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From the Editor

Beyond “Clovis and Beyond”

The “Clovis and Beyond” conference held in Santa Fe late last year was a bellwether event in First Americans studies. It afforded a virtually unprecedented opportunity for scholars along with members of the general public to hear a number of presentations on state-of-the-art Paleoamerican archaeology and to view a truly remarkable selection of artifacts. (If you couldn’t make it to the conference, check out Web page **www.clovisandbeyond.org** for more information.)

While the conference was, for me, an overwhelmingly positive experience and the presentations were uniformly fascinating, I was surprised by a number of statements made by different speakers suggesting an unfortunate degree of provincialism in Paleoamericana. I suppose it shouldn’t come as such a shock in this age of increasing specialization, but I thought it worth a few words of comment.

David Madsen, summarizing the results of a Smithsonian workshop on north Asian/North American connections, argued for the significance of the presence or absence of microblades in the Upper Paleolithic of northwestern Asia vis-à-vis the putative pre-Clovis and Clovis industries of America. In eastern North America, bladelets are a prominent part of the lithic industries at Poverty Point during the late Archaic and the much later Hopewell culture. These eruptions of specialized bladelet production do not appear to be related to each other, and in both cases they have poorly understood antecedents and no apparent successors. Bladelet technology appears more or less abruptly, flourishes for a time, and then is abruptly abandoned. The absence of bladelets in subsequent cultures in no way vitiates our understanding of the essential continuity between the bladelet-using cultures and those that both preceded and followed them in these regions. Adopting a wider perspective on the issue suggests the production of bladelets/microblades is one solution to a set of particular, but not unique (and not necessarily identical), problems posed by the circumstances and constraints of raw material availability, functional considerations, group mobility, and other factors.

David Meltzer presented his thoughts “on Clovis exploration and colonization of new lands.” As one part of the paper, he elaborated on the significance of Paleoamerican artifact caches such as the magnificent Fenn cache on display at the conference. He offered the interpretation that such features would have facilitated the rapid exploration of unknown territory by establishing secure supply depots for Pleistocene pioneers who had not yet discovered local deposits of lithic raw material. This is an interesting notion, but it ignores the fact that similar "caches" are even more typical of succeeding Archaic and many later cultures that had, by then, learned all about the local resources. Therefore, the presence of "caches" need not imply pioneer provisioning. (I have favored the interpretation that many of these caches were ceremonial in nature [Lepper 1999:377], but it has long been recognized that the "ceremonial" label can be something of a dodge reflecting ignorance rather than insight.)

The climax of the conference was Dennis Stanford's keynote address in which he engagingly presented his argument that Solutrean boat people made their way across the North Atlantic to become the progenitors of the Clovis culture. He presented a list of traits shared by both the Clovis and Solutrean cultures and concluded with the plea that researchers "keep an open mind rather than be constrained by the narrow, unimaginative thinking of the past" (1999:54). In a previous essay, I noted that imaginative views on Clovis and Solutrean links have not been limited to modern thinkers. Moreover, colleagues who reject Stanford's hypothesis (see, for example, Clark, this volume) are not necessarily hidebound traditionalists.

A predictable, if unintended, consequence of Stanford's appeal for researchers to be more open to the idea of Solutrean seafaring has been a boost for proponents of pre-Columbian contacts of all sorts between the Old World and the New. For example, the editorial board of the Midwest Epigraphic Society announced in their newsletter that the promulgation of Stanford's ideas "has lessened the political notion of proof and believability for many aspects of the study of pre-Columbian diffusion of culture to the Americas" (Covey 1999).

In a review of claims for various pre-Columbian contacts, MacPherson makes the following trenchant point, equally relevant to Stanford's hypothesis:

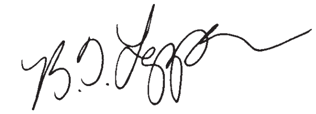
> No evidence exists to substantiate claims for crossing of the Atlantic by Bronze Age Europeans, biblical Hebrews, classical Carthaginians and Romans, early Christians, Jews and Moslems, West Africans, or any others. The strongest argument against such claims is that the mid-Atlantic islands—the real ones—were among the last parts of the habitable earth to be populated and settled: Iceland, in 874; Madeira, after 1420; the Azores, about 1432; the Cape Verde group, after 1460; Ascension, discovered in 1501, not settled until 1815; Saint Helena, discovered in 1506, not inhabited until 1816. (MacPherson 1997:24)

We certainly need to keep an open mind to innovative and imaginative new ideas. And I hope *Current Research in the Pleistocene* can be one forum in which such ideas are presented and debated. But opening our minds to new ideas and interpretations does not mean accepting uncritically claims based on inadequate data or untested inferences.

Cultures can evolve rapidly and sometimes follow converging yet quite independent paths. Lithic technology is not hard-wired in our genes; and similarity between artifacts is not a reliable index of bio-cultural relatedness. We must guard against becoming so narrowly focused on our specialties that we lose sight of the broader archaeological, anthropological, and biological contexts into which our theories must ultimately fit.

The "Clovis and Beyond" conference was a wonderful opportunity to

broaden our perspective and to actually see a diverse selection of the hard data upon which our theories are based. I hope we can do it again soon!



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Archaeology

Results of Continued Surface Collection and Phase II Testing at the Hawk's Nest Clovis (Gainey) Site in Northeastern Illinois

Daniel S. Amick, Thomas J. Loebel, Rochelle Lurie, and Julieann Van Nest

This paper presents an update of earlier work reported on surface collections at Hawk's Nest (11L344), a fluted-point occupation located in an upland plowed field about 40 km northwest of Chicago (Amick et al. 1997; Kullen et al. 1992). Controlled surface collections have continued, and Phase II archaeological testing was conducted in fall 1999 given the landowner's desire to comply with state regulations pursuant to property development plans. Our current knowledge about the site and its significance is largely the result of these repeated surface collections. Most of the stone tools are technologically diagnostic of the Gainey Complex, an early Clovis variant around the southern Great Lakes (Deller and Ellis 1988:255; Simons et al. 1984; Storck 1991; Storck and Spiess 1994:125).

Between January 1992 and December 1999, a cumulative total of 152 chipped stone tools, 6 cores, 10 channel flakes, and 604 waste flakes were collected on a minimum of 29 surveys excepting visits when no artifacts were found. Surface recovery rates ranged up to 17 tools but normally averaged 3–4 tools on each collection. Nearly all these tools are fragmentary and plow-damaged (Mallouf 1981). Controlled excavation of 70 square meters during Phase II work produced an additional 11 stone tools, 6 channel flakes, and 458 waste flakes (Loebel et al. 2000). These artifacts are largely confined to the plowzone, but a few have been located below it, suggesting small pockets of the Clovis component may still remain in situ below the plowzone. This excavated assemblage also contains higher proportions of debitage and small tools indicating bias in the surface assemblage.

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Surface remains are concentrated on a slope adjacent to a wetland basin that probably existed from glacial recession until drainage tile was laid around A.D. 1900 (Curry et al. 1999:15). Backhoe trenching revealed a relatively undisturbed late-Pleistocene/Holocene sedimentary sequence (gray silt underlying black muck) at the margins of the wetland, which contained uncarbonized logs radiocarbon dated to 13,480 ± 110 yr B.P. (AA-36634) and spruce-bearing macrobotanical assemblages (Van Nest 1999). However, organic preservation is extremely poor on the slope surface and plowzone where Clovis artifacts are concentrated about 30–120 m north of the wetland. Excavation yielded sparse charcoal within root casts and a weathered fragment of mineralized bone, which cannot be clearly associated with the Clovis component.

The lithic assemblage now includes 16 projectile points diagnostic of Holocene-era occupations; they differ in lithology from the remaining tools and most of the waste flakes, which we believe derive from the Gainey Complex occupation(s). This Clovis assemblage is composed primarily of cherts found to the south and southwest including (in order of occurrence) unnamed Silurian cherts from 80–110 km south, Moline from 200 km west-southwest, Oneota and Shakopee from 110 km southwest, Burlington and Salem from 245 km southwest, Upper Mercer (tentative) from 500 km southeast, and Attica from 230 km southeast. Bifaces and side scrapers are primarily Silurian and Oneota, while endscrapers exhibit the highest proportion of Moline.

Currently, the Hawk's Nest Clovis assemblage includes 44 fragmentary bifaces, 40 endscrapers, 36 side scrapers, 8 combination end-side scrapers, 17 scraper fragments, 2 flake gravers, 16 channel flakes, 5 tabular bipolar cores, 1 core fragment, 2 hammerstones, 1 hammerstone spall, and 1 anvil stone. Descriptions of Clovis biface manufacture (Bradley 1991; Callahan 1979; Morrow and Morrow 1995; Storck 1997) can be used to classify 39 of these bifaces into production stages: one is classified as Stage 1 (initial edging); five are assigned to Stage 2 (primary thinning), although large sizes suggest these are bifacial core fragments rather than projectile point blanks; two unusual Stage 2/3 bifaces are classified as adze-like tools (Tomenchuk and Storck 1998); 13 bifaces are assigned to Stage 3 (secondary thinning and shaping); four exhibit basal fluting platforms and are classified as Stage 4 (prepared for fluting); 13 bifaces show evidence of at least one flute removal and are classified as Stage 5 (fluted preforms); and only one can be classified as a Stage 6 biface (finished fluted point with margin grinding). These proportions suggest that Stage 2 or Stage 3 Clovis bifaces may have been transported to the site, where subsequent thinning and fluting operations took place. These activities suggest that Clovis groups at Hawk's Nest may have anticipated the need for stone projectile points at a nearby hunting location. However, a range of activities related to secondary processing from a recent kill is suggested by substantial numbers of side scrapers, endscrapers, and other tools.

We originally thought the site was consistent with patterns of generalized foraging, but the growing assemblage size and its distinctive content suggest a place that was repeatedly used as a transient camp during extended hunting forays (perhaps seasonal) within this region. Such functional inferences will

require further testing but are consistent with current models that suggest Gainey settlement-subsistence is dependent upon the logistical hunting of caribou (Deller and Ellis 1988:255; Simons et al. 1984; Storck 1991; Storck and Spiess 1994:125).

Special thanks to the landowners and 70-plus excavation volunteers from the local community and the Sauk Trail, South Suburban, and Kenosha Archaeological Societies, as well as to students and faculty from Loyola and the University of Illinois at Chicago. Our excavation efforts would not have been possible without your help. Thanks also to Julieann Van Nest and Steve Forman (UIC) for contributions to understanding the quaternary geomorphology at the site.

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Patterns of Toolstone Use in Late-Pleistocene/ Early-Holocene Assemblages of the Mojave Desert

Mark E. Basgall

Paleoindian flaked-stone assemblages from the Desert West, notable for high variation in patterns of material use, consistently show more diverse toolstone profiles than those dating to subsequent periods and frequently reflect preferential use of certain raw materials for specific artifact forms. These patterns relate in part to high levels of residential mobility and consistent curation of some tool classes, but also imply functional imperatives based on toolstone durability and resilience. Beck and Jones (1990), for example, find evidence suggesting that crescents and scrapers were routinely manufactured from silicates, irrespective of source distance, while projectile points and bifaces show no obvious lithic preferences. Material profiles from the Black Rock led Amick (1995) to question the latter premise, showing an asymmetrical reliance on non-local obsidians for point production. Late-Pleistocene/early-Holocene assemblages from the northern Mojave Desert are assessed with respect to raw material use profiles.

Data examined in this paper derive from 11 Lake Mojave components within Nelson Lake basin at Fort Irwin, San Bernardino County, California (Basgall 1993). Characterized by both Western Stemmed and Great Basin Concave-base projectile points, bifaces and refined scrapers (formed flake tools), simple flake- and core-tool forms, general flake cores, and abundant chipping debris, chronometric indicators place these occupations between ca. 11,000 and 7,000 yr B.P. (Basgall 1993, 1995; Basgall and Hall 1994). The artifact sample includes some 2,576 formed artifacts and 82,196 pieces of unmodified debitage (Table 1). For purposes of this examination, cryptocrystalline silicates are broken into "local" and "other" groups. The former, of variable quality, are abundant within local alluvial deposits and were presumably acquired from geologic sources within the basin. Other cryptocrystallines, generally of very high quality, represent materials known to be absent (or unrecognized) within nearby toolstone deposits. Remaining material groups include volcanics (basalt, felsite, rhyolite, obsidian) and quartzitics (quartz, quartzite). Artifact-quality basalt is abundant within the basin; quartzitics occur occasionally in local alluvium; felsite and rhyolite are extremely rare or absent in the area. Chemical assessment of obsidian from these components ascribes most artifacts to the Coso Volcanic Field (110 km NW), with about 8 percent of the material provisionally attributed to a source in the Saline Range (160 km N/NW).

Tool-debitage ratios from Nelson Lake are consistent with the expectation that locally available basalt and cryptocrystalline materials provided the focus of on-site reduction activities (Table 1); both are represented by 2–10 times

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Table 1. Flaked stone material profiles by class, Lake Mohave components, Nelson Basin.

Material	PRO	BIF	FFT	SFT	CRT	DEB	Total	Tool:Debitage
CCR-L		14	182	237	67	93	14481	15074 1:24.4
CCR-O		7	39	120	23	29	925	1143 1:4.2
Basalt	26	1275	129	116	64	65462	67072	1:40.7
Felsite	15	13	4	5	-	321	358	1:8.7
Rhyolite	16	32	7	2	2	290	349	1:4.9
Obsidian	12	29	1	4	-	626	672	1:13.6
Quartzitic	-	2	8	1	2	91	104	1:7.0
Adjusted Residuals: All Artifact Classes (X^2 = 4729.64, df = 30)								
CCR-L		-0.55	-6.49	17.14	5.01	11.25		-7.06
CCR-O		5.29	3.93	43.76	11.79	16.65		-31.79
Basalt	-11.73	1.96	-29.77	-9.42	-15.43	21.08		
Felsite	23.78	2.50	1.28	4.26	-0.90	-8.06		
Rhyolite	25.74	10.15	3.42	1.17	1.38	-15.12		
Obsidian	13.42	4.75	-1.51	1.74	-1.23	-5.77		
Quartzitic	-0.33	0.05	9.40	1.42	3.67	-5.62		
Adjusted Residuals: Formed Artifacts Only (X^2 = 1086.73, df = 24)								
CCR-L		-1.71	-17.26	14.20	2.83	8.82		
CCR-O		-0.24	-13.65	13.75	1.16	3.50		
Basalt	-6.70	24.41	-19.18	-2.96	-8.52			
Felsite	12.36	-3.25	-1.36	1.11	-1.73			
Rhyolite	9.99	-1.08	-1.52	-1.42	-1.18			
Obsidian	8.42	0.28	-3.01	0.06	-1.93			
Quartzitic	-0.69	-3.38	3.81	-0.10	1.11			

Note: PRO, projectile point; BIF, biface; FFT, formed flake tool (cf. refined scraper); SFT, simple flake tool (cf. edge-modified flake); CRT, general flake core/core tool; DEB, debitage; CCR-L, local cryptocrystalline silicates; CCR-O, other (non-local) cryptocrystalline silicates.

the amount of chipping debris as other material groups. A chi-square statistic further indicates significant differences in the proportion of raw material types among different artifact classes. An analysis of residuals can be used to identify which toolstones are over- and under-represented among specific classes assuming a random, uniform distribution (values in excess of 1.96 significant at the 0.05 level, positive or negative trends indicating the direction of deviation [cf. Everitt 1977]). Looking first at the inclusive assemblage, including debitage, only basalt is over-represented among debitage; remaining toolstones occur in less than expected frequencies, with non-local cryptocrystallines and rhyolites especially rare in the sample. Adjusted residuals for formed artifacts only highlight preferential use of certain materials for specific tool forms or technological strategies. Cryptocrystalline silicates are under-represented among both projectile points and bifaces, being especially abundant among formed flake tools (scrapers) and cores/core tools; significantly, locally available silicates are better represented among simple flake implements (edge-modified flakes) and cores/core tools than non-local varieties. Basalt, by contrast, occurs almost wholly as bifaces, under-represented in all other artifact classes. Other volcanics (felsite, rhyolite, obsidian) are over-represented only among projectile points, proportions in other tool classes conforming to chance (excepting obsidian formed flake

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1A2, a West Texas Cody Campsite

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Site 1A2 is located in a dunefield on the Southern High Plains in Andrews County, west-central Texas. Richard Rose discovered the site in 1981, and surface collections were made during erosional episodes through 1998. Most of the artifacts were found in the 1980s. A total of 23 identifiable projectile points, all but two manufactured from Edward's chert, were recovered representing Midland (n = 2), Goshen (n = 1), Firstview (n = 8), and Archaic notched and stemmed points (n = 12). A tip and blade fragment represent an undetermined Paleoindian point type. A late-stage Cody preform was also recovered.

A variety of formal tools including endscrapers (n = 161), a side scraper, convergent scrapers (n = 3), limaces (n = 12), gravers (n = 5), and bifaces (n = 7) occurred in a limited area of the site that yielded only Cody points (Fig. 1A) and are associated with the Cody component. The vast majority of the tools were manufactured from Edward's chert with the exception of 10

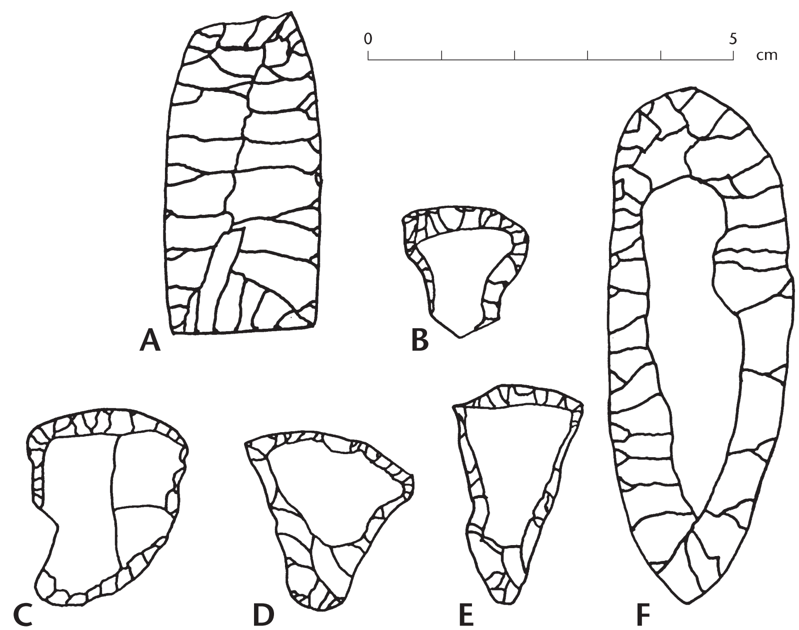

Figure 1. 1A2 Cody component tools. **A,** Firstview point; **B–E,** endscrapers; **F,** limace.

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chalcedony end scrapers, 2 chalcedony bifaces, 1 obsidian biface, and 2 unidentified chert endscrapers. In all, 198 formal Cody tools are represented at 1A2 indicating a wide range of activities suggestive of a camp/processing area.

The endscrapers (Fig. 1B–E) are comparable to those documented at other Cody sites such as Claypool (Dick and Mountain 1960), Horner (Frison 1987), Jurgens (Wheat 1979), Niska (Meyer 1985), and R-6 (Stanford and Patten 1984) as well as the Folsom Elida site (Hester 1962, Warnicka 1961) and Lindenmeier (Wilmsen and Roberts 1972). Hester (1962:105) describes the Elida endscrapers as similar to the 1A2 sample and characterized by "their small size and the tendency for the subtriangular form to possess definite points on the perimeter, scraping edge, and occasionally at all three corners." Endscraper size at 1A2 is variable, with length ranging from 4.96 to 1.56 cm (x = 2.6, n = 139), maximum width 3.57–1.21 (x = 2.07, n = 154), and maximum thickness 1.27– .29 (x = .69, n = 158). The small size may be in part a function of distance from source, a situation similar to Elida, Claypool, and Niska. The majority of endscrapers (83 percent) are complete, reworked, and heavily worn. Half of the endscrapers are spurred (n = 86, 53 percent) and of these, 43 have a single spur and 43 specimens have two spurs, also characteristic of the Niska endscrapers. One of the 1A2 endscrapers was broken and could be refit. This is similar to several endscrapers documented by Stanford and Patten (1984) at R-6 suggestive of intensive use and reworking. Shott (1995) has shown spurs to be correlated with small, reworked end scrapers.

End scrapers and limaces (Fig 1.f) are the dominant tool forms at 1A2 and represent processing activities perhaps associated with a bison kill yet to be discovered. The Cody assemblage is unusual for the abundance of end scrapers and is distinct from other Cody sites such as Seminole Rose (Collins et al. 1997), a probable kill site, which is dominated by projectile points. Such complementary assemblages may simply reflect sampling windows of extensive sites rather than distinct site types.

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Deconstructing the North Atlantic Connection

G. A. Clark

This short, informal essay constitutes a reaction to the "North Atlantic Model" for the initial colonization of the New World proposed recently by Dennis Stanford and Bruce Bradley at the Clovis & Beyond Conference in Santa Fe, New Mexico (October, 1999).

As I understand it from newspaper accounts (e.g., Wilford 1999), a report on the conference (Holden 1999), and the Smithsonian Web page (mnh.si.edu/arctic/html/ancient.html), Stanford and Bradley are proposing that the New World might have been colonized from the east by maritime Solutreans from northern Spain, who emigrated from that area during the last glacial maximum (c. 18 kyr B.P.) in skin boats, skirting the edges of the pack ice that surrounded Iceland and Greenland and covered much of the Arctic Ocean during glacial pulses. Stanford has felt for a long time that maritime colonization models in general have been overlooked or de-emphasized in favor of those focusing on the Bering Land Bridge, the most generally accepted model and the one best supported empirically (e.g., papers in West [1996], Straus et al. [1996]). However, most of his previous arguments have had to do with the colonization of the Pacific Rim (e.g., Stanford 1983; mnh.si.edu/arctic/html/ancient.html).

The notion of a Solutrean-Clovis connection, which goes back to the 1930s with Frank Hibben's long-discredited Sandia culture (e.g., 1941), seems to be based on three things: (1) the apparent lack of technological and typological antecedents to Clovis in North America and Siberia; (2) specific typological similarities between big foliate bifacial points made on blades and found in Solutrean and Clovis sites, and (3) what Stanford believes to be a wealth of technological parallels, including *outre passé* or overshot flaking, particular kinds of endscrapers, bone foreshafts, engraved limestone tablets, and point caches associated with red ochre—all supposedly unique to these two archaeological constructs. Here I try to deconstruct the logic of inference underlying the arguments of Stanford and Bradley, and also offer some observations on the empirical support for them (see also Lepper [1998],

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Sellet [1998]). To put it bluntly, there is absolutely no empirical support for any kind of a Solutrean-Clovis connection. There are three major obstacles to such a connection.

First, there is a time gap of at least 4,500 years between the latest Iberian Solutrean, well dated radiometrically to c. 16,000 years ago (e.g., Straus 1990), and Clovis, equally well dated to around 11,500 (e.g., Frison and Bonnichsen 1996). The intervening time interval in Spain is filled with the variously subdivided Magdalenian and Azilian, neither of which exhibits much in the way of bifacial flaking, although there's just enough of it to indicate that they could do it when they wanted to.

Second, there is the North Atlantic obstacle, a not inconsiderable body of water that Stanford thinks could have been crossed by Solutreans in skin boats in as little as two weeks. This scenario apparently involves Solutreans being "pushed toward the coast" by severe glacial conditions, encountering pack ice, and following it north and west along its southern fringes until they eventually arrive in Nova Scotia, living on seabirds, fish, and marine mammals during a voyage that would have covered a distance of at least 5,000 km. However, we know a great deal about Solutrean adaptations to the coastal environments of northern Spain, and—as Lawrence Straus pointed out recently in a *Science* interview—there is no evidence whatsoever that they exploited marine resources to any great extent, no evidence of watercraft of any kind or of marine species that would imply their presence, no evidence that they were able to undertake 5,000-km cruises (see Clark and Straus [1983] for an overview of north Spanish Solutrean adaptations). There is also the issue of what the itinerant Solutreans might have used for fuel during the crossing (unless they were eating everything raw) and, of course, what might have provoked these voyages in the first place. A relatively rapid east-to-west crossing of the North Atlantic would have to contend with the Rennell's Current, a very strong west-to-east-trending branch of the Gulf Stream (Houston 1967). The Rennell's Current kept the Cantabrian coast relatively warm and moist throughout the Tardiglacial (Clark 1983).

Finally, there is Stanford and Bradley's normative conception of the Solutrean itself—what a Solutrean assemblage "looks like" and how it might be defined technotypologically. Although one might think they would know better (esp. Bradley), *there is an enormous amount of equifinality in lithic reduction,* technology and typology do not necessarily co-vary with one another, and bifacial foliate points are found all over the world and through time, at least from the late Pleistocene on. Bifacial foliate artifacts that resemble Solutrean points (and *CRP* readers should keep in mind that Solutrean points themselves exhibit a wide range of variation) show up in the pottery Mesolithic of Russian East Asia, well dated to c. 13,000 years ago (e.g., papers in Kononenko [1996]); in the central European Mousterian, and in European Russia (the famous *blattspitzen*—Bordes 1968); in the paleolithic of China (e.g., Yi and Clark 1983, 1985); in the MSA of South Africa (e.g., Clark 1982), in pre-Dynastic Egypt (e.g., Butzer 1978), not to mention post-Clovis Paleoindian artifacts in the New World.

Solutrean and Clovis points are neither technologically nor typologically

unique, are not confined to a particular time interval, do not conform to rigid design constraints, and cannot be used to document historical connectivity. So tracking the prehistoric peregrinations of Soluteans from Iberia to the New World by tracking formal similarities in Solutrean and Clovis points is simply not credible. The other supposedly diagnostic artifacts (end-scrapers, foreshafts, plaquettes) are even less distinctive and are ubiquitous in the Upper Paleolithic of western Eurasia. Solutrean assemblages as a whole bear no specific resemblances to Clovis.

I suggest that what we think of as "Solutrean" and "Clovis" are fairly visible parts of a universal technology related to big-game hunting. The formal convergence in big foliate points can be explained completely and unambiguously in functional terms. They show up with a certain frequency in times and places where big-game hunting is practiced; they only make up part (albeit a highly visible part) of much broader technocomplexes that comprise artifacts bearing no specific resemblance to either Clovis or Solutrean; and they only occur in areas where relatively fine-grained cryptocrystalline rocks are available in large enough chunks to make big blade blanks.

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Paleoindian Points in North Carolina

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The following is an update on a Paleoindian point survey I recently began in North Carolina. Presently, the point sample consists of 189 points, including 83 previously described points (Perkinson 1971, 1973). Geographically, Paleoindian points were recorded in 64 of North Carolina's 100 counties—spanning every geographic region in the state (i.e., Coastal Plain, Piedmont, and Mountains) (Figure 1). Most counties have two or fewer specimens, with Granville County having a sample high 15 points. Point distribution is particularly concentrated in the central and eastern portion of the Piedmont and along the Fall Line. In the Coastal Plain and Mountains, concentrations tend to parallel major river valleys. The Piedmont concentration may be related to greater surface exposure (i.e., more eroded soils) than the other regions. Yet this distribution likely reflects some prehistoric reality, since the eastern Piedmont is the source of the best knappable stone in the state (Gardner 1983; Goodyear et al. 1990).

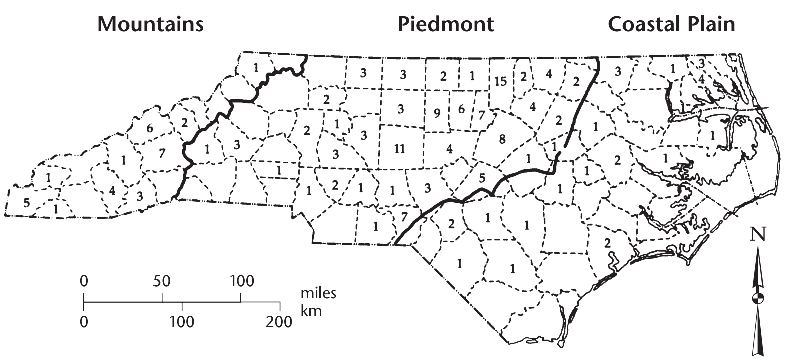

Figure 1. Distribution of Paleoindian Points in North Carolina by county.

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Metavolcanic stone (n = 96) dominates raw material types, and these points tend to concentrate in the Piedmont (n = 69). In particular, several points were probably made from Uwharrie rhyolite, which represents the best-known raw material source in the state (Daniel and Butler 1991, 1996). Relatively few quartz points (n = 17) are present in the assemblage, undoubtedly because of the high variability in quartz knapping quality and the difficulty in recognizing fluting on these small specimens. Chert (n = 53) represents a variety of cryptocrystalline materials such as jasper and chalcedony. These materials almost certainly originated from several as yet unidentified sources located outside North Carolina; however, several specimens appear to be a Knox variety that occurs in eastern Tennessee. Roughly equal frequencies of chert points were recorded in the Mountains (n = 22) and Piedmont (n = 21) despite the fact that the Piedmont covers more than twice the area of the Mountains. Lesser chert quantities (n = 10) were recovered from the Fall Line/Coastal Plain. In any case, the presence of chert points in these regions possibly reflects the movement of groups there from outside the state. The last raw material category in the collection is a residual "other" category (n = 20), which includes a few examples of several materials such as quartzite and crystal quartz.

Given these data, one might speculate that Paleoindian settlement was centered in the Piedmont, with some movement into the Coastal Plain along the major waterways between the two regions. Occupation of the mountains, on the other hand, appears unrelated to the Piedmont and Coastal Plain. The apparent absence, for instance, of Tennessee cherts in the Piedmont and Piedmont rhyolite in the Mountains bespeaks an absence of movement or contact between the regions.

To date, point classification has been largely subjective, based upon morphological forms recognized elsewhere in the Southeast. Clovis (n = 109) was the predominate form identified in the survey and was recorded in every region of the state. While this category generally corresponds to the Southwestern form, it does not represent a uniform type, particularly with respect to basal shape. The exact significance of these variations in basal shape is unknown; however, one might suggest that they represent both Clovis and post-Clovis phenomena.

A Clovis variant (n = 35) represents the second most frequent type category (e.g. Anderson et al. 1990; Goodyear et al. 1990). This type name categorizes any small (less than 50 mm long) fluted or basally thinned lanceolate point identified by a pentagonal or triangular blade; it is also less well made than the larger Clovis-like forms. While this type may represent a late Paleoindian manifestation (Gardner and Verrey 1979), some may also represent specimens heavily reworked from more recognizable forms (see Goodyear et al. 1990). Clovis variants are most common in the Piedmont (n = 21) and occur with much less frequency in the Mountains (n = 5) or Fall Line/Coastal Plain (n = 9).

A distinctive fluted form similar to the mid-South Redstone type (Mason (porcupine), and *Bison* sp. This humanly collected suite of utilized birds and small mammals seems to square with a possible Folsom occupation rather than one by Clovis hunter-gatherers. The co-associated lithic artifact macro- and microdebitage assemblage (7,474 flakes and 17 tools), described in detail and analyzed technologically and functionally from a formational perspective by Baumler (1996), yielded no additional clues to the cultural identity of this informative, stratigraphically discrete Folsom secondary refuse-discard surface feature. Distinguished were 21 lithic raw material groups (based on lithology, color, texture, and other macroscopic properties) selected by knappers for Folsom tool production upstream and maintenance (Baumler 1996) in contrast with those that characterize lithic selection for downstream Clovis Occupation 1: chert, chert/silicified sediment, obsidian, quartz crystal, quartzite, and agate versus Madison chert, olive-green chert, dark brown agate, and silicified limestone, as described by Greiser (Davis and Greiser 1992:239). Inter-locality variability as between the separately interpreted artifact functional classes might also be explainable by spatially related differential task performance, a possibility not yet fully examined.

The stratified Paleoindian occupations, sampled at two laterally separated and two different vertical scales at Indian Creek, are incorporated within a series of braided-stream and fan deposits that accumulated within a moderate-gradient, narrow bedrock-confined mountain valley (Albanese 1985; Ottersberg 1987). The archaeological stratigraphic samples are thus necessarily intercorrelated to derive an integrated time-stratigraphic-occupational sequence for the Indian Creek site section (irrespective of locality): pre-Clovis Glacier Peak tephra, c. 11,100 yr B.P.; Clovis-age, c. 11,000 yr B.P.; Folsom-age, c. 10,680 and 10,400 yr B.P.; Agate Basin, age indeterminate; and Hell Gap/Haskett, c. 10,000 yr B.P.

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Towards the Testing of the Null Hypothesis for the Origins of Amerindians

German V. Dziebel

The archaeological picture of the human presence in the Americas remains inconclusive in view of the lack of technological parallels between Clovis bifaces and late-Pleistocene Siberian or East Asian assemblages. Alternatively, microblade industries that distinguish the Siberian Paleolithic beginning 23,000–20,000 yr B.P. are absent in the Americas.

The fact that Clovis-type industries tend to become younger and decrease in diversity and frequency in British Columbia and Alaska along the putative ice-free corridor further complicates the situation. Some archaeologists (Bryan 1991:21; Clark 1991; Dixon 1993:119; Müller-Beck 1967) suggest that a reverse south-to-north population movement from transglacial Alaska is no less possible than the traditional conception of Siberian hunters entering the New World from the northernmost tip of Asia. The recent discovery of an Americanoid fluted point at the Uptar site in northeast Siberia dated to 8,300 yr B.P. [^{14}C] (King and Slobodin 1996), together with other Holocene complexes from the Northeast and the Amur River Basin (Ushki VII–VI, probably no earlier than 10,500 yr B.P. (Kuznetsov 1994:142); Osipovka; Serdyak; Avlondya, Ust'-Belaya; Novopetrovka; Khin'skaya; Glazkovo; Kullaty; Serovo; and others featuring bifacial points similar to the earliest American cultures—occasionally with the diagnostic fluting (cf. Chard 1974; Derevianko 1969; Tolstoy 1958)—led some researchers to hypothesize a reverse migration (technological diffusion) from America into Siberia in the early Holocene (Bryan 1978:309; Chard 1959; Dikov 1979a, 1979b; Hicks 1998; Slobodin 1999:487; Tolstoy 1958). One should also bear in mind that the only Asian late-Pleistocene/early-Holocene skull that shows distinct affinities with American Indian crania, namely the Upper Cave Zhoukoudian (Neves

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and Pucciarelli 1998), is probably *younger* (10,600 yr B.P.) (Kamminga 1992) than Clovis.

The emerging startling controversy in American archaeology is therefore that the Clovis culture long believed to have originated in the New World (Krieger 1964:55) shows not a population expansion from Asia but a migration from America into Asia across the Bering bridge. Paradoxically, *the Clovis First paradigm is in need of pre-Clovis sites in order to demonstrate archaeologically that America was actually peopled from the Old World.*

The lack of reliable archaeological sites in pre–14,000 yr B.P. America is consistent not only with the lack of human occupation but equally with small population size, isolation, and certain patterns of mobility among the earliest Americans. A single archaeological site in a region occupied by small isolated demes would be as important as a series of sites left by a rapidly growing or stable large population. Alternatively, the paucity of lithics in the American archaeological record is consistent not only with the lack of human presence but equally with a pattern of economic adaptation marginal in the Old World Pleistocene, namely, the one that lays emphasis on perishables (bone, wood, bark) on the one hand, and "soft" practices (foraging, trapping, driving) on the other. Thus the sudden proliferation of sites throughout the Americas around 12,000 yr B.P. may represent "the upper part of a sigmoid curve, with the base of the curve lying well back in the middle Pleistocene" (Gruhn 1997:30). The recent acceptance of Monte Verde II raises the probability that other pre-Clovis sites such as Cactus Hill (16,000–15,000 yr B.P.), Meadowcroft Rockshelter Stratum II (15,000–13,000 yr B.P.), Pendejo Cave (25,000–12,000 yr B.P.), Monte Verde I (33,000 yr B.P.), Pedra Furada (40,000 yr B.P.) indeed mark the presence of early inhabitants in the Americas.

The belief that humans colonized the Americas from Asia penetrated European consciousness well before science could give it any empirical or theoretical support. Since then the accumulation of data has been oriented towards making the evidence *compatible* with this assumption; as a result, the *null hypothesis* has never been adequately tested. For the history of any geographically distinct region, the null hypothesis boils down to the assumption that its population is not derivative of any other population. The lack of conclusive evidence for the peopling of the Americas from any Old World location is coupled with continuing uncertainty about the origins of living humans in the Old World (Smith and Harold 1997) to the effect that the discussion of the origins of Amerindians should be more sensitive to the necessity of noncontroversial rejecting of the null hypothesis for this continent. It seems that Pleistocene archaeology can greatly benefit from adopting the long-standing and well-supported tradition in population genetics (Chakraborty and Weiss 1991; Neel 1970; Ward 1997) to treat Amerindians as exemplary of the earliest human adaptive condition.

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A Stratified Association of Mammoth Remains and Archaeological Materials at Running Springs, San Miguel Island, California

Jon M. Erlandson

California's northern Channel Islands have produced numerous associations of pygmy mammoth (*Mammuthus exilis*) bones and possible evidence for human occupation (e.g., Berger 1982; Orr 1968). These associations, some dated in excess of 40,000 R.Y.B.P., remain poorly documented and are viewed skeptically by most scholars (i.e., Erlandson 1994; Moratto 1984). However, as the chronological gap between extinction of the mammoths and the arrival of humans narrows, it seems increasingly likely that credible associations of mammoth and archaeological remains will be found. The youngest well-dated mammoth remains now date to about 12,500 [rc] yr B.P., while the oldest evidence for human occupation dates between about 10,500 and 11,000 [rc] yr B.P. (Erlandson et al. 1996; J. Johnson et al. 1999).

Running Springs on San Miguel Island is an excellent place to search for such associations (D. Johnson 1972), with abundant fresh water on an arid island, stratified sediments that span the Pleistocene-Holocene transition, and numerous mammoth fossils and archaeological sites. Several eroding gullies also provide extensive stratigraphic exposures with new material exposed annually, areas I have been monitoring for several years. In 1995, a concentration of calcined mammoth bone and charcoal associated with a burned soil—but no archaeological materials—was noted eroding from Pleistocene sediments in a gully wall near the west end of Running Springs. About 5 m farther up the gully, an unburned mammoth tooth was also found in situ about 25 cm below the ground surface.

In 1998, I found a second mammoth tooth eroding from the same gully wall within a meter of the first tooth. Scraping the profile to expose the stratigraphy, I found a large flaked core tool completely embedded in the sediment and in direct contact with the mammoth tooth. The tooth and this heavily battered core tool were found in stratified tan sediments 25–35 cm below the surface. Similar core tools made from volcanic beach cobbles are common in sites on northwest San Miguel Island and do not appear to be temporally diagnostic.

Knowing the complex depositional history of many Channel Island localities, and the poorly documented claims for similar associations, I examined the stratigraphy and structure of this locality more closely. At the same level as the tooth and core tool, I found several small mussel (*Mytilus californianus*) shell fragments oriented along a paleosurface sloping gently uphill. Five meters up this slope was a small midden 5–10 cm thick of densely packed marine shells. Eroding from the edge of the midden were numerous large

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mussel and limpet (*Lottia gigantea*) shells and several pieces of chipped stone debitage. This shell midden formed in gray-brown silty clay soil not present where the tooth and core tool were found. A mussel shell found next to the tool, however, had this dark soil in its concave interior, suggesting that it and probably the core tool were derived from the midden up slope. Thus a stratigraphic unconformity seems to separate the light-colored mammoth-bearing sediments from the darker archaeological soil, with constituents from the two mixed on an erosional paleosurface.

I was intrigued by the similarity of these associations to several Santa Rosa Island localities Orr (1968) described as containing mammoth bones, chipped-stone artifacts, and small amounts of marine shell. With an opportunity to examine how stratified associations of paleontological and archaeological materials of different ages could form, I collected a large mussel shell from the intact shell midden. Submitting this shell for ^{14}C dating, I expected a middle- or late-Holocene date to confirm my idea that the materials were spatially but not temporally associated.

Instead, analysis of the well-preserved shell produced an uncorrected date of 8940 ± 140 [rc] yr B.P. (Beta-130893), a $^{13}C/^{12}C$ adjusted age of 9380 ± 140 [rc] yr B.P., and a calendar age of approximately 9900 [cal] yr B.P. Except for Daisy Cave components dated to c. 10,600 and 9400 [rc] yr B.P. (Erlandson et al. 1996), the Running Springs site is the oldest shell midden currently known on the Channel Islands. This early date also raises the possibility that spatially associated mammoth bones and archaeological remains at the site may also be temporally and functionally related, or that other site deposits might produce evidence for the contemporaneity of mammoths and humans on San Miguel Island. Further research is required to verify such associations, however, and additional study of the Running Springs site is planned.

Even if the mammoth remains and shell midden are not contemporaneous, the presence of a 9,900-year-old shell midden at Running Springs adds to the evidence for a very early occupation of the Channel Islands by maritime peoples. This small inconspicuous shell midden is exactly what the earliest island campsites should look like if they were left behind by small, mobile groups of people. Until California archaeologists pay more attention to such small low-density sites, we are unlikely to learn much more about the earliest inhabitants of the area.

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New Evidence for Early Occupations in the Argentine Pampas, Los Helechos Site

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A long-span occupation has been reported during the last two decades for the Argentine Pampas (Politis 1989). Clearly represented in the sequence is an early component in the Tandilia Range with dates corresponding to the late Pleistocene–early Holocene (for example, Flegenheimer and Zárate 1997, Mazzanti 1997, 1999). Twenty dates are reported, which range between 11,150 and 8,060 yr B.P., yet most of the sites are dated between 10,000 and 11,000 yr B.P. Other early sites reported in the surrounding plains are Paso Otero 5 in the Quequén Valley and Arroyo Seco site, 50 and 100 km from Tandilia (Martínez 1997; Politis 1989).

The greatest distance separating the nine early sites excavated in Tandilia is 50 km; there are both open-air sites and rockshelters. Lithic assemblages include a variety of unifacial artifacts, such as side scrapers, gravers, scraper planes, etc. Strategies of intensive toolstone use, such as point rejuvenation and recycling and bipolar reduction, are present. Bifacial reduction is represented at most sites by fishtail points and bifacial reduction flakes and sometimes by other artifacts as well. Ground stone tools, though scarce, are characteristic. Where faunal remains are preserved, they include both extinct Pleistocene and living species, yet organic remains are lacking at most sites.

Before the 1980s, few sites had been excavated in the Tandilia range and the Quaternary stratigraphy of the area was not well known. Later geoarchaeological research showed that the matrix of the early component at many sites is a reddish clayey silt layer (Zárate and Flegenheimer 1991). According to Orquera (pers. comm. 1999) a brief excavation undertaken by Lafón during 1967 at Los Helechos shelter, Planchón de Sierra Larga, yielded a double side scraper and some flakes. These were recovered from a reddish clayey layer. During 1999 we relocated this shelter and resumed excavations. Our survey revealed that only a small section of about 3 m^2 had been previously excavated down to the bedrock. In other sections, excavations were abandoned above the occupation level. Therefore, most of the site is still untouched. We then excavated 1.5 m^2 to assess the existence of an early occupation at the site.

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Los Helechos is a small rockshelter looking towards the west. Its front opening is 8.5 m wide, and it is 4 m long with a deeper corner. Its location is 37° 52′ S and 58° 38′ W, in the Cerro Chato, south of Sierra Larga.

This shelter presents a well-preserved stratigraphy, the total thickness of sediments being about 1.3 m. The lower level is a sterile gray, very well developed paleosol horizon. It is overlain by the reddish clayey silt mentioned above, which is 15–20 cm thick (Level 5). This level yielded the scarce archaeological artifacts excavated at the site, as well as charcoal fragments. It is sealed by a layer of clasts of local orthoquartzite, unconformably overlaid by silty Holocene sediments.

A charcoal sample from the artifactually rich level (Level 5) was dated by AMS and yielded a ^{14}C date of 9640 ± 40 yr B.P. (Beta-137747). During the 1999 excavations only nine flakes were recovered. Eight are regional orthoquartzite, that is, found within a radius of 10 to 40 km according to Meltzer (1989), corresponding to the Sierras Bayas Formation (Flegenheimer et al. 1999). Of these, seven are very small trimming flakes (less than 1.5 cm of maximum length) of colored orthoquartzite; the eighth measures 2.8 cm and is white. Also another small flake (1.5 cm), with cortex, is made of an igneous rock, probably from the Ventana Range, distant 250 km. Flakes on local orthoquartzite corresponding to the Balcarce Formation are difficult to recognize.

In conclusion, the re-excavation of Los Helechos has up to now yielded evidence of a very ephemeral Paleoindian occupation. However, it must be remembered that most of the shelter is still unexcavated. The complete stratigraphic sequence may help explain events not clearly registered at other sites (for example, the clast level sealing the occupation).

It may also prove useful to deal with two other issues of importance in the area. First, there is little information yet about the most recent Paleoindian occupations; to discuss this matter, however, this first dating needs to be corroborated with further dates. Second, a pattern of great intersite variability has been described for early occupations, with domestic sites of varied sizes and characteristics, a large re-equipment site, kill sites, etc. (Flegenheimer 1994; Mazzanti 1999). In this context, ephemeral occupations present an interesting potential for understanding settlement strategies and land use.

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The Ghost Site, a Folsom/Goshen Locality in South Dakota

Michael Fosha and Frédéric Sellet

Current Paleoindian research in South Dakota has identified a number of previously unreported Folsom and Goshen finds (Sellet and Fosha 2000). This report is a preliminary discussion of one of the newly identified localities. The Ghost site is located in a landscape dominated by isolated buttes, mesas, and erosional features. Two separate collections include Goshen and Folsom projectile points, preforms, and channel flakes found eroding out of a paleosol from a small defined area over the last decade. No bone or flaking debris has been collected at this time. The assemblage comprises 19 points, 3 preforms and 1 channel flake. Folsom artifacts represent the bulk of the assemblage (n = 18) with a lesser amount of Goshen (n = 5).

Folsom projectile points include 2 complete or nearly complete artifacts (one specimen was heavily reworked before it was lost or discarded) (Figure 1A), 7 basal fragments, 5 midsections, and 1 tip. The average length of the two specimens is 40.79 mm, width 21.99 mm, and thickness 5.23 mm. Preforms include one base and one midsection (both fluted on one side only). One channel flake midsection was also recovered.

Goshen projectile points (Figure 1B) include three complete specimens, one midsection and one base. One tip is refitted to a base with contrasting patination, and one specimen exhibits extensive resharpening prior to loss or abandonment. The complete Goshen points averaged 61.13 mm in length (or 68.74 mm omitting one heavily reworked specimen), 22.98 mm in width and 5.16 mm in length.

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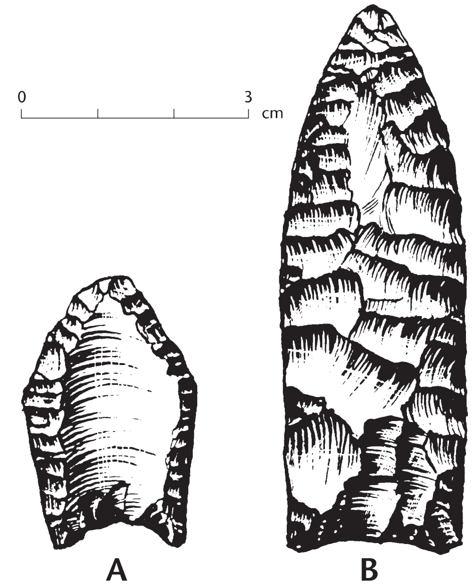

Figure 1. Selected artifacts from the Ghost site (**A,** Folsom; **B,** Goshen).

Lithic material was identified visually on the assemblage. Patination is very light, with a small percentage having heavy patination. Goshen artifacts include silicified wood (n = 3, 60 percent), white chert (n = 1, 20 percent), and porcellanite (n = 1, 20 percent). Folsom artifacts include silicified wood (n = 7, 38 percent), white patinated chalcedony (n = 4, 22 percent), porcellanite (n = 4, 22 percent), brown chalcedony (n = 1, 6 percent), orange/brown chalcedony (n = 1, 6 percent), and brown chert (n = 1, 6 percent). The porcellanite and silicified wood are the most common lithic material represented (n = 15, 66 percent) and come from the most readily available sources (less than 100 km). The combined chalcedony (n = 6, 26 percent) and cherts (n = 2, 8 percent) represent more exotic lithics.

While specimens from the Ghost site locality represent a biased collection, they nevertheless suggest a campsite where broken projectile points were discarded and fluting performed at a location distant from raw material sources. They illustrate the importance of private collections to Paleoindian research in sparsely populated areas that experience minor archaeological attention.

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A ^{14}C Date on a Late-Pleistocene *Camelops* at the Casper–Hell Gap Site, Wyoming

George C. Frison

Removal of 8 m of dune sand overlying the highest cobble terrace of the North Platte River within the city limits of Casper, Wyoming, in 1971 revealed the remains of a catastrophic kill of nearly 100 bison identified as *Bison antiquus*. Two avocationals, Rodney Laird and David Egolf, visited the location immediately after sand removal and found bison bone, several Hell Gap–type projectile points, and one Clovis point (Figure 1). The University of Wyoming (UW) excavated part of the site in 1971 (Frison 1974). A ^{14}C charcoal date is 9880 ± 350 yr B.P. (RL-125) and one on bone is 10,060 ± 170 yr B.P. (RL-208), both consistent with dates on Hell Gap (Irwin-Williams et al. 1973). UW recovered a large assemblage of Hell Gap points and tools but no Clovis points. Geologic study (Albanese 1974) revealed that a long, narrow, steep-sided parabolic sand dune was used as a bison trap and that dune sand covered the bones soon after. The cobble terrace being impervious to water, a pond formed in the trough of the dune over the bone bed. The heavily mineralized pond water resulted in an unusually well preserved bonebed.

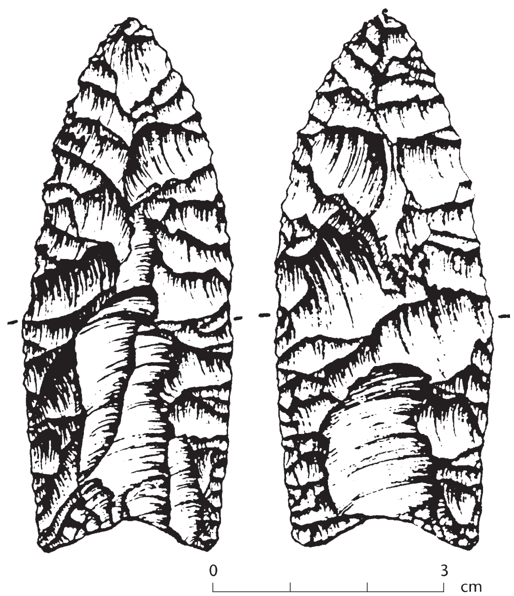

Figure 1. Clovis point found at the Casper Hell Gap site in 1971.

Part of the site was left intact for future investigation, but industrial expansion forced UW to excavate the remainder of the site in 1975. At the extreme windward part of the parabolic dune, we recovered several long bones and other elements of *Camelops* mixed with *Bison antiquus* bones (Frison et al. 1978). We assumed the camel and bison bones were the same age, providing evidence of a later than expected date of *Camelops* survival on the Northern Plains. In addition, we suggested the left camel humerus exhibited evidence of human activity in the form of depressed fractures and spiral breaks on both sides of the distal diaphysis (Frison et al. 1978:11). Several camel long bone fragments also demonstrate green bone breakage.

Recently, we received a ^{14}C age of 11,190 ± 50 yr B.P. (CAMS-61899) from a camel astragalus recovered at the Casper site in 1975. This has forced a reevaluation of some aspects of the Casper site. (1) Because the camel date fits well with known Clovis dates (Haynes 1993), there is a possibility that the Clovis point and the camel bones represent an earlier site component and that the former was involved in the death of the latter. (2) We have no basis to measure the relative preservation potential of camel and bison bone, but the former must have been covered with sand and remained in that condition for the more than 1,000 years between the deposition of the two. (3) This date, if correct, rules out the Casper site camel as a late survival of *Camelops* on the Northern Plains.

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Site 45KT1362, a c. 10,000 yr B.P. Occupation in Central Washington

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Recent erosion exposed an unusually dense layer of artifacts 6–8 cm thick, resulting in the discovery of site 45KT1362 in 1997. These cultural materials

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are in the upper (aeolian) portion of a sand deposit approximately 5 m thick. The lower 3.5 m of the sand appears to be of late-Pleistocene Missoula flood origin. A Mount St. Helens and overlying Glacier Peak tephra couplet below the occupation surface provides a lower limiting age of about 11,200 yr B.P. (Foit et al. 1993; Gough 1995, 1999; Porter 1978) for known site use. Three closely spaced buried soil A horizons between the tephra couplet and the occupation surface indicate wetter soil conditions and riparian vegetation growth during the terminal Pleistocene or early Holocene that have not been subsequently duplicated at this locality. Test excavations in 1998 (Gough 1999) and large-scale excavations in 1999 resulted in the recovery of more than 102,000 artifacts from the sealed, vertically discrete, paleo-occupation surface.

The summer 1999 excavations exposed 33 contiguous 1-by-1-m units within a 5-by-8-m block. The former occupation surface is striking for its continuous distribution and density of artifacts and features within an 8-cm-thick layer. Features consist of two surface burns and flake concentrations, including four that appear to be lithic workshop debris dumps suggestive of raw material reduction onto a skin/mat and subsequent disposal outside of primary activity areas. The burns are charcoal-rich deposits 2 to 8 cm thick containing burned and unburned artifacts and faunal remains, and minor amounts of oxidized sediment. Charcoal from the two burns and other occupation surface features dating to the early Holocene provide a reasonable assessment of site age (Table 1).

The artifact assemblage includes debitage (>96,000), projectile points/knives (n = 3), bifaces and fragments (n = 32), unifacial scrapers/composite implements (n = 16), bone implements/worked bone (n = 13), cores/expended cores (n = 5), modified flakes (n = 63), palettes/grinding stones (n = 3), an edge-ground cobble, and a diverse faunal sample (n = 5,021). The overwhelming majority of debitage and formed lithic objects is of locally available cryptocrystalline silica raw materials, although obsidian flakes from the Oregon Cascade Range Obsidian Cliffs source almost 300 km to the south are also present. Two of the three palettes bear stains of red ochre, and all three exhibit striae on at least one face. Bison (*Bison bison*), elk (*Cervus canadensis*), small mammal, and bird remains are identified in the test excavation faunal sample. Analysis of the complete faunal sample is ongoing.

At least one of the three projectile points is a classic "Cascade" (Leonhardy and Rice 1970) form, having the characteristic feature of being manufactured of fine-grained igneous stone (andesite or basalt). A second fragmentary specimen is most similar to the Cascade form. The final projectile point is relatively small but has the outline and ground base-stem margins of typical Haskett points (Butler 1965; Sargeant 1973). This is noteworthy since at least three of the large bifaces share strongest typological affinities to Haskett points. Unlike the small Haskett-like projectile point, the bifaces are within the size parameters of finished Haskett Type 1 points exceeding 15 cm in length. Bone artifacts include what appear to be two small bone beads and two bone bead performs. The first form resembles a coffee bean in shape. The beads do not exceed 6 mm in maximum dimension and are grooved around their circumference. The two bead preforms are c. 2 mm in width, have not been drilled, retain connecting pieces of bone suggestive of a late stage of manufacture, and represent seven unfinished beads.

Table 1. Dated charcoal from site 45KT1362.

Laboratory no./method	Provenience	^{14}C age uncorrected (yr B.P.)
Beta 124167/AMS	Oxidized stain and artifacts	10,180 ± 40
Beta 133650/Radiometric	Feature 99.1, burn	10,680 ± 190
Beta 133663/AMS	Feature 99.1, burn	10,160 ± 60
Beta 133665/AMS	Feature 99.3, burn	10,130 ± 60
Beta 133664/AMS	Feature 99.6, flake concentration	10,010 ± 60

Analyses are ongoing, and plans for additional excavations have been approved for the summer of 2000. Upcoming work will focus on excavating areas around the two burn features and examining for potential earlier-dating occupations. Information obtained to date is suggestive of possible overwintering at this locale or, at a minimum, a stay incorporating residential features and/or discrete primary and secondary activity areas. The abundance of debitage (including quantities of bifacial thinning flakes) and fragmentary bifaces in a variety of stages of manufacture indicates that large biface manufacture was a primary activity. The combined data sets indicate a single or very few occupation episodes.

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New AMS ^{14}C Ages for the Tolbaga Upper Paleolithic Site, Transbaikal, Siberia

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The site of Tolbaga is located along the Khilok River, 10 km east of the town of Novopavlovka, Chita Oblast', Russia (51° 14′ N, 109° 20′ E). Chita Pedagogical Institute archaeologists excavated the site in 1972–1979 (Bazarov et al. 1982), and again in 1985–1986 (Vasil'ev et al. 1986, 1987). An area of about 1,000 m^2 has been exposed, and extensive lithic and faunal assemblages (> 10,000 pieces) have been recovered. These materials constitute the type assemblage for the early Upper Paleolithic "Tolbaginskaia Culture" of the Transbaikal (Kirillov 1987; Konstantinov 1996). In 1996, we examined a representative stratigraphic profile, observed artifacts and bones in situ, and collected bone samples for ^{14}C dating. Here we briefly review the Tolbaga site and its archaeological collections and present new AMS ^{14}C evidence leading to a revised interpretation of the site's age.

Tolbaga lies near the head of a colluvial slope adjacent to the Khilok River valley. Colluvial sediments overlying bedrock measure 2.5 m thick and are characterized as sands and sandy loams with varying amounts of scree (Bazarov et al. 1982). These represent alternating episodes of gradual creep and rapid stone wash. The Paleolithic component occurs in geologic unit 4, 80 cm below the modern surface, but isolated artifacts are frequently encountered higher in the profile (Bazarov et al. 1982; Vasil'ev et al. 1986). Vasil'ev et al. (1986, 1987) have demonstrated that most artifacts are oriented with the modern slope, implying considerable downslope movement of artifacts on this Paleolithic surface.

The Tolbaga lithic industry has been described in detail by several researchers (Bazarov et al. 1982; Goebel 1993; Kirillov 1987; Vasil'ev et al. 1987). Primary working is characterized by blades and flake-blades removed chiefly from flat-faced cores. Secondary working is almost exclusively unifacial and marginal. Tools include retouched blades and flakes, end-scrapers, unifacial points, gravers, angle burins, side scrapers, notches, cobble choppers, and hammerstones. Bone awls and points also occur, as does a woolly rhinoceros vertebra carved into the form of a bear's head (Konstantinov et al. 1983). Faunal remains include horse, woolly rhinoceros, Kiakhta antelope, Mongolian gazelle, argali sheep, and reindeer (Ovodov 1987). Despite the downslope movement of artifacts and stones by gravity and sheet wash, the excavators identify remains of seven stone-lined dwellings, numerous hearths, and three possible storage pits (Bazarov et al. 1982; Meshcherin 1985; Vasil'ev et al. 1987).

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Bazarov et al. (1982) report two conventional ^{14}C ages on bone from Tolbaga's early Upper Paleolithic component. A set of woolly rhinoceros bones yielded an age of 34,860 ± 2,100 yr B.P. (SOAN-1522), and a set of miscellaneous bones yielded an age of 27,210 ± 300 yr B.P. (SOAN-1523). The older date has been considered more reliable by most researchers because it came from a cluster of bones of a known extinct species (Bazarov et al. 1982) and because of lithic technological similarities with the Varvarina Gora assemblage, another Transbaikal early Upper Paleolithic site radiocarbon dated to 35,000–30,000 yr B.P. (Goebel 1993; Kirillov 1987; Konstantinov 1996; Vasil'ev et al. 1987).

Because conventional ^{14}C dating of bone is known to result in potentially inaccurate ages (Taylor 1997), we set out to redate the Tolbaga early Upper Paleolithic component through AMS ^{14}C procedures. Our 1996 site visit having failed to yield any datable wood charcoal, we too were forced to rely on bone for analysis. We collected a sample of bone from S. Vasil'ev's ongoing excavation (AA-26740) and obtained a curated sample of bone from M. Konstantinov's 1975 excavation (AA-8874). AMS ^{14}C analysis of these samples was conducted at the NSF-Arizona AMS Facility. Sample pretreatment followed methods described by Long et al. (1989). Samples were decalcified in weak hydrochloric acid and bathed in hot water to extract protein gelatin. The protein gelatin was filtered, freeze-dried, and hydrolyzed, and resulting gelatin hydrolyzate was passed through XAD-2 resin to separate amino acids from humic and fulvic acids. The XAD-2-purified samples were then converted to graphite accelerator targets for AMS dating (Jull et al. 1983).

Resulting AMS ^{14}C determinations (corrected for carbon-isotope fractionation) are 29,200 ± 1,000 (AA-26740) and 25,200 ± 260 yr B.P. (AA-8874). Both samples were very well preserved, producing sufficient yields of datable protein (6.2 percent and 10.2 percent, respectively). These new ages suggest that the Tolbaga industry may actually fall within the interval of 30,000–25,000 yr B.P., providing support for the younger conventional ^{14}C age of 27,200 yr B.P. reported by Bazarov et al. (1982). However, none of the four ^{14}C ages for the site are statistically contemporaneous at one standard error. Perhaps all the bones have been contaminated and the age estimates are therefore faulty, or perhaps the results suggest that the site was repeatedly occupied for 5000–10,000 years by early Upper Paleolithic hunter-gatherers. The latter interpretation is supported by the level of preservation of the AMS-dated samples, as well as by the character of the cultural component—an extensive and sometimes jumbled mass of stone tools, debitage, and animal bones in a relatively shallow colluvial context.

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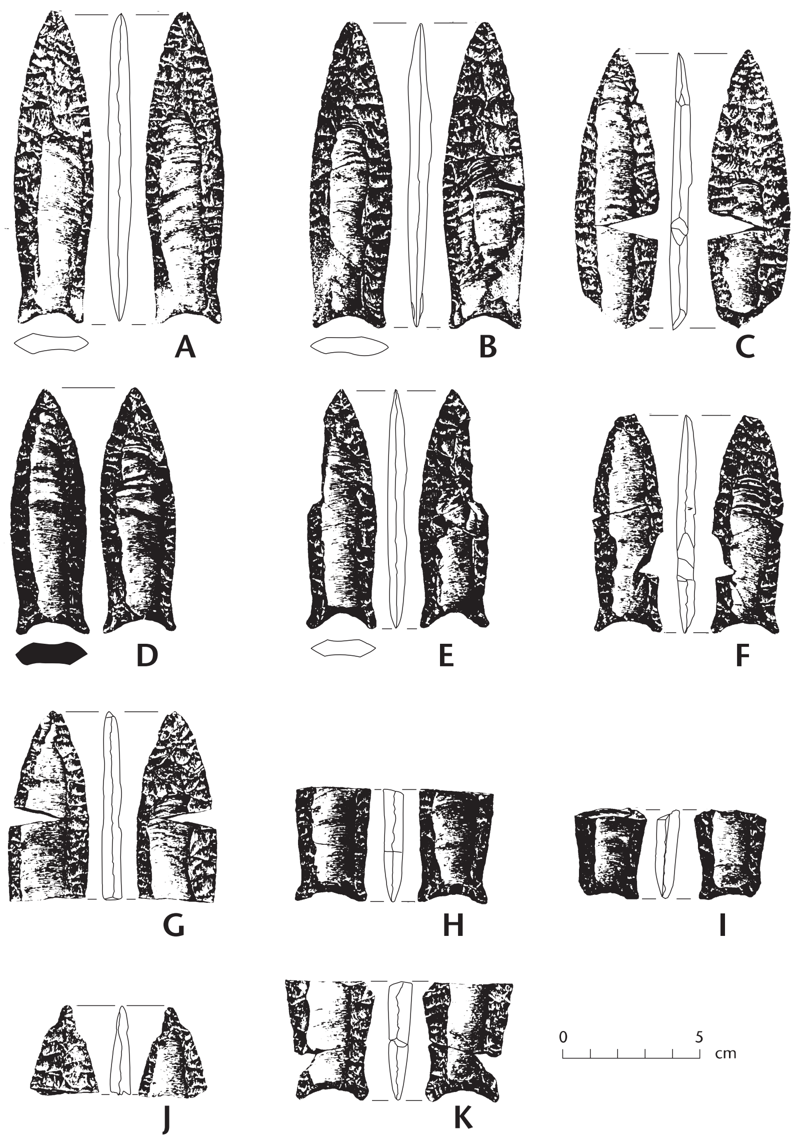

Figure 1. Cumberland points from Trinity.

Paleoindian Point–Type Representation at the Triple S Ranch Locality, North-Central Texas

Virginia Hatfield

Surface collections from sites near Evant, Texas, in Hamilton County demonstrate a long sequence of occupation beginning in early-Paleoindian times. The collection locality includes multiple sites on Cretaceous limestone ridges with no soil development, canyons with soil deposition on slopes, and along streams. In this area, there are several springs and streams that drain into Cowhouse creek, a major tributary of the Brazos river. Nearby is a high-quality quarry of Cretaceous age chert, probably a variety of Edwards chert. Located on the northeast edge of the Edwards Plateau, the area is at the nexus of three distinct physiographic zones dominated by a juniper, oak, and mesquite savanna (Black 1989; Ellis et al. 1995; Johnson and Goode 1994). One of several sites in the area is Triple S Ranch (Hatfield 1997), which occupies part of a colluvial slope at the mouth of the spring. Given the nearby chert resource, the ecological variability, perennial spring action, and the diversity of tool forms, this site probably served as an ideal camp and retooling location.

Several generations of landowners have made intensive collections from the multiple sites on their property (the Triple S Ranch locality). One prolific area is a dense lithic scatter on a ridge immediately west of the Triple S Ranch site (Hatfield 1996). At present, about 2000 artifacts, primarily stemmed projectile point/knives representing Paleoindian to late-Prehistoric types, have been documented in the surface collection. Figure 1 illustrates the frequency of Paleoindian types and examples of the types documented. Paleoindian point types constitute 3 percent of the stemmed biface assemblage. A wide variety of lithic materials are represented in the surface assemblage, predominantly varieties of Edwards chert including Fort Hood Yellow, Heiner Lake Tan, and Heiner Lake Translucent Brown (Treirweiler 1994). Also observed is a black fossiliferous chert, which is either Marble Falls or Owl Creek chert.

The diversity of projectile point/knife types represented in the surface collection demonstrates recurrent occupations throughout prehistory. Retooling and tool manufacturing are indicated by retouch and fracture patterns. Future analytical goals for the collection include investigating the patterning of individual attributes of projectile point/knives through time. This ongoing analysis shifts the level of investigation from groups of attributes packaged as point types to individual attributes. Patterning of these individual attributes is measured temporally by assumed projectile point/knife–type time period associations. The changing attribute patterns through time can be interpreted using a selectionist archaeological perspective (e.g., Beck 1998). Research objectives include determining whether or

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not patterning due to selection can be isolated from stochastic variability of attributes.

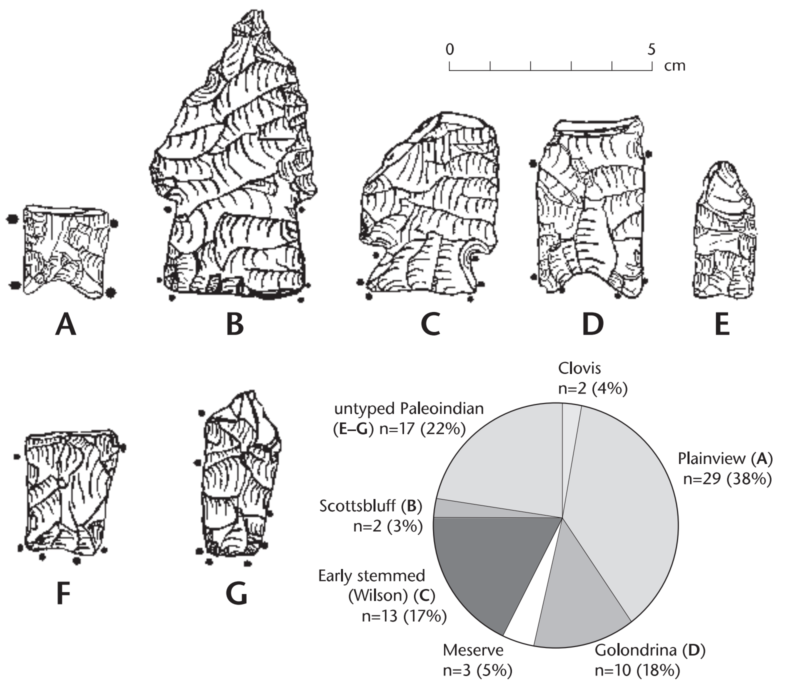

Figure 1. Paleoindian types from the Smith Collection.

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Inventory of Inundated Paleoindian Sites in the Lower Aucilla-Wacissa River Drainage, Jefferson County, North Florida

C. Andrew Hemmings

Recent work by the Florida Museum of Natural History and the Florida Bureau of Archaeological Research in the Aucilla-Wacissa drainage has documented numerous underwater Paleoindian sites. Figure 1 plots the location of the principal sites known to have produced important Paleoindian materials. Nine of the stratified sites that the Aucilla River Prehistory Project has investigated over the last two decades are listed. Additionally, three locales that have produced exceptional isolated occurrences near unexcavated stratigraphic sequences are shown (#7, Glory Hole; #8, Mandalay; and #9, Totem Shoal).

In addition to material recovered from these 12 sites, hundreds of Paleoindian projectile points have been recovered from both rivers (see especially Dunbar 1991). These isolated occurrences certainly include unrecognized sites that warrant closer scrutiny in years to come. Eight of the sites listed in the Aucilla River have produced diagnostic Clovis points or ivory tools or both. The density of sites clearly indicates that the region was blanketed with people very early in the prehistory of Florida.

Wacissa River

1 Alexon *Bison antiquus* Kill (8JE570): Skull with impact fractured point tip embedded in horn core; dates of 9900 ± 200 and 11,170 ± 130 yr B.P. (Webb et al. 1984; Mihlbachler et al. 2000 manuscript accepted).

2 Ryan-Harley Site (8JE1004): Closed context diagnostic Suwannee material. Datable organics recovered (Dunbar et al. 1999, 2000).

Aucilla River

Half Mile Rise Section

3 Page-Ladson (8JE591): Unfluted Clovis(?) points with overshot flaking; Suwannee points and ivory tools in surface assemblage. Cut mastodon tusk in digesta (12,350 ± 50 yr B.P.) (Beta-112236) (Webb et al. 1998).

Little River Section

4 Little River Rapids (8JE603): Clovis point and ivory "foreshaft" in surface assemblage. Very late date for *Tapirus* and *Mammuthus* (11,450 ± 90 yr B.P.) (Beta-107296) (Webb et al. 1998).

5 Mathen-Childers (8JE604): Distal left mastodon ulna found with an ivory tool fragment embedded in it (Mark Muniz pers. comm.); Clovis point in surface assemblage.

6 Latvis/Simpson (8JE1500): Simpson point and ivory tool sliver in sur-

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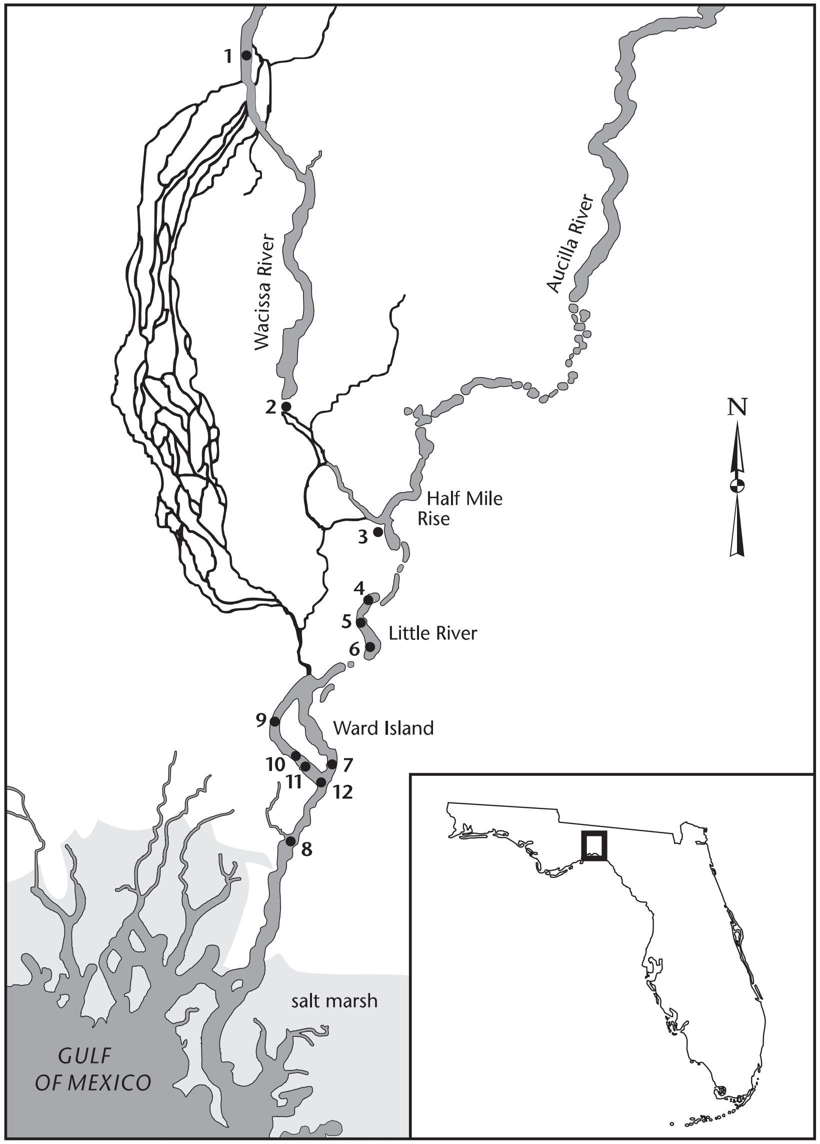

Figure 1. Principal sites in the Aucilla and Wacissa Rivers.

face assemblage; unstained 31,610 ± 240 yr B.P. (Beta-85549) juvenile female mastodon in digesta deposit (Mihlbachler 1998).

Lower Aucilla—Continuous to Gulf

7 The Glory Hole: Barbed ivory point in surface assemblage; well-stratified sediments remain unexcavated.

8 Mandalay: Clovis projectile point and two "daggers" made from *Equus* metatarsals in surface assemblage.

West Run of Aucilla River

9 Totem Shoal: Clovis, Simpson and Suwannee points found with at least eight ivory "foreshafts" in surface assemblage; contains unexamined stratified deposits.

10 Sloth Hole (8JE121): Six known Clovis points and no fewer than 28 ivory "foreshafts"; awaiting date on ivory tool from stratified context.

11 Cypress Hole (8JE1499): Numerous Paleoindian diagnostics including Clovis points; stratified sediments buried by meters of loose bone bed.

12 Fossil Hole (8JE1497): Inundated quarry abandoned prior to 8,500 [rc] yr B.P. (uncalibrated) (Hemmings 1999).

Special thanks go to the National Geographic Society and the Florida Department of State for grants that provided for exploration of this river system.

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Folsom Adornment and Bone Technology

Jack L. Hofman, Richard O. Rose, Larry D. Martin, and Daniel S. Amick

The discovery of a tiny bead in Folsom-age deposits at the Shifting Sands site in Texas offers insights into Paleoindian bone technology and ornamentation. The bead is less than 2 mm in maximum diameter, made of bone, and was apparently used in conjunction with numerous similar beads for decorating some garment or object (Figure 1A). This is the only such bead known from a Folsom site and is the smallest of few disk beads known from New World Paleoindian sites (cf. Fladmark et al. 1988; Hester 1972; Stanford 1999). Its size suggests that such artifacts have probably gone unrecorded due to traditional recovery and sorting methods. Production of such beads (and needles) may explain the purpose of some rib and flat bone artifacts with closely spaced parallel lines (Bradley 1997; Frison and Craig 1982; Wilmsen and Roberts 1978; see Hofman 1996:59). Needles, beads, and grooved pieces represent related elements of the Folsom bone technological system and should co-occur repeatedly.

Shifting Sands (41WK21) is located in Winkler County, west-central Texas (Amick and Rose 1990; Hofman et al. 1990). Systematic surface collections made regularly since 1981 have yielded more than 500 lithic artifacts and 6,000 pieces of debitage of Folsom age from an active dune field. Several eroded areas have distinctive artifact associations that represent a bison kill-processing area, camping, retooling, hide working, and other domestic activities. Lithic evidence suggests that at least 50 bison were killed in Area 3, probably during cool weather (Hofman 1999).

Area 6, where the bead was found, has also yielded large unifacial tools, end scrapers, spurred endscrapers, side scrapers, ultra-thin biface fragments, projectile points (three Folsom and three Midland), channel flakes, gravers, burins, radial break pieces, and informal flake tools. More than 50 artifacts and several hundred small flakes have been recovered from this area as it eroded. Refitted artifacts link Area 6 with Areas 3 and 5.

The Shifting Sands bead was recovered June 30, 1991, following 10 years of systematic collecting. On that date, 75 flakes were recovered from Area 6 including only one more than 2 cm in size. All flakes were placed in a new clean plastic bag as collected. In many cases a small amount of sand adheres to the underneath side of flakes due to the calcareous nature of the sands. The bead was discovered in the small amount of sand in the Area 6 flake bag.

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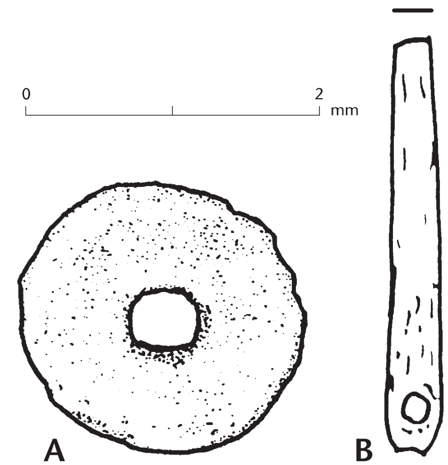

Figure 1. A, Folsom bead from Shifting sands; **B,** Midland needle from Winkler 1 site (after Blaine and Wendorf 1972).

The bead had a single grain of reddish brown sand wedged into the small hole, but no other sand adhered to the bead at the time of discovery. The bead had apparently been loosely cemented along with particles of sand to the underneath side of a flake.

The Shifting Sands site deposits are similar to those of Winkler-1 (Holliday 1997), which yielded an eyed bone needle in association with Midland artifacts (Figure 1B; see Blaine and Wendorf 1972). This small needle, recovered during fine screening of a control area, corroborates that small bone artifacts are occasionally preserved in ancient sites in these dune settings. The Winkler-1 needle has a broken tip but presently measures 13.34 mm long, 1.72 mm wide, and 1.07 mm thick. The maximum diameter of the eye is 0.75 mm. Width of the needle is comparable to the diameter of the Shifting Sands bead. Similar needles have been reported from several Folsom and other Paleoindian sites (Frison and Bradley 1980; Frison and Craig 1982; Green et al. 1998; Redder 1985).

The circular bead measures 1.84 mm in maximum diameter, 0.61 mm in maximum thickness, and has a hole diameter of 0.38 mm. Under SEM observation, the bead exhibits polish around the edges and on the surfaces of the hole. The bead was made with a fine engraving or perforating tool with subsequent abrasion and polishing. There is no evidence of drilling. Semenov (1964:Fig. 23, p. 76) illustrates the distinctive difference between perforated beads made by scratching, hand drilling, and bow drilling. Blaine and Wendorf (1972) suggest gravers were used to perforate needles, but Frison suggests that the spur on the corner of an endscraper is more suitable for this task and that a truncated and snapped flake is also very effective (Frison and Craig 1982:168). Semenov indicated that replicating a Sunghir ivory bead required 30 to 60 minutes. Bone or ivory beads are common at some Upper Paleolithic sites (Bader 1978; Krotova and Belan 1993; Otte 1981; Shimkin 1978; Soffer 1985; Taborin 1993; White 1993), and we assume early Paleoindians entered the New World with this technology.

The small bead reported here would not be used effectively in isolation. We suggest it was employed in conjunction with numerous comparable beads on clothing or as other adornment. We should expect that when one such bead is found, there would have been dozens if not hundreds present, although others were not necessarily lost in the same place. The reported Paleoindian beads indicate that these artifacts occur in a variety of contexts and not just in burials (Redder 1985; Rice 1972). Beads may have been lost from garments or decorated articles in work areas, such as Area 6. Standard screen recovery will usually not include artifacts of this size. Screen recovery and not knowing to look for such small artifacts are probably the most significant factors responsible for the lack of previous reports of this Paleoindian artifact type.

The bead adds a new trait to the Folsom complex, but more importantly, it provides important clues to other aspects of the Folsom bone technological system and holds implications suggesting the need to revise "standard" recovery techniques.

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Boca Negra Wash, a New Folsom Site in the Middle Rio Grande Valley, New Mexico

Bruce B. Huckell and J. David Kilby

Since the mid-1960s it has been known that the middle Rio Grande Valley of New Mexico contains an abundance of Paleoindian sites (Judge 1973; Judge and Dawson 1972). However, with the exception of the Rio Rancho Folsom site (Dawson and Judge 1969), these sites were known largely from surface

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collections. In June of 1998, the first author discovered a previously unrecorded Folsom site on the broad relict surface known as the West Mesa or Llano de Albuquerque that separates the Rio Grande and Rio Puerco valleys. The site lies at an elevation of approximately 1,661 m (5,400 ft) in mixed grass and scrub vegetation on the northeastern portion of the basalt flows emanating from the Albuquerque volcanoes. With permission from the State Lands Office, a testing program under the aegis of the Maxwell Museum of Anthropology, University of New Mexico, was inaugurated in January 1999 to assess the site and its research potential. Particularly, could this site contribute to an ongoing larger research effort—centered on the reinvestigation and analysis of Dawson's Rio Rancho site—to investigate Folsom land use in north-central New Mexico? The authors have directed the ongoing work, with assistance from Department of Anthropology graduate student volunteers.

Like so many of its counterparts in the region, the Boca Negra Wash site is positioned adjacent to a small (c. 90 m by 60 m) playa. By the mid-1930s, a dirt road was constructed through the area, crossing the eastern edge of the playa and impacting a portion of the cultural occupation area. Our intensive surface survey revealed two spatially discrete activity loci separated by approximately 60 m, one east and the other south of the playa. From the c. 80 m by 45 m eastern locus (Locus A) we point-plotted and collected 68 surface artifacts, including a Folsom point tip, the distal end of a Folsom point preform, a biface fragment, a graver, two endscrapers, and abundant debitage. Most artifacts are of Pedernal chert, obsidian (cf. Jemez Mountains), and Chuska (also known as Washington or Narbona Pass) chert; primary outcrops of these materials lie 70 km to 220 km away. The remainder includes cherts not immediately assignable to known sources. Post-Folsom artifacts are two sherds, both from the surface near the road. We have excavated five 1-m test pits in Locus A, recovering from one to five subsurface artifacts (12 total) in each. Preliminary assessment of their pedostratigraphic context places them within the upper part of the Bt horizon of a cumulate soil developed on a thin-sheet sand deposit resting atop a lava flow. From the second locus (Locus B, c. 20 m by 30 m) we recovered 38 pieces of debitage dominated by the same three major materials listed above, along with a fragmentary endscraper. No test pits have been excavated in Locus B.

A cross pattern of auger holes placed in the playa revealed a depositional sequence consisting of a 35-cm layer of slightly clayey sand, which rests atop some 70 cm of typical playa sandy clay exhibiting what appears to be well-developed soil. Beneath this unit is a lacustrine clay deposit approximately 60 cm thick near the center of the playa, thinning towards the edges. It rests atop a unit of eolian sand 2 m or more thick. The playa supports a distinctive grass species, but has not been observed to hold surface water.

Approximately 40 m east of Locus A, in the bottom of an east-west-trending swale, several small bone fragments were observed on the surface. They display a prominent coating of calcium carbonate and represent a large mammal, but cannot be specifically identified. We have two 1-m test pits under excavation, one of which has yielded additional bone fragments brought up from depth by a rodent. Each unit has yielded a flake.

Testing continues at the Boca Negra Wash site, but preliminary indications are that it is essentially a single-component Folsom camp with much of its artifact assemblage shallowly buried. It holds considerable potential to inform studies of Folsom technological organization (Amick 1996), raw material economies, and mobility, as well as intrasite organization of activities. Moreover, the playa deposits afford the chance to begin building a late-Pleistocene paleoenvironmental record for the Albuquerque Basin; none currently exists. Finally, should the faunal material in the swale be associated with Folsom hunting, the Boca Negra Wash site would be the first known kill and camp site in central New Mexico.

We appreciate the cooperation and support of the New Mexico Historic Preservation Division, Office of Cultural Affairs, particularly David Eck and Glenna Dean, as well as Daniel Reiley and Norman Nelson. Thanks as well to UNM students Briggs Buchanan, Marit Munson, Beth Bagwell, and Marianne Tyndall for their help in excavation.

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Cody Technology at the McLeod Site, Saskatchewan, Canada

Dennis C. Joyes

Locally severe wind erosion in the late 1980s led to the discovery of one of the largest and most diverse collections of Cody artifacts on the Canadian Plains (Joyes 1997a, b). More than 85 Eden-Scottsbluff projectile points and point fragments, 5 Cody knives and possibly associated scrapers, drills, and bifaces were found at the McLeod site (DiNb-6), a blowout 2.4 km east of Radville in the upper Long Creek drainage of southeastern Saskatchewan. Artifacts, flakes, fire-cracked rock, and small bone fragments were collected from an eroding sand ridge adjacent to an ephemeral wetland; however, the original location of these materials in the collapsed Solodized Solonetz soil profile has yet to be determined.

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formed flake tools (scrapers), 24 simple flake tools (edge-modified flakes), one core tool, six general flake cores, three assayed nodules, over 6,800 pieces of unmodified debitage, two edge abraders, and one milling stone fragment. Projectile points include a series of robust broad-stemmed forms with clear affinities to the Western Stemmed Tradition (Bryan 1980). These artifacts are morphologically variable, specimens ranging from 29–75 mm in maximal length with strong (Silver Lake type) to weak (Lake Mohave type) shoulders; blade-stem proportions range from squat to elongate (1.0–5.2:1).

Bifaces in the collection occur in varying stages of reduction: four are thick, percussion-flaked blanks with limited planar symmetry and irregular, sinuous margins; four are thinned, symmetrical preforms with regular edges; and four are carefully pressure-flaked artifacts that in at least two instances clearly derive from broken points. Though small, the biface sample is consistent with on-site reduction of large flake blanks into refined preforms and complete projectile points. Formed flake tools from the site are consistently made on robust, thick blanks that are poorly represented in the associated debitage collection. These were in at least some cases apparently brought to their present location in a finished or near-finished state. By contrast, simple flake tools are commonly made on flake types that are abundant in the site debitage profile and were presumably made as needed from readily available raw materials. The few flake cores recovered appear to constitute locally available cobbles that were split to provide large flake blanks; none evince careful platform preparation or specialized technological characteristics. Assayed nodules likewise are local cobbles tested for internal characteristics and knapping suitability.

Technological analysis of debitage samples is still ongoing, but preliminary results indicate a focus on bifacial reduction. Cortical debris is present in small amounts, testifying to reduction of local cobbles, but most of the percussion flakes constitute biface thinning residues. A dearth of interior percussion flakes indicates that flake blanks were worked directly into bifaces, while modest quantities of pressure retouch debris speak to later stages of tool shaping and finishing. All in all, flaked-stone constituents from MNO-680 appear consistent with short-term retooling activities performed in the context of active subsistence pursuits. Processing implements such as points and scrapers are more prevalent than would be expected if lithic acquisition were an emphasis of the occupation. Poor organic preservation precluded recovery of faunal remains, although the character of the assemblage and site situation is consistent with hunting.

The MNO-680 flaked-stone material profile is dominated by obsidian. Only 3 of 78 formed artifacts are non-obsidian (two formed flake tools of chert and one simple flake tool of basalt), as are a paultry 38 unmodified flakes (33 chert and 5 basalt). Chemical characterization (XRF-analysis) of 30 obsidian tools indicates a significant variety of source types, particularly among artifact classes subject to curation. At least seven geochemical types are represented in the sample, including Casa Diablo (< 5 km distant), Mono Glass Mountain (15 km), Truman-Queen (40 km), Bodie Hills (55 km), Fish Springs (75 km), Queen Impostor (85 km), and Saline Valley (95 km); Casa Diablo and Mono Glass Mountain would have been available within a daily foraging radius, the others presumably requiring more substantial movements (residential or logistical) to acquire. It is significant that fully 50 percent of the projectile points originated at more distant source areas, compared with 40 percent of bifaces and 17 percent of formed and simple flake tools; one analyzed core was traced to the adjacent Casa Diablo source. These findings are consistent with previous studies in the region (Basgall 1989; Basgall and Giambastiani 1995; Delacorte 1999; Delacorte et al. 1995) that suggest early-Holocene populations traversed extensive areas in relatively short order (still retaining distant materials in active tool kits). Data from MNO-680 imply comparatively recent visits to areas some 55 km north and nearly 100 km south of the location.

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Microblade Technocomplexes in North and East Asia

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Microblade industries are regarded as a distinctive attribute of the North Asian and North American stone age. However, microblade cores, microblades and the by-products of their manufacture too often are studied in isolation from the entire assemblage of artifacts found at Upper Paleolithic sites. These artifacts invariably occur in association with other stone and bone

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implements such as blade cores, blades, scrapers, endscrapers, burins, inset points and their shafts, needles, and other artifacts. So it is important to investigate microblade industries as a part of the whole archaeological context in which they occur. This consideration is underscored by the discovery of typical microcores and microblades in Upper Paleolithic assemblages of Eastern Europe.

There are three clusters of Paleolithic sites in Primorie (south of the Russian Far East). These are the Razdol'naya, Ilistaya, and Zerkal'naya areas. Despite differences in raw materials, blade and microblade cores, blades, cores and preforms, split pebbles, and numerous flakes from these sites are very similar in their morphology and technology. Based on the percentage of different implement categories, two types of site groups may be recognized in the Primorien Paleolithic. The first is characterized by the use of particular raw materials, numerous cores, core blanks, debitage, and rare tools. This group of sites may be interpreted as workshop areas (Ustinovka 1, Ustinovka 3, Ustinovka 5).

The second site type is characterized by a greater diversity of tools including scrapers, endscrapers, burins, axes, bifacial and unifacial points. These assemblages (Gorbatka 3-5, Ilistaya 1-3, Timopheevka 1-2, Ustinovka 4, Ustinovka 6; Suvorovo 3-4) are interpreted as habitation sites.

In the Razdol'naya River area a collection of artifacts was obtained at the Utesnoe 3 site, which was discovered on an eroded slope of the Krasoyarovskaya hills 8 km southwest of Ussuriisk city. Part of the hill was destroyed by a cart track, and redeposited stone artifacts were scattered over 1,500 m^2 of this slope. As a result, the original stratigraphic context of the 53 implements collected from this site is undetermined. This collection consisted of 29 flakes (10 of basalt, 2 with pebble cortex; 8 crystalline ignimbrite, 1 of obsidian; 3 large and 16 small flakes), the upper part of a blade with cortex and a small blade-like flake from jasper. Another part of the collection included an amorphous core or boat-shaped tool (crystalline ignimbrite), a wedge-shaped core on a split bifacial blank (obsidian), a ski-like spell (basalt with cortex), reduced by a blow made perpendicularly to the long axis of the blank; 2 transverse burins on flakes. A number of other artifacts also were made from basalt: a flake with retouched edge margins, a point on a flake with a retouched basal margin (bifacial preform?), a large and a small oval biface with pebble cortex, four small oval bifaces (one with cortex on the proximal end), three subtriangular elongate bifaces with straight bases, two bifacial implements with straight bases and rounded tips (one with cortex on one edge), and three bifacial blanks (one is oval in outline while the rest are subtriangular). Typologically, these bifacial implements are comparable to artifacts from other Paleolithic sites in Primorie. It is important to note that these bifaces were associated with microblades and transverse burins. These implements are highly characteristic of the late Paleolithic period of Primorie, North China, Japan and eastern Siberia. A basalt ski spell is highly diagnostic of this collection because it demonstrates that this basalt biface was split in the same way as were the wedge-shaped cores and transverse burins. Therefore, I conclude that the artifact collection from this site, in spite of its uncertain context, represents the whole complex and is late Paleolithic in age (c. 12,000–9,000 yr B.P.). The high percentage of tools relative to debitage and the total quantity of artifacts suggest that the Utesnoe 3 site was neither a workshop nor a habitation area. Bifacial tools, which are the main implement group at this site, were not broken, but were unfinished. Thus, this slope was not used as a base camp, a manufacturing area, or a butchering site in spite of the fact that it offered a good view of the Razdol'naya River valley. It is possible that the Utesnoe 3 collection represents a cache and that its position on a slope resulted in the artifacts being scattered over a large area. A retouched projectile point made from crystalline ignimbrite also was discovered at this site, but its relation to the other artifacts is not known.

Early-Holocene Scraper Assemblage from the Skyrocket Site (CA-CAL-629/620)

Roger Marks La Jeunesse and John Howard Pryor

Descriptions of early-Holocene lithic assemblages from western North America emphasize bifaces to the near exclusion of unifacial tools (e.g., Grayson 1993:238–244). This communication will describe distinctive "scraper" types recovered at the Skyrocket site (CA-CAL-629/630), with reference to their presence in other early-Holocene assemblages. Skyrocket unifaces illustrate two important facts about these tools. First, even though they are often associated with mid-Holocene sites, they constitute an important part of early-Holocene assemblages. Secondly, they remain basically stylistically the same throughout the time period 9,400–7,000 yr B.P., at least at Skyrocket. This fact suggests that these tools are more "conservative" in nature than bifaces recovered in the same deposits (La Jeunesse and Pryor 1998:29–32).

Skyrocket is located 40 miles east of Stockton, California, in the lower Sierran foothills. It has a "sealed deposit" dating between 9,400 and 7,000 yr B.P. (La Jeunesse and Pryor 1998:30), and the most commonly occurring unifacial type in this assemblage is the discoidal scraper (30 percent of the assemblage), characterized by its round to oval shape, with retouching along its perimeter (Figure 1, N–O). This type is associated with the Western Pluvial Lakes Tradition (WPLT) as it occurs in the Lake Mojave and San Dieguito complexes (Moratto 1984:94–98), and it has also been found in deposits containing Pinto points (Amsden 1935:48–49).

The next most frequent type at Skyrocket is the keeled scraper (16 percent),

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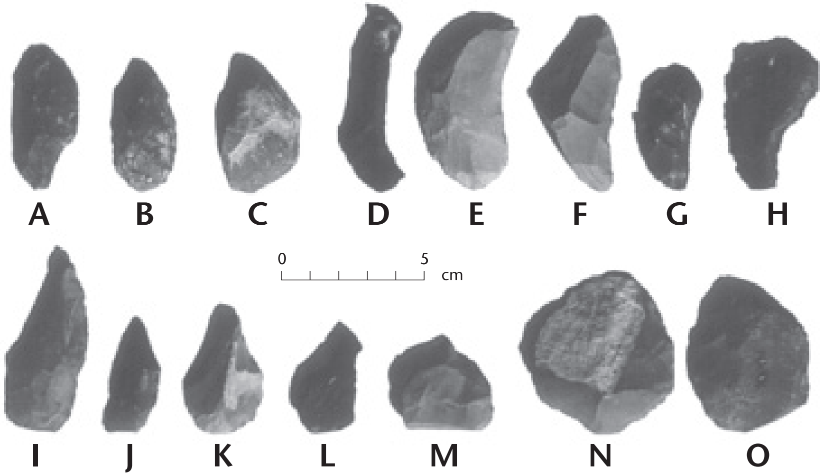

Figure 1. Early-Holocene scraper assemblage.

which is elliptical in outline and triangular in cross-section (Rogers 1966:189), with a working edge around its perimeter (Figure 1, A–C). This type, which has also been found in WPLT deposits (Moratto 1984:95,98; Rogers 1966:189) associated with Pinto assemblages (Amsden 1935:36, 39), was recovered near Skyrocket at the Clarks Flat site, an early-Holocene deposit in the central Sierra of California (Peak and Crew 1990:107, 306–307).

Pointed scrapers (16 percent), comparable in frequency to the Keeled type, are unifacial tools similar in shape to bifacial gravers (Figure 1, I–M). They are characterized by a "bit" that projects from the tool, while the base is variable in shape. They have been referred to by Rogers (1966:187, 189) as "chisel gravers" and "beaked scrapers." Pointed scrapers are associated with the San Dieguito complex (Rogers 1966:62, 186) and Pinto assemblages (Harrington 1957:59); they were recovered by Peak and Crew (1990:310–311) at Clarks Flat.

Occurring less frequently but potentially temporally diagnostic are concave scrapers (5 percent). At Skyrocket this type occurs only in the early-Holocene deposits. It is defined by the contour of its working edge (Figure 1, D–H), sometimes but not always lunate shaped. Warren (1995 pers. comm.) has suggested that the lunate variety may be comparable to unifacial crescents. Examples of this type have been recovered at a variety of sites including Clarks Flat (Peak and Crew 1990:308–309), San Dieguito (Rogers 1966:64), and Pinto (Amsden 1935:41).

The frequency of unifacial tool types (scrapers) described above for Skyrocket does not change during the time period between 9,400 and 7,000 yr B.P., even though the biface assemblage undergoes a major transformation from Western Stemmed to Pinto (La Jeunesse and Pryor 1998). Lastly, starting with the alithermal deposits at Skyrocket 7,000 yr B.P., we see the marked disappearance of these formed unifacial tools and their replacement by more expediently made flaked scrapers, such as end and side types.

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Reevaluation of the Alexon Bison Kill Site, Wacissa River, Jefferson County, Florida

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Webb et al. (1984) reported a bison kill site found in the Wacissa River, north Florida. The only evidence of human-bison interaction was the partial skull of a female *Bison antiquus* (UF 43201) with a chert object imbedded in the right fronto-parietal region. Webb et al. (1984:387) concluded that the chert fragment was "a section of a projectile point that was intentionally driven into the . . . skull" and that the "presence of the point confirms the association of *Bison antiquus* and humans." Two aspects of this Pleistocene *Bison*/Paleoindian association remain uncertain.

(1) Two radiocarbon dates of 9990 ± 200 yr B.P. (Beta-5941) and 11,170 ± 130 yr B.P. (Beta-5942) were reported from cranial fragments that did not articulate with the skull and a right humerus fragment. A mandible, seven vertebrae, and various limb and foot bones were reported to have belonged to the same individual. Material more recently collected from the site includes two right astragali (UF 49076, UF 205006) and a third horn core (UF 205007), indicating more than a single individual is represented. Thus, neither of the radiocarbon dates can be directly associated with the skull. We attempted direct dating, but it was found that multiple chemical residues used to preserve and cast the specimen have saturated the skull. Because of this we were not able to retrieve a direct date on the specimen.

(2) The object is made of local Suwannee chert. It is about 10 mm in length, 6.5 mm in maximum thickness, and biconvex in cross section. Shattering and weathering have destroyed any original flaking scars or diagnostic

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features on the exposed portion. As an alternative to removing the chert object we CT scanned (Computed Tomography) the skull. Figure 1 shows the triangular object penetrating the cranium and protruding into the sinus cavity. The shape of the object is consistent with impact fracture tip damage where one side of the tip penetrated the bone while the other side fractured and was lost.

The only alternative explanation for the chert object in the skull is that the bison somehow lodged the rock into its forehead during a fall. The lack of subsequent bone growth around the chert object indicates that the animal died within 24 hours of the object being embedded and suggests that the animal was either trapped where it was found or hunted. The bison remains were not found within a particularly deep portion of the river, and there are no treacherous limestone exposures in the area. The bison does not appear to have been trapped. While we cannot positively identify the object as an artifact, it is likely to be cultural in origin.

We can rule out Bolen and Beaver Lake points by comparing blade cross sections. A Clovis, Simpson, or Suwannee point is likely, but there is no way to

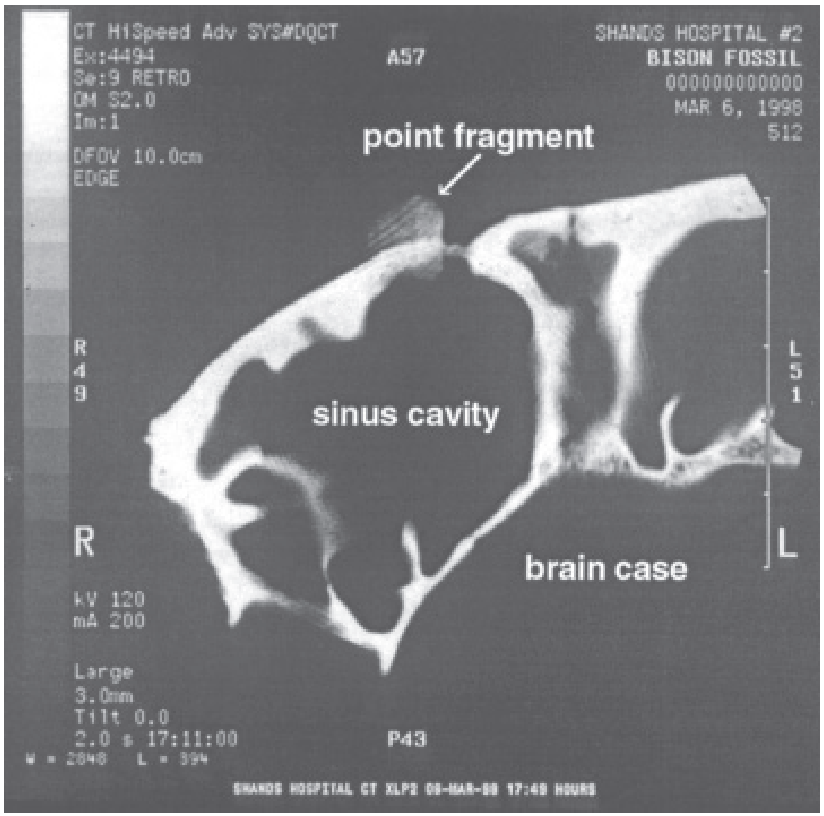

Figure 1. Sagittal section of fronto-parietal region of Bison skull (UF 43201) with imbedded chert object. Anterior is to the right.

determine which. Clearly, Paleoindian interactions with extinct Pleistocene fauna are documented in Florida by bone and ivory artifacts (Dunbar and Webb 1996). In the case of this bison specimen, no diagnostic artifactual features remain and the skull cannot confidently be dated. Thus, we are left with a tantalizing association between an unspecified group of Paleoindians and an extinct Pleistocene *Bison*.

We acknowledge the generous radiology staff at Shands hospital, Gainesville, for the use of CT equipment and for their technical assistance.

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Reinvestigating the Lucy Site in Central New Mexico

Joseph J. Miller

Early-Paleoindian artifacts exposed on the deflated surface (c. 20,000 m2) of the Lucy site (LA4974) were reported to Frank Hibben at the University of New Mexico. During a preliminary site visit by Hibben and William Roosa in 1954, a Sandia-type projectile was discovered in association with extinct fauna (identified tentatively as proboscidean) (Roosa 1956, 1968). Additional field-work by Roosa between 1954 and 1959 recovered 13 diagnostic Sandia artifacts in and around the Lucy site. Four tools were argued to be in situ in sediments stratigraphically deeper than assumed Clovis- or Folsom-age deposits (Roosa 1968:33–35). Roosa's temporal designation independently verified Hibben's claim of great antiquity for Sandia (Hibben 1941).

Roosa used stratigraphic correlation of distinct sedimentary phenomena to continent-wide geological events to establish the age of the Sandia materials (Roosa 1968). In the discussion of the Lucy stratigraphy, Roosa (1968) describes, from the surface, one layer of aeolian sediments (Layer 1) followed by 10 layers of water-laid sediments (Layers 2–11). Excavations yielded a Scottsbluff point in Layer 3 and the Sandia remains in layer 7. Layer 6, which was culturally sterile, consisted of three thin beds of sandy silt or "clay" interbedded with silty sand representing a maximum of cool, wet climate (Roosa 1968:57). Roosa surmised, based on the presence of the Scottsbluff point in Layer 3, that everything deeper was older than c. 8,500 yr B.P. This conclusion meant that Layer 6 could easily be correlated with the late-

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Pleistocene Valders Advance (c. 11,900–11,000 yr B.P.), thus providing Sandia with an age greater than c. 11,900 yr B.P. (Roosa 1968). Roosa ultimately concluded that the postulated Sandia kill "apparently occurred late in the Pleistocene just prior to a major peak of cold wet climate" (1968:92).

Besides being historically important, the Lucy site has additional significance. It has yielded a wide range of Paleoindian diagnostics (including Clovis, Folsom, and Agate Basin) on the surface, and a single example of a subsurface point (Scottsbluff). While archaeological sites that are typologically indicative of late-Pleistocene or early-Holocene occupation are common in the Estancia Basin (n = 18) (Haynes 1955; Lyons 1969), most sites occur in the heavily deflated dune fields surrounding the basin. As a result, sites consist of mixed surface scatters without any directly dated horizons. Based on Roosa's (1968) detailed correlation of site stratigraphy to environmental events, and the presence of a buried late-Paleoindian point (Scottsbluff), it appeared that some intact layers at the Lucy site may provide a unique opportunity to investigate a buried Paleoindian site on the ancient beachstrands of Pleistocene Lake Estancia.

During the summer of 1998, the SMU/QUEST archaeological crew preformed test excavations, mechanical (Giddings) coring, and hand augering to re-expose the original stratigraphic sections excavated by Jerry Harbour and Roosa (Harbour 1958; Roosa 1968). Research was designed to explore the potential for buried late-Pleistocene/early-Holocene materials and to assess the site stratigraphy and geochronology in order to better understand the possible context of the archaeological remains previously reported (Roosa 1956, 1968). In particular, the aim was to evaluate the link between local "marker beds" of sediment and regional geological events.

Roosa suggested that layer 6, described as composed of three dark gray "clay" zones indicating wet conditions, corresponded to the Valders Advance (c. 11,900 to 11,000 yr B.P.) (1968). Two sediment samples from layer 6, including the "clay" bands, were submitted for AMS dating. These samples, Lucy 98-1 and Lucy 98-2, taken from the top "clay" band and the bottom "clay" band respectively, yielded dates on humates of 5780 ± 70 yr B.P. (Beta-126391) and 5460 ± 60 yr B.P. (Beta-126392).

Three main conclusions can be drawn from the results of the field research. First, layer 6, which was originally assumed to be related to the Valders Advance, dates to the mid-Holocene and post-Altithermal. The lacustrine deposits in layer 6 likely represent spring recharge following the Altithermal. In addition, the stratigraphic work in and around the original excavations suggests that only Layer 6 represents pond deposits, and these were restricted to the area of original excavations.

Second, the direct dating of layer 6 at Lucy speaks to the question concerning the likelihood of buried late-Pleistocene deposits. The Scottsbluff projectile point found in Layer 3 was likely redeposited as a function of bioturbation. Observations made during the summer 1998 field season indicate that mixing due to rodent activity appears to be a potential problem at the Lucy site.

Finally, accurately dating the Sandia artifacts earlier than Clovis or Folsom relied on the assumption that the stratigraphic marker beds revealed at Lucy corresponded to dated events known elsewhere. The dates reported above are much later than required and make it unlikely that the Sandia remains from the Lucy site are as old as previously suggested.

For more information concerning the Sandia Cave controversy see Preston (1995) and Stevens and Agogino (1975). Field research at the Lucy site was done under the auspices of the Quest Archaeological Research Fund; Dr. David Meltzer, Director. I would like to thank Dr. David Meltzer for field direction and comments on this paper. Vance T. Holliday for supplying his geological expertise in the field. Rusty Greaves for support and direction in the field. Finally, my friends and colleagues Jason LaBelle, John Seebach and Todd Surovell who endured relentless sandstorms and thankless hours of labor to support this field project.

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41TG378, a Clovis Site in West Central Texas

David L. Nickels, Raymond Mauldin, and Chela N. Nickels

An archaeological survey of 41.25 km^2 conducted in Tom Green County, Texas, recorded seven sites with probable Paleoindian components (Mauldin and Nickels 2000). Most of these components, identified by a single point within a scatter of non-diagnostic lithic debris, reflect late-Paleoindian occupations. However, 41TG378 has a variety of Clovis-age artifacts. Preliminary investigations suggest that within this multicomponent site occupying 12,170 m^2, Clovis-age artifacts are potentially distinguishable from later debris by their heavy patination.

Paleoindian artifacts collected from the surface of 41TG378 include a Clovis point base (Figure 1). The point, only the second documented in Tom Green County (Meltzer and Bever 1995:47–81), is made of Edwards chert. It has a basal width of 22.39 mm, a maximum width of 25.53 mm, and a flute thickness of 4.90 mm. Basal grinding is present. Several other heavily

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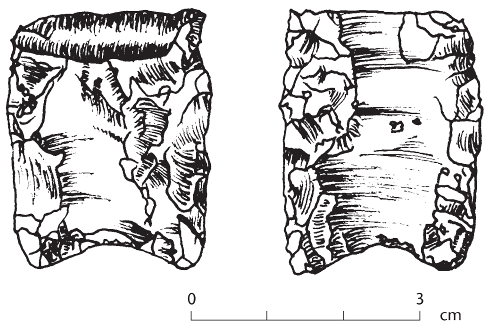

Figure 1. Clovis point recovered from the surface of 41TG378.

patinated bifaces, debitage with heavy patination, and a bifacially flaked quartz crystal are also present at the site.

41TG378 lies on the extreme southern edge of the Rolling Plains, an undulating plain with sometimes steeply eroded canyons (Fenneman 1931:54). Comparing county data from the Texas Clovis Fluted Point Survey (Meltzer 1987, 1995; Meltzer and Bever 1995) in combination with terrain maps (TPWD 1999) suggests that counties dominated by Rolling Plains have some of the lowest frequencies of Clovis points in the state (Meltzer 1987; Meltzer and Bever 1995). While Clovis points are recorded in roughly 50 percent of the 254 Texas counties (Meltzer and Bever 1995:53), only 29 percent of the 41 counties dominated by Rolling Plains have Clovis points. Ten of these 12 counties cluster at the southern end of the Rolling Plains, and all Rolling Plains counties with multiple Clovis points (n = 7) are in this area (Meltzer and Bever 1995: 48-50).

Beyond this apparent concentration of Clovis material, there is a paucity of data on Clovis occupation in the region. Preliminary testing at 41TG378, consisting of the excavation of two 1-by-1-m units and eight shovel tests, suggests that subsurface deposits are confined to the upper 10 cm. The shallow nature of the site limits the potential for subsistence data, but the apparent ability to identify Clovis tools and debris suggests that 41TG378 has significant potential for investigating Clovis lithic technology.

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TPWD 1999 Natural Subregions of Texas. Map compiled by the Texas Parks and Wildlife, GIS Laboratory. Austin, Texas.

New Evidence of Early Bifacial Industries on the Isthmus of Panama

Georges A. Pearson

For many years, the Paleoindian record of Panama was limited to isolated finds around Lake Alajuela/Madden (Bird and Cooke 1978; Ranere and Cooke 1991; Sander 1964) until a survey of the Santa Maria watershed, in the early 1980s (*Proyecto Santa Maria*, Cooke and Ranere 1984, 1992a), located additional early sites. Among these was the Corona rockshelter dating to 10,440 ± 650 ^{14}C yr B.P. (Cooke and Ranere 1992b) and the La Mula West site (Cooke 1998; Cooke and Ranere 1992b; Ranere 1997; Ranere and Cooke 1996), where Clovis-like points were discovered near an area containing a hearth dated at 11,350 ± 250 ^{14}C yr B.P. (Crusoe and Felton 1974). This same survey also found a bifacial projectile point on the shore of Lake La Yeguada situated at an elevation 650 m a.s.l on the Pacific side of the Continental Divide. The sudden appearance of particulate carbon in Lake La Yeguada deposits c. 11,050 ^{14}C yr B.P. suggests that Paleoindians were repeatedly burning the surrounding vegetation either to attract game, facilitate the growth of favored plants, or clear areas for camps (Bush et al. 1992; Piperno et al. 1990, 1991).

Based on these findings, a new reconnaissance project was conducted around Lake La Yeguada to locate Paleoindian sites along its shores and in the immediate mountainous zone. The goal of this survey was to verify if late-Pleistocene/early-Holocene hunter-gatherers had ventured at higher elevations on the Isthmus. In conjunction with this survey, active prospecting for lithic raw material sources was carried out in order to build a comparative reference collection for the Smithsonian Tropical Research Institute.

More than 30 preceramic sites (i.e., isolated finds, open-air sites, quarry/workshops, rockshelters) were discovered during the two-month survey. The most important discoveries were made at ten quarry/workshops in the vicinity of the lake. These open quarries were discovered on eroded surfaces where lag deposits of fine-grained jasper boulders were found. Quarry dimensions vary from 30 to 100 m^2 and consist of dense surface scatters of manufacturing debris, cores, and finished and unfinished implements. Tools discovered at these localities include several bifaces, large scraper-planes, and spurred endscrapers (Figure 1). A significant discovery is a stemmed point with a flute-like basal thinning scar on one side of its broken base.

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Late-Pleistocene and Holocene Microblade Industries at the Moose Creek Site

Georges A. Pearson

The Moose Creek site is located in the Nenana Valley in central Alaska. The site's deposits are composed of eolian silt and sand totaling approximately 80 cm in thickness. Re-excavations in 1996, following the work of Hoffecker (1985, 1996), discovered a Nenana-complex occupation dating to c. 11,200 ^{14}C yr B.P. overlain by two microblade components separated by a layer of culturally sterile sand. At the time, the microblade occupations were believed to belong to a late-Pleistocene and Holocene phase of the Denali complex. The oldest microblades (Denali I) were associated with a paleosol located 15 cm above the Nenana complex material and were tentatively dated to c. 10,600 ^{14}C yr B.P. based on radiocarbon dates from the nearby Dry Creek site (Pearson 1997). Diagnostic artifacts included 27 microblades and a Donnelly burin (West 1981). The microblades were all made from the same lithic material and found in a tight cluster, suggesting that they were manufacturing by-products. Although microblade cores and platform rejuvenation tablets were not discovered, several microblade overshots indicate that the core had a wedge-shaped fluted face. Additional objects from this component include several complete and fragmented bifaces, a blade, and biconvex lanceolate projectile point tips and bases. A hearth, associated with fire-cracked rock, a flake scatter, and an exhausted core was also found at this level. A charcoal sample collected from the densest part of this feature yielded an AMS date of 10,500 ± 60 ^{14}C yr B.P. (Beta-106040).

The second Denali-complex occupation (Denali II) was discovered within undulating bands of buried forest soils (paleo-Bw horizons) and separated from the Denali I component by a 25-cm-thick sand layer. Diagnostic artifacts discovered within the paleosols include microblades and a microblade core platform rejuvenation tablet. Other tools include endscrapers, a blade, and a broken lanceolate projectile point preform. Hearths and other features were not observed at this level. An AMS date of 5680 ± 50 ^{14}C yr B.P. (Beta-106041) was measured from a piece of charcoal collected at the base of the buried forest soil complex just above the sand layer separating the two microblade components. This date, however, does not give a direct age for the second microblade assemblage since it was measured from charcoal of undemonstrated cultural origin.

An earlier date for the Denali II component would be stratigraphically more sound, considering that it overlies a sand deposit that seems to correlate with the beginning of the Younger Dryas interval (Björck et al. 1996; Johnsen et al. 1992). This event, believed to be responsible for depositing several late-Pleistocene sand sheets in the Nenana Valley (Bigelow et al. 1990), is also synchronous with the brief reversal of the McKinley Park IV Stade (Ten Brink and Waythomas 1985).

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Recent work demonstrates that the majority of dates associated with Holocene Denali-complex occupations in central Alaska range from 8,500 to 8,000 cal yr B.P. (Mason et al., in press). This period correlates with the cold, dry climate of the Mesoglacial (Alley et al. 1997; Beget 1983) and a decrease in spruce in the region (Ager 1983, 1985; Edwards and Barker 1994; Ten Brink and Waythomas 1985). Falling within this interval are four radiocarbon assays from the microblade occupation at the Panguingue Creek site (Component II) located approximately 18 km south of Moose Creek. Cultural dates for Component II at Panguingue Creek average 7711 ± 97 ^{14}C yr B.P. (Goebel and Bigelow 1992, 1996) and may represent a more valid age for the Holocene microblades at Moose Creek. The 10,500 ^{14}C yr B.P. date from the Denali I hearth at Moose Creek supports the previous age estimates of 10,615 ± 100 (AA-11728) and 10,690 ± 250 (SI-1561) ^{14}C yr B.P. for the early microblades at Dry Creek (Bigelow and Powers 1994).

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An Early Lithic Assemblage from the Tuluaq Site, Northwest Alaska

Jeff Rasic and Robert Gal

The Tuluaq Site (49DEL360) is a lithic workshop and hunting station located in the De Long Mountains, the westernmost extension of the Brooks Range in Arctic Alaska. The site lies on a small tributary of the Kelly River named Wrench Creek and is situated on a prominent hill that provides a panoramic view of the valley. Two large chert outcrops, located within 3 km of the site, were an important quarry source used by the occupants of Tuluaq and by earlier and later inhabitants of the region (Malyk-Selivinova et al. 1998).

National Park Service researchers identified and tested the site in 1998 and performed additional testing in 1999. Surface collections and subsurface testing revealed dense clusters of debitage, primarily from bifacial reduction, and numerous tools (Figure 1). The largest class of formed artifacts is bifaces broken during manufacture (n = 353). All stages of a reduction sequence are represented by these rejects, from minimally modified flake and tabular blanks to nearly finished projectile points. Another important category of artifacts is projectile points that were discarded after use (n = 55). Most of these are proximal or medial fragments that would have remained hafted after breakage (73 percent), many exhibit fractures typical of impact damage (53 percent), and seven specimens show evidence of resharpening or rejuvenation, thus suggesting retooling/discard events at the site rather than breakage during manufacture. These large lanceolate-shaped points exhibit thick biconvex cross sections, rounded bases, edge-ground proximal margins, and robust collateral pressure finishing. Similar projectiles were first recognized at the Irwin-Sluiceway site, located 150 km east of Tuluaq and dated to around 10,000 yr B.P. (Dennis Stanford unpublished data); they have since been identified in collections from other sites in the De Long Mountains-Noatak region such as the NR-5 Site (Anderson 1972:79–83), and 49DEL185 (Bowers et al. 1998).

Other artifacts from the site include thick elongate unifacial tools (n = 5), unifacial endscrapers (n = 3), gravers, and a variety of retouched or utilized flakes. A single fluted point typical of those found in other Brooks Range sites (e.g. Alexander 1987; Humphrey 1966; Solecki 1951; Thompson 1948) and a

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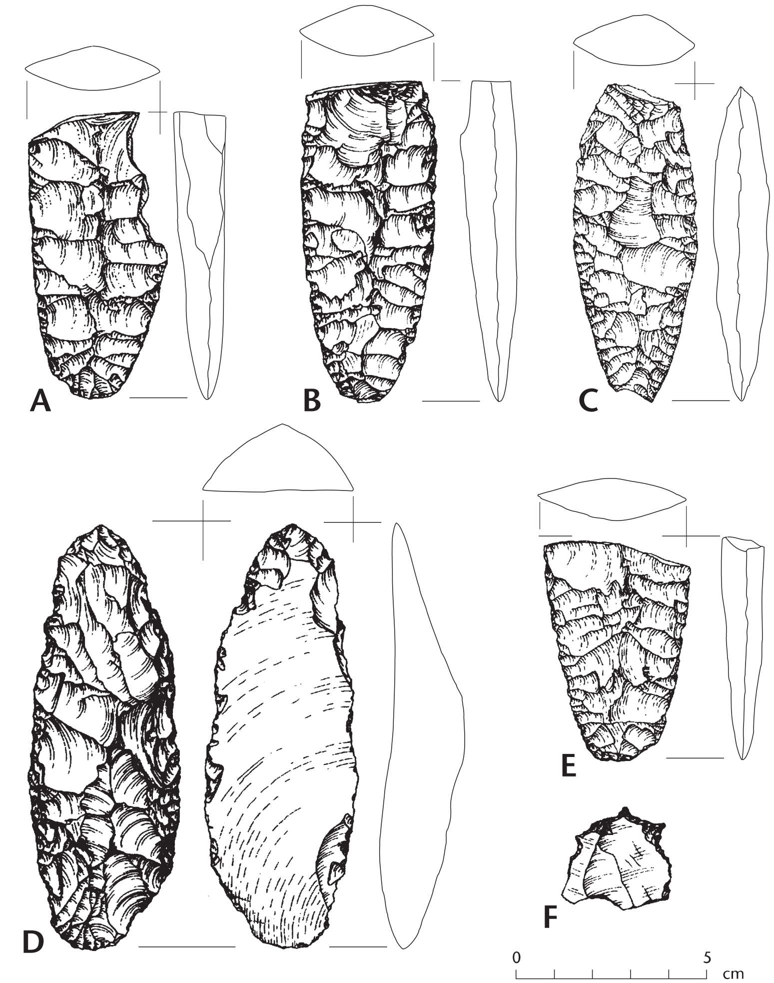

Figure 1. Stone tools from the Tuluaq site: (**A, B**) impact-damaged projectile point bases; (**C**) resharpened projectile point; (**D**) thick, unifacial tool; (**E**) projectile point base; (**F**) flake graver.

single wedge-shaped microblade core were found in isolated surface locations.

Point-plotted pieces of willow (Salicaceae) or poplar charcoal, recovered from discrete clusters of charcoal-stained or oxidized soil and directly associated with chipping debris, returned AMS dates of 7950 ± 40 (Beta-133394), 11,180 ± 80 (Beta-122322), and 11,200 ± 40 yr B.P. (Beta-133393). A fourth date of 11,110 ± 80 yr B.P. (Beta-122323), also derived from a single nodule of willow or poplar charcoal, was recovered from a bulk soil sample. Its relation to cultural activity at the site is less secure.

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Possible Pre–Clovis-Age Artifacts from the Big Eddy Site

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Excavations were resumed in 1999 at the Big Eddy site (23CE426), located on the Ozarks/Eastern Plains border in southwest Missouri. Excavations in 1997 revealed multiple early- to late-Paleoindian components in the lower part of a thick stratified late-Pleistocene/early-Holocene alluvial unit (Lopinot et al. 1998a, 1998b; Ray et al. 1998). The 1997 excavations were largely terminated near the base of the early-Paleoindian deposits at a depth of 3.5 m. However, exploratory tests at deeper levels revealed possible in situ artifacts, manuports, and small charcoal fragments to a depth of 4 m. Two ^{14}C samples revealed the sediments at 396–409 cm dated between 12,700 and 13,000 yr B.P. (Hajic et al. 1998:90).

In 1999, Block B/C was reopened and work resumed at the 3.5-m level through 1.3 m of pre-Clovis-age deposits. An area of 16 m^2 was excavated in

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5-cm levels down to a paleo-gravel bar underlying the thick alluvial sequence. Charcoal fragments were scattered throughout the deposits, and 39 fragments were piece-plotted and collected. Five charcoal fragments from depths between 3.5 and 4.0 m were submitted for AMS assay. They yielded the following results: 3.58 m = 12,320 ± 130 yr B.P. (AA-34586), 3.64 m = 11,930 ± 110 yr B.P. (AA-34587), 3.75 m = 12,250 ± 100 yr B.P. (AA-34588), 3.83 m = 11,375 ± 80 yr B.P. (AA-34589), and 3.86 m = 12,590 ± 85 yr B.P. (AA-34590). The ^{14}C ages indicate the deposits below about 3.55 m are pre-Clovis in age.

Lithic items from the excavations include flake debitage, large unmodified rocks, and at least two modified rocks. Seventeen pieces of flake debitage were collected, ten of which were recovered beneath Clovis-age contexts. The flakes from these contexts are sparse and relatively small (< 2 cm^2), and it is possible that all have been translocated downward from overlying Paleoindian deposits. At least four large unmodified cobbles and boulders (2.1–9.6 kg) were also found in pre–Clovis-age fine-grained sediments, and three other large cobbles in similar contexts were reported previously by Ray (1998:219). Given their occurrence in fine-grained upper point bar sediments, these cobbles and boulders appear to be too large to have been transported by stream to this landscape position and are therefore probably manuports.

The best evidence for in situ pre-Clovis artifacts is a large possible anvil stone and a nearby possible hammerstone, both recovered from fine-grained silty clay loam sediments (Ray and Lopinot 2000:83–88). The possible anvil stone is a large tabular boulder of indurated sandstone with subangular edges. It was fractured into two fragments, which were only 4–6 cm apart. Both were laying flat on the same paleogeomorphic surface at a depth of 3.84 m. The two fragments refit along a sharp angular fracture. The overall weight of the possible anvil stone is 18.4 kg. It measures 44.0 cm long, 27.5 cm wide, and 15.2 cm thick.

Several attributes of the possible anvil stone indicate human modification. First, a roundish shallow pitted area 4.8 cm in diameter (bisected by the fracture) is evident on the upright surface when the two fragments are refitted (Figure 1A). This pitted area is located just off-center toward a pointed end of the boulder. Second, a percussion spall 6.0 cm long, 2.7 cm wide, and 1.6 cm thick refits between the two anvil fragments (Figure 1B). This spall exhibits a diffuse positive bulb of percussion on both faces, possibly produced by a forceful vertical blow from a large hard hammer. The spall point of impact is located near one edge of the anvil 4.0 cm from the center of the pitted area. Third, a large (9.2 cm wide) negative bulb of percussion scar is located on one edge of the smaller fragment 6.0 cm from the percussion spall (Figure 1C). Fourth, the refit (broken) side of the in situ smaller fragment was rotated approximately 120 degrees counterclockwise (viewed from above) from the refit side of the larger fragment, and the smaller fragment partially overlay the percussion spall. Additionally, the rotated smaller fragment was situated in a lateral position relative to the larger fragment and perpendicular to the apparent direction of flow in the nearby Sac River paleo-channel.

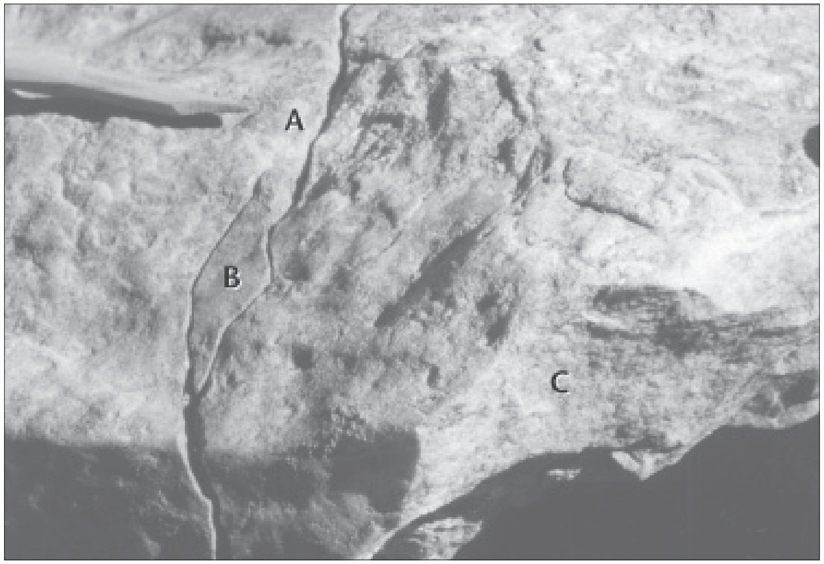

Figure 1. Anvil stone recovered from a pre-Clovis context at the Big Eddy site. **A,** pitted area; **B,** percussion spall; **C,** negative percussion scar. Scale: 1 in = 2.3 in (5.9 cm).

The other modified rock is a large subrounded, oblong cobble of oolitic chert. It weighs 4.5 kg and measures 21.6 cm long, 15 cm wide, and 12.0 cm thick. The modification, restricted to one poll and consisting of a minimum of seven relict cones of percussion (i.e., intact Hertzian cones), represents forceful contact with a hard object. A hairline fracture extends through the center of two impact cones. These attributes suggest this large cobble may have been utilized as a hard hammer. It was found 1.5 m west of the sandstone boulder with its base at a depth of 365 cm.

Although the possible hammerstone and anvil stone may be associated, a clear relationship is not evident. Nevertheless, these two artifacts are interpreted as evidence of pre-Clovis hammering activities, possible for processing megafaunal bone. Similar anvil stones and hammerstones have been reported in association with mammoth bone in pre-Clovis contexts at the Cooperton site in Oklahoma (Anderson 1975), Bonfire Shelter in Texas (Bement 1986), and the Lamb Spring site in Colorado (Stanford 1983).

In contrast to our assessment of these objects as possible artifacts, two of three use-wear specialists cast doubt on human modification of these items. Ahler (2000) and Kay (2000) suggest several possible natural mechanical and chemical processes to account for the modifications. Dillehay (2000), however, sees distinct possibilities of cultural modification on both specimens. There are many scenarios that could be offered to account for the transportation and/or modification of the possible anvil stone and hammerstone, including fluvial corrasion, ice rafting, megafaunal trampling, falling tree limbs, lightning, and freezing-thawing. Nevertheless, we contend that none of these natural modes of transportation or modification adequately account

for three very important contextual attributes associated with the possible anvil stone: (1) the position of the 18.4-kg boulder in fine-grained sediments; (2) the "in-place" rotation of the smaller fragment approximately 120 degrees from its refit with the larger fragment; and (3) the superposition of the smaller fragment over the spall flake.

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Reassessing the Silverhorn Folsom Site in Central Utah

Alan R. Schroedl

In 1953, a local collector reported recovering a Folsom point in situ at the base of an alluvial cut bank in Horn Silver Gulch in central Utah to the Statewide Archeological Survey (SAS). The site was recorded in 1953 as 42EM8 by Jack Rudy of the SAS. In 1954, James Gunnerson, also of the SAS, conducted limited testing at the site, which he called the Silverhorn site. In late 1954, Gunnerson prepared and submitted a short paper on the excavation results (Gunnerson 1956).

In the article, Gunnerson notes the presence of a dozen buried cultural layers and describes the Folsom point and two bifaces "which closely resemble blades found associated with Plainview-like points" (1956:414). One of these bifaces was purportedly recovered from an occupation level below the Folsom point. He also states that limited testing failed to produce more fluted points and notes in passing that "burned areas or hearths, chips, bone fragments, and occasional artifacts are to be found." (Gunnerson 1956:412). According to Gunnerson, "Work at the site was abandoned only when the occupational debris thinned out and, for all practical purposes, disappeared. No further work at the site is planned." (Gunnerson 1956:414).

I revisited the site in late 1999. In early 2000, I conducted a thorough review of the original site form, excavation notes, photos, general correspondence, and artifact collections from the site at the Utah Museum of Natural History to evaluate the nature of the recovered artifact assemblage and to determine the accuracy of the stratigraphic sequence identified by Gunnerson. The review identified additional information about the site not reported in his 1956 publication.

Gunnerson submitted his article to *American Antiquity* in 1954. In 1955 he conducted additional excavations at the site, presumably at the request of Jesse D. Jennings, Director of the SAS. These additional excavations also failed to produce any fluted points, although several additional biface fragments, several charcoal samples, and two groundstone artifacts were collected.

I was unable to satisfactorily correlate the artifacts from the Silverhorn site in the Utah Museum of Natural History collections with the site notes and field documentation from 1954 and 1955. The exact provenience of any specific artifact relative to the level of the Folsom point is uncertain. There is some evidence to suggest that at least a few of the artifacts were collected from a later occupation on the alluvial terrace in front of the cut bank. Nonetheless, an evaluation of artifact assemblage as a whole is informative.

The chipped-stone debitage assemblage (most likely the 1954 surface

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collection from the terrace, as it appears no debitage was collected in 1955) consists of a small bag of more than 50 bifacial thinning flakes manufactured from a poor-quality local raw material. The five biface fragments (two of which are reported by Gunnerson) are of generally higher-quality non-local material but do not have any distinctive Paleoindian characteristics. None of the bifaces fall into the range of ultrathin bifaces recovered at other Folsom sites (William et al. 1997). The few bone fragments appear to be non-cultural small mammals, and the two groundstone artifacts are well-formed shaped sandstone mano fragments. In light of the current knowledge of central Utah archeology, these artifacts as a group would most easily classify out as an Archaic assemblage. They could also be associated with formative Fremont occupation in the area. Gunnerson (1956) fails to note that Fremont masonry structures and pictographs occur in a rockshelter less than 100 m downstream from the Silverhorn site.

The 1999 field inspection and a review of the 1955 photographs suggest that both the 1954 and 1955 excavations by Gunnerson were conducted several meters away from where the Folsom point was reportedly recovered. These potential Paleoindian deposits may still be intact, buried under secondary fill from road widening by the county over the past 40 or more years.

In summary, most of the "occupation levels" noted by Gunnerson appear to be alluvial strata with naturally deposited water-worn charcoal. The artifacts assemblage he collected is probably not Paleoindian but a mixed assemblage from a later occupation on the terrace in front of the cut bank. The 1954 and 1955 excavations may not have actually focused on the area where the Folsom point was reportedly recovered.

The 1999 field inspection demonstrates that many of the reported "occupation levels" (i.e., alluvial strata with water-rolled charcoal) are still intact in the alluvial cut bank and that additional investigations might be warranted. Even if no Paleoindian components are present (since the collector may not have accurately recalled when he found the Folsom point), the remnants of the alluvial cut bank and the presence of water-worn charcoal in the deposits would allow the development of a well-dated late-Pleistocene/Holocene alluvial sequence for Horn Silver Gulch in central Utah.

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Distribution of Folsom and Goshen Artifacts in South Dakota

Frédéric Sellet and Michael Fosha

This research report summarizes the results of an ongoing survey of Paleoindian projectile points in South Dakota. The enterprise, started in the Fall of 1999, includes all diagnostic Paleoindian types found in private collections as well as the ones on file at the South Dakota Archaeological Research Center. It comprises projectile points, preforms, knives, and channel flakes. The following account is a preliminary discussion of the distribution of the Folsom and Goshen types.

Although similar large-scale surveys do exist for other parts of the plains, none had ever been attempted for South Dakota. Such an exercise has obvious limitations: those encompass biases in collection methods as well as gaps in surveyed areas. Notwithstanding these restrictions, our goal is to make the data available for larger scale settlement analyses, and at the same time to set the stage for future work on Paleoindian adaptive strategies in South Dakota.

A total of 37 Folsom and 30 Goshen points have been recorded to date. This includes 39 artifacts in private collections, 14 from excavated contexts, and 14 that have been recorded by other scholars (their attribution to the Folsom or Goshen types was verified from drawings).

The two types were found in close association at three localities: the Jim Pitts site in the southern Black Hills (Donohue 1999), the Ghost site in the northwestern corner of the state (Fosha and Sellet 2000), and a third locality in the Badlands. These results complement the reanalysis of the Hell Gap site in Wyoming, where inter-stratification of the types was demonstrated (Sellet 1999).

The spatial patterning visible in Figure 1 triggers several remarks:

- Both Folsom and Goshen points are scarce in South Dakota. We strongly feel that this reflects past research agendas rather than true archaeological patterns.

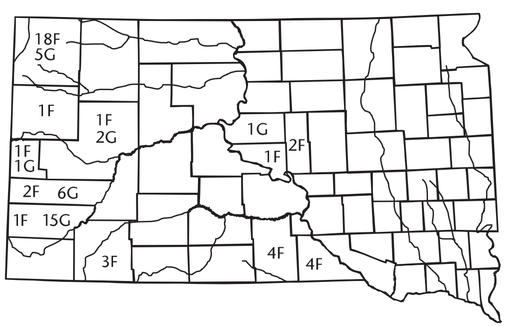

Figure 1. Map of South Dakota showing the number of Folsom (**F**) and Goshen (**G**) artifacts per county.

- The finds are unevenly distributed through space. The small sample as well as the biases inherent to the collection of the data could explain the phenomenon. For example, Folsom points are more easily identifiable and have historically generated greater interest than Goshen points; therefore the absence of Goshen points in areas where Folsom points have been found is probably insignificant.
- Finally, it is interesting to note that the Paleoindian points found in the Black Hills are restricted to the outskirts. This is not sufficient, however, to rule out the possibility of an exploitation of the hills by Paleoindian groups. The evidence simply suggests that most settlements were located at the edge of the Black Hills.

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The Late-Pleistocene/Early-Holocene Transition in Western New York: A Reexamination of the Ritchie-Fitting Hypothesis

Kevin P. Smith and Richard S. Laub

About 30 years ago, William Ritchie (1965, 1971) and James Fitting (1968) proposed that pine-rich boreal forests dominated the lower Great Lakes and Northeast during the Pleistocene/Holocene transition. They suggested that the perceived scarcity of late-Paleoindian and early-Archaic (sensu Ellis and Deller 1990, Ellis et al. 1990) sites in this region reflected insufficient availability of game animals to support resident human populations during the first millennia following glacial withdrawal. This perspective has been challenged in parts of the Northeast, but still influences discussions of lower Great Lakes regional prehistory (Dincauze and Mulholland 1977; Funk 1993; Funk and Wellman 1984; Mason 1981). Archaeological surveys and excava-

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tions by Trubowitz (1979, 1983) and the authors in western New York support neither the archaeological nor the paleo-environmental bases of the "Ritchie-Fitting hypothesis."

From 1992 to 1997, one of us (Smith) surveyed the upper Spring Creek basin (Genesee County, New York), a lowland tributary drainage in proximity to the Hiscock site (Laub 1994; Laub et al. 1988), and examined major regional museum collections from a wider region of western New York. More than 100 Paleoindian and early-Archaic diagnostic projectile points were identified in this study, including Gainey and Barnes Paleoindian forms; Hi-Lo, Hardaway, Kessell, and Big Sandy-like early side-notched forms marking the Paleoindian/early-Archaic transition; and Thebes, Kirk, and Bifurcate-series bifaces diagnostic of the early Archaic (Smith 1995, Smith et al. 1998). Early-Archaic diagnostics were more common than Paleoindian types, but less so than middle- or late-Archaic styles. Although information on the early-Holocene use of upland regions remains limited, Paleoindian and Bifurcate series diagnostics are also known from such locations in western New York.

The styles and diversity of late-Paleoindian and early-Archaic diagnostics from western New York mirror sequences from the mid-continent and southern Ontario, but differ somewhat from contemporary sequences in New England, Maritime Canada, and the Mid-Atlantic coast. By the middle Archaic (8,000–6,000 yr B.P.), links to the Northeast appear closer. Lithic materials from distant (> 100 km) sources constitute 15–20 percent of regional Paleoindian assemblages, while cherts available within 50 km were used for 99 percent of early-Holocene diagnostics. In addition to high-quality Onondaga chert, lower-grade cherts (Lockport, Reynales, and Huronian [Holland 1999]) from localized bedrock sources and glacial gravels were used as early as the Hi-Lo phase. This suggests decreased mobility during the early Archaic, in contrast with models proposed for the western Lake Erie basin (Ellis et al. 1991; Stothers 1996).

Regional Paleoindian and early-Archaic populations may have exploited a mosaic-like environment of great diversity. The early-Holocene component at the Hiscock site contains a rich record of late-Quaternary environments and biota. The remains of deer *(Odocoileus virginianus)*, wapiti *(Cervus elaphus)* and passenger pigeon *(Ectopistes migratorius)* are common in the basal-Holocene Hiscock deposits. AMS dates confirm their early-Holocene age: Specimen F5NE-144, the right mandibular ramus of a deer, dated to 7880 ± 90 yr B.P. (Beta-24410). Specimen F6NE-51, the coronoid process of a wapiti mandible, dated to 8620 ± 50 yr B.P. (CAMS-27142). Although specimen F6NE-58, the humerus of a passenger pigeon, failed to produce a date, it lay 2 m from the wapiti specimen and in the same stratigraphic position. Both the wapiti and pigeon bones were in the base of a fine-grained peat, a nearby sample of which dated to 8570 ± 90 yr B.P. (Beta-34287).

These results indicate that potential game species existed in a lowland (elevation 189 m) swamp forest setting in western New York during the early Holocene. Pollen and wood samples show the area around Hiscock to have been dominated by pine, with a strong presence of spruce and tamarack. Increases in beech pollen and a slightly later oak macrofossil (7470 ± 95 yr B.P. [Beta- 34288]) imply, however, a deciduous mast-producing component in this forest (Miller 1988), consistent with early-Holocene conditions in adjacent southern Ontario (McAndrews 1994). The Doerfel mastodon site (Laub and McAndrews 1999), an upland (517 m) kettle hole 80 km southwest of Hiscock, shows evidence of dry conditions in the terminal Pleistocene, an absence of early-Holocene sediment, and a mid-Holocene peat horizon. Its suggestions of altitudinally drier conditions matches Miller's (1973) characterization of early-Holocene upland forests dominated by white pine, oaks, and sugar maple.

Currently available data do not suggest a hiatus in regional settlement, but may not reflect equal use of all the region's landforms during the early Holocene. For western New York, evidence of late-Pleistocene/early-Holocene occupations is most obvious in the lowlands, especially in proximity to wetlands, suggesting a focus on the biotically rich microenvironments of evolving postglacial wetlands (Nicholas 1988). Evidence from upland regions remains spotty. The reliance on local chert types and secondary chert sources, however, suggests that people had "settled in" to the region by the beginning of the early Holocene. Paleo-environmental data from Hiscock confirm that migratory and resident game species central to later Holocene subsistence adaptations were also present by this time.

William A. Lovis (Department of Anthropology, Michigan State University) and Ronald F. Williamson (Archaeological Services, Inc., Toronto) reviewed drafts of this paper and provided valuable comments. Excavation and study of the Hiscock Site is funded by the George G. and Elizabeth G. Smith Foundation of Buffalo. The authors wish to thank the many volunteers who assisted in the fieldwork on which this paper is based. Any errors of fact or interpretation remain the sole responsibilities of the authors.

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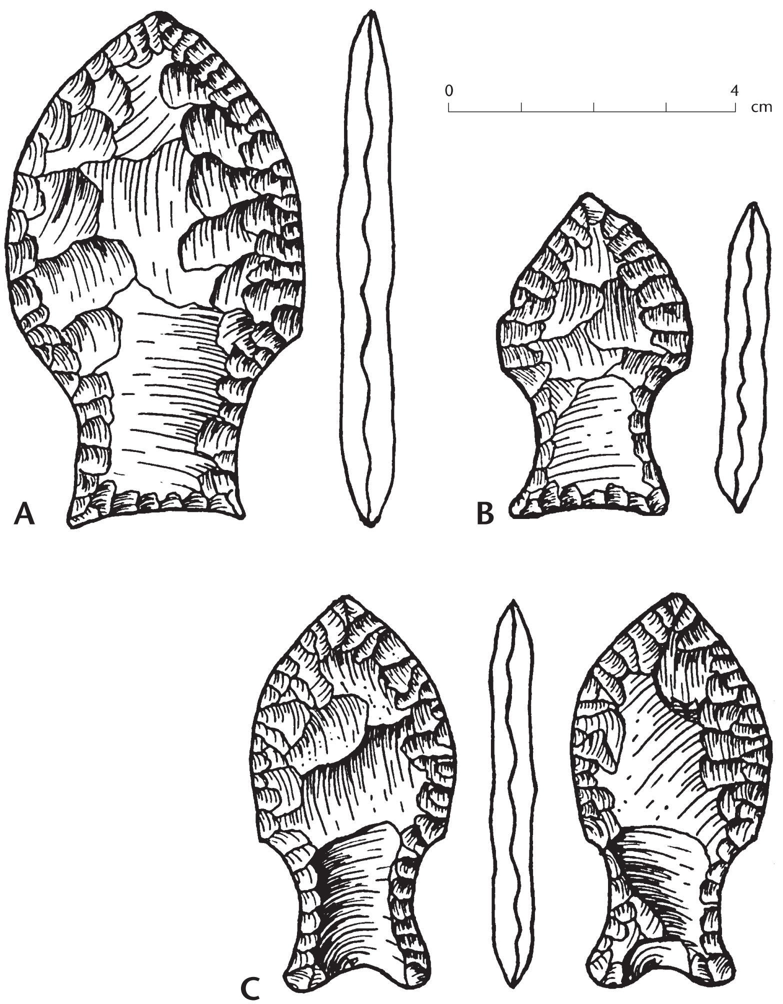

Figure 1. Fishtail projectile points (FPPs) from the Negro mid river (Uruguay). **A,** Classic FPP in size and proportions, red highly silicified limestone (RHSL) (Rueda collection); **B,** FPP resharpened, RHSL (Bálsamo collection); **C,** FPP fluted on both sides, RHSL: (Aizpún collection). Drawings by the author.

The Crook County Clovis Cache Revisited

Kenneth B. Tankersley

Crook County is one of seven reported caches of Clovis bifaces (Anderson and Tiffany 1972; Frison 1991; Gramly 1993; Jones and Bonnichsen 1994; Stanford and Jodry 1988; Woods and Titmus 1985). However, the exact location and geologic nature of the find spot has been poorly documented. The cache was discovered in the summer of 1963 by Harold Erickson during an exploratory oil and gas survey in northern Crook County, Wyoming (Tankersley 1998). Erickson reported that the cache was partially exposed in a freshly bulldozed road made during the construction of a small reservoir. The road cut down a hillside from a bench top to the bottom of a broad coulee (Byrd 1997a:19). The find spot was situated near a survey stake beneath a low (1.8–2.4 m high) sandstone bluff, in a very red compact soil about 15 cm thick, 1.2 m wide, and approximately 1.5 m below the surface (Byrd 1997b:38).

In an effort to relocate the site, a geoarchaeological laboratory and field project was initiated in 1997. The work included a petrographic and geochemical analysis of the flaked-stone artifacts, examination of the 1963 oil and gas exploration records for Crook County, contemporary maps, and a surface survey of the area. The goals of the project were to determine the topographic and stratigraphic setting of the cache site, define the red ochre source area, and locate potential Clovis activity areas.

Although the investigation is ongoing, there are a number of important findings that warrant reporting. In 1963, most of the petroleum exploration in Crook County was concentrated on the eastern end of the historically famous Powder River Basin oil and gas fields. This information restricted the search to a rectangular area about 14 by 7 km. Geologically, the bedrock stratigraphy of this area is composed of Cretaceous shale in the east and sandstone in west. Given that the find spot was near a sandstone outcrop, possible site locations were further narrowed to a triangular tract of land roughly 11 by 9 by 5 km located in the extreme northwestern portion of Crook County. Within this section, there were only three locations with dirt roads near sandstone exposures and in the vicinity of drill holes. Of these, only one led downhill to small reservoir at the base of a broad coulee.

On June 25, 1999, a surface survey of the area was conducted with the help of C. Vance Haynes (University of Arizona), John D. Holland (Buffalo Museum of Science), and Forrest Fenn (Santa Fe). At an elevation of approximately 1,280 m amsl, we found a thin discontinuous band of red ochre exposed in a roadcut located below a small bedrock outcrop of buff-colored sandstone and adjacent to a survey stake. The red ochre is a blood-red hematitic mudstone in a light greenish gray shale that extends across the old dirt road (Haynes 1999). The rancher-landowner informed us that the tank dam at the end of the road was constructed during the summer of 1963.

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In addition to nine flaked-stone bifaces, Harold Erickson reported finding two broken cylindrical bone artifacts that he described as "tent pegs as big as your finger and a foot long" (Byrd 1997a:19). He was unable to determine whether they were broken during his excavation or by the bulldozer (Byrd 1997b:38). A fragment (1.3 cm wide, 3.0 cm long, and 0.6 cm thick) of heavily mineralized cortical bone was found on the surface of the site. Considering the high degree of fossilization, it is uncertain whether the specimen is a fragment of one of the broken bone artifacts described by Erickson or from a Cretaceous-age marine vertebrate.

A stratified spring site was examined approximately 1 km northwest of the cache site. An endscraper and two flake fragments were found weathering from a terrace scarp. Although none of the artifacts are temporally diagnostic, the stratigraphic profile is similar to that described for the Hell Gap site in southeastern Wyoming (Frison 1998; Haynes 1993; Irwin-Williams et al. 1973).

The geologic setting of the cache site may be culturally significant. The red ochre is not anthropogenic. Rather, it occurs as a discontinuous bed within the shale of the Fox Hills formation and extends to the surface with little soil development. The cache was intentionally buried in a natural deposit of red ochre. Like the Sunrise site in southeastern Wyoming (Tankersley et al. 1996), the burial of bone and flaked-stone tools and weapons in a red ochre source may have been associated with an ideological element of the Clovis culture, possibly hunting magic (Stafford 1990:72-23). A ritual perspective of the cache is further supported by the topographic position of the site. It overlooks a spectacular southeast vista that includes the Missouri Buttes, Devils Tower, and the Bear Lodge and Sundance Mountains. These intrusive igneous bodies have been sacred to the hunters of the High Plains from time immemorial.

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Adair-Steadman, a Folsom Lithic Workshop on the Southern Plains of Texas

Curtis Tunnell, Eileen Johnson, and Vance T. Holliday

The Adair-Steadman site (41FS2), about 60 km northwest of Abilene, Texas, produced one of the most complete and extensive collections of Folsom manufacturing debris in North America. Thousands of artifacts were recovered during excavations in the early 1970s by personnel from the Texas Historical Commission (THC). A wide array of stone tools (particularly endscrapers with broken or exhausted bits) and associated debris reflect an intensively utilized base camp. Numerous point bases, point preforms broken in a variety of ways during manufacture, and hundreds of channel flakes indicate a production workshop. Based on this material, Tunnell (1977) reconstructed the production process for fluted points at Adair-Steadman and proposed a punch technique to achieve the fluting. Using morphometric analysis of the Adair-Steadman and Lindenmeier production debris and Folsom points, Tunnell and Johnson (1991) concluded that technical differences were small and a great consistency existed over vast distances based primarily on a single unified technology in channel flake removal.

Adair-Steadman is on the second of several broad but low terraces that flank the wide floodplain of the Clear Fork of the Brazos River. The site is near the margin of an extensive dune field, one of several along the north side of the Clear Fork Valley in the area. The dune field includes both active and stabilized dunes. Little is known of the stratigraphy or history of the dunes in the area, but the lack of stratification in the site sediments and the

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ately above a Last Interglacial beach, but it does not support Carter's contention that these tools date to the Last Interglacial. To fully understand the context of Rogers's finds, a synopsis of the local geology is critical.

The bedrock in the immediate area consists of steeply tilted marine shales of the Miocene Rincon formation. These shales have been truncated by a marine terrace cut during the Last Interglacial, then uplifted to their present elevation about 20 m above sea level. After sea level dropped, up to 10 m of eolian and alluvial sediments were deposited atop the beach deposits that covered the marine terrace. During the Last Glacial, Tecolote Canyon cut through these sediments and incised itself deeply into the bedrock, forming several stream terraces.

The result is a terraced coastal landscape, with the high marine terrace forming flattened ridges that flank Tecolote Canyon, several lower alluvial terraces, and a series of intermediate slopes between terraces. All the terraces and some of the intermediate slopes contain archaeological materials dating to the early, middle, or late Holocene. In general, older archaeological materials are found on the higher terraces because the lower terraces have only stabilized since the late Holocene.

In the 1980s, Erlandson carefully examined Pleistocene stratigraphic exposures in Tecolote Canyon twice searching for evidence for Rogers's deeply buried Millingstone locality without success. In 1997, grading of an access road through Pleistocene terrace deposits on the east rim of the canyon was carefully monitored by archaeological and Native American consultants until Miocene bedrock was encountered. Although paleosols and evidence for wildfires were noted in the Pleistocene sediments, no archaeological materials were found.

While examining CA-SBA-74 on the north side of Highway 101, however, we discovered a deeply buried concentration of sandstone milling tools and chert flakes eroding from an arroyo cut through alluvium on the marine terrace east of Tecolote Canyon. After several site visits, 14 metate fragments and 12 manos have been recovered from a stretch roughly 30 m long of the arroyo bottom. Most of the ground-stone artifacts were found in the ravine bottom, but five well-preserved manos were found in situ within an indurated cobble-strewn alluvium, two immediately above the bedrock and three 50–100 cm above it. We carefully searched the arroyo for temporally diagnostic artifacts or datable organic remains, but none have been found.

Most of the ground-stone artifacts are heavily modified by human use, with clearly pecked, faceted, and polished surfaces. They are virtually identical to the numerous manos and metates found in early- and middle-Holocene sites along the southern California coast. Significantly, none of the ground-stone tools exhibit disc or plow marks, suggesting that they were deposited prior to historic farming of the area. As Rogers (1929:59) noted, the geological context suggests that the tools have been redeposited by alluvial processes, but there is little or no evidence for the battering or abrasion expected if they had been transported far.

Historic aerial photos suggest that this ravine once cut through the north bank of the old highway and may have been the source of the landslide that

Rogers examined. Thus, the landslide track reported by Rogers and the artifact-bearing ravine we discovered may be the same locality. Our investigation of CA-SBA-106 has confirmed D. B. Roger's description of milling tools found deeply buried in alluvium directly overlying a Last Interglacial beach. Where Rogers recognized no evidence for gullying or stratigraphic unconformities, however, we found the opposite. Our findings suggest that the milling tools have probably been redeposited from a 4,000- to 5,000-year-old Millingstone site, CA-SBA-74, located immediately above the ravine. While it is no longer possible to fully evaluate the stratigraphic context of Rogers's original finds, study of aerial photographs suggests the tools he found atop the ancient beach deposit were also in alluvial sediments redeposited by cyclical arroyo cutting and filling during the Holocene. Although the eventual discovery of datable materials at CA-SBA-106 could alter our conclusions, Carter's (1978) claim for the presence of a Last Interglacial Millingstone site along the Santa Barbara Coast remains highly questionable.

We thank John Ruiz of the Coastal Band of the Chumash Nation for allowing us to collect materials eroding from the ravine at CA-SBA-74/106

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Additional Organic Artifacts from the Broken Mammoth Site, Big Delta, Alaska

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Broken Mammoth is a stratified Pre-Clovis site located c. 13 km NW of Big Delta in east-central Alaska. Archaeological materials are entrained in a 2-m loess cap above 50 cm of late glacial sands, resting on an 80-m schistose bedrock bluff overlooking the central Tanana River valley. Late-Pleistocene

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and early-Holocene materials are embedded within two distinct paleosol complexes, each consisting of at least three paleosol units lying from c. 1.5 to 2 m below the surface. Radiocarbon dates associated with these paleosols (on charcoal, bone, and mammoth ivory) are internally consistent and range from 11,800 to 9,300 yr B.P. (Yesner 1996, Holmes 1996). Excavations were undertaken at the site from 1990 through 1993 and recommenced in 1998; additional excavations are planned for 2000. All the lithic materials deriving from these units to date are referable to the Nenana Complex *sensu* Goebel et al. (1991). Additional lithic materials attributable to this complex excavated during the 1998 field season include examples of basalt macroblades and large planoconvex core-scrapers, made from local quartz ventifacts. A large workshop for such ventifact artifact production was uncovered in the basal paleosol complex (dating c. 11,500 yr B.P.) in 1998. No microblade technology has been uncovered from these units.

Broken Mammoth is best known for the excellent organic preservation associated with the basal paleosol complexes at the site. Well-preserved animal bones are derived primarily from (super)bison [*Bison priscus*], elk (wapiti/red deer) [*Cervus elaphus*], Arctic/tundra hare [*Lepus othus*], Arctic fox [*Alopex lagopus*], and a variety of birds, including tundra swan, geese, dabbling ducks, and ptarmigan (Yesner 1994, 1996). Considering the diversity of small animal species utilized, particularly birds, cordage facilities such as nets and traps were undoubtedly employed to maximize return rates, as suggested for the Upper Paleolithic by Soffer et al. (1998). Excavations in 1998 at Broken Mammoth demonstrated that moose [*Alces alces*] were more important to late-Pleistocene inhabitants than previously suspected. Mammoth remains are limited to ivory tusk fragments, probably used exclusively for tool manufacture, as indicated by a microchip lodged in a mammoth tusk groove uncovered in 1990. Most greatly predate human occupation at the site, but a new date of c. 11,800 yr B.P. on ivory fragments, equivalent to charcoal dates from the lowest paleosol complex, raises the possibility of contemporaneity of humans and mammoth there. Butchering marks have finally been recognized in microscopic studies of animal bones from the site; they are more frequently visible on bird bones and mammal skull fragments. Animal bones outnumber organic artifacts by a 100:1 ratio, but this is equivalent to the ratio of lithic debitage to formal tools. Broken Mammoth has provided the only organic tools known from the Nenana Complex, including bi-beveled mammoth ivory rods, a mammoth ivory point fragment, a possible atlatl handle made from mammoth ivory, two additional bone points, an eyed needle, and a bone toggle.

In 1998, a bone rod was uncovered from the basal paleosol complexes at Broken Mammoth, associated with a stone-lined hearth previously dated to c. 10,500 yr B.P., as well as a bone scatter containing bison teeth, small mammal bones, bird bones, and mammoth ivory fragments. There were also a few non-diagnostic chert flakes associated with the hearth area, but generally few lithics in this part of the site. The rod itself (Figure 1) is planoconvex in cross section; although broken into three sections, it is nearly complete (length c. 160 mm). Hatching marks suggestive of attached cordage are present on both extremities of the piece as well as on its midsection. One possible interpretation of this

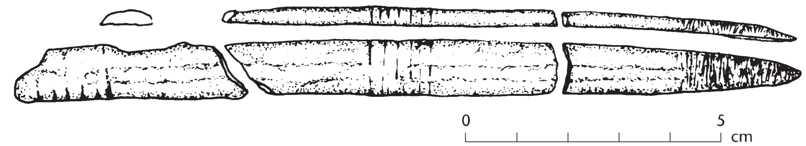

Figure 1. Planoconvex bone rod from the Broken Mammoth site, east-central Alaska.

(Pearson 2000) is that a second, mirror-image piece was attached in a leister style to the flat ventral surface of the rod. In that sense, it may have operated in a similar fashion to the mammoth ivory rods and rod fragments previously discovered at the site, as well as similar rods (of ivory, antler, and bone) known from other Paleoindian as well as Upper Paleolithic sites ("*baguettes demi-rondes*"; cf. Pearson 1999). All probably served as foreshafts, and were probably lashed together on their ventral surfaces around a projectile point and a main shaft, then glued with some kind of mastic (Tankersley 1994). In this sense, they were analogous to longitudinal halves of clothespin foreshafts also known from Paleoindian sites (Callahan 1994), including the Trail Creek Caves in northwestern Alaska (Larsen 1968). The system may have been originally developed to accommodate the triangular, basally thinned "Chindadn" points of the Nenana Complex known from Trail Creek as well as the Nenana Valley. Fluting may have been developed later to adapt this technology to larger "Clovis" points for mammoth hunting.

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The Excavation and Geoarchaeology of North Point Site on the Trinity River, Texas

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North Point is the first site with a Paleoindian component to be systematically investigated on the West Fork of the Trinity River. Generally accepted diagnostic artifacts uncovered include Clovis-like fluted, Dalton, and Golondrina projectile points, and Clovis-like snapped prismatic blades. Occupation of the river terrace locality continued well into the Holocene. The West Fork is the consequent stream of the Trinity River, whose other major forks are the Elm and East Fork. The Aubrey Site is located some 30 miles east of North Point on the Elm Fork. Man-made lakes currently cover much of the original floodplain and terraces along all three of these streams, which join south of the Dallas/Fort Worth Metroplex, the reason for this extensive hydrologic development. Aubrey (Ferring 1990, 1993) was investigated with extensive funding from the U.S. Army Corps of Engineers during the planning and development phase of one of these lakes. Unfortunately, the larger West Fork was dammed to its near-maximum potential with the construction of a string of lakes by the 1930s. A tremendous archaeological record was thus lost long prior to mitigation requirements.

The West Fork should be of particular interest to Paleoindian studies because it provides a potential avenue connecting the western plains to the cross timbers and prairie regions of the east. The Trinity River, furthermore, flows through a pine forest region before it debouches into the Gulf of Mexico approximately 48 miles west of the McFaddin Beach Paleoindian site, where 90–95 percent of raw materials used to manufacture Paleoindian tools were derived from central and east Texas localities; many far inland (Hester et al. 1992). Connections between sites in these various ecotones along the Trinity River during the Pleistocene/Holocene transition have not received significant attention. The North Point Site (41TR148) was a highly favorable locality for camps throughout human occupation of the region because, prior to the construction of Eagle Mountain Lake, it occupied a level terrace of fine silts overlooking a sweeping meander of a partially spring-fed river. As part of this research project, the terrace system was identified for the first time along the West Fork. It was discovered that this system correlated closely with that of the Elm Fork previously identified by Ferring (1993); the terrace on which North Point is located was identified as Hickory Creek.

There is much that can be learned from long-term occupational sites such as North Point, not only from lithic remains but also in terms of site formation processes. Challenges in investigating Paleoindian occupation of the West Fork of the Trinity River arise because all the terraces are believed to be at least 20,000 years old and the floodplain localities are either inundated or deeply buried, like Aubrey, under more than 8 m of alluvium. Thus, if information is not gleaned from the older terrace deposits, what little information is still available for investigation is lost.

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Due to the nature of the old terrace surface, the environmental regime, and biodisturbance, artifacts do not remain on the surface as they might in, say, a desert environment. A total volume of 18 m^2 has been excavated at North Point. Plotting artifacts by size exhibits a clear pattern of size sorting, with flakes smaller than 1 cm migrating up and heavier artifacts migrating down. Due to the tremendous stability of the landform, which appears to have maintained persistent vegetative cover over long periods of time, artifacts are rarely found on the surface, but instead are buried in a well-developed paleo-alfisol (a high base soil with argillic horizon) at a depth of 8–55 cm. At this depth, a highly compacted silty clay loam is encountered with many clay films and weak, coarse subangular blocky structure. This Bt2 horizon provides an effective barrier to artifact translocation from the ancient stable surface above. The intermediate sandy loam permits a high degree of translocation to the extent that students, visitors, and volunteers frequently wished to designate the level at approximately 50–55 cm a "living floor" until the soil dynamics were explained. Some 2,095 lithic artifacts were uncovered during two field seasons: 234 unifacially flaked tools, 64 bifacially flaked tools, 42 groundstone tools, 40 cores, and 1,711 debitage. Raw materials include Alibates dolomite, Tecovas quartzite, and Edwards chert. Nonlithic artifacts include red ochre, partially burnt wood (oak), and mussel shell. No faunal or human remains were uncovered.

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Physical Anthropology

A Possible Second Early-Holocene Skull from Central Washington

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In the summer of 1996, while Central Washington University was conducting its NAGPRA inventory, the senior author noticed among a group of skulls of unknown provenience a neurocranium that bore a remarkable similarity to a specimen from Kennewick, Washington. After the Kennewick Man bones had been ^{14}C dated at 8410 ± 60 yr B.P. (Taylor et al. 1998), the second skull, known only as CWU-DO1, took on a new significance.

We submitted a small sample of bone from the petrous portion of the right temporal bone to UC–Riverside for AMS dating to determine if similar morphology corresponded to similar age. The bone protein was in good condition, and a corrected age of 8020 ± 50 yr B.P. (UCR 3565/CAMS-38950) was obtained on a total amino acid fraction ($\delta^{13}C$ = -14.5 per mil). An additional sample of the same bone analyzed by Stafford Research Laboratories produced two uncorrected results, 8140 ± 50 yr B.P. (SRLA-1061/ CAMS-55193) on gelatin from untreated collagen and 8110 ± 50 yr B.P. (SRLA-1061064/CAMS-55196) from XAD-gelatin.

The specimen is faceless and lacks the central portion of the cranial base, but is otherwise intact and not deformed. It is high, long, and narrow (cranial index 70.9, dolicocranic), with an unusually narrow cranial base and narrow, forwardly placed face (as indicated by the nasion radius, which at 105 mm is

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in the 99th percentile for modern crania). Like the Kennewick Man skull (Chatters 2000), its temporal lines are placed high on the parietals and extend posteriorly to the lambdoidal suture. Superior and inferior nuchal lines are well developed, and there is an inion hook. Nuchal development, very large mastoid processes, a moderate supraorbital ridge, and rounded supraorbital margin mark this individual as male. Closure of sutures gives an age estimate of 40–60 years. The only notable pathology is a small, circular defect on the right frontal, which appears to mark a healed depressed fracture. A brownish red stain, which looks like ochre but has yet to be analyzed for composition, covers parts of the left temporal and parietal bones. Morphometric analysis comparing CWU-DO1 with the Howells (1973) worldwide database shows that, like most Paleoamerican skulls (e.g., Chatters et al. 1999; Jantz and Owsley 1999), CWU-DO1 differs significantly from all modern peoples, but is most similar to Polynesians.

Although the skull was of unknown provenience, we suspect it comes from eastern Washington and have sought to evaluate that hypothesis by searching records from the Thomas Burke Memorial Washington State Museum (which released some skeletons to CWU in the 1970s), exploring bone chemistry, and analyzing sediment found cemented inside the cranial vault. Gravimetric, tephra, phytolith, and pollen analyses are being performed on the soil. The record search has thus far proved fruitless. Gravimetric analyses show that the sediment is loess and that, if the skull is from the Pacific Northwest, its source is probably somewhere in the western or southern Columbia Basin (Busacca and McDonald 1994). Opal phytoliths include a significant number of types from chloridoid grasses and few forms from the grass cells that are involved in flexure when plants are under water stress. This indicates a semiarid to arid environment and, again assuming a Northwest origin, that the source is near an ephemeral stream or lake. Tephra and pollen analyses are as yet incomplete. Contamination of the bone by sulfur, probably from precipitated gypsum, further narrows the point of origin to the Quincy or northern Pasco sub-basins, where numerous ephemeral lakes are found. Finally, the $\delta^{13}C$ value may bespeak a high marine component in the diet, but we as yet lack the results of nitrogen analysis needed to evaluate this contention. If confirmed, and if tephra analyses find ash from Cascade Range volcanoes, our findings strongly suggest that the skull is from a 1,500-km^2 area of the interior Northwest. Should that prove to be the case, pending acquisition of funds from the National Park Service, CWU will explore possible cultural affiliation of CWU-DO1 in discussions with representatives of the region's tribes.

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Prehistoric Human Skeletal Remains from Jalisco, Mexico

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The likelihood of a late-Pleistocene human presence in Jalisco, Mexico, is supported by culturally modified faunal bones, diagnostic lithics, and mineralized human bones; this report concerns the latter, which were analyzed by Irish, using standard osteological procedures (Bass 1981; Brothwell 1981; Ortner and Putschar 1985; Shipman et al. 1986; Ubelaker 1989; White 1991). All materials were recovered 50 km southeast of Guadalajara, in the Lake Chapala and Zacoalco Playa basins.

The human remains are thought to be of late-Pleistocene age based on faunal correlation. Many have been in Solórzano's possession for some time; others were recently collected. Like associated fauna, all are mineralized, dark in color, and fragmentary. We have a focus on their origins and will work to establish exact field proveniences in May 2000.

The Chapala bones (n = 10) have an MNI of three, based on two left superciliary arches (brow ridges) and a deciduous incisor. The superior border of each brow is blunt, implying the sex was male in both cases. However, size variation of other fragments suggests males and females are represented. The deciduous incisor is from a three-year-old; the rest represent young adults.

One Chapala superciliary arch deserves specific mention due to its large size. Studies by Solórzano show the bone resembles that in archaic *Homo sapiens* at Arago, France. In an unpublished 1990 report, Texas A&M osteologists suggest the brow's thickness and robustness are comparable to those of

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KNM-ER 3733 (African *Homo erectus*). Our measurements show the central torus thickness is 13.3, compared with 8.5 mm for KNM-ER 3733; the lateral torus thickness is 11.5 versus 9.0 mm (Rightmire 1998). Thus, for the sake of comparison, the brow is more like that of Zhoukoudian Skull XI (Asian *Homo erectus*), with a central torus thickness of 13.2 ± mm; lateral torus thickness was not measured (Rightmire 1998). Modern brows are too diminutive to allow these measurements. The brow also shows pneumatization (air pockets) along its length.

However, to reiterate the findings of the Texas A&M workers, these comparisons do not imply that pre-*Homo sapiens* were in the Americas. No phylogenetic or age implications are intended. Instead, the comparisons demonstrate the size relative to most New World specimens, although brows on the Brazilian Lagoa Santa skull (Bryan 1978) and on recent Tierra del Fuego and Patagonia crania (Lahr 1995; C. L. Brace pers. comm. 1998) appear comparable.

Twenty-one fragments from Zacoalco also have an MNI of three, based on duplicate mandible and parietal fragments. Sex determination is difficult, but size variation suggests both males and females. Concerning age, an unerupted third molar crypt indicates a 12- to 16-year-old. The remainder were adults or older adults, based on cranial suture closure, a fully formed third molar socket, and Pacchionian depressions on an inner parietal surface (see Ortner and Putschar 1985).

A Zacoalco maxilla fragment, with sockets for the canine and premolars, also deserves mention due to its size. It is much thicker and more robust than comparative specimens from other prehistoric Native American males. Like the Chapala brow, the fragment could be lost in a collection of archaic *Homo sapiens* maxillae. However, again, no phylogenetic inferences are intended. Instead, the robust Chapala and Zacoalco remains may be suggestive of region-specific variation in late-Pleistocene central Mexico, as noted elsewhere (Pompa 1987).

Lastly, despite the fact that the remains are mineralized and recovered with Pleistocene-age fauna, we are continuing an attempt to obtain a chronometric date. Radiocarbon dating of the remains is difficult due to mineralization. However, a Zacoalco molar was thought to contain remnant organics for AMS dating. With permission from the Museo Regional de Guadalajara, the tooth was sent to a U.S. lab that previously dated a Chapala swamp deer (*Blastoceros* spp.) incisor at 18,200 yr B.P. Unfortunately, the human protein was more heavily mineralized; the amount of carbon after combustion was too small to provide a reliable date. Thus, we must locate additional remains. Still, a ^{13}C value of -24 was obtained, implying that the tooth came from a non-agriculturalist; this value exceeds that from known Paleoindian fossils (e.g., Kennewick).

In sum, these cursory descriptions are presented for the purpose of initiating comparisons with other New World Pleistocene-age remains. A future objective is to delineate the Jalisco finds in a broader spatial and temporal context. However, in-depth regional and extra-regional comparisons must await additional data collection. Although our research team received a

major setback by the death of Jack Lobdell, continuing work in the project area appears promising.

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Ancient DNA and Kennewick Man: A Review of Tuross and Kolman's Kennewick Man Ancient DNA Report

D. Andrew Merriwether

Tuross and Kolman (2000) have written a thorough review of the ancient DNA literature and the prospects for conducting ancient DNA experiments on the Kennewick Man remains. They review many of the pitfalls and problems that are well known within the ancient DNA research community. While agreeing strongly with much of what they say in their report, I think there are some important caveats to a number of their statements.

The quality of the DNA recovered from ancient remains is a primary concern. Ancient DNA already has been successfully recovered and analyzed from several New World human skeletons of early-Holocene age (e.g., Hauswirth et al. 1994; Metheny and Woodward 1992; Stone and Stoneking 1994, 1998).

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Consequently, there is no reason to believe that a 10,000-year-old specimen is less likely to yield intact DNA than a 1,000-year-old specimen. Indeed, Tuross and Kolman (2000) ignore the fact that Frederika Kaestle, then in David Glenn Smith's laboratory at the University of California–Davis, had already successfully extracted DNA from Kennewick Man, but was prohibited from continuing her research to confirm her work because of the provisions of the NAGPRA legislation.

A second concern relates to the amount of bone sample that would be needed to successfully conduct DNA testing. Tuross and Kolman (2000) assert that 30 grams of bone would be required to extract and analyze DNA from Kennewick Man. On the contrary, I know of no other ancient DNA researcher who ever uses more than a few grams of bone, and usually less than a gram. Moreover, there are numerous studies (including many animal studies) in which researchers have successfully extracted DNA from only a few grams of bone (Merriwether et al. 1994). Tuross and Kolman (2000) also claim that teeth are not a good source of DNA because of the low yield of DNA. This is simply wrong. We routinely use teeth as the source of ancient DNA in my laboratory, and, in fact, prefer teeth to bone samples. While the yield may be reduced compared with a similar volume of bone, the level of inhibition is often reduced and the quality of the DNA is often better (Merriwether et al. 1994; Merriwether unpublished data). Teeth remain a sealed system for a much longer time than does bone, and they are far easier to sterilize and decontaminate than bone. Furthermore, they are loaded with hydroxyapatite, which tightly binds DNA. In this regard, it is interesting to note that hydroxyapatite is routinely used in molecular genetics labs to bind DNA in columns during purification and separation techniques. Lastly, in defense of teeth, they are a far less visibly destructive source of DNA. Samples can be extracted from the pulp cavity without significantly damaging the outer surface of the tooth.

Tuross and Kolman (2000) emphasize the problem of modern contamination of samples of ancient biological specimens. This is always the primary concern of any ancient DNA project. On the positive side, modern Native American genetic variation is extremely well defined, and identification of mitochondrial DNA matching, or a few mutations away from, any modern Native American sequence would be an important finding. In addition, most laboratory technicians and archaeologists do not have Native American mtDNA haplotypes, which are probably the most likely sources of modern contamination. Given these facts about analyzing Kennewick Man DNA, the considerable access that some tribal groups have been given to extensively handle the remains is quite disturbing because the possibility of contamination by those individuals would be very hard to rule out. For this reason, I suggest the use of teeth, which are easier to decontaminate, for DNA testing. Moreover, I would recommend at least three independent samplings of the remains to overcome the likelihood of modern contamination.

Another problem to consider is how the results of the analysis of any DNA recovered from the Kennewick Man are to be interpreted. There are several possible results: (a) Kennewick Man is found to have a "classic" mtDNA pattern (A, B, C, D, X6, and X7) already documented in living Native Americans (note that X6 and X7 are derived from C and D originally); (b) Kennewick Man has the newly reported haplogroup X (Brown et al. 1998), seen primarily in Europe and the New World and possibly nowhere in between; (c) Kennewick Man has a classic European haplotype not seen in New World native populations; (d) Kennewick Man has a haplotype present in Asian or Siberian populations; and (e) Kennewick Man has a haplotype never before observed.

How would we interpret these different scenarios? If alternative (a) were the result, it would rule out claims that the remains came from an ancient European. One can make this conclusion because there is no genetic overlap between Native Americans and Europeans, with the exception of haplogroup X (Brown et al. 1998). If haplogroup X were observed, scenario (c) might still be possible, but only until the haplotype was further determined to be ancient or modern in its genetic composition. Since there are five fixed mutational differences between the European version of haplogroup X and that observed in Native Americans, such a discrimination would not be terribly difficult to make. Conversely, if alternative (c) were the result, then one should strongly suspect that the observed haplotype derived from laboratory contamination rather than being actual ancient DNA from Kennewick Man. However, if this DNA sequence truly was European-like, but did not match any known European sequences, including those who handled the bone sample, then there would be room for controversy in the interpretation. If alternative (d) were the case, then it would represent evidence that some Asian founding populations that entered the Americas did not genetically contribute to populations that eventually gave rise to modern Native American tribes. It would also indicate possible source areas for Paleoindian individuals such as Kennewick Man, who do not closely resemble modern Native American populations. If alternative (e) were the result, then we would want to determine if the mtDNA sequence clustered with those from any living worldwide populations. If it clustered with any Asian or Siberian populations, then it would likely be anointed a new founding mtDNA lineage. Anything else would be controversial.

What about assigning specific tribal ancestry to the remains? This is impossible at the present time, since not enough Native Americans have been sequenced to identify tribal-specific haplotypes. Given the antiquity of this skeleton, it is not inconceivable that the descendants of the Kennewick Man tribe now live in South or Central America. Some regionally specific markers are now emerging, and once a few thousand more individuals are sequenced, we will have a better idea of how this sequence variation is distributed spatially and temporally. At this time, it is very unlikely that any one group will be shown to be lineally related to Kennewick Man, and almost no Native population could be excluded. This could lead to the unfortunate scenario of his remains being repatriated to a population that represents the descendants of the group that killed Kennewick Man. In other words, just because most Native Americans have closely related mtDNA and Y chromosome haplotypes does not mean that all Native American groups should be able claim any remains that are discovered. The similarity is on the order of Germans claiming Basque remains, or Greeks claiming Swedish remains, simply because they were found in Europe. Different people from different cultures may have similar mtDNAs, as seen in many published data sets.

That being said, as we obtain more modern mtDNA sequences for comparison, regional patterns emerge and are doing so, and these may allow us to speak more directly to repatriation claims. One start in this direction would be for the three groups claiming ancestry to assist in collecting DNA samples from their own tribal groups for analysis. An exact match between Kennewick Man and a member of one of the groups would still not be definitive proof of lineal ancestry, or that some other group is not similarly related, but it would certainly provide a better case nonetheless.

Finally, an extremely important point not discussed by Tuross and Kolman is that the extracted DNA, if curated, might yield information in the future, even if it fails to do so now, due to breakthroughs in DNA technology and chemistry. This is even more important with regard to the markers we can look at now, versus what may become possible in the future.

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Lithic Studies

Functional Analysis of Clovis Artifacts from the Martens Site (23SL222), St. Louis County, Missouri

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In most Clovis assemblage studies, tools are assigned to standardized classes such as endscraper, side scraper, graver, etc. (e.g., Irwin and Wormington 1970). The very few reported Clovis tool functional studies involve use-wear in a tangential manner (e.g., Biggs et al. 1970; Wilmsen 1968, 1970) or restricted numbers or types of artifacts (e.g., Kay 1995, 1999). Given renewed thinking about continent-wide diversity in Clovis adaptations (see Collins 1999a, 1999b:35–45; Frison 1993; Graham et al. 1981; Lepper and Meltzer 1991; Meltzer 1993), there is strong need for detailed functional assessment of multiple, complete Clovis assemblages.

We summarize here functional study of selected Clovis artifacts from 1997 excavations (Morrow 1998) at the Martens site, 23SL222, an upland occupation in St. Louis County, Missouri. The Morrows selected 25 chipped-stone artifacts for analysis by Ahler from among all artifacts recovered from 1997 excavations. The sample comprises tools of probable Clovis origin based on artifact size, form, raw material, technology, and lack of heat treatment. The central goal is to apply use-wear analysis to determine overall functional characteristics of the Clovis tools and assess behavioral implications for Clovis activities at the Martens site. We use low-magnification use-wear methods (Ahler 1979; Odell 1996:32–33) for observation, recording, and interpretation.

The tool sample is morphologically and technologically diverse, consisting of 10 utilized flakes/blades, 4 side scrapers, 3 retouched flake/blades, 3 stout beaks, 1 simple graver, 1 coronal graver, 1 endscraper, 1 reworked biface, and 1 complete Clovis point. Flakes of irregular shape with complex dorsal scar patterns (n = 8) are the dominant blank type, with elongated complex flakes (n = 4), blade-like flakes (n = 4), blades (n = 3), and bifacial thinning flakes (n = 1) also occurring. Eleven artifacts have unifacial retouching, 12 exhibit only utilization damage, and 2 are shaped bifaces.

An important attribute is transport wear (or "bag wear"), a pervasive alteration of artifact edges and surfaces that signifies long-term tool or tool blank curation and transport prior to final use and discard (Ahler 1997).

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Transport wear is definite on the reworked biface and one elongated retouched flake and possibly occurs on three retouched flakes. Low transport wear frequency indicates little importation of tool blanks or curated implements (Ahler and Jodry [1998] provide contrastive Folsom data) and likely relates to stone procurement from nearby sources (Morrow 1998).

Thirty-eight discrete functional tool occurrences or uses (employable units or EUs, Knudson 1973:17) are detected within the 25 artifacts. Among these are 16 cutting/sawing or slicing tools, 6 scraping tools, 5 planing/wedging tools, 3 heavy slotting tools, 5 delicate graving/perforating tools, 1 projectile point, and 2 miscellaneous tools. Among cutting tools, worked materials include bone/antler/ivory (n = 1), medium hardness wood or similar plant material (n = 8), and material as soft as hide or flesh (n = 7). Among scraping tools, three were used on bone/antler/ivory, two on soft plant material, and one on wet or fresh hide (no dry hide scraping occurs). Several planing/wedging tools are specialized implements for shaping or splitting wood. All beaks were apparently used to slot or groove wood or harder material, and five graver tips were used in several dragging, grooving, and rotary motions. The Clovis point was resharpened but lacks use-wear or impact damage.

Several artifacts made on elongated unretouched and retouched flakes and blades are multipurpose, combining cutting and scraping and sometimes specialized planing and wedging uses. Although several functions sometimes occur within a single artifact, they are readily differentiated based on wear pattern and location. Notable in the collection is a high degree of functional clarity—79 percent of artifacts have use-wear sufficient for clear functional interpretation of both work motion and material. Very few specimens have so little use-wear that functional assessment is obscure.

Short-term use occurrences (13 of 24 artifacts) and unbroken, still-usable specimens (16 of 24 artifacts) dominate the sample; only 3 specimens show long-term use based on wear intensity or resharpening. From these facts, we infer little pressure due to mobility and/or raw material constraints to transport usable tools onto or away from the site or to conduct extensive maintenance of useful tools. Regarding work materials, seven tools link clearly to soft or woody plant materials, nine to animal parts such as meat, hide, and/or bone/antler/ivory, and seven to either plant or animal material. Site activities were therefore only partially oriented towards hunting and processing of game products, while substantial effort was given to manipulating woody or other plant products. Martens data clearly indicate diversified rather than specialized activities. Inferences regarding group mobility are less clear. More extensive interpretation awaits comparative data from other Clovis contexts.

Non-Clovis artifacts occur across the surface of the Martens site and were recovered in the 1997 excavations. Inferred Clovis association for the tools reported here, while subjective, was guided by the Morrows' substantial familiarity with many unquestionable Clovis tools in the extensive surface collection accumulated by Richard Martens over a period of several years. This study was supported by a grant from the Greater St. Louis Archaeological Society. We are particularly grateful to Richard Martens for his continuing support of this and other research at the site. This note is Research Contribution Number 20 of PaleoCultural Research Group.

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Technological Comments on Some Paleoindian Lithic Artifacts from Ilaló, Ecuador

Hugo G. Nami

As a part of a major project to evaluate similarities and differences between North and South American Paleoindian lithic reduction sequences, I studied diverse assemblages from both hemispheres (e.g., Nami 1997a, 1999). To continue and control the results of this investigation, it is crucial to observe other assemblages from the intermediate area existing between the northern and the southern part of the Americas. With this in mind, I analyzed artifacts from the Ilaló region in northern Ecuador. This is a well-known area because the El Inga site yielded evidence of the late-Pleistocene/early-Holocene hunter-gatherers in northwestern South America (Bell 1965).

As has been stated by Mayer-Oakes (1986a), there are two formal varieties in the Paleoindian projectile points. He differentiated between Fell's cave and El Inga Broad stemmed, called here Fell and El Inga respectively. Both patterns show a distinctive style of manufacture from other points found at Ilaló, such as the lanceolate Ayampitin and stemmed specimens that belong to post-Paleoindian occupations (Mayer-Oakes 1986a). Fell projectile points were also found at San José and San Cayetano sites (Mayer-Oakes 1986b).

I also examined the Bonifaz and Bell's lithic collections curated at the Museo del Banco Central de Ecuador at Quito. The artifacts belong to the Bell's excavations at El Inga site (Bell 1965) and surface collections made by Bonifaz (e.g., 1978, 1979). The lithic assemblage includes cores, early stages of manufacture of diverse bifacial artifacts, blades, preforms and finished stone tools. A variety of Paleoindian artifacts were found with diverse flake, blade, and bifacial strategies. Despite the information yielded by previous scholars on this topic (e.g., Bell 1965; Mayer-Oakes 1986a, 1986b; Salazar 1979, 1980), the advances in lithic studies and Paleoindian archaeology that have occurred in the last decade allow additional observations. The Paleoindian collections include broken bifaces in different stages of reduction. Based on experimental and archaeological data from Patagonia, some bifaces might be considered early stages of manufacture of Fell projectile points (cf. Nami 1997a, 1997b, 1999). Additionally, the archaeological evidence also shows the manufacture from thin flakes (Bird 1969; Nami 1997a, 1997b, 1998, 2000). Distinctive El Inga bifacial early stages of manufacture, preforms, and finished products show similarities in their reduction sequence with Fell. However, formal differences emerge in the final preforms and the finished products. There are also Fell fluted preforms showing variability in the platform preparation for fluting, including nipple isolation and beveling, such has been observed previously at the San José site (Mayer-Oakes et al. 1995) and other Fell assemblages from Uruguay (Nami in prep.).

The morphological similarities with Fell projectile points from other

Hugo G. Nami CONICET, B. Mitre 1970 Piso 5 "A", Buenos Aires (1039), Argentina.

places in South America are astonishing. In this sense, Bird (1969) reported metrical and some technical data in his seminal article on the Ecuadorian and Patagonian comparison. However, additional subtle similarities emerge from the detailed technical analysis based on the contemporary analytical criteria, such as the experimental replication recently performed (Nami 1997a, 1997b, 1999). Although many Ecuadorian artifacts are fluted, they also show basal treatment by short and long pressure retouch such has been observed in those from Patagonia and other areas of South America. They include basal thinning by pressure retouch, shaping by short retouch (not larger than 4 mm^2), and fluting (Nami 1997b). The recent detailed studies show that there is coherency from a technical viewpoint; I found strong similarities in the final shaping by short parallel irregular retouch, the stem preparation, and their basal grinding.

There is also a remarkable similarity with the artifacts from Fell's cave. In the Ecuadorian collections there are many projectile points discarded for different reasons. However, their study reveals interesting data related to discard and resharpening behavior. In this sense, the discarded products acquire a very similar morphology. In the Fell projectile points this kind of resharpening is highly characteristic (Nami 1998). After fractures, Paleoindian knappers used to follow the same original design in the edges by continuing their convexity. As a result, the final steps in the resharpening produce very small rounded or dulled blades. With few exceptions, there are no straight or concave borders such as appear with other technologies (e.g., Ahler 1971). This situation seems to be a constant characteristic in the Fell projectile points and might reflect a distinctive patterned resharpening behavior. Diverse types of impact fractures in the blades and the stems indicate that, in many cases, resharpening was probably not performed for various reasons. One reason is because there was not enough mass in the blades to allow this practice. Except with El Inga, which shows some morphological differences probably due to function, Fell shows great differences in morphological and technical attributes from the rest of the projectile points found at Ilaló. Like other Paleoindian sites with Fell, the presence of early stages of manufacture, broken preforms, discarded heavily resharpened points, and broken stems suggests that weaponry repair and manufacture of projectile points might have been done at the Ilaló sites (cf. Nami 1998).

The variability in the Fell from Ilaló practically replicates the variation of this kind of artifact observed in the sites from Central and Southern Chile (Bird 1988; Nami 1987; Nuñez et al. 1992) and the ones found in Argentina and Uruguay (see Bosch et al. 1972; Flegenheimer 1980; Miotti 1992, etc.; Nami 1987; Schobinger 1974). Although some scholars noted the discontinuous distributions of Fell projectile points (Borrero 1983), their distribution in South America is becoming more continuous. The morphological and technical similarities among Ecuadorian Fell projectile points and those from Peru (Chauchat et al. 1998), Chile (Nuñez et al. 1992), Argentina (Flegenheimer 1980; Miotti 1992) and Uruguay (Bosch et al. 1972) is remarkable. The degree of variability in Fell's Cave projectile points from northern and southern South America is comparable to that observed in

Folsom projectile points from the northern and southern Great Plains of North America (Bonnichsen et al. 1987). In this sense, the technological similarities support the existence of much variability in the Fell lithic assemblages.

The recognition of some preforms from Ilaló allows the identification of an artifact coming from the Paleoindian level with Fell projectile points in Cueva del Medio (Nami 1996). An El Inga-like artifact from this site emerges as another bifacial form in the Paleoindian lithic assemblages in southern Chile. Therefore, under the results of this research, the points illustrated by Dillehay (1997 fig. 3.2) from south-central Chile might be considered a part of the variability that exists in projectile points manufactured by the latest Pleistocene hunter-gatherers in southern South America.

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Paleoenvironments: Plants

Reconstruction of Vegetative Histories and Paleoenvironments in Northeastern Kansas Based on Opal Phytolith Analysis

Steven Bozarth

Opal phytoliths are microscopic silica bodies formed by the precipitation of hydrated silica dioxide within plant cells, cell walls, and intercellular spaces (Rovner 1975). Monocotyledons, particularly the Poaceae (grass family), produce a wide variety of morphologically distinctive phytolith forms. The most taxonomically useful types of grass phytoliths are silicified short cells, which are diagnostic at the subfamily level (Brown 1984; Twiss 1987).

Dicotyledons also produce diagnostic phytoliths (Bozarth 1992; Geis 1973; Rovner 1971; Wilding et al. 1977). In contrast to the monocots, most dicot phytoliths are generally not preserved in sediment, as they usually consist of fragile silicified cell walls (Wilding and Drees 1971). However, the association of well-preserved spinulose spheres with arboreal dicot phytoliths in late-Pleistocene loess in Nebraska indicates that these distinctive phytoliths are also formed in deciduous trees or understory plants (Bozarth 1998a, 1998b). In addition, there are several types of taxonomically useful phytoliths produced in the Pinaceae (pine family), some of which are well preserved (Bozarth 1988, 1994; Klein and Geis 1978; Norgren 1973).

Site 27 is one of seven sites at Fort Riley, located in northeastern Kansas, for which paleoenvironments have been reconstructed based on phytolith analysis (Johnson 1998). Phytoliths were extracted from 27 sediment samples collected at this loess-mantled upland site using a procedure based on heavy-liquid flotation and centrifugation. Variations in phytolith data indicate at least five different paleoenvironmental zones (Figure 1). Zone F (>190cm), with a basal date of 21,290 ^{14}C ± 150 yr B.P. (ISGS 3614), is characterized by relatively high frequencies of spinulose spheres indicating a deciduous woodland was growing on the site. This interpretation is supported by low phytolith concentrations typical of woodlands. The trend of decreasing spinulose spheres with an increase in Pooids (cool, moist season grasses) and a decrease in Chloridoids (short grasses adapted to warm, dry environments)

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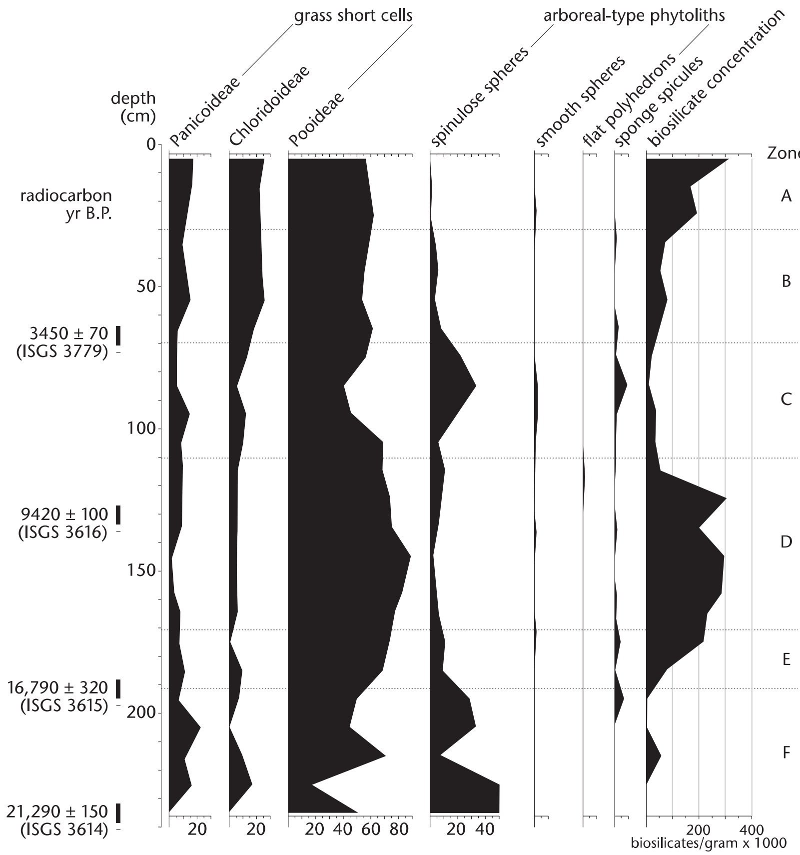

Figure 1. Frequency of grass subfamilies and arboreal-type phytoliths at Site 27, Fort Riley, Kansas.

in Zone F indicates a cooler, moister period with fewer trees c. 17,000 ^{14}C yr B.P. The anomalous data from the isolate at 215 cm may be the result of the sediment sample having been collected in a krotovina.

The trend of decreasing arboreal type phytoliths and an increase in Pooid short cells in Zone F continues into Zone E, an apparent transitional period. Zone D is characterized by the highest frequency of Pooid phytoliths in the profile, indicating a cool, moist environment. The low frequency of spinulose spheres suggests that only a few trees were growing at the site, a hypothesis supported by high phytolith concentrations indicative of grasslands. The arboreal component appears to expand in Zone C, based on an increase in spinulose spheres and a decline in phytolith concentration.

Zone B is characterized by a decrease in arboreal phytoliths and an increase in Chloridoids, indicating a drier climate. It appears to be transitional to Zone A, which coincides with the modern surface soil. The high phytolith concentration is typical of a tall grass prairie, the potential natural vegetation of the region (Küchler 1974).

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Preliminary Results of a Late-Glacial Pollen Sequence from Shannon Lake, St. Louis County, Minnesota

James K. Huber

Palynological investigations of a core from Shannon Lake, St. Louis County, Minnesota, are currently being undertaken to aid in understanding Native American occupation in the area. Preliminary pollen analysis indicates that the pollen sequence records both regional and local vegetational change during the late glacial/postglacial transition. Shannon lake is located approximately 40 km west northwest of Virginia, Minnesota (92° 58′ 18″ N, 47° 37′ 48″ W). A prehistoric archaeological site is located on Shannon Lake.

Only the lowermost 90 cm of the 790-cm core recovered from Shannon Lake has been analyzed for pollen. The sediment from this portion of the core is composed of gray silty clay (Figure 1).

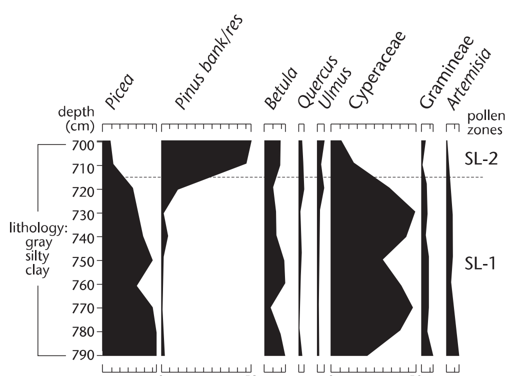

Figure 1. Pollen percentage diagram of selected taxa, Shannon Lake, St. Louis County, Minnesota.

The pollen diagram from the site has been divided into two pollen-assemblage zones representing the late glacial and early postglacial vegetational history in the area. Zone SL-1 is characterized by more than 50 percent nonarboreal pollen (NAP). Sedge (Cyperaceae), grass (Poaceae), and wormwood (*Artemisia*) are the dominant NAP types (Figure 1). The most abundant arboreal pollen (AP) types are spruce (*Picea*) and birch (*Betula*). Zone SL-1 is comparable to the Compositae-Cyperaceae Assemblage Zone of Cushing (1967).

SL-2 is characterized by an increase in jack/red pine (*Pinus banksiana/P. resinosa*) and a decrease in spruce and sedge (Figure 1). Pine and spruce combined make up more than 50 percent of the pollen sum. Zone SL-2 is comparable to the *Picea-Pinus* Assemblage Zone of Cushing (1967). The increase in elm (*Ulmus*) in Zone SL-2 indicates the postglacial elm maxima occurred between 10,000 and 9,000 yr. B.P. (Wright 1968; Maher 1977).

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Conspicuously absent from this pollen sequence is the *Betula-Picea* Assemblage Zone that commonly occurs between these two zones in northeast Minnesota (Cushing 1967). The *Betula-Picea* Assemblage Zone dates between 10,500 and 10,200 yr. B.P. (Cushing 1967). Subsequent close-interval pollen analysis may reveal the presence of this zone.

Pollen analysis of the Shannon Lake core is continuing, as well as analysis of the nonsiliceous algae recovered in conjunction with the pollen. Radiocarbon dating of the core is planned. When this investigation is finished, the results will provide additional information on the vegetational and phycological history of the Shannon Lake watershed. This information may also aid in understanding Native American occupation of the area.

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Alaskan North Slope Permafrost Yields Pleistocene Tree

Frank F. Willingham, David E. Putnam, and Gordon Brower

We wish to report the recovery of an unusual wood specimen from the surface of alluvial sediments along the Ikpikpuk River of the Alaska North Slope, near its juncture with the Chipp River and the site known locally as Chipp No. 9. This site is approximately 12.2 meters amsl and 45 km inland (south) of the Arctic coast. The specimen consists of a small spruce tree 1.35 m in length with root fan attached, and 6.17 cm in diameter at the trunk base. It exhibits no evidence of human modification that might indicate it was carried in from the coast by people. Although we cannot be certain of the stratigraphic context of this specimen, there is precedence for the association of wood with Pleistocene animal fossils along this same river system (Geist 1961). The

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wood is in a good state of preservation, especially compared with wood collected locally from frozen gravels estimated in the 125,000 yr B.P. range The specimen was radiocarbon-dated at Conventional C^{14} Age 30,900 ± 380 yr B.P. (Beta Analytic, Inc., Beta-119733). Subsequent sectioning of the lower trunk revealed 102 growth rings. The genus *Picea* was confirmed by conventional wood maceration and microscopic examination procedures (Panshin and DeZeeuw 1980). Additional samples of the specimen have been sent for further examination to Dr. Tom Ager at the U.S. Geological Survey Laboratory in Denver, CO, and Dr. Glenn Juday at the University of Alaska–Fairbanks, Forest Sciences Department.

This find resulted from a brief reconnaissance survey we made in the summer of 1998 in response to reports from Eskimo hunters of scattered small stands and lone specimens of dwarf conifers along the Chipp and Ikpikpuk rivers of the North Slope. We did not find living specimens of *Picea* growing on the north slope, but have yet to visit several specific locations mentioned by our Inupiat informants.

Our specimen is of particular interest because of its age, which places it in the mid-Wisconsin interstadial. Presumably this period was characterized by a of series unstable climates that oscillated between short warm and cold intervals, hardly enough time for the distribution of spruce into new territory (T. Ager pers. comm. 1999). Although there are abundant data confirming the presence of *Picea* in areas to the south of the North Slope, or during older or younger time periods (Lowe and Walker 1998; West 1996), there is little we can find to suggest that spruce were growing on the North Slope during the Wisconsin glaciation. We have speculated on several scenarios as to how this could have happened, but are not ready to advance an explanation without further field work. We note with interest the documentation of several living groves of *Populus balsamifera* on the North Slope recently (J. Bockheim pers. comm. 1999), and suggest that perhaps there has been greater persistence of woody plants on the north slope than was previously thought.

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Paleoenvironments: Vertebrates

Rodent and Badger Remains from Terminal-Pleistocene/Holocene Deposits in Southern Jackson Hole, Wyoming

Kenneth P. Cannon, Meghan Sittler, and Paul W. Parmalee

In a previous issue of *CRP*, we (Cannon et al. 1999) reported on geoarchaeological investigations at the Crescent H Ranch site (48TE1079). In this paper, we report on an assemblage of rodent and badger remains from this site. Based on direct dating and stratigraphic position, these remains suggest terminal-Pleistocene through Holocene age.

Vertebrate faunal remains from terminal Pleistocene deposits have not previously been reported for Jackson Hole, Teton County, Wyoming. In fact, remains from this period are generally lacking in the Greater Yellowstone Ecosystem. Although a few exceptions exist (e.g., Mummy Cave pre-11,000 cal yr B.P. deposit; Hughes n.d.), some of these are of dubious association. For example, the record of bison reported from a construction excavation at Astoria Hot Springs (48TE342) in association with mollusk shell dated to 11,940 ± 500 yr B.P. (Ives et al. 1964:60) may be viewed with some skepticism.

The lack of a faunal record from this dynamic time period is notable, considering all that is known concerning glacial history (e.g., Good and Pierce 1996; Pierce and Good 1992; Pierce et al. 1998), climate, and vegetation (e.g., Whitlock 1993).

Identification of the rodent assemblage is based on cranial specimens, although postcranial elements are also present in the aggregate. None of the rodents appears to have been deposited at the site as a direct result of human behavior; they are probably natural deaths that are incidentally associated with cultural material. Four rodent taxa (montane vole [*Microtus montanus*], least chipmunk [*Tamias minimus*], ground squirrel [*Spermophilus* spp.], and northern pocket gopher [*Thomomys talpoides*]) are represented by 190 cranial specimens, with the majority (NISP = 150) recovered from Block E in the southeastern portion of the site (Sittler 1999). All species represented presently occur in Teton County (Clark and Stromberg 1987).

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Block B excavations produced a record of human and paleoenvironmental information extending back to the terminal Pleistocene. Charcoal from a paleosol was minimally dated to 4050 ± 70 yr B.P. at 122 cmbs (Cannon et al. 1999). Two taxa, *Spermophilus* sp. and *Thomomys talpoides*, are represented in this block. At this point in the analysis we prefer to group them into two broad stratigraphic units, Early and Late. The Early Unit includes specimens from excavation levels 16–19 and is pre-4,050 yr B.P. in age. This assemblage consists of one *Spermophilus* sp. and two *Thomomys talpoides* specimens. The Late Unit consists of excavation levels 1–7 and is post-4,050 yr B.P. in age. This assemblage consists exclusively of *Thomomys talpoides* (NISP = 7).

Excavation levels 1–23 of Block E contained evidence of human occupation that included a 3630 ± 80 yr B.P. fired rock feature at 79 cmbs (Cannon et al. 1999). Because of the limits on radiometric dates at this time, the rodent assemblage will be discussed in three general stratigraphic units: Early, Middle, and Late. The Early assemblage consists of 35 specimens from excavation levels 16–24 and probably dates from the Pleistocene into the early Holocene. *Spermophilus* spp. (NISP = 12), and *Thomomys talpoides* (NISP = 23) were represented. Six *Spermophilus* specimens were recovered from levels 23–25 and are probably terminal Pleistocene in age. These specimens are charcoal in color and marked by manganese deposits along the alveolar portion of the mandible and teeth.

Direct dating of two *Spermophilus* specimens provides strong support for the age of the Early assemblage. The humerus of a subadult from level 24 (221 cmbs) returned an age of 12,230 ± 80 yr B.P. (Beta-141866; $\delta^{13}C = -21.3‰$). The second age of 14,220 ± 100 yr B.P. (Beta-141457; $\delta^{13}C = -20.5‰$) was returned on an ilium recovered from level 16 (147.9 cmbs). Although the ages are stratigraphically reversed, they are both within primary deposits of Pleistocene loess.

The Middle assemblage (levels 9–15) is probably middle Holocene in age and includes 56 specimens representing four taxa: *Microtus montanus* (NISP = 4), *Spermophilus* spp. (NISP = 7), *Thomomys talpoides* (NISP = 43), and *Tamias minimus* (NISP = 2).

The Late assemblage includes 59 specimens from excavation levels 2–8 and is post-3,000 yr B.P. in age. Two taxa are represented, *Spermophilus* spp. (NISP = 16) and *Thomomys talpoides* (NISP = 43)

An abraded left proximal ulna of a badger (*Taxidea taxus*) was recovered from Block E of at a depth of 269 cmbs (level 25). The element was recovered from non-cultural deposits of silt loam and was submitted for radiometric assay. An AMS age of 15,720 ± 70 yr B.P. (Beta-132861; $\delta^{13}C = -20.5‰$) was returned. We chose this specimen for dating since it represented the deepest organic material recovered and will provide a minimum age for the landform and a lower bracketing age for the cultural deposits.

Complete documentation (i.e., line drawing and photographs) of the specimen was made prior to its submission for analysis. The element weighs 3.5 grams and measures 53.95 mm in length. Measurements following von den Driesch (1976: Figure 33e) include maximum anterior-posterior width (10.5 mm), maximum medial-lateral width (5.6 mm), and greatest breadth

across the coronoid process (7.0 mm). Because of its weathered condition, no other measurements could be obtained.

Additional analyses of the post-cranial elements are underway, and direct dating of specimens is planned for the future (Sittler 2000). A final report on the archeology and paleoenvironment of the Fall Creek Road sites will be published in late 2000 by the Midwest Archeological Center.

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Two New Records for Pleistocene Birds in Central Mexico

Eduardo Corona-M. and Oscar J. Polaco

The town of Tepexpan, State of Mexico, to the northeast of Mexico City, is a site well known by prehistorians and paleontologists since 1946–1947, when human remains, then believed to be some of the oldest in Mexico, were excavated. These remains were associated with extinct fauna, mostly mammoth (*Mammuthus imperator*). In those early excavations, an isolated bird bone was found and identified as a pied-billed grebe (*Podylymbus podiceps*) (Wetmore 1949). There have been contradictory statements about the geological age of this site, some authors proposing an age range of 10,000 to 15,000 yr. B.P., and others proposing 7000 to 9000 yr. B.P., but all concur that this is a late-Pleistocene locality, as do we.

In 1984, a new locality in Tepexpan was excavated. It is located in the land of the Dr. Adolfo M. Nieto Hospital, adjacent to the localities studied in previous years, at geographic coordinates 19° 36′ 42″ N, 98° 57′ 00″ W (Santamaría 1985; Santamaría and Polaco 1984). Remains of mammoth, fish, rodents, and birds were found, and that material was housed without further identification in the collection of the Laboratorio de Paleozoología, INAH. Recently, study of the bird bones was undertaken, and we report on the initial findings.

The five bones studied are black colored and well mineralized. They were cleaned of sediments and compared with the specimens of the osteological collection in the laboratory (Table 1). Measurements were taken in millimeters , after Gilbert et al. (1985). Bird names and the taxon arrangement follow the American Ornithologist's Union checklist (1998).

Pelecaniformes: Phalacrocoracidae

Phalacrocorax auritus (Lesson)

Material: left humerus, right incomplete ulna, right radius, left carpometacarpus without metacarpal III.

Remarks: The measurements compare favorably with those from the literature (Gilbert *et al.* 1985), and with a Recent specimen from the laboratory (Table 1, Specimen 2); this similarity also extends to qualitative characters. This species was previously reported by Brodkorb and Phillips (1986) from the Tlapacoya locality, about 35 km away to the south of Tepexpan; unfortunately, that report was very short and not clearly documented. In any case, this report confirms that the double-crested cormorant inhabited the lakes in the Pleistocene of Central Mexico. Today, it has been extirpated from the region, and its distributional range is on both coasts of Mexico, inland in northern Mexico to Sonora, Nuevo León, and San Luis Potosí (Howell and Webb 1995).

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Table 1. *Phalacrocorax auritus*, comparative measurements (mm).

	Length	Breadth
Humerus		
Tepexpan specimen	147.26	23.73
Recent specimen	148.38	23.18
Gilbert et al. 1985	147–156	23–24
Radius		
Tepexpan specimen	150.72	7.70
Recent specimen	150.4	7.60
Gilbert et al. 1985	145–155	8–10
Ulna		
Tepexpan specimen	147.84■	
Recent specimen	160.25	
Gilbert et al. 1985	150–159	
Carpometacarpus		
Tepexpan specimen	71.22	13.16
Recent specimen	71.56	13.19
Gilbert et al. 1985	69–75	13–14

■incomplete

Phoenicopteriformes: Phoenicopteridae

Phoenicopterus ruber? Linnaeus

Material: proximal fragment of right scapula; furcular and coracoidal articulations absent.

Remarks: The fragment resembles the Recent specimen, but it is too poorly preserved to confirm the identification; therefore measurements were not taken. The flamingo is a species noted previously in the Pleistocene record, most recently from the Tocuila site (Corona-M. and Arroyo Cabrales 1997), 10 km away from Tepexpan. The presence of the flamingo in this locality, and in other records shows the importance of Pleistocene populations of flamingos in the lakes of Central Mexico. Currently, the flamingo has been extirpated from the region, and inhabits lagoons in Ría Celestún and Ría Lagartos, in the Yucatán Peninsula (Howell and Webb 1995).

Both bird records are interesting because they presently occur in tropical conditions, and their presence in Central Mexico could indicate a different climatic condition during the late Pleistocene than at the present. Further research is warranted, including comparisons with other sites in the region.

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Diet and Paleoecology of Columbian Mammoth (*Mammuthus columbi*) Determined from Phytoliths and Diatoms in Teeth

Katrina E. Gobetz and Steven R. Bozarth

Opal phytoliths from dental residues have been used to reconstruct diets of modern and prehistoric bison and cattle (Bozarth and Hofman 1998; Middleton 1990). The objective of this study was to determine the best method to obtain phytoliths from a mammoth tooth, and whether paleoecological information could be gained from the analysis.

The lower third molar of a Columbian mammoth (*Mammuthus columbi*) from Kansas (KUVP 129777) was used for analysis. Mammoth molars are composed of many flat, transverse plates specialized for grinding abrasive vegetation (Maglio 1973). The occlusal surface forms a continually wearing plate that cannot accumulate calculus like cusped molars. However, phytoliths could have become embedded in the soft dentine and cementum layers on the occlusal surface. Scraping the occlusal surface yielded an insufficient sample size (0.89 g) containing only four phytoliths, so an alternative method of sampling the tooth was attempted instead.

A section of 4 cm length and width and 3 cm depth was removed from the occlusal surface of KUVP 129777. Tooth fragments (dry weight 87.93 g) were washed with acetone to remove preservatives, then with soap and distilled water. Insoluble residue was strained through a 500-µm sieve. Dentine and cementum were processed following the method of Bozarth (1991).

Grass long cell and pooid trapezoid phytoliths (Brown 1984; Twiss et al. 1969) were most frequent in the sample, forming 29 percent and 31 percent of the total biogenic silica count, respectively (Figure 1). Diatoms of the genus *Rhopalodia* were also relatively numerous (15 percent of total). Pooid grasses are common in cool, moist environments (Twiss 1987), whereas *Rhopalodia* are epiphytic on leaf litter and other vegetation in freshwater ponds, streams, and lakes (Krammer and Lange-Bertalot 1991). Apparently, this mammoth consumed large amounts of cool-climate grasses near pond/lake margins or in a riparian habitat.

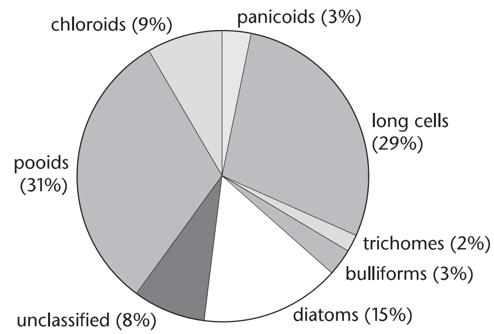

Figure 1. Relative frequencies (percentages) of phytoliths and diatoms in biogenic silica from *Mammuthus columbi* molar KUVP 129777. Total biogenic silica count = 160.

Phytolith assemblages from browsers indicate that herbaceous/woody dicots are much more poorly represented than grasses (Gobetz and Bozarth unpubl. data), so whether the mammoth fed on trees and aquatic vegetation is uncertain. However, results are consistent with dietary evidence for mammoths (Davis et al. 1984; Davis et al. 1985) and suggest that phytolith analysis can reveal major dietary constituents. Mammoths and other herbivores with hypsodont molar batteries may require bulk sampling for effective recovery of biogenic silica from teeth.

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Mastodon Body Weight Estimates from Footprints and a Scale Model

William J. Hubbard, Daniel C. Fisher, and P. Nick Kardulias

Excavation of a late-Pleistocene mastodon (*Mammut americanum*) skeleton led to discovery of a mastodon trackway at the Brennan site, near Saline, in southern Michigan (Fisher 1994). Compound (fore+hind) footprints were preserved by deformation of the contact between a lower, clay-rich sand unit and overlying marl, just above the stratigraphic position of the skeletal remains. The trackway parallels the shore of a late-Pleistocene lake, and its vertical position relative to nearby laterally equivalent lake-margin facies suggests formation in water about 1 m deep. The footprints are slightly larger (c. 40 cm foreprint diameter) than expected of a fully grown female mastodon and are thus attributed to a male.

A 12-meter section of the trackway is documented by a fiberglass mold showing (in order of formation) nine compound footprints and a single forefoot print without hindfoot representation. The compound prints typically show the front portion of the hindfoot occluding about half the area of the forefoot. Print 5 has less overlap than normal, prints 7–9 have more overlap than normal, and interprint spacing is reduced notably between prints 9 and 10. Videotapes of elephants walking and maps of their trackways (recorded by DCF) indicate that, with increasing speed, the hindfoot is placed farther forward relative to the forefoot of the same side, initially increasing overlap, although at higher speeds the hindfoot steps completely beyond the forefoot. All compound prints on the Brennan trackway correspond to a slow walk (stride length c. 2.67 m), but the overlap patterns suggest slight deceleration near print 5, return to the former speed by print 6, and further slight acceleration through prints 7–9. At this point, the trackway pattern suggests the animal stopped, bringing the fore and hindprints out of coincidence.

Sediment grain-size distribution does not vary appreciably along this portion of the trackway, and depth variation among compound prints (mean = 14.4 cm; s.d. = 2.5 cm; n = 9) may be explained by velocity changes and details of sediment loading associated with acceleration and deceleration. The most pronounced depth difference is between the compound prints and print 10, the isolated foreprint (5 cm deep). Our interpretation is that the double-strike of compound prints induced viscous behavior in the substrate that was not seen under the conditions of plastic deformation that appear to have characterized formation of the isolated foreprint.

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We estimated body weight first from a commercially available model, selected for relative conformity to proportions of mounted skeletons and altered slightly to improve its transverse aspect. Its volume, measured by displacement, was 330 ml. The anatomical dimension best recorded on the trackway was forefoot diameter, but this dimension of the model was unsuitable for computing a scale factor because of the risk of error propagation due to small absolute size. To relate the model to the trackway, we used the ratio of forefoot width to hip height on the Burning Tree mastodon (Fisher et al. 1994), for which these measurements could be reconstructed (55 cm/206 cm), to estimate a hip height for the trackway-mastodon (150 cm) and from this, a scale factor of 1:21.4 for the model. Assuming isometry for individuals differing in size may introduce error, but this is probably small relative to other uncertainties. Assuming a whole-animal bulk density of 1 gm/cm^3 (Alexander 1985:3), we estimate body mass of the trackway-mastodon at 3,234 kg.

A second weight estimate was derived from the footprints using an equation for "sinkage" of off-road vehicles, $p = (k_c/b+k\phi)z^n$, where p is substrate pressure, k_c and k_ϕ are coefficients dependent on sediment type, b is the minimum dimension of loading area, n is an "exponent of deformation" dependent on water content, and z is equivalent to footprint depth (Wong 1978). Given the viscous behavior induced by compound prints, print 10, formed under standing weight, conforms best to the system studied by Wong. We used values of k_c, k_ϕ, and n given by Wong for sediment similar to the Brennan sediment in which the footprints formed ("Sandy Loam, Michigan"), at a water content (23 percent) close to what we measured for Brennan sediment that would just retain impressed topography. We assumed the forequarters supported 60 percent of body weight and accounted for the buoyant force due to leg-volume displacement in water 1 m deep. This yielded a mass estimate of 2,992 kg, in reasonable accord with the model estimate. Additional study may refine assumptions used here, but we propose 3,000 kg as a reasonable value for body weight of a mature, but incompletely grown, male mastodon, slightly larger than an adult female.

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New Mammals for the Pleistocene of Zacatecas, Mexico

Nashieli Jau-Mexia, Oscar J. Polaco, and Joaquín Arroyo-Cabrales

As part of a continuing study of fossil localities in Mexico, a new fauna was found in the State of Zacatecas, Mexico, composed mainly of small mammals. The site is located in the Municipality of Pánuco, 23° 05′ 15″ N, 102° 31′ 20″ W, at an elevation of 2,150 meters. Several crevices in the Upper Cretaceous rock are filled with sandy-silty clay (and iron hydroxides and oxides) that contains the fossil material.

Among the identified species, a shrew and a rabbit are noteworthy. The insectivore *Notiosorex crawfordi* was identified by a right M1, a right mandibular ramus fragment with m1 and m2, a left ramus fragment with m2, and 3 left m2s. The material is similar to Recent specimens. Measurements (in millimeters) for one fossil M1 and five fossil m2s (average, and minimum and maximum in parentheses), followed, after a semicolon by the same data for seven Recent specimens are (measurements follow Reumer 1984): M1: width between the parastyle and the protocone base, 1.4; 1.26 (1.25–1.35); width between the metastyle and the hypocone base, 1.4; 1.40 (1.30–1.45). For m2: length between paraconid and buccal cingulum, 0.72 (0.65–0.80); 0.67 (0.65–0.85); hypoconid length, 1.24 (1.20–1.30); 1.19 (1.10–1.25). Only two previous fossil records were known in Mexico for this species, one from Jimenez Cave, Chihuahua (Messing 1986), and the other for El Abra Cave, Tamaulipas (Dalquest and Roth 1970).

An isolated left p3 was identified as pertaining to the lagomorph genus (Figure 1) *Aztlanolagus*, a taxon poorly known for the late Pleistocene (Russell and Harris 1984). The presence of an enamel lake separated from the posterior external crenulated reentrant angle, and the three reentrant angles on the trigonid are diagnostic characters for this genus. The measurements of the specimen, premolar length and width (2.1mm, 1.8mm), are within the range recorded for the species by Russell and Harris (1984). They recorded the only previously known specimen for Mexico from Jimenez Cave, Chihuahua, located about 600 km to the north from the Zacatecan site.

The presence of *Aztlanolagus*, and in general the overall faunal composition, including the genera *Thomomys*, *Perognathus*, *Neotoma*, *Sigmodon*, *Reithrodontomys*, *Peromyscus*, *Onychomys*, *Baiomys*, and *Conepatus*, point to a late-Pleistocene age for this fauna.

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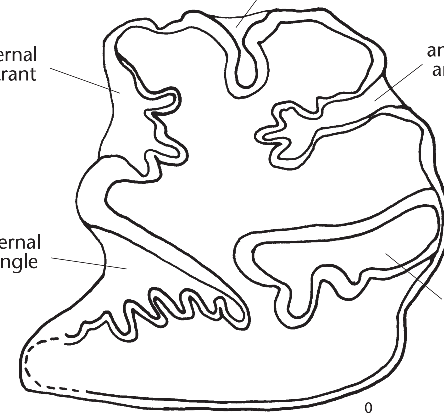

Figure 1. Left p3 from *Aztlanolagus* sp., collected in Zacatecas, Mexico.

We thank Eileen Johnson for her review of the text.

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Early-Holocene Muskrat in Wisconsin

Eileen Johnson, Patrick J. Lewis, Richard Strauss, and James A. Clark, Jr.

Previous research on muskrat (*Ondatra zibethicus*) lower first molars (m1) indicates that molar morphology is indicative of particular environmental and climatic conditions (Lewis 1998; Lewis et al. 2000a; Nelson and Semken

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1970; Semken 1966). This correlation between morphology and environment allowed the paleoenvironmental assessment of the muskrat remains from 47WN718, an early-Holocene locality from northeastern Wisconsin. This site is representative of the Lake Poygan–phase occupations dated to ca. 8,500 to 9,000 yr B.P., based on projectile point chronology (Clark 1995). The site is located within the Wolf River marsh, a tributary stream draining into the Lake Poygan basin that today is prime muskrat habitat of marshes and lakes (Errington 1963). A muskrat m1 comes from below the Ap horizon, associated with rhyolite debitage and Hixton biface fragments. Comparison of the 47WN718 molar to modern muskrat molars also allowed for subspecific diagnosis and the study of the temporal depth of muskrat subspecies in the area.

Length and width were measured for the m1 occlusal surface (Lewis 1998; Lewis and Johnson 1997; Nelson and Semken 1970). These measurements were tested for significant differences against regional populations of *Ondatra zibethicus zibethicus* molars from Illinois (n = 70), Manitoba (n = 14), and Michigan (n = 23) with analysis of variance (ANOVA). Length-to-width ratios were compared with several modern and subfossil subspecies from a variety of habitats.

The molar (47WN718-lot 95-2) was from an adult muskrat of c. 2 years in age based on size, wear pattern, and root development (Galbreath 1954; Lewis 1998; Viriot et al. 1993). While the molar was slightly smaller than other regional populations of modern *Ondatra zibethicus zibethicus*, ANOVA results ($\alpha = 0.05$) for length and width indicated the differences were insignificant ($p = 0.054$ for length, $p = 0.77$ for width). As modern muskrat molars are not sexually dimorphic (Lewis et al., 2000b), the smaller size was not based on sexual dimorphism. The length-to-width ratio also was similar to modern *O.z. zibethicus* (Figure 1), suggesting a cool climate (Nelson and Semken 1970). The ratio, although not as large as would have been expected from a strictly riverine muskrat (represented by *O.z. ripensis* and *O.z. holdenensis*), was larger (i.e., from a cooler habitat) than the contemporaneous subspecies *O.z. erringtonensis* from Lubbock Lake (Lewis 1998; Lewis et al. 2000a). From SEM analysis, scratches indicative of pond and marsh muskrat populations (Gutierrez et al. 1998; Lewis et al. 2000c; Teaford 1991) were the predominant microwear pattern. The paleohabitat indicated, therefore, was a cool climate with a pond or marsh environment.

The presence of this molar at 8,500 to 9,000 yr B.P. indicates stability of the *Ondatra zibethicus zibethicus* subspecies in the region throughout the Holocene. The morphological differences between the 47WN718 molar and the molars from Lubbock Lake were similar to those found between modern subspecies, supporting the hypothesis that a variety of subspecies of *O. zibethicus* were present well into the past. The muskrat data are concordant with the regional vegetation model for this general period of a mesic deciduous forest with prairie elements that included the grass and sedge families (Baker et al. 1992:385). At 47WN718, the presence of a muskrat subspecies inhabiting ponds and marshes lends support to Clark's (1995) interpretation of areas of open water adjacent to Lake Poygan–phase sites. Furthermore, its

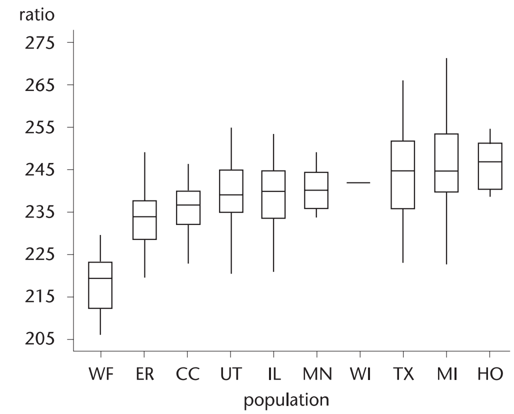

Figure 1. Length-to-width ratios from modern samples of *Ondatra zibethicus zibethicus* (IL from Illinois, MN from Manitoba, MI from Michigan), *O.z. ripensis* (TX from Texas), *O.z. osoyoosensis* (UT from Utah), *O.z. cinnamominus* (CC from Colorado and WF from Wichita Falls, Texas); subfossil populations *of O.z. holdenensis* (HO), and *O.z. erringtonensis* (ER) from Texas; compared with the molar from 47WN718 (WI). (Data from Lewis 1998; Lewis and Johnson 1997; Nelson and Semken 1970; Lewis et al. 1999a).

co-occurrence with Blanding's turtle (*Emydoidea blandingi*) provides additional support of marshes and ponds in the immediate environment, with inferred sedge and grass vegetation that also is corroborated by the microwear evidence.

Thanks to Steve Kuehn (Wisconsin State Historical Society) for loaning the muskrat material and sharing information (particularly on the presence of Blanding's turtle), Holmes A. Semken (Department of Geology, University of Iowa) for sharing muskrat dental data, and Ozlen Grantham (Department of Biology, Texas Tech University) for the SEM work. Site 47WN718 is known as the Russell Wohlt site after the landowner who graciously allowed access. Research funded by the Museum of Texas Tech University as part of the ongoing Lubbock Lake Landmark regional research into the late Quaternary climate and paleoecology of the Southern Plains.

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Paleodiet of the Early-Holocene Population in Primorye, Russian Far East: Stable Carbon and Nitrogen Isotope Data of Human Bone Collagen

Yaroslav V. Kuzmin, Minoru Yoneda, and Michael P. Richards

Marine food resources were exploited in Northeast Asia probably as early as 13,000–11,000 yr B.P. at Maeda Kochi site in Japan (Keally and Miyazaki 1986); 15,000 yr B.P. at the Ustinovka site group in Primorye (Maritime) Province (Vasilievsky et al. 1997); definitely around 10,000 yr B.P. on Honshu Island at the Natsushima shell midden (cf. Aikens and Higuchi 1982); and 10,900–10,400 yr B.P. on Kamchatka Peninsula at the Ushki site, layer 6 (Dikov 1996: 245–246). Thus, studying the earliest traces of marine adaptation in Northeast Asia is an important part of reconstructing prehistoric economy, especially when direct evidences like human bone collagen are available.

A study of prehistoric diet in the Primorye Province was conducted on two Early Neolithic sites, Boisman 2 and Chertovy Vorota cave, using isotopic composition of both nitrogen (δ^{15}N) and carbon (δ^{13}C) in human bone collagen. The Boisman 2 site is located on the coast of Peter the Great Gulf (42° 47′ N; 131° 16′ E); the Chertovy Vorota site is situated 30 km from the sea, in a low mountain region (44° 29′ N, 135° 23′ E). Radiocarbon ages are c. 6600–5900 yr B.P. for Chertovy Vorota, and c. 6400–5300 yr B.P. for Boisman 2 (Kuzmin et al. 1998). According to archaeological data and faunal remains, the main kinds of economic activity at Boisman 2 were hunting, fishing, and marine mollusc gathering (Popov et al. 1997); at Chertovy Vorota, hunting and gathering of terrestrial plants prevailed (Andreeva 1991). In total, bones from 13 skeletons were analyzed (Table 1).

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Table 1. Isotopic composition of human bone collagen from the Primorye Neolithic sites.

Site	Sex	Age	^{13}C, ‰	^{15}N, ‰	^{14}C age, yr B.P.
Boisman 2	M	18–20	-14.7	+18.1	6000 (assumed)
	F	40–45	-14.1	+18.2	6080 ± 70
	?	10–12	-14.3	+18.0	5960 ± 50
	M	55–60	-14.1	+17.1	5860 ± 100
	M	14–15	-15.1	+18.2	6000 ± 60
	F	24–29	-13.9	+18.3	6020 ± 50
	M	40–45	-14.7	+17.5	5690 ± 60
	F	20–25	-14.6	+17.9	5780 ± 70
	M	20–25	-13.8	+18.5	6060 ± 90
	M	25–30	-14.1	+18.7	5890 ± 60
Average of 10			**-14.3**	**+18.1**	
Chertovy Vorota	?	5–10	-16.5	+17.1	6300 (assumed)
	F	40–50	-17.4	+12.9	6300 (assumed)
	M	20–25	-17.7	+12.2	6300 (assumed)
Average of 3			**-17.2**	**+14.1**	

At the Boisman 2 site, the following results were obtained: δ^{15}N, +17.1to +18.8‰ (average +18.1‰); δ^{13}C, -13.8 to -15.1‰ (average -14.3‰). At the Chertovy Vorota site: δ^{15}N, +12.2 to +17.1‰ (average +14.1‰); δ^{13}C, -16.5 to -17.1‰ (average -17.2‰). According to published sources for marine food consumers from the coasts of North America, native settlers of the Sakhalin and Hokkaido Islands, Mesolithic peoples in coastal Europe, and the Cape people in South Africa, δ^{15}N varies from +15.0 to +20.0‰, and δ^{13}C from -17.0 to -11.0‰. Whereas for terrestrial food consumers of Europe, Japan, North America, and South Africa, δ^{15}N varies from +12.5 to +19.0‰, and δ^{13}C from -20.2 to -16.5‰ (Chisholm et al. 1982; Minagawa and Akazawa 1992; Richards and Hedges 1999; Roksandic et al. 1988; Schoeninger et al. 1983; Sealy and van der Merwe 1985).

Our results show that people from both sites consumed protein of marine origin, presumably of high trophic level such as fish and sea mammals. Such interpretation for the Boisman 2 is clear because the site represents a typical shell midden with well-preserved bones of marine and terrestrial mammals and marine fish, and marine mollusc shells (Alekseeva et al. 1999). Stable isotope analysis establishes that marine mammals such as seals and sea lions were the main protein source, accounting for more than 80 percent of total diet.

The stable isotope data interpretation for Chertovy Vorota is more complicated. Zooarchaeological data show that the main objects of hunting were terrestrial mammals, bears (*Ursus arctos* L., *U. tibetanus* G. Cuv.), wild boar (*Sus scrofa* L.), badger (*Meles meles* L.), and red deer (*Cervus elaphus* L.) (Kuzmin 1997). The presence of fish bones (unidentified as to species) and marine mollusc shells is also noted (Andreeva 1991). However, stable isotope data show that marine protein contribution to human diet was about 25 percent, and we suggest that anadromous fish (salmonids) were one of the main targets of economic activity. The Chertovy Vorota cave is located near a small stream, where salmon could run from the Sea of Japan. The evidence of human contacts with the sea coast, such as the marine mollusc shells, allow us to presume that the degree of exploitation of marine food resources was much higher than was established using archaeological and faunal data. The $\delta^{15}N$ value of +17.1‰ measured for the child skeleton from Chertovy Vorota should be considered anomalous due to a growing state.

Thus, the first results of the early-Holocene paleodiet reconstruction from mainland Russian Far East show a high degree of marine adaptation at c. 7000–6000 yr B.P. This suggests that in terminal Pleistocene, c. 15,000–10,000 yr B.P., prehistoric people in Northeast Asia exploited marine food resources, and that the contribution of marine protein from mammals, fish, and invertebrates was significant since at least c. 10,000 yr B.P.

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New Records and Range Extensions of *Cervalces, Rangifer,* and *Bootherium* in the Southeastern United States

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During the past 20 years, the documented ranges of the boreal ungulate genera *Cervalces* (stag-moose), *Rangifer* (caribou), and *Bootherium* (Harlan's musk ox) have been expanding progressively southward in the southeastern United States as new specimens are found in the field or recognized in existing collections (Churcher and Pinsof 1987; Faunmap Working Group 1994; McDonald and Ray 1993; McDonald et al. 1996; Ruddell 1999). Here we report seven new records representing these genera from the southeastern United States and report ^{14}C dates from Saltville, Virginia, that bracket their co-occurrence at that locality. One of those dates is on bone that has been modified by humans. Catalog acronyms MPP, USNM, and VMNH refer to the Memphis Pink Palace Museum, the United States National Museum of Natural History, and the Virginia Museum of Natural History, respectively.

Norfolk, Virginia A partial right antler (USNM 482368) of an adult male *Rangifer tarandus* collected by Gerald H. Johnson and Jason Early during excavation of a dry dock at the Newport News Shipbuilding facility. The specimen came from an organic-rich stratum interpreted as a coastal terrestrial hydrosere that was situated near the base of the Shirley Formation. The Shirley Formation is considered to be of late middle-Pleistocene age (G. H. Johnson, pers. comm.); if this age assignment is correct, USNM 482368 is the earliest record of *Rangifer* in mid-latitude North America of which we have knowledge (McDonald et al. 1996).

Beaufort County, South Carolina A partial mature mandibular m3 (cast: USNM 467597) of *Bootherium bombifrons* collected by John Lee Hudson

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from Saint Helena Sound. Along with other battered remains of large vertebrates of Rancholabrean age, USNM 467597 was found at a depth of about 9 m where it had eroded from a stratum of gravel. This specimen extends the documented range of *Bootherium* south on the Atlantic Coastal Plain by some 250 miles.

Continental Shelf off Maryland The shaft and distal end of a mature femur (USNM 437903) of (?) *Cervalces* collected from the Continental Shelf about 27 miles east of Ocean City, Maryland, by Richard Klempke. This specimen is tentatively assigned to *Cervalces* on the basis of the distal articular features, the details of which are distinctly more alcine than ovibovine.

Coahoma County, Mississippi Three partial antlers (MPP 1995.38.16, MPP 1995.40.122, Wise/Lamb 73) of *Rangifer* collected from gravel bars in the Mississippi River in Coahoma County, Mississippi. These specimens are laterally compressed, gracile, and likely represent females or subadult males (Ruddell 1999); they extend the documented range of *Rangifer* to the southwest by some 125 miles.

Desha County, Arkansas A single left metatarsal (MPP 1995.8.2) collected on a gravel bar in the Mississippi River in Desha County, Arkansas, provisionally assigned to (?) *Cervalces* because of its large size and geographic location (Ruddell 1999). This record extends the range of *Cervalces* in the Mississippi Valley to the south by nearly 200 miles.

Saltville, Virginia A partial shaft of a tibia (VMNH 721) of a mature *Bootherium bombifrons* recovered in 1992 from site SV-2 in Saltville Valley, Smyth County, Virginia. This specimen is noteworthy because it has yielded one of only a few radiocarbon dates derived directly from remains of *Bootherium* (Beta 117541: 14,510 ± 80 yr B.P.) and it appears to have been modified by humans (McDonald 1996, in press; McDonald and Kay 1999).

Records of *Bootherium* from South Carolina and *Cervalces* and *Rangifer* from the Mississippi River extend the ranges of these genera farther south than previously has been documented. The synchronous evolution of ranges for these three genera increasingly suggests that they might have existed as a cohort of large-bodied boreal ungulates even in the southeastern extremes of their ranges. Certainly their individual ranges in the southeast are similar. All three genera co-occurred at Saltville from at least 14,510 ± 80 yr B.P. (Beta 117541) until sometime between 13,950 ± 70 yr B.P. (Beta 65209, on wood; all three genera were present at and after this date) and 10,000 yr B.P. (Beta 5056: 10,050 ± 110 yr B.P., on paleosol; of the three genera, only *Bootherium* was present at Saltville at this date). All three genera are represented in the Mississippi River faunas studied by Ruddell (1999), and *Rangifer* and *Bootherium* are both known from the Superior Stone Company/Martin Marietta Quarry at New Bern, North Carolina. The partial tibia from Saltville (VMNH 721) not only provides a rare ^{14}C-dated record of *Bootherium*, but it is also one of the oldest directly dated human artifacts in North America and represents only the second direct association yet recognized between *Bootherium bombifrons* and *Homo sapiens* (Lent 1999).

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Late-Glacial Record of *Dicrostonyx* from Honey Dipper Den, Jones County, East-Central Iowa

Richard W. Slaughter and Steven P. Jones

Honey Dipper Den is a small cave located 6 km northwest of Anamosa, Iowa. Matrix (0.043 m^3) was collected from its surface and washed through 1.4-mm wire mesh. Mammalian dental elements (n = 809) were picked from the remaining concentrate, identified, and placed in the University of Iowa Paleontology Repository. The bone assemblage is highly fragmented and contains many corroded specimens indicating accumulation by mammalian carnivores (Andrews and Evans 1983). The association of flesh-bearing bones and arctic mammal material indicates that the deposits contain a mixture of Holocene and late-Wisconsinan remains. Thirty-five mammalian species are represented in the sample by a minimum of 107 individuals. Nine mammalian species were identified that no longer occur in the area (Hall and Kelson 1959).

The extralocal component of the fauna contains two steppe-adapted mammals, the northern grasshopper mouse (*Onychomys leucogaster*, MNI = 1) and the northern pocket gopher (*Thomomys talpoides*, MNI = 1). The northern grasshopper mouse still lives in western Iowa and was not extirpated from the

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eastern half of the state until the late Holocene (Bowles et al. 1998). The closest occurrence of the northern pocket gopher is in South Dakota, about 600 km from the site. Available evidence suggests that this species was eliminated from the region at or near the end of the Pleistocene.

Four of the extralocal mammals have boreal centers of distribution: the southern red-backed vole (*Clethrionomys gapperi*, MNI = 6); heather vole (*Phenacomys intermedius*, MNI = 2); northern bog lemming (*Synaptomys borealis*, MNI = 1); and yellow-cheeked vole (*Microtus xanthognathus*, MNI = 8). The southern red-backed vole still occurs in Iowa, but is known only from a single north-central county. However, this species was present in eastern Iowa as recently as the late Holocene (Bowles et al. 1998). The nearest heather vole and northern bog lemming populations are in northernmost Minnesota, roughly 600 km from the site. The closest record of the yellow-cheeked vole is from the west coast of Hudson Bay, approximately 1,600 km from Honey Dipper Den. The heather vole, northern bog lemming, and yellow-cheeked vole appear to have been extirpated from Iowa during the latest Pleistocene or early Holocene.

Three tundra-dwelling mammals are represented in the vertebrate assemblage: the collared lemming (*Dicrostonyx* sp., MNI = 1); brown lemming (*Lemmus sibiricus*, MNI = 2); and singing vole (*Microtus miurus*, MNI = 1). The nearest populations of collared lemmings and brown lemmings live on the west coast of Hudson Bay, about 1,600 km from Honey Dipper Den. The closest occurrence of the singing vole is in the western Northwest Territories, almost 3,300 km from the site. Previous records of these species in eastern Iowa are limited to the full-glacial period (21,000–16,000 yr B.P.; Baker et al. 1986; Foley and Raue 1987; Woodman et al. 1996).

A collared lemming partial left mandible from Honey Dipper Den was AMS radiocarbon dated at 15,490 ± 100 yr B.P. (NZA 10693). This is the first late-glacial (16,000–10,000 yr B.P.) record of an arctic micromammal from the Midwestern United States. The mandible's C/N ratio (3.01) and gelatin yield percentage (90 percent) indicate that its bone protein was well preserved and that the date on the specimen is accurate (DeNiro 1985; Stafford et al. 1988).

Because modern collared lemmings are restricted to the arctic tundra zone, the Honey Dipper Den mandible suggests that tundra plants existed in eastern Iowa around 15,500 yr B.P. (Banfield 1974). The Fort Dodge and Saylorville sites in central Iowa also provide evidence that tundra vegetation was present during the late-glacial period. At Fort Dodge, plant macrofossils from four tundra species have been recovered from an organic horizon dated at 15,310 and 15,140 yr B.P. (Baker 1996). Of the ten insect species represented in Unit II at Saylorville (15,400–14,000 yr B.P.), seven now live exclusively in tundra or forest-tundra (Schwert 1992). The biotic assemblages at Fort Dodge and Saylorville accumulated adjacent to the Des Moines Lobe of the Laurentide ice sheet. In contrast, Honey Dipper Den was at least 200 km from the glacial front when the collared lemming mandible was deposited. Therefore, it appears that within Iowa, tundra plants were not confined to ice margins during the late-glacial period.

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Vegetation Partitioning among Lujanian (Late-Pleistocene/Early-Holocene) Armored Herbivores in the Pampean Region

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The Lujanian Land Mammal Age ranges from c. 300,000 yr B.P. to 8,500 yr B.P. Many species of this fauna were widespread in South America, but the majority of the fossils are recovered from Pampean Region sediments of the Guerrero member of the Lujan Formation c. 20,000–8,500 yr B.P., corresponding to the last glacial maximum and the earliest Holocene. As a result of extensive glaciation in the Andes, a dry, cool climate occurred in the Pampean Region, as summarized by Tonni et al. (1999 and references therein). The effective shift of climatic zones was approximately 750 km

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northeastwards relative to present conditions. According to this scenario, the area of Luján, in the northeastern part of the Pampean Region, would have had climatic conditions similar to the climate existing today in Northern Patagonia (lat. 39°S). This suggests a mean annual temperature about 2.5–3°C lower. Rainfall must have been considerably lower, about 350 mm per year, less than half of today's value. The vegetation over this span has been interpreted as a psammophytic steppe similar to the modern vegetation of the northwestern part of this region (Prieto 1996).

I analyze a particular fossil assemblage, the Luján local fauna described by Tonni et al. (1985). The fauna is impressive for its abundance of large herbivores. There are about 30 species of herbivorous mammals ranging from approximately 50 kg to several tons, more than half of them edentates, as well as one giant rodent, four notoungulates, one litoptern, one perissodactyl, six artiodactyls, and a gomphothere. Within edentates, the armored forms (C*ingulata*) are predominant: one eutatine armadillo (*Eutatus seguini*, *Dasypodidae*), one pampathere (*Pampatherium typum*, *Pampatheriidae*) and nine or ten glyptodonts (*Neothoracophorus* spp., *Plaxhaplous* sp., *Doedicurus* sp., *Panochthus* sp., and *Glypodon* spp., *Glyptodontidae*).

E. seguini and *P. typum* were common in the region. *E. seguini* is one of the largest representatives of the family, with a body size similar to that of the living "giant armadillo" *Priodontes maximus*, approximately 50 kg. Other contemporary armadillos were much smaller or not specialized herbivores. Pampatheres bear strong general resemblance to dasypodids, from which they are distinguished primarily by their larger size, estimated to have reached nearly 200 kg in *P. typum*. Glyptodonts were huge beasts ranging from a few hundred kilograms up to one and a half tons (Fariña et al. 1998).

According to Fariña (1996), the fauna containing such a diversity of large herbivores did not contain a proportionally diverse suite of large carnivores. In addition, the coexistence of so many large herbivores in such a poor environment suggests strong competition for resources. Here I analyze plant resource exploitation among sympatric Lujanian herbivorous armored xenarthrans.

Morphofunctional studies reveal that the main dietary difference among these cingulates was the degree of coarseness of the vegetation they were capable of processing. The general morphology of the masticatory apparatus of *E. seguini* resembles that of browser ungulates of moderate to small size, such as some deer and antelope (Vizcaíno and Bargo1998). Pampatheres were also diverse in regard to the coarseness of vegetation they ate, *P. typum* being better suited to grazing than the tropical *Holmesina* spp. (De Iuliis et al. in press; Vizcaíno et al. 1998). Fariña (1985, 1988) and Fariña and Vizcaíno (submitted) suggested that masticatory movement in glyptodonts, even with their peculiarities, roughly resembled that of ruminants, and that they were probably grazers. These differences in capacity might reflect competitive exclusion through niche partitioning among sympatric species.

Previous authors clearly established a relationship between body size and feeding style in antelopes (Jarman 1974; McNaughton and Georgiadis 1986; Spencer 1995). Small species are predominantly browsers and tend to be highly selective feeders, relying on specific plants or plant parts. These

species utilize very diverse diets. On the other hand, the larger species are relatively generalized grazers. They rely on a wide range of grasses, but may graze and browse. Although feeding strategies among antelopes cannot be applied strictly to cingulate edentates, they provide insight on general dietary style: while the eutatine is mainly a browser, the larger pampatheres (up to 200 kg) and glyptodonts (between one and two tons) represent increasing degrees of grazing habits. Moreover, morphometric and morphofunctional studies currently in progress suggest that the smaller glyptodonts had more browsing habits, while the larger are proposed to have grazed to a greater extent. This scenario may be applicable to other herbivores.

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Four New AMS ^{14}C Dates on *Microtus xanthognathus*, with Comments on Midwestern Paleoecology

Steven C. Wallace

Fossiliferous deposits from the Dutch Creek Fissure of the Wapsipinicon local fauna, located within the Dutch Creek valley of Wapsipinicon State Park, Jones County, Iowa, have produced abundant late-Wisconsinan micro-vertebrate remains. Taxa recovered include boreal indicators *Phenacomys intermedius* (heather vole), *Synaptomys borealis* (northern bog lemming), and *Clethrionomys gapperi* (southern red-backed vole); a taiga indicator, *Microtus xanthognathus* (yellow-cheeked vole); and tundra indicators *Dicrostonyx torquatus* (collared lemming), *Microtus miurus* (singing vole), and *Lemmus sibiricus* (brown lemming). None of these taxa is found in the area today. Although this assemblage does contain some Holocene material, the bulk of the specimens are late Wisconsinan in age.

AMS ^{14}C dates of 13,460 ± 120 (NZA 10446), 17,280 ± 170 (NZA 10444), 17,810 ± 160 (NZA 10443), and 25,470 ± 350 yr B.P. (NZA 10445) obtained from four mandibles of *Microtus xanthognathus* span most of the late Wisconsinan and include the oldest Midwestern date for the species. Three eastern Iowa fossil localities (Figure 1) suggest the presence of *M. xanthognathus* during the glacial maximum. Although dated by associated plant macrofossils, *M. xanthognathus* remains from Elkader (20,530 ± 130 yr B.P.; Woodman 1996) and Duhme Cave (21,780 ± 240 yr B.P.; Jans 1993) represent the earliest part of the last glacial maximum, whereas specimens from Conklin Quarry represent the end of the last glacial maximum (18,090 ± 190 to 16,710 ± 210 yr B.P.; Baker et al. 1986). These associations, along with the new dates from Dutch Creek, indicate that *M. xanthognathus* was present in eastern Iowa from 25,500 yr B.P. to 13,500 yr B.P., including the entire glacial maximum (c. 20,000–18,000 yr B.P.).

The occurrence of *Microtus xanthognathus*, a species indicative of taiga (Figure 1), during the full glacial and glacial maximum suggests that there was a forest component to the flora of eastern Iowa during this period. This interpretation supports the Baker et al. (1986) conclusion that a widespread tundra-parkland was prevalent in eastern Iowa during the full glacial, and suggests that this parkland was present during the glacial maximum as well.

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Figure 1. Map showing the modern range of the yellow-cheeked vole and the locations of the Wapsipinicon (W), Conklin Quarry (C), Duhme Cave (D), and Elkader (E) local faunas in Iowa.

Doeden Local Fauna (Illinoian/Sangamonian?), Eastern Montana

Michael C. Wilson and Christopher L. Hill

Pleistocene fossils have been found within the Yellowstone River valley since at least 1908, when fragments of mammoth (*Mammuthus*) were recovered near Glendive (Hay 1914, 1924). The most important assemblage of fossils comes from the Doeden gravel pit north of the Yellowstone River, across from Miles City, Montana. The Museum of the Rockies (MOR) was contacted by Kathy Doeden, one of the owners of the Doeden Pit, and a visit was made by Leslie B. Davis and Michael C. Wilson in 1976 to collect some of these fossils. Subsequently, other specimens were donated; their provenance was demonstrated by a musk-ox fragment which could be refit with a specimen collected in 1976. In 1982, an MOR team recovered a partial mammoth skull and additional material from the gravels.

The Doeden gravel pit is in Pleistocene high-terrace deposits (Colton et al. 1984), which have a base about 64 m above the river. At Doeden, the terrace gravels are overlain by Pleistocene "silts" at an elevation of about 82 m above the Yellowstone. The gravel pit is largely associated with one terrace surface, but does impinge upon the riser to the next; therefore it is possible that the collection includes fossils of different ages. Even within the terrace fill, there is the possibility of multiple nested (inset) gravels or of laterally time-transgressive deposits. There are several potential sedimentologic and taphonomic contexts associated with the terrace deposits, so the fossil sample is treated as a local fauna that will possibly be subdivided at a later date into faunules.

Pit operators reported that most of the material was recovered from the upper 3 m of gravel in the main terrace fill. The deposits as sampled are at least 6 m deep (maximum thickness is about 20 m), so the fauna is largely from the upper half. Some pit workers suggested that the bones were in "fingers" of gravel that extend roughly transverse to the trend of the Yellowstone River valley, suggesting a relationship with a depositional bedform and probably reflecting the known hydraulic equivalence of large bones with pebbly gravels. Poorly preserved tree trunks and wood fragments have been encountered in the pit, but all crumble to dust upon exposure and drying.

The Doeden local fauna includes two ground sloths, *Megalonyx* sp. and *Paramylodon* sp.; mammoth, *Mammuthus* sp.; mastodon, *Mammut americanum*; giant short-faced bear, *Arctodus* sp.; one or two horses, *Equus* spp.; camel, *Camelops* sp.; an antilocaprid; a medium- to large-size cervid; and a musk ox or shrub ox, *Symbos* sp. It includes the first Montana records for two ground

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sloths, *Megalonyx* and *Paramylodon*, as well as the giant short-faced bear, *Arctodus*. *Megalonyx* is represented by a proximal left femur, a right tibia, and an ungual #3 (pes); *Paramylodon* material includes a left tibia and a vertebra; *Arctodus* is represented by the distal half of a left humerus.

Material of *Mammuthus* includes a skull, partial mandible, incomplete upper and lower molars, tusk fragments, and limb bone fragments. *Mammut americanum* materials include teeth, parts of a maxilla, and possibly some tusk fragments. *Equus* material includes teeth and a metapodial. *Camelops* is similarly represented by limb bones (a proximal right cubitus, three distal left cubiti, a metatarsal), as well as a fragment of a mandible (dentary) with teeth. The MOR collection also contains an antilocaprid (a limb bone fragment), and a cervid (an antler burr). *Symbos* material includes a partial frontlet with associated horn core fragment, an axis vertebra, a proximal right ulna, and a distal right radius.

The age of the Doeden gravels can be constrained by the c. 600 kyr Lava Creek B tephra found at 80 and 130 m above the Yellowstone River (Bergantino 1991; Izett and Wilcox 1982) and in upstream drainages around 90 m (cf. Reheis et al. 1991). Calcretes cementing the 30- to 34-m terrace of the Tongue River, which enters the Yellowstone at Miles City, are dated to about 160 kyr, while the 24- to 27-m terrace dates to 124 kyr (Hinrichs 1988). Thus, the Doeden gravels may date to the later part of the middle Pleistocene.

The character of the fauna suggests an open grassland environment with at least riparian woodlands if not a more extensive patchy brushland. The equids were obligate grazers, while even *Camelops* appears to have been at least partly a grazer; *Arctodus* is thought to have been a cursorial predator well suited to open country. Most of the specimens show light to moderate abrasion, suggesting limited transport, and they are not likely to represent a single local community type.

A preliminary faunal list of material collected in the 1970s was prepared by Wilson with the advice of Greg McDonald, who examined the sloth material, and was communicated to Bjorn Kurtén and Elaine Anderson (Kurtén and Anderson 1980). Specimens in the MOR collection have also been identified or briefly examined by Mick Hager, Jack Fisher, Greg McDonald, S. David Webb, Don Rasmussen, Jack Horner, and Hill.

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Geoarchaeology of the Shestakovo Upper Paleolithic Site, Western Siberia: Human-Mammoth Interactions during the Last Glacial Maximum

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The Upper Paleolithic site of Shestakovo, southwestern Siberia (55° 54′ N; 87° 57′ E), lies along the right bank of the Kiya River. Deposits at Shestakovo are primarily eolian and colluvial in origin and correspond to the Sartan Glaciation (c. 24,000–18,000 yr B.P.). Numerous mammal bones were found in primary association with Upper Paleolithic artifacts in cultural layers 5 through 7A. Nearly 90 percent of the recovered faunal remains represent mammoth (*Mammuthus primigenius* Blum.). Geoarchaeological studies, however, point to a complex formation history for the site, especially as regards the relationship between accumulated mammoth bones and Paleolithic human activities. Here we report on recent taphonomic, geochemical, and radiocarbon analyses.

Taphonomic analyses identify important contrasts in the degree of surface weathering and occurrence of both human and carnivore modification exhibited by bones of different species. In general, the mammoth bones are heavily weathered and very fragmentary, indicating a prolonged period of open air exposure. Only a small proportion of these bones preserve clear carnivore tooth marks. A greater number of the mammoth bone specimens show clear evidence of human modification, including burning, cut marks,

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percussion damage, and painting with red pigment. The degree of surface preservation for bones representing other mammalian species, such as wooly rhinoceros (*Coelodonta antiquitatis* Blum.), horse (*Equus caballus* L.), and reindeer (*Rangifer tarandus* L.), is significantly better (Derevianko et al. in press). A long period of surface exposure is not indicated for the remains of these other mammalian species.

The high frequency of juvenile mammoths in the faunal assemblage may reflect attritional mortality (Derevianko et al. in press), a common feature of proboscidean bone assemblages found near waterholes (Haynes 1985). Other mammalian fauna appear to be dominated by prime-aged adults, although the sample size is too small to offer conclusive evidence.

Geochemical analyses of the Shestakovo sediments show that they are enriched in calcium, magnesium, and sodium (Leschinsky 1998). We suggest therefore that mammoths were attracted to Shestakovo because of natural salts occurring within the outcrops and that mammoth bones accumulated around these salt licks over a period of time through natural attritional mortality (Derevianko et al. in press; Leschinsky 1998).

Analysis of the ^{14}C date series (Table 1) provides tentative support for this conclusion. The available dates, particularly those from layer # 6, confirm that Paleolithic human populations coexisted on the landscape with mammoths. Wood charcoal dates from layer No. 6 are directly associated with the age of human occupation and range from c. 20,800 yr B.P. to c. 23,250 yr B.P. (Table 1). Mammoth bone dates from the same layer range from c. 20,480 yr B.P. to c. 24,360 yr B.P. The older radiocarbon age derived from sample GrA-10935 suggests that humans may have scavenged mammoth bones from

Table 1. Radiocarbon dates from cultural layers 5–7, Shestakovo site.

Layer no.	^{14}C date, yr B.P.	Lab code and no.	Material dated
5	18,040 ± 175	SOAN-3610	mammoth bone
5	19,190 ± 310	SOAN-3609	mammoth bone
5	21,560 ± 100	GrA-13234	mammoth tooth
6	20,360 ± 210	SOAN-3608	bulk collagen (horse and reindeer)
6	20,480 ± 180	SOAN-3607	mammoth bone
6	20,770 ± 560	SOAN-3218	burnt mammoth bone
6	20,800 ± 450	SOAN-3606	charcoal
6	22,340 + 180/-170	GrA-13240	mammoth bone
6	23,250 ± 110	GrA-13233	charcoal
6	24,360 ± 150	GrA-10935	burnt mammoth bone
7	21,300 ± 420	SOAN-3611	mammoth bone
7A	22,240 ± 185	SOAN-3612	mammoth bone

deposits predating human occupation of the site. Burning on this sample implies that humans did play a role in bone accumulation. Further dating studies are needed to corroborate this apparent discrepancy between charcoal- and mammoth bone–derived dates.

The results of ^{14}C dating establish the coexistence of Paleolithic humans and mammoths in southwestern Siberia. However, examination of the radiocarbon dates in conjunction with taphonomic and geochemical evidence suggests an alternative hypothesis: Paleolithic human groups at Shestakovo may have scavenged sub-fossil mammoth bones from a nearby natural surface accumulation. Bones from other animals including horse and reindeer, in contrast, display much better preservation and most likely represent kills transported to the site as part of specialized human hunting activities. There is little evidence from Shestakovo to suggest that human hunting pressure had a significant long-term effect on Siberian mammoth populations.

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Paleoenvironments: Geosciences

Pleistocene Lakes along the Southwest Margin of the Laurentide Ice Sheet

Christopher L. Hill

A series of Pleistocene lakes were formed by the Laurentide Ice Sheet (LIS) where it blocked parts of the upper Missouri River and Yellowstone River drainages in northern Montana. The general distribution and approximate size of these lakes has been known for some time (Alden 1932; Calhoun 1906; Colton et al. 1961; Flint et al. 1959; Montagne 1972). The presence of these lakes is potentially valuable in developing models concerned with the timing and extent of various lobes formed along the southwest margin of the LIS. Thus, the lakes were incorporated into summaries such as Lemke et al. (1966) and Clayton and Moran (1982). The ice margins in the glacial lake Great Falls region are related to the Shelby lobe and the Loma sublobe of the Havre lobe (Fullerton and Colton 1986). The timing of the advance and retreat of these glacial lobes is of some interest, since it may serve to test the proposal that there was a single advance of the southwestern margin of the LIS during the late Pleistocene (Jackson et al. 1999; Jackson et al. 1997; Young et al. 1994; Young et al. 1999).

Because glacial Lake Great Falls was created when the LIS blocked the Missouri River, examining stratigraphic sequences within this basin may help test models of the timing of the advance and retreat of the ice margin. For instance, glacial lake and till deposits near Belt have been mapped as Illinoian in age, implying a pre–late-Wisconsin advance of the LIS (Vuke et al. 1995). Detailed microstratigraphic studies in the area southeast of Great Falls, within the Missouri River Valley between Belt Creek and Widow's Coulee, demonstrate the presence of a local glacial-related sedimentary sequence. Cretaceous bedrock is overlain by sediments that can be correlated with the Pleistocene "Older Gravels" (Lemke and Maughn 1977). Typically these deposits are composed of rounded gravel, cobbles, and boulders with some thick lenses of well sorted sands. In exposures north of Belt Creek, the upper part is oxidized and the rocks are sometimes coated with clays and carbonate. These gravels seem to reflect deposition by the Pleistocene Missouri River.

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Near Belt Creek and Hower Coulee these gravels are overlain by a sequence of laminated clays and silts. In some exposures the laminated sediments are interrupted by beds of well-sorted sand. North of Belt Creek, in "Outhouse Coulee," this sequence is over 8 m thick and contains rhythmites consisting of fine silts and clay interpreted as varves, and several beds of crossbedded sand. These deposits are thought to reflect sedimentation into glacial Lake Great Falls.

Directly overlying the laminated silts and clays is a diamicton. At the Outhouse Coulee exposure the deposit is composed of a matrix of silt and clay supporting gravels and boulders. At exposures west of Hower Coulee, the top part of what appears to be this same diamicton is weathered and oxidized. The diamicton is interpreted as till deposited from the southwestward advance of the Loma sublobe of the Havre lobe, perhaps of Illinoian age. The advance of this sublobe from the east could have blocked the Missouri River and caused the deposition of the underlying glacial lake sediments. The weathered zone at the top of the diamicton may be a paleosol formed during the interval after the retreat of the Illinoian margin of the Loma sublobe and prior to a late-Wisconsin southeastward advance of the Shelby lobe into the region.

Throughout the area the diamicton is overlain by a unit consisting of thick beds of sands, thinner beds of silts, and occasional lenses of gravels. These may partly be lithologic equivalents of the upper subunit of glacial Lake Great Falls (Lemke and Maughan 1977). The crossbedded sands are well sorted and contain abundant fragments of charcoal, while some of the more silty sediments contain molluscs. If these deposits represent a younger stage of glacial Lake Great Falls, they imply a later (post-Illinoian?) blockage of the Missouri River. This lake could be associated with a late-Wisconsin advance of the Shelby sublobe from the northwest. If so, the paleosol underlying these sediments (within the top of the diamicton) would potentially date to the Sangamon and early-middle Wisconsin. These sandier deposits may correlate with glacial lake sediments exposed at Holter Lake (Hill and Valppu 1997). The stratigraphy between Belt Creek and Widow's Coulee could be interpreted as potentially indicating both the Illinoian advance of the Loma sublobe as well as the late-Wisconsin advance of the Shelby lobe.

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A Small Holocene Fossiliferous Deposit of Marine-brackish Origin on the Southeastern Coast of the Pampean Region of Argentina

Eduardo P. Tonni, Alberto L. Cione, Néstor Landoni, and Aníbal J. Figini

The southeastern Atlantic coast of the Pampean region between Mar del Plata and Bahía Blanca is formed by cliffs that reach a maximum of 35 m above sea level. Quaternary marine sediments are restricted to some river valleys. One of these streams is the Arroyo Las Brusquitas (Figure 1). Holocene marine deposits cropping out in the valley were studied by some of us (Bonadonna et al. 1995; Fidalgo and Tonni 1983). Recently, a bed of dark brown (10YR2/2) to almost black silty sands was found about 250 m south of the arroyo Las Brusquitas (38° 14′ 4″ S, 57° 47′ 02″ W, Figure 1). These sediments are 50 cm thick and crop out along 200 m, slightly above the present highest tide level. The following taxa were found in the bed: *Chaetopleura*

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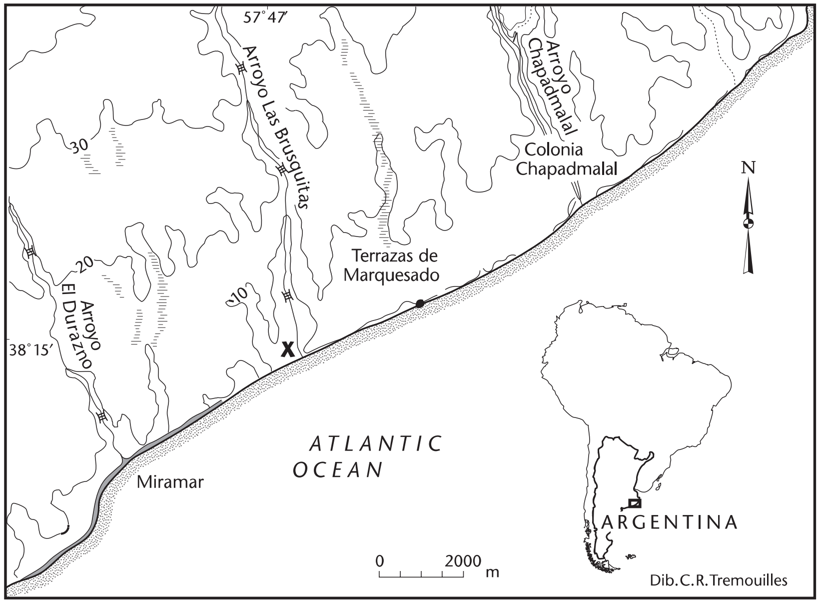

Figure 1. Location map; X indicates the site.

isabellei (Placophora); *Heleobia australis* and *Crepidula aculeata* (Gastropoda); *Mytilus platensis, Brachidontes rodriguezi, Ostrea equestris, Mactra isabellana, Pitar rostratus* and *Tagelus plebeius* (Pelecypoda). Excepting *Chaetopleura isabellei* specimens, fossils show no evidence of transport (e.g., pelecypods present valves in articulation).

The substratum, which does not crop out, is formed by clayish silts strongly cemented with calcium carbonate of Chapadmalalan age (see Cione and Tonni 1995). A compact bank of *Ostrea equestris* was established on this substratum. This oyster is typical of hard substrata and is adapted to higher salinity than other species of the genus *Ostrea.* All specimens preserve articulated valves. Over this bank, a stratum with abundant specimens of the marine pelecypod *Pitar rostratus* occurs. The uppermost stratum includes specimens of an inhabitant of brackish waters, *Tagelus plebeius,* in life position. Specimens of different individual ages of *T. plebeius* were found. They mainly occur in the western sector of the outcrop, near a small stream.

The Las Brusquitas outcrop corresponds to a sea level higher than present. A date of 5830 ± 80 (LP 297, corrected to 6169–6307 ± 68 yr B.P.) obtained from *Ostrea equestris* valves shows that it is assignable to the Hysithermal (see Aguirre and Whatley 1995; Tonni et al. 1999).

The species are typical of rocky substrata in infralittoral environments in the area. We infer that normal marine conditions prevailed while the lower and middle sections were being deposited. A gradual sea level fall or emergence of a littoral feature such a sandy bar provoked establishment of a mixohaline environment, possibly an albufere represented by the upper

section with *Tagelus plebeius.* The increasing freshwater input precipitated the local extinction of marine species.

We acknowledge the financial support of CONICET, CIC, ANPCyT, University Nac. La Plata.

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The Pleistocene-Holocene Transition in the Eastern Andean Piedmont of Mendoza, Argentina

Marcelo A. Zárate

In the eastern Andean piedmont of Mendoza (33° S to 35° S, 69° W) in Argentina, the late-Pleistocene/Holocene record consists of up to 25 m of alluvial and eolian sediments with several interbedded paleosols. The deposits, which overlie a Miocene-Pleistocene sedimentary in-filling 1,500 to 1,800 m thick of a longitudinal graben (González Díaz y Fauqué 1993), form a low-relief plain descending from 1,100 to 850 m asl in an eastward direction. Previous studies in the area grouped the sediments into two lithostratigraphic units and, based on a single ^{14}C date, attributed the succession to the Holocene (Polanski 1963). This contribution reports and discusses preliminary results of stratigraphic and radiocarbon analyses focused on the Pleistocene-Holocene transition. All the ^{14}C dates were derived from organic sediments.

The lower part of the succession is characterized by a well-defined laterally traceable paleosol whose relative altitude varies along the stream banks.

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Taken together with the parallel changes in sedimentary facies, the field evidence suggests the occurrence of a paleotopography with a relative relief of 10 m. At the lowermost paleotopographic settings, the paleosol consists of a peat-like horizon developed on massive sandy silts overlying fluvial gravels. Laterally, as the relative altitude increases, it grades into a dark brown A horizon. Paludal deposits composed of diatomites interbedded with clay and peat layers bury the paleosol and are overlain by a laterally continuous fluvial gravel bed.

At the highest paleotopographic settings, the paleosol is made up of a much thinner and lighter-brown A horizon developed on massive silty sand materials (loess) interbedded with alluvium and tephra layers. No paludal deposits are present, and the paleosol is buried by the fluvial gravel bed.

Although the beginning of the lower paleosol formation is still not bracketed, preliminary results suggest it was well underway prior to c. 10,000 ^{14}C yr B.P. Its formation at Puente la Estacada (PLE) was interrupted after c. 9920 ± 110 ^{14}C yr B.P. (Beta 131879) by the accumulation of diatomites and silty material, though it was reestablished by c. 9700 ± 70 ^{14}C yr B.P. (Beta 131880) with the development of an accretionary dark brown A horizon that continued until c. 8690 ± 70 ^{14}C yr B.P. (Beta 131881). At Puente El Zampal (PEZ), 10 km upstream from PLE, the lower paleosol was buried by diatomaceous and clay deposits, including peat-like layers, after c. 9610 ± 70 yr B.P. (Beta 135579). These paludal facies were followed by the deposition of the fluvial gravel bed after c. 9420 ± 60 ^{14}C yr B.P. (Beta 135580).

The upper portion of the succession is composed of massive to finely stratified silts and sands of floodplain environments. Two superposed paleosols, comprising light brown A horizons, occur in the middle part. These are traceable discontinuously along the stream banks. The uppermost of the two superposed paleosols at PEZ was dated to 7890 ± 50 ^{14}C yr B.P. (Beta 135581)

The lower paleosol documents an interval of relative landscape stability. The differences in the ^{14}C dates are attributable to variations in the paleotopographic settings. The succeeding paludal facies accumulated over a short time interval in response to greater availability of water, followed by a progressive increase in fluvial sedimentation rates under more energetic conditions.

From a regional perspective the environmental changes documented by this succession are synchronous with those reported in the southern Pampas of Buenos Aires. Here, the alluvial record includes an accretionary marshland paleosol formed c. 10,000 yr B.P. (Zárate et al. in press). However, the climatic shift at the Pleistocene-Holocene transition in these two areas, 1,500 km apart, seems to have been in opposite directions. In the southern Pampas, the paleosol marks an increase in moisture towards the subhumid-humid to humid climate that prevailed during the early part of the Holocene (Prieto 1996). In the eastern Andean area, on the other hand, pollen data from Gruta del Indio and Agua de la Cueva localities indicate a shift towards drier conditions between 9,000 and 8,000 yr B.P. (D'Antoni 1983; García et al. 1999). This could be reflected by the higher alluvial sedimentation rates following the deposition of the paludal facies.

Future research will focus on pollen analysis of the succession, along with a search for evidence of archaeological occupations during this time interval in the Andean piedmont.

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Erratum

Figure 1 below replaces Figure 1 in "Beaver (*Castor canadensis*) and Mastodon (*Mammut americanum*) in a Late-Pleistocene Upland Spruce Forest, Western New York State," by Richard S. Laub and John H. McAndrews, on p. 139 of *Current Research in the Pleistocene,* Vol. 16, 1999.

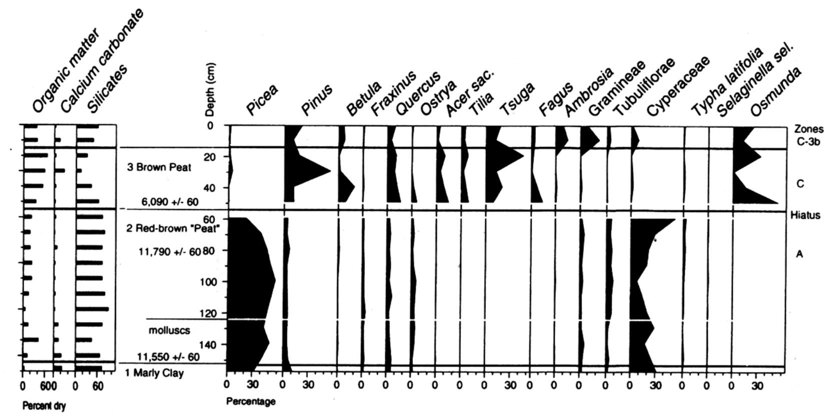

Figure 1. Pollen diagram from the Doerfel mastodon site; only the main pollen and spore types are shown. The percentage sum is 200 upland plants including Cyperaceae but excluding aquatic pollen grains and spores. Four contemporaneous late-Pleistocene pollen sites lie within 40 km of Doerfel: Belmont Bog (Spear & Miller 1976), Nichols Brook (Fritz et al. 1987), and Houghton and Protection bogs (Miller 1973). Geochemical analysis was done by loss-on-ignition.

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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.

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