate that, on average, Pinto forms associate with mid-Holocene age contexts and the Stemmed series is an early-Holocene marker. Were the former morphology consistently older, as suggested by Jenkins (1987) and Schroth (1994), it should be more prevalent across early-Holocene stemmed-producing contexts (e.g., Nelson [with four sites] and SBR-4963). There is almost certainly some temporal overlap between the two, but it is probably comparatively limited (on the order of 1,000 years) and co-associations can generally be attributed to depositional mixing and long-term use of specific locations. These data also imply that any chronological overlap relates primarily to the Silver Lake type, weakly shouldered, tapering-stem Lake Mohave forms far more common in earlier contexts: Silver Lake types account for 79% of Stemmed points in the Stahl, SBR-2348, and SBR-5251 samples, 66% at SBR-4562 and SBR-4966, 52% at SBR-5250, and 49% in the Nelson and SBR-4963 assemblages. Inasmuch as Silver Lake points differ from Pinto forms mainly in lacking a basal indentation, this pattern is perhaps less than surprising.

The Fort Irwin research is the result of efforts by many individuals, three of whom deserve special recognition: Deborah Jones analyzed flaked stone from the SBR-5250, SBR-5251, and Nelson localities; Mark Giambastiani performed the same on SBR-2348 and SBR-4562 materials; and M. C. Hall has been an invaluable partner in the larger Fort Irwin project.

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The Retooling Index, Seasonality, and the Folsom-Age Cooper Bison Kill

Leland C. Bement

The 1994 excavation at the Cooper site (34HP45) in northwestern Oklahoma unearthed the remains of three late-summer/early-fall Folsom-age bison kills in a gully that fed into the North Canadian River floodplain (Bement 1994). The stratified deposits yielded lithic assemblages conducive to analysis by application of the retooling index proposed by Hofman (1992). The retooling index is based on the bivariate plotting of the mean length of complete points against the percentage of reworked tips in a site's assemblage. As an assemblage undergoes use, points are either replaced when broken or reworked if replacement stores are depleted. Thus, the lithic stores will be spent and the overall size of points will be reduced as a result of resharpening/rejuvenation (ibid.).

Sites such as Elida in eastern New Mexico (Hester 1962) have a spent assemblage where nearly 70% of the points are reworked and mean length is under 30 mm. At the other extreme is the Folsom site in New Mexico (Figgins 1927), where 20% of the points are reworked and mean size is over 40 mm (Hofman 1992).

The Cooper site's flaked-tool assemblage consists of 32 whole or fragmented Folsom points, 7 large flake knives, and 104 resharpening flakes. Six points were recovered from slump material that had eroded from the site deposits and are not considered in this analysis. This collection results from three separate kill episodes and contains artifacts made from three widely spaced lithic sources. These are Edwards Plateau chert from central Texas, Alibates agatized dolomite from the Texas panhandle, and Niobrara jasper from northwestern Kansas. Distances of these sources from the Cooper site are 350 km, 160 km, and 330 km, respectively. The possibility that some of the Alibates tools are actually made from Day Creek could provide a closer source of this material.

The lithic assemblage from the first kill at the site contains seven projectile points: three (43%) Alibates and four (57%) Edwards. Mean length is 33.9 mm, and reworked tips constitute 25% of the assemblage. All reworked specimens are Alibates. Two of the points (one Alibates, one Edwards) are not fluted, whereas the other three are complete enough to tell they are fluted on both surfaces (two Edwards, one Alibates).

The second kill also yielded seven projectiles. All points from this kill are made from Edwards chert. Mean length is 32.1 mm, and 71% are reworked. One point is fluted on only one surface, but the rest are fluted on both. On one specimen, the flutes originate from the tip. This is an example of a broken point that was turned around when rejuvenated.

The third bone bed at the site yielded 12 points and point fragments. Of this total, one (8%) is made of Niobrara, nine (75%) are Alibates, and two (17%) are Edwards. The mean length is 33.0 mm; the percent of reworked tips is 44%. Only

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one of the two Edwards points is reworked, whereas two of six Alibates and the one Niobrara point are reworked. Three Alibates points are too fragmented to tell if they are reworked or not. One of the Alibates projectile points is fluted on only one surface. The others are fluted on both surfaces.

According to the retooling index, the assemblage from the lowest kill reflects a relatively abundant lithic supply, that of the middle kill is highly depleted, and that of the upper kill is midway between the other two.

The nearby Lipscomb site has an assemblage that contains both Edwards and Alibates projectiles, and the seasonality of the kill is also late summer/early fall (Hofman et al. 1991; Todd 1991). Mean point length is over 50 mm, and nearly 30% of the projectiles are reworked (Hofman 1992). Lipscomb provides yet another disparate retooling index for a site in the same region as Cooper and at a kill during the same season.

All four kills occurred during late summer/early fall. From the standpoint of the lithic technology the hunters were at significantly different stages in the depletion and/or condition of their lithic stores. Yet, all four groups ended up in the same region at the same time of the year. The seasonal redundancy of all four kills suggests that these hunters planned on being in this region during a specific season regardless of where else they had been or, more importantly, the state of their lithic tool kit.

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Folsom Lithic Technology, Tool Function, and Tool-Stone Availability

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This paper explores the relationships among raw-material availability, tool function, and Folsom production technology at the Bobtail Wolf site (32DU955A). Folsom lithic assemblages are characterized by sophisticated production technologies and the use of high-quality, often exotic tool stones. The Bobtail Wolf stone-tool collection provides an opportunity to investigate the lithic technology of highly mobile Folsom groups in an area of abundant tool-stone.

The site is located in the Spring Creek valley in the Knife River flint (KRF) quarry area, western North Dakota. Though later components are also present, this discussion is limited to the Folsom deposits. We conducted extensive block excavations from 1992 through 1994, removing 307 cubic meters with fine mesh water-screen recovery. I defined three site areas based on analysis of tools, flaking debris, features, and geology. The core rise area is in the center of the site and is 40 cm higher than the surrounding landscape. The rise contains the remains of maintenance activities and stone-tool production. The western terrace area is marked by the Leonard Paleosol, a late-Pleistocene to early-Holocene buried soil (Clayton et al. 1976). Folsom workers carried out maintenance tasks in this area, and they also left 12 concentrations of KRF flaking debris that probably mark the places where knappers flaked one to several bifacial preforms. The southern part of the site is mainly a tool-stone procurement and lithic-workshop area (Root 1993; Root and Emerson 1994). The three areas are here called the rise, the terrace, and the southern area. On the site, KRF occurs in surface, shallowly buried lag, and stream channel deposits.

Stone-tool technology is related to group mobility and raw-material availability, as well as tool function (Andrefsky 1994; Bamforth 1990, 1991; Parry and Kelly 1987; Shott 1986). By comparing the three areas listed above, mobility and stone availability are held constant, and differences in production technology that may be related to tool function can be examined. Folsom groups were extremely mobile, and movements may have exceeded those known for ethnographically described people. Folsom groups also organized their lithic technology around the use of high-quality tool-stone (Amick 1994; Hofman 1992). Enough KRF occurs on and near Bobtail Wolf to supply small groups, and superior flint is abundant just a few kilometers to the east.

I classified the tool and core collection according to eight technological classes. The sample analyzed here contains 654 tools and cores from unmixed Folsom contexts from 1992 and 1993 excavations. Although these classes are defined only by production technology, there is a relationship with tool function because many artifacts are preforms or cores. The technological classes are:

1. bifacial and other prepared cores (n = 26),
2. bifacial tools (n = 223), including finished and unfinished implements,

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3. patterned flake tools (n = 7), including tools with substantial production modification such as spurred endscrapers,
4. radial break tools (n = 66),
5. unpatterned flake and other marginally retouched tools (n = 172), including implements with little modification such as utilized or marginally retouched flakes,
6. unprepared cores (n = 29),
7. tested raw materials (n = 117), and
8. other tools made by unpatterned technologies (n = 14).

Bifacial and prepared cores represent complex technologies designed to produce large flake blanks suitable for manufacture into many forms. Bifacial tools represent manufacture of several tool types, including Folsom points, extremely thin, flat cutting tools, and thicker biconvex tools. Most bifaces were not cores. Bifacial flaking served to shape and thin the tools, not to remove flakes of standardized shapes or large size. Only 16 bifacial thinning flakes were made into tools. Manufacture of bifaces, patterned flake tools, and prepared cores requires relatively large inputs of labor. These are usually long-use-life tools and are typical components of a curated technology. Production of unpatterned flake tools from unprepared cores and radial break tools requires little time. These have short use-lives and are parts of an expedient technology (Bamforth 1986).

To simplify comparisons between areas, I combined the unprepared cores and all unpatterned tools as expedient implements. I eliminated tested materials because they represent the beginning stages of all technologies. I calculated the proportions of prepared cores, bifacial tools, patterned flake tools, and expedient tools from each area. Without the 117 tested raw materials, this includes 122 tools and cores from the rise, 231 from the terrace, and 184 from the southern area. Patterned flake tools make up about 1% and prepared cores make up about 5% of each area. Expedient technologies make up 56% of the rise, 58% of the terrace and 46% of the southern area. Bifaces make up 37% of the rise, 36% of the terrace, and 48% of the southern area.

There are both expedient and curated components to the Folsom technology at Bobtail Wolf site. Bifaces are the largest technological class in the southern area, whereas most tools from the rise and terrace are expedient implements. The technological composition of the tool collection from each area is in part conditioned by the activities that were conducted. Areas of maintenance activities are dominated by expedient tools. The southern area, which is dominated by tool production, contains a large proportion of bifaces. The heavy use of expedient technologies in all areas was due to the abundance of tool-stone and the prevalence of maintenance activities. Most bifaces are preforms made for transport and use elsewhere, probably outside the KRF source area, where tool-stone is less abundant. Thus, the use of patterned, curated technology was probably conditioned by both anticipated tool needs and potential movements away from sources of stone.

This suggests that given abundant raw materials, the tasks carried out are a strong determinant of production technology. Most maintenance tasks were conducted with expediently made flake tools, though these tasks could have been accomplished with bifaces or patterned unifaces. The need to produce tools for future use, perhaps far from tool-stone sources, led to the production of patterned tools and cores. Folsom people relied on expedient technologies at Bobtail Wolf because of the abundant stone and the need to carry out maintenance tasks such as tool repair. At Bobtail Wolf, raw-material availability and task orientation played large roles in determining the technologies used by Folsom knappers to produce required tools.

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Folsom Point and Biface Manufacture in the Knife River Flint Quarry Area

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One characteristic of Folsom technology is the staged reduction of stone tools. For example, projectile points were often fluted and used far from the location

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of stone procurement and preform manufacture. Folsom craftspeople commonly flaked unfluted preforms at quarries and carried these with them as they moved across the landscape. Knappers fluted these preforms at camps, often far from the quarries where they originally fashioned the preforms (Hofman 1991). The recent discovery of two Folsom sites in the Knife River flint (KRF) quarry area, western North Dakota, provides additional data on the pattern of stone procurement and tool manufacture.

The Bobtail Wolf (32DU955A) and Big Black (32DU955C) sites are multicomponent camps and lithic workshops located 350 m apart in the Spring Creek Valley in an extensive area of KRF quarries and workshops. Both have evidence of extensive multiple Folsom occupations preserved within the Leonard Paleosol and other geologic contexts (Root and Emerson 1994; William 1994). The buried Leonard soil marks a late-Pleistocene to early-Holocene alluvial terrace surface.

In this paper we summarize data on bifacial reduction activities and provide information on the kinds of bifacial tools that knappers made for transport from the workshops. Core reduction played a relatively minor role at the sites. Excavations occurred during 1990 and 1992–1994; only 1990–1993 samples are discussed here. The tool and core sample from excavated unmixed Folsom contexts includes 654 from the Bobtail Wolf site and 227 from Big Black site. We also include 13 Folsom points and seven channel flakes from Bobtail Wolf, and 10 points and 12 channel flakes from Big Black from surface or mixed proveniences.

Folsom knappers gathered tabular flint cobbles from on-site sources at Bobtail Wolf. They probably also collected flint from other nearby sources such as stream beds. Both sites contain bifaces in all stages of manufacture. The early stages dominate at Bobtail Wolf, whereas later stages occur more often at Big Black. Tested cobbles make up 17.9% (n = 117) of the Bobtail Wolf sample, and 13.2% (n = 30) of the Big Black sample. Most tested pieces are tabular cobbles. Most bifaces were made directly from such cobbles, and these probably represent the initial stage of biface manufacture. We classified all bifacial blanks and preforms according to the stages defined by Callahan (1979). Excluding Folsom projectile point preforms, 157 of 181 unfinished bifaces (86.7%) from Bobtail Wolf are early-stage rejects (edging or primary thinning). Only 24 (13.3%) are late-stage preforms (secondary thinning or shaping). At Big Black, 41 of 72 unfinished bifaces are early-stage tools (56.9%) and 31 (43.1%) are late-stage preforms. Most unfinished tools were rejected because of breakage during manufacture.

All stages of fluted-point production occurred at both sites, though fluting of KRF preforms probably occurred most often at Big Black. There are more channel flakes from Big Black (n = 32) than from Bobtail Wolf (n = 26). All channel flakes from Big Black are KRF, whereas four channel flakes from Bobtail Wolf are nonlocal stone (one porcellanite, one Rainy Buttes silicified wood, and two moss agate). We recovered 16 Folsom points from Bobtail Wolf. Seven (44%) are KRF, six preforms and one finished point. Nine are non-KRF materials, two preforms and seven finished points. These include tools of Rainy Buttes silicified wood, porcellanite, chalcedony, moss agate, silicified wood, and nonlocal chert. We recovered 25 Folsom points from Big Black. Nineteen (76%) are KRF, 15 preforms and four finished points. The six non-KRF artifacts are all finished points; one is jasper and five are chalcedony. Rainy Buttes silicified wood occurs 100 km south of the sites. Specific sources of the remaining non-KRF artifacts are not known, but these materials occur south and west of the sites at distances of up to 400 km. Knappers probably carried non-KRF point preforms to the sites in forms ready for fluting (stages 4 or 5 of Frison and Bradley 1980:45–52). Preliminary analysis of non-KRF debitage and the lack of earlier-stage Folsom preforms provide no conclusive evidence for early-stage reduction of nonlocal preforms on the sites, though knappers attempted to flute them there (stages 5 through 10). All recovered non-KRF point preforms were broken during fluting.

Thus, Folsom knappers carried preforms of nonlocal stones 100 km or more to the KRF quarry area. They fluted these along with newly made KRF preforms. Presumably, craftspeople also manufactured unfluted preforms of KRF, but carried these away for fluting in other places. Thus, hunters left the KRF source area with fluted points ofKRF, and perhaps with Rainy Buttes silicified wood, moss agate, chalcedony, chert, and porcellanite fluted points as well. They also carried away unfluted-point preforms of KRF, and late-stage percussion-flaked bifacial tool preforms designed for manufacture into implements other than projectile points.

The activities carried out at Bobtail Wolf and Big Black are somewhat complementary. Flint procurement and the early stages of tool production were stressed at Bobtail Wolf. At Big Black, knappers carried out the later stages of biface manufacture with greater relative frequency than at Bobtail Wolf. Most Folsom points from Bobtail Wolf are finished tools rejected because of breakage during use, and most of these were made of nonlocal stones. Most Folsom points from Big Black are KRF preforms broken during fluting. Thus, these sites may represent related occupations. People may have gathered stone and carried out early-stage reduction most frequently at Bobtail Wolf. They also discarded used and broken projectile points there. These people may have carried point preforms the short distance to Big Black for fluting. They may also have carried early-stage biface preforms to Big Black for continued percussion flaking. Thus, in the KRF source area, knappers may have staged fluted point and bifacial tool production in different, but proximate localities. Alternatively, the sites may be unrelated occupations. It is possible that assemblage variation stems from differences in the tool kits brought to the sites that resulted from differences in previous retooling and tool-depletion events (Hofman 1992), and not staged reduction within the KRF quarry area.

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Taphonomy—Bone Modification

The Possible Influence of Low Temperature on Bone Weathering in Curecanti National Recreation Area, Southwest Colorado

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During the last 15 to 20 years, bone-modification studies have become an integral part of taphonomic analysis. Weathering, one process that modifies bone, has received considerable attention. Behrensmeyer's (1978) seminal study described six stages of bone weathering based on criteria such as grease content, presence or absence of soft tissues, and the patterns of cortical bone cracking. Specifically, her stage 0 is defined by a bone surface with no cracking or flaking that is likely to still be greasy; soft tissue may still be present. Stage 1 shows longitudinal cracking of the outer cortical bone. In stage 2, the outer cortical bone is beginning to flake off the surface. Longitudinal cracks are deeper than in stage 1. In stage 3 the bone has a fibrous look to it, as all the outer bone is gone. Stage 4 is fibrous bone with large splinters, and in stage 5 the bone is falling apart. Although she defined these discrete stages, others have recognized the transitional nature of the weathering process (e.g., Fiorillo, 1989; Johnson, 1985).

This paper presents a weathering-stage profile of a sample of bones found in southwest Colorado and suggests that prolonged exposure to colder temperatures may have an influence on slowing the rates of bone weathering.

Curecanti National Recreation Area, in southwest Colorado, receives approximately 32.5 cm of precipitation per year, and has annual temperatures that range from -40 to 32° C, with an annual average temperature of 1° and an average winter low of -20°. Frost occurs from September through June. The study site is a subalpine, open grassland, and the elevation in the region examined for this study varies from 2,220 m to 2,340 m.

I examined isolated bones and bone fragments, associated bones, skeletons and partial skeletons found along various traverses and noted weathering stages. The term specimen here refers to finds in any one of these categories. All elements of a skeleton, except teeth, are included in the sample. The sample consisted of 214 mammal specimens, 14 bird specimens and 4 fish specimens.

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The mammal assemblage is dominated by the remains of medium to large ungulates, and rodents and lagomorphs. All bird bones are songbird-sized.

The profile of weathering stages for 230 specimens examined is shown in Figure 1. The most obvious feature of this profile is the abundance of weathering stage 0 (41%). The dominance of weathering stage 0 in this profile is unlike that of other profiles published based on modern bones (e.g., Behrensmeyer, 1978; Gifford, 1984; Lyman and Fox, 1989; Potts, 1986). These other profiles are all dominated by high percentages of weathering stage 1.

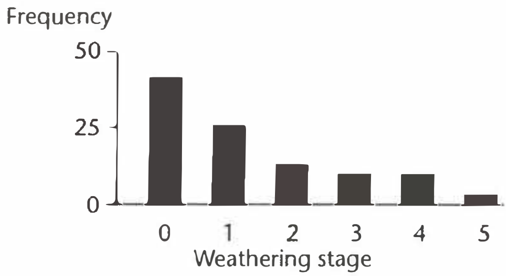

Figure 1. Weathering-stage profile from sample of 230 bone specimens from Curecanti National Recreation Area. Weathering stages follow those of Behrensmeyer (1978). Note the abundance of bones in weathering stage 0.

The Curecanti profile is most similar to that of the Amboseli (southern Kenya) hyaena den of Potts (1986). However, based on the fact that his sample is composed of 20% of small compact elements of the skeleton, such as podials, phalanges, and sesamoids, and that 87% of this subset is in stage 0, he argues that this group of elements weathers more slowly than other skeletal elements and removes this component from his data. The resulting data set, based on limb bones, is dominated by weathering stages 0, 1, and 3.

In the Curecanti data set, 18% of the sample is composed of small, compact elements and 17% of this subset is in stage 0. Therefore, these skeletal elements have no influence in the weathering-stage profile shown in Figure 1.

Comparison of the modern landscape bone-weathering profile from this study to similar profiles from Kenya (Behrensmeyer, 1978; Gifford, 1984; Potts, 1986) shows the Curecanti sample dominated by weathering stage 0 compared with these samples. The weathering profiles of both Behrensmeyer (1978) and Potts (1986) are from assemblages of specimens from the Amboseli Basin of southern Kenya. Behrensmeyer (1993) reports an average monthly high temperature between 26 and 34° C, and an average rainfall of 35 to 40 cm annually for this region. To the north, in the area around Lake Turkana, in the vicinity where Gifford (1984) obtained her weathering profile, Behrensmeyer (1975) reports maximum daily high temperatures of 34–36° C and approximately 38 cm of rain. The variation in rainfall between these three regions (32.5–40 cm) seems small compared with the differences in average temperatures between the Kenya sites and Curecanti. The predominantly low temperatures at Curecanti may be responsible for inhibiting the rate of weathering, thereby resulting in the abundance of weathering stage 0.

I thank Richard Harris and Lynn Cudlip of the National Park Service for providing me climate data for

Curecanti National Recreation Area, and I thank Cathleen May of the U.S. Forest Service for assisting me in the field. I also thank Dr. Bradley T. Lepper and an anonymous reviewer for their constructive comments. This project was funded through the National Park Service and this paper is University of California Museum of Paleontology Contribution No. 1637.

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New Insights into Late-Pleistocene Bone Technology at the Hiscock Site, Western New York State

John Tomenchuk and Richard S. Laub

A taphonomic and an archaeological analysis of the Pleistocene vertebrate fossils (primarily *Mammut americanum*) from the Hiscock site was initiated in 1994. The aim of the study was to distinguish cultural from natural bone modification and to identify Ice Age artifacts. In turn, it was hoped that the project would enhance our understanding of a rarely preserved aspect of Pleistocene material culture in North America.

About 20% of the excavated collection was selectively analyzed during the project. Thirteen of the approximately 300 bones examined were recognized as culturally modified. One specimen, a tanged mastodon rib tool (field No. I5SE-213), had been identified previously and is the subject of a forthcoming publication (Laub et al. 1996). The 12 additionally confirmed artifacts include

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two antler pressure flakers (F7SW-130 and H4NE-37); two bifacially flaked tools—one of ivory (H6NW-122), the other of mastodon cortical bone (F8SE-89); one mastodon tusk-tip flaker or pry bar (I4SW-575); one ellipsoidal ivory flake (F7SE-120); one mastodon rib spatula (F7SE-129); one broken ground ivory point (H4NE-48); one chisel-shaped mastodon cortical-bone pry bar (F8SE-85); one mastodon long-bone wedge (F7SE-51); one unifacially flaked mastodon acetabulum tool (H6SW-158); and one socketed mastodon neural spine (F8NW-75). This report focuses on three ivory tools which provide a glimpse of the late-Pleistocene bone industry in western New York state. All three artifacts originated in the Pleistocene "gravelly clay" layer.

The first specimen is the bifacially flaked ivory tool. Considering both the placement of the service edge and the manner in which it was fashioned, a commensurate analogue would be a chopper/chopping tool. A minimum of eight flakes were struck from an originally hand-size tusk segment to produce an edge (e.g., Hannus 1989; 1990). On the basis of the relative extent to which each of the eight flake scars is proximally truncated, the sequence of flake removals can be reconstructed.

The "chopping" edge lacks signs of intentional abrasion. However, use-wear analysis (at 50X) of the edge reveals polish at several discrete loci. Scratches, oriented predominantly parallel or perpendicular to the nearest edge, are superimposed over several polish loci. Despite considerable cross-sectional rounding (i.e., blunting), the service edge manifests little if any bruising or crushing. Such use-wear traces suggest that the tool was used as a skinning and/or butchering implement.

The second artifact, the ellipsoidal ivory flake, possesses a salient bulb at its proximal end. Most platform-defining ridges appear lightly abraded and faceted. Most lateral and distal edges, formed by the natural "feather" termination of the flake-producing fracture, are unmodified and devoid of unequivocal use-wear traces. A single, inversely flaked notch occurs along one of the lateral edges, parallel to the bulbar swelling. Except for minor discrepancies in size and shape, the flake's ventral (bulbar) surface articulates almost perfectly with the scar of the first edge-forming flake removed from the preceding ivory "chopping" tool.

While most edges lack evidence of cultural modification, the surfaces do not. Thirty-nine small sub-spherical indentations occur within a confined area of the convex, stratigraphically inferior surface. The indentation diameters segregated into two partially overlapping clusters of 0.730 ± 0.092 mm ($n = 15$) and 0.530 ± 0.074 mm ($n = 24$). Extrusive bulges—indicative of ductile deformation—partly rim many of the larger pits. The meaning of these enigmatic depressions will be investigated further.

The last ivory specimen is the flattish, partially ground point. One lateral edge is gently beveled along its entire length; the opposite edge is beveled at the tip only. The proximal extremity resulted from a post-manufacture flexure break. An in-line reverse deflection produced an incipient (second) flexure break midway between the tip and the splintered proximal end. Microscopic scrutiny (at 50X) of the pointed end reveals localized crushing. In the context of beam theory (e.g., Timoshenko and Gere 1961), the foregoing pattern of transverse breakage, together with the localized crushing of the tip, indicates the specimen was axially loaded with an excessively large compressive force while both its extremities were immobilized.

Use-wear analysis also indicates that after sustaining damage, the ivory projectile point was recycled as a perforator. However, the time interval between the two use-events was sufficiently long for the specimen to acquire a noticeable patina or stain. During the specimen's secondary use, stained areas of the tip were eroded, exposing an unstained substrate. Distinct patches of use-related polish straddle the boundaries between the stained and unstained surfaces.

In summary, tool design in at least two cases can be characterized as informal. This suggests expedient—hence largely style-free—tool production. While design considerations are clearly formalized in the case of the ivory point, the implied investment of time and effort is nullified by the fact that the specimen was recycled. Based on detailed use-wear examinations, the apparent utilitarian functions of the three ivory tools can be subsumed under the general rubrics of skinning and hide working.

Finally, the apparent recycling of specimen H4NE-48 after it was stained, raises questions about the contemporaneity of the Hiscock Pleistocene artifacts, and about the feasibility of distinguishing different Pleistocene technologies at the Hiscock site. Notwithstanding stratigraphic disturbance of the Pleistocene sediments (see Laub, this volume), direct percussion flaking and so-called plate-surface grinding (following Campana 1989) were the two principal modes of ivory (and bone) tool manufacture during the late Pleistocene. Both modes were also employed in the production of the Gainey fluted points found at the Hiscock site (see Laub 1994, 1995) and, regionally, in the manufacture of similar fluted points at other Paleoindian sites in western New York state (Gramly 1988) and adjacent southwestern Ontario (Deller and Ellis 1988). In other words, it is not necessary at present to postulate a non-Paleoindian origin for any of the bone artifacts identified thus far at the Hiscock site.

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Methods

Radiocarbon Age of Carbonate Sediments (Travertine, Pedoconcretions, and Biogenic Carbonates): A New Method Based on Organic Residues, Employing Stable-Isotope Control of Carbon Sources

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Conventional radiocarbon assay of carbonate sediments may yield unreliable ages because the source(s) of ^{14}C in the calcium carbonate are unknown. Some of this ^{14}C may be extinct if it derived from calcareous bedrock through aqueous solution or incidental grazing by gastropods. Equilibration of ^{14}C in inorganic carbonate/bicarbonate with atmospheric (neogenic) ^{14}C may be incomplete, giving spurious radiocarbon ages. Yet carbonate sediments, including biogenic materials (e.g., mollusc shell, coral, stromatolites), are commonly preserved in stratigraphic contexts in which wood, humates, and other organic-carbon sources are rare or absent. A convenient, testable, accurate method for dating calcareous sediments is needed.

Our technique for dating carbonate sediments utilizes independent constraints on resulting radiocarbon ages. Control is based on identifying carbon sources and their paths of assimilation into the sediment. Our method does not involve the assay of inorganic carbonate, but rather, analysis of organic matter from calcareous laminae and individual calcite and aragonite crystals. Laminated travertine at springs, waterfalls, and canals is an ideal substrate for cyanobacteria, benthic diatoms, mosses, and green algae, and may trap dissolved and suspended organic matter (organic acids and leaf litter) and eolian particles (pollen and

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spores). These materials are rapidly encased in calcium carbonate precipitated at rates of ~0.5 to 1 cm/yr. Using a simple extraction method (Winsborough et al. 1995), we found that dissolution of calcitic travertine in hydrochloric acid leaves an insoluble residue that is ~5% of the treated sample by dry weight. Of this residue, recovered organic carbon constitutes ~10%, or ~0.5% of the carbonate sample. Speleothems, another type of carbonate sediment, may trap organic acids and fine organic particles that were transported through the aquifer, as well as bat guano, insects, allochthonous plant debris, and low-light diatoms and algae within caves. Lauritzen and others (1994:52,54) identified organic compounds in cave flowstone, including humic and fulvic acids, amino acids, and peptides constituting 0.3 to 1.0 μmol/g of calcite, or roughly ≤5%. Calcareous pedoconcretions in calcic soils also may encapsulate organic matter that was inherited from the soil's parent sediment or translocated through the soil profile. We recovered ~5% of organic carbon from such concretions. The carbonate sediment appears to serve as a time capsule, preserving the organic matter and sequestering it from subsequent contamination with younger carbon.

The fundamental issue to be addressed in relation to these radiocarbon assays concerns the source of the dated carbon. A ^{14}C analysis of organic residues from calcareous pedoconcretions, for example, may indicate either the time of deposition of the parent sediment or the time of pedogenesis, or may reflect a mix of carbon sources of different ages. A means of separating and identifying the contributing carbon sources would resolve much of the uncertainty in the ^{14}C age of the organic residue with respect to the age of the carbonate sediment. To date, two approaches have produced encouraging results: $\delta^{13}C$, and biochemical analyses of the organic residues. Use of $\delta^{13}C$ will be discussed here.

Our studies involve carbonate sediments from semiarid southern Mexico and western Texas. C4 plants dominate both regions, and have a mean $\delta^{13}C$ value of -13‰ relative to PDB (Boutton 1991:177). The $\delta^{13}C$ of our organic residues from travertine-encrusted prehistoric irrigation canals in Mexico is depleted, averaging -24.7‰ with a range of ± 1.5‰ about the mean. These values are consistent with the $\delta^{13}C$ of aquatic plants, which generally conduct C3 photosynthesis and have a mean $\delta^{13}C$ of -27‰ (Boutton 1991 177, 181). This finding indicates that the microbial mat colonizing the wetted surface of the canal is the primary source of organic carbon in the travertine. Radiocarbon ages of the organic residues are 2,000 to 2,550 yr B.P., corresponding to the established cultural chronology. The inorganic carbonate yielded a radiocarbon age of 17,700 yr B.P., which clearly does not represent the age of the canal. Even if the apparent age is adjusted for partial equilibration with the atmosphere using the methods of Pearson (1966) and Rightmire (1967), the resulting estimates are still much too old. The carbonate has a $\delta^{13}C$ of -0.4‰, which is consistent with that of the Lower Cretaceous limestone that is the aquifer from which springs discharged into the canals (Craig 1953). Radiocarbon age of the inorganic carbonate reveals incorporation of carbon from radiocarbon-extinct limestone.

Carbonate pedoconcretions from western Texas were also investigated. The concretions formed in relict cienega (marsh) deposits that were overprinted pedogenically following a Holocene water-table decline. Humates from the clayey sediments provide a ^{14}C age of 970 yr B.P. and a $\delta^{13}C$ of -22.6‰, which is slightly enriched, but generally compatible with a C3 plant source. Age and $\delta^{13}C$ of the organic residue from the concretions are 1,190 yr B.P. and -17.0‰, respectively, indicating pedogenic input of C4 carbon. Apparent age of the inorganic carbonate fraction is 3,410 yr B.P., with $\delta^{13}C$ of -2.3‰, very close to that of Permian and lower-Cretaceous carbonates that were major sources of lithoclastic sediment in this area. In this example, age of the organic residue relates to the decline of the water table and the onset of pedogenesis. In contrast, organic matter continued to accumulate in the soil after lithification of the concretions, skewing the apparent age based on humates. Carbonate samples can yield accurate, informative ^{14}C age when organic extracts are assayed and when $\delta^{13}C$ of credible carbon sources are evaluated.

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Experiments on Subaqueous Meat Caching

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Subaqueous meat caching by Paleoindians was proposed as an explanatory model for at least some occurrences of faunal remains in late-Pleistocene ponds and bogs in the Great Lakes region of North America (Fisher 1989). This model

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was based on work at the Heisler site in southern Michigan, where partly disarticulated skeletal remains of a young male American mastodon (*Mammut americanum*) occurred in several clusters, at 1–2 m paleodepth, in peaty marl deposited in a late-Pleistocene pond. Tusk-growth lines indicated late-autumn death, radiocarbon dating of XAD-purified gelatin hydrolysate yielded an age of 11,770 ± 110 yr B.P. (NSRL-282/AA-6979), and patterns of bone modification suggested butchery by humans (Fisher 1987; in press). Interpretation as an instance of subaqueous meat caching was prompted by discovery of vertical posts associated with two bone clusters and several features interpreted as remains of "clastic anchors" made by filling sections of mastodon intestine with sand and gravel from the pond margin (Fisher 1989). The posts may have marked locations of submerged carcass parts, facilitating later retrieval, and the clastic anchors may have assisted in submersion or retention of carcass parts on the pond bottom. Ethnographic analogies support the general plausibility of such a model (e.g., Taylor 1969), but limits on its feasibility imposed by climate and prey body size were largely unexplored.

Experiments on subaqueous meat caching began in 1989 by submersion of small carcass units (mostly commercially butchered legs of lamb) in Crane Pond (a shallow open-water pond) and Big Cassandra Bog (a peat bog typical of late-stage in-filling of many pond sequences), in the University of Michigan's E. S. George Reserve near Hell, Michigan. Caches set out in autumn through mid-winter were left in place for 1–2 yr. Pond caches were anchored to the bottom, and bog caches were covered with peat. Some caches were checked at intervals of 2–4 weeks, but others were left undisturbed until early in the summer following emplacement. For most of the first winter, carcass units retained essentially fresh interiors and only a moderately deteriorated external surface. By spring, progressive discoloration had penetrated inward 1–2 cm, but interior tissues remained fresh-looking and with only a moderately sour smell. Samples retrieved in late April, 1992, and tested by Analytic & Biological Laboratories, Farmington Hills, Michigan, showed very low bacterial counts, comparable to those of control samples maintained in a household freezer, and no significant occurrence of bacterial pathogens.

While demonstrating the feasibility of subaqueous meat caching on some scale, even with current local climate, these experiments left important questions unresolved. Is the degradational trajectory of carcass units weighing 3 to 5 kg representative of carcass units more massive by over an order of magnitude, such as those indicated at the Heisler site? Is anchoring or tethering to the pond bottom relevant only with respect to fresh density of carcass units, or are there circumstances under which substantial density changes occur? Intestinal sections filled with clastic material have obvious potential as anchors, but what about moderate lengths of intestine without clastic material, such as was recovered at the Burning Tree mastodon site (Lepper et al. 1991), also interpreted as an underwater meat-cache (Fisher et al. 1991, 1994)?

An opportunity to investigate these issues arose in February, 1993, through the death, by natural causes related to senescence, of a 28-year-old, 680-kg draft horse belonging to an acquaintance in southern Michigan. The carcass was skinned and partly disarticulated, and units weighing 13–78 kg were cached in a shallow pond by insertion through a hole chopped in its frozen surface. Two clastic anchors were made from short sections of intestine, and several 2-m sections of intestine were tied off at each end and placed into the pond without emptying their contents or adding clastic material. These showed an interesting subsequent history, as gas produced through fermentation of intestinal contents accumulated at one end, allowing it to float toward the surface, while food remains accumulated at the other end, tethering it to the pond bottom. Abrasion and/or heat transfer from the floating ends opened holes in the ice while the rest of the pond surface was still frozen, and open water remained around these floats for the rest of winter. Footprints on the snow-covered ice recorded investigation of these floats by small mammals, but the floats remained intact until they finally decomposed in August. Clastic anchors retained their integrity throughout this same interval, although their initial density was compromised by gas accumulation.

Autumn cache emplacement by swimming, wading, or floating is practical, but for a winter alternative to chopping through ice, I placed large cobbles (20–30 cm diameter) on the pond surface. Warmed by sunlight, these often penetrated ice at about 5 cm/day. Modest planning and minimal effort produced a hole that could be easily enlarged by marginal fracture. Cobbles or boulders associated with faunal remains in pond sediments (e.g., Hansen 1993) could therefore relate to anchoring or tethering of carcass units or to ice entry at the time of cache emplacement or recovery.

Representative carcass units from the horse were checked at 2-week intervals through the following midsummer. While ice remained on the pond, the condition of interior meat was essentially fresh. Following a brief warming in March, the meat became more acidic and took on a progressively stronger "cheesy" smell and taste, apparently due to colonization by lactobacilli. By April, intramuscular accumulation of carbon dioxide caused floatation of all carcass units and led to profuse growth of algae on exterior surfaces, but the changes induced by lactobacilli inhibited growth of pathogenic putrefactive bacteria (Pierson et al. 1970). Floatation allowed some untethered units to drift ashore, where they were partly scavenged by canids. Most of these units were then retrieved and tethered with the rest of the cache. This appeared to offer adequate protection, as no further impact by terrestrial scavengers was noted. By June, modification by lactobacilli was advanced, but meat and fat remained edible. Despite a strong smell (subdued by cooking) and sour taste, meat retained considerable nutritive value until July and August, when advanced tissue breakdown led to bone exposure and incipient disarticulation.

Subaqueous meat caching appears feasible under a wide range of climatic conditions and offers advantages in management of time and effort following resource acquisition and low-risk protection of the resource until it is needed. A surprisingly complex natural history promotes preservation of even large carcass units in shallow ponds. Whether a local alternative or a supplement to subaerial meat caching (Frison and Todd 1986; Gramly 1988), late-Pleistocene and Holocene occurrences of mastodon, mammoth, musk ox, Scott's moose, elk, deer, sloth and other mammals suggest that it may have been a seasonally important aspect of the subsistence strategy of Paleoindians and later groups.

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The U.S. Geological Survey Alaskan Radiocarbon Data Base

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Since 1951 49 U.S. and foreign laboratories have reported more than 4,000 radiocarbon ages on samples collected from Alaska. The number of radiocarbon age determinations has increased as the result of a shift toward research that required more precise dating of geological processes and archaeological sites in

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the Arctic (e.g., see Combellick and Reger 1994; Kunz and Reanier 1994; Mills 1994; Nelson and others 1988).

The Radiocarbon Dating Laboratory of the Institute of Marine Science, University of Alaska, compiled the first comprehensive database of radiocarbon ages for Alaska and adjacent portions of the Yukon Territory and British Columbia (Wilson and Young 1976). Approximately 10 years later a literature search of both geological and archaeological publications led to the publication of a bibliography of Alaskan radiocarbon ages (Galloway 1984). Galloway (1987a, b) used this bibliography and a modified form of Wilson and Young's age list to produce a radiocarbon database for Alaska. A description of an earlier version of the database can be found in Galloway and Kra (1990).

The Alaskan Radiocarbon Data Base currently contains more than 4,000 radiocarbon age determinations. Each record in the Alaska database consists of 15 fields: (1) radiocarbon age determination, in years B.P., (2) the standard deviation, or one-sigma error, (3) the laboratory code number, (4) calendar age with one-sigma error, if there is no published age determination in years B.P., (5) $\delta^{13}C$, and (6) $\delta^{14}C$ with one-sigma error, (7) latitude, in degrees, minutes, and seconds, (8) longitude, in degrees, minutes, and seconds, (9) notation that a precise location was not given, (10) latitude, in decimal degrees, (11) longitude, in decimal degrees, (12) 1:250,000-scale quadrangle name abbreviation, (13) 1:63,360-scale quadrangle name abbreviation, (14) geographic region abbreviation, and (15) author citation index.

Most age lists appearing in *Radiocarbon* contain geographic coordinates. However, some of the coordinates published give a general (geographic region or quadrangle) location only. Many journal articles and other reports often give a general location, either on a generalized location map or as a statement that the sample was collected near a particular geographic location. If the geographic location mentioned is listed in the Dictionary of Alaska Place Names (Orth 1967), the geographic coordinates listed for that location are entered into the latitude and longitude fields. Since this is an imprecise location, field 9 will contain an asterisk denoting that the given latitude and longitude were not given in the original reference but were obtained from another source. In order to facilitate a search of the database that covers a large area, each record contains an abbreviation for a geographic region and a quadrangle abbreviation, if known. Geographic regions and 1:250,000-scale quadrangle name abbreviations are those used by the U.S. Geological Survey, Branch of Alaskan Geology and are listed in Galloway (1984, 1987a). The author citation index field contains at least one published reference for each record. Unpublished ages and ages without proper documentation are excluded from the Alaskan Radiocarbon Data Base. However, if a publication contains an age without the accompanying laboratory number, I have written the author requesting the appropriate information. If the author provides the laboratory number, the age determination is then added to the database with the following statement in the author citation index [laboratory number from author, affiliation, written commun., date the information was received].

The Alaska Radiocarbon Data Base is available from the author in Nutshell®, ver. 2.0, ASCII character (comma delimited), or DIF® file formats on IBMcompatible diskettes. A separate bibliography of over 680 published citations, in U.S. Geological Survey bibliographic style, is also available as a Microsoft® Word for Windows version 2.0 for MS-DOS®, an ASCII character file, or in Microsoft® RFT format. The U.S. Geological Survey Alaskan Radiocarbon Data Base should not be considered exhaustive, but it is fairly complete through September 1994.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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Alex Krieger's Pre-Projectile Point Stage

J. Kulisheck

In a previous paper, I noted that the history of the study of the first Americans was characterized by a general lack of claims for a very early (or "Pre-Clovis," as it has come to be known) antiquity in the 20-odd years that followed the Folsom discovery in 1927 (Kulisheck 1994). The 1950s, however, saw a dramatic rise in the number of reported sites offered as earlier than Paleoindian. Understanding

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why the rise took place then, and not in the previous 20 years, may lie not in the actual discovery of better sites, but rather in the epistemological need for an archaeological record prior to Clovis to explain the origin of Paleoindian finds.

By far the most significant proponent in the 1950s of a pre-Clovis antiquity in the Americas was Alex Krieger. Krieger, already well known in the field from his work in the 1940s on culture history in Texas and the Southeast, assumed the editorship of the "Notes and News" section for "Early Man" for *American Antiquity* in 1950 (Story 1991). While initially publishing reports of conventional Paleoindian finds in Notes and News, by 1954 Krieger was publicizing potentially earlier finds, becoming the primary proponent for a New World history prior to Clovis, a period which Krieger would subsequently term the "Pre-Projectile Point Stage" (Krieger 1964:42–45). Krieger's advocacy led him on a tour of sites in ten Latin American countries in 1962 in search of pre-Clovis evidence (Krieger 1964:23).

That Krieger was an advocate of a long human history in the Americas is not surprising given his active work in Paleoindian and other early archaeology, such as his involvement in the Midland site (Wendorf and Krieger 1959; Wendorf et. al. 1955). However, Krieger was not simply a proponent; he was critical of interpretations of the evidence offered for several finds, such as the authenticity of the Texas Street site, and the age of the Clovis point at the Lewisville site (Krieger 1957, 1958, 1959). Despite his recognition of the ambiguous status of many sites, Krieger supported the concept of a Pre-projectile Point Stage through the late 1950s and early 1960s.

At the heart of Krieger's presupposition that New World prehistory began before Paleoindian was his understanding of typology and the relationship of typological change to chronology: that levels of technology observable within types were indicative of the developmental, or evolutionary stage of the type (Krieger 1964). Krieger was careful not to repeat a mistake commonly made by archaeologists in the late 19th and early 20th century in that he clearly recognized that the developmental level of a type and its age were independent of one another, and that types exhibiting a lower level of development could be contemporaneous with those more technologically advanced (Krieger 1953a:248, 1965). However, the lack of a clear antecedent for Paleoindian industries in Siberia prior to Clovis times (Chard 1959; Krieger 1953b:239) necessitated that there be a lower stage of development in the New World ancestral to Paleoindian—a Pre-Projectile Point Stage. It was the logic of a human history prior to Paleoindian occupations, rather than the quality of any direct evidence for that occupation, that appears to be the reason why Krieger, despite occasional reservations, argued for the validity of many otherwise questionable sites. By the end of the 1950s, Krieger's views were widely accepted in the general archaeological literature (e.g., Willey 1960; Willey and Phillips 1958:82–86).

The support for the notion of a Pre-Projectile Point Stage began to erode following Haynes's hypothesis for a very rapid occupation of the New World beginning in the terminal Pleistocene. Haynes's view was formulated from the correlation of new radiocarbon on Clovis sites with emerging geochronological evidence for the timing of the opening of an ice-free corridor from Beringia (Haynes 1964). The priority given to geologic and chronological evidence in Haynes's explanation for New World human origins eliminated the need for typological arguments to explain the sudden appearance of Clovis, an epistemological shift which mirrored broader trends in American archaeology away from typology for explanation (Trigger 1989:294–295).

The rise and fall of Krieger's Pre-Projectile Point Stage in the 1950s and early 1960s suggests that in its early stages the renewed search and claims for a great human antiquity in the New World arose from epistemological, rather than evidential, concerns. The nature of the evidence offered for Pre-Projectile Point sites differed little from the discredited finds of the late 19th and early 20th century: they featured artifacts of questionable human agency and dubious middle- and late-Pleistocene geological contexts (Greenman 1957; Roosa and Peckham 1954). Only when it was recognized in the 1950s that Paleoindian types had no apparent Old World antecedents did it, by Krieger's typological reasoning, become necessary to accept these Pre-Projectile Point sites in the New World, regardless of their evidential security.

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On the Identification of Blood Residues on Paleoindian Artifacts

Raymond P. Mauldin, Jeff D. Leach, and Daniel S. Amick

Researchers interested in Paleoindian subsistence have turned to immunological techniques to identify animal species from blood residues potentially adhering to stone tools (Amick 1994; Brush et al. 1994; Cannon and Newman 1994; Hyland and Anderson 1990). However, the validity of immunological results on archaeological samples is open to question. Doubts have been raised concerning the survival of protein residues in archaeological situations (Cattaneo et al. 1993; Eisele 1994; Gurfinkel and Franklin 1988; Hattori and Newman 1990; Hyland et al. 1990; Root and Emerson 1994) as well as the ability to detect and correctly identify degraded proteins using biomolecular techniques (Child and Pollard 1992; Smith and Wilson 1992).

Here, we present some results of tests on residue identification using a commercially available immunological technique. In this experiment, we coated 31 replicas of chipped stone tools with blood of known animal species and submitted them to cross-over immunoelectrophoresis (CIEP) analysis, a technique developed in forensic research (Culliford 1964; Newman and Julig 1989). The CIEP technique involves the exposure of blood residues, in this case isolated from artifacts, to a series of antisera developed for particular species. An antiserum is developed by injecting a rabbit (host animal) with the serum of the animal (e.g., elk) that one wishes to identify. The host animal generates antibodies to the foreign substance(s) that are then isolated (antiserum) for comparisons to unknown residues. Depending on the method, a positive reaction should occur when the antiserum comes in contact with the serum of the species for which it was developed (e.g., Child and Pollard 1992; Culliford 1964; Eisele 1994). However, the antisera used here are polyclonal and thus may react with other species within a family (see Nolin et al. 1994). That is, residue isolated from a particular species, such as elk, may react with antisera developed for any member of the Cervidae family (e.g., moose, deer).

The stone-tool replicas were contaminated with modern blood by cutting or scraping animal tissues. The tissue samples included one human, four elk (*Cervus elaphus*), two mice (*Peromyscus* spp.), two coyotes (*Canis latrans*), four deer (*Odocoileus hemionus*), one turkey (*Meleagris gallopavo*), one cow (*Bos*), and fifteen rabbits (*Lepus californicus*). The stone tools were tested against a series of antisera, including those developed for bovine, chicken, deer, dog, elk, guinea-pig, human, pronghorn, mouse, rabbit, rat, and turkey.

Our results are disappointing. Residues are correctly and unambiguously

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identified to the family level in only 55% (n = 17) of the cases. In seven samples (23%), the animal of origin was one of several species identified as present on the artifact, but reactions also occurred outside the family level. For example, an artifact used to cut rabbit reacted with anti-rabbit serum but also reacted with anti-mouse serum. In three cases (10%), no reaction with the antiserum of the animal of origin occurred, but the residues reacted with antisera of other species outside the family level. For example, an artifact used to cut a mouse reacted only with anti-deer and anti-elk sera. Reasons for these failures are unknown, but these results demonstrate that false positive reactions can occur outside the family level.

Finally, in four cases (13%) no residues were identified on these tools. While reasons for this lack of identification are unclear, it may be possible that the biological activity of these residues samples was severely degraded. The biological activity of proteins can be rapidly lost soon after an organism dies (Sensabaugh et al. 1971). The time lapse was one to two months between coating our experimental artifacts with fresh blood and subsequent testing. If significant degradation of blood proteins can occur over this brief period, then detection and identification of ancient species represented by residues on Paleoindian artifacts is doubtful.

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Paleoenvironments: Plants

A Preliminary Pollen Investigation of Upper Mississippi River Terrace Deposits, Lake Pepin Locality, Minnesota

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An investigation of Upper Mississippi River Valley fluvial terraces is being conducted to establish a relationship between late-Wisconsin-phase glaciation and terrace formation. The Upper Mississippi River Valley was glaciated twice during the late Wisconsin by the Superior Lobe (St. Croix phase) and Grantsburg Sublobe of the Des Moines Lobe (Pine City phase). Preliminary pollen investigations are being undertaken to aid in developing the chronology of the terrace formation.

The study area is located between eastern Minnesota and western Wisconsin, south of the Twin Cities area in the Lake Pepin locality. Within the study area, the average highest elevation is approximately 365 m. The lowest elevations are along the floodplain of the Mississippi River Valley, at approximately 202 m. According to Sloan (1985), the fluvial geomorphology of southeastern Minnesota is entirely Pleistocene in age. The Superior Lobe advanced into southeastern Minnesota from the northeast approximately 16,000 ^{14}C yr B.P., terminating south of the Twin Cities area, and forming the St. Croix Moraine (Wright 1972). The Upper Mississippi River carried outwash of the advancing Superior Lobe that raised the local base-level significantly higher than present within the study area. After the retreat of the Superior Lobe, the Upper Mississippi River Valley underwent a period of downcutting that lowered the local base-level below present level, forming several prominent high terraces within the study area. After a period of about 2,000 years of downcutting, the Upper Mississippi River Valley underwent an episode of infilling from outwash produced by the Grantsburg Sublobe of the Des Moines Lobe, 14,000 ^{14}C yr B.P. (Wright 1972). The Grantsburg Sublobe entered the study area from the southwest and contributed outwash to the Upper Mississippi River that once again raised the local base-level significantly higher than present. Retreat of the Des Moines Lobe, catastrophic draining of Glacial

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Lake Agassiz, and high-volume discharge contributions from the St. Croix River during the late Pleistocene have created a number of terrace surfaces throughout the Upper Mississippi River Valley.

A reddish brown silty clay of the Superior Lobe Outwash terrace deposit from Bay City Gravel Pit 1 (93° 30′ N, 44° 36′ W) was analyzed for pollen. The estimated age for this sample is 16,000 ^{14}C yr B.P. The outcrop is approximately 8 m high and composed of red to red-brown coarse to fine-grained fluvial outwash, with several lenses of silty clay. Bed thickness in this unit is highly variable, ranging from greater than 1 m to less than 1 cm. Although pollen concentration in this sample is low, preliminary analysis yielded the following pollen types: *Picea* (spruce), *Pinus* (pine), *Larix* (tamarack), *Salix* (willow), *Cornus* (dogwood), *Ulmus* (elm), *Artemisia* (wormwood), *Gramineae* (grass), and *Cyperaceae* (sedge). Spores of *Pteridium*-type (bracken fern), *Dryopteris*-type (Goldie's fern), and *Lycopodium* (clubmoss) were also found. The assemblage is most similar to the late-glacial Zone K (the lowermost zone) at Kirchner Marsh (Wright et al. 1963).

A gray silty clay of the Grantsburg Sublobe of the Des Moines Lobe from a terrace outcrop in the Cannon River, a tributary to the Upper Mississippi was also analyzed for pollen (92° 41′ N, 44° 35′ W). The Cannon River was a major conduit for Grantsburg Sublobe Outwash during the Pine City phase, 14,000 ^{14}C yr B.P. The outcrop is approximately 10 m from top to bottom and is composed of rhythmically layered units of alternating gray clay and silt, oxidized to a yellow straw color near the top 4 m. Bed thickness varies from several centimeters to millimeters in width. In this sample pollen concentration is also low. *Picea* is the dominant pollen type. However, *Pinus*, *Betula* (birch), *Ostrya/Carpinus* (hop-hornbeam/hornbeam), *Cyperaceae* and *Pteridium*-type spores are also present. The pollen spectrum is consistent with the late-glacial *Picea-Pinus* pollen assemblage zone of Cushing (1967). Found in conjunction with the pollen were coenobia of *Pediastrum Boryanum*, a planktonic green algae (*Chlorophycophyta*) that commonly inhabits lakes and swamps (Prescott 1982).

Macrofossil and more detailed pollen analyses are currently being conducted on several fluvial terrace sites within the study area. Upon completion, this information should aid in determining the Upper Mississippi River terrace development chronology.

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Paleoenvironments: Vertebrates

Age of the Miami Mastodon

Robert C. Dunnell and T. M. Hamilton

In July 1973, as part of the improvement of County Road F in Saline County, the Missouri Highway Department cut through a high loess bluff on the south bank of the Missouri River just outside the town of Miami, Missouri. The landowner, T. M. Hamilton, noticed some bone and notified Robert T. Bray, who was directing the University of Missouri field school nearby. Bray informed Carl H. Chapman of the University of Missouri. Thus Chapman directed the excavation of what turned out to be an adult mastodon.

The bone horizon was approximately 4.7 m from the surface and 8.8 m from the base of the loess, well back from the edge of the bluff. One molar was well preserved; the rest of the bone was in bad condition with only one tusk, one scapula, one humerus, and a mass of ribs identifiable. Chapman also encountered at least two flakes, another flake he termed as scraper because of edge wear, a pebble, and two pieces of limestone. Excepting the "limestone," which might be pedogenic in origin in a calcareous loess, these materials are plainly foreign to the loess, and a human transport agent is indicated. A description of Chapman's work will be published in the *Missouri Archaeological Society Quarterly.*

Chapman reported this find briefly in the *Archaeology of Missouri, I* (1975:50, 53–54), where he characterizes it as the only secure association of elephants and people in Missouri, rejecting the spring associations of Koch fame as well as more recent ones and even Kimmswick (1975:49–53).

In the mid-1970s this association was undatable. With technological innovations in dating over the past 20 years it has become possible to date the site. Because of the poor condition of the bones, six bones and a tusk fragment had been jacketed in plaster in the field, and these "pods," consisting of bone and a sediment pedestal, were at the Illinois State Museum, when a fire at the University of Missouri curation facility destroyed most of the remaining materials.

Two complementary methods have been employed in dating the Miami mastodon, AMS ^{14}C dating and thermoluminescence (TL) sediment dating. The AMS dates were done by the National Ocean Science AMS Facility at Woods Hole Oceanographic Institution on the "collagen" fraction of the bone. Their analysis

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of the extract's nitrogen content showed it to be much lower than that of modern bone, indicating extensive diagenesis. Energy-dispersive X-ray analysis at the University of Washington showed the inorganic fraction to be calcium phosphate rather than a carbonate replacement of the original hydroxyapatite. Two bone samples had too little carbon remaining to be dated. Two others are in close agreement: 35,900 ± 900 yr B.P. and 35,733 ± 251 yr B.P.

TL analysis is consistent with the AMS ^{14}C results. G. W. Berger employed a partial-bleach method on polymineralic fine grains, obtaining an estimate of 41.7 ± 6.1 kya. The TL event dated is the deposition of the loess approximately 4 cm beneath the tusk and thus is expected to be somewhat earlier than the elephant; however, radiocarbon dates older than 20,000 years are on the order of 3,500 years too young because of variations in the atmospheric ^{14}C reservoir (Bard et al. 1990). Thus the TL date is not only compatible with the AMS results but is likely closer to the true age. Berger's estimate did not take into account the presence of the bone. As bone can concentrate U, the TL age may be somewhat younger than 41.7 kya. Tusk U, Th, and ^{40}K measurements have been made at the University of Washington, but Berger has not yet recalculated the sample age.

While the find site was completely destroyed in 1973, funding is being sought to provide a more precise age of the sediment using optical stimulated luminescence and high-resolution gamma spectrometry at the University of Washington. If this confirms the age of the Miami mastodon, reinvestigation of this locality may be warranted.

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Middle Wisconsin Bear and Rodent Remains Discovered on Prince of Wales Island, Alaska

Timothy H. Heaton

The extensive karst lands of Prince of Wales Island in the southern Alexander Archipelago have yielded early postglacial vertebrate deposits in several different habitats (Heaton and Grady 1992, 1993; Heaton and Love 1995). The dominant mammalian species are grizzly bear (*Ursus arctos*) and black bear (*Ursus americanus*) dating to at least 12,300 yr B.P. Several of the caves are located in glacial valleys or cirques that were disrupted by glaciation. Radiocarbon dates on these remains provide useful age limits for glacial retreat and postglacial colonization but offer

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little hope of elucidating biogeographic patterns during or before the last glaciation. But two caves have recently been found to contain vertebrate remains that predate the late-Wisconsin glacial maximum (21,000–16,000 yr B.P.; Blaise et al. 1990), and these provide the first glimpses of the Archipelago's more distant biotic past.

During the 1994 field season the proximal end of a femur (including half the shaft) of a large bear was collected from On Your Knees Cave and was radiocarbon dated to 35,365 ± 800 yr B.P. (AA-15227). This femur appears to be from a grizzly bear and is nearly as large as the femur of the grizzly giant recovered from El Capitan Cave (Heaton and Grady 1992, 1993). On Your Knees Cave consists of two small passages, each extending about 40 m into the hillside. The femur was found eroding out of the shallow silt floor 10 m inside the entrance. Found nearby in an organic surface layer were a canine fragment and broken calcaneum of a smaller bear (probably black bear), the nearly complete skeleton of a river otter (*Lutra canadensis*), a bird femur, and an abundance of ground fish bone. Since these bones were not buried in silt, they may be Holocene.

Deeper in the same passageway, 25 m from the cave entrance, other bear bones were found eroding from silt deposits on the walls of the tight crawlway. The distal end of a tibia and a first, second, and third phalanx were collected, all of which appear to be from a small black bear. The tibia was radiocarbon dated to 41,600 ± 1,500 yr B.P. (AA-16831). This age is very close to the limit of radiocarbon dating and may not be finite, so the lab issued an alternate date of >39,100 yr B.P.

The association of grizzly and black bears, river otters, and fish is identical to the El Capitan Cave fauna (Heaton and Grady 1992, 1993), although at On Your Knees Cave they may not all be contemporaneous. The apparent coexistence of grizzly and black bears both before and after the peak of late Wisconsin glaciation is highly significant. Prior to 1990, grizzly bears were thought never to have inhabited Prince of Wales Island, since they do not occur there today (Klein 1965). It now appears that both species either colonized the island twice or survived on it through the peak of glaciation. The high $\delta^{13}C$ value of the femur (AA-15227) suggests that this bear was more of a fish eater than its postglacial counterparts (Heaton 1995). If nunataks or coastal refugia were present and fish were available as food, then there is no reason to discount the possibility that bears survived the glacial maximum in the Alexander Archipelago. Evidence for refugia during the height of Wisconsin glaciation has been found on the Queen Charlotte Islands, 250 km to the south (Clague 1989; Mathewes 1989; Warner et al. 1982).

On Your Knees Cave is located in the extreme northwest corner of Prince of Wales Island on a peninsula called Protection Head. This site is adjacent to Sumner Strait, a major glacier-cut channel through the archipelago. Protection head is not in the path of any former valley glaciers but may have been overridden during the glacial maximum. The cave was likely a shallow den site 42,000 to 35,000 years ago and has not been disturbed by extensive erosion or deposition since then. Cave sediments hold the only clue to the glacial history of the peninsula's karst land, and they have not yet been studied.

A vertebrate microfauna of even older age has been found in Devil's Canopy

Cave, located 35 km southeast of On Your Knees Cave in a narrow neck of land between El Capitan Passage and Whale Passage. This cave contains a stream and is part of an extensive hydrologic cavern complex. Rodent remains have been recovered from a 1-m-thick silt deposit located in a dry passage 5 m above the present stream level. In 1992 a marmot (*Marmota*) incisor was found which is beyond the age of radiocarbon dating, or >44,500 yr B.P. (AA-8871A). Marmots do not currently live on Prince of Wales Island and have not been found in postglacial deposits. In 1994, 100 kg of slumping silt was wet screened in the cave and searched for bone. Recovered elements include a marmot molar, a lower jaw of deer mouse (*Peromyscus*), a number of skeletal elements of small rodents, and some insect and plant fragments. The marmot molar is smaller than the hoary marmot (*M. caligata*) that lives on the Alaska mainland but is similar in size to the yellow-bellied marmot (*M. flaviventris*) of the western United States. Further investigation may reveal fossiliferous units within the undisturbed portion of the deposit.

The silt deposit in Devil's Canopy Cave is of glacial origin (containing many mineral types besides calcite) and apparently filled the cave passage prior to subsequent dissolution and downcutting by the cave stream. This part of the island was likely overridden by glaciers, but, like Protection Head, was not in a position to experience deep glacial scouring that would obliterate shallow cave deposits. These two sites, as well as refugia on the Queen Charlotte Islands (Clague 1989; Mathewes 1989; Warner et al. 1982), suggest that low-elevation ridges are the best places to search for fossil deposits predating the late-Wisconsin glacial maximum.

Kevin Allred took me to On Your Knees Cave and assisted with sample collection. James Baichtal introduced me to Devil's Canopy Cave. David Love assisted with screen washing and sediment sorting. The radiocarbon dates were funded by Tongass National Forest.

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Interpretation of $\delta^{13}C$ Values from Vertebrate Remains of the Alexander Archipelago, S.E. Alaska

Timothy H. Heaton

Late-Pleistocene vertebrate remains have been found and radiocarbon dated from seven caves on Prince of Wales Island and several smaller islands nearby. Twenty-one dated samples have been provided with ^{13}C corrections, and these stable isotope values offer insights into the ecology and diet of the island's prehistoric vertebrates. At El Capitan Cave a large volume of ground fish bone (flatfish, sculpin, and at least 20 other marine species) was found associated with remains of grizzly bears (*Ursus arctos*), black bears (*Ursus americanus*), river otters (*Lutra canadensis*), shrews, bats, and several species of rodents (Heaton and Grady 1992, 1993). The association of bears, otters, and fish was also found at On Your Knees Cave, though possibly of different ages (Heaton, 1995). Both appear to be den sites. A higher-elevation grizzly bear den in Bumper Cave lacks fish, otter, and black bear (Heaton and Love 1995).

It has been established that different primary producers select carbon isotopes from their environment in different ratios, and that these isotopic signatures are passed on, with predictable modifications, to higher levels in the food web. Different body tissues concentrate ^{13}C in different proportions, but the concentration remains the same or increases only slightly in higher trophic levels (Tieszen and Boutton 1988). The Alexander Archipelago closely approximates the simple two-food-source model outlined by Fry and Sherr (1984). Terrestrial plants of northern latitudes are virtually all of the C_3 photosynthetic type and yield $\delta^{13}C$ values averaging -27‰ (Tieszen and Boutton 1988), with a $\delta^{13}C$ enrichment correction to about -21‰ for the bone collagen of animals getting their food from terrestrial plant sources. A charcoal sample from El Capitan Cave provided a $\delta^{13}C$ value of -23.0‰, which is at the high end of the normal range for C_3 wood. By contrast, three early-Holocene fish-bone samples from El Capitan Cave have yielded $\delta^{13}C$ values of -16.1, -13.2, and -11.1‰ (mean of -13.5‰). These high $\delta^{13}C$ values are typical of marine fishes, though the food web by which they obtain these values is complex (Fry and Sherr 1984). Since these values are based on bone-collagen samples, similar or slightly higher values would be expected in the bone collagen of any predator that uses them as its primary food source.

The purpose of this analysis is to determine the diet of prehistoric island mammals and establish which species is responsible for the extensive ground fish remains in coastal caves. Based on the analysis above, expected $\delta^{13}C$ values in the

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bone collagen of mammals would be approximately as follows: -21‰ for exclusive terrestrial plant feeders, -13‰ for exclusive marine fish feeders, and an intermediate value for mixed feeders.

Remains of four postglacial black bears have been radiocarbon dated, all from El Capitan Cave (Heaton and Grady 1992, 1993). The $\delta^{13}C$ values range from -18.7 to -22.1‰ with a mean of -20.5‰. A middle-Wisconsin (or older) black bear from On Your Knees Cave (Heaton 1995) has a similar $\delta^{13}C$ value of -20.7‰. In spite of the coastal location of these caves, such low values suggest that the black bears obtained their food almost exclusively from terrestrial sources. These values match closely those that Bocherens et al. (1994) found in modern Alaska black bears and several species of fossil bears interpreted as being C_3 plant eaters, thus strengthening this conclusion.

The consistent terrestrial signature of fossil black bear $\delta^{13}C$ values found in this study is curious because modern black bears on Prince of Wales Island have frequently been seen feeding on marine fishes. This is an unusual habit for black bears, and it may not have begun until after grizzly bears disappeared from the island. A stable-isotope study of modern black bears on Prince of Wales island is needed to confirm this proposed dietary shift.

Seven early postglacial grizzly bears have been dated from Prince of Wales Island (Heaton and Grady 1993, Heaton and Love 1995): two from El Capitan Cave (coastal), four from Bumper Cave (subalpine), and one from Blowing in the Wind Cave (alpine). The $\delta^{13}C$ values range from -16.8 to -19.5‰ with a mean of -18.1‰. The -19.5‰ value came from the only sample based on tooth rather than bone. Bocherens et al. (1994) found tooth-collagen samples in bears to have $\delta^{13}C$ values up to 1.1‰ lower than bone-collagen samples. The lowest of the bone $\delta^{13}C$ values is -18.5‰, which is from a juvenile, and Bocherens et al. (1994) found juvenile $\delta^{13}C$ values to be lower than those of adults. $\delta^{13}C$ values of the five adult bone samples ranges from -16.8 to -18.3‰ with a mean of -17.8‰. These values are all higher than the highest value for black bears (-18.7‰) and they suggest that the grizzly bears had a marine component to their diet. Curiously, grizzly remains recovered from caves higher in elevation and farther from the ocean do not have lower $\delta^{13}C$ values than their coastal counterparts as might be expected.

A ninth grizzly bear, recovered from On Your Knees Cave (Heaton 1995), dates to the middle of the Wisconsin glacial and has a $\delta^{13}C$ value of -15.9‰, the highest of any bear in this study. Plant food may have been scarce during the glacial epoch, and a predominantly fish diet would account for this high value.

A river otter bone from El Capitan Cave has been radiocarbon dated, and its $\delta^{13}C$ value is -10.0‰, the highest of the 21 samples. This suggests a predominantly marine diet with a $\delta^{13}C$ trophic level enrichment in addition. These data, combined with the unique association of otter and fish bone, suggests that the otters are responsible for the extensive fish deposits in El Capitan and On Your Knees Caves. This conclusion is consistent in detail with studies of river otter diets and den sites in the Alexander Archipelago (Larsen 1984).

A marmot incisor from Devil's Canopy Cave, reported by Heaton (1995), has a $\delta^{13}C$ value of -23.7‰. This indicates a terrestrial-plant diet, as would be expected for this species. The unusually low $\delta^{13}C$ value might be due to the tooth sample, though continuously growing teeth like rodent incisors are generally not depleted in ^{13}C as are rooted teeth (Bocherens et al. 1994). Since the age of this tooth is beyond the range of radiocarbon dating, no specific environmental interpretation can be made.

A deer humerus from Nautilus Cave (Heceta Island), radiocarbon dated at 8,180 ± 70 yr B.P. (AA-10574), has a $\delta^{13}C$ value of -25.2‰, by far the lowest of the 21 samples. This value is so low that the deer likely obtained its plant food from a closed-canopy forest. In such forests much of the CO_2 taken in by vegetation low in the canopy is recycled from the forest itself, and therefore the carbon is repeatedly depleted in ^{13}C by the C_3 plants (Tieszen and Boutton 1988). This level of depletion suggests that the dense rain forest conditions of the Alexander Archipelago were established prior to 8,000 years ago.

This paper benefited greatly from discussions with Larry L. Tieszen. Kevin Allred and James Baichtal discovered most of the vertebrate remains reported herein. Becky Wigen identified the fish remains. Isotope analyses were conducted by the University of Arizona and Beta Analytic Inc. Funding for the analyses was provided by Tongass National Forest and the National Geographic Society.

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A Late Farmdalian-Woodfordian Fauna from Lovewell Reservoir, Jewell County, Kansas

Steven R. Holen, R. George Corner, and Rolfe D. Mandel

Since the construction of the Bureau of Reclamation Lovewell Reservoir on White Rock Creek in the early 1950s, severe erosion on the north shoreline has exposed a late-Pleistocene terrace fill containing a diverse faunal assemblage. During the 1960s and 1970s archaeologists twice responded to the discovery of proboscidean remains. The first discovery consisted of much of the skeleton of a single mammoth, and the second was a single mammoth tusk.

In 1988, the senior author investigated the location where Clovis artifacts had been found along the north shore of the reservoir (Holen 1989). Several faunal elements, including some from extinct species, were found on the beach. Mandel, who had previously conducted reconnaissance at the reservoir, identified a sharp contact between point-bar deposits consisting of medium-sized gravels and an upper unit of fine-grained overbank deposits about 3 m thick. Test units in the point-bar deposits, which contained extinct Pleistocene fauna, were excavated to determine if this was the source of the Clovis artifacts found on the beach after severe erosional episodes. While no lithic artifacts were found, vertebrate remains were discovered in situ in the upper 50 cm of the point-bar gravels including *Camelops hesternus* (Yesterday's camel), *Equus* spp. (large and small horse), indet. fish, *Bufo* sp. (toad), *Heterodon* sp. (hognose snake), *Thamnophis* sp. (garter snake), *Coluber constrictor* (blue racer), passerine bird, *Spermophilus tridecemlineatus* (thirteen-lined ground squirrel), *Cynomys* sp. (prairie dog), *Geomys bursarius* (plains pocket gopher), *Perognathus* sp. (pocket mouse), *Peromyscus* sp. (indet. mouse), and *Microtus* sp. (vole).

One *Equus* sp. lateral metacarpal, excavated from 30 cm deep in the point-bar deposit, was dated to 22,770 ± 810 yr. B.P. (CAMS 17406). This age represents the transition from Farmdalian to Woodfordian time and correlates well with radiocarbon ages from the upper part of the soil developed in Gilman Canyon Formation in the central Great Plains. The exact stratigraphic position of the Clovis artifacts has not been located, and the radiocarbon age of bone from the test units indicates the artifacts are eroding from higher in the stratigraphic section.

Fine-grained alluvium above the point-bar deposits, in locations spatially separated from the test excavations, yielded *Mammuthus cf. M. columbi* (Columbian mammoth), *Camelops hesternus,* and *Bison cf. B.b. antiquus.* The Lovewell Mammoth, first excavated by archaeologists from the Kansas State Historical Society in 1969, was reinvestigated in the fall of 1991 during very low lake level. An in situ

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spirally fractured fragment of limb bone excavated from fine-grained alluvium yielded a radiocarbon age of 18,250 ± yr 90 B.P. (CAMS 15636). This age is consistent with the radiocarbon age on *Equus* bone from the point-bar deposits to the west and represents a glacial-maximum occurrence of mammoth. Both radiocarbon dates were on total amino acids extracted from bone collagen by Thomas Stafford, Laboratory for AMS Radiocarbon Research, INSTAAR, University of Colorado (Stafford 1991).

A previous salvage excavation had recovered *Hemiauchenia macrocephala* (large-headed llama) that was found in silts stratigraphically below silts and gravels (Logan et al. 1991:97–99). A radiocarbon date on a bulk sample of organic-rich sediment from a location near the excavation yielded an age of 13,410 ± 300 yr B.P. (Tx-3666). This radiocarbon date should be considered a *minimum* age for these deposits and the *Hemiauchenia* specimen.

Pleistocene remains recovered from the eroded surface of the beach include all the previously mentioned megafauna. In addition, a large ungual phalanx of *Megalonyx jeffersonii* (Jefferson's ground sloth), a proximal ulna of *Canis dirus* (dire wolf), and a partial innominate and metapodial fragments of *Hemiauchenia* were found. Based on the exposed deposits, it is likely that all surface specimens date to the late Farmdalian or Woodfordian. Both excavated and surface collected faunal materials constitute the Lovewell Local Fauna presently housed at the University of Nebraska State Museum. Continued work along the shoreline will be conducted during the 1995 field season.

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A Pleistocene Mammalian Fauna from Adrian Valley, Lyon County, West Central Nevada

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A small assemblage representing a new fauna, the Adrian Valley Local Fauna, was discovered during a survey of the mammalian fossils from west central Nevada in the collections of the Natural History Museum of Los Angeles County (LACM).

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The fragmentary, but well-preserved, fossils were recovered from locality LACM 6228, which occurs in fluvio-lacustrine sediments exposed on the west side of Adrian Valley, Lyon County, Nevada (latitude 38° 13′ 29″ N, longitude 119° 16′ 58″ W). These sediments occur from 1,316 to 1,341 m in elevation and consist of 25 m of alternating sandy siltstones and pebble conglomerates that unconformably overlie the Miocene "Coal Valley Formation" and unconformably underlie late-Quaternary alluvium. Fossils came from a light tan siltstone in the middle of the unit at an elevation of about 1,329 m. Moore (1969) previously mapped these sediments and correlative beds of similar lithology exposed on the east side of Adrian Valley as "older Quaternary alluvium."

The Adrian Valley Local Fauna consists of the following taxa: *Leporidae*, gen. indet. (rabbit, represented by one metapodial, one calcaneum); *Proboscidea*, family indet. (proboscidean, represented by one partial tusk); *Equus* sp. indet. (horse, represented by 15 isolated appendicular elements); *Oreamnos americanus* (American mountain goat, represented by one partial metacarpal); and *Cervidae*, gen. indet. (deer, represented by one partial metapodial, one proximal phalanx). The Adrian Valley horse can be identified only as a moderate-size, stout-legged species of *Equus* (Figure 1). The partial metacarpal (LACM 138021) of the mountain goat *Oreamnos* is morphologically indistinguishable from those of the extant *O. americanus* (Figure 1). The *Oreamnos* metacarpal measures 130.4 mm in length and 47.7 mm in greatest distal width; therefore, it is not the smaller, extinct form *O. haringtoni* (Harington's mountain goat).

Fossil specimens of *O. americanus* are rare; it has previously been recorded from the Sangamonian interglacial deposits of Quesnel Forks, British Columbia (Harington, 1971) and the following Rancholabrean localities south of the North American continental glacial margin: Potter Creek and Samwell Caves, California; Booth Canyon, Idaho; and Horned Owl, Bell, and Little Box Elder Caves, Wyoming (Anderson, 1974; Furlong, 1906; Guilday et al., 1967; Mead and Lawler, 1994; Sinclair, 1903; Zeimans and Walker, 1974). The occurrence of *O. americanus* in the Adrian Valley Local Fauna represents the first record of this species from Nevada and extends its paleogeographic range about 600 km southward into the Great Basin.

King (1978) regarded Adrian Valley as having a fluvial origin; a result of Pleistocene lake overflow of a paleo-divide between the Walker Basin and the Pleistocene lakes to the north during Eetza time of Lake Lahontan (350,000–130,000 yr B.P.) or pre-Lahontan time (>900,000 yr B.P.). By the Sehoo time of Lake Lahontan (35,000–8,000 yr B.P.), Adrian Valley existed as a well-developed tributary of the Carson River with its headwaters in the Pine Nut Mountains and was periodically inundated by Lake Lahontan as demonstrated by eroded shore terraces and lake deposits of dendritic tufa and clay (King, 1978; Morrison, 1991). The fossil-bearing sediments could not have been deposited during Sehoo time because the late-Quaternary alluvium unconformably overlying the lower exposures of the sediments is encrusted with dendritic tufa, which is characteristic of the Sehoo Alloformation (Morrison, 1964; 1991). The occurrence of *O. americanus*, whose known geologic range is Rancholabrean to Holocene (>400,000 yr B.P.) south of the North American continental glacial margin, indicates that the fossil-bearing sediments probably date sometime from latest Paiute or earliest Eetza

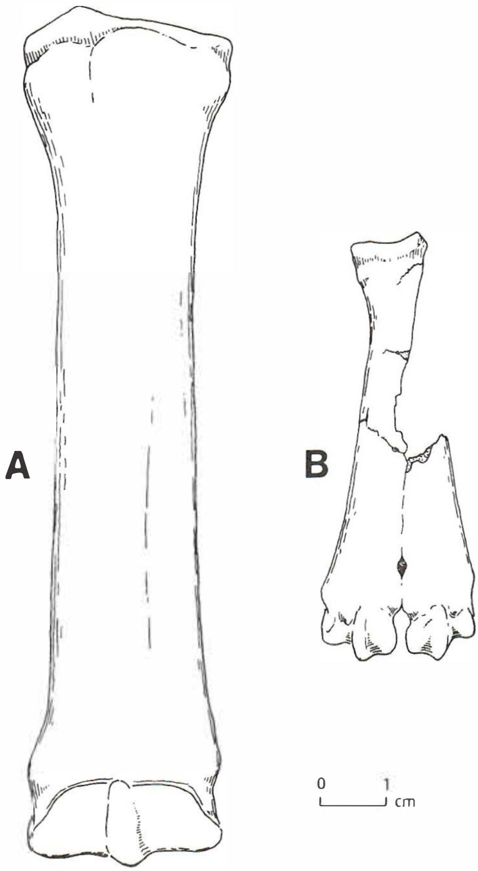

Figure 1. Metacarpals of *Equus* sp. indet. and *Oreamnos americanus* from Adrian Valley. **A,** *Equus* sp. indet., LACM 138020. **B,** *O. americanus,* LACM 138021. Anterior views. Scale = 20 mm.

time up to as late as Wyemaha time of Lake Lahontan (400,000–35,000 yr B.P.). However, correlative sediments of those at the fossil locality occur in the slopes along both sides of Adrian Valley, which could indicate that they were once a continuous lithologic unit that was cut through during the overflow that formed the valley. If this overflow occurred in pre-Lahontan time, then the fauna would be older than 400,000 yr B.P., or Irvingtonian in age, and the presence of *O. americanus* would represent the oldest geologic occurrence of this species south of the North American continental glacial margin. Determination of a more precise age than Pleistocene for the fauna will have to await the discovery of additional diagnostic fossils.

I am grateful to Christopher A. Shaw of the George C. Page Museum and Jim I. Mead of the Northern Arizona University for their help in confirming the identification of the *O. americanus* specimen, and I am also indebted to Jim I. Mead for his constructive comments on the original drafts of this report.

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Black-footed Ferret *(Mustela nigripes)* in the Late Pleistocene, Illinoian, of Nebraska

Jean Bright Martin and Larry D. Martin

There are a number of records of the black-footed ferret, *Mustela nigripes*, from the Wisconsinan of North America, but until recently the earliest record was a single ramus, University of Nebraska State Museum (UNSM) 20023, found by Jean (Bright) Martin in the late Illinoian of Clay County, Nebraska (Kurten and Andersen, 1980, p. 152).

Prairie dogs are uncommon before the Illinoian and this may account for the absence or rarity of earlier records of ferrets in North America. The deposits in Clay County, Nebraska, were exposed in road cuts along Highway 74 at the junction of S-18E and just west of that junction, continuing into Adams County.

The sediments that produced this fauna are fluviatile silts and sands grading up into loessic silts overlain by the Sangamon Soil, Gilman Canyon Formation and Peoria Loess. Schultz and Martin (1970) called the silts just below the

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Sangamon Paleosoil, the Gothenburg Member of the Loveland Loess. The Gothenburg Member is thought to be late Illinoian in age or about 200,000 yr. B.P. Associated with the ferret were remains of a Pleistocene prairie dog (*Cynomys* sp.), the Kimball ground squirrel (*Spermophilus kimballensis*), and a vole (*Microtus* cf. *ochrogaster*). On the south side of the road cut in an adjacent gully is a slightly lower part of the section consisting of fluviatile sands. These sands produced fragments of mammoth teeth (*Mammuthus* sp.) as well as a catfish spine (*Ictalurus* cf. *furcatus*) and numerous freshwater mollusks (*Sphaerium, Helisoma,* etc.). A short distance further west in Adams County similar road cuts on Highway 74 produced a tarsometatarsus of a female turkey (*Meleagris gallopavo*) along with mammoth and fossil horse remains also from the Gothenburg Member.

Mustela nigripes is larger than the long-tailed weasel, *M. frenata,* but is close to the size of the mink (*M. vision*) and has been confused with it in at least one case (Schultz, 1934). Schultz lists a specimen from the "Citellus Zone" = Gilman Canyon Formation, 10 miles southwest of Maxwell in Lincoln County, Nebraska. The lower jaw of *M. nigripes* may be distinguished from that of *M. vision* by the greater relative width of the talonid in the mink.

UNSM 2023 measured in mm gives lengths of: p2-p4 = 10; m1-m2 = 9.6; m1 = 8.4; widths of m1 = 3.4; ramus at p4-m1 = 4.7; and depths of ramus at p3-p4 = 8.2; m1-m2 = 8. When comparedwith the measurements given by Youngman (1994), these measurements fall well within the range of *M. nigripes* and are smaller than those of the steppe ferret. The only exception is the width of the ramus indicating that the jaw is a little more robust than in the modern samples. The smaller size of the black-footed ferret compared with the steppe ferret may reflect a need to fit comfortably in prairie dog excavations and was already established by the late Illinoian. A possible Kansan record of *M. nigripes* occurs in the Porcupine Cave Local Fauna of Colorado (Youngman, 1994).

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Additional Occurrences of *Cervalces scotti* from the Pleistocene of New York

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Remains of the extinct elk-moose (*Cervalces scotti*) are known from over 60 localities, forming a broad band that begins in the Great Plains and extends eastward to the Atlantic continental shelf (Churcher 1991; Churcher and Pinsof 1987). Additional specimens, most notably three mummies (Guthrie 1990), are known from Alaska and adjacent Yukon Territory. Examination of Churcher's (1991) data shows that non-antler elements of *C. scotti* are nearly as common as its distinctive antler beam and palmation. Buckley and Willis (1970) reported an antler tine and various postcranial elements of *C. scotti* collected in 1968 from Orange County, New York, with an associated date of 10,950 ± 150 yr B.P. (I-4016). Two recent discoveries of *C. scotti* in western New York, both consisting of non-antler remains, constitute the second and third occurrences of the species in the state. These discoveries fall within the known distribution of *C. scotti* (Churcher 1991:Figure 2).

The identity of the New York specimens was ascertained by comparison with the following materials: upper cheek teeth of *C. scotti* in the collection of the Cincinnati Museum of Natural History (CMNS VP 1754); a left humerus, left metacarpal, and lower molar series of *C. scotti* in the collection of the Orton Geological Museum, Columbus (OSU 39145c, 39145h, and 39145d, respective); and an uncatalogued partial palate and mandible of *Alces alces* (moose) in the recent osteologic collection of the Buffalo Museum of Science (BMS).

Three cheek teeth referable to *C. scotti* were collected from the Hiscock Site in the town of Byron, Genesee County, New York (Laub 1990; Laub et al. 1988). The most prominent member of the Hiscock fauna is *Mammut americanum* (mastodon), whose remains account for a MNI of 8. The cheek teeth recovered from the Pleistocene horizon (gravelly clay layer of Laub et al. 1988) are: BMS E26824, the posterior half of a left lower molar; BMS E26825, the anterior half of a left lower P2; and BMS E26642, a labial crescent from a (left?) lower molar. Laub (1994) gave a preliminary identification of BMS E26642 as a partial lower P4 tooth of either *A. alces* or *C. scotti.* Although the three Hiscock specimens are incomplete, their relatively large size and enamel morphology conforms more to the teeth of *Cervalces* than to those of *Alces.*

Two well-preserved postcranial elements of *C. scotti* were collected in association with the Farview Mastodon, a nearly complete skeleton in the collection of the Rochester Museum & Science Center (RMSC), Rochester, New York. The mastodon was recovered in January 1991 from a pond on the property of the Farview Golf and Country Inn, approximately 3.4 km south-southeast of Avon, Livingston County, New York. A sample taken from a rib fragment of the

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mastodon gave a date of 11,565 ± 105 yr B.P. (AA 7397/X-359). One of the *Cervalces* bones, a complete right humerus (RMSC 94.08.03), has a maximum length of 390 mm, greatest breadth at the proximal end of 99.4 mm, smallest breadth of the diaphysis of 44.6 mm, and greatest breadth at the distal end of 84.7 mm. The other bone, a complete right metacarpal (RMSC 94.08.04), has a maximum length of 367 mm, proximal depth and width of 47.6 and 66.4 mm, respectively, and distal depth and breadth of 45.4 and 71.9 mm, respectively. The metacarpal bears a distinct puncture wound, presumably received from the bite of a carnivore, just proximal to the distal epiphyseal line.

The association of *Mammut* and *Cervalces* with late-Pleistocene *Picea* (spruce) taiga of the eastern United States has been repeatedly recognized in biogeographic analyses. McDonald (1989) emphasized the relationship between *Cervalces* and spruce forest, and hypothesized that additional specimens could provide direct confirmation of the *Cervalces-Picea* association. A small sample of pollen that consists primarily of spruce was recovered from sediment within the shaft of the Farview *Cervalces* metacarpal. The pollen spectrum corresponds to the 10,000 to 11,000 yr B.P. pollen zonation (1b) in the Ontario area (J. H. McAndrews 1992; written comm. to Richard Laub). Spruce has also been identified (as pollen and macrofossils) in the Hiscock Site's late-Pleistocene flora (Miller 1988). These observations support the idea that large browsing herbivores such as *Cervalces* and *Mammut* occupied late-Pleistocene spruce taiga.

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Paleoenvironments: Geosciences

Upper Pleistocene Geology of the Merrell Site (24BE1659), Centennial Valley, S.W. Montana

John P. Albanese, Christopher L. Hill, and Leslie B. Davis

The stratigraphic context of Pleistocene fossils from Centennial Valley in southwestern Montana, studied by the Museum of the Rockies (MOR) in 1994, indicates the remains are found within older deposits indicative of a lake or marshlike setting and younger deposits within a buried "gully." The strata contain, besides mammoth, extinct forms of camel and horse, and other Mammoth-steppe species (cf. Dundas 1992). Artifacts were found in overlying Holocene bioturbated colluvium. Magnetic survey, test excavations, and surface collecting by the MOR in 1994 demonstrated a shallow subsurface provenance for most artifacts within a 40-cm severely bioturbated zone.

The stratigraphic succession, consisting of five sedimentary units (A–E), is exposed along a north-trending scarp that borders the west side of Lima Reservoir. In excavation pits C and E, the sedimentary units were separated into local descriptive lithologies (LDL) which provide examples of facies variants of the units.

The units provide a framework which can be used to assess the potential taphonomic processes and paleogeographic and regional paleoenvironmental contexts of the fossil and artifact accumulations at the site. The basal unit (A) is a massive, very fine to fine-grained silty, clayey sand with occasional pebbles interpreted to have accumulated mainly as alluvium, although portions may also be lacustrine. The overlying Unit B is a dark, grayish-brown, organic-rich bed that varies in composition from clayey, silty, very fine sand to a sandy, silty clay which displays soft-sediment deformation structures. In pit E, it includes LDL1 and LDL2. Mammoth bone from this unit yielded an age on organics of 36,520 ± 710 yr ^{14}C B.P. (B-74032).

The organic-rich portion of Unit B displayed along the scarp face pinches out

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and merges into a limonitic gley fossil soil horizon. The oxidized gley paleosol is part of Unit B and is interpreted to be the weathered lateral equivalent of the organic-rich deposits. Unit B is thought to have formed in a waterlogged marsh within a depression that was about 2 m deep and 85 m long.

Unit C overlies Unit B and consists of a thin-bedded to laminated sequence seemingly predominated by fluvial deposits composed of very fine to fine-grained, silty, clayey sand that grades to sandy clay or silt. It contains coarser clastic lenses, particularly in the upper portion. In pit E, Unit C was divided on the basis of texture into LDL3 and LDL4. Post-depositional alterations include soft-sediment deformation and microfaults. Mollusc fragments and ostracods are also present.

At the northern end of the scarp, a small deposit of mammoth bones which yielded an age of 19,310 ± 90 ^{14}C B.P. (Beta-77826) occurs on the floor of the "gully" that was incised into Unit C. The sediment that fills the depression is designated as Unit D. A massive, sandy, pebbly colluvium (Unit E) of Holocene age unconformably overlies all older units.

The stratigraphic sequence is postulated to have formed as a consequence of a series of events. Unit A was deposited primarily as alluvium with possible intermittent shifts to a lacustrine environment. Sediments of Unit B accumulated in intermittent ponds located in shallow, closed depressions around 37,000 ^{14}C B.P., perhaps situated on or near a floodplain. They reflect a habitat setting related to margins of Pleistocene ponds or marshes, and fauna indicate the presence of a steppe or grassland prior to the Last Glacial Maximum.

After the deposition of Unit B, sedimentation along the valley drainage seems to indicate braided stream deposition, which was followed by an episode of stream incision and the creation of an arroyo-type "gully." Mammoth bones located within the "arroyo" fill yielded a radiocarbon age of around 19,300 B.P. A marked unconformity at the top of the Pleistocene sequence is overlain by a deposit of sandy, Holocene colluvium which contains artifacts.

The Centennial Valley was unglaciated, although pre-Bull Lake, Bull Lake, and Pinedale till have been reported on the Centennial Mountains to the south (Montagne 1972; Witkind 1976). Water seems to have at least intermittently filled the basin from the Plio-Pleistocene to terminal Pleistocene (Feth 1961; Mannick 1980; Sonderegger et al. 1982). The water bodies may have formed as a result of dramatically different climatic conditions; they could be the result of either increased precipitation and reduced evaporation, or products of glacial meltwater during glacial-interglacial transition intervals. Evidence of tectonic activity (displacement scarps, liquefaction features, and microfault structures) also exists. Hot springs created along faults may have provided microhabitats within the valley that would have attracted Ice Age animals and be a partial explanation for their present preservation.

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Soil Investigations at the Cooper Site

Brian J. Carter and Leland C. Bement

The Cooper site (34HP45) is a Folsom bison kill in northwest Oklahoma. The site contains three separate kills found in sandy loam sediment layers stacked vertically (Bement, 1994). The layers contained the remains of 40 articulated skeletons and 103 stone artifacts including 32 Folsom points. A bison skull within the lowest bone bed had a red zigzag line painted on its frontal.

The site is located on a small ridge adjacent to and 6 m above the floodplain of the North Canadian (Beaver) River (Figure 1). The small ridge is bounded east and west by arroyos. Soil-profile descriptions at the site identify a weakly developed (lacks a B horizon) soil at the modern ground surface formed in eolian sand, overlying an eroded buried soil (paleosol) formed in arroyo sediments that are resting on bedrock of red Permian sandstone and shale. The sediments and soils are common for the area (Myers, 1959; Nance et al. 1960). The three layers containing bones are found within the arroyo sediments (C soil horizons) at the base of the buried soil. The buried soil contains a well-developed B horizon (2Btk,b) containing moderate subangular blocky structure and translocation and enrichment of clay and carbonate. The well-developed B horizon within the buried soil is indicative for morphological soil formation during past centuries, most likely many thousands of years. The buried soil also indicates that arroyo deposition discontinued sometime after burial of bison-kill layers for a lengthy time period before deposition of the overlying eolian sand.

Two sediment layers were sampled for ^{14}C analysis. The dark brown discontinuous 2A,b horizon from the top of the buried soil is 1,100 ± 50 yr B.P. (Beta 74202).

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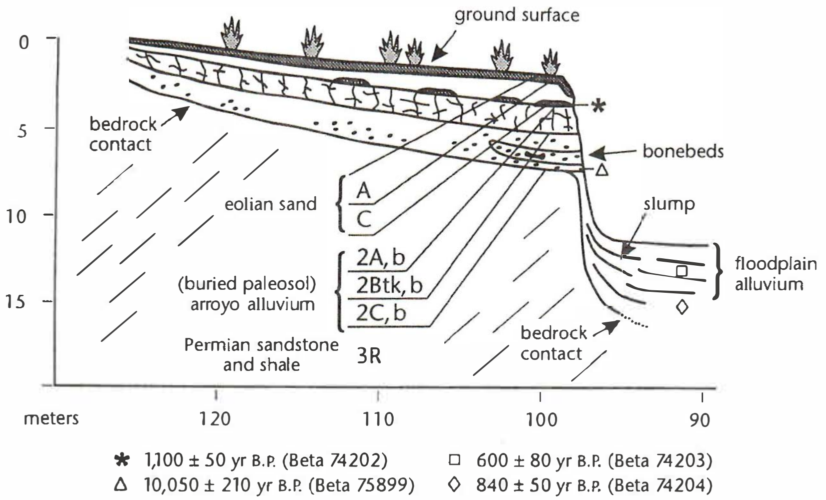

Figure 1. Schematic of soil-sediment stratigraphy at Cooper site (north-south profile).

A dark-brown 2C,b horizon immediately below the lowest bone bed is 10,050 ± 210 yr B.P. (Beta 75899). Debris, including scattered bones and artifacts from the site, is found in slump and floodplain sediments adjacent to the ridge. Within floodplain sediments buried soils are described and sampled for ^{14}C analysis. Buried A,b horizons at depths of 140 to 150 cm and 160 to 176 cm are 600 ± 80 yr B.P. (Beta 74203) and 840 ± 50 yr B.P. (Beta 74204) respectively. The site has been actively eroding over the last 600 to 900 years.

Based on soil-profile descriptions and ^{14}C analyses, the site began as an arroyo eroding into Permian bedrock. Arroyo deposition followed bedrock incision filling the arroyo and covering late-Pleistocene bison-kill remains. Decomposition of carcass remnants by facultative aerobic and anaerobic microorganisms produced gray reduced bone-bed layers within predominantly red-oxidized sediments above and below the bone bed. The gleyed soil horizons in the periphery of the bones indicated rapid burial of decomposing organic matter and are similar to features identified at the Waugh site (Hofman et al. 1992). Arroyo deposition stopped and a soil formed during the mid to late Holocene. During the late Holocene continued arroyo erosion and eolian deposition have left the site as a buried arroyo remnant.

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Locating Paleoamerican Occupations in S.W. Montana Placered Valleys

Leslie B. Davis and Christopher L. Hill

Several tactics are being employed by the Museum of the Rockies to discover in situ Paleoamerican (ca. 11,300–7,500 ^{14}C B.P.) artifact assemblages in the northern Rockies and northwestern Plains of North America. These include looking for and inspecting: a) tephra exposures, specifically Glacier Peak, which dates to ca. 11,150 ^{14}C B.P.; b) bone beds containing remains of Pleistocene fauna; c) eolian deposits and associated paleosols; d) sites close to proglacial and pluvial lakes and along predicted travel routes; and e) exposures of naturally or artificially incised valleys.

While each of these geoarchaeological approaches has been useful to some extent in predicting potential site locations, the inspection of placered montane valleys has been the most immediately productive strategy. Gold placer-mining operations in the 19th and 20th century in some Rocky Mountain valleys in southwestern Montana caused the exposure of Paleoamerican occupations at unexpected depths. Hydraulicking and dredging operations have substantially reduced the size of floodplains and tributary fans that had previously contained buried artifact-bearing deposits (cf. Lyden 1987; Rohe 1985; Spence 1989). The existence of potentially archaeologically significant deposits can be ascertained by close examination of weathered valley-margin scarps.

Present knowledge regarding the location of buried preserved Paleoamerican occupations in the mountains and plains of Montana is limited. Excavations in floodplains along the Upper Missouri National Wild and Scenic River in the plains, for example, provided access to archaeological deposits no older than 3,000 yr B.P. (Davis 1976; Davis et al. 1982). Sites at elevated locations in mountain valleys are seldom older than 5,500 B.P., with the exception of Steel's Pass at 7,500 ^{14}C B.P. (Davis et al. 1995), Myers-Hindman at 9,400 ^{14}C B.P. (Lahren 1976), Sheep Rock Spring at 9,400 ^{14}C B.P. (Wilson and Davis 1994), and others.

To date, Paleoamerican artifacts have been identified in Montana largely as a function of erosion and later recognition by collectors and industrial disturbances such as agriculture and placer mining for gold (Davis and Greiser 1992). For instance, a dredged 7.73-m alluvial/colluvial sequence along the south cutbank of Indian Creek (24BW626) was found to contain 28 stratified prehistoric human occupations, ranging in age from 10,980 to 4,000 ^{14}C B.P. A Folsom complex occupation dated at 10,980 ^{14}C B.P. underlies Agate Basin and Hell Gap

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complex (10,000 ^{14}C B.P.) Paleoamerican occupations (Davis 1986; Davis and Greiser 1992). Glacier Peak tephra was observed in that section underlying the Folsom surface. Had Indian Creek valley fill not been mined in the 19th and 20th centuries, the presence of Paleoamerican artifacts there, especially at such depth, would not have been anticipated.

Another example is provided by Barton Creek, where the valley center was dredged. The oldest charcoal deposit within a 5.85-m section of valley fill along the north valley scarp in Barton Gulch (24MA171) yielded an age of 10,360 ^{14}C B.P. (TX-7822). The initial Paleoamerican occupation, the Alder complex, was dated at 9,400 ^{14}C B.P. (Davis et al. 1989), while an overlying Hardinger complex Paleoamerican occupation was dated at 8,780 ^{14}C B.P. (Davis et al. 1988).

These two lower-Holocene examples suggest that prospecting for deeply buried but now artificially exposed Paleoamerican artifact accumulations, by the inspection of Placered valley margins, is a potentially productive research strategy. The occurrence of artifacts in preserved catchments at such depths may largely explain the dearth of in situ evidence of Paleoamerican occurrences in the northern Rockies.

Central to this geoarchaeological site-prediction approach is the development of models which help to select particular placer-mined drainages to test for the presence of upper-Pleistocene and lower-Holocene sediments which may contain fossils of extinct fauna and Paleoamerican artifact accumulations. The exposed sections at Indian Creek and Barton Gulch did not yield, with the exception of Glacier Peak tephra at Indian Creek, sediments much older than 11,000 ^{14}C B.P. If this were a regional pattern, it might be expected that evidence of post-Clovis-age deposits, but not earlier Pleistocene deposits, would be present. An alternative depositional model would lead to the prediction that earlier deposits are present and may be likely locations to search for Clovis and potential pre-Clovis artifact accumulations. Within specific valleys, the depositional record is a product of both regional-scale (e.g., glaciation) and local geomorphic circumstances. Within the Gold Creek drainage (Loen 1994), for instance, both late-Pleistocene till and postglacial alluvial deposits were mined. The evaluation of these types of exposures for modeling paleotopography may provide a basis for predicting and locating early Paleoamerican artifactual deposits in placered valleys of western North America.

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Late-Pleistocene Volcanic Activity in the Pacific Northwest: Cultural and Environmental Considerations

Loren G. Davis

The environmental influences of volcanic eruptions have been considered in the Pacific Northwest, but poorly applied in efforts to understand regional cultural adaptations to late-Pleistocene environments. With the recent discovery of Paleoindian artifacts in a near-association with the Glacier Peak eruptive event (Mehringer and Foit 1990), consideration of human interaction within a volcanically active environment has gained considerable interest. Efforts directed at reconstructing late-Pleistocene environmental conditions in the Pacific Northwest have emphasized the retreating Cordilleran ice sheet and its influences upon climate and ecology (Bonnichsen et al. 1994). This presentation will highlight aspects of late-Pleistocene volcanism and its implications for ecologic forcing.

Between ca. 13,000 and 10,700 yr B.P. eruptive activity is noted at Mount St.

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Helens (Mullineaux 1986) and Glacier Peak (Fryxell 1965; Porter 1978) in the Cascade Mountains of Washington. These two sources produced several extensive, discrete lobes of tephra, which are distributed throughout much of the region (Carrara et al. 1986; Fryxell 1965; Moody 1978; Porter 1978). The influence of volcanic tephras targets ecologic relationships between flora and fauna, which, if unbalanced, may introduce stress. Human populations dependent upon these biotic components can suffer the effects of tephra falls through an alteration in these subsistence resources (Matz 1991).

The production of sulfuric aerosols has been shown to force climate toward negative values (Devine et al. 1984; Rampino and Self 1984; Rampino et al. 1988; Self et al. 1981). Volcanically forced increases in global albedo have been suggested as a means of instigating glacial advance (Bray 1976; Flohn 1974; Ives et al. 1974). A direct relationship has been shown between volcanic sulfur production, as recorded in Greenland ice (Hammer et al. 1980), and glacial advance in the Northern Hemisphere (Porter 1981, 1986). The volcanic potential for influencing climate has implications for understanding late-Pleistocene glacial instability. The degree of causality, if any, between volcanic activity in the Cascade Range and oscillations of Cordilleran ice is not well understood and almost entirely unexplored.

This brief discussion is offered as a means of promoting the consideration of volcanism in late-Pleistocene reconstructions of both environment and culture process. Research accounting for volcanic activity within late-Pleistocene environments of the Pacific Northwest is needed to fully understand the distinct archaeological record of the region.

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A Model of Potential Marsh Productivity and Implications for Paleoindian Land Use, Warner Valley, Oregon

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The influence of regional environments on human settlement and subsistence strategies at the end of the Pleistocene is much discussed among archaeologists (Kelly and Todd 1988; Meltzer 1993). In the northern Great Basin, however, few detailed studies of Paleoindian adaptations have been conducted (Simms 1988; Willig et al. 1988). The emphasis of these studies has been on early use of locations near remnant shorelines of pluvial lakes (Bedwell 1973; Grayson 1988). Little synthetic work has been done to determine whether Paleoindian adaptations focused on resources associated with the actual lakes, and in most cases detailed landscape studies have not been conducted. Exceptions include the Dietz Site, Oregon (Willig 1988), and Sunshine Wells, Nevada (Beck et al. 1994).

Recent geoarchaeological research in Warner Valley, Oregon, provides additional insight into the relationships between paleo-landscapes and lacustrine productivity. As a means of assessing the distribution of resources that may have been available to the earliest occupants of the area, a landscape model (Figure 1) relating lake elevation and potential marsh productivity has been constructed. Model calculations are based on shoreline mapping at specific lake elevations, combined with those areas of lake having a depth of 1.5 m or less, a proxy for marsh potential. Although an absolute chronology of lake levels has yet to be established, several important generalizations can be made. Topographic con-

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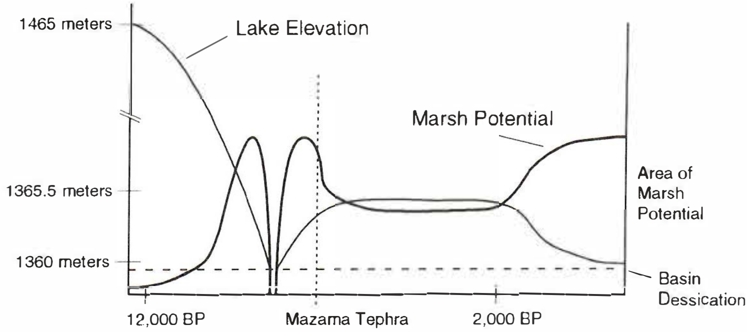

Figure 1. Relationship of lake elevation and area of potential marsh productivity.

straints dictate that few shallow-water environments were associated with periods of deep pluvial lake-stands in Warner Valley. As a consequence, marsh potential was greatly diminished. Prior to total desiccation, however, there would have been periods of increased marsh potential.

The paleo-landscape reconstruction shows that, in Warner Valley, lake and marsh resources would have been diminished in quantity and availability during the late Pleistocene/earliest Holocene. In contrast to models of Paleoindian dependence on lake resources, the Warner Valley landscape model presents an alternative. Campsites may have been located near the lakes, but resource use may have been directed toward mammals attracted to the lakes.

Prior evaluation of early archaeological patterns in Warner Valley is limited, and this research is not intended as a definitive statement of Paleoindian adaptations in the area. The model does, however, provide a means of evaluation of resource bases and their distributions through time and demonstrates the efficacy of such reconstructions for the study of prehistoric adaptation strategies.

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Special Focus—NAGPRA

NAGPRA and First Americans Studies

Alan L. Schneider

In 1990 Congress enacted the Native American Graves Protection and Repatriation Act ("NAGPRA," or the "Act"[1]). NAGPRA was controversial when it was passed, and it remains so to this day. Some of this controversy is undoubtedly due to the profound changes that NAGPRA has made in the way archaeology is (and will be) conducted in this country. Changes of this magnitude are seldom made without profound discomfort and contention. But that is not the only reason for the controversy surrounding the Act. Some of it is also due to uncertainty and misconceptions about what the Act requires and who it affects. The purpose of this article is to clear up a few of these misconceptions and to give archaeologists a frame of reference for identifying and responding to potential NAGPRA situations.

Discussed here are the following issues: (1) who must comply with the Act, (2) what items are subject to repatriation under the Act, (3) who can claim repatriation rights under the Act, and (4) who has the burden of proof in a repatriation claim.

Discussion of these issues will be preceded by a brief overview of the Act and its current enforcement status.

This article is written principally from the standpoint of how the Act relates to First Americans studies. In many respects, however, the issues discussed herein will also be relevant to archaeologists who study more recent time periods. Readers should bear in mind that the views expressed in this article represent the author's interpretation of the Act and its potential impact on First American studies. They should not be taken as the final word, or as all that can be said, on these matters. Readers should also keep in mind that situations not covered by NAGPRA may be subject to regulation under state law or local ordinances. A classic example is the recent reburial of a 10,600-year-old skeleton found near Buell, Idaho. Repatriation and reburial of this skeleton was based upon application of Idaho law, not on NAGPRA. For these reasons, institutions and researchers must

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review carefully the specific facts of each situation when faced with potential repatriation issues.

1. Overview and Current Status

Repatriation. The primary purpose of NAGPRA is to mandate and regulate the repatriation (i.e., return) of Native American and Native Hawaiian "cultural items." To accomplish this objective, the Act establishes a complex set of rules to govern ownership of such items and the steps to be followed in their repatriation. Civil penalties can be imposed on "museums" that fail to comply with their repatriation obligations.[2] In addition, violators can be sued in federal court.[3]

Consultation and Notice. NAGPRA also gives Native Americans and Native Hawaiians certain consultation and notice rights if "cultural items" are disturbed or discovered in the field. If an activity is commenced that would result in the intentional removal or excavation of a "cultural item" located on federal or tribal land, the appropriate tribe or Native Hawaiian organization must be consulted in advance.[4] In the event of an unanticipated or inadvertent discovery, written notice must be given to the appropriate tribe or Native Hawaiian organization.[5] They have 30 days in which to respond. In the interim, all activity in "the area of the discovery" must cease and the "cultural item" must be protected from further disturbance. Except in the case of "an item" located on tribal land,[6] consent of the affected tribe or Native Hawaiian organization is not needed for eventual removal or excavation of the item in question.[7] Violations of these requirements can be punished through enforcement actions in federal court[8] and through administratively imposed civil penalties on noncomplying "museums."[9]

Scientific Study. NAGPRA provides that "cultural items" may be retained for scientific studies that "would be of major benefit to the United States."[10] Items so retained must be repatriated within 90 days after completion of the study. The Act does not define what is meant by the phrase "major benefit to the United States." Nor does it specify what kinds of tests can be conducted, or how long can be taken for completion of a study. These and other details were left for elaboration in administrative regulations.[11] Since such regulations have yet to be adopted, the precise scope of this scientific study exception remains vague.

Current Status. On May 28, 1993, the National Park Service acting on behalf of the Department of the Interior published proposed regulations under the Act. The public was invited to comment on these proposals before final regulations were adopted. Although the public comment period has technically expired, final regulations have not been adopted as of the date of this article.[12] In addition, NAGPRA has not yet been tested in court in any reported decision. As a result, many questions concerning interpretation and application of the Act to specific fact situations remain unanswered.[13]

2. Persons Subject to the Act

Not everyone is subject to NAGPRA. The Act's provisions apply only to: (a) federal agencies, (b) institutions that come within the term "museum," and (c) persons who excavate or discover "cultural items" on federal or tribal land.

Federal Agencies. All federal agencies that have "possession or control" over "cultural items" are subject to the Act.[14] Although the Act does not specifically say so, it is reasonable to assume that its provisions also apply to parties acting under or on behalf of a federal agency (such as contract archaeologists working on a federal contract).

Museums. As used in the Act, the term "museum" means: (a) State and local government agencies; (b) any other institution that receives federal funds.[15] It thus includes privately owned universities, colleges, research centers and other private organizations if they receive federal funds in any form. Institutions that do not receive federal funds are not "museums" for purposes of the Act even though they may possess or control Native American or Native Hawaiian artifacts or human remains. Also excluded is the Smithsonian since it is regulated by its own repatriation statute.[16] Institutions that qualify as "museums" are subject to the Act with respect to any "cultural items" in their possession.[17] It is not necessary that the "cultural items" be traceable to federal or tribal lands. NAGPRA applies to "museums" regardless of where the "cultural items" were acquired.

Other Persons. Also covered by the Act are persons who excavate or discover "cultural items" on federal or tribal land after the date of the Act (i.e., November 16, 1990).[18] It is not necessary that the person be acting for or on behalf of a federal agency or "museum." All persons regardless of their capacity are covered. When used in statutes, the term "person" is generally interpreted to include not only individuals, but also corporations, institutions and other artificial entities.

Comments. Parties who do not fall within any of the above categories are not obligated to comply with the repatriation or the notice and consultation requirements of the Act. For example, private persons conducting excavations on private (or state) land are not subject to the Act.[19] Also generally excluded are collections held by individuals or by institutions that do not qualify as "museums" (at least to the extent that they do not include any "cultural items" recovered from federal or tribal land after November 16, 1990).

3. Items Subject to the Act

NAGPRA applies only to "cultural items." There are five categories of such items: (a) sacred objects, (b) objects of cultural patrimony, (c) associated funerary objects, (d) unassociated funerary objects, and (e) human remains. Regardless of its origins, if an object does not fit within one of these categories, it is not subject to repatriation or other regulation under the Act.

Sacred Objects. As used in NAGPRA, the term "sacred object" has a very specific restricted meaning. To qualify as a sacred object, an item must be more than just an object of veneration. Sacred objects include only those ceremonial objects that are "needed by traditional Native American religious leaders for the practice of traditional Native American religions by their present day adherents."[20] Application of this test to objects found in First Americans contexts will be problematic in most situations. First, even if an object appears to be ceremonial in nature, it will be difficult to determine the object's actual religious significance (if any) to the people who made and used it. Second, it is unlikely that objects of such antiquity will be "needed" for the current practice of traditional religious rites.

Objects of Cultural Patrimony. Application of this category to objects from First Americans contexts will also be problematic. An item is an object of cultural patrimony only if: (1) it has "ongoing historical, traditional, or cultural importance central to the Native American group or culture"; *and* (2) it could not be alienated, appropriated or conveyed by any single individual; *and* (3) it was considered to be inalienable by the Native American group at the time it was separated from the group.[21] Given the great expanse of time and cultural change that separates the Paleoindian period from the present, it will be difficult (if not impossible) to establish the cultural elements needed to meet these conditions.

Funerary Objects. Funerary objects can be either associated or unassociated—the distinction largely depends upon whether they are now separated from the remains with which they were buried.[22] In either case, an item is not a funerary object for purposes of NAGPRA unless it can be reasonably concluded that the object was placed with individual human remains either at time of death or later "as part of the death rite or ceremony of a culture."[23] Under this definition, mere proximity to a burial is not enough to bring an artifact within the coverage of the Act. For example, it will not include artifacts that have come to be "associated" with human remains due to mixing of site deposits or other non-ritual causes. Separating such artifacts from objects that were deliberately placed with a burial should be relatively straightforward in most situations. Where it is not, the burden will be on the repatriation claimant to resolve any questions that may exist since the burden of proof in repatriation cases rests with the claimant (see Section 5 below).[24]

Human Remains. The term "human remains" is not defined in the Act. Under the regulations proposed by the National Park Service, the term has been defined to include not only intact bodies but also parts and remains of bodies (such as bones, tissue, ashes, etc.).[25] This has been interpreted to exclude naturally shed hair not found in a burial context.[26] It remains to be determined whether the same interpretation will be given to other biological materials that may have been shed or intentionally separated from a body during lifetime (such as fingernail clippings, skin peelings, etc.). Another unresolved issue is whether NAGPRA applies to Paleoindian cadavers and skeletal materials. Such items are clearly human remains. It is not entirely clear, however, whether Congress intended to extend NAGPRA to remains and other "cultural items" from such remote time periods. The primary focus during Congressional consideration of the Act appears to have been on remains and objects from more recent periods, and how to reunite them with the modern peoples who have a familial or cultural connection to such items.[27] The legislative history is silent, however, about whether the same concerns were felt for items from more remote time periods.

4. Persons Entitled to Repatriation Rights

Lineal Descendants. Under the Act, lineal descendants have the first right to claim ownership of the remains, associated funerary objects and sacred objects of their ancestors.[28] The Act does not define how descent is to be determined or over how many generations it can be claimed. The regulations proposed by the National Park Service are more specific. They state that a lineal descendant is a person who can trace his or her ancestry to a known individual "directly and without interruption by means of the traditional kinship system of the appropriate Indian tribe. . . ."[29] This seems to imply that each person in the chain of descent must be identified, and that it must be calculated within the context of known kinship systems. If so, this would effectively preclude lineal-descent claims in First Americans situations given the present limitations on our knowledge of early time periods and their populations.

Discoveries on Tribal Land. If there are no lineal descendants, any human remains and associated funerary objects discovered on Native American or Native Hawaiian tribal land can be claimed by the occupying tribe or Native Hawaiian organization.[30] A tribe or Native Hawaiian organization also has priority rights to any unassociated funerary objects, sacred objects and objects of cultural patrimony discovered on its tribal land.

Culturally Affiliated Groups. If human remains or other "cultural items" are not claimed by a person or group having priority rights as noted above, they can be claimed by whichever Native American tribe or Native Hawaiian organization that has "the closest cultural affiliation with such remains and objects. . . ."[31] Under the Act, a claim of cultural affiliation requires proof of "a relationship of shared group identity which can be reasonably traced historically or prehistorically between a present day Indian tribe or Native Hawaiian organization and an identifiable earlier group."[32] This standard has several elements that will be difficult (if not impossible) to meet in First Americans contexts. First, one must link the remains or other objects in question to a specific "identifiable" ancient American group. Second, the linkage between that group and a present tribal group must be established. Third, it must be shown that both groups have a "shared group identity." Establishing such propositions over the long period of time separating the present from the Paleoindian period will be problematic at best.

Other Situations. The status of "cultural items" not covered by the above situations is somewhat murky. The Act provides that if an unclaimed object was discovered on land judicially recognized as having been aboriginally occupied by a tribe, it can be claimed by such tribe[33] unless another tribe can show a "stronger cultural relationship."[34] There are several difficulties in applying these provisions. First, the Act does not define what is meant by the term "cultural relationship" as opposed to the term "cultural affiliation."[35] Second, this section of the Act does not use the terms "remains" and "objects" in a consistent fashion. How this inconsistency will affect judicial interpretation of these provisions remains to be seen. Third, these provisions apply only to those federal lands that were recognized by a final judgment of the Indian Claims Commission or the Court of Claims as having been aboriginally occupied by a tribe. Large areas of the United States are not covered by such a judicial determination. The Act is silent as to the status of otherwise unclaimed "cultural objects" that are discovered in such areas. Presumably this is an issue to be addressed in future regulations.

5. Burden of Proof

Claimant's Burden. Under the Act, a party requesting repatriation of a "cultural item" has the burden of proving that it is entitled to ownership or possession of the item in question. To do so, the claimant must be able to show that: (a) the party currently in possession of the item is a museum or other person subject to the Act, (b) the item in question is a "cultural item" within the meaning of the Act, and (c) the claimant has superior rights to the item. Since NAGPRA claims are civil and not criminal matters, a claimant does not have to prove its case beyond a reasonable doubt. Instead, the relevant standard of proof is a "preponderance of the evidence."[36] This means that a claimant must present sufficient evidence to convince a reasonable person that the claimant is entitled to prevail on its claim.

Relevant Evidence. The Act provides that the types of evidence that can be used to resolve questions of cultural affiliation include "geographical, kinship, biological, archaeological, anthropological, linguistic, folklore, oral traditional, historical, or other relevant information or expert opinion."[37] In ordinary civil cases, evidence encompassed by some of these categories would typically be considered inadmissible because of the rule against hearsay. The Act does not expressly provide that the same types of evidence can also be used to resolve other NAGPRA issues. However, the National Park Service's proposed regulations would apply this expanded evidence rule to kinship issues.[38]

Right of Possession Defense. The Act provides that federal agencies and museums may reject an otherwise valid claim for repatriation if they can prove a "right of possession" to the object in question.[39] In the case of unassociated funerary objects, sacred objects and objects of cultural patrimony, this can be established by showing that the object was originally acquired from a Native American or Native Hawaiian individual or group that had authority to alienate the object.[40] For human remains and associated funerary objects, right of possession can be established by showing that the remains or objects were excavated, exhumed or otherwise obtained with the full knowledge and consent of the next of kin or the "official governing body" of the tribe or Native Hawaiian organization.[41] Agencies or museums asserting a defense of right of possession have the burden of proof on such defense.[42]

Conclusion

The potential impact of NAGPRA on First Americans studies is difficult to predict at this time. Only a small percentage of the artifacts recovered from First Americans sites are likely to fall within the classification of "cultural items." The greatest existing uncertainties are whether ancient human remains will be held to be within the scope of the Act, and if so, what opportunities will be given to researchers to study such remains before they are repatriated. It may be some time before these (and other) issues are finally resolved. In the interim, researchers should proceed carefully when faced with decisions concerning the application of NAGPRA to specific fact situations.

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1. Public Law 101-601, Nov. 16, 1990, 104 Statutes 3048 (hereinafter cited as "Statute"); 25 U.S.C. 3001-3013.
2. Statute, Section 9(a); 25 U.S.C. 3007(a).
3. Statute, Section 15; 25 U.S.C. 3013.
4. Statute, Section 3(c); 25 U.S.C. 3002(c).
5. Statute, Section 3(d)(1); 25 U.S.C. 3002(d)(1). Notice must also be given to the federal agency having primary management authority over the land where the discovery was made.
6. Statute, Section 3(c)(2); 25 U.S.C. 3002 (c)(2).

7. However, compliance with the notice and consultation requirements of the National Historic Preservation Act may also be necessary in the case of sites and activities subject to that statute. For details see regulations in 36 Code of Federal Regulations Part 800. As of the date of this article, those regulations were in process of revision.
8. Statute, Section 15; 25 U.S.C. 3013.
9. Statute, Section 9(a); 25 U.S.C. 3007(a).
10. Statute, Section 7(b); 25 U.S.C. 3005(b).
11. Statute, Section 13; 25 U.S.C. 3011.
12. i.e., as of October 12, 1995.
13. Adoption of the regulations currently proposed by the National Park Service will not necessarily resolve all unanswered questions. Among other things, those regulations do not contain provisions on civil penalties and on the disposition of unidentifiable human remains. In addition, it remains to be seen how the regulations will be treated if they are challenged in court.
14. See, e.g., Statute, Sections 5(a), 6(a), 7(a); 25 U.S.C. 3003(a), 3004(a), 3005(a).
15. Statute, Section 2(8); 25 U.S.C. 3001(8).
16. See National Museum of the American Indian Act, 20 U.S.C. 80 q-11 to 13.
17. Statute, Section 2(8); 25 U.S.C. 3001(8).
18. Statute, Section 3(d); 25 U.S.C. 3002(d).
19. Such activities, however, may be subject to regulation under State law.
20. Statute, Section 2(3)(C); 25 U.S.C. 3001(3)(C).
21. Statute, Section 2(3)(D); 25 U.S.C. 3001(3)(D).
22. Statute, Section 2(3)(B); 25 U.S.C. 3001(3)(B).
23. Statute, Section 2(3)(A) & (B); 25 U.S.C. 3001(3)(A) & (B).
24. Unassociated funerary objects must meet a further test. They must be directly linkable to either: (a) specific individuals or families; or (b) known human remains; or (c) a specific burial site culturally affiliated with a particular Indian tribe. Statute, Section 2(3)(B); 25 U.S.C. 3001(3)(B).
25. Section 10.2(b)(1) of Proposed Rules dated May 28, 1993, Federal Register, Vol. 58, No. 102 (hereinafter cited as "Proposed Rules").
26. Letter dated February 10, 1995, from the National Park Service to the Chairman, The Confederated Salish and Kootenai Tribes of the Flathead Nation; letter dated July 7, 1995, from the Montana State Office of the Bureau of Land Management, United States Department of the Interior, to the Chairman, Confederated Salish and Kootenai Tribes.
27. See Congressional Reports and Comments published in United States Code Congressional and Administrative News, 1990, Vol. 7, p. 4367.
28. Statute, Sections 3(a)(1), 7(a)(5)(A); 25 U.S.C. 3002(a)(1), 3005(a)(5)(A).
29. Proposed Rules, Section 10.2 (a)(14).
30. Statute, Section 3(a)(2)(A); 25 U.S.C. 3002(a)(2)(A).
31. Statute, Section 3(a)(2)(B); 25 U.S.C. 3002(a)(2)(B).
32. Statute, Section 2(2); 25 U.S.C. 3001(2).
33. Statute, Section 3(a)(2)(C)(1); 25 U.S.C. 3002 (a)(2)(C)(1).
34. Statute, Section 3(a)(2)(C)(2); 25 U.S.C. 3002 (a)(2)(C)(2).
35. The regulations proposed by the National Park Service are also silent on this issue.
36. Statute, Section 3(a)(2)(C)(2), 7(a)(4); 25 U.S.C. 3002 (a)(2)(C)(2), 3005 (a)(4).
37. Statute, Section 7(a)(4); 25 U.S.C. 3005(a)(4).
38. Proposed Rules, Section 10.14(d).
39. Statute, Section 7(c); 25 U.S.C. 3005(c).
40. Statute, Section 2(13); 25 U.S.C. 3001(13).
41. Id.
42. Statute, Section 7(c); 25 U.S.C. 3005(c).

Loss of Early Human History to Laws Based on Indian Religion

Clement W. Meighan

One of the perhaps unintended consequences of recent and planned legislation concerning the archaeology of the United States is the fact that the very earliest human sites have not been excluded from any of the laws and statutes, which on the federal level include the Native American Graves Protection and Repatriation Act and the Archaeological Resources Protection Act (Hutt et al. 1992; see also Meighan 1992, 1994). The result is that the thin evidence for the most ancient settlers of our country is being destroyed through reburial. There are many reasons for scholarly concern about this situation:

1) Very few human locations attributable to the late Pleistocene in the New World are excavated and reported. The older a site is, the more likely its contents have been lost to disturbance or deterioration; hence we know thousands of sites of the past 5,000 years for every one that is known to be older. Documented sites older than 10,000 years are remarkably few in number, and when we eliminate from their number those sites which have only a few artifacts, as well as the questionable or partly investigated locations, our knowledge is based on only a handful of studies. For example, the 28-page journal article by Haury et al. (1959) on the Clovis finds at the Lehner site in southern Arizona is still a major source of information on this early culture, and it is to be noted that this site is merely a hunting location with no human remains, no houses or other structures, and a very limited range of human manufactures. Indeed, we do not know much more about Clovis man than that he was a hunter of extinct mammoth. The scarcity of excavated sites is an indication of how limited is our knowledge of early peoples in the New World, and how important is the discovery of new evidence. It is a mistake to treat these sites as of no more value than a site a few hundred years old, and even more of a mistake to assume without question that the humans of these early times were directly related to contemporary Indians, and that they were "ancestors" equivalent to parents and grandparents.

2) The many technical and analytical methods for gaining information about early archaeological sites were nearly all developed with the past 50 years: radiocarbon dating and its refinements, trace-element analyses, and genetic comparison based on DNA, to mention just a few examples. The explosion of these scientific techniques in recent years certainly argues that much better and unimagined methodology will be available in the near future. All these methods require an actual specimen (bone or artifact); they cannot be done with notes, photographs, or plaster casts. Loss of the actual finds therefore closes all possibility for additional studies which are

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essential to answering questions about the early settlement of the New World. We need only consider what a loss it was when the bones of Peking Man disappeared during World War II, when none of the contemporary science was available for the study of such finds. Essential questions will always remain unanswered; the same is true for the early-man material now being lost to political action in the U.S.

While some archaeologists seem unaware that early-human material is threatened, the absence of any time cutoff in federal and state legislation is critical. An extreme example is the find of a human skeleton in a road excavation in Idaho, radiocarbon dated at 10,600 years ago. Skeletons of this age are few and far between; skeletons of this age which have been directly dated by radiocarbon are certainly no more than a handful for the entire New World.

Under Idaho law, however, it was deemed necessary to give this skeleton to the contemporary Shoshone-Bannock Indians, and the remains and a few associated artifacts were reburied, i.e., destroyed. Furthermore, Idaho law requires no demonstration of relationship between Indian claimants and archaeological remains, so anyone claiming to be an Indian can make claims on any archaeological material deemed "sacred," including not only human skeletons but all associated finds. The reburial was condoned and arranged by the State Historic Preservation Office of Idaho—the very name of which indicates its mission is to *preserve* the historical and archaeological resources of the state.

In the case of the Idaho skeleton, who can show any relationship whatever between that ancient human and the contemporary Shoshone-Bannock? All evidence indicates that the Shoshone-Bannock have not been in their present territory for more than 1,000 years or so, but the skeleton dates from over 10,000 years ago, being separated from modern humans by over 400 generations. An essential amendment to NAGPRA and all other burial-related legislation is to establish a time cutoff, which leaves all archaeological materials older than a certain age exempt from "ancestor" claims. Some groups, notably the American Committee for Preservation of Archaeological Collections, have made this argument for years, but it has been routinely ignored by legislators, and regrettably by most of the professional archaeological organizations. Indian activists have prevailed, claiming that all human remains in the New World are "ancestors" to which anyone with any particle of Indian ancestry, from any area of the country, has a legitimate religious and spiritual claim.

Legislation based on this clearly fallacious mythology is an indication of the general lack of time sense and a sense of history on the part of our populace in general and our politicians in particular. The passing of laws based on Indian religion and ignorance of the most fundamental scientific facts is astonishing in a country which is the biggest beneficiary of the achievements of Western science. In a recent article in the *Public Historian,* I commented:

> Historians are, unlike the mass of the people, trained to have a time sense in which they discriminate those events which take place in a generation or two from those which take place over centuries and millennia. They recognize that events which are greatly removed in time have diminishing connections to living people, and that, for example, contemporary Egyptians are not culturally very much like the Egyptians under the pharaohs, even though they are certainly biological descendants. [Meighan 1992:40]

Does it mean anything that the reburied Idaho skeleton represents an individual who lived 5,000 years before the pyramids of Egypt were constructed and over 10,000 years before Europeans discovered the New World?

Aside from the finds which have already been made, some of which have been cared for in museums for over 100 years and are now being given up to Indian claimants, an even more serious threat is in the limiting and prohibiting of research excavations searching for new evidence. Again, this has a disproportionate effect on the earliest sites, since there aren't that many of them known, the sites are often buried or substantially altered, and much intensive and costly excavation is required to define early cultures. "Early man" is, of course, a moving target, and what was considered an early-human site when I was a student is now placed comparatively late in the archaeological sequence.

In calling attention to the effects of anti-archaeology legislation, it must be said that there are some justifications for considering legislation in these areas. So, as far as NAGPRA is concerned, it is exceedingly doubtful that a law based on religion (*any* religion) is constitutional, but archaeologists do not object to reburying the bones of known relatives of living people, and it is a rare circumstance for such bones to be dug by archaeologists in any event. Existing laws governing cemeteries are probably adequate to deal with dead people who have living relatives with some degree of closeness to the deceased.

Instead of factual evidence, the effect of U.S. legislation is to suppress, conceal, and destroy the truth that can come from scientific study and the preservation of archaeological collections. While religious freedom requires that everyone be entitled to believe whatever their faith proclaims, such freedom of belief should not control the actions of those holding different beliefs, and it should not deny the right of scholars to seek the truth according to scientific methods and evidence.

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Information for Contributors

GENERAL INFORMATION

Categories of notes are: 1) Archaeology, 2) Physical Anthropology, 3) Lithic Studies, 4) Taphonomy–Bone Modification, 5) Methods, 6) Paleoenvironments (with subsections: Plants, Invertebrates, Vertebrates and Geosciences), and 7) Special Focus. The last category is reserved for a pre-selected topic for which CSFA solicits manuscripts. No more than 65 papers will be accepted for each issue. Each contributor will have no more than two papers published in each issue, and only one paper as senior author.

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FORM AND STYLE

The following are some preferred abbreviations, words and spellings: Paleoindian (or Paleoamerican), archaeology, ca. (circa), yr B.P. (years before present), early-, mid-, late- (i.e., early-Holocene), ^{14}C (radiocarbon 14; ^{16}C, etc.), in situ, et al., pers. comm., CRM (cultural resource management), and AMS or TAMS (accelerator mass spectrometer technique of radiocarbon dating). Metric units should be used and abbreviated throughout: mm, cm, m, km, ha, m^2, etc.

Numbers should be written out when they start a sentence and when they are numbers one through nine (exception: ". . . researchers recovered 20 choppers, 10 burins, and 2 knives"). Numbers greater than nine should be written as numerals. All numbers greater than 999, including radiocarbon ages, should use a comma (22,000 ± 1,210 yr B.P.; 1,000 years ago; 12,000 mollusks).

Radiocarbon dates should be expressed in ^{14}C years before present (yr B.P.) and should include the standard error and the laboratory number, i.e., 11,000 ± 250 yr B.P. (A-1026).

All underlined and italicized words will be italicized in final form. Use of Latin or common names is acceptable, but include the name not used in parentheses following first usage (e.g., ". . . recovered the dung of the Shasta ground sloth (*Nothrotheriops shastensis).*" If technical jargon or abbreviations are used, provide an explanation in parentheses or use a more common term.

References cited in the text must adhere to the style guide printed in *American Antiquity,* 48 (2):429–442; 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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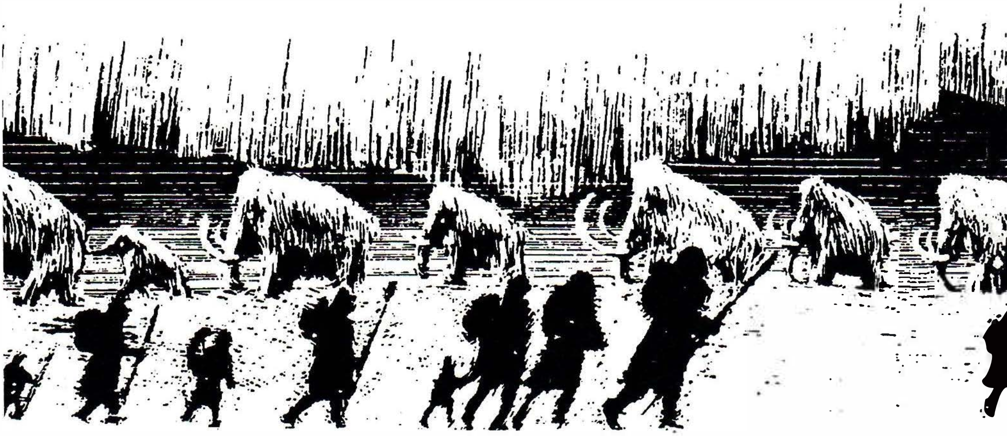

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