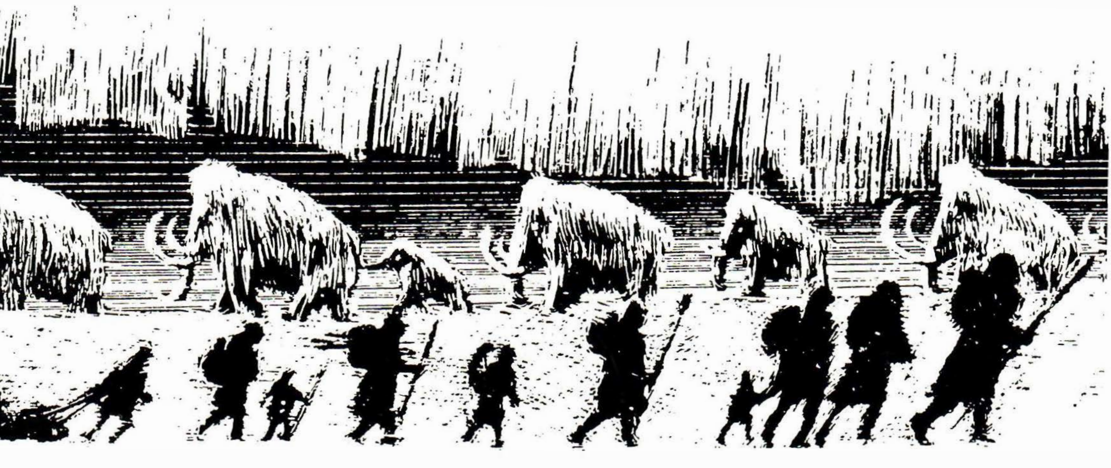
CURRENT RESEARCH IN THE PLEISTOCENE

Volume 7 1990



A Peopling of the Americas Publication

CURRENT RESEARCH IN THE PLEISTOCENE

Volume 7 1990

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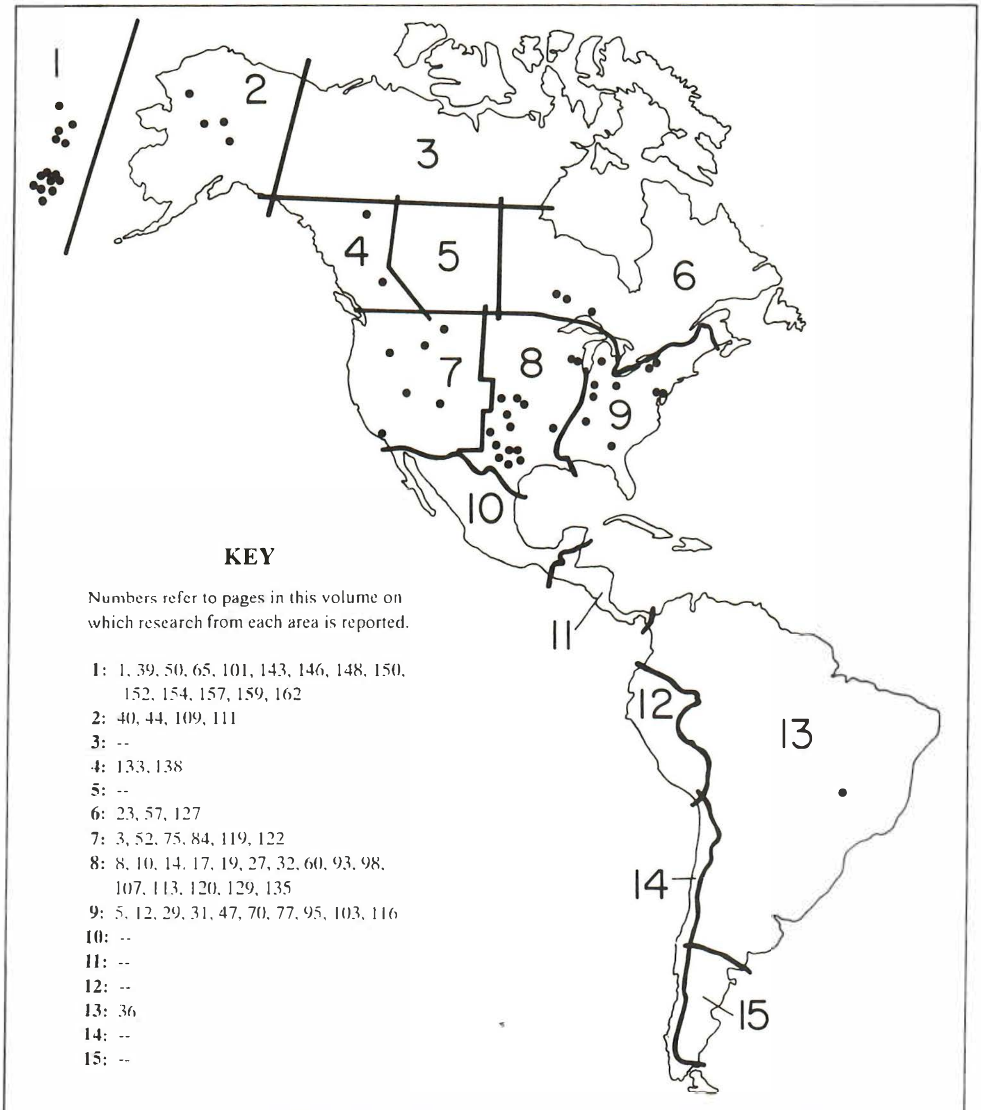

KEY

Numbers refer to pages in this volume on which research from each area is reported.

From the Editor

This is the seventh year that *Current Research in the Pleistocene* has been published. Each year we see a voluminous amount of material that needs to get out to each researcher—and this year and volume are no exception. This edition contains 63 articles.

This year we moved the production of *CRP* to Northern Arizona University. Dave Meltzer and I are trying to streamline the production. We now have the production system designed to make editing and desktop publishing a reality for *CRP*. However, we now need your help. We need each author who submits a manuscript to follow the *CRP* style guide. You would be surprised at what we receive in the mail as "camera ready" manuscripts. If you are going to submit a manuscript to us for inclusion into *CRP*, please FIRST look at this issue of the journal—and then follow its style for your manuscript. Please also look at the style guidelines printed at the back of this issue. There are a few changes from previous years. Most of all please note that you must (should—please) submit your manuscript both in hard copy and as an ASCII disk file. The hard copies I will use to make my editing marks and to send out for peer review. The ASCII disk file is what we will use for the desktop publishing system to input your manuscript. This will save me loads of time, keep the cost of the volume down, and keep your "camera ready" manuscript as clean as you sent it in to me.

Dave Meltzer is my Associate Editor. His job is to read all archaeological related manuscripts, provide his own review, and determine who should be an outside reviewer for each manuscript. Although I read all manuscripts, Dave does save me a great deal of time and he does provide another set of eyes for making sure that each manuscript is "clean" and ready for the reader. I have also requested the help of Dr. Larry D. Agenbroad and Dr. R. Scott Anderson to help serve as partial reviewers. They read paleontological/geological and ecological manuscripts (respectively) and suggest outside reviewers and provide their own opinions for each manuscript. Dave and I want to make *CRP* a peer reviewed journal, but to keep in touch with the "within a year turnaround time.".

This year we have a Regional Focus section—Hokkaido, Japan. Charles Keally was so kind as to act as the go-between for *CRP* and the various Japanese authors. Keally made sure that all manuscripts were the correct length and that all figures were of top quality. Charles Keally did an excellent job of editing the Regional Focus. If you have an idea for future Regional Focus topics, please let Dave or me know.

The word is becoming streamlined—as *CRP* is trying to do too. In this effort, please follow the 1990 style guidelines, provide us with an ASCII file, and get the manuscripts in early. Remember you can use FAX and BITNET to get in touch with either Dave or me.

Jim I. Mead

Archaeology

Transitional Paleolithic-Neolithic Settlement and Subsistence in Alashan League, Western Inner Mongolia, People's Republic of China

Robert L. Bettinger, Robert G. Elston, David B. Madsen, Li Zhuangwei, and You Yuzhu

In 1989, we initiated an archaeological research program comparing two environmentally similar, but historically independent, arid regions: central northern China and the Great Basin of western North America. The immediate goal was to determine if survey techniques developed to locate Holocene hunter-gatherer sites in the Great Basin could successfully locate late Pleistocene-early Holocene sites in western Inner Mongolia. We suspected that similar site location patterns would reflect similar subsistence-settlement behavior by prehistoric hunter-gatherers in both regions. Short of this, comparison of parallels and differences in Great Basin and Mongolian site locations should help address the question of what considerations structure the selection of these localities.

We conducted a series of small, purposive surface surveys in an undeveloped area along the margin of the Alashan Plain, Inner Mongolia, west of the Helan Shan. The Alashan region is separated from the Yellow River by the Helan Shan, a rugged, north-south trending mountain range that crests at about 3,500 m. To the east are the muddy plains of the Yellow River near

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Yinchuan, Ningxia Autonomous Region; to the west the arid Alashan Plains and its sand deserts (shamo), the Tengger Shamo and Ulan Buh Shamo.

The nature and distribution of biotic communities in this region are reminiscent of those encountered in the Great Basin: upper mountain slopes dominated by coniferous woodlands give way to brush and grass scrublands in high foothills and then to impoverished xeric associations in low foothills and adjacent sand dunes. These communities are cross-cut by seasonal streams that sink into the desert sands or terminate in salt marshes around alkali lakes and playas.

Given this familiar biotic arrangement, our Alashan surveys targeted specific kinds of locations defined by combinations of landforms, proximity to water, vegetation, and slope aspect that Great Basin hunter-gatherers have been shown to prefer. We examined four such locations in Alashan.

Canyon mouths: Rudimentary circular and square stone foundations, generally unaccompanied by chipped stone tools or debris ranging in age from recent to quite old (judging from lichen growths) were recorded at several canyon mouth locations. Contemporary Mongol and Han herders/farmer homesteads are concentrated in similar canyon mouth settings.

Arroyo margin: A short distance downstream from the canyon mouth sites, late Paleolithic (30,000–10,000 yr B.P.) lithic scatters dominated by small quartz and quartzite end scrapers and blades were encountered on old fan surfaces flanking the margins of arroyos with seasonally active streams.

Fan toe/dune margin: About 15 km downstream from the canyon mouths, the piedmont alluvial fans terminate, giving way to lofty dunes that define the eastern margin of the Tengger Shamo. The interface between fan toes and dune margins is littered with archaeological debris, primarily chipped stone and ceramics, which are particularly abundant in sand "blowouts" adjacent to what were presumably once-active stream braids. Late Paleolithic artifacts are common, but normally occur mixed with early Neolithic and later components.

Marshes: Rich and extensive late Paleolithic/early Neolithic assemblages were present at both playa-margin marsh locations visited, similar to those recently discovered in the Ordos Desert to the east (Wang and Olsen 1989). In addition to aceramic lithic scatters, two sites exhibited coarse brown pottery, microliths, circular, clay-lined house floors and relatively abundant faunal remains dominated by birds and small mammals, with some larger ungulates. The house floors suggest longer term residential occupations than those observed in other kinds of locations.

Assuming that late Paleolithic and early Neolithic sites are not ubiquitous in Inner Mongolia, our extremely limited surface inventory in the western Tengger Shamo suggests that late Paleolithic and early Neolithic site locations in Alashan are influenced by geomorphic and biological factors similar to those that influenced prehistoric site location in the Great Basin of North America. This hypothesis will be tested in 1990 by a systematic survey that will encompass all Alashan biotic communities including several (e.g., Helan Shan coniferous forests) not covered by our brief initial survey. We will use the resulting data to begin comparison of late Paleolithic and early Neolithic adaptations in Alashan to intensified, broad-spectrum foraging in Owens Valley, California, and the Carson Desert, Nevada, and to Fremont horticulture in Utah. The spatial congruence of late Paleolithic and early Neolithic assemblages in Alashan suggests that chances are good for the discovery of sites documenting the poorly understood Paleolithic/Neolithic transitions (ca. 10,000–7,000 yr B.P.).

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New Paleoindian Discoveries at Mammoth Meadow, Southwestern Montana

Robson Bonnichsen, Diane Douglas, Marvin Beatty, Mort D. Turner, Joanne C. Turner, and Bill Stanyard

Geoarchaeological investigations (1986–1989) in southwestern Montana led to the discovery of the South Everson Creek and Black Canyon Quarry and Workshop Complex. The complex occurs at the base of the Beaverhead Mountains in the Bitter Root Range, approximately 7 km from the Continental Divide (Bonnichsen et al. 1989).

Local bedrock deposits have played an important role in attracting prehistoric people to the area. Hydrothermal solutions rich in silica rose along fractures and faults in what may be Challis Formation volcanics into lake bed and flood plain deposits of Tertiary age. Colloidal silica was deposited in voids and replaced-non-siliceous material in wall rocks (Sharp and Cavender 1962; Staatz 1979). Native Americans in search of tool making materials excavated local bed rock and fluvial deposits exposed by erosional escarpments for chalcedony opal, porcelanite, jasper, oolitic limestone, and sandstone. Repeated use of this lithic, oolitic limestone, and sandstone. Repeated use of

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this lithic source through time has produced an archaeological record with numerous quarry pits and workshop loci.

Excavation of Mammoth Meadow I (1986–1989), located on the first terrace above South Everson Creek, has exposed a stratified multi-component lithic workshop/habitation locus of late Pleistocene and Holocene age (Figure 1). Excavations have produced hearths, flint knapping features, and approximately 12,000 specimens, which are mostly flaked stone tools made from local materials. An important faunal record is also present.

The oldest archaeological deposits in geological context occur in Unit IVa; a unit characterized by angular olivine basalt cobbles and boulders embedded in clay. These clays may represent deposits from a late Pleistocene lake or pond. Although the unit lacks diagnostic projectile points, small flakes, a possible bola ball, bison (*Bison* sp.) teeth and bones, and what appear to be fragments of two mammoth (*Mammuthus* sp.) ribs are present. Also of interest is the discovery of hair.

An unusual Cody-complex lithic-workshop floor, 4–10 cm thick, occurs at the bottom of Unit III. Unit III is clay loam in which part of the clay may be pedogenic with strongly developed peds at its top and suggests a period of environmental stability. The middle-like occupation with Cody and Eden points, numerous bifaces, preforms, flake tools, and animal bones is a significant tool production locality where thousands of Cody age artifacts were manufactured. Notable artifacts from the workshop floor include blade core preforms, exhausted blade cores, blades 15–20 cm in length, and blade tools. Patches of red ochre up to 40 cm in diameter occur in the Cody living floor and some flakes and artifacts are coated with ochre.

To summarize, excavations at Mammoth Meadow have produced a stratigraphic sequence of workshop/habitation features, faunal, and lithic assemblages. When dated, the site's charcoal record will allow this sequence to be placed in temporal perspective.

The discovery of redeposited human-made flakes in the fluvial gravels of Unit IVb, down to 160 cm below the datum, led to an auguring and backhoe trenching program up slope from Mammoth Meadow I in search of older deposits. The discovery of new Paleoindian levels not represented at Mammoth Meadow I below the well-defined Cody Complex will be a focus of future field research.

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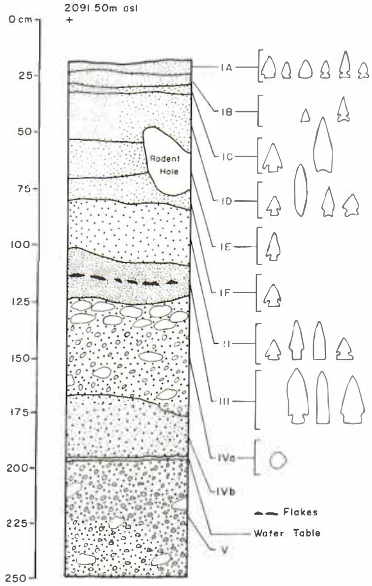

Figure 1. Stratigraphic units at Mammoth Meadow I: (I) dark gray to black silt loam; (II) dark gray to black clay loam; (III) black clay; (IVa) grayish-brown cobbley gravelly sandy loam; (IVb) brownish gray loamy sand; and (V) sand, gravels, cobbles, and boulders.

Paleoindian Fluted Point and Site Survey in Tennessee: the 1989 Season

John B. Broster and Mark R. Norton

The Tennessee Division of Archaeology has completed its second year of a state-wide Paleoindian site and projectile point survey. We have added a considerable amount of information to the data base gathered last year (Broster 1989). Several projects have been undertaken during 1989. Again, the

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local collectors and amateur archaeologists must be commended for their help in providing information on previously unrecorded sites. This survey would not have been possible without their unselfish donation of time and data.

The Division has recorded an additional 64 isolated fluted projectile points (40 Clovis, 23 Cumberlands, and 1 Redstone) (Figure 1). All of these artifacts are provenienced to a specific location. The recorded number of fluted points is expected to increase sharply in the following months, as more and more collectors are making their data available for study.

Of equal importance, has been the addition of 15 sites to our Paleoindian files. Of these sites, one was exclusively a Clovis occupation. Twelve sites have produced a combination of Cumberland, Quad, and Beaver Lake projectile points as well as uniface tools. The remaining two sites contain only unfluted assembledges (Beaver Lake, Quad, and Dalton). Nine of the sites are located along the margins of Kentucky Lake on the boundary between west and middle Tennessee. One site was found in west Tennessee adjacent to Flippin Creek. An additional five sites were noted in the central basin of middle Tennessee.

A third major project has been concerned with an analysis of the Twelkemeier site (40Hs173), located on the first terrace of the Tennessee River. A collection of 18 projectile points, 12 bifaces, and 86 unifacial tools were donated to the Division by Mr. Herman Twelkemeier. Diagnostic artifacts include Clovis preforms, Cumberland, Quad, and Beaver Lake projectile points. This is one of the largest collections of materials to be given to the state, and is an important addition to our understanding of the Paleoindian period for the region.

In the central basin, test excavations were conducted in the spring of 1989 on the Johnson-Hawkins site (40Dv313). This site was reported by a local collector, David Johnson. He had found Clovis, Cumberland, and Beaver Lake projectile points eroding into the Cumberland River. Numerous unifacial tools were located at times of low water in the general area. It was hoped that a possible intact Paleoindian occupation might be present. Unfortunately, this was not the case. Testing revealed that at least the major portion of the Paleoindian component had been removed by action of the river. Additional sections of the site are proposed for testing in the spring of 1990.

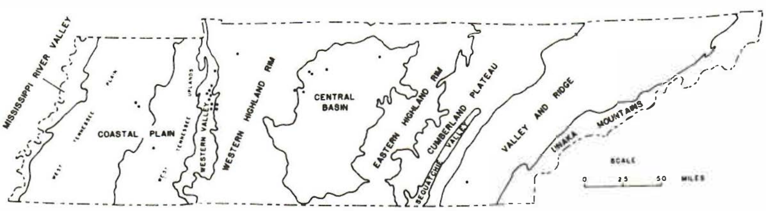

Figure 1. Recorded Paleoindian sites in Tennessee.

As a working model, we are presently using definitions for proposed Paleoindian phases, which were presented by Anderson in his study of Paleoindian adaptations in the Southeastern United States (Anderson 1989). He proposed an early Paleoindian, comprised of Clovis occupations, as dating from 11,500 to 11,000 yr B.P. This of course generally follows the known dating of Clovis sites in the western states. His second phase, the middle Paleoindian, would date to between 11,000 and 10,500 yr B.P. Fluted projectile point types, such as Cumberland and Redstone, are considered diagnostic for the earlier part of this period. He states that types such as Beaver Lake and Quad are representative of the end of the phase. These types probably continue in use into the following phase of Paleoindian occupation. This late Paleoindian, or as it has sometimes been called, the Transitional Paleoindian, is projected to date from 10,500 to 9,800 yr B.P. The diagnostic projectile point types for this final phase are the Dalton, Harpeth River, and Plano forms. One must be very careful in using these proposed phases, as firm carbon dates are lacking for the Tennessee region. They must be considered a possible starting point for the evaluation of the Paleoindian period.

We plan to continue our recording of collections and sites with the next field season. Surveys and test excavations are to be undertaken in both the western valley and central basin of Tennessee. It is hoped that work in eastern Tennessee will also be possible during the coming year.

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Quaternary Geology and Prehistory of the Vera Daniels Site, Travis County, Texas

Michael B. Collins, Michael D. Blum, Robert A. Ricklis, and Salvatore Valastro, Jr.

Two phases of subsurface investigation, reconnaissance in 1988 (Espey, Huston, and Associates n.d.) and testing in 1989 (Ricklis et al. n.d.), have revealed deep, stratified late Quaternary deposits containing Paleoindian and Archaic cultural components at the Vera Daniels Site (41TV1364) in Travis County, Central Texas. The site is associated with an extensive terrace complex in the valley of the Colorado River near its confluence with Barton Creek. This locality is in the Balcones Fault Zone, an area of topographic, geologic, edaphic, biotic and climatic transition between the Edwards Plateau and the Gulf Coastal Plain. The great ecotone stretching the length of the Balcones Fault Zone is locally enhanced by the presence of Barton Springs, a perennial aquifer-fed conduit that today has a discharge of five million liters per hour.

With the triangular-shaped study area between Barton Creek and the Colorado River are a high, dissected terrace of probable middle to late Pleistocene age and a multi-level Holocene terrace complex. Deposits underlying the Holocene terrace complex comprise three sedimentary suites, latest Pleistocene to early-middle Holocene valley margin colluvial sediments, latest Pleistocene to early-middle Holocene fluvial deposits, and late Holocene fluvial deposits. Colluvial fan wedges are abutted against a scarp comprised of (Cretaceous) bedrock overlain by the middle to late Pleistocene alluvium. Colluvial deposits consist of strongly calcareous silty clays and clayey silts interbedded with lenses of mostly limestone and chert gravels and reworked carbonate nodules, are from 3 to 5 m thick, are strong brown to yellowish red in color, and manifest a weakly developed soil profile. Paleoindian (Clovis, Plainview) and early archaic lithic artifacts, mostly with deep patination, occur in poorly stratified order beneath middle to late Archaic artifacts. Radiocarbon ages of 5,540±90 (TX-6530) and 5,010±100 (TX-6529) were obtained from bulk sediment samples in association with Paleoindian materials. This apparent discrepancy is discussed below.

The just described valley margin colluvial sediments pinch out in the direction of the Colorado River and Barton Creek where they are replaced by coeval, siliceous fluvial deposits that represent formerly active constructional

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floodplains of the Colorado River and slackwater sediments deposited by floodwaters backing up Barton Creek valley from the much larger master stream. Coring determined that these deposits exceed 12 m in thickness nearer the Colorado River but range from 3.5 to 6.5 m in thickness in the site area. Temporally diagnostic Paleoindian through early Archaic artifacts and four radiocarbon determinations on bulk sediment samples, all in proper stratigraphic order and in close agreement, place this floodplain construction from ca. 11,000 to ca. 5,000 yr B.P. Cultural lithics and hearths occur in thin, discrete lenses. No charcoal, bone, or other organic material was preserved other than snail tests and sparse fresh water mussel shell fragments.

Unconformably overlying both the latest Pleistocene to early-middle Holocene colluvial and fluvial deposits on the higher elevation surface of the Holocene terrace complex is up to 1.8 m of fine sandy silts to silty sands again deposited in the floodplain setting, mostly by the Colorado River. These deposits are modified by pedogenesis and contain middle Archaic artifacts (2,000 to 3,000 yr B.P.). Radiocarbon ages from bulk sediment samples cluster around 3300 yr B.P. and are in close agreement with age ranges from the artifacts. The lower surface is underlain by thick, coeval, channel-related deposits of late Holocene age. Abandonment of these as environments of frequent deposition probably occurred around 1,000 years ago, contemporaneously with incision by many other streams in the south central United States (Blum and Valastro 1989; Hall in press).

The extensive area of rapid floodplain construction in latest Pleistocene to early-middle Holocene times provided ideal conditions for the burial and stratigraphic segregation of multiple archeological components. Discovery of such components by deep mechanical trenching and radiocarbon dating of clay-rich bulk sediment samples provide an effective archaeological strategy for evaluating archaeological sites of this kind. In regard to the colluvial fan deposits, the radiocarbon determinations do not agree with age estimates based on diagnostic artifacts and the stratigraphic relationship between the colluvium and adjacent fluvial deposits. At present, the basis for this lack of agreement is unknown; either archaeological materials were reworked into colluvial deposits from the adjacent Pleistocene terrace, or samples themselves were contaminated by younger carbon introduced by groundwater and/or pedogenesis.

We thank the City of Austin, Texas, for support of this project.

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The 1989 Investigations at the Aubrey Clovis Site, Texas

C. Reid Ferring

The Aubrey Clovis Site (41DN479) was discovered in 1988 in a deep artificial channel in Denton County, Texas. Following test excavations (Ferring 1989a,b,c), an eight month field season in 1989 included geological, archaeological and paleoecological investigations. The site contains 14 m of late Pleistocene and Holocene sediments below the flood plain of the Elm Fork Trinity River. Entrenchment of the valley took place between ca. 20,000 and 15,000 yr B.P. Late Pleistocene sand and gravel channel deposits were left as remnants above bedrock and are the oldest sediments at the locality. A cut-off channel of that stream became the pool for a spring that was active for the rest of the Pleistocene and part of the early Holocene. Stratified lacustrine silts, marls and peats filled the spring pool in the late Pleistocene. These sediments contain well preserved paleoecological data including: pollen, vertebrates, molluscs, diatoms, ostracodes, plant macrofossils, and insects. Six radiocarbon ages on these sediments range from 14,208±218 yr B.P. (SMU-2236) to 13,275±410 yr B.P. (SMU-2195). Following a period of erosion and/or deflation of the pond sediments, a colluvial/alluvial fan prograded over the pond.

Clovis age faunas and artifacts occur on the colluvial sediments, on the disconformity in the pond axis, and in two camp loci on the late Pleistocene sandy remnant: Area B is on the eastern edge of the pond and Area F is near a paleochannel about 125 m to the east. Clovis occupation of the site is minimally dated by three radiocarbon ages: a) on fluvial-lacustrine clays overlying Clovis artifacts and faunas in the pond (10,946±87 yr B.P. (SMU-2194)) b) on floodplain clays that bury the Clovis surface in Area B (10,724±90 yr B.P. (SMU-2338)) and, c) on fill from the paleochannel (10,360±150 yr B.P. (Beta-32002)). These ages and geologic data allow definition of the Clovis paleosurface (the Pleistocene-Holocene stratigraphic boundary) along a 250 m exposure at the locality.

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Above the Clovis paleosurface are 7.5–9.0 m of Holocene sediments. These include colluvium near the valley margin and distal floodplain facies over the rest of the locality. In the camp areas the Clovis occupation surface is overlain by an early Holocene cumulic soil. Above this are ca. 6 m of clays with a thick, cumulic late Holocene soil at the surface. A humate sample from 3.5 m above the Clovis occupation surface yielded an age of 7,581±330 yr B.P. (SMU-2339).

Archaeological investigations of the Clovis occupations at the site focused on the two camp areas and a bison kill/processing area. At the western margin of the pond ca. 1,100 identifiable vertebrate elements were recovered from the disconformity between late Pleistocene and Holocene sediments. These include well preserved remains of a single bison (*Bison*); a distal bison humerus has an impact fracture to the shaft and possible cut marks. Resharpening chips and one large quartzite blade were recovered from the same stratigraphic position.

At the camp area in Locus B, a total of 114 m^2 was excavated and about 6,100 lithic artifacts were recovered. This assemblage is dominated by manufacturing and tool maintenance debris. In a 1 m diameter cluster, ca. 2,000 pieces of biface reduction debitage were recovered. A large overpassed biface thinning flake and several refitted flakes show the quartzite preform was about 8 cm wide when brought to the site. This compares with large Clovis bifacial preforms from the Anzick site in Montana (Lahren and Bonnichsen 1974). Other bifaces from this locus include a Clovis point and an impact-damaged fragment located adjacent to a charcoal-burned bone concentration. Classic Clovis blade technology is represented by large blade blanks for scrapers, several blade fragments, and a large chalcedony blade core tablet. Other debitage concentrations at this locus appear limited to tool resharpening debris. Several clusters of charcoal and burned bone occur on this surface, but no discrete hearth features could be seen during excavations. Burned large mammal, small mammal, and turtle bones suggest a variety of game was processed in this camp locus.

In Locus F, 66 m^2 of another Clovis living surface were excavated. About 3,800 lithic artifacts and limited faunal materials were recovered. Discrete activity areas include a cluster of ca. 1,500 flakes and chips, apparently generated during the repair or resharpening of at least three bifaces. Tools from Locus F include several biface fragments, two gravers, an end scraper fragment, burin spalls, and retouched pieces.

The Clovis occupation at the Aubrey site appears to have been quite brief. No overlap of artifact clusters is apparent, and lithic artifacts segregate from clusters of burned bone. The identical stratigraphic positions and very similar lithic raw materials from Loci B and F are evidence that these areas were occupied either at the same time or during a short interval. However, artifacts and faunal materials were still being exposed in the peripheries of excavation blocks when fieldwork was terminated. Also, boreholes drilled to the north and south of the artificial channel revealed pond and paleochannel sediments over a large area, and other Clovis components may be presented along these features.

Although a large sample of debitage was recovered, the tool sample includes only about 30 pieces. Long distance acquisition of raw materials and clearly intensive tool curation are indicated by these assemblages. While artifacts, faunal and spatial analyses are in progress, it is clear that the Aubrey site contains a remarkably well-preserved record of Clovis technology, intrasite patterning and subsistence, in a geologic context with abundant data on late Pleistocene and early Holocene paleoenvironments.

Research at the Aubrey Site is funded by the U.S. Corps of Engineers, Fort Worth District. Their assistance and support is gratefully acknowledged.

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The Late Pleistocene–Early Holocene Occupation of the Munson Springs Site (33-Li-251), Locus A, Licking County, Ohio

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The Munson Springs Site (33-Li-251) is located in a small, south-facing amphitheater-shaped basin which drains into lower Raccoon Creek in central Licking County, Ohio. The subject of this report is Locus A, an oval (8 m by 10 m) topographic high which has yield several early Archaic and Paleoindian artifacts in a test trench dug across its center (Allison 1989). Locus A lies on a channery silt loam-mantled colluvial footslope (9% gradient) between two

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perennial spring. Valley side perennial springs here and at similar topographic settings in the area are due to interbedded shale and fine sandstone units which from perched aquifers at the contact between overlying sandstones and underlying impermeable shales. The topography and soils in the hollow clearly indicate that 1) the footslope has been quite stable under natural conditions and that the colluvium was largely in place by the time of early human occupation (ca. 11,000 yr B.P.) and 2) that the low oval rise is not natural but consists of human-worked deposits.

A minimum of four distinct cultural components tentatively are identified at the Munson Springs site, Locus A: 1) an ephemeral Historic component; 2) a Woodland occupation; 3) probably a series of early Archaic occupations; 4) an early Paleoindian component. The dominant artifact class is fire-cracked rock which is concentrated within the very dark gray, charcoal-rich uppermost stratum covering the eastern half of the rise. Preliminary investigations suggest that this stratum represents intensive and apparently multiple in situ burning episodes. Ceramics and lithic debitage are associated with this stratum.

Below this stratum are a series of complicated and discontinuous cobbly silt loam strata interrupted by intrusive pit features. Diagnostic projectile points recovered from these strata include on Kirk Corner Notched, one possible St. Albans Side Notched, and a fragment of a large side notched point; all are early archaic forms. In addition, one MacCorkle Stemmed was recovered in situ adjacent to Locus A and one Kirk Corner Notched was recovered out of context in the backdirt from the trenching. Thus far, no ceramics have been observed within these strata. While this variegated gray brown (10YR 3/2 to 5/3) material lacks the distinct horizonation and soil structure of an undisturbed forest soil, the texture and the distribution of clay films do suggest significant post depositional soil profile development.

Underlying this series of strata, an early Paleoindian lanceolate preform was discovered in non-variegated, brown (8.5YR 4/4), B horizon material which appears to be natural colluvium. This material grades to a clay loam with blocky structure and many clay skins characteristic of a well-developed argillic B horizon. This horizon extends horizontally through the oval rise indicating that the natural surface was fairly flat along the slope contour. The preform exhibits a single large basal thinning flake and an extensively retouched left lateral margin indicating probable use as a cutting implement (Callahan 1979; Lepper 1983). A 1 m by 1 m test pit over the location of the early Paleoindian preform produced evidence for a more extensive occupation level. One large backed uniface, a basal fragment of a channel flake, and nine additional flakes primarily related to biface reduction were recovered in association with the paleoindian preform. The source material for these artifacts appears to be predominantly local Flint Ridge flint as well as some Upper Mercer chert. In addition a non-contiguous test pit yielded possible artifacts at a corresponding depth.

The full extent and nature of the Paleoindian occupation of the Munson Springs Site has not been determined. The locality conforms to the expectations for an early Paleoindian small base camp based on a land use model developed for neighboring Coshocton County (Lepper 1988). The presence of a substantial early Archaic component at the Munson Springs site tends to corroborate the proposition of continuity in the late Pleistocene–early Holocene settlement patterns (Meltzer and Smith 1986).

Research at the Pig site is being conducted under the auspices of the Licking County Archaeology and Landmarks Society. The authors wish to acknowledge the contributions of our colleagues in this team project: William Dancey, Paul Hooge, Paul Pacheco, Dee Anne Wymer, and numerous dedicated volunteers. Special thanks are extended to Herb and Frank Murphy for their continued support of archaeological research on this property.

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Plainview Artifacts at the St. Mary's Hall Site, South Central Texas

Thomas R. Hester

In 1977, the author carried out excavations at site 41BX228, the St. Mary's Hall site in Bexar County, south central Texas. The site yielded a discrete Plainview occupation, buried beneath Archaic and late Prehistoric deposits. Two brief reports have been published (Hester 1978, 1979), providing basic information on the excavations, but a final report has not yet appeared. In the course of the preparation of the final volume, two excellent papers have been

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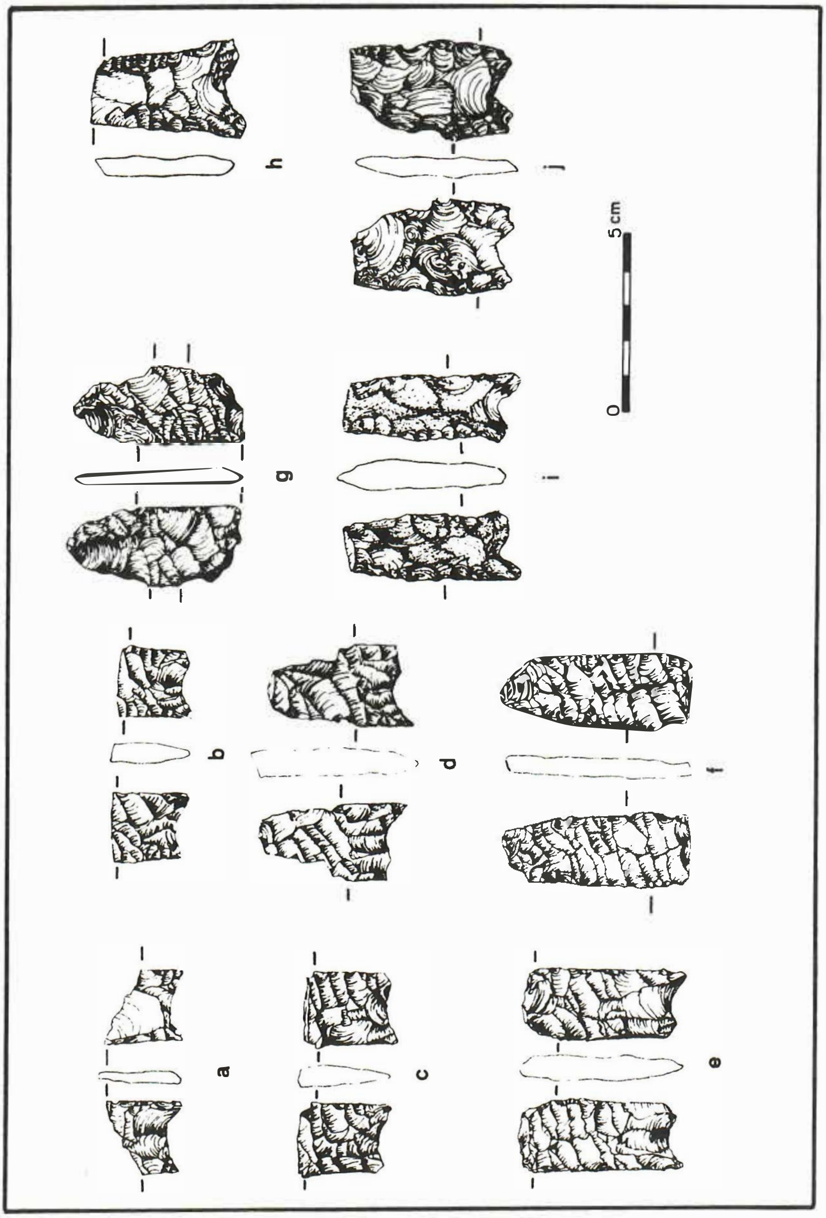

Figure 1. Plainview Points from St. Mary's Hall (41BX228), Texas. a–e basal fragments; f, medial fragment. Dashes indicate extent of lateral smoothing; the basal edges of a–e are all smoothed. Plainview Points from St. Mary's Hall (41BX228), Texas. g, medial fragment; h–j, basal fragments (specimen h is alternately beveled, with heavy edge and may have been used as a knife). Dashes indicate extent of lateral smoothing; the basal edges of h–j are all smoothed.

written on the Plainview artifacts; one deals with Plainview lithic technology at the site (Knepper n.d.) and the other with the projectile points from the Plainview and overlying late Paleoindian and early Archaic occupations (Greco n.d.).

Due to the delay in the final report, it is felt that brief descriptions of the Plainview projectile points, and more importantly, technical illustrations of the specimens, be published for comparative studies. Here there is space to note only the Plainview specimens; two Angostura bases and a Golondrina fragment were found stratigraphically above the Plainview occupation.

Ten artifacts identified as Plainview points, or fragments thereof, were identified at St. Mary's Hall; eight are basal fragments and two others are medial section (Figure 1). The basal fragments are made of tan, brown, and gray cherts, moderately to heavily patinated. Two have been thermal-factured, and two have had subsequent reworking after they were broken. One of these (Figure 1, h) has been alternately beveled on both lateral edges and these edges are heavily worn, suggesting that this specimen served as a knife rather than (or in addition to) being a projectile point. Basal thinning ranges from long, vertical flakes to arc-shaped removals.

The two medial fragments are also patinated, and one has been heavily burned. Diagnonal parallel flakes are seen on one specimen (Figure 1, f), a pattern also observable on several other points in this assemblage (e.g., Figure 1, b–e). Length and width data are highly variable, due to breakage and thermal fracture. Maximum thicknesses are: three at 5 mm, four at 6 mm; two at 7 mm, and one at 8 mm.

The St. Mary's Hall specimens are perhaps best described in terms of their form and their context as "campsite" Plainviews—discarded after breakage during the hunt (and sometimes apparently tossed into hearths). However, it should be pointed out that local cherts were being exploited for the manufacture of new (replacement?) projectile points. A fairly complete reduction sequence, from "blanks" through "preform" stages is present in the assemblage, is described in detail by Knepper (n.d.). A parallel-sided bifacial Clear Fork tool, and two unifaces, one complete and one bit fragment, were also in the assemblage (Knepper n.d.). The Clear Fork biface (Turner and Hester 1985) is very similar to one recovered at Baker Cave, Val Verde County, Texas, radiocarbon dated at 9,000 yr B.P. (Hester 1983). No direct dates are presently available for the St. Mary's Hall Plainview sample. The points are very similar to those from Bonfire Shelter (located 300 km west of St. Mary's Hall), found in a bison (*Bison*) kill context dated at about 10,200 yr B.P. by Dibble (1970). A very small charcoal sample from St. Mary's Hall is presently undergoing AMS analysis.

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Projectile Points of the San Patrice Horizon on the Southern Plains of Texas

Thomas R. Hester and Sam W. Newcomb

In a recent monograph, Johnson (1989) has presented an illuminating synthesis of late Paleoindian cultural patterns in the eastern woodlands of Texas. Among those patterns is what he terms the "classic San Patrice" culture. Typical artifacts include San Patrice points of the Hope and St. Johns variety and the Albany uniface or "knife" (Turner and Hester 1985). Johnson (1989:26) notes that while the San Patrice pattern is concentrated in eastern Texas and adjacent woodland areas "dart points quite like those of the San Patrice type have even been found on the South Plains."

The South Plains artifacts to which Johnson alludes are three stemmed dart points (Figure 1,a) from the Rex Rodgers site in Briscoe County, on the Llano Estacado of Texas (Hughes and Willey 1978). These were associated a kill of six bison resembling *Bison antiquus* and *B. occidentalis* (Hughes and Willey 1978). Occurring in the same context were two lanceolate points of Plainview type.

The three stemmed points from Rex Rodgers are very similar to San Patrice, and given their antiquity (estimated by Hughes and Willey 1978 to be 9,000–10,500 yr B.P.), and the age of additional specimens of this form (Figure 1,b) at Horn Shelter No. 2 (9,500–9,980 yr B.P.; Watt 1978) on the Brazos River in

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central Texas, they are likely coeval with east Texas San Patrice (Turner and Hester 1985). To these data, Hughes and Willey (1978) added reports of the occurrence of other San Patrice like points on the South Plains, including one from the Steadman site in Fisher County.

We add in this note information on a specimen found by the junior author on the margin of the South Plains. The point (Figure 1,c,c') is from the surface of site 41SF20 in Shackelford County. This site is east of the town of Leuders, on the south side of the Clear Fork of the Brazos River. It is of fine-grained grained glossy gray chert, with light purple to pink coloration suggestive of heat-treating. It has been thinned by the removal of long, single flutes on both faces, although on one face (Figure 1,c'), several subsequent thinning flakes were detached. The basal and lower lateral edges are heavily smoothed. Length is 63 mm, maximum width, 27.5 mm, and thickness, from 5.0 to 6.5 mm. It is considerably larger than the Rex Rodgers specimens, but about the same size as one of the Horn Shelter No. 2 points (Figure 1,b). Using Johnson's (1989) terminology, the Leuders specimen would be a "new or first stage point."

Two crude bifaces, one a possible preform, were found on the surface of 41SF20. They were made of a light brown chert, distinct from the projectile point, and it is , of course, impossible to ascertain if they were associated with it.

In summary, this note has called attention to the occurrence of projectile points of San Patrice style far to the west of the east Texas woodlands. We feel that these western specimens are horizon markers of the San Patrice cultural pattern, occurring well beyond the core area as defined by Johnson (1989). A major thesis of Johnson's monograph is the interaction of Plains and Woodland Paleoindian societies. He suggests such contacts involving the peoples who made Plainview and Dalton artifacts. The data from Rex Rodgers would indicate Plainview and San Patrice contemporaneity. The other specimens, such as the Leuders artifact, indicate that the peoples of Johnson's "Woodlands" intruded into the margins of the South Plains with some frequency.

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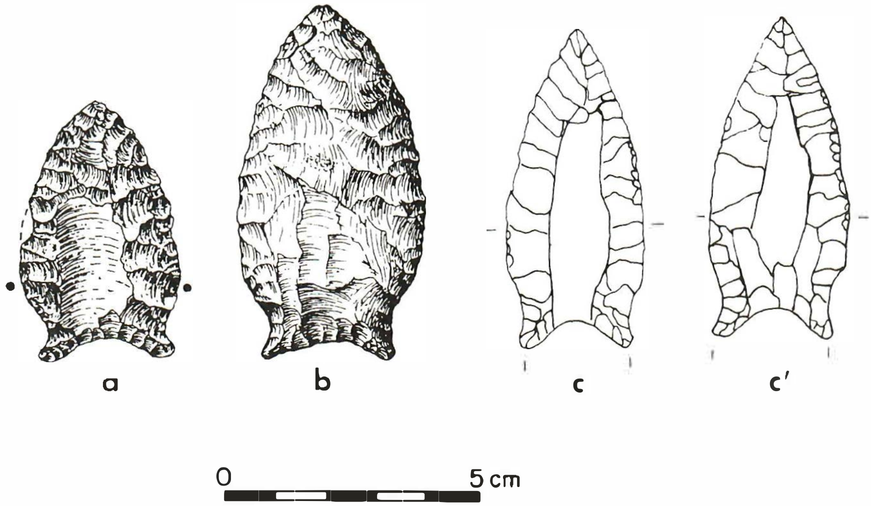

Figure 1. Rex Rodgers site (Turner and Hester 1985); b, Horn Shelter No. 2 (Johnson 1989); c,c' both sides of Leuders (41SF20) specimen.

Cedar Creek: A Folsom Locality in Southwestern Oklahoma

Jack L. Hofman

Oklahoma's most well known Folsom locality, Cedar Creek (34WA6), is located along a small canyon tributary of the Washita River in the dissected rolling plains north of the Wichita Mountains (Bell 1954; Hofman 1990). Professional study of the locality began in 1947 (Bell 1948), but in situ Folsom deposits have as yet not been located. Folsom artifacts have been found primarily along a 3 km long section of the stream. The term locality is used because the traditional concept of a site with an easily delimited concentration of cultural debris is not applicable to the Folsom sample from Cedar Creek. Folsom age artifacts found in the canyon are believed to be derived from a stratigraphic unit which overlies Permian age sandstone. This stratum is comparable to one from which the Clovis-age Domebo mammoth was recovered about 40 km southeast of Cedar Creek (Leonhardy 1966). Available radiocarbon dates on charcoal and wood from this basal unit at Cedar Creek are between 9,100 and 9,700 yr B.P.

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(Hofman 1988a). These are younger than known Folsom dates, but the maximum age of this stratum in Cedar Creek has not been determined.

Several exposures of Pleistocene deposits are present on the canyon slopes and these are currently being studied. Mammoth, mastodon, horse, bison, giant armadillo, and gastropods are represented in the fauna from these as yet undated deposits, but no cultural material has been found in association.

Although Clovis, Plainview, Dalton, Scottsbluff, and other Paleoindian point types have been found there, Cedar Creek is most notably a Folsom locality. It has yielded more Folsom artifacts than any other Oklahoma site now documented. Examples of Cedar Creek Folsom artifacts are shown in Figure 1 (also, Bell 1954).

A total of 40 projectile points, 9 fluted preforms, 7 channel flakes, and 14 Midland points are now documented in several collections, and additional specimens remain to be studied. Projectile points are represented by 11 complete or nearly complete artifacts (several of which had been reworked prior to final loss or discard), 9 basal fragments (several with distinctive impact brakes on their distal ends), 9 tip fragments, and 11 blades sections. The Folsom points are made primarily from Edwards Chert (n=31, 77.5%) derived from central or west-central Texas (the closest quality sources are over 300 km south of Cedar Creek), with 12.5% (n=5) Alibates (from the Canadian River valley in the Texas Panhandle more than 250 km to the northwest), and 10% other materials.

The exotic lithics have only been identified visually so the sourcing is tentative. One complete specimen is probably Washington Pass Chalcedony from Chuska Mountains in northwest New Mexico and a unifacial scraper is also made of this material. One reworked point is made of gray and black banded chert similar to the "Zebra Chert" which predominates in the Lone Butte Folsom assemblage from south-central New Mexico (Broilo 1973; D. Stanford pers. comm. 1987). A small reworked point is thought to be Flattop Chalcedony which has its source area near Sterling, Colorado. One specimen is a fine quartzite of unknown origin. Of the 14 Midland points recorded from Cedar Creek, one tip is manufactured from Niobrara Jasper with the closest source area in northwestern Kansas. Two Folsom points from other sites in Oklahoma were also made from Niobrara Jasper (Hofman 1988b; Hofman and Wyckoff 1987). Documented channel flakes from Cedar Creek are made of Edwards Chert.

Midland points from Cedar Creek are primarily made from Edwards Chert (n=9, 64.3%), with a few Alibates specimens (n=3, 21.4%), the Niobrara fragment, and one of unidentified material. Midland points are represented by 6 complete points (3 with reworked tips), 4 bases, 2 tips, and 2 blade sections. The mean thickness of these Midland points (0.38 cm) compares well to the maximum thickness (not fluted thickness) of the Folsom points (0.39 cm) from Cedar Creek. In all aspects other than fluting the technology of the Folsom and Midland points from Cedar Creek compare quite well. Six (45%) of the 13 Midland points exhibit evidence of being made from flake blanks, and the thin, very flat-surfaced, and sometimes longitudinally curved flake blanks are

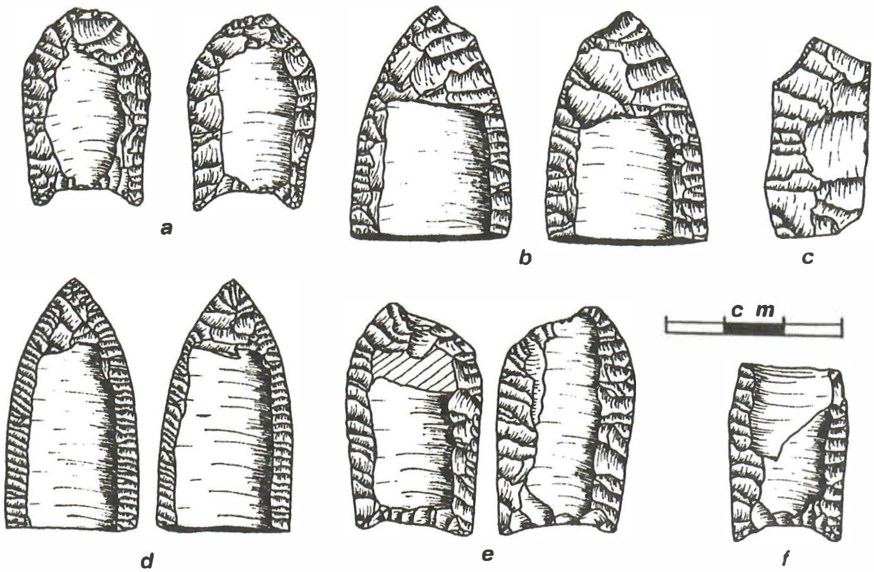

Figure 1. Folsom artifacts from Cedar Creek, Oklahoma. a: Folsom point of "Zebra Chert" b: Folsom tip of Alibates; c: utilized channel flake; d: Folsom tip of Edwards Chert; e: reworked and impact damaged Folsom point of Edwards Chert; f: Folsom base of Edwards Chert with a reworked and impact damaged distal end.

often not conducive to successful fluting. The nine fluted Folsom preforms from Cedar Creek include only two (22%) with remnant facets from flake blanks. This may support an interpretation that Midland points are commonly made from blanks which are not well suited to fluting.

Unfluted points compose a significant percentage of Folsom point samples from a number of Folsom sites including Lindenmeier, Blackwater Draw, Elida, and Shifting Sands (Hofman n.d.). The Folsom preforms are mostly Edwards Chert (n=7, 77.8%), with one possible Edwards and one Alibates preform. The proportion of this Oklahoma Folsom assemblage manufactured from Edwards Chert is comparable to that at Blackwater Draw (Hester 1972) and Lipscomb (Hofman and Todd 1990).

The manufacture of fluted points at Cedar Creek from Edwards Chert and Alibates preforms documents the transport of tool stone in the form of large flakes, flake tools, or bifacial cores over considerable distances. Moreover, it suggests that the relatively "risky" fluting process was executed even in situations like Cedar Creek where there is no local supply of replacement stone suitable for Folsom point production. This probably reflects the high confidence of Folsom flint knappers and their highly mobile existence. Folsom assemblages exhibit evidence that there was considerable planning depth (Binford 1989), and an ability to contend with a variety of situations or uncertainties (Hofman n.d.; Ingbar and Hofman 1989). Folsom people operated in western Oklahoma with no apparent concern for the local dearth of suitable lithic materials for manufacture of replacement stone elements. They apparently transported, curated, and possibly cached the needed lithic resources so that their subsistence activities were not limited by or directly tethered to key sources of high quality tool stone.

The question remains as to why Cedar Creek was attractive to Folsom hunters. The location has several positive features including a reliable source of good water, prominent overlooks suitable for monitoring game movements, open grassland and playa lakes in the immediate vicinity, steep-walled canyons and topographic features suitable for trapping or stalking bison or other game, a variety of wood for implements and fuel, and protected setting which would have been valued by people and prey species during periods of severe weather. Activities evidenced at Cedar Creek include hunting, retooling of equipment, processing hides and food, and probably camping. A number of large skulls and other elements of fossil bison have been recovered from this canyon and the impact damaged projectile points indicate hunting was conducted in the area. A variety of Paleoindian tool types made primarily on Edwards Chert flakes are recorded from Cedar Creek and suggest that a variety of processing, maintenance, and manufacturing activities were executed. Tool types include end scrapers, spurred end scrapers, gravers, and delicate combination tools made on thin flakes (Hofman 1990).

Among the fundamental lessons from the ongoing investigations at Cedar Creek is the importance of private collections to archaeological studies, the importance of long term investigations as opposed to "single visit" sampling for interpreting sites, and the limitations of the traditional site concept for studying the archaeological record, especially that left by nomadic hunter-gatherer groups.

Many individuals have contributed to the study of Cedar Creek archaeology and I want specifically to thank Dan Base (deceased), James Hemming, Dean Gamel, Frank Newkumet, Phil Newkumet, Ron and Rich Schuermann, Bobby Repp, Terrell Nowka, Lloyd Davis, Monty Little, Jim Cox, Robert Bell, Charles Wallis, Brian Carter, Fred Nials, Russell Graham, Walter Klippel, and Tom Stafford.

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Sandy Ridge—A Gainey Occupation Site in South-Central Ontario

Lawrence J. Jackson

The Gainey Complex, as first defined in the work of Simons et al. (1984; 1987), Deller and Ellis (1988), and Ellis (1989) is a good Clovis analogue for the Great Lakes region. Identified principally by the use of large, concave based, parallel-sided fluted points, Gainey is the earliest recognized occupation in the lower Great Lakes region, with the possible exception of Enterline (Roosa 1965). The Gainey Complex, as yet only partially defined, extends from southern Ontario through lower peninsula Michigan, and into eastern Ohio. Definition of the nature of Gainey settlement pattern, diagnostic tool assemblages, raw material use, and small to large site relationships will be important research questions through the 1990s.

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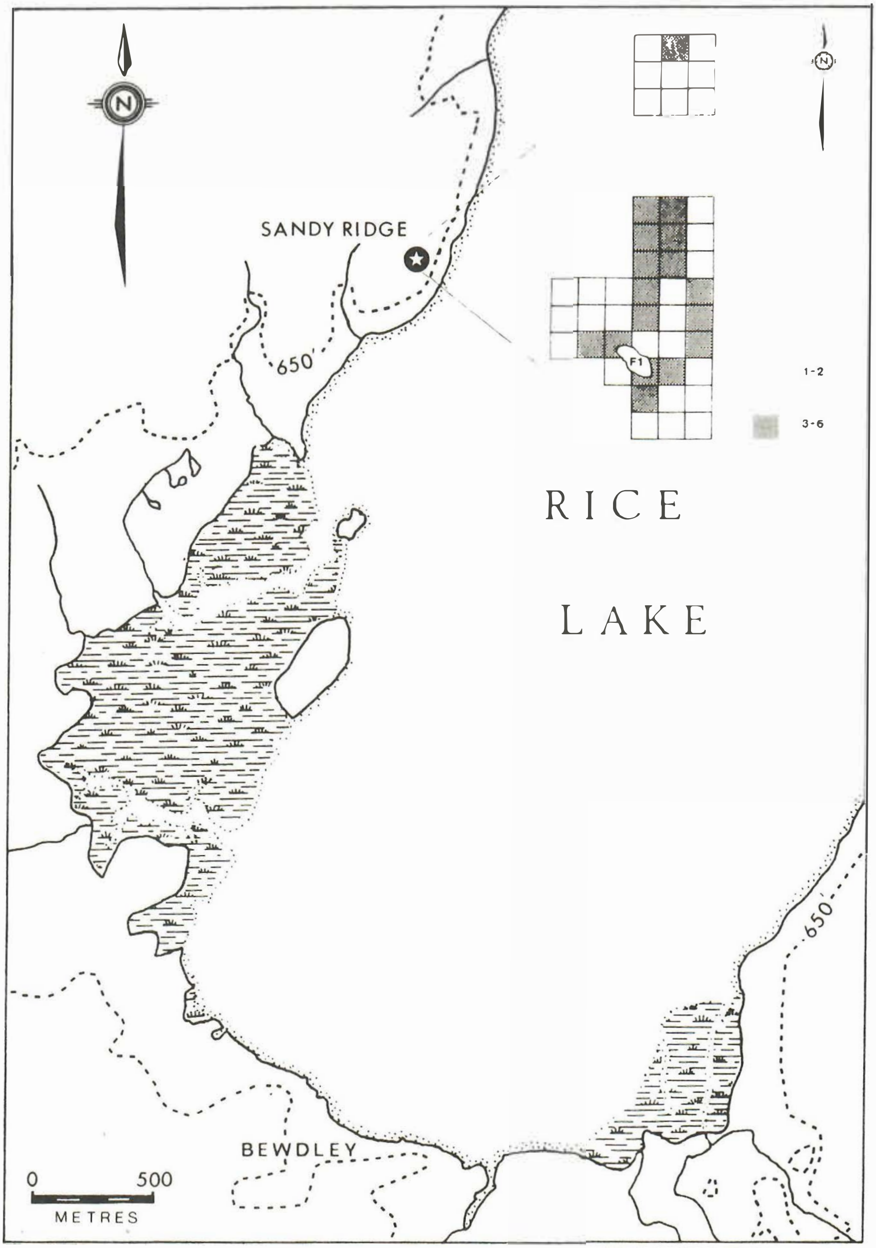

Figure 1. Location of Sandy Ridge Site, Rice Lake, Ontario and Density Diagram for scraper retouched flakes from 1989 test excavation.

Discovery of the Gainey type site in interior Michigan early in this decade emphasized that strandline occupation, best known for the Barnes Complex in Ontario, was not the only or even the primary focus of early Paleoindian occupation (Storck 1978). Continuing excavations at Gainey suggest that it may be the largest occupation site in the entire Great Lakes region, surpassing even the Parkhill and Fisher sites in Ontario.

As noted by Ellis and Deller (1988), there are perhaps six to nine Gainey occupation sites in southwestern Ontario. Another three are known in south-central Ontario, two of these in the Rice Lake area (Jackson 1990). All are small sites and most are located away from proglacial Great Lake strandlines. Known mainly from surface collections, these sites have produced small tool assemblages dominated by unifacial tools. Bifaces, including fluted points, are relatively rare—suggesting that there is functional site differentiation. Preliminary evidence from the Rice Lake area offers the first indication from southern Ontario of tool kit composition and spatial patterning on a regional basis for small, interior Gainey Complex sites.

The Sandy Ridge site was discovered on the north shore of Rice Lake in 1989. Routine conservation work following deep ploughing with new farm machinery revealed the existence of a small activity area with distinctive Collingwood chert from the Niagara Escarpment and quartzes from the Precambrian Shield. Surface recoveries included a large side scraper on a quarry face blank, a well-defined piece esquille, a single-spur flake graver, a biface fragment, a thick rectangular end scraper, scraper retouch flakes and flat flakes—all on Collingwood chert. End and side scrapers on white and rock crystal quartz, as well as scraper retouch flakes on these materials, were also recovered. Based on the surface distribution of diagnostic artifacts, test excavations were undertaken to define the occupation (Figure 1).

Testing of a 46 m^2 area revealed the existence of a large subsoil feature containing calcined bone and a plough zone distribution of scraper retouch flakes suggesting a special activity area. Total recoveries from the site in 1989 amounted to 235 items, 47.5% of these on Collingwood chert, 15.4% crystal quartz, 15.4% white quartz, 14.2% Onondaga chert, and 7.5% other materials. Tool types included trianguloid endscrapers, convex and asymmetrical side scrapers, bend-break tools, gravers, an unhafted perforator, two piece esquilles, scraper and biface retouch flakes, a channel flake and a biface edge fragment.

As indicated in Figure 1, test excavation exposed one hearth feature about 1.2 by 0.5 m in size. Designated Feature 1, it consists of light sandy soil encasing calcined bone and has good definition along two sides which border hard-packed (possibly fire-hardened) silty sand. Some 572 calcined bone fragments weighing close to 40 grams were recovered. No cultural materials were found in the feature but Collingwood chert, quartz, and other flakes were directly above it—strongly suggesting a sealed feature context. Judging from the recovery of more than 70 calcined bone fragments from plough zone contexts in a 2 m radius of Feature 1, original contents may have been between 700 and 1,000 fragments with a weight of perhaps 100 grams. Bone breakage patterns are consistent with the known practice of extracting marrow from long bones—particularly distal limbs.

Preliminary faunal identification of feature bone supports the presence of cervid distal elements. If radiocarbon analysis is successful it could provide the first dating of the Gainey Complex in the Great Lakes region. The site assemblage of heavily rejuvenated scrapers, abundant scraper retouch flakes, and calcined cervid limb elements all suggest a single major economic activity—the processing of cervid kills at or near actual hunting sites. A suggested function for associated piece esquilles is the splitting of bone for marrow extraction.

That the Rice Lake region was repeatedly or consistently used for activities of this nature is reinforced by identification of six sites with Collingwood chert dominance within a 10 km radius. One site has an extensive artifact assemblage comparable to that at Sandy Ridge. Additional work at these Rice Lake sites is expected to produce important new data bearing on the nature and function of smaller interior sites, as well as spatial patterning and relationships of the Gainey Complex. A major goal will be to clearly differentiate Gainey from Barnes complex occupations on the basis of tool types other than fluted points. Gainey does have apparent typological differences in scraper and perforator types, as well as presence/absence contrasts of tools such as backed bifaces. The occurrence of piece esquilles, calcined bone and scraper rejuvenation activities on small Gainey Complex sites in Ontario offers an intriguing clue for future research.

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The Distribution of Folsom Points in Texas

Floyd B. Largent, Jr. and Michael R. Waters

The first study delineating the distribution of the Folsom culture in Texas was undertaken by Fischel in 1939. He documented a total of 22 Folsom and "Folsom-like" points from five Texas counties. A later study by Hester (1967) recorded the distribution of over 70 Folsom points from 15 counties. By contrast, our recent study (Largent et al. n.d.) documents 329 Folsom points from 86 sites in 57 counties (Figure 1). The data for this study were collected by compiling information from published sources and from correspondence with professional and avocational archaeologists.

Although Folsom sites and their diagnostic projectile points were found throughout Texas, they appear to cluster in the Southwest, Panhandle/Plains, and Central regions of Texas, as defined by Suhm et al. (1954). Statistical tests confirm that Folsom site distribution is nonrandom and not related to archaeological collection/research activities. Folsom point distributions compare well with the geographic distribution of the vegetation zones present during the late Pleistocene (Bryant and Holloway 1985). Folsom sites are most common in the prehistoric grassland and parkland zones, but are virtually absent in areas that were dominated by woodland vegetation. This correspondence is not surprising, considering that bison (*Bison*), the major food source of the Folsom people, occupied the grassland and parkland areas on greater numbers than the forested regions. Similar relationships are observed between the distribution of Folsom artifacts and grassland regions for both Oklahoma (Hofman 1987) and Kansas (Brown and Logan 1987).

Metrically, Folsom points are very similar throughout the state, and compare favorably with the points collected at the type site in Lindenmeier, Colorado (Wilmsen and Roberts 1978). Morphological attributes (as defined by Wilmsen and Roberts 1978) from our sample of approximately 65 points include: point length, range 22.4 to 74.0 mm, average 37.6 mm; basal width, range 13 to 30 mm, average 18.6 mm; maximum width, range 15.6 to 34.6 mm, average 22.4 mm; flute scar length, range 13.0 to 55.3 mm, average 26.8 mm; and flute scar width, range 7.0 to 17.8 mm, average 12.3 mm. Most points were found along their basal edges. Material types used to create the points ranged from agatized wood to the ubiquitous Edwards and Alibates flints (Largent et al.

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n.d.). All sites with reliable radiocarbon ages fall within the range between 11,000 and 10,000 yr B.P.

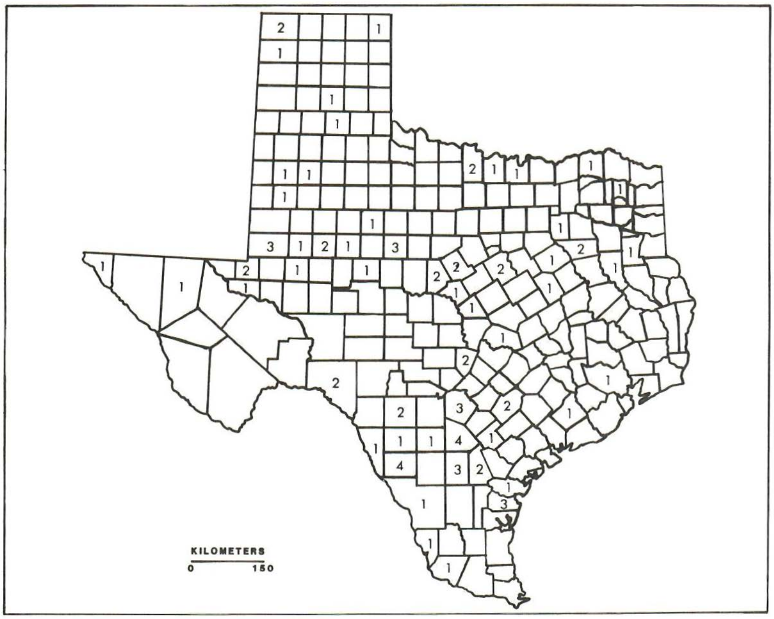

Figure 1. Folsom Localities in Texas (N = 86).

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Recent Excavation at the Paw Paw Cove Site: A Maryland Coastal Plain Paleoindian Habitation Locality

Darrin Lowery

Excavations in 1989 at the Paw Paw Cove site (18 TA 212) have revealed the first in situ Paleoindian artifacts noted for the Delmarva Peninsula. The Paw Paw Cove site is located on Maryland's Coastal Plain and it is situated at the headwaters of two small inundated streams which flow into the Chesapeake Bay. As a result of Holocene sea level rise, the two streams have created a small freshwater/saltwater marsh environment. During the time of Paleoindian occupation, the site would have been in an upland topographic setting. Three sub-concentrations of artifacts have been noted at 18 TA 212, all of which are located on an Othello series of soils and are nearly level and poorly drained. Two of the sub-concentrations have been discovered as a result of erosion by the Chesapeake Bay. The third was discovered as a result of test excavations conducted along the inland side of one of the streams. The purpose of the test excavations was to note the stratigraphy along the inland side of the site and compare it with the stratigraphy exposed by erosion at the two other sub-concentrations.

The Paw Paw Cove site was first discovered in 1979, by the author, as a result of surface collecting the eroded sediments along the shoreline. Continued collecting at the site has produced 17 fluted points, 11 preforms, and approximately 200 flake tools. The flake tools found at the site indicate a full range of tool types, as noted in other Paleoindian sites (Lowery 1989). Artifact analysis indicates an extensive use of local cobble resources and some of the preforms, endscrapers, sidescrapers, and utilized flakes retain evidence of cobble cortex on one or more of their surfaces. Fluted points, on the average, are quite small and flake scars indicate that they have been highly resharpened. The largest fluted point from the site complex represents the typical eastern fluted point form (Figure 1A). Smaller fluted points from the site have greatly distorted outlines due to resharpening (Figure 1B). Multiple working edges are present on most of the flake tools. Cores indicate that the cobbles utilized were also quite small and very few pieces of debitage lack utilization scars. The artifact data suggests that the Paw Paw Cove occupants were curating their tools based on the limiting factor of cobble size and lithic quality. Cobble utilization constrained the size of most of the artifacts and resulted in the maximum utilization of each individual artifact. Present evidence suggests that the Paw Paw Cove site represents a series of base camps located around the headwaters of two small streams.

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A single test unit was excavated on the inland side of the site and has produced a complete fluted point (Figure 1C) and one fragmentary piece of debitage (Figure 1D). The artifacts were found within a yellow fragipan located on top of a gray/blue clay strata approximately 40 cm below the base of the plow zone. Through the support of Dr. Dennis Stanford and Dr. C. Vance Haynes, wood from the gray/blue clay strata has provided an age estimate of 17,820±170 yr B.P. (AA-3870). A significant hiatus has also been noted between the artifact strata and the gray/blue clay strata (C. Vance Haynes, pers. comm.).

Future attempts at excavation will be conducted by Dr. Jay F. Custer of the University of Delaware, Center for Archaeological Research. The focus of these efforts will be directed towards the in situ component, the geology of the area around and within the marsh, and attempts will also be made at locating other buried living surfaces.

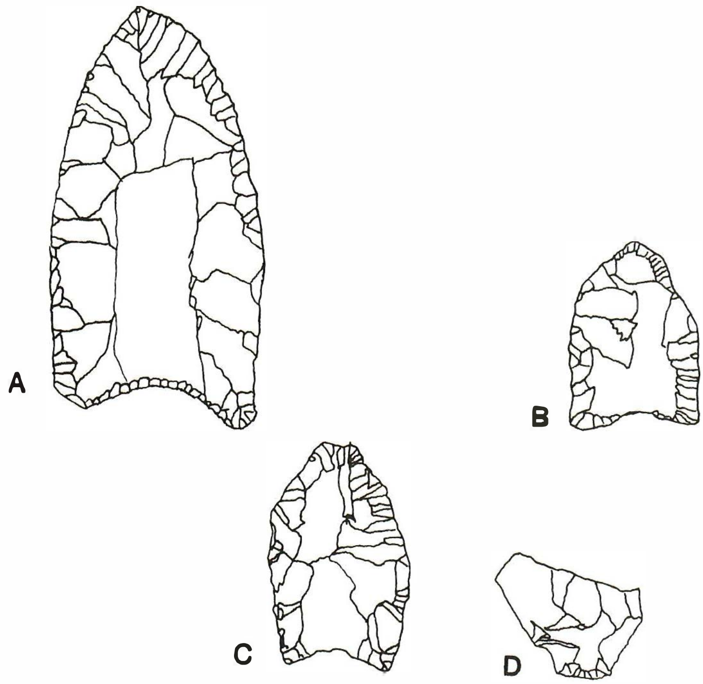

Figure 1. Artifacts from Paw Paw Cove.

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Recent Archaeological Investigations at the Crane Point Site, Talbot County, Maryland

Darrin Lowery and Jay F. Custer

The Crane Point site is located in Talbot County, on the Eastern Shore of Maryland. The current location of the site is along an eroding shoreline of the Chesapeake Bay and the majority of the artifacts recovered from the site to date have been found along an eroding beach. However, recent test excavations and study of the local geomorphology show that the site would have been located on an upland drainage divide near a freshwater wetland throughout most of the Holocene period. It has only been during the past 200 years that post-Pleistocene sea level rise has brought the shore of the Chesapeake Bay to the immediate vicinity of the site.

The Crane Point site was discovered by Lowery who has found a total of 26 diagnostic projectile points at the site, all of which date to early Holocene times. Although the majority of the points date to the early Archaic period, late Paleoindian points, including Dalton-Hardaway types (Figure 1), are present. Given the fact that no other diagnostic projectile points have been found at the site, the collection of artifacts from the site is thought to represent a relatively pure late Paleoindian/early Archaic assemblage whose context is similar to that of a plowzone or surface collected assemblage.

The lithic artifact assemblage includes a wide variety of flake tools, debitage, bifaces, and ground stone tools including hammerstones, celts, adzes, and grinding or abrading tools. Flaked stone tools are manufactured primarily from primary cryptocrystalline jaspers and cherts with more than 70% of the assemblage manufactured from jasper. Many of the tools that were discarded at the site are quite large and still have usable tool edges. Multiple tools are uncommon in the assemblage and these features of the tool kit indicate that the site's inhabitants were not especially careful in their use of lithic raw materials even though primary cryptocrystalline materials were not available in the immediate area. Only a small amount of the artifact assemblage was manufactured from locally available secondary cobble materials indicating that broken and discarded tools were not being actively replaced at the site.

Test excavations at the site recovered additional late Paleoindian artifacts from a 40 cm thick fragipan soil which also forms the eroding beach at the site. Pedogenic development of a fragipan soil requires an initial soil deposit with a silty matrix and the probable origin of the soils at the site is aeolian. A similar fragipan soil yielded Paleoindian artifacts at the Paw Paw Cove site (Lowery 1989), which is located less than 5 km from the Crane Point site, and this distinctive fragipan soil may represent a time-stratigraphic unit for the middle section of the Maryland Eastern Shore.

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A hearth feature eroding from the fragipan soils was also salvaged from the site. Flotation of the hearth feature recovered charred hickory (*Carya*), acorn, and butternut (*Juglans*) hulls along with *Amaranth* and *Chenopodium* seeds. Analysis of charcoal samples by Cindy McWeeny of Yale University revealed the presence of oak (*Quercus*) and pine (*Pinus*). No radiocarbon date has yet been obtained for the charcoal sample.

Further excavations are planned at the site to collect additional artifacts from good stratigraphic context and to identify additional cultural features.

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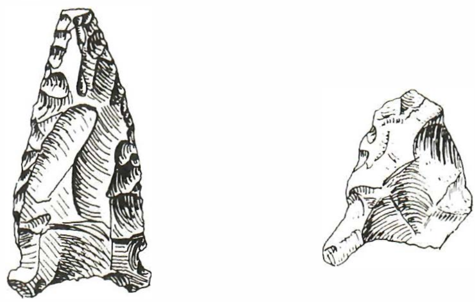

Figure 1. Projectile Points from Crane Point site.

Hell Gap Points in the Southern Rolling Plains of Texas

Robert J. Mallouf

The Hell Gap point type was formalized by Agogino (1961) on the basis of finds made in east central Wyoming, and Irwin-Williams et al. (1973) defined the Hell Gap cultural complex and its early chronological position (ca. 10,000–9,500 yr B.P.) at the Hell Gap Site in southeastern Wyoming. Major investigations of Hell Gap components were conducted at the Jones-Miller site, a bison kill and processing station in northeastern Colorado (Stanford 1974; 1984), and at the Casper site, a bison kill in east central Wyoming (Frison 1974). The Agate Basin

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site in eastern Wyoming yielded additional data on Hell Gap bison processing areas, campsite features, and aspects of stone tool manufacture (Frison 1982).

Little is known concerning the distribution of Hell Gap components outside the Northern Plains, Agogino (1961) noted that Hell Gap points seem to occur most commonly in the eastern sections of Wyoming and Colorado, with sporadic occurrences in Montana, Idaho, Ohio, and the Alberta region of Canada. To the south in Texas, Hell Gap points have sometimes been ignored as curiosities, or mistakenly lumped-in with temporally later point styles.

Figure 1 provides three examples of Hell Gap points from the southern margin of the Rolling Plains in West Texas. Two of the specimens (Figure 1, a–b) are from a site at the periphery of a sand sheet overlooking the Clear Fork of the Brazos River basin. A third specimen (Figure 1c) is from the cutbank of a spring-fed arroyo system on the crest of the Callahan Divide, a linear erosional outlier of the Edwards Plateau that marks the southernmost edge of the Rolling Plains. The two sites at which these points were found are separated by a distance of less than 50 km. Interestingly, the points are fashioned from three different kinds of high-quality stone—Alibates agate (Figure 1a), Edwards chert (Figure 1b), and Tecovas jasper (Figure 1c). While major sources for Edwards chert are found locally (Tunnell 1978; Mallouf 1989), the nearest source areas for Alibates agate (Shaeffer 1958) and Tecovas jasper (Hughes 1955; Holliday and Welty 1981) are located over 350 km and 200 km to the northwest, respectively, which may be an indication of considerable mobility on the part of the Hell Gap hunters.

The three Texas specimens illustrated in Figure 1 provide a range of stylistic variability found among Hell Gap points from the region. Such variability can often be attributed to the reworking of points broken during use. Although missing its blade portion, the specimen in Figure 1a may represent an unrefurbished point that was broken only once—immediately above the shoulders—and discarded. In terms of morphology and technology, this specimen is remarkably similar to a number of Hell Gap points from the Casper (Frison 1974, figures 1.35–1.43) and Jones-Miller (Stanford 1984, figure 6) sites. The contracting stem is ground along basal and lateral edges up to—and slightly beyond—the rounded shoulders.

The point in Figure 1b exhibits characteristic Hell Gap stem morphology and flaking patterns, but the blade on this specimen has been reworked subsequent to breakage. The point was then broken again and discarded. Stem edges are ground in the same fashion as the point in Figure 1a. Again, the similarity to specimens from the Casper and Jones-Miller sites is noteworthy.

The specimen in Figure 1c was probably refurbished on several occasions, leading to significant modifications of both stem and blade. Flaking patterns on this example are quite different from those on the previously described specimens, with the original flake scars having been largely obliterated during repeated episodes of reworking. However, the degree and extent of stem edge grinding is essentially the same as that of the other two points.

Together, these three examples reveal some processual changes in the morphological and technological aspects of Hell Gap points as they were broken and refurbished. In the case of the point in Figure 1a, breakage was too low above the shoulders of the point to allow for reshaping of a blade. The blade of the specimen in Figure 1b was reworked on at least one occasion, while the stem was left unaltered. Both the blade and stem of the third specimen (Figure 1c) were altered through repeated episodes of reworking, resulting in a point of smaller size with modified flaking patterns throughout. Similar patterns of manufacture, use, breakage, and reworking of projectile points are evident among Hell Gap assemblages from the Northern Plains.

There probably are many interesting parallels between Hell Gap components of the Northern Plains and those of the Southern Plains, although there is as yet little data available for the latter area. The first step toward the compilation of a data base on Hell Gap components in Texas must be the recognition that such components do in fact exist, at least in the northern section of the state. Otherwise, pertinent information and significant sites may continue to be overlooked, as seems to have been the case in the past.

Gratitude is extended to Link Adair, A.B. Shelton, and Roger Carter. Pen and ink drawings are by Ed Aiken.

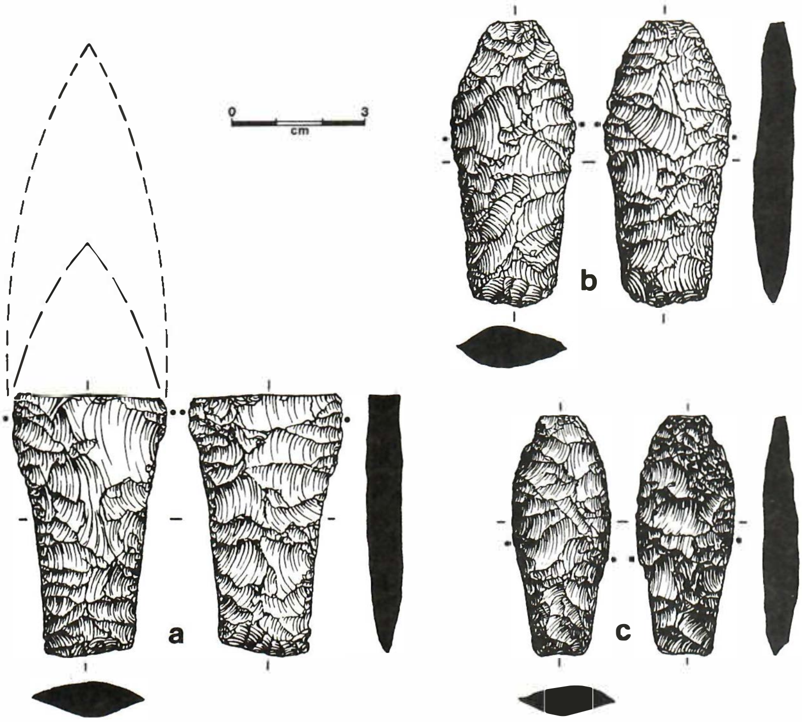

Figure 1. Examples of Hell Gap points from the Osage Plains. Dots indicate extent of basal and lateral edge grinding.

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The Oldest Hearths of Pedra Furada, Brasil: Thermoluminescence Analysis of Heated Stones

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The oldest levels of the Pedra Furada rock shelter in northeastern Brazil (8°51'S, 42°33'20" W) are now completely excavated and their stratigraphy and chronology are open for discussion.

Seventeen ^{14}C dates for the Pleistocene layers range from >47,000 (GIF, TAN 89098) to 14,300±260 yr B.P. (GIF 6159), and the first occupations are now being dated by thermoluminescence (TL) at the Centre des Faibles Radioactivités (Gif sur Yvette, France), by two of us (N.M. and H.V.). The archaeological study is carried out by F.P.

This note is concerned with the morphology and evolution of the cultural remains, lithic and structural, in particular, and attempts to answer questions raised about the anthropic origin of the latter (see debate in Guidon et al., in press).

The cultural phase of Pedra Furada, defined for the first time in a short paper by the discoverer of the site (Guidon and Delibrias 1986) as a long and relatively continuous development for 30,000 years. The only archaeological remains are a lithic industry of quartz and quartzite pebbles, locally available, and an important set of 87 stone structures, 45 of which show evidence of fire in the form of charcoal and fire-stained pebbles.

The structures, made from conglomerate pebbles and small blocks of sandstone wall, are circular or elliptical in shape with an average surface area of 0.89 m^2. The size decreases progressively from the Lower (1.2 m^2) to the Upper phase (0.5 m^2). The highest occupation density occurs between 32,000 and 25,000 yr B.P. (lower Pedra Furada).

It has been suggested that the fire could have had a natural origin (Lynch in James 1989) or that the stone structures are of geological origin (James 1989). In order to confirm their anthropic origin as hearths, a sample of 86 quartz pebbles and sandstone blocks, collected within and around the structures, were analyzed by TL; the same specimens were chosen for the TL dating. The following results were obtained: 50 pebbles and 3 sandstone fragments (60% of the specimens) had been heated to at least 200–250°C, i.e., the lower limit of this technique (Valladas 1981).

The heated pebbles were not scattered on the excavated surface, but were concentrated beside the structures, as can be seen in Figure 1. In this hearth, ^{14}C dated to 42,400±2,600 yr B.P. (GIF, TAN, 89097), the large majority of the heated samples were on the western side, suggesting a possible cleaning and

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re-use of the structure. If a brush fire had been responsible for the heating of the stones, it could not leave a set of heated ones next to others that remained unheated.

Because of the very slow rate of soil formation at Pedra Furada (an average of 0.1 mm/year) and the very old age of the lower layers, rarely does one find high concentrations of charcoal, except in the lucky case of structure n° 49, the oldest hearth from Pedra Furada, dated to >47,000 yr B.P. with AMS (GIF, TAN 89098), see figure 8 in Guidon et al. in press). The function of this structure, however, is still unknown. Soil acidity is responsible for the lack of the organic part of the archaeological evidence, so we are searching for archaeo-zoological data in more basic deposits such as the limestone outcrops a few kilometers away from Pedra Furada.

The great importance of the Pleistocenic structures at Pedra Furada is attributed not only to their value as a special kind of "solid evidence" of the ancient peopling of the Americas, but even more to the fact that they provide, till now, the only means of seeing the prehistoric evolution of the area for over 30,000 years.

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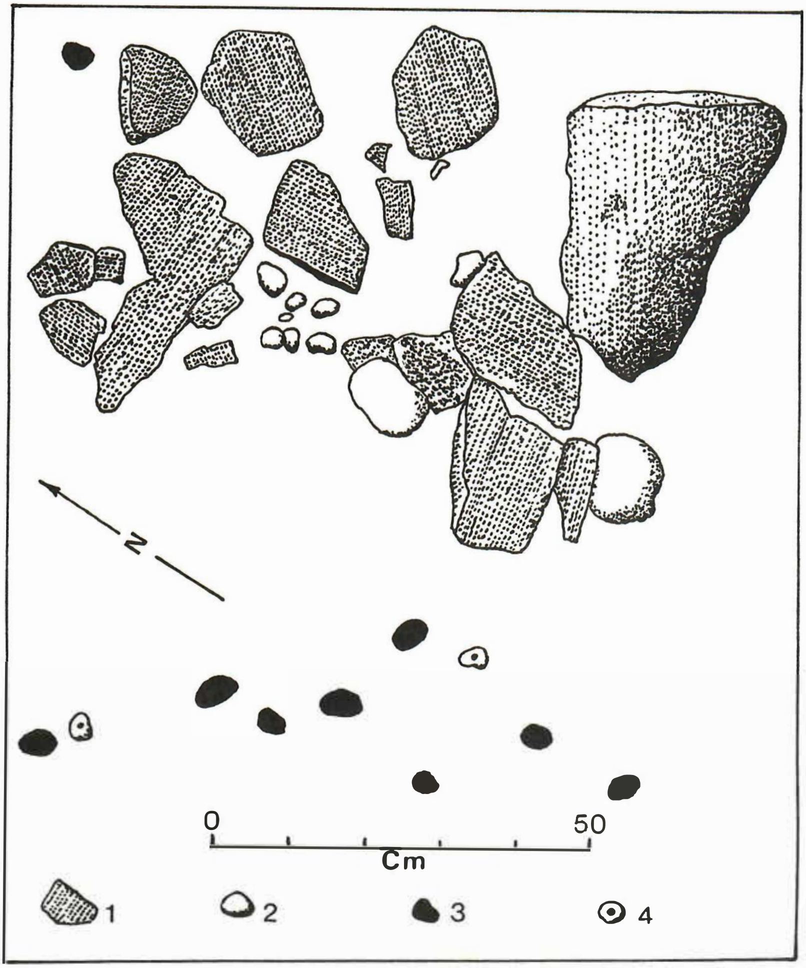

Figure 1. Hearth N°65 from Pedra Furada Lower phase. 1) Sandstone block. 2) Quartz or quartzite pebble. 3) Heated sample (TL). 4) Unheated sample (TL).

A New Upper Paleolithic Site from Northeast China

Peng Jiang and Chuan Kun Ho

A large number of mammalian fossils were found by a local farmer at Daqiaotun of Yushu county on October, 1988. After examining the mammalian fossils and one lithic artifact, the Joint Expedition of Yushu County Museum and Jilin Institute of Archaeology begin test-excavating the site in November, 1988.

The site is 16 km southwest of Yushu County and 2 km south of the famous Zhoujiayoufang localities. The tributary of the Larin River flows from the northern upper stream through here and then drains off the Sugari River. The local loess plateau, 200–220 m high, is dissected into undulating hills. The second terrace, consisting of grayish green silt and bearing mammalian fossils , is 10 m above the present river.

There are four stratigraphic units that can be distinguished: unit 4, black soil; unit 3, brownish yellow subclay; unit 2, grayish green, brownish yellow medium sand; unit 1, grayish green silty sand. Most of the mammalian fossils and lithic artifacts were unearthed from unit 1. Units 1 and 2 basically consist of the Holocene river beach deposit. It is possible that the deposits which include lithic and mammalian remains were reworked from the Guxiangtun Formation. If that is the case, the site may be estimated to the upper Pleistocene.

The discovered lithic assemblage includes cores (wedge-shaped, conical, and polyhedral), and trapezoidal and irregular flakes. The tool types are scrapers (single straight, convex, and round) and choppers. Raw materials are mostly quartzite and vein quartz. Manufacturing techniques are predominantly direct hammer percussion. Two out of 1,925 pieces of mammalian fossils were identified as bone tools, and one of them is a scraper made of ivory. Another 35 pieces bear signs of human workmanship. Gnaw marks are found on 103 pieces, of which 68 are gnawed by hyenas. The presence of hyenas at the site may suggest the site could be upper Pleistocene in age.

The faunal assemblage consists of *Canis lupus* (wolf), *Vulpes* sp. (fox), *Crocuta ultima* (hyaena), *Mammuthus primigenius* (woolly mammoth), *Mammuthus sungari* (mammoth), *Equus przewalskyi* (horse), *Equus* sp. (horse), *Coelodonta antiquitatis* (woolly rhinoceros), *Sus scrofa* (pig), *Megaloceros ordosianus* (giant elk), *Cervus xanthopygus* (deer), *Capreolus manchuricuss* (roe deer), *Bison* sp. (bison), *Gazella przewalskyi* (gazelle).

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During the upper Pleistocene, faunal assemblages of northeast China are represented by *Mammuthus-Coelodonta* Fauna (Jiang 1987). From the species list mentioned above, most of the fauna from Daqiaotun are predominantly periglacial-adapted large herbivores. In addition, such an assemblage is also the main component of the Yushu fauna (Ho and Jiang n.d.). Our preliminary taphonomical study of anatomical part frequencies indicates that more than 47 minimum number of individuals of large herbivores were either hunted and processed at the river side by the late *Homo sapiens* collectors or scavenged by carnivores. The paleoecological setting was inferred to be open steppe and grassland in terms of faunal component. The discovery of the Daqiaotun site will definitely provide us a comparative faunal collection to study taphonomy with other open-air sites, e.g., Zhoujiayoufang, Jilin Province (Sun et al. 1981) and Yanjiagang, Heilongjiang Province (You et al. 1986).

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Late Pleistocene Occupation at Walker Road: New Data on the Central Alaskan Nenana Complex

W.R. Powers, F.E. Goebel, and N.H. Bigelow

Recent excavations at the central Alaskan Walker Road site have produced a deeply buried set of lithic remains contemporaneous with the Clovis culture of the North American Great Plains. Walker Road was initially discovered by J. Hoffecker in 1980, and survey excavations occurred in 1984. Intensive excavations began in 1985 and continued into the 1989 field season. Some preliminary results of our excavations are presented below.

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Walker Road is located in the foothills of the central North Alaska Range, 16 km north of Healy. This Nenana Valley site is situated along an erosional surface incised into the early Wisconsin Healy glacial outwash terrace, which is capped by a 1 m thick deposit of aeolian silts and sands. Within this loess deposit are two cultural levels, a terminal Pleistocene component ascribed to the Nenana Complex, and, by virtue of its age, a late Holocene component attributed to the Athabaskan phase of central Alaskan prehistory (Powers and Hoffecker 1989; Dixon 1985). Almost 1 m of aeolian sediments separate these two components recording over 11,000 years of paleoenvironmental and climatic history.

The late Pleistocene/Holocene stratigraphy at Walker Road can be broadly described as a series of loesses containing varying amounts of aeolian sand and two major paleosol horizons. The Nenana Complex artifacts lie immediately above glacial outwash at the base of the loess deposit and are overlain by a sandy loess unit registering sharp deterioration and increased wind velocity (Bigelow et al. In Press). These terminal Pleistocene units are capped by a broad gray-black paleosol complex which displays whitish streaks and lenses recording multiple episodes of soil formation. Cryoturbation and/or tectonic activity have heavily disturbed this pedocomplex, causing a highly distorted appearance which has been identified elsewhere in the Nenana Valley, including Dry Creek (Thorson and Hamilton 1977). A single ^{14}C date of 8,720±25 yr B.P. (AA-1692) from this unit indicates an early Holocene age. The second paleosol complex is situated higher in the section within a series of alternating sands and loesses. Two ^{14}C dates from near the base of this paleosol indicates a late Holocene age: 3,816±79 yr B.P. (AA-1693), and 4,415±95 yr B.P. (GX-12875). The top of the section is dominated by the modern soil displaying distinct O, A, and B horizons, and also containing the late prehistoric cultural level.

As noted above, Walker Road contains two stratigraphically distinct cultural components. Component I is late Pleistocene in age and appears to be contemporaneous with the Clovis culture. Initial conventional ^{14}C dating in 1984 indicated an age of 11,820±120 yr B.P. (Beta-11254), whereas subsequent dating through AMS techniques produced three ^{14}C dates of 11,300±120 yr B.P. (AA-2264), 11,170±180 yr B.P. (AA-1681), and 11,010±230 yr B.P. (AA-1683). Each of these dates was run on cultural charcoal collected from two heaths 6 m apart.

The Walker Road lithic industry is characterized by blade and flake primary technologies, unifacial and bifacial secondary technologies, and a tool kit including end scrapers, side scrapers, wedges, perforators, bifacial "knives," bifacially worked *Chindadn* points, and large cobble tools, some in the form of planes (Figure 1). Significantly, no microblade cores, microblades, or associated microcore debitage have been recovered in this lithic assemblage now numbering 182 tools and over 4,500 debitage pieces.

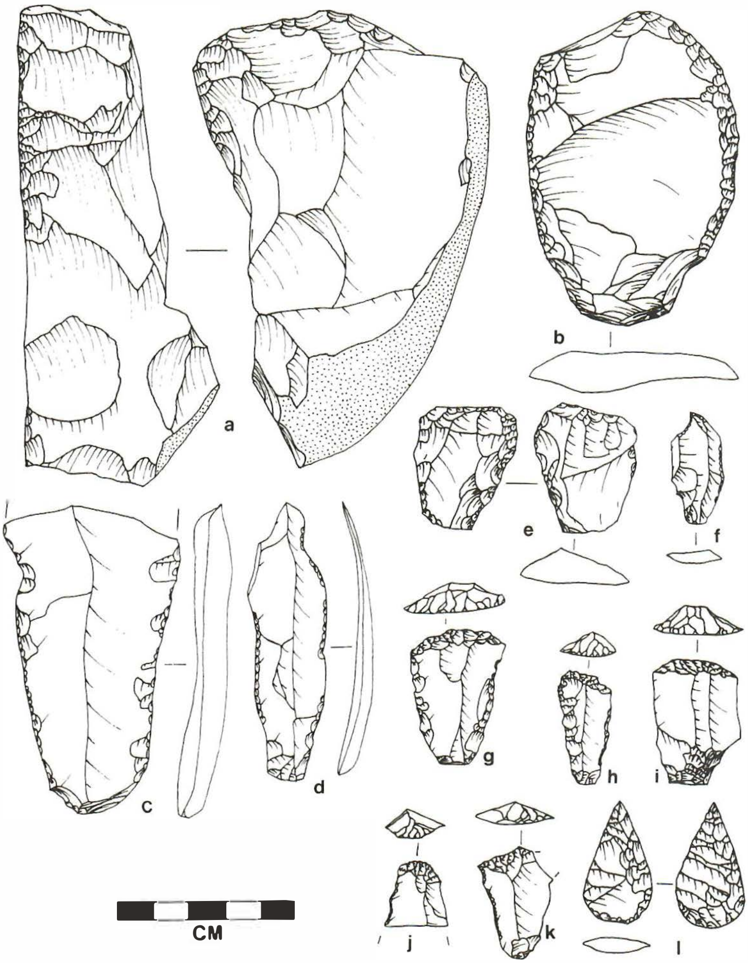

Figure 1. Walker Road lithic artifacts: (a) transverse plane; (b) double convex side scraper; (c,d) bilaterially retouched blades; (e) wedge (*pièce ésquillée*); (f) multiple perforator; (g-j) end scrapers on blades; (k) spurred end scraper; (l) *Chindadn* point.

The Nenana Complex hunters most likely utilized Walker Road as a base camp where activities related to hunting occurred. These activities included the production and/or repair of hunting weapons as well as the processing of large mammal carcasses, although no identifiable faunal remains have been recovered from the site. Three spatially separate clusters of cultural remains have been delineated, two of which are major concentrations ca. 5 m in diameter. Each of these displays a well-defined hearth, a substantial number of stone tools, unidentifiable bone fragments, and red ochre. Preliminary spatial analyses suggest that one of these clusters represents the remnants of a circular tent-like surface structure, based on a centrally-located hearth, an extremely high density of stone tools, and the types of tools found within the

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The Distribution of Fluted Points in Indiana: An Update

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Dorwin's "Fluted Points and Late-Pleistocene Geochronology in Indiana" was the first, and also the last, systematic survey of fluted points in Indiana. His survey documented 195 projectile points and noted that the highest frequency of these artifacts occurred in the southern part of the state, particularly along the Ohio River (Dorwin 1966).

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Over the past seven years, we have updated Dorwin's work in three thematic surveys: (1) the karstic region of southcentral Indiana (Smith 1984); (2) the upper Wabash drainage basin (Holsten and Cochran 1986); and the lower Wabash, White, Whitewater, and Ohio drainage basins (Tankersley 1987). The results of these efforts are illustrated in Figure 1. Our surveys involved the identification and documentation of fluted points, verification of their findspots, and an analysis of the raw material from which they were manufactured. Most of the basic fieldwork was devoted to intensive interviews of collectors, who were the source of the vast majority of the early Paleoindian data. Only artifacts to which at least county provenience could be ascribed were recorded.

Our surveys documented 400 fluted points from 55 counties and 114 archaeological sites. While fluted points were recovered from virtually all microtopographic settings, the highest frequency (72%, n=288) occurred on the surface of riparian settings or overlooks (22%, n=88) of those areas. The larger and more diversified sites (n=27) are located on the terraces and floodplains of major streams. More than half of the fluted points sampled (n=208) occur in the unglaciated portion of the state (see Figure 1). This land use pattern is comparable to that described by Seeman and Prufer (1982) for Ohio.

A number of typological/geographical patterns are also evident: (1) Clovis points occur throughout Indiana; (2) Cumberland points are more abundant in the unglaciated region, especially along the Ohio River; and (3) Barnes, Crowfield, and Holcombe points are restricted to the glaciated landscape of the northern half of the state.

Most of the fluted points in Indiana were manufactured from lithic raw materials that outcrop in the state: 42% Wyandotte chert; 15% Holland chert; 15% nonspecific glacial cherts; 11% Attica or Muldraugh chert; 4% poor-quality Mississippian cherts (i.e., Indian Creek, Upper St. Louis, and Bryantsville cherts); and 3% poor-quality Silurian and Devonian cherts (i.e., Laurel, Liston Creek, and Jeffersonville cherts). Ten percent of the fluted points were manufactured from exotic lithic materials, i.e., lithic source areas located more than 200 km from the artifact's findspot: Burlington and Cobden/Dongola cherts (Illinois), Flint Ridge and Upper Mercer cherts (Ohio), Hopkinsville chert (Kentucky), Dover chert (Tennessee), and Hixton silicified sandstone (Wisconsin).

While the known distribution of fluted points in Indiana can be correlated with collector activity (Lepper 1983), we feel that the patterns identified by our recent investigations compare favorably with large scale, coarse-grained patterns of early Paleoindian land use and lithic exploitation in the midwestern United States.

These investigations were made possible through multiple grants from the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology.

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confines of the feature (Goebel and Powers 1989). The proposed structure area is circular in shape, 5 m in diameter, and outlined by a dense concentration of over 130 stone tools which is strictly confined to the "dwelling space" or "drop zone" (Skelnar 1976; Binford 1983). The area outside this boundary (the "toss zone") is devoid of stone tools as well as debitage, except along the south-facing margin of the cluster, where an opening in the tent may have existed.

Comparative typological analyses of the Walker Road and Dry Creek assemblages have conclusively shown that the Nenana Complex lithic industries display many features similar to the Clovis assemblages from Blackwater Draw and Murray Springs (Goebel et al. In Press). With the exception of fluted points in Clovis and *Chindadn* points in the Nenana Complex, the two stone industries are virtually identical. These similarities in the lithic technologies and ^{14}C chronologies suggest to us that the Nenana Complex and Clovis may be remnants of the same Macroindian peopling event. This migration most likely occurred immediately following the opening of the "ice-free corridor" ca 12,500 yr B.P.

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Archaeological Reconnaissance in the Great Kobuk Sand Dunes, Northwest Alaska

Dennis J. Stanford, James W. Jordan, E. James Dixon, and Margaret A. Jodry

A reconnaissance-level archaeological survey was conducted in the Great Kobuk Sand Dunes of Kobuk Valley National Monument in northwest Alaska in August 1989 (Figure 1). The objective of this investigation was to test the archaeological potential of Arctic dune environments in light of settlement models developed in the southwestern United States in similar topographic settings.

Exploitation of dune topography for hunting has been documented at several Paleoindian sites from the southwestern United States (Frison 1974, 1978; Jodry 1987). Parabolic dunes serve as animal traps, while additional ambush localities are provided at interdune ponds and in deflation basins where the proximity of the water table encourages locally abundant forage. Analogous settings in Alaskan dune fields may have been similarly utilized by Paleoindian populations.

Great Kobuk Sand Dunes: Stabilized dune fields are numerous in Alaska, but associated vegetation (i.e., tundra and forest) seriously limits site visibility. Therefore, an active dune field with limited vegetation, Great Kobuk Sand Dunes, was selected. The Great Kobuk Dunes are located in the central Kobuk River valley of northwest Alaska about 24 km west/southwest of the Onion Portage site and 200 km inland from Kotzebue. The dunes form a portion (62 km^2) of a larger seas (650 km^2) of stabilized eolian sand derived primarily from glacial erosion within the Brooks Range and redeposited by glaciolucustrine, alluvial, and eolian processes during the Wisconsin (Hamilton et al. 1987).

This portion of the Kobuk valley has a subarctic, almost semiarid climate. Approximate temperatures range from a July mean of 15°C to a January mean of -19°C. Mean annual precipitation is approximately 500 mm, contributed primarily as summer rainfall (Hare and Hay 1974). The transition from zones of continuous to discontinuous permafrost occur in the central Kobuk valley and it is uncertain whether permafrost conditions occur in the active dune field (Dijkmans et al. 1986).

The Great Kobuk Dunes have received limited geomorphologic investigation (Koster and Dijkmans 1988; Hamilton et al. 1987; Galloway and Koster 1982; Fernald 1964) which provides an initial framework in which prehistoric human exploitation of this arctic environment can be explored.

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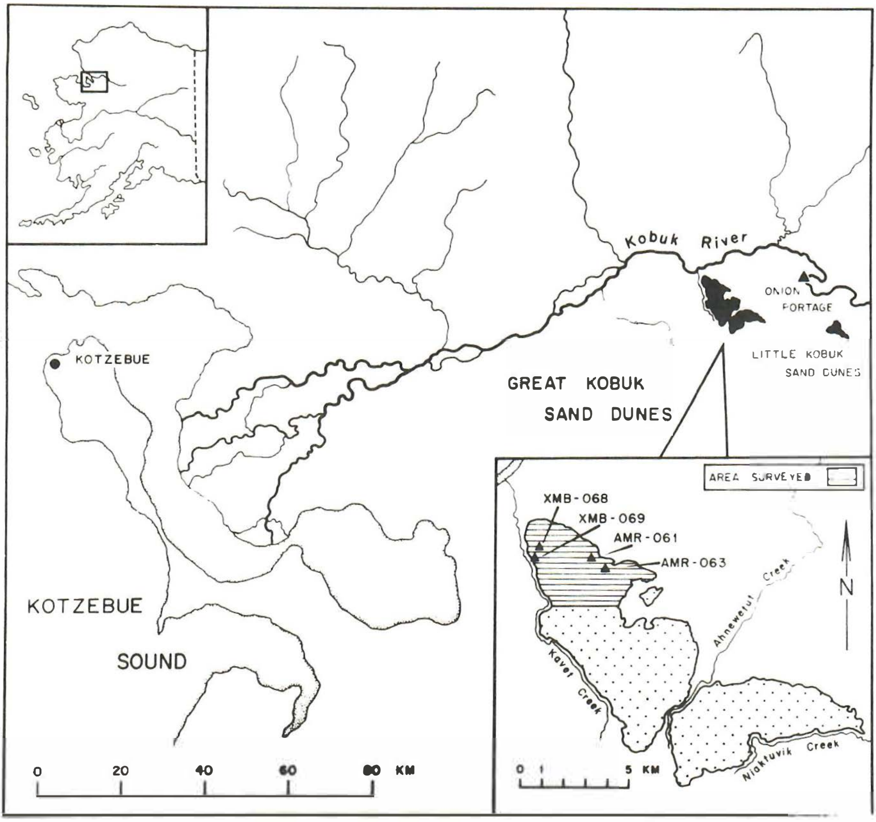

Figure 1. Location of Great Kobuk Sand Dunes and archaeological sites found during 1989 survey.

Survey areas were chosen from aerial photographs (NASA 1:60,000 color-infrared) and concentrated on dune-margin deflation basins and areas that have recently been exhumed following dune transgression in the northern and northwestern portions of the Great Kobuk Dunes. These areas are commonly swept free of recent, unconsolidated sand and are often characterized by ancient spring vents, calcrete horizons, and other surfaces indicative of former water table position. Here the active dunes consist of N-S to NW-SE oriented transverse dunes (5 to 15 m in height) interspersed with relatively flat interdune areas that are occasionally covered with low vegetation. A series of springs currently form amphitheater-like depressions at the base of the active dune front and drain the dune field toward Kavet Creek (Koster and Dijkmans 1988). Potable water can also be readily obtained by digging shallow wells in these topographic locations.

Survey Results: The National Park Service permit stipulated a no collection/no subsurface testing policy; site observations are based on surface and available dune margin profile indications.

The remains of four sites and three additional, isolated artifacts were encountered. Site XMB-068 produced microblades characteristic of the Arctic

Small Tool Complex (ca 3,500–4,200 yr B.P.). Site XMB-069 appears to be temporally associated with the Northern Archaic (ca. 4,200–5,800 yr B.P.) and yield a scatter of heavily-weathered fragments of large mammal bone, a corner-notched projectile point and a few scattered flakes eroding from a thin, but fairly continuous, buried soil horizon. This horizon appears to denote the former position of an interdune pond margin.

Site AMR-063 consists of a scatter of large blades, some retouched and others burinated which may be related to the American Paleo-Arctic Tradition. These tools were located in a deflation basin and appear to be associated with a calcrete deposit dated, in other areas of the dunes, to approximately 10,000 yr B.P. (Dijkmans et al. 1986).

Artifacts observed at AMR-061 include blades and microblades, large unifacial endscrapers made on blades, a large, crudely-flaked biface (24 cm long), and a flake knife. Other than the biface, all tools were made of the fine-grained cherts characteristic of the Lisburne Formation. The overall size, type of tools, and lithic material represented are similar to those reported by Anderson (1988) from the Akmak occupation at the Onion Portage site (ca. 9,600–9,700 yr B.P.). The latter two sites appear to be eroding from buried paleosols and further examination of these localities may provide materials suitable for radiocarbon dating. This could shed light on the temporal placement of the American Paleo-Arctic Tradition in Alaska and possibly provide new data on cultural adaptations to the Arctic during the late Pleistocene/early Holocene climatic transition.

The results of this initial survey indicate that prehistoric hunters did utilize Arctic dune environments. Caribou and moose tracks observed on the survey further attest to the continued presence of large game animals in the area of active dunes. The preliminary data is tantalizing, but determining whether pond margins, spring localities and deflation basins served as focal points for man/animal interactions will require continued research. Additional survey is being planned for the summer of 1990 in the eastern portion of the Great Kobuk Dunes and in the adjacent Little Kobuk Dunes.

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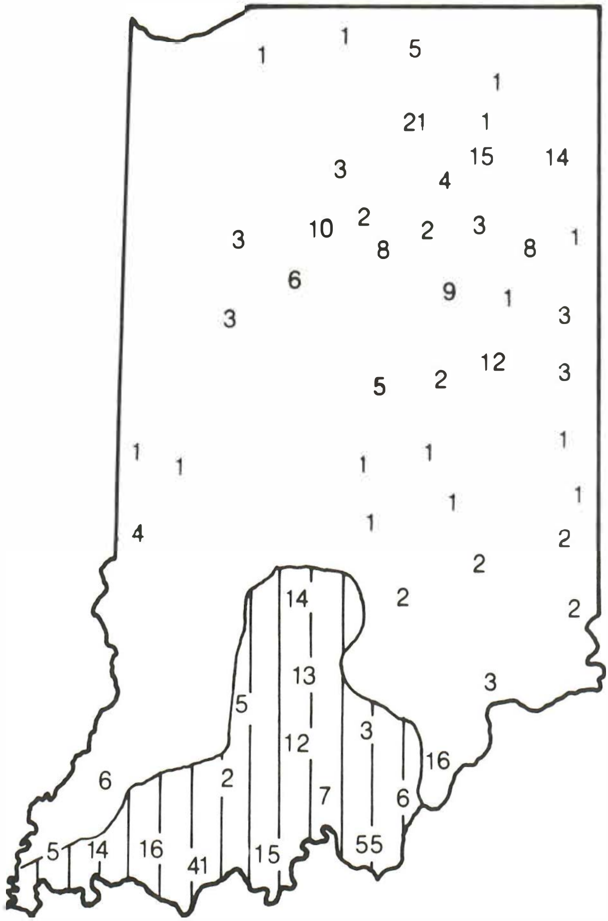

Figure 1. An updated distribution of fluted projectile points in Indiana as of 1989. The unglaciated portion of the state is indicated by vertical lines.

Geoarchaeological Studies, People's Republic of China: The Cuijiaai Section Near Lanzhou, Gansu Province

Michael Clayton Wilson

Geoarchaeological and ethnoarchaeological studies were undertaken in 1988 by a Canadian-Chinese team, directed by the author, in Gansu and Qinghai provinces, northwest People's Republic of China, under a research agreement with the Department of Geography, Lanzhou University, Lanzhou, Gansu. Work centered on geoarchaeological studies at the loess section of Cuijiaai, Gansu, and ethnoarchaeological studies of abandoned Tibetan pastoralist sites near Qinghai Lake, Qinghai (Wilson and McKinnon 1989). Preliminary studies were also made of aeolian deposits and beaches on Qinghai Lake. The *Homo erectus* sites of Gongwangling and Chenjiawo, near Lantian, Shaanxi province, were also visited. Follow-up studies in 1989 were cancelled at the last minute due to unrest in China but additional field work is planned for the near future.

Th loess section of Cuijiaai (Wilson 1988, 1989), immediately west of Lanzhou city, is 2 km long and extends to Xigu city. The section is the riser of a major terrace, the front of which stands 65 m above the next lower surface, itself only a few meters above the Huanghe. Intermediate terraces are present nearby, but their value in correlation (as paired terraces rather than stepped slip-off surfaces) has yet to be demonstrated. The Cuijiaai section tentatively represents fill of T4, with the nearby 335 m loess section at Jiuzhoutai (Burbank and Li 1985) approximately T6. The upper part of the Cuijiaai section is here regarded as colluvial, however, and terrace correlation requires comparison of buried alluvial filltops, not colluvial cover.

Our studies in 1987 made it clear that Chinese scientists use the term "loess" without genetic connotations; "loess" includes aeolian, alluvial, lacustrine and colluvial facies. This has important pedagogic implications, because the prevailing American view is that early Chinese archaeological sites are typically found in aeolian loess settings. Direct examination of sites, reading of Chinese literature and discussions with Chinese colleagues lead the author to conclude that few, if any, Paleolithic sites in the Gansu area of the loess plateau are in aeolian loess settings, most being instead in "alluvial loess" (e.g., the upper Paleolithic site of Liujiacha; Xie 1982). One exception could be the Lantian sites in Shaanxi province, where a case for aeolian origin has been made (An et al. 1987); however, our team observed at Chenjiawo that buried "soils" had sharp lower boundaries and gradational upper boundaries possibly suggesting weathered fining-upward sequences (with heavy mineral

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concentrations near the base accounting for the color change) rather than soils. This must be tested through further field and laboratory studies.

Finds of broken stone and bone in 1987 suggested potential at Cuijiaai for in-place archaeological material (Wilson 1988). In 1988 our team scoured the western portion of the cut. The lower half is tilted Pliocene to ?early Quaternary variably indurated sandstone redbeds to coarse conglomerates. A major unconformity 26 to 33 m above the base drops eastward (downstream). Atop it is late Pleistocene cobbly alluvium (Unit A), 5 to 6.5 m thick and also dropping eastward. Unit B, a sequence of interbedded clays, silts, sands and pebbly "grits" with gravel lenses, extends up to a "grit" band 42 to 43 m above base. Unlike the underlying gravels, these beds are horizontal. Unit B is a floodplain sequence, displaying levee deposits ("grits" which can be traced laterally to channel fills), fining-upward cycles from "grit" to silt, and occasional laminated clays. Sands at its base are transitional from the gravels and display trough and climbing ripple cross-stratification. Laminated clays near the base represent backswamp ponds and show bioturbation. Rodent burrows in "grits" and sands within 2 m of the base of Unit B indicate periodic surface stability.

From 43 m upward, massive "loess" (Unit C) is locally interrupted by pebble lenses and is interpreted as colluvium. It give the terrace a sloping surface; back from the Huanghe the surface rises to 100 m above river. Loess in higher terraces served as the source from which textural characteristics were inherited.

After a two-week search, archaeological materials were discovered 6 m above the base of Unit B in reddish "grit" (26 m below surface). Since this is the base of a fining-upward cycle, the artifacts have likely been moved fluvially, but lack of sorting by size and localization over 6 m lateral distance suggests minimal transport. Material included 12 flakes (one elongate with single dorsal ridge and distal retouch), a cobble spall core, and a bone fragment (large mammal). The core has cortex on one face and discoidal shaping of the other, followed by removal of a large Levallois-like flake. One small flake fits onto the core; all are of quartzite. Pending permission to study this material (which remains in China), little more can be released at present. Huang (1986) correlates these deposits with others dated ca. 30,000 to 20,000 yr B.P. in the loess plateau, based on pollen studies at Cuijiaai. Direct dating evidence is not available, so this is speculative; we have a sample of gastropods for radiocarbon dating.

The studies yield these results: (1) confirmation that reworked loess of alluvial, lacustrine, and colluvial origin dominates lower terrace deposits in Gansu; (2) confirmation of the archaeological potential of terrace alluvial loess deposits; (3) indications that archaeological sites on the loess plateau tend to be in alluvial and colluvial rather than aeolian loess; and (4) discovery of a new Paleolithic site through intensive search of a selected section. The possibility of excavation by foreigners remains uncertain and subject to negotiation, reflecting Chinese concerns about stewardship of the resources.

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A. McKinnon (University of Calgary), Ineke Bruining and Darcy Dean (University of Lethbridge), and Zhang Hucai, Qing Yong, and Dai Xuerong (Lanzhou University). I am particularly grateful to Prof. Zhang Linyuan and Vice-president Ai Nanshan of Lanzhou University and Dr. Xie Jun Yi of the Gansu Provincial Museum for their advice and assistance.

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Western Clovis Occupation at the Dietz Site, Northern Alkali Lake Basin, Oregon

Judith A. Willig

Archaeological research in the northern Alkali Lake Basin of south-central Oregon, and at the Dietz site (35LK1529), has been conducted since 1983. A major focus has been to establish the relative chronology and environmental context of (and ecological influences on) the earliest inhabitants of the basin

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(Willig 1989). The following summary updates earlier preliminary reports (Fagan 1986, 1988; Willig 1984, 1988).

The Dietz site is an extremely large lithic scatter situated in the northern Alkali Lake Basin—a structural basin once occupied by Pluvial Lake Alkali and a number of smaller, shallow terminal Pleistocene and early Holocene lakes (Willig 1989). Dense surface concentrations of tools and lithic debris mostly occur in spatially discrete, single-component clusters which, together, extend for 1,250 m along low relief remnant shorelines. The largest component at the site is represented by numerous fluted point fragments assignable to the western Clovis tradition (cf. Willig and Aikens 1988). There are still no reliable, well-documented radiocarbon dates for Clovis fluted points at Dietz or in the far west; their approximate time range based on typological comparisons to well-dated sites in the Southwest and Plains would seem to fall between 11,500 and 11,000 yr B.P. (Willig 1990).

Additionally, a number of stemmed and shouldered points have been recovered at the Dietz site, and 30 other lakeside campsites in the basin. These include points of the Western Stemmed tradition (Willig and Aikens 1988): Cougar Mountain, Parman, Windust, Lake Mohave, Silver Lake, Haskett, Cascade, Plano-like and Great Basin Concave Base (Willig 1989). Numerous crescents and ground stone artifacts frequently occur in direct association with these sites. Radiocarbon dates for Western Stemmed occupation indicate a fairly even spread across a time range from 11,000 to 7,000 yr B.P. (Willig and Aikens 1988).

Archaeological testing and surface collection at the Dietz site has yielded a total of 60 fluted point fragments, made almost exclusively of obsidian (figures in Willig 1989, 1990). These include 12 complete or near-complete points, 4 tip fragments, 8 midsections, 8 base-midsections, and 28 base fragments. Fagan (1988) considers an additional 25 blanks and 27 flute flakes to be diagnostic Clovis artifacts. Like other major western Clovis sites (Willig 1990), there is a wide range of size among the point fragments recovered (Figure 1), possibly reflecting functional or individual variation to be expected within a large sample (Richard Hughes pers. comm. 1988).

Additionally, numerous combination fluted-stemmed forms have been recovered (Willig 1989). These may represent temporally "transitional" forms between fluted and stemmed types—like those documented in the Clovis-Folsom-Plano sequence of the Plains (Aikens 1978; Frison 1978; Haynes 1980). They may also represent various stages of reduction, or re-use and re-working of "relict" tools (Willig 1989). Many other tools have also been recovered, including scrapers, gravers, bifacial blanks, preforms, knives, wedges, abrading stones, hammerstones and a variety of flake tools (Fagan 1988).

Based on analysis of debitage and artifacts from separate lithic clusters at the Dietz site, Fagan (1988) concludes that tool kits, manufacturing techniques and biface reduction stages are strikingly different for Clovis and Stemmed groups, suggesting that both cultural and temporal differences exist between the two assemblages. This supports conclusions made from other technological studies reported in the far west (Willig 1990). Fagan (1988) also reports that

Clovis clusters at Dietz are more dominated by exotic obsidian than Stemmed ones, although the conclusion is preliminary. If it holds, it suggests that numerous exotic blanks were reduced on site into finished Clovis tools, which were then resharpened, recycled or discarded on site after breakage. However, an abundance of cortex flakes of local obsidian indicates use of local materials in tool manufacture as well.

Geoarchaeological analyses have also helped to reconstruct early human settlement patterns and lake history in the northern Alkali Lake Basin (Willig 1988, 1989). The terminal Pleistocene Western Clovis occupation at the Dietz site was oriented to the northwestern shore of a small, shallow lake or marsh (30 to 50 cm deep) in the center of the basin. This was followed in the early Holocene by a substantial two-stage lakeside settlement of Western Stemmed groups at 31 sites which line the periphery of two slightly deeper (1.5 to 2.0 m deep), closely sequent lakes and marsh fringes spanning the entire northern basin.

Reconstructed Clovis and Stemmed-era occupation surfaces have been stratigraphically correlated to separate shallow lake levels present in the basin from 12,000 to 7,500 yr B.P. Results have demonstrated a clear vertical and horizontal separation of western Clovis from Stemmed-era occupation surfaces—the strongest case yet reported in the far west for separating these two assemblages in relative time (Willig 1988, 1989). The data from here, and elsewhere (Willig and Aikens 1988), strongly suggest that Western Stemmed complexes postdate the Clovis presence in the far west, although they follow closely in time. Additionally, there is now potential for documenting surviving remnants of buried Clovis occupation surfaces, overlain by deposits containing Western Stemmed points, at several localities in the basin (Willig 1989). These areas are the focus of future tests excavations, along with expanded site survey and model testing in adjacent sub-basins.

The presence of a major Western Clovis lake-marsh encampment, followed by a strong lakeside focus during Western Stemmed occupation, suggests there must have been a fairly stable, at least seasonally productive, ecological situation which made the northern Alkali Lake Basin attractive to hunter-gatherers between 12,000 and 7,000 yr B.P. These data indicate the early development of an economy "tethered" (Taylor 1964), to ecologically productive wetlands during the Pleistocene-Holocene transition (Willig 1988, 1989)—a pattern seen in other western lake basins (cf. Willig and Aikens 1988).

The northern Alkali Lake Basin, unlike adjacent sub-basins, was particularly well suited for the development of shallow, freshwater lakes and marsh habitats, and offered a unique combination of fresh water, raw materials, and wetland food resources (Willig 1988, 1989). If obsidian procurement alone was the major focus at the Dietz site—a possibility not indicated by Fagan's work (1988)—there would have been innumerable other places of choice in the area overshadowed by the rich, expansive Horse Mountain obsidian source 5 km southwest of the site. If proximity to obsidian and fresh drinking water were the foci of site choice, there are numerous other possibilities in the vicinity which would have offered both—such as the large canyon drainage 2.5 km southwest of the site (cf. figures 30–31 in Willing 1989).

The data from the far west suggest that early economic strategies did not involve a specialized focus on either hunting large terrestrial game or foraging in lake-marsh habitats (Bedwell 1970). Rather, there was a generalized, broad spectrum exploitation of a wide variety of habitats within catchment areas (Willig 1988, 1989). Such "Archaic" strategies are known as early as 10,000 yr B.P. in the far west, and may have already been in place by 11,500 yr B.P. (Willig and Aikens 1988). This kind of strategy, tethered to mesic habitats, is keenly fit for the dynamic mosaic of regional resources so characteristic of the Pleistocene-Holocene transition.

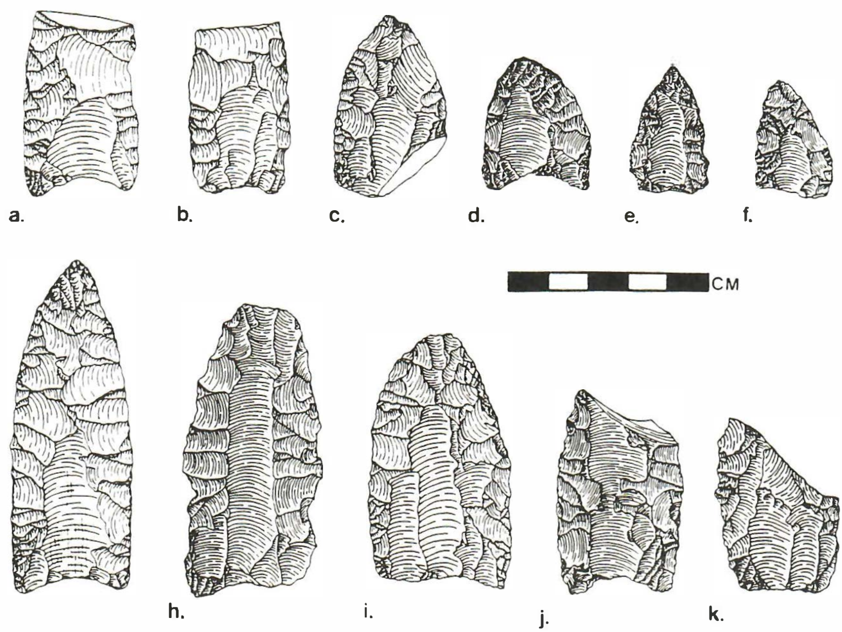

Figure 1. Sample of western Clovis (fluted) points from the Dietz site (35 LK 1529): a. #553-417; b. #553-435; c. #553-14; d. #553-260; e. #553-241; f. #553-232; g. #553-319; h. #553-258; i. #553-262; j. #553-19; k. #553-199. Drawings by Wyndeth V. Moisan.

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An Early Archaic Lithic Assemblage from the Nettling Site in Southwestern Ontario

Stanley Wortner, William Fox, and Christopher Ellis

The early Archaic (10,000 to 8,000 yr B.P.) remains one of the poorest known developments in the Great Lakes area, but a number of sites and findspots have been reported in recent years, especially in southern Ontario (Ellis et al. in press; Roberts 1985; Wright 1978). While most of the known sites are small and ephemeral, a notable exception is the Nettling site. The large artifact assemblage from this site includes over 1,600 tools and preforms and is currently being analyzed by these authors.

The site is situated in a cultivated field some 5 km from the modern Lake Erie shore just southwest of London, Ontario. It consists of two main dense concentrations of surface lithic materials which cover, respectively, ca. 800 and 600 m^2, and a smaller (<50 m^2) ephemeral cluster at the southern site margin. The site was intensively surface collected between 1965 and 1979, and excavations have been confined to digging four small test units. A single late Paleoindian point and 15 early and middle Woodland artifacts have been recovered from one of the main concentrations; five late Woodland artifacts from the other. Otherwise, the assemblage is exclusively attributable to the early Archaic occupation.

Excluding five bifurcate-based points from one of the main concentrations, the remaining 158 points are exclusively well-made, thin, corner-notched, serrated forms, closely resembling examples of the "Kirk Corner-Notched Cluster" dated to ca. 9,500 to 8,900 yr B.P. in the southeastern United States (Coe 1964; Chapman 1985). While notched and serrated points need not be early Archaic (see Lovis 1989; Youse 1985), the remainder of the assemblage includes several tool forms diagnostic of the early Archaic in the Southeast and leave little doubt as to Nettling's affiliation. These include: large trianguloid biface tools (n=25; Chapman 1985; figure 5.3a); expanding-, notched-, and rectanguloid-based drills (n=27; Kimball and Chapman 1977: figure 24a, 24b; Coe 1964: figure 62c); small, trianguloid to ovoid end scrapers (n=117), about half of which have completely parallel-flaked dorsal surfaces (Kimball and Chapman 1977); specialized stemmed concave side scrapers (n=16; Morse 1971: figure 4c, 1976: figure 2i); chipped celts with ground bits (n=32) or preforms for the same (n=6) on slate or sub-greywacke (Kimball and Chapman 1977); oval abraders with central grooves on one or both faces (n=2; Morse 1976:

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figure 5); and ovate siltstone chopper/scrapers (n=2; Kimball and Chapman 1977). The remainder of the assemblage consists of material such as preforms, denticulates, piercers, retouched flakes, pitted cobbles, among others. However, all three concentrations at the site have also yielded finished and unfinished examples of ground and polished tubular atlatl weights with one flattened site (n=13). These have never been reported in the early Archaic. Nonetheless, the predominance of definitive early Archaic material at the site combined with the recovery of the weights from all three site concentrations, leads us to suspect such an association at Nettling.

An interesting aspect of the site is the high percentage of Ohio cherts. These materials make up over 30% of the tool assemblage and 18% of the debris; totals far in excess of that reported from any prehistoric site in Ontario. Pipe Creek from some 200 km to the southwest in the Sandusky Bay area of Ohio is the most common of these cherts but Upper Mercer from sources 350 km south of Nettling is also well-represented. The remainder of the assemblage consists mainly of Onondaga and Selkirk cherts obtained from site local secondary deposits. Significantly, Ohio cherts are common among the discarded tools but not among the unfinished ones where Ontario cherts predominate. For example, 49% of the points are on Ohio cherts, but only 7% of the preforms. These data clearly indicate a case of tool kit replacement with exhausted tools on Ohio cherts acquired elsewhere in the annual round being discarded in favor of freshly made tool on local materials.

As a result of its largely single component nature, study of the Nettling assemblage clearly has important potential. For example, it provides the first real opportunity in the region to go beyond points and delimit the nature of whole early Archaic tool kits. This knowledge is essential to developing higher order inferences concerning early Archaic cultural systems and to documenting the extent and nature of the Paleoindian to Archaic transition in the area. These and other questions will be addressed through our continuing analyses.

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Northwestern Oklahoma's Burnham Site: Glimpses Beyond Clovis?

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In 1986, farm pond construction in northwestern Oklahoma's Woods County uncovered three exposures of ponded sediments containing late Pleistocene fauna. Brief testing in 1986 recovered the skull and a few bones of a large horned bison (initially thought representative of *Bison latifrons* but now believed to be *B. alleni* or *B. cheneyi*) along with a few bones of other mammals and reptiles (Wyckoff et al. 1987). Subsequent laboratory sorting of waterscreened (2 mm mesh) debris surprisingly yielded resharpening flakes from the same levels as those containing the bison remains. Slightly expanded excavation in 1988 recovered more flakes and segments of chipped stone tools from the same stratigraphic contexts (Wyckoff 1989). As of September 1, 1989, the artifact inventory included 22 flakes, 2 broken chipped stone tools, and a minimally flaked cobble. These come from alluvial deposits that also yielded remains of bison, horse, elephant, turtle, small mammals, and aquatic snails. The artifact and fossil bearing strata have yielded radiocarbon dates of 26,820±350 yr B.P. (charcoal, AA-3838), 31,150±700 yr B.P. (snails, Beta-23045), 35,890±850 yr B.P. (snails, AA-3837), and 40,900±1600 yr B.P. (charcoal, AA-3840).

From September 28 to October 24, 1989, interdisciplinary research was undertaken at the Burnham site by the authors and more than 70 volunteers (most from the Oklahoma Anthropological Society). Partially funded by the National Geographic Society, this work was designed to better document the site's geomorphic context, record and date the site's alluvial and soil profiles, collect and analyze any recovered faunal and floral remains for information on the site's age and environmental changes, and ascertain the origin and age of the human artifacts.

The 1989 field work entailed manually excavating and waterscreening nearly 23 m^3 of sediments and soils from 31 different 1 by 1 meter squares in the site's

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East Grid. These squares were west and east of those where bison bones and artifacts were found. The 1989 excavations exposed an atlas and two thoracic vertebrae, several ribs, and the right mandible of the large horned bison. Also, at least three flint flakes were recovered.

To obtain a broader perspective of the site's setting and geology, the manual excavations were augmented by 9 scattered, deep (4.8 to 6.96 m) cores and nearly 45 m of backhoe trenches. Of these latter, the principal one was at right angles to the modern arroyo's sideslope, paralleled the North 3 line of the East Grid, and was 22 m long (east-west) and nearly 3 m deep. Near its west end and center, respectively, 9 m and 7 m long trenches adjoin, extend northward, and provide profiles paralleling the modern arroyo. An unconnected 5 m long trench was also excavated parallel to and some 15 m north of the principal trench in order to obtain a profile where the ground surface was not graded during pond construction.

A generalized profile through the manually dug grid and along the principal backhoe trench is shown in Figure 1. This profile depicts the major stratigraphic units recognized by the project's pedologist and two geologists. Because the actual details and processes responsible for this profile are still under study, a refined version will undoubtedly look slightly different. Charcoal samples from several of the undated strata are currently being radiocarbon dated.

Core findings attest to the site occurring in an unusual setting. Some 6 m of reddish sandy sediment accumulated in a large depression. The origin of this feature was initially hypothesized to be salt dissolution and collapse of the underlying Permian bedrock (Gustavson and Finley 1985), but basal gravels are evidence the depression formed from ancient stream erosion. Based on core findings and the eastern third of the principal profile (Figure 1), after deposition of the basal gravel the depression filled with red silty sand. Once it accumulated to elevation 97.6, this fill began undergoing pedogenesis. At 97.8, this soil is carbonate enriched and contains occasional bone fragments and numerous charcoal pieces. A charred log segment from this depth was radiocarbon dated at "greater than 38,000" years ago (Beta-33950). Above elevation 98.0, the aggrading sandy fill contains two thin charcoal stained horizons and remnants of at least two calcic horizons (Figure 1). The western extent of all these horizons was terminated by at least two erosional channels. These filled with alternating units of slightly coarse, mottled red sediments or with fine sandy gleyed sediments. Beds of these latter are typically gray and contain thousands of snails. Preliminary identification indicates these latter are predominantly species common to ponded or slow sluggish streams.

Four stratified units of gray ponded sediments are believed manifest in the site's profiles (Figure 1). The lowest and the two highest gleyed units are as yet undated. The second highest contains a bed of partially mineralized, disarticulated horse bones and datable charcoal. No artifacts are known to occur in this or the highest gleyed unit.

All artifacts come from the lower part of the second lowest gleyed unit and the uppermost 20 cm of the underlying mottled red fill. Here, too, occur the unmineralized bones of a large horned bison. As noted, the radiocarbon dates for these two strata range from 26,000 to 40,000 years ago.

At several places, the profiles manifest fossil burrows that penetrate more than one stratum. Also, the profiles are locally highly contorted, perhaps due to spring activity. Notably, the area yielding the artifacts and large horned bison remains appears least affected by biological or hydrological mixing. As yet, no artifacts have been recorded for any overlying strata.

Despite the seemingly tight context for the Burnham artifacts, they are believed to have washed to that position from some former surface in the nearby soil profile. The 28 flakes come from nearly 20 different tools, a fact that makes it unlikely that they result from tool resharpening while butchering the large horned bison. Also, the bison bones have yet to manifest marks clearly attributable to butchering.

In summary, three field sessions at the Burnham site have consistently yielded human artifacts in deposits more than 25,000 years old. While profile manifest clues to mixing of deposits, such clues are sparse where the artifacts occur, and no sign of humans has been found in overlying channel fill strata. Attention is now being focused on the alluvial stratigraphy and adjacent soil profiles in order to delineate which segment of the latter contains remnants of a humanly occupied, former surface.

We deeply appreciate the National Geographic Society support of the 1989 research. We are indebted to the many volunteers who donated time, effort, and money to the project. A special thanks goes to the Keith Burnham family for allowing the work and to the Oklahoma Museum of Natural History (Michael Mares, director) for funding the initial radiocarbon dates. Doug Donahue and Austin Long (University of Arizona NSF Accelerator Facility for Radioisotope Dating) were especially helpful in providing the dates. The encouragement and interest of Jack Hofman, Kent Kuehler, Bob Brooks, Peggy Flynn, Vance Haynes, George Frison, W.W. Crook, Larry Banks, Russell Graham, and Robert E. Bell are most appreciated.

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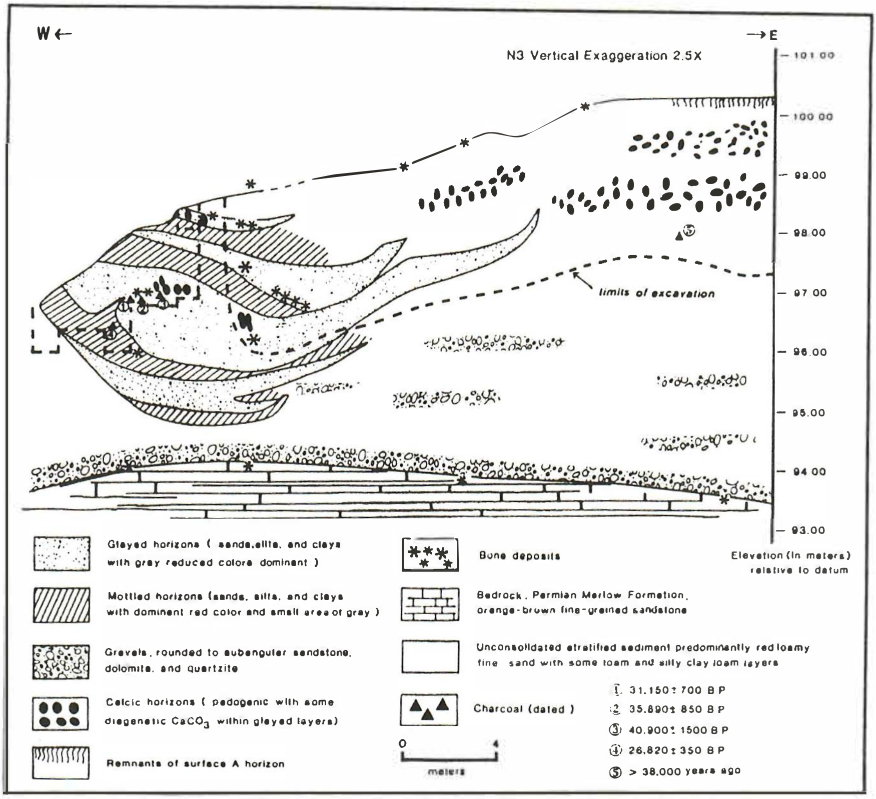

Figure 1. Generalized profile along North 3 grid line, Burnham site (34W0-73), Woods County, Oklahoma.

Physical Anthropology

Paleolithic Siberian Dentition from Denisova and Okladnikov Caves, Altayskiy Kray, U.S.S.R.

Christy G. Turner, II

In conjunction with a long-term research project in the U.S.S.R. on the origins, evolution, and cladistics of Eurasians and Native Americans, my wife (Jacqueline) and I spent part of June, 1987, inspecting the on-going and past excavations of several open and cave sites being conducted in the Altai Mountains by members of the Institute of History, Philology, and Philosophy, U.S.S.R. Academy of Sciences, Siberian Branch, Novosibirsk. The work was under the direction of Academician A.P. Derevyanko and Archeology Department Chairman R.S. Vasilievsky, and involved field supervisors V.I. Molodin, and S.V. Markin plus their crews and associated specialists, including vertebrate paleontologists N. Ivleva and N. Ovodov. The limestone cave sites in which the human dental remains were found are called Denisova (1,000 m above sea level) and Okladnikov (previously named Sibiryachikha I; 650 m above sea level). These sites are located at approximately 51°30'N, 84°30'E in Altayskiy Kray, about 360 km northwest of the "four corners" area of the U.S.S.R., Kazakhistan S.S.R., Mongolia, and China. The principal regional river is the north-trending Anuy which joins the Kara Sea-bound Ob River south of Barnaul. Soloneshnoye is the principal regional town, reachable much of the year only by small aircraft or heavy-duty truck.

The pre-Holocene occupation deposits of the caves and their fronting talus slopes contain almost entirely Mousterian tool types, except in the terminal Pleistocene levels where upper Paleolithic blades, microblades, and bone art occur (Derevyanko et al. 1985; Derevyanko and Markin 1987; Turner 1987; Markin, pers. comm.). Both limestone caves have been occupied more than 35,000 years according to Soviet dating. J.L. Bischoff (U.S.G.S., Menlo Park) ran a uranium series assay on a bovid leg bone from near the bottom of

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Okladnikov Cave, producing a date of "at least 38,000 years ago." Ivleva and Ovodov have identified vast amounts of excellently preserved faunal remains which include mixed steppe and forest types with some mid-Pleistocene species.

Seven isolated subadult and adult teeth were found in addition to small amounts of fragmented human bone (Turner n.d.): left UI1, right Lm1, left LP1, two left and one right LM3s, and a (L?)m2. The provenience for each tooth indicates all date before the upper Paleolithic. As expected, given the dating and types of food refuse, the teeth lack caries and show heavy wear and some chipping, even on one of the deciduous molars. The teeth are large, equalling those of Australian Aboriginals. The adult Altai individuals seemed to have died relatively young.

Preliminary comparisons with European, Asian, and New World teeth suggest that the individuals making up this small sample could have been European-related, Neandertal-grade people despite their geographic proximity to northwest Mongolia and China where only the Sinodont dental pattern has been identified to date. Anatomical features of the Altai teeth have more similarities with Neandertals Shanidar 2, Monsempron, Lot-et-Garonne, Gibraltar II, and Krapina, than with various Cro-Magnons. There is no suggestion of Mongoloid or native American affiliation, nor any hint that the Altai teeth were on the threshold of evolving into the Sinodont pattern. It is anticipated that more human skeletal and dental remains will be discovered as excavations proceed in these and other Paleolithic Altai sites because the limestone context provides outstanding osteological preservation.

Field and museum work were made possible by assistance from the U.S. National Academy of Sciences and the U.S.S.R. Academy of Sciences.

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Lithic Studies

A North American Paleoindian Projectile Point Database

David G. Anderson

Fluted and other diagnostic Paleoindian projectile point surveys are being conducted across North America, and are enthusiastically maintained by avocational and professional archaeologists alike. Unfortunately, while many state and province surveys have reported high point totals, published attribute and provenience data for individual artifacts in many cases is either nonexistent or accessible only with great difficulty. This kind of information needs to be more accessible, and in a format facilitating analysis.

The author has been compiling data about Paleoindian projectile point occurrence in North America, specifically information about the number and type of points that have been found in each county, parish, or similar political unit. The database is maintained on personal computer diskettes, and is available to researchers upon request. The occurrence file give the numbers of Paleoindian points, by type (where such data is available), for each county or parish, in each state or province in North America. Bibliographic references accompany each entry, documenting the sources of data. To date the compilation has focused on Eastern North America. Information from the western part of the continent is slowly being added to this database.

The distribution of early and middle Paleoindian projectile points in Eastern North America illustrated in Figure 1 was produced from county/parish-level totals of fluted points from each state or province, where such data was available to the author. At present the data set from Eastern North America encompasses over 9,000 fluted and nonfluted early and middle Paleoindian projectile points. An extended discussion of this research effort, and how such data can be used to examine questions of Paleoindian colonization, settlement

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patterns, and mobility strategies has been published elsewhere (Anderson 1990).

The author is also compiling measurements on individual Paleoindian artifacts. Specific information recorded includes: artifact catalog number (or referenced Paleoindian projectile point survey number); maximum length, estimated complete length, maximum width, basal width, maximum thickness, depth of basal concavity, length of fluting (obverse/reverse), number of flutes (obverse/reverse), length of lateral grinding (each side), raw material, color presence/absence of basal grinding, point type, recorder, site number, county or parish, state or province, published references (including page number, with references to published photographs specifically indicated), and owner or curation repository. Other attribute data is added to the files on a case by case basis. All measurements should be to the nearest mm. Obviously only some of these attributes can be recorded for many artifacts (i.e., those that are broken, or those for which provenience data has been lost). Published projectile point attribute data from several state surveys and site assemblages have been compiled (e.g., Anderson et al. 1990; Loring 1980; McCary 1984; Perkinson 1971, 1973), and the database presently contains information on some 1,500 points, most from the southeastern United States.

Researchers wishing to contribute data to this effort for incorporation into the database can do so by sending listings or references of primary data to the author. Either compatible text files or hard copies that can be transcribed can be used. All files are maintained on Apple Macintosh 3.5" 800K diskettes in Microsoft Excel (version 2.2) and standard text files. Copies of the database files will be sent to researchers upon request. Contact the author prior to sending blank diskettes or computerized files, to ensure compatibility.

The author wishes to thank the following researchers for providing primary data toward this effort: Tyler Bastian, Mark J. Brooks, John B. Broster, James S. Dunbar, Eugene Futato, William M. Gardner, Brad Koldehoff, Dan F. Morse, Philip "Duke" Rivet, Kenneth B. Tankersley, and Henry T. Wright.

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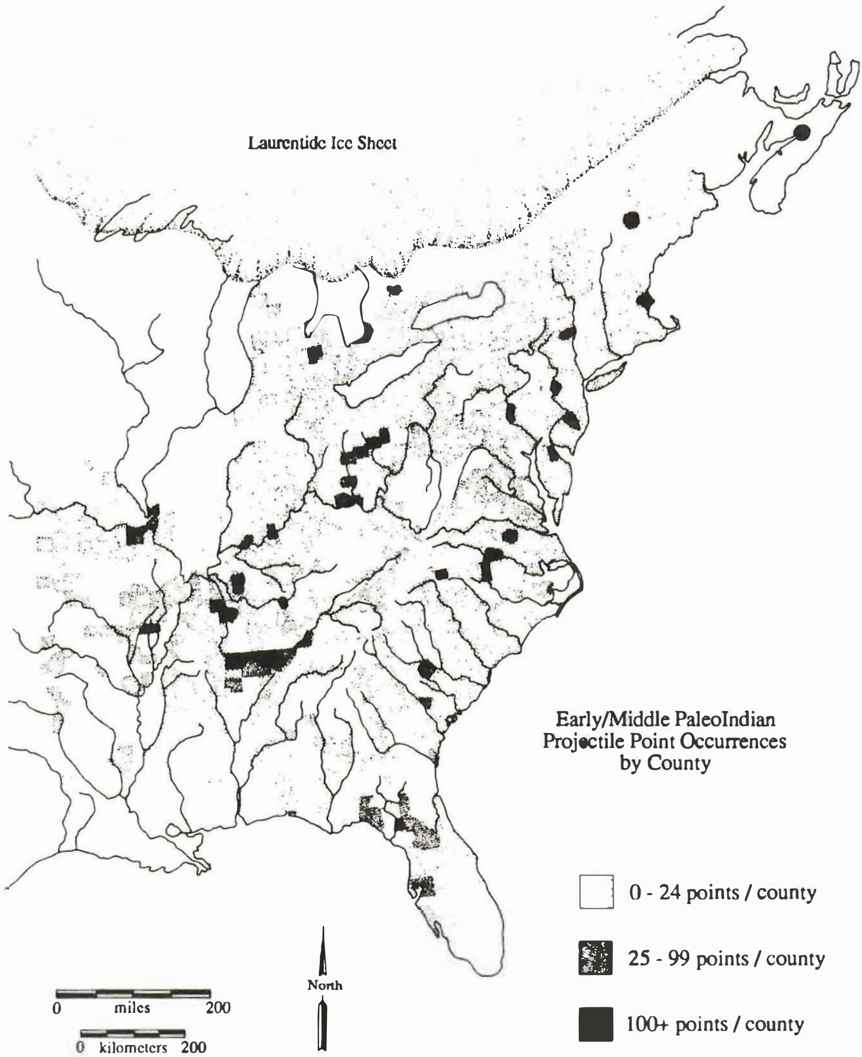

Figure 1. Early and middle Paleoindian projectile points in Eastern North America: summary data (from Anderson 1990).

Update on the Georgia Paleoindian Survey

David G. Anderson, R. Jerald Ledbetter, and Lisa D. O'Steen

Since 1986 the authors have been conducting a Paleoindian artifact survey in Georgia, a state where no formal recording had occurred previously (Anderson et al. 1986, 1987). Initially directed to fluted points, the survey expanded almost immediately to encompass Paleoindian points of all types, including complete, broken, and reworked points. As of January 1990 data on 216 Paleoindian projectile points have been recorded, including 73 Clovis, 13 possible Clovis, 14 Clovis variants, 1 fluted lanceolate (a preform of indeterminate type), 14 Simpsons, 10 Suwannees, 1 Cumberland, 12 unfluted lanceolates of indeterminate type, 1 Llano-like form, 1 Beaver Lake, 2 Quads, 49 'fluted' Daltons, and 25 unfluted Daltons. A monograph with descriptive information about these artifacts, and summarizing Paleoindian research in Georgia has recently been published (Anderson et al. 1990).

Paleoindian components in Georgia have been provisionally grouped into three temporal categories, corresponding to early, middle, and late Paleoindian subperiods. The early Paleoindian is thought to date from ca. 11,500–11,000 yr B.P. and is characterized by Clovis, possible Clovis, and Clovis variant forms. Possible Clovis points resemble the classic Clovis type, but minor typological uncertainty existed, as many were broken specimens. Smaller fluted forms, most of which appear to be extensively resharpened Clovis points, have been noted in the Georgia and South Carolina Piedmont, and have been provisionally called Clovis variants (Michie 1977). The middle Paleoindian is thought to date from ca. 11,000–10,500 yr B.P. and is characterized by the Cumberland, Suwannee, and Simpson types. Continuation of these forms after 10,500 yr B.P. is possible. The late Paleoindian is thought to date from ca. 10,500 to 9,900 yr B.P., and is characterized by Dalton and related types, including Quad and Beaver Lake. A number of Woodland forms exhibiting basal thinning scars are present in the state, including the Greenville, Yadkin, and Tallahassee types. These are identifiable as later artifacts from their triangular morphology, crude flaking pattern, and absence of basal or lateral grinding.

Paleoindian artifacts have been recorded from 40 counties, mostly from the north-central Piedmont and the southwestern Coastal Plain. Few points are reported from the southeastern Coastal Plain along the lower reaches of the

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Ogeechee, Ocmulgee, and Altamaha rivers. This low incidence may reflect avoidance of these areas due to an absence of high quality lithic raw material. A second distributional void characterizes the northern, mountainous region of the state.

The concentration of Paleoindian artifacts in southwest Georgia may be linked to the high quality chert sources that outcrop in this area. Concentrations of Paleoindian artifacts occur just to the south in Florida along the Aucilla, Wacissa, and Suwannee rivers (Dunbar et al. 1988); southwest Georgia may well have been traversed by these peoples. The restriction of Suwannee and Simpson points, which are extremely common in Florida, largely to areas south of the Fall Line, supports such an inference. Ten of the 14 Simpson points and all 10 of the Suwannee points documented during the survey came from the counties below the Fall Line.

The large numbers of Paleoindian artifacts found in the central Piedmont suggests Paleoindian use of this region was fairly appreciable. Survey data indicates that terrain along both major and minor drainages was visited, as well as in the uplands, with some evidence for increasing use of the uplands over time (O'Steen et al. 1986). A range of site types have been documented including short-term camps, residential camps, and quarry areas. River overlooks near shoals appear to have been favored. One possible aggregation locus, where large numbers of people may have regularly convened, appears to have been present in the Barnett Shoals area along the upper Oconee River.

A decline in the use of Coastal Plain chert, a high quality raw material, and a general increase in the use of lower quality materials such as quartz, metavolcanics, and orthoquartzites is evident over the course of the Paleoindian era. Use of extralocal material was most pronounced during the early and middle Paleoindian periods north of the Fall Line. South of the Fall Line Coastal Plain chert was common during every period; its ready availability in outcrops may have obviated the need to extralocal materials. Raw material source analyses indicate local groups carried or exchanged points 150 or more km from quarry areas.

Clovis points, although exhibiting a wide range, tend to be fairly small, averaging just over 60 mm in length. Clovis points of Coastal Plain chert were longer, on the average, than Clovis points made on other materials. Possible Clovis and Clovis variants were even smaller still, averaging under 40 mm in length. An appreciable majority of these point forms were found north of the Fall Line, and most are locally available materials. Their small size may be due, in part to manufacturing constraints of the raw materials they are made from, which include quartz and low quality Piedmont chert. Middle Paleoindian Simpson and Suwannee points were appreciably larger, averaging ca. 70 and 80 mm in length, respectively. This may be due to the occurrence of these types of primarily from south of the Fall Line, in close proximity to high quality chert sources in southern and central Georgia. Late Paleoindian Dalton points were fairly small, with bifaces exhibiting pronounced 'fluting' or more properly basal thinning typically larger than points without this thinning.

To test whether artifact reduction or exhaustion occurred as distance from raw material source increased, the size of Coastal Plain chert Clovis points found north and south of the Fall Line was examined. Clovis points from north of the Fall Line averaged ca 5 mm smaller in overall length than those to the south. Clovis points found north of the Fall Line were also slightly thicker, on the average, suggesting some concern about loss due to breakage, assuming, as is plausible, that thinner points were known to break more readily than thicker points. Likewise, chert Clovis points from north of the Fall Line had smaller basal concavities, again suggesting (if not a stylistic difference) concern for durability, assuming that points with a solid base were sturdier in the haft, or less likely to break, than those with a concave base. Finally, flute length was greater on the north Georgia specimens, indicating greater care in manufacture. All of these attributes might be expected on points that were to be carried and used at an appreciable distance from a raw material source, since they would probably improve point durability and efficiency.

Examining the incidence of Paleoindian and early Archaic projectile points at a number of locations in Georgia, major increases in the numbers of observed diagnostics were evident between the early and late Paleoindian subperiods, and again from the late Paleoindian to the early Archaic. If these data reflect regional population levels they suggest that major population growth was occurring, and that the considerable filling of the landscape had occurred by the start of the early Archaic.

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Observations on Clovis Lithic Technology

Michael B. Collins

Utilitarian lithic artifacts from Clovis contexts or with strong Clovis affinities indicate that two lithic reductive strategies, prismatic blade production and bifacial reduction, prevailed in the area that is now the south central United States. Forty two artifacts from eleven sites in Texas and one in New Mexico are considered (41UV2: 1 blade core, 1 point, 3 preforms, 2 fluted preforms; 41LL3: 2 blade cores, 41TA148: 1 point, 1 preform, 1 blade-flake; 41NV659: 14 prismatic blades; 41TV1364: 1 preform; 41RB1: 2 points; Marion County, Texas, isolated find: 1 point; 41LU1: 1 point; 41MD21: 1 point; 41GL175: 1 blade core; 41BX52: 1 point, 2 end scrapers on blades; and 29RV3: [casts of] 6 blades). The utilitarian nature of this sample is clear from contexts, use wear, and refurbishing.

Prismatic blades were struck from large prepared cores using indirect percussion. Overall, cores are conical with the platform plane at right angles to proximal blade facets. Multiple blade facets form a convex face extending from two-thirds to full circumference of the core. Although the platform plane is approximately perpendicular to the proximal core face, it is composed of multiple, short, deep flake scars emanating from its periphery. The negative bulbar scar of each of these flakes produces an acute angle of approximately 70° with the core face. The punch was placed in these concavities for blade removal; the ca. 70° angle is retained on the blades. These platform maintenance flakes commonly terminated in hinges with the cumulative effect of producing large central knots on the platforms. Such platforms were rejuvenated by removal of core tablet flakes. Light grinding appears on some blade platforms. Some ridges on blade exteriors as well as on core faces show attrition, apparently in part from curation between episodes of blade removal. Blades have minute platforms, almost no bulbs, minimal ripple marks on the interior surface, and strong curvature. Blades were utilized intact as shown by edge damage or segmented and retouched into end scrapers and other forms; they were not made into points.

Bifaces were fashioned from large flake-blades or from cores. All bifaces appear to be Clovis point preforms rather than finished implements. Direct, soft hammer percussion was used in all but final edge trimming. Early stage bifaces were fashioned with minimal platform preparation and relatively few flake removals. Platforms were produced by roughly chipping a bevel along the biface edge; no grinding is evidenced. Broad flakes extending completely or nearly the width of the biface were removed. A Clovis-point outline (straight base, convergent tip, straight to slightly convex edges) was maintained through

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all but the earliest stages of bifacial flaking. The base was beveled with a few flake removals to serve as the first fluting platform. Subsequently, the opposite face was beveled to accommodate the second fluting. Flutes appear to have been removed by direct percussion. Final trimming, probably by pressure flaking, resulted in even edges and symmetrical outlines centered on the flutes. Some final flaking intrudes on the flute scars. If bases and edges of points were ground prior to completion, it is not evidenced in the present sample.

Large thin flakes, including products of bifacial thinning, were utilized in an unmodified state or retouched for use. Scrapers are among the forms made on such flakes.

Points were resharpened, often repeatedly. Initial lengths were near or above 100 mm; unbroken, resharpened points near 50 mm in length were discarded at knapping localities close to raw material sources; unbroken, resharpened points near 40 mm in length were lost or discarded on Llano Estacado sites distant from raw material sources.

Both blade and biface production utilized various high quality raw materials. Multiple sources are often represented at single sites. Mobility rather than exchange probably accounts for this pattern.

Suggestions are probably warranted that similar but larger bifaces cached at such sites as Ritchie Roberts, Anzick, and Simon served non-utilitarian functions (Bonnichsen 1977; Woods and Titmus 1985). Nevertheless, these larger objects, from sites far to the northwest of the present sample, manifest the same technological hallmarks as do their utilitarian counterparts in this sample—few, broad, commonly overshot thinning flakes; pointed preforms; basal beveling; and direct percussion fluting. Although similar chipped lithic forms can be produced in a variety of ways and such forms can result from diffusion, the closely similar technological attributes manifest by the "preforms" from Anzick, Simon, Ritchie Roberts, and the several sites discussed here imply manufacture by individuals inspired by enculturation, not acculturation.

I thank the staffs of the Texas Archeological Research Laboratory, the Texas Historical Commission, Texas Memorial Museum, and Texas Department of Highways and Public Transportation as well as David Meltzer and R.K. Saunders for access to collections and documentation.

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Chronological Studies of Paleoindian Surface Sites in Eastern Nevada

George T. Jones and Charlotte Beck

Since 1986 we have investigated a rich surface archaeological record of late Pleistocene-early Holocene age in southern Butte Valley, Nevada. Thus far, collections ranging in size between 7 and 4,218 lithic artifacts have been collected from 15 sites; an additional 335 artifacts have been collected from 37 "offsite" survey tracts. The sites rest either on shoreline terraces associated with pluvial Lake Gale or relic alluvial terraces. Projectile points from site assemblages, including Lake Mohave, Silver Lake, and Cougar Mountain types (which date elsewhere in the Great Basin to between 8,000 and 11,500 yr B.P.) suggest these sites may date to the final Lake Gale stillstand, perhaps 10,500 yr B.P. (Mifflin and Wheat 1979; Benson and Thompson 1987).

Material and technological variability are strongly expressed across these collections, reflecting 1) the mechanical properties and availability of various toolstone types (Beck and Jones 1990) and 2) the nature and scale of lithic reduction at these sites (Beck and Jones 1989). Because of the presence of extralocal lithic sources, particularly among obsidian artifacts, we hope to be able to use information about source location to evaluate the territorial scale of Paleoindian settlement patterns. But does use of extralocal toolstone types also fit a chronological pattern; that is, does this record suggest shifting access to geologic sources resulting from changes in the scale or organization of population movements? Before a question of this nature can be addressed, however, a satisfactory relative chronology must be constructed for the sites.

Building cultural chronologies for surface records in the Great Basin has often proved difficult. While applied effectively to the Archaic sequence, conventional cross-dating approaches employing time-sensitive projectile points have had limited success for the Paleoindian record. There are a number of reasons for this failure; e.g., 1) there are few well-dated stratigraphic sequences on which to base comparisons, 2) point samples in all settings are typically small, and 3) surfaces often exhibit considerable component mixture. As a result, it is difficult not only to estimate the duration and modal ages of each projectile point style, but to determine if regional differences exist in the ages of each style.

These circumstances have prompted our investigation of the application of obsidian hydration dating to these surface assemblages (Jones 1988). We have initiated a pilot dating project, beginning with a sample of 115 obsidian artifacts recovered from 9 sites (n=87) and 10 "offsite" survey tracts (n=28). This sample contains all obsidian projectile points along with other tools and flakes, and

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represents a range of obsidian types (identified on the basis of color and inclusions). X-ray fluorescence (performed by R.E. Hughes of California State University, Sacramento) has revealed 13 distinct geochemistries in our sample, only two of which match reported sources. One is a local pebble source that lies on the Butte Valley floor. The other, known as the Brown's Bench source, is extensively distributed in northeast Nevada-south Idaho, some 200–250 km from the study area. Interestingly, these two obsidians are the dominant glasses represented in this sample. Clearly, obsidian was transported considerable distances by Paleoindian groups, whether as a result of high group mobility or through exchange.

Hydration band measurements were made by R. Jackson of Lithicron on 100 specimens that proved optically suitable for study. Our first concern is with the hydration analysis of the projectile points, since they offer an independent test of the hydration results. The 18 specimens include seven geochemical types. Although sample size limits comparison, we still find that Paleoindian styles (n=11) in each chemical type possess deeper hydration rims than Archaic points (n=3) of the corresponding geochemistry. Four points with unclear typologic affiliations also fall within the range of the early group. These results strengthen our confidence in the sensitivity of the technique and the suitability of the Butte Valley sample.

Our second interest is to investigate use of these data to build relative chronological orders of site occupation. Although our results are not conclusive because of small sample sizes brought about by the unexpectedly high number of sources represented, six of the sites possess sufficient numbers of obsidian artifacts of the same sources for comparison. Using different obsidian types, four hypothetical orders can be created. When these orders are combined, only a single arrangement can be found that contains no reversals of hydration measurements. This, the most parsimonious arrangement, we suggest reflects the relative ages of the sites.

Results concerning site occupational events are less clear and require investigations of large samples of obsidian. Source and hydration studies of another 600 obsidian artifacts from Butte Valley sites are now underway. The additional sample will permit us to evaluate indications from the preliminary study that some sites represent very brief occupation episodes while others suggest longer, if punctuated, patterns.

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A Microwear Analysis of Paleoindian "Socketed" Endscrapers from Southcentral Indiana

Edward E. Smith and Nicholas Toth

A small number of distinctive type of uniface tool have been recovered from the surface of a series of sites with Paleoindian components in southcentral Indiana. These tools are manufactured from blades, and are characterized by a rounded or spatulate bit and a long, constricted "rat-tailed" haft element. These artifacts are usually manufactured from Wyandotte chert. A fully-developed core and blade industry is present in southcentral Indiana, reminiscent of the Llano blade industry of western North American (Green 1963).

The second author analyzed microscopically five "rat-tailed" scrapers for evidence of wear traces following the methodology outlined by Keeley (1980). Of this sample, only one specimen (Figure 1) had identifiable use-wear; a very heavy polish along the end-scraper edge characterized by a rough texture, a matt luster, heavy rounding, occasional pitting, and striae perpendicular to the edge. This wear pattern is consistent with a tool that was used for scraping hides. There was no such polish on the sides or the "tail" end of the specimen. There is no evidence that the "tail" was used in a drill-like function. This suggests that the tail of the scraper form was fashioned to facilitate hafting. The remaining four specimens in our sample appear to have been broken in manufacture or use; wear polishes may have been obscured by subsequent resharpening.

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These tools comprise a small percentage of the hafted endscrapers from Paleoindian sites in southcentral Indiana. Most specimens are considerably larger than the typical "snub-nosed" endscrapers found on North American Paleoindian sites. As such, they may represent a new tool type, manufactured from large prepared blades. The long, carefully flakes "tail" may have been socketed in a bone or wood haft. Some functional differences between the smaller endscrapers and the large "socketed" endscrapers are inferred.

We thank Rachael Freyman for the illustration.

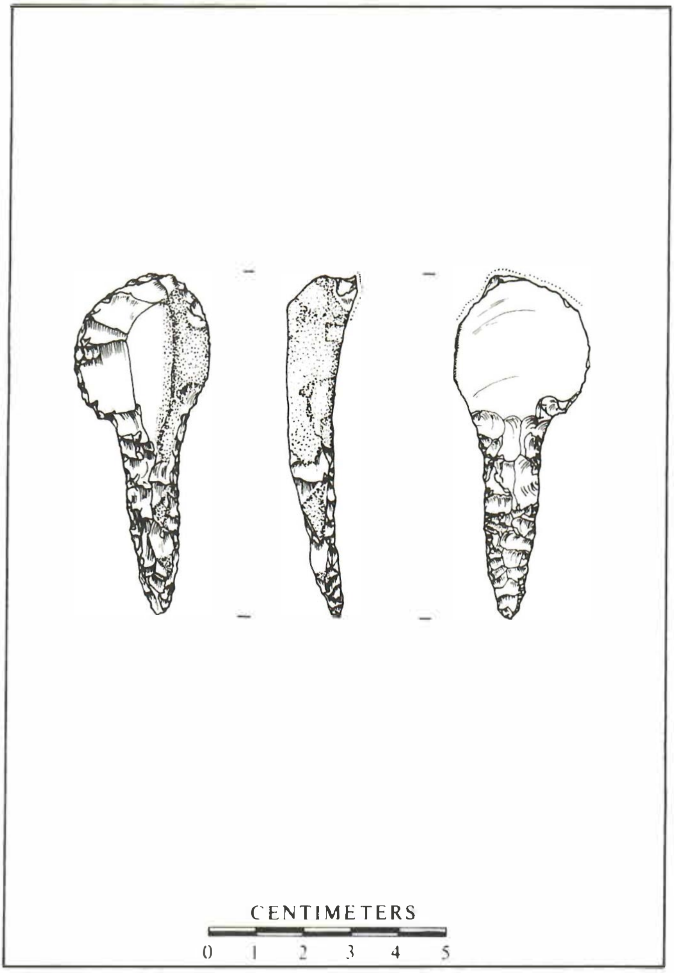

Figure 1. A Paleoindian "socketed" endscraper from southcentral Indiana. The dotted lines indicate the area of use-wear polish.

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Methods

A Method for Differentiating Modern from Ancient Proboscidean Ivory in Worked Objects

Edgard O. Espinoza, Mary-Jacque Mann, James P. LeMay and Kent A. Oakes

The visual identification of proboscidean ivory in worked objects is facilitated by a unique pattern of crossing lines which is readily apparent in transverse section. These lines appear as a thick band within the dentine covering from approximately thirty to one hundred percent of the dentinal area between the cementum and the central nerve cavity. They have been referred to as "curvilinear lozenges" (Owen 1856), "engine-turned decussat(ions)" (Penniman 1952), and "rhombic meshes" (Thornton 1980). A generally accepted term for this pattern is Schreger lines (Hanausek 1907). Measurable angles occur at the crossing of Schreger lines.

Two researchers, Penniman (1952) and Sanford (1973), observed that the Schreger line pattern seemed to form narrower angles in mammoth ivory than in modern elephant ivory. Pursuant to this observation, we examined 21 samples of modern elephant ivory (*Loxodonta africana* and *Elephus maximus*) and 19 samples of ancient mammoth and mastodont ivory (*Mammuthus primigenius*, *Mammuthus columbi*, *Mammuthus* unspecified, *Mammut* unspecified, *Gomphotherium simpsoni* and *Gomphotherium* unspecified) for Schreger angulation measurement.

Initial examination of our samples showed that Schreger angles appear in two forms. We have designated these forms as inside angles and outside angles (Figure 1). Inside angles are slightly concave and open to the inner (medial) area of the tusk. Outside angles are somewhat convex and open to the outer (lateral) area of the tusk.

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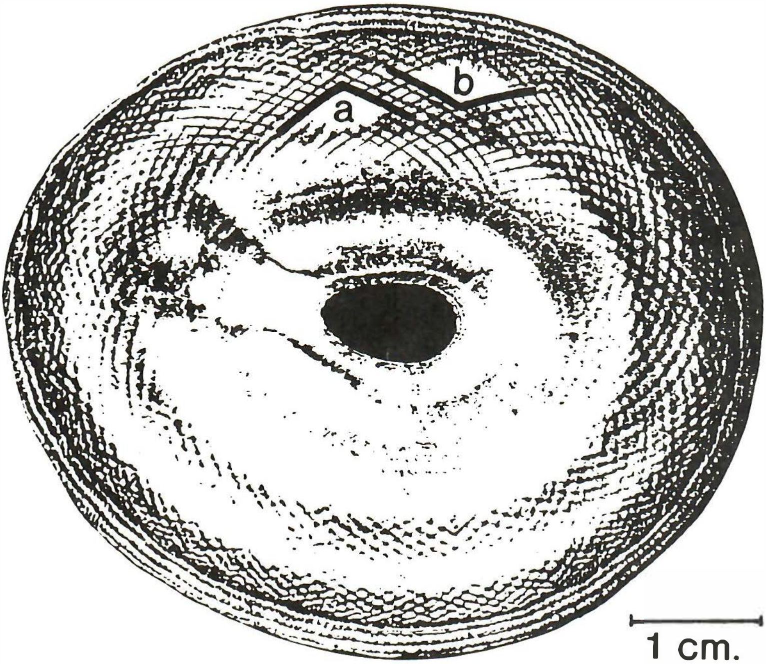

Figure 1. Enhanced photocopy of Schreger angles in a transverse section of African elephant (*Loxodonta africana*) tusk: a. inside angle b. outside angle.

Of two methods used to measure Schreger angles, the first method utilized photocopy technology to capture and enhance the Schreger angles. A blue xerographic transparency sheet was imposed between an ivory sample and the photocopy machine's glass copy plate. The machine was then set for a variable enlargement factor of up to 141%. The Schreger angles which appeared on the resulting photocopy of the ivory sample were marked with a pen or pencil and measured using a protractor. This method is preferable for angle measurement on flat objects. Photographic enlargement or digital image enhancement can be used in place of photocopy capture and enhancement.

The second method involved the production of an angle template. A 6 by 21.5 cm piece of clear xerographic transparency sheet was inked with a series of thirteen 1 cm squares containing angles from 60° to 140°. The marked angles were in 5° increments in the mid-range and 10° increments in the low and high ranges. This template was overlaid on a photocopy of the ivory sample or directly on the sample itself. The observed Schreger angles were "fitted" to one of the template angles for approximate angle measurements. This method can be performed on flat objects or on moderately curved surfaces. Digital image enhancement can be particularly useful with curved surfaces.

We measured five inside and five outside angles in each of our modern ivory samples and two to five inside/outside angle sets in our ancient ivory samples. Modern elephant inside Schreger angles ranged from 96° to 149° with a mean angle of 115°. Modern elephant outside Schreger angles ranged from 105° to 156° with a mean angle of 130°. The ancient ivory samples showed significantly lower mean Schreger angles. The inside angles in our ancient samples ranged from 40° to 95° with a mean of 73°. The outside angles from these samples ranged from 39° to 100° with a mean of 76°. The inside and outside and Schreger angles vary less in ancient than in modern proboscidean ivory.

An area of angle overlap exists in the lower end of the modern elephant inside angle range and the upper end of the ancient inner/outer proboscidean angle ranges. This area of overlap can be observed in modern ivory in the section of the dentine with a manifest Schreger lines which is closest to the central nerve cavity. Misidentification based upon angle measurement in this overlap zone can often be avoided by measuring multiple angles over as wide an area as possible.

While visual identification of proboscidean ivory using Schreger line recognition is a relatively simple routine matter, the non-destructive differentiation of modern and ancient ivories, particularly in worked objects, is not. However, we believe that we have observed and recorded a statistically reliable and reproducible method for distinguishing between modern and ancient proboscidean ivory. A comprehensive report on the results of our ivory analyses is currently in preparation.

We wish to thank Dr. Richard Tedford, Dr. Larry Agenbroad, Dr. Clayton Ray, and Mr. William Gould for generously donating ancient ivory samples for our research.

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Flat Top Mountain and Initial Observations on Desert Varnish Cation Ratio Values from Southeastern Utah

Timothy M. Kearns, Ronald I. Dorn, and Dennis J. Stanford

This paper reports the results of cation ratio (CR) assays of artifacts from four localities in southeastern Utah. Although the CR dating technique is in an early state of development, recent research indicates that it may be a useful tool for dating of surface artifacts and may provide data relative to the existence of a pre-Clovis occupation in the American Southwest.

Desert varnish is an arid lands aspect of rock varnish, a natural phenomenon that occurs on rock surfaces throughout the world in a variety of environments (Cooke and Warren 1973; Dorn 1983; Dorn and Oberlander 1982; Mabbut 1977). The varnish is typically manifested as a dark chocolate brown to black mineralized coating on exposed rock surfaces and consists of mostly clay with manganese, iron oxides, hydroxides, and other trace elements (Dorn 1983; Potter and Rossman 1977, 1979). Opinions regarding the origin and rate of varnish formation are varied.

Arguments for considerable antiquity for varnish coated artifacts and features are currently being addressed by CR and radiocarbon dating (Bamforth and Dorn 1988; Dolzani 1988; Dorn 1983, 1989; Dorn et al. 1986; Dorn et al. 1989; Dorn and Whitley 1984). Cation ratio values derived from varnish on artifacts attributed to Malpais and San Dieguito complexes from the Sierra Pinacate region of northern Sonora, Mexico, in general support both the relative age and chronological placement of these complexes (J. Hayden, pers. comm.; Dolzani 1988).

Surface sites located on stable landforms on Flat Top Mountain in southeastern Utah have produced artifacts with varying degrees of varnish. Two sites, 42SA16950 and 42SA16951, yielded artifacts which closely resemble the hypothesized San Dieguito Phase I and Malpais core and flake industries (Hayden 1976). Additional artifacts of various classic southwestern traditions were found which were also coated with desert varnish, but to a much lesser degree. Another site, 42SA16823, located on McElmo Creek 13 km to the east contained several artifacts with developing varnish and a hearth radiocarbon dated to 1380±60 yr B.P. (Beta-12657) (570±60 A.D.). Additionally, a Clovis age

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site situated on Lime Ridge, 37 km due west of Flat Top Mountain (Davis and Brown 1986), produced artifacts coated with desert varnish. As these sites shared similar biochemical environments which produced artifacts of known chronological placement and varying degrees of desert varnish, it was thought that CR assays of a sample of these tools might be useful for testing the potential of the cation dating technique in providing relative ages of the Flat Top Mountain artifacts.

A preliminary study was conducted in which cation ratios were derived for 20 specimens, including 2 conjoined artifact sets, diagnostic projectile points, and choppers. Both unmodified cortex as well as flake scar surfaces were tested on two artifacts. In most instances three individual CR values were obtained from each specimen and a composite value established. The results of these assays are presented in Figure 1.

Cation ratio (K+CA:T) determinations are not dates, they are relative values where the smaller the value the older the age. Also, when the values are plotted on a time scale, they are not linear, rather they are semilog. Absolute chronometric determination can be calibrated by cross referencing CR values with a curve established by available numerical ages (Colman et al. 1987; Dorn et al. 1989). The calibration curves are, however, regional in scope and a specific curve has not yet been developed for the Four Corners Region. Also, the CR values mark the onset of varnish formation and thereby denote a minimum age for the specimen.

Notwithstanding the potential problems (field and lab) inherent in the interpretation of CR values (Dorn 1989), we offer the following observations from the results of our study; (1) The variability of the CR values among conjoined artifact sets is within the range of variability of multiple values derived from individual artifacts and support the credibility of the technique., (2) As anticipated, values obtained for cortex were smaller, thence older, than the flake scar value from the same specimen. The magnitude of the differences would indicate that the parent pieces had been exposed on the surface for some time prior to their modification., (3) Values obtained on the Lime Ridge Clovis specimens tightly cluster and are among the smallest (i.e., oldest) values., (4) The values obtained for the McElmo Creek hearth site are among the largest, and therefore most recent in age, and fit well with the 1380±60 yr B.P. (570±60 A.D.) ^{14}C date., (5) Values obtained on one Archaic point fall between the Lime Ridge and McElmo Creek values. Values for another Archaic point are among the highest (i.e., youngest) and are somewhat anomalous. However, this point appears to have been curated prehistorically and may be associated with post A.D. 1300 ceramics. If so, the CR values are as expected., (6) The CR values resulted in a semilog order which is verified by other dating methods and appears consistent with curves calculated from other areas (Dorn 1989), and (7) some of the artifacts from the Flat Top Mountain have smaller values than the Clovis artifacts, which may imply that they are older. Others cluster with the Clovis age specimens and some may have been produced during the late Archaic-early Formative period.

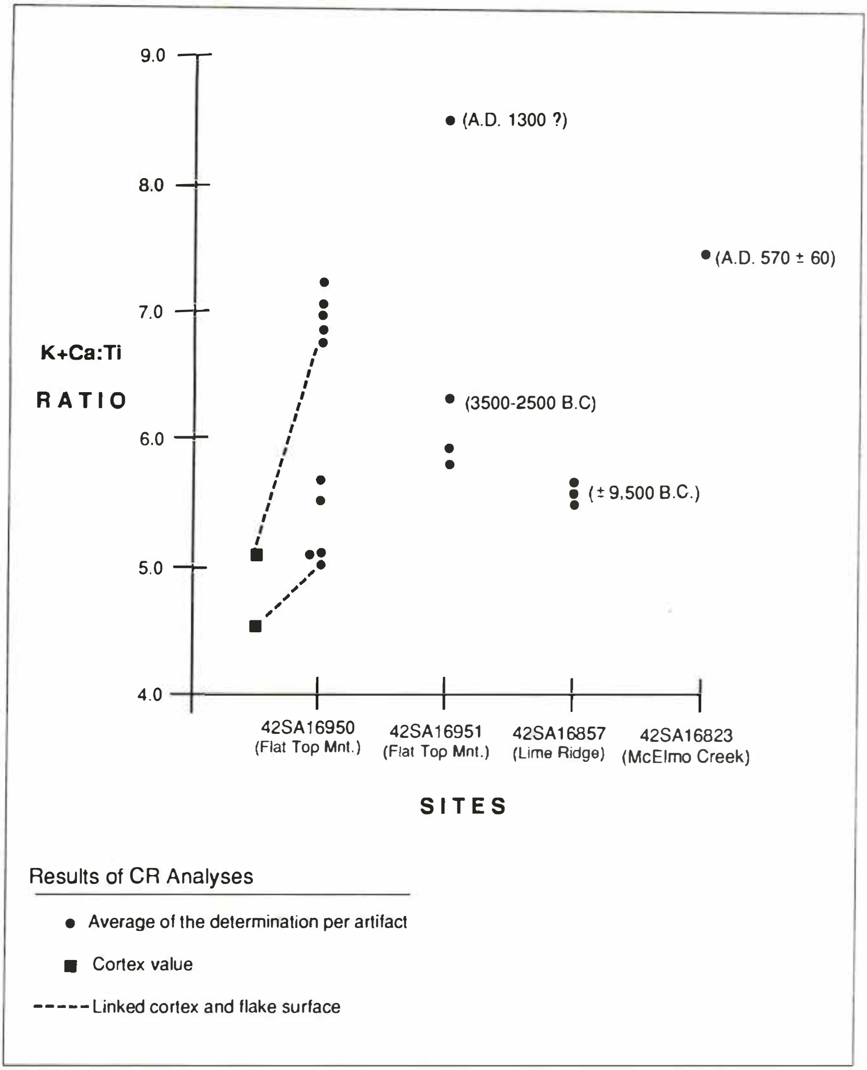

Figure 1. Distribution of desert varnish cation ratio values from southeastern Utah.

Although there may be problems with the CR technique, the results tend to correlate sequentially with the known radiocarbon dated archaeological phases. The potential implications of these observations are tantalizing and suggest that the CR technique may be useful for dating surface artifacts. However, the ultimate resolution must rest on the development of a ^{14}C calibrated cation ratio curve for the Four Corners Region and further verification of the technique.

The authors thank W.E. Davis of Abajo Archaeology, Bluff, UT for permission to sample the Lime Ridge specimens. Funding for the project was provided by the Smithsonian Institution.

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Fossil Bone Coloration as a Paleoenvironmental Indicator

Larry D. Martin and Jeanette Spencer

The color of fossilized bone is often used as an index to its geological age although most kinds of petrifaction are largely independent of age. The use of petrifaction as an age indicator seems to be based on the effects of different climates on the chemistry of the fossilization process (Houston et al. 1966). We have been acutely aware of this fact when working with the late Pleistocene and Holocene bones from the sandbars of the Kansas River near Bonner Springs, Kansas (Johnson 1987). In this case we noted that the extinct fauna uniformly had a very dark coloration, as did certain extant forms (*Bison*, bison) that could be reliably assigned to the early Holocene on the basis of progressive size changes. This dark color only occurred in bones that had been buried in the river channel. Human interments and bones buried by loess or flood deposits in the terraces are light in color. Late Holocene bones have a tendency to be a lighter color than do the older bones but some examples of domestic animal bones are actually quite dark in coloration, so at best color is a poor indicator of age.

Recent chemical analyses (Robins pers. comm. 1988) have indicated that the darkly colored bones have a high surface concentration of iron and that the dark color and iron content are correlated. We have also observed that late Pleistocene bones from sandbars and gravel pits further west in Kansas are of a much lighter color than those in eastern Kansas.

We surveyed the University of Kansas Museum of Natural History Vertebrate Paleontology (KUVP) collection of several hundred bones from river channel deposits for coloration using a Munsell Color Chart. The bones ranged from hue 5YR moderate orange to dusty brown with a few brownish black, hue 10YR pale yellowish orange to dusty yellowish brown. The most significant variation was in the lightness values taken on wet bone samples. We divided these into two groups: one of light colored bones ranging in Munsell lightness values from 4–8, and dark colored bones ranging in lightness values from 1–3.

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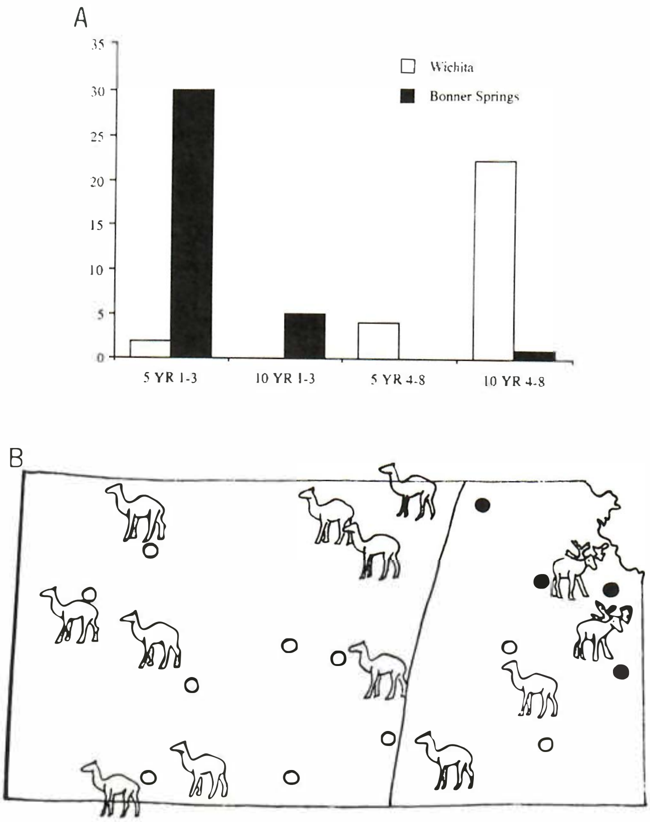

Figure 1. A. Graph comparing the Munsell color values of bones from the Wichita gravel pits with those from the sandbars near Bonner Springs, Kansas. B. Map showing the Kansas locations of bone samples (closed circles) over 75% Munsell color values 1–3 (dark bones) and over 75% values 4–8 (open circles; light bones). The north/south line divides the region of pedocal soils to the west and pedalfer soils to the east. The distribution of *Camelops* and *Cervalces* finds are indicated by the small camel and moose drawings.

Comparison of lightness values of bones from the Wichita sandpits (Rogers and Martin 1985) with those from the Bonner Springs sandbars demonstrates the remarkable difference in color values between the two regions (Figure 1A). A map showing the distribution of late Pleistocene sites showing dominance of either one of the two sets of lightness values quickly demonstrates that dark colored bones are restricted to the northeastern corner of the state and their western extent extends roughly to the line separating pedocal and pedalfer soils in the state. This is not too surprising as pedalfer soils are iron rich and are in part the result of abundant leaching of iron into the water table. Light colored bones do extend further to the southeast than does the soil class boundary and in that sense it correlates almost exactly with the distribution of *Camelops* (camel) in Kansas, while the dark colored bones correlate almost exactly with the distribution of the *Cervalces* (stagmoose) (Figure 1B). The coloration of the bones thus correlate with the *Camelops* and *Symbos-Cervalces* faunal provinces (Martin and Hoffmann 1986), and may be a good proxy for mapping the distribution of past environments independently from interpretations based on the presumed habitat requirements of extinct animals. This is an especially attractive concept because fossil bones from wide geographic areas are concentrated in museums and usually have the best available temporal data. It should be possible to utilize these collections to make taxon-independent maps of some types of past environmental parameters, as our knowledge of bone preservation improves.

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Procedure of the Preservation of Bone that has been Submerged in Water

William L. Parsons

The difficulty with the preservation of bone that has been submerged in water for any great length of time is the damage that is caused by any procedure that would dry out the specimen before it has been completely prepared. The method used on bone from the Hiscock Site, a late Quaternary paleontological and archaeological locality in Western New York (Laub, and N. Miller this volume), eliminates any need for drying until the specimen is prepared.

The procedure is quite simple. Start with an ethanol (denatured alcohol, technical grade) based Butvar (B-72 Polyvinyl Butyral from Monsanto). Next a

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series of four containers should be arranged. The first fill with water. The second fill with a 50% solution of ethanol and water. The third fill with 100% ethanol, and lastly a container filled with a fairly thick concentrated Butvar/ethanol solution. The specimen is to be submerged in each of these containers, gradually replacing the water with ethanol and finally allowing the ethanol to draw in the Butvar solution. The length of time this procedure should take is dependent upon the size, thickness, and delicacy of the specimen. Intermediate solutions of ethanol and water might be introduced in order to insure a more gradual transition from water to Butvar. The result should be that the first time the specimen is allowed to dry will be only when it has been thoroughly saturated with Butvar. Results over the past five years in regard to the Hiscock specimens have been quite satisfactory. Whether it has been the bone of a mastodon or that of a passenger pigeon, all specimens treated in this manner result in very little warping or cracking.

I would appreciate hearing from anyone who uses this technique on either bone or wood.

Paleoenvironments: Plants

A Late Glacial and Early Postglacial Nonsiliceous Algae Sequences for Southeast Wisconsin

James K. Huber and David F. Overstreet

Phycological investigations of nonsiliceous algae from a small bog in Kenosha County, Wisconsin (herein designated at Wis Bog) indicate that the basin has undergone two periods of hypertrophism. The pollen sequence from the same site indicates a shift from the late glacial spruce (*Picea*) zone to one dominated by pine (*Pinus*) and thermophilous deciduous elements between approximately 12,850 and 10,300 yr B.P. (Huber and Rapp 1989).

A 200-cm sediment column was removed for analysis from an excavated unit near the center of the bog. The sediments are primarily composed of degraded peat and gyttja overlying glacial sediments. Only the sediment between 59 and 170 cm contains enough pollen and algae to count other than the 0–10 cm interval which represents the ragweed (*Ambrosia*) rise found in conjunction with pioneer settlement in the upper Midwest (King 1981). Two samples from the sediment column were radiocarbon dated; they are: 87–92 cm, 10,990±150 yr B.P. (Beta-29229) on detrital gyttja and 140–170 cm, 12,600±120 yr B.P. (Beta-29230) on a conifer branch.

The sequence from Wis Bog has been divided into four algae zones (Figure 1). Based on sedimentation rates, Zone I dates from approximately 12,850–12,250 yr B.P. By the beginning of Zone I, a thriving algae community had already been established. Several factors indicate that Zone I was experiencing a period of hypertrophism: elevated *Scenedesmus* levels, an indicator of high nutrient concentration (Cronberg 1982); extremely high algae influx (22,800–55,150 algae/cm^2/yr) and concentration (242,000–1,253,700 algae/cm^3 of wet

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sediment); and high abundances of *Pediastrum* sp., especially *P. boryanum*—an indicator of lake eutrophication (Cronberg 1982). Dinoflagellate cysts (dormant, thick-walled cells) were also observed in Zone I (Figure 1); however their paleoecological significance is not known at this time.

Zone II is marked by a dramatic decrease in *Scenedesmus* (Figure 1). The presence of *Zygnema*-type, *Spirogyra*-type, and *Mougeotia*-type resting spores in Zone II indicates stagnant, shallow, and generally mesotrophic conditions (Van Geel 1978). This zone ends about 11,600 yr B.P. based on sedimentation rates.

A second *Scenedesmus* maximum (Figure 1) occurs in Zone III indicating that Wis Bog underwent a second phase of hypertrophism. Based on sedimentation rates this zone ends at approximately 10,650 yr B.P.

Zone IV is characterized by the almost complete disappearance of *Scenedesmus* and the reduction or disappearance of many other algae taxa (Figure 1). The decline of almost all algae taxa in Zone IV suggests a shift to oligotrophic conditions. The uppermost level of Zone IV is dated at 10,300 yr B.P. based on sedimentation rates; however, the temporal extent is unknown as a result of a hiatus at the top.

Periods of increased *Scenedesmus* abundance (Huber 1988, 1989) and a *Pediastrum* peak associated with the late glacial spruce zone (Crisman 1978; Huber 1988, 1989) have been recorded from sites in Minnesota. These records have been interpreted as indicating increased productivity. The nonsiliceous algae sequence from Wis Bog indicates that the basin underwent increased productivity during the late glacial spruce zone similar to that found in several lakes in Minnesota. Continuing efforts to understand shifts in lake productivity should aid in the interpretation of the environmental conditions at the end of the Pleistocene.

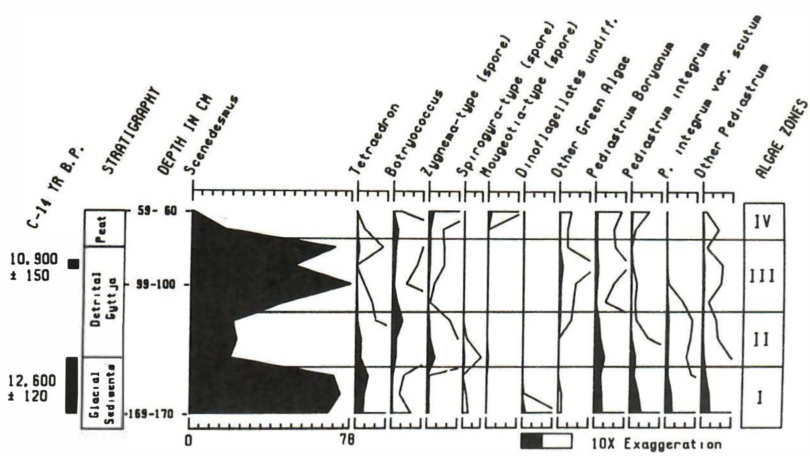

Figure 1. Algae percentage diagram of selected taxa from Wis Bog, Kenosha County, Wisconsin.

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Late-Pleistocene Cones of Jack Pine (*Pinus banksiana*) at the Hiscock Site, Western New York State

Norton G. Miller

The biogeography of the boreal North American conifer, jack pine (*Pinus banksiana*), has been studied extensively, combining the results of investigations of variation in extant populations with an analysis of its Quaternary paleobotanical record. There have been two interpretations of the late Pleistocene history of jack pine (Critchfield 1985), and in particular of the abrupt and rapid appearance of this tree in the deglaciated upper Midwest between 11,000 and 10,000 yr B.P. (Wright 1964). (1) Jack pine, having been eliminated from this region after 18,000 yr B.P., spread rapidly into the Midwest

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across the eastern Great Lakes area during late glacial time from an Appalachian or Piedmont refugium. (2) Small, localized, late glacial populations of jack pine, contributing little to the pollen rain, existed in the Midwest south of the glacial boundary, and these stands acted as centers of dispersal when conditions were appropriate for expansion.

To evaluate these alternatives adequately, more information is needed on the chronology of first appearance of jack pine fossils in eastern and central North America. The fossil record of jack pine consists mostly of its small (Whitehead 1964), smooth-furrowed (McAndrews 1966) pollen, rarely with other palynological criteria evaluated (Ammann 1977). Sometimes its pollen and needles occur together (Watts 1979). Isolated cones of jack pine are much easier to identify, but they seem to be uncommon fossils.

Late Pleistocene sediments at the Hiscock Site, a 0.18 ha peatland in western New York State (43°5'N, 78°5'N; see Laub, and Parson, this volume) contain numerous cones of jack pine. Single scales from each of the two cones illustrated in Miller (1988) have been radiocarbon dated using the AMS technique at 11,135±100 yr B.P. (Beta-28829; ETH-4812) and 11,200±100 yr B.P. (Beta-28830; ETH-4813). The age of these fossils antedates the times of arrival of jack pine in Michigan, northern Illinois, and Wisconsin by 200 to 800 years and supports the concept of an eastern source for the westward late glacial migration of jack pine into the midcontinent region.

The Hiscock Site is being systematically excavated square by square following a grid established in 1983. At the close of the field season in 1989, 14 complete or nearly complete jack pine cones had been discovered, in addition to 10 partial cones, 2 cones scales, 4 cone-scale apophyses, 3 seeds, and 2 skeletonized cones consisting largely of vascular tissue. These fossils were recovered from screen residues or obtained as the squares were excavated by troweling. Even the best preserved specimens appear to have been abraded prior to deposition because they have smooth apophyses and generally indistinct umbos, which lack a prickle (Figure 1). The cones remain closed when kept wet but open if they are allowed to dry.

Two aspects of the Hiscock Site and its paleobotany are of interest in connection with the late Quaternary migrational history of jack pine. (1) Its cones occur in sediments in which pine pollen is only about 5% of a sum consisting of all terrestrial seed-plant pollen types. Pollen of all trees totalled 20%. This unexpected discovery has been explained by suggesting that the late Pleistocene sediment was dominated by the pollen of at- or near-site herbs, a high abundance of which was favored by the small size of the basin and its shallowness (Miller 1988). It cannot be ruled out, however, that much of the herb pollen reached the basin in another way. The cone-bearing sediment is sandy, silty clay, with numerous short decorticated twigs of spruce (*Picea*) or tamarack (*Larix*) that appear to have been eaten by mastodonts (*Mammut*) (Laub et al. 1990). Some of the plant food of these large herbivores must have accompanied them to the basin where any associated pollen was either passed by defecation or released into the sediment after the death of the animal, thereby adding pollen to the basin. To date, the bones and tusks of six mastodonts (MNI) have been recovered from late Pleistocene sediments at the Hiscock Site. (2) The value of investigating sedimentary basins of a type generally ignored in paleoecological studies is demonstrated by our work at Hiscock. Lakes containing continuous sedimentary records have been the preferred study sites. Nevertheless, the small Hiscock basin and its interrupted depositional record, perhaps secondarily modified by spring action, has presented a wealth of new and biogeographically important information. Similar deposits elsewhere should be investigated in connection with the distributional history of jack pine and related problems in biogeography, especially now that techniques are available to date minute plant fragments.

Excavations at the Hiscock Site are under the direction of Richard S. Laub, Buffalo Museum of Science, to whom I am indebted for the loan of specimens and other generous assistance. This note is published as contribution number 651 of the New York State Science Service.

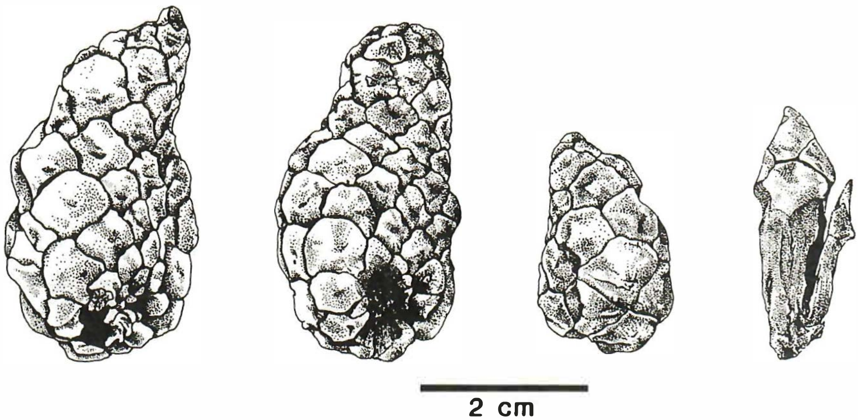

Figure 1. Late Pleistocene cones of jack pine (*Pinus banksiana*) from the Hiscock Site, Genesee County, New York. Grid locations and depths from left: G3NE(61 cm), G4NW(53 cm), G5SW(86 cm), F5NW(60–63 cm).

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A Late Glacial and Early Postglacial Pollen Record from Kenosha County, Southeast Wisconsin

David F. Overstreet and James K. Huber

Palynological investigations were undertaken at a small cattail (*Typha latifolia*) covered bog in Kenosha County, Wisconsin, herein designated as Wis Bog. This study was initiated to aid in the understanding of Paleoindian occupation in the area. The pollen sequence at Wis Bog records local and regional vegetational change from approximately 12,850 to 10,300 yr B.P. during the late glacial/postglacial transition.

A 1- x 2-m unit was excavated near the center of the bog and a 10- x 10-cm sediment column 200 cm long was removed from the wall for analysis. The sediments are primarily composed of peat and detrital gyttja overlying glacial deposits. Sediments younger than 10,950 yr. B.P. are degraded and contain too little pollen to count except for the upper 10 cm representing the ragweed (*Ambrosia*) rise found in conjunction with land clearance in the Midwest (King 1981).

Radiocarbon dates were determined for two levels from the sediment column: 87–92 cm, 10,990±150 yr B.P. (Beta-29229) on detrital gyttja and 140–170 cm, 12,600±120 yr B.P. (Beta-29230) on a conifer branch.

The pollen diagram from the site has been divided into three zones (Figure 1). Based on sedimentation rates, Zone I dates from 12,850 to 12,250 yr B.P. and is comparable to other late glacial spruce (*Picea*) zones in the upper Midwest

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(Holloway and Bryant 1985). *Picea* is the dominant pollen type in Zone I (Figure 1). Cedar (Cupressaceae), oak (*Quercus*), and other deciduous taxa also occur in low amounts as well as grass (Gramineae), wormwood (*Artemisia*), and (*Ambrosia*). Pollen influx is low, <4,000 grains/cm^2/yr. Zone I is interpreted as representing an open spruce woodland or a mosaic of spruce woodland with tundra or tundra parkland.

The transition to Zone II is marked by an increase in the deciduous taxa *Quercus*, ash (*Fraxinus*), hophornbeam/hornbeam (*Ostrya/Carpinus*), and poplar (*Populus*) (Figure 1). *Picea* continues to be dominant while pollen influx increases, ranging from 4,800–13,000 grains/cm^2/yr. The presence of a closing forest of spruce-with-deciduous-elements is indicated by the high percentage and influx of *Picea*, the increased abundance of deciduous taxa, and the increased pollen influx. Zone II ends at approximately 10,650 yr B.P. based on sedimentation rates.

Zone III is characterized by a decrease in *Picea* and maxima in pine (*Pinus*), birch (*Betula*), and elm (*Ulmus*) (Figure 1). Nonarboreal (NAP) pollen increases from 5% to 11%. Zone III represents the decline of spruce woodland in the vicinity of Wis Bog and its subsequent replacement by pine, birch, and thermophilous deciduous genera. The small increase in NAP taxa suggests a more open forest than in Zone II or the presence of more forest openings.

The changing paleoenvironment, indicated by the pollen sequence from Wis Bog, resulted in a shift in available plant resources for Paleoindian occupants of the area. Further investigations may reveal possible trends in local Paleoindian plant exploitation throughout the late glacial/postglacial transition.

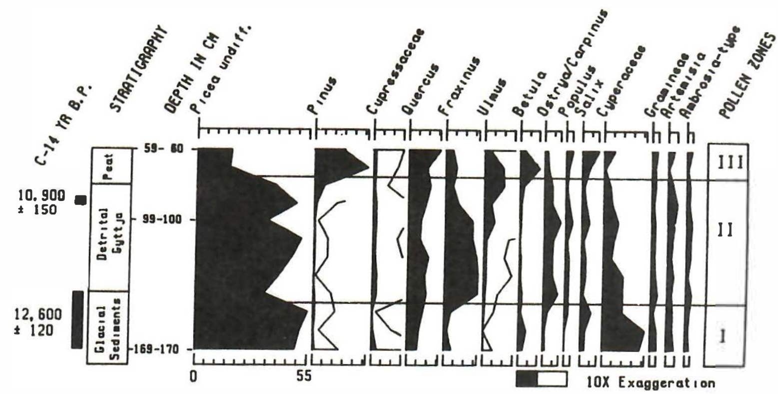

Figure 1. Pollen percentage diagram of selected taxa from Wis Bog, Kenosha County, Wisconsin.

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Paleoenvironments: Invertebrates

The Phenomen of Mass Beetle Genus *Morychus* from Pleistocene Deposits in Northeastern Asia

D.I. Berman

Remains of pill beetles (Byrrhidae) identified earlier as *Morychus aeneus* and *Chrysobyrrhulus rutilans* (Kiselev 1981) are highly numerous in Pleistocene deposits in the northeastern Asia. It was shown (Kuzmina and Korotyaev 1987) that recent *M. viridis* in the USSR North-East belongs to *Morychus aeneus* and to *M. viridis*. The latter tanum is the most abundant of the fossil pill beetles in the USSR (S.A. Kuzmina, pers. comm.).

Biotopic distribution of *Morychus viridis* was studied in the Upper Kolyma Basin, 1985-1988 in about 80 ecosystems. *M. viridis* can be found only in xerophytic communities, however, exclusively in those where the plants *Polytrichum piliferum* (the mass on which larvae develop) and *Carex argunensis*, along with *C. rupestris* or *C. obtusata* (determined by T.V. Egorova and B.A. Yurtsev). The moss is one of the highly distributed and ecologically plastic plant species. *Carex argunensis* is a xerophil and in our region it can serve as the indicator of condition in which *M. viridis* larvae can develop on *P. piliferum*. Those groupings are confined to places which are well drained in summer and snowless in winter. Usually they occupy axial parts of mountain ranges and drifts. From the upper borderline of light forests (about 1,000 m above sea level) they include mountain-tundra species and on 400 m above sea level—mountain xerophytes and meadow-steppe species. Infrequently they jointly form peculiar tundra-steppe communities, where invertebrates are also of mixed nature. The highest numbers of *M. viridis* larvae (100 spp. per 1 m^2) are found on driest and floristically poorest places and in driad-carex groupings of *Dryas octopetala*. Here, they are found both as small patches (30 cm in diameter) and as separate plants. Like *C. argunensis*, *M. viridis* is a

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xerophil well tolerant of temperatures, year sums of air daily positive average temperatures at 1,500 m above sea level are 750° and at 350 m—1400°. Like other organisms of snowless biotopes, *M. viridis* is tolerant of cold; minimal temperatures on soil surface are -50° to 55°C in January. We also have found *M. viridis* in Chukotka (the southern coast of the Chaun Inlet) in tundra-steppe groupings of *C. rupestris, C. supina spaniocarpa* and *C. obtusata;* and on places covered with *C. rupestris* in the Middle Amguema. We also have found it along the Nera River valley (right tributary of the Indigirka River) on steppe slopes.

M. aeneus larva (up to 150 specimens per 1 m^2) live on meadows on the Kolyma River terraces in *Ceratodon purpureus* where soil are sandy-loam. Solitary beetles were found at 900 m above sea level. *M. aeneolus* is also found in the moss *C. purpureus* in North America (P. Johnson, University of Wisconsin-Madison, USA, pers. comm.).

Apparently, *M. viridis* is a stenotop and oligophage on *Polytrichum piliferum,* i.e., it is ecologically a specialized species. This fact allows to use it for reconstruction of environments during formation of the deposits containing numerous remains of *M. viridis.* It is reasonable to suppose that vegetation cover of flood-lands in such periods was mainly composed by undersized grass grouping with xerophilous *Carex* prevalence and with necessary presence of *P. piliferum.* The composition of co-dominants and other concomitant plants could change from steppe to tundra species depending on warm temperatures. Warm temperatures can vary significantly with unchangeable climate depending on location on the micro- or nannoreliefs. Remains of steppe and tundra insect species that were found along with *M. viridis* are indicative for warm temperatures. Recognition of xerophytic nature of general environment implies reduction of meso- and gygrophylic groupings positions in the vegetation cover mosaic. *Carex* domination in vegetation composition was supposed for river valleys in Alaska (Yurtsev 1981) where spore pollen spectra with domination of *Carex* pollen were revealed in late Pleistocene deposits (Schweger 1979).

The most important feature of *C. argunensis* communities is their chionophobous nature, which is based on the attachment to the location where winds are very strong. Winds remote fruticose lichens, hence, xerophilous communities can avoid biotic pressure of those plants. The lichens gradually suppress *Carex* and concomitant plants as winds reduce. It can be assumed the similar importance of winds for landscapes in Pleistocene, that is well-coordinated with early conception summarized by R. Guthrie. Narrow ecological specialization of *M. viridis* makes it possible to suppose relative monotony of forming conditions of the deposits within the limits of vast fossil areas.

In the Amguema River basin, *C. supina spaniocarpe* and *P. piliferum* scanty xerophytic communities are often located on old flood-land terraces of different levels rich in former river-bed channels and lakes. In continental environments and at higher summer temperatures, steppification also affects invertebrates fauna.

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A Post-Chippewa to Pre-Nipissing Low Level Water Fluctuation in the Herring Lakes Embayment, Benzie County, Michigan

Barry B. Miller and Calvin J. Mullett

A 332 cm vibracore from the NW shore of Upper Herring Lake (Figure 1) has provided a record of water-level fluctuations that extends back 7,100 yr B.P. The lake occupies the eastern part of a U-shaped depression within the Manistee Moraine which formed an embayment during the high water level represented by Main Lake Algonquin. Isolation of Upper Herring Lake from the remainder of the embayment has been attributed to development of mid-bay bars during this lake stage (Dorr and Eschman 1970).

The lower 76 cm of core (332–356 cm) are fossiliferous marls dominated by pulmonate aquatic gastropods and pisidiid clams. Charcoal from 15 cm above the base of the core has an accelerator radiocarbon age of 7,065±85 yr B.P. (Beta-32221; ETH-5661). This unit is overlain by 24 cm of organic rich, fine sand (256–232 cm) and a 20 cm layer of peat (232–212 cm) that has yield a 5,640±70 yr B.P. (Beta-32243) age. The sand unit includes two terrestrial taxa, *Gastrocopta tappaniana,* and *Oxyloma* sp., and an aquatic pulmonate, *Acella haldemania,* a

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species that favors protected, shallow areas of eutrophic lakes and ponds (Burch and Jung 1987). Overlying the sand and peat is 164 cm of fossiliferous marl (212–48 cm) with a molluscan fauna similar to that found in the marl below the sand and peat. The upper 48 cm of the core is a woody, peat, with abundant molluscs in the lower 5 cm of this unit.

Lithologic and faunal changes represented by the transition from marl accumulation to deposition of the overlying sand and peat units imply increased eutrophication and significant shallowing of the water between 7,100 and 5,700 yr B.P. If Upper Herring Lake was isolated from the western part of the embayment by growth of mid-bay bars during the Main Algonquin lake level, as suggested by Dorr and Eschman (1970), then these water-level changes must be due to other factors.

Climatic change has been suggested as another factor contributing to some of the water plane oscillations in the Lake Michigan basin since the early Chippewa low level, about 10,200 yr B.P. (Larsen 1985). The apparent drop in water depth observed in the Upper Herring Lake core coincides with the post-Chippewa to pre-Nipissing low water level in the southern Lake Michigan reported by Larsen (1985), who attributed this fluctuation to climatic effects. The Upper Herring Lake core may be recording another manifestation of this same climatic change.

This study was supported by a Kent State University Summer Research Appointment and National Geographic Society grant 4046-89.

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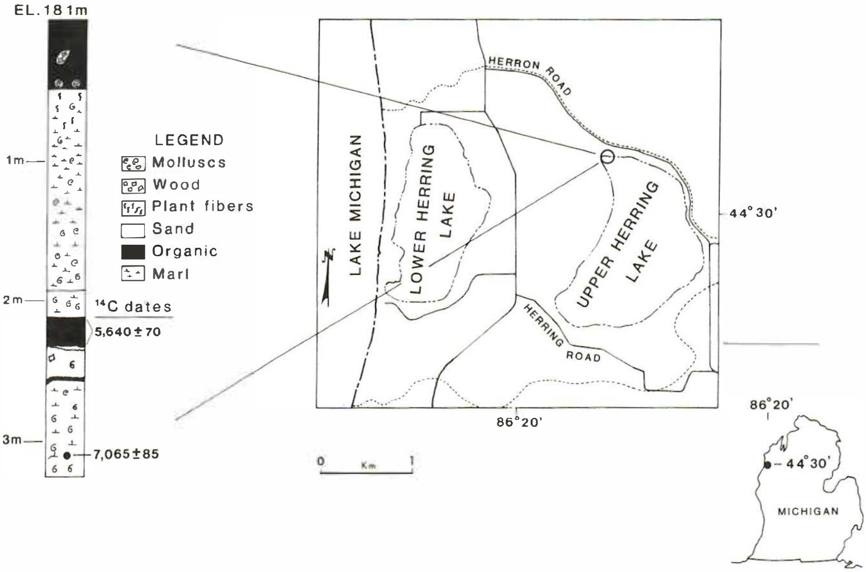

Figure 1. Location of core (circle from NW shore of Upper Herring Lake, Benzie County, Michigan and lithologic description. The lake occupies part of a depression, outlined by a thin dashed line, within the Manistee Moraine.

Paleoenvironments: Vertebrates

A Large White-tailed Prairie Dog, *Cynomys* (*Leucocrossuromys*), from the Pleistocene of Kansas.

H. Thomas Goodwin

A well preserved skull with lower jaws of a prairie dog, genus *Cynomys*, was collected by Allen Graffham in 1943 from a Pleistocene gravel pit in Finney County, west-central Kansas. This specimen, University of Kansas Museum of Natural History Vertebrate Paleontology (KUVP) 6908, represents a large white-tailed species, subgenus *Leucocrossuromys*. The subgenus today includes three species of high-elevation basins and valleys of the Rocky Mountain region—*C. gunnisoni*, *C. parvidens*, and *C. leucurus* (Hall 1981). No white-tailed species occur today on the Great Plains, now occupied by a black-tailed prairie dog, *C. ludovicianus*, subgenus *Cynomys* (Hall 1981).

Other researchers have reported Pleistocene white-tailed prairie dogs from the central Plains (Semken 1966, Stewart 1975, Voorhies and Corner 1985), primarily based on one character—the presence of a stylid connecting the ectolophid and talonid on fossil m3s as usually found on modern white-tailed, but not black-tailed specimens (Semken 1966). However, independent criteria are needed because the validity of identifications based only on this character have been questioned (Stewart 1975). KUVP 6908 bears a white-tailed character on the m3, but also preserves two white-tailed cranial characters, not previously documented on fossils from the central Plains. First, the anteroventral margin of the jugal forms a rounded prominence (Figure 1A) as in modern white-tailed species; it is not strongly triangular (Figure 1B) as in modern black-tailed species (Hollister 1916). Second, the dorsal margin of the occiput, in posterior view, is broad and relatively flattened (Figure 1D) as usually seen in one extant white-tailed species, *C. leucurus* (Figure 1E). In contrast, this margin is domed

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and much less flattened in modern black-tailed prairie dogs (Figure 1C). Clearly, the fossil represents a white-tailed species.

Condylobasal length of the fossil (61.9 mm) is greater than average values from samples of modern C. *ludovicianus* [$\bar{X}$ (SD) = 59.4(2.11 mm, n=31] and C. *leucurus* [$\bar{X}$ (SD) = 58.9(2.12) mm, n= 15], the two largest extant species. Large size evidently characterized Pleistocene white-tailed prairie dogs of the Plains. Voorhies and Corner (1985) noted large size of putative white-tailed specimens from Nebraska, and Burns (1989) described a new late Pleistocene white-tailed species (C. *churcherii*) from Alberta, based primarily on large size.

Large-sized white-tailed prairie dogs from Alberta, Nebraska, and Kansas may represent the same extinct Pleistocene species, probably closely related to the extant C. *leucurus*. The extent, temporal stability, and paleoenvironmental implications of the range of this Pleistocene species are presently under study.

I thank L.D. Martin for his helpful comments on an earlier draft of this paper.

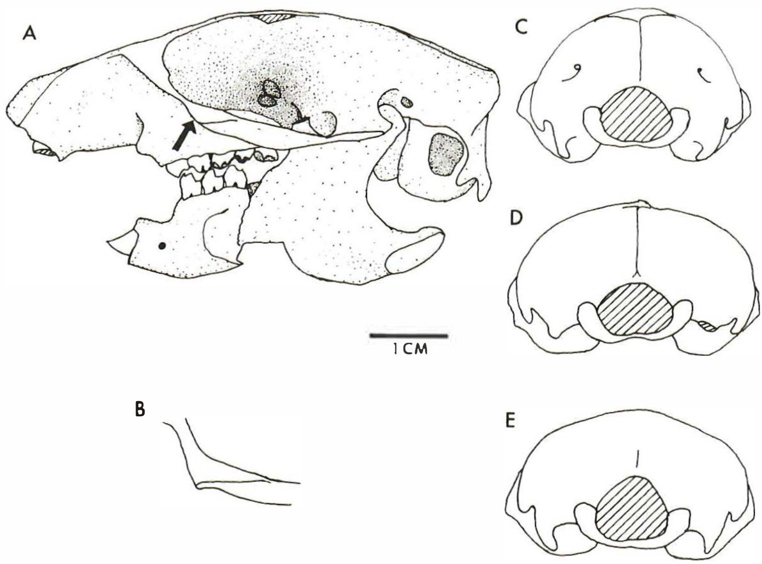

Figure 1. Skull and lower jaw of a fossil white-tailed prairie dog, KUVP 6908, with the jugal indicated by an arrow (A). The jugal of a recent black-tailed prairie dog is shown for comparison (B). Posterior view of the occiput of a recent black-tailed specimen (C); the fossil, KUVP 6908 (D); and a recent white-tailed specimen (E). The scale bar applies to all figures except (B).

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New Dates on Alaskan Quaternary Dogs and Wolves

R. Dale Guthrie

We know wolves (*Canis*) were domesticated in Eurasia prior to 12,000 yr B.P. Clearly dogs (*C. familiaris*) accompanied people to the New World rather early, as dog fossils occur in Paleoindian sites (Walker and Frison 1982)—the question is how early? I think it is getting clear when the first human colonists arrived but it is still unclear whether they had dogs. Because dogs are man-made animals, dog skulls are evidence of human presence, as valid as human skeletons or finished lithic tools. Specific shifts in cranial and dental contours (Nowak 1979; Walker and Frison 1982) produced by domestication make it possible to distinguish dog and wolf skulls. Dog skulls dating prior to 12,000 yr B.P. would throw new light on a number of important chronological issues.

Sixty years of fossil collecting from gold-mining exposures in Interior Alaska have yield a number of wolf and dog skulls. It has been assumed that these dog skulls were ancient, because they were collected at localities consisting mainly of late Pleistocene age sediments and were accompanied by extinct genera of Pleistocene mammals (mammoth, *Mammuthus* and bonnet-horned muskoxen, *Bootherium*). These Alaskan dog skulls had not been dated because conventional radiometric ^{14}C methods would have required destruction of the entire specimen; however, AMS dating techniques have made it possible to date minute samples. The following AMS dates on *Canis familiaris* skulls are from the Alaskan specimens in the American Museum of Natural History. F:AM-688 70932 from Fairbanks Creek, 105±50 yr B.P. (AA-

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3900); F:AM-672 8171 from Fairbanks Region, 355±60 yr B.P. (AA-3901); F:AM-82 1006 from Ester Pit, 140±80 yr B.P. (AA-3903); F:AM-199 8698 from Ester Creek 490±50 yr B.P. (AA-3903); F:AM-30434 from Cleary Creek, 600±70 yr B.P. (AA-3905); F:AM-30473 from Fairbanks Area, 330±70 yr. B.P. (AA-3907); F:AM-200 4345 from Little Eldorado Creek 130±50 yr B.P. (AA-3908); F:AM-197 8697 from Ester Creek (New Cut), 230±55 yr B.P. (AA-3909); F:AM-340 1038 from Little Eldorado Creek, 140±80 yr B.P. (AA-3910); F:AM-482 2548 from Cripple Creek, 370±105 yr B.P. (AA-3911).

The AMS dates show these dog skulls were recent or sub-recent specimens which became mixed with Pleistocene bones. Since most Alaskan Pleistocene fossils were picked up as byproducts from hydralic removal of frozen silt at placer gold mines (Guthrie 1990), there was ample possibility for mixing. The dates on these particular skulls do not mean all dog bones from Alaskan mining deposits are so recent. In the future I hope to date all Alaskan fossil dog skulls, on the chance that some may date much earlier.

A wolf, *Canis lupus*, skull, stained an identical hue, from the same collection (F:AM-295 5219 from Fairbanks Creek) was dated by the same technique. It dated at the peak of the last glaciation: 18,610±165 yr B.P. (AA-3912). This is the first individually dated Pleistocene wolf skull from Alaska (there are many undated wolf fossils and wolf-chewed bones of large herbivores are common).

This set of dated dog skulls lets us answer a question that frequently arises in Beringian archaeology and paleontology; what happens when more recent bones are soaked with highly organic Pleistocene muck until they turn as dark in color as the Pleistocene specimens? Apparently only small amounts of fossil carbon are taken up and, though the bone may appear very old, the reliability of collagen dating is not significantly threatened. Thus, we can more confidently turn to isotope dating when faced with enigmatic Beringian Pleistocene bones (Nelson et al. 1986; Guthrie and Greenwalt 1988 for additional evidence).

I express my thanks to the American Museum of Natural History for their permission to date these specimens. Dating was done by the AMS lab at the University of Arizona, Tucson.

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New Dates on Alaskan Quaternary Moose, *Cervalces-Alces*—Archaeological, Evolutionary, and Ecological Implications

R. Dale Guthrie

Moose-like animals in the form of *Cervalces gallicus* first appear in the fossil record of Eurasia during the early Pleistocene (Azzaroli 1985). *Cervalces* colonized North America in the late Pleistocene. This New World "stag moose", *Cervalces scotti,* distinguished by its bizarre convoluted palms, diverged from the simple-palmed Old Word *C. latifrons,* but retained other *Cervalces* features: broad occiput, long basal antler trunk, elongated nasal bones, among others. Sometime during the last glaciation, Eurasian *C. latifrons* underwent rapid evolutionary changes toward anatomically modern moose (*Alces alces*). The New World *C. scotti* became extinct at the end of the Pleistocene. Alaskan fossil antlers do not show the convuluted palms characteristic of North American *C. scotti,* suggesting that *C. latifrons* entered the New World via Alaska during isotope stage 3, but that *C. scotti* which evolved in mid-continent North America, never "backwashed" into Alaska.

Although this outline is more-or-less agreed upon, problems, particularly chronological ones, remain (Churcher and Pinsof 1987). Alaska and Northeast Asia are critical locations to track Alcini evolution. Fortunately, quite a few fossil moose have been found in the north, but almost none are accompanied by secure dates. I have just dated less than 10% of the Alaskan *Cervalces-Alces* specimens, including three mummies. These dates reveal an interesting pattern.

Three mummies of *Cervalces* have been found in Alaska (Guthrie 1990). These mummies, which were found near Fairbanks, Alaska, date from the Boutellier Interval (isotope stage 3): F:AM-274-4002, yearling bull from Little Eldorado Creek, 33,000±750 yr B.P. (AA-3897, AMS on skin); F:AM-274-4001, young cow from Little Eldorado Creek, 25,330±200 yr B.P. (AA-3896, AMS on skins); UA-V64, young bull from Livengood, 32,040+870/-980 yr B.P. (DIC-3090, radiometric on skin).

Three fossil antlers, identical in form to extant moose antlers, were also dated. The first two were chosen because they show cut-marks made by a saw or similar tool. Both were collected by O.W. Geist in 1935. One, F:AM-2039 (Box 76) from the Fairbanks Region, was labeled "Frozen in place about 15 ft below surface and some 2 ft below the partial cranium of a bison also showing on the same exposed face of the cut." The date on this specimen was 8,740±70 yr B.P. (DIC-2414, radiometric date on antler collagen). This antler is the oldest evidence of *A. alces* in Alaska and is also the earliest case of Alaskan moose showing evidence of human use. The second cut antler, F:AM-539 from

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Goldstream Creek, dated much more recently, 740±40 yr B.P. (DIC-2415, radiometric date on antler collagen). The third fossil *Alces alces* antler was one I collected from Pearl Creek, Alaska, near Fairbanks. The date on this large antler was 5,380±55 yr B.P. (DIC-2416, radiometric date on antler collagen).

This is a small Alaskan sample but it is notable that: (1) there are no dates within the last full glacial (isotope stage 2), (2) transitional *Cervalces* date from the Boutellier Interval (isotope stage 3), (3) anatomically modern moose are confined to the Holocene. The resources upon which modern Alaskan moose depend, such as boreal forest succession vegetation and rich riparian willows, were missing from the full glacial (isotope stage 2), so the absence of moose in Beringia during this time is not surprising. Shrubby habitat, suitable for moose, did exist during the last interstade (isotope stage 3) and it was occupied by a *C. latifrons*. Between the end of the last interstade (ca. 24,000 yr B.P.) and the return of shrubs after the full glacial (ca. 14,000 yr B.P.), the archaic moose *C. latifrons* was replaced by advanced moose, *A. alces*. Evidently, *A. alces* was the product of rapid evolutionary change in the mid-latitude Asia. Asiatic peoples moving into Beringia at the end of the last glaciation and thence south into the New World, seem to have been accompanied by another colonist, *A. alces*.

I wish to thank the American Museum of Natural History for allowing me to date Alaskan moose in the Frick Collection (F:AM), and the University of Alaska Faculty Grant Program which made the dating possible.

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The Koehn-Schneider Mammoth Site of Western Kansas

William C. Johnson, Nadine Cheney, and Charles W. Martin

The Koehn-Schneider site (14GL496) is located 1 km east of the town of Tribune in Greeley County, Kansas. Here, mammoth remains have been found and excavated from the alluvial fill of White Woman Creek. The bone material was exposed spring 1987 when concentrated runoff from the construction area of an electrical substation eroded a gully from and normal to the right (south) channel bank of White Woman Creek. Excavation of the site was conducted and the specimens removed for preservation and display. An adult (probable female) mammoth (*Mammuthus columbi*) skull, mandible, and tusk, plus a juvenile tusk, were found. The material was buried very close the the edge of the bank and would have been exposed if the channel had laterally eroded but a few centimeters. Because the skull was facing away from the channel and bones have in years past been reportedly found within the channel at that location, it is possible that the body of the animal(s) had been periodically eroding out of the alluvial fill. Unfortunately, none of the bones previously found in the channel bed have been recovered for identification. The skull, mandible, and tusks were found resting within the upper portion of a clayey silt layer situated in the basal sand and gravel fill approximately 50 cm above the present channel bed.

The gully exposure and backhoe trenches provided a complete section of the alluvial fill at the site (Figure 1). White Woman Creek is developed within the Ogallala Formation, and less than 2 m of fill exist below the channel bed at the site. Approximately 1.5 km upstream the creek bed is directly on Ogallala bedrock. Two terraces occur at the site, the lower of which is a cut surface, i.e., the terraces have a common fill that can be traced in the gully cut. There is 3–4 cm of basal sand and gravel fill overlying the Ogallala. Within the middle of the unit is a 50–60 cm thick clayey silt layer, relatively rich in organic matter. It is with this layer that the mammoth bones were associated. The coarse basal fill is overlain by a clay and silt unit, exhibiting three pronounced buried paleosols that consists of simple A/C horizonations. Radiocarbon ages (^{13}C corrected) were determined on humates from samples of the upper 5 cm of the buried A horizons. In ascending stratigraphic order, the soil ages are 11,170±170 (Tx-6371), 9,800±120 (Tx-6372), and 7,460±130 yr. B.P. (Tx-6373). Also ivory and bone were dated from the adult mammoth, producing a ^{13}C corrected, apatite-based age of 11,050±170 yr B.P. (Tx-6405). Since radiocarbon dating of the mammoth

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was done on the apatite fraction and the overlying cumulic Ab horizon is slightly older, we would estimate that the true radiocarbon age of the animal is closer to 11,400 yr B.P.

The latest Pleistocene and Holocene history of the site, as reconstructed from the stratigraphy, first indicates movement of Ogallala-derived sands and gravels through the system. An interruption in the deposition occurred when the fine sediments were deposited in a quite-water environment; during this time the mammoths were present. There was then a brief resumption in coarse sediment deposition, which buried the mammoth remains. Fine sediments comprise the Holocene fill, within which the soils developed during times of negligible floodplain aggradation. The time at which entrenchment occurred is unknown, but it was likely within the last 2,000 years.

As with many such finds, the possibility for cultural association, albeit slight, should be considered. At this site, the condition and orientation of the skull and other bones indicate they were not transported by water. Further, possible butcher marks exist on the right side of the skull. Clovis points have been found in the area, but the closest thus far was located about 1.5 km upstream. If this were a kill site, one would envision the mammoth, possibly with a calf, being killed while bogged down in the muddly sediments of the ponded water area. A cultural association at this site is certainly tenuous, however.

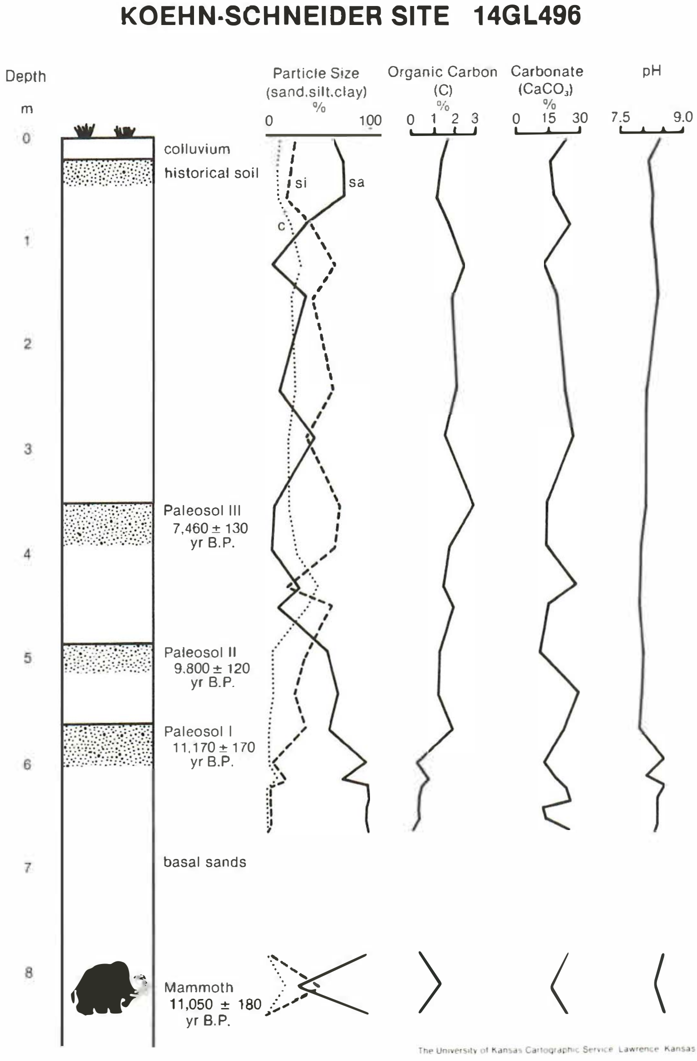

Figure 1. A summary of stratigraphic information for the site.

The Hiscock Site (Western New York): Recent Developments of Pleistocene and Early Holocene Interest

Richard S. Laub

The Hiscock Site lies between Buffalo and Rochester, in the town of Byron, Genesee County, New York (see N. Miller, and Parsons this volume). In an excavation project that began in 1983, the Buffalo Museum of Science has collected a large assemblage of late Quaternary paleontological and archaeological remains from this locality, and a number of reports have appeared in the literature: Steadman et al. 1986; Steadman and Miller 1987; Muller and Calkin 1988; Laub et al 1988; Miller 1988; Steadman 1988; Fisher 1988; Gramly 1988. Laub has reported field results periodically in the issues of "Collections", newsletter of the Buffalo Society of Natural Sciences. The present report provides an up-date on developments as of the 1987 field season.

Pleistocene sediments at the site are essentially limited to several irregular basins in the floor of a larger basin. These deposits appear related to spring activity, and the secondary basins are suggested by Muller and Calkin (1988) to have developed through spring-sapping. Field observations appear to support this view.

Remains of a minimum of six mastodons (*Mammut americanum*) have been recognized to date, based on tusks (two mature males, one mature female, two juveniles, one undetermined individual). Mastodon, and other Pleistocene remains typically occur in sediment rich with short sections of conifer twigs. Size distribution and condition of these twigs are similar to those of the components of fecal boluses of modern Indian elephants (*Elephas maximus*), as well as putative ground sloth (Mylodont) "stomach contents." The twigs also agree with material commonly reported in association with mastodon gastrointestinal contents, perhaps largely fecal. A manuscript has been submitted on this study, identifying some of the twigs as either spruce (*Picea*) or tamarack (*Larix*). Several skeletonized jack pine cones (*Pinus banksiana; fide* Norton G. Miller, N.Y. State Museum) were found among the twigs, suggesting that this species may have been part of the animals' diet. Lack of herbaceous macro-remains among these materials might be a consequence of differential preservation, rather than dietary habits.

A number of animals new to the site have been found, but not yet fully identified. A fragmentary tooth of a large ruminant, consistent with moose (*Alces*) or stag-moose (*Cervalces*), was found at the base of the Pleistocene deposit. More precise identification will have to await discovery of additional

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material. An ulna of a goose-sized bird was found embedded in a layer dating to about 8,500 yr B.P. (Beta-34287). A small bone fragment (Pleistocene) and a large posterior rib (early? Holocene) may belong to additional animals, but their study has not yet progressed sufficiently to allow certainty.

Two possible intact coprolites occurred at a level suggesting an early Holocene age. As there is evidence of bioturbation at the site, these could have been deposited within burrows, and might not be of great antiquity. Should they prove to be coprolites, their age will have to be determined by ^{14}C analysis.

Laub et al. (1988) briefly discussed a number of Pleistocene artifacts excavated from the site. In 1987 and 1989 two additional tools were found. One, the proximal portion of a fluted point (Buffalo Museum of Science catalog no. C28844), occurred anomalously in the highest stratum of the site basin, considered to date from the time of European settlement, and may have been tossed from the surrounding slope by a passer-by. The second point (C24846) is more nearly complete, lacking a proximal corner. It lay in the Pleistocene spring deposits among mastodon bone fragments and confer twigs. Due to evidence of mixing within the spring deposits, it cannot be assumed that tool and fossils belong to a single event. Nevertheless, three confer twigs and some bone particularly close to the point (within 8 cm) are being individually dated by the AMS method. Should they all fit within a narrow range, this might suggest an age for the artifact.

All four Pleistocene points found to date appear to have been broken and re-worked into processing tools such as scraper (*fide* R. Michael Gramly, Buffalo Museum of Science). Taken on combination with Fisher's (1988) determination that at least some of the mastodons died in late winter or spring (a trait shared by those of his mastodons that lacked obvious evidence of butchery), it is possible that Hiscock represents, at least in part, a scavenging site for Paleoindians. At least one mastodon bone has been found with marks whose pattern suggests human involvement.

The first fluted point found at the site (C24956) was located near a cluster of large cervid vertebrae (Laub et al. 1988). As dating suggested these lay in a lag deposit, on an erosional surface, it was not assumed that point and bones were related historically. An AMS date obtained recently (Beta-24411) confirms that at least some of the bones considerably post-date the artifact.

Of recently determined ^{14}C ages, the following pertain to the late Pleistocene and early Holocene: *Mammut* innominate, 10,515±120 yr B.P. (Beta-24412); conifer twig, possibly *Mammut* gastrointestinal contents as discussed above, 10,465±110 yr B.P. (NSRL-198/AA-4943); fine-grained peat layer overlying Pleistocene spring deposits and containing bird bones, 8,520±95 yr B.P. (Beta-34287); *Odocoileus* mandible , 7,880±90 yr B.P. (Beta-24410); white oak wood, 7,435±95 yr B.P. (Beta-34288); cervid thoracic vertebra fond with other cervid bones near fluted point (C24956) in what appears to be a lag deposit, 6,220±85 yr B.P. (Beta-24411).

Finally, one must list as a particularly significant development, the donation last year of this remarkably rich site by the Hiscock family to the Buffalo Museum of Science. This very generous act secures the Hiscock Site for the benefit of Science. It may be hoped that Charles and Doris Hiscock will serve as an example to others, who can thereby directly contribute to the advancement of human knowledge.

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Ovibos moschatus from the Pleistocene of Montana

John F. Neas

A partial skull of the musk ox, *Ovibos moschatus,* was collected by Mrs. William Hass from a gravel pit near Outlook in Sheridan County, Montana. The specimen (KUVP 7037) was catalogued in the early 1940's, but the exact year of its collection is unknown. This skull is important in that it further refines our knowledge of the Pleistocene distribution of musk oxen in the United States.

The specimen consists of a nearly complete cranium, frontal portions of both orbits, and short, complete and symmetrical horn-cores; the facial region is missing (Figure 1). Measurements (mm) are: width at notch between orbits and horn-cores; 159.5; length from dorsal midline to tip of left horn-cores, 187.0; height of occipital crest from bottom of condyles, 125.1. Exostosis at the base of the horns nearly meet at the midline and clearly indicate a male. The animal was at least seven years of age and possibly older, as evidenced by the degree of fusion of the occipital elements, and the downward deflection of the horns close to the sides of the temporal fossae (Allen 1913), the pronounced pharyngeal (basilar) tubercles, the strongly flexed basicranial axis, and the considerably resorbed horn-cores. Old bull musk oxen, such as this specimen, are frequently solitary individuals, but they usually rejoin herds during the winter and when predators threaten (Freeman 1971).

Ovibos moschatus is usually considered to be tundra specific or, more rarely, a loess-steppe indicator (Harington 1970). Approximately 70 specimens are known from Alaska and 20 from Canada (Alberta, British Columbia, Manitoba, Northwest Territories, Ontario, Yukon Territory). In addition to Montana, *Ovibos* has been found in Colorado, Illinois, Indiana, Iowa, Minnesota, Nebraska, New York, Ohio, South Dakota, Wisconsin, and Wyoming. With a few exceptions, these latter finds occur either just north or south of a line marking the maximum extent of the Wisconsin glaciation (Kitts 1953). The earliest record of *Ovibos* in the New World is from the Illinoian (Irvingtonian) of Alaska (Nome and Cripple Creek Sump), but in Europe *Ovibos* is known from earlier deposits (Günz-Mindel age) at Süssenborn and Obergünzberg, Germany (Kahlke 1964).

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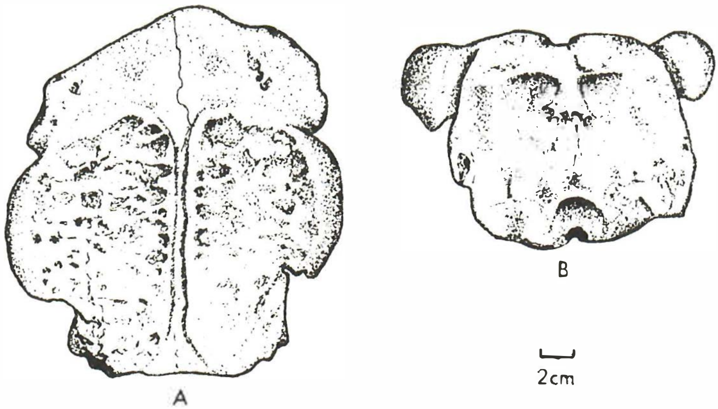

Figure 1. Dorsal (A), and Posterior (B) views of *Ovibos moschatus* skull from Outlook, Montana (KUVP 7037).

Pleistocene Lamines from Kansas

John F. Neas and Jean P. Hall

Several important specimens of camelids have been described from Kansas, including the type specimens of *Megatylopus cochrani* (Hibbard and Riggs), *Camelops kansanus* Leidy, and *Alforjas taylori* Harrison. Our knowledge of

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Kansas lamines, however, is mostly that of pre-Pleistocene forms, such as *Hemiauchenia vera* (Matthew), the type specimen from Hemphillian (Ogallala Group) deposits near Long Island, and referred *H. blancoensis* from Blancan sediments of the Rexroad, Keefe Canyon and White Rock local faunas (Hibbard 1970; Kurten and Anderson 1980). Hay (1924) reported several camelid specimens from Kansas, but their size and his descriptions do not conform to those of lamines. The only previous report of Pleistocene llamas in Kansas is that of *Hemiauchenia macrocephala* from the Rancholabrean Cragin Quarry of Meade County (Hibbard 1970).

Hemiauchenia differs from *Paleolama* in several dental characters, in having less stocky limbs, and in spatial distribution. While both forms are known from South America, Texas and Florida, *Hemiauchenia* is known from many states west of the Mississippi River (Webb 1974; Kurten and Anderson 1980). *Hemiauchenia* also is clearly smaller than all other contemporaneous Pleistocene camelids of North America (Corner 1987).

Recently identified *Hemiauchenia* specimens from the Pleistocene of Kansas include two proximal phalanges—one from the Kansas River near Bonner Springs (KUVP 85206; collected by the J. Ashberger family from the SE1/4, sec.6, T12S, R23E) and the other from a sandpit of the Miles Sand Company in Wichita (SW1/4, sec.19, T26S, R1E)—and an uncatalogued partial skeleton (presently in the Museum of Anthropology, Kansas University) from Jewell County. As can be seen in Figure 1, the scar for the suspensory ligament on the proximal phalanges of *Hemiauchenia* is "W-shaped" with raised posterolateral corners; it does not extend below the proximal fourth of the bone (Harrison 1979). These are compared with a proximal phalanx of *Camelops* (KUVP 85215), also from the Miles Sand Company. In *Camelops,* the scar is more "U-shaped" and extends at least half the length of the volar surface (Webb 1965). Measurements (mm) of the Kansas River and Wichita *Hemiauchenia* and *Camelops* phalanges, respectively, are: proximal width, 28.7, 30.7, 39.0; anteroposterior diameter of proximal end, 28.8, 29.2, 34.3. The Wichita *Hemiauchenia* phalanx has a total length of 102.3 mm and a width of the distal trochlea of 23.3 mm. Kurten and Anderson (1980) show an additional record of *Hemiauchenia* in northeastern Kansas but that record properly belongs to the type specimen of *H. parva* from Herculaneum, Missouri (D. Webb and E. Anderson, pers. comm.)

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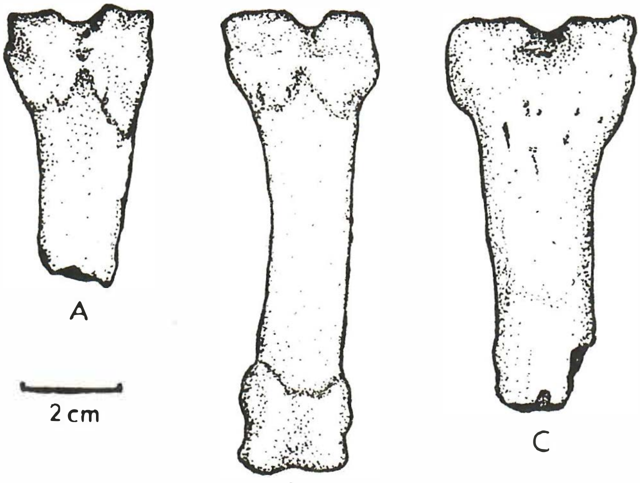

Figure 1. Volar views of proximal phalanges of: A) *Hemiauchenia* sp., KUVP 94003, from near Bonner Springs, KS; B) *Hemiauchenia* sp. KUVP 85206, from Wichita, KS; C) *Camelops* sp., KUVP 85215, from Wichita, KS.

Was a Taphonomic Bias Present in the Fossil Accumulation at Pit 13, Rancho La Brea, California: an Interpretation Using Dire Wolf (*Canis dirus*)

Michael W. Ruddell

The late Pleistocene fossil deposits of Rancho La Brea, California, provide one of the largest paleontological collections in the world. The dire wolf (*Canis*

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dirus), is the most abundant vertebrate found at Rancho La Brea and therefore affords the potential for a paleo-population study. I have undertaken a study to determine if microevolutionary change can be recognized for the period of deposition that occurred at the locality. Based on collagen radiocarbon dates from extinct fauna, the period in question is from approximately >36,000 yr B.P. to 11,000 yr B.P. (Marcus and Berger 1984). The underlying assumption necessary for this study is that the individuals intrapped in the various pits are representative of an average population for each episode of deposition.

In order to assess if a change through time in the dire wolf population could be defined, 14 measurements of the skull were chosen. Each measurement was statistically analyzed by using a time dependent regression representing the aforementioned time period. An interesting and very consistent fact became apparent in the regressions. The values measured from Pit 13 appeared to be smaller than those from the other pits used for analysis in every instance. Some measured values fell close to those from Pit 13, but not with any consistency. The somewhat undersized morphometric measurements were probably inducing the slope to appear negative. When Pit 13 data was eliminated, the slope appeared to be more or less at zero, or in other words, no change through time could be detected using this method. Only one measurement has possible significance, the width of the zygomatic arch: R-squared value 0.442 including Pit 13, and 0.382 after excluding Pit 13. Although significant, a somewhat weak coefficient of determination is evident, and, it is also evident that data from Pit 13 still appears somewhat aberrant.

Shaw and Tejada-Flores (1985), in a study of the ectocuneiforms of sabre-tooth cat (*Smilodon*) from Rancho La Brea concluded that based upon body mass calculations and the frequency of truncated ectocuneiforms that an increase in size occurred. However, specimens from Pit 13 were significantly smaller than those from the same time period. They suggested that possibly Pit 13 represents a period of deposition in which only smaller individuals were trapped. Unfortunately, no accurate taphonomic data is available concerning the excavation of Pit 13, only the original field notes which did indicate that *Smilodon* elements appeared smaller than other pits (Shaw, pers. comm. 1989).

Even with the lack of detailed excavation notes it appears that fossil accumulation at Pit 13 was different in contrast with the other pit localities at Rancho La Brea. The preliminary evidence of my research of *Canis dirus* skulls, and the *Smilodon* ectocuneiform study, seems to indicate a taphonomic bias selecting for smaller individuals of these two species. Or, alternatively, for some unknown reason, the local population at the time of Pit 13 deposition were all smaller than the presumed norm. These conclusions could be examined by further study of Pit 13 in the following areas: the relative amount of juveniles, other skeletal elements of *Canis dirus* and *Smilodon* should be measured and studied, and other taxa should be analyzed. Rancho La Brea provides the paleobiologist with a unique opportunity to study a paleo-population. Therefore, the taphonomic implications of Pit 13 could be investigated for future research.

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Distribution of *Mammut americanum* in the New World

Jeheskel Shoshani

Sixty-seven years have elapsed since the surveys by Hay (1923, 1924) on remains of the American mastodon, *Mammut americanum*, were published. Osborn (1936) revised Hay's maps, and this note updates *M. americanum* distribution using museum collections and consulting these references: Dreimanis (1968), Frick (1933), Gustafson et al. (1979), Harington (1977), Hay (1925), King and Saunders (1984), Mead et al. (1979), Miller (1987), Oldale et al. (1987), Skeels (1962), Shoshani (1989), D. Walker (pers. comm., Dec., 1989, via J.J. Saunders), West and Dallman (1980), and Whitmore et al. (1967). Collections at the American Museum of Natural History (New York), the Florida Museum of Natural History, the George C. Page Museum (California), the Tyrrell Museum of Paleontology (Alberta), and the University of Michigan Museum of paleontology were also studied.

Data presented here (Figure 1) are summarized as: [1] the minimum estimate of *M. americanum* in the New World is 1,473 individuals (an increase of about 187% since the first surveys), and [2] the vast majority (80.8%) of the specimens were found in the eastern half of North America (corroborating the hypothesis of association of the American mastodon with forested regions; King and Saunders 1984). Radiocarbon dates indicate that *M. americanum* became extinct close to the Pleistocene-Holocene boundary, about 10,000 years ago (Mead and Meltzer 1984). This survey is by no means complete; rather, it is a brief communication intended to stimulate researchers to continue to update this distribution map so that we may be able to construct maps similar to those of Agenbroad (1984) for *Mammuthus*.

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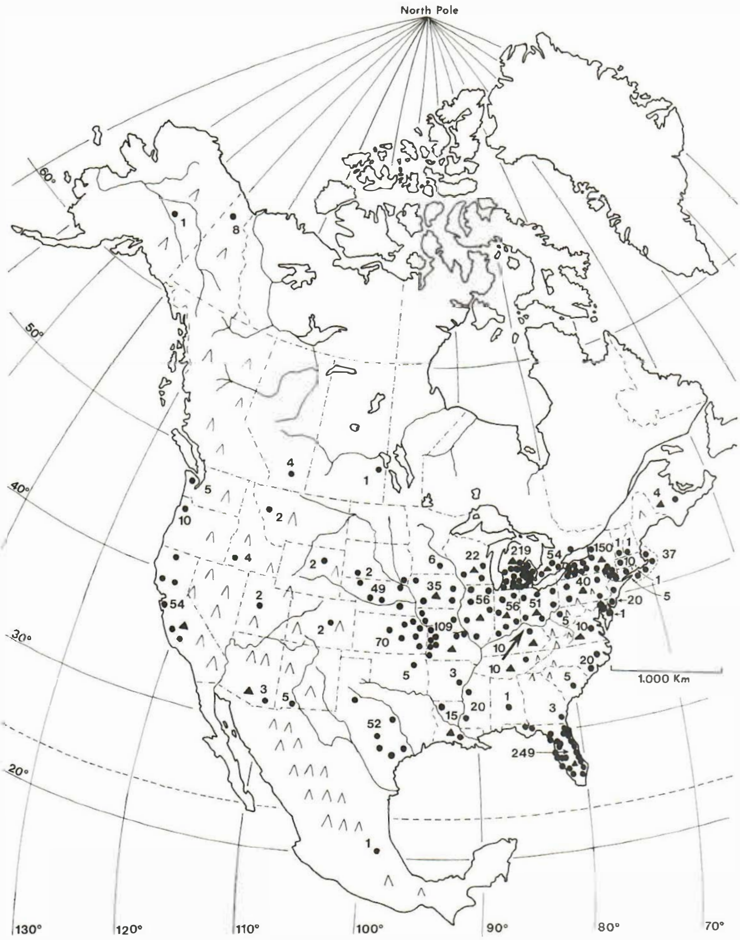

Figure 1. An updated distribution map showing locations were this species was found in the New World (modified after maps in Hay, 1923 and 1924, and Osborn 1936). As can be ascertained from the available literature, there are no records of *M. americanum* for these states: Maine, Nevada, and North Dakota (artwork by G.H. Marchant). KEY: Dot = 1–10 individuals; numbers are minimal totals for each state, province or country. Triangle = ^{14}C dates are available (after Mead and Meltzer 1984). Arrow = type locality of *Mammut americanum* (*Elephas americanus* of Kerr, 1792; see Osborn 1936) Big-Bone Lick, south of the Ohio River, Boone County, Kentucky. Inverted "v" =mountainous regions.

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New Faunal Identifications from the Udora Site: A Gainey-Clovis Occupation Site in Southern Ontario

Arthur E. Spiess and Peter L. Storck

Excavations in 1987 at the Udora site uncovered a subsurface feature which produced, in addition to artifacts and debitage, ca. 293 g of calcined animals bone (Storck 1988). Analysis of the bone by R. Previc (1987) resulted in the identification of seven complete and fragmentary bones belonging to Cervidae (cf. white-tailed deer or caribou). Leporidae (cf. hare or rabbit). and Canidae (cf. fox). Subsequently, with Previc's agreement, Spiess examined the calcined bone to determine whether additional or more specific identification(s) might be possible, particularly with respect to the cervid material with which as a class he is especially familiar (Spiess 1979; Spiess et al. 1985).

Spiess identified three specimens (fragments of an astragalus, an auxiliary metacarpal, and a proximal phalange) to the family level (e.g., Cervidae) and eight specimens to the genus or species level. Of the latter, three specimens (two fragments of a second phalange and a sesamoid) are identified as caribou (*Rangifer tarandus*). Three specimens (fragments of a metacarpal, proximal portion of a tibia, and a mandibular condyle) are identified to *Lepus* but, unfortunately, cannot be differentiated between the varying hare (*Lepus americanus*) and the Arctic hare (*Lepus arcticus*). Finally, two fox bones are identified: one, the distal fragment of a right humerus, could be either red fox (*Vulpes vulpes*) or Arctic fox (*Alopex lagopus*), while the second, a carpus accessorium, is identified on the basis of morphological and metric criteria as Arctic fox.

The above mentioned identifications represent a minimum of two individuals of caribou and one individual each for fox and hare. The minimum of two caribou is based upon differences in morphology between the two proximal fragments of phalange II. One specimen clearly belonged to an adult caribou. The second specimen, and several of the Cervidae fragments, exhibit

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morphology that is associated with smaller or immature caribou. We doubt that a single caribou would exhibit this range of morphology, but do not have direct evidence (e.g., unfused epiphyses, erupting teeth) for the presence of a younger, and therefore a second, individual. It should be noted that because small bones from the hoof tend to be more readily preserved and identified, the dominance of hoof bones in the sample is not evidence of human selectivity, but rather the result of differential preservation and perhaps of effects of calcination (Spiess n.d.). All the bones ascribed to hare and fox could conceivably have come from single individuals.

In addition to the material described above, seven specimens were identified to the taxonomic level of order (e.g., mammal-size). There are no fish or bird bones in the sample.

The most ecologically specific identification in the Udora faunal sample is that of Arctic fox. Unlike caribou and hare which live in ecologically more diverse habitats, the Arctic fox today has a more restricted distribution, occurring primarily on the tundra (and sea-ice and only extending its range southward into the northern margins of the boreal woodland during winter. If arctic fox had a similar habitat preference during late glacial times and the individual in the Udora feature was obtained locally, the Udora site would have occurred in a tundra or on the margins of an open forest-tundra environment. Unfortunately, there is insufficient chronological control over paleoenvironmental data in southern Ontario to suggest when this environment may have exited in the area of the Udora site. Although the process of forestation may have begun sometime prior to 12,500 yr B.P., and was completed when the transition from the spruce (*Picea*) to pine (*Pinus*) occurred ca 10,400 yr B.P., there is no agreement as to how long the process took and whether it occurred early or late in the interval (see, for example, Anderson 1982; Karrow and Warner 1988; Mott and Farley-Gill 1978; Terasmae 1981; Storck n.d.). When the chronology of late glacial/early Holocene forestation is more fully understood, the faunal data from the Udora site promises to give a rough "date", as well as an environmental context, for the Gainey/Clovis occupation of the Great Lakes region.

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Accelerator ^{14}C Dating of Two Micromammal Species Representative of the Late Pleistocene Disharmonious Fauna from Peccary Cave, Newton County, Arkansas

Thomas W. Stafford, Jr. and Holmes A. Semken, Jr.

Late Pleistocene faunas are characterized by high species diversity. Although the contemporaneity of megafauna species has never been questioned, the chronologies for the micromammal biota are less certain. The disparity in the interpretation between megamammals (>60 kg) and micromammals (e.g., rodents) is not only in their age concordance, but also with their response to the onset of the Holocene and the suitability of each group as a proxy for climate (Graham 1979; Martin and Hoffman 1987).

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The extinction of 35 species of large vertebrates ca 11,000 to 11,500 yr B.P. was abrupt. No similar extinction event is known for micromammals (Semken 1984), but the geographic range of many was restricted severely in an individualistic manner (Graham 1985); geographic redistribution of species continues at a reduced rate until present (Semken 1983). Completely modern faunal compositions at Peccary Cave apparently developed at 2,300 yr B.P. (Semken 1984).

The characteristic of late Pleistocene micromammal accumulations is their "disharmony"—the apparently contemporaneous existence of species that are allopatric today and which represent the juxtaposition of species now separated into temperate, boreal and arctic biomes (Lundelius et al. 1983; Semken 1984, 1988). The concept was proposed by Hibbard (1960), who attributed the distribution to equable climates with cooler summers that facilitated southward migration of Boreal species, and winters sufficiently moderate that temperate species were not extirpated. These faunal associations were defined as "disharmonious" (Semken 1984) or "intermingled" (Graham 1985). Examples include northern species such as *Phenacomys intermedius* (heather vole) and *Clethrionomys gapperi* (red-backed vole) occurring in strata with southern species such as *Neotoma floridana* (eastern Woodrat) and *Cryptotis parva* (least shrew).

The late Pleistocene contemporaneity of now allopatric species has major paleoclimatological implications: (1) The association implies biomes with no modern analogs, and (2) Climates with reduced seasonal extremes, especially summers. If equable climates existed during the late Pleistocene and highly seasonal ones developed during the Holocene, climate change (Graham and Lundelius 1984) would be a viable alternative to overkill-by-humans (Martin 1984) as an explanation for late Pleistocene extinctions.

Equability has been proposed strongly because disharmonious faunas are the "rule" in strata dating 16,000 to 9,000 yr B.P. Alternative explanations include (1) Sedimentary reworking, resulting in faunal assemblages instead of local faunules (Hibbard 1952), (2) Slow sedimentation causing physical juxtaposition of allopatric specimens as biomes shift in response to glacial events (Guilday 1962) and (3) Harvesting of several life zones in mountainous regions by raptorial birds that deposit the bones in one locality (Guilday 1962).

We tested the disharmonious fauna hypothesis by dating directly two rodent species by accelerator mass spectrometry (AMS) ^{14}C measurement. The fossils were from the lowest fossiliferous stratum (Unit C, Trench 15, level 2, square 9) of Peccary Cave, northwestern Arkansas (Semken 1984). The specimens comprised one jaw of *Neotoma floridana* (491 mg, with dentition) and three dentate jaws of *Clethrionomys gapperi* (66.9 mg). *N. floridana* is endemic to the Peccary Cave area today. The nearest occurrence of *C. gapperi* is 830 km to the north and 960 km to the east. The AMS ^{14}C dates on XAD-2 purified gelatin hydrolyzate (Stafford et al. 1988) were: 16,660±165 yr B.P. (AA-4941) on *C. gapperi* and 16,830±210 yr B.P. (AA-4942) on *N. floridana*. Accuracy is assumed because the fossils had the %N and collagenous amino acid composition of well preserved bone (Stafford et al. 1987; 1988). These two ages are similar to

16,700±250 yr B.P. (I-5262) on "bone collagen" (Quinn 1972) from *Platygonus* (extinct, short-faced peccary) from Stratum C deposits elsewhere in Peccary Cave.

The ^{14}C ages for vole and woodrat fossils from Peccary Cave represent the first direct test of the disharmonious fauna hypothesis. These dates support the conclusion that these species were contemporaneous in Arkansas during the Pleistocene and that climatic equability is a valid concept for the Peccary Cave vicinity. If disharmonious faunas representing equable-climate biomes are not a result of sedimentary reworking, the shift from less seasonal to highly seasonal climates will remain a testable hypothesis for late Pleistocene megafauna extinctions. These results do not preclude humans as having caused the extinctions. The data do imply that the roles of climate change and over-hunting by humans can be evaluated experimentally.

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Paleoenvironments: Geosciences

Geologic Evidence for an Ice-Free-Corridor in Northeastern British Columbia, Canada

Peter T. Bobrowsky and Nat Rutter

Quaternary geologic investigations were undertaken in the northern Rocky Mountain Trench (RMT) of western Canada (Bobrowsky 1989a). Detailed stratigraphic and sedimentologic study of unconsolidated sediments centered on bluff sections exposed along the Finlay River of northeastern British Columbia. Supplementary work included collection of wood for amino acid racemization and radiocarbon dating, as well as pollen analysis and paleomagnetic analysis.

Study efforts relied on a facies analytical approach (Bobrowsky 1989b). Genetic interpretations for the facies varied from lodgment and meltout till deposits to subaerial debris flow and glaciodeltaic sediments. Lithostratigraphic units were then established at each of the localities. The type and frequency of facies varied between the units. Cross-correlation of the units resulted in the composite stratigraphy illustrated in Figure 1 (Bobrowsky and Rutter 1989). Stratigraphic position, inherent properties (e.g., lithologies), and radiometric control support the proposed composite stratigraphy.

The nine sediment packages identified for this region represent two distinct cycles of glaciation. The oldest sediments (late Tertiary to Quaternary) are preglacial distal braided river deposits (Package A). The first cycle of glaciation is represented by Packages B–D. This glaciation could not be dated, but is probably early Wisconsin or pre-Sangamonian. Associated deposits and erratics indicate this was an extensive event, one which transported unique lithologies from west of the RMT, eastwards across the Rocky Mountains and into the foothills. Sediment Package E is mid-Wisconsin, and possibly older, ranging in age from >44,000 yr B.P. (GSC-837) to 15,180±100 yr B.P. (TO-708).

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Other critical dates from this interval include: 18,750±120 yr B.P. (TO-709), and 23,280±750 yr B.P. (AECV-351C). The new series of dates extend this nonglacial interval by 10,000 years over previous estimates (e.g., Mathews 1980). Pollen from this nonglacial interval is dominated by *Picea* (spruce, 88.3%), with lesser amounts of *Pinus* (pine 4.1%), *Abies* fir, 3.7%), *Alnus*(alder, 1.1%), Cyperaceae (1.4%), and the remainder indeterminate (1.4%).

The second (final) glaciation is late Wisconsin, and is bracketed by the following dates: 15,180±100 yr B.P. and 10,100±90 yr B.P. (GSC-2036). Sediment Packages F–H are correlated to this event. This glaciation was less extensive than the former and was probably restricted to a valley glacier (montane) which travelled down the RMT and long the Peace River valley as far east as the Portage Mtn Moraine (near Hudson's Hope). Package I sediments are postglacial (late Wisconsin to modern).

In northwestern Alberta, recent studies indicate that a single (late Wisconsin) glaciation affected the region during the Quaternary (Liverman et al. 1989). Laurentide ice travelled through northwestern Alberta and into northeastern British Columbia (BC) sometime after 25,000 years ago. Laurentide deglaciation of northeastern BC then occurred sometime after 13,500 yr B.P. (Rutter 1984). The earliest dated archaeological site in the Peace District is Charlie Lake Cave, which is considered to be 10,500 years old (Fladmark et al. 1988). The final implications of the above studies and the geological investigations reviewed here are: 1) ice-free conditions during the mid-Wisconsin persisted to about 15,000 yr B.P., well beyond previous estimates of 25,000 yr B.P.; 2) if coalescence occurred, then the earliest human migration/occupation in the area may have occurred just before 15,000 yr B.P. or just after 13,500 yr B.P., however, there is no clear evidence of ice coalescence; and, 3) the late Wisconsin Cordilleran advance (montane ice) terminated 90 km west of Ft. St. John at Portage Mtn. Moraine, at which time the Laurentide ice front had probably retreated well back into Alberta.

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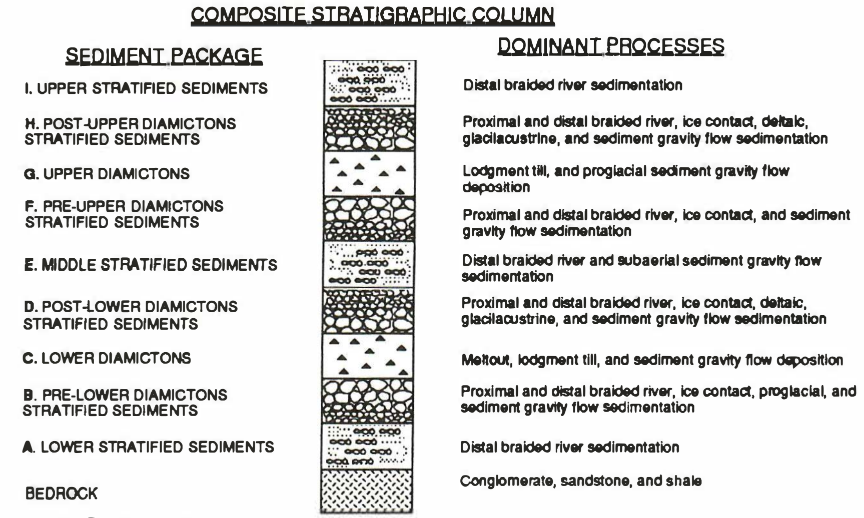

Figure 1. Composite Stratigraphy.

Late Pleistocene Valley Fills on the Southern High Plains

Vance T. Holliday

The Southern High Plains (northwestern Texas and eastern New Mexico) is crossed by a number of northwest-southeast-trending dry valleys or "draws", tributaries of the Red, Brazos, and Colorado rivers (Figure 1). The draws have long been known to contain outstanding records of late Quaternary environments and human occupation, including well-known Paleoindian sites (Figure 1) (e.g., Haynes 1975; Holliday 1989; Johnson 1986; Stafford 1981; Wendorf and Hester 1975). Understanding the record of the draws is therefore crucial to understanding the Paleoindian occupation of the region. Classically,

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the late Pleistocene valley fill is described as a basal stream deposit (sand and gravel) associated with the Clovis occupation, overlain by lake and marsh sediments (diatomaceous and sapropelic mud, DSM) containing Folsom or later Paleoindian remains. The contact of the alluvium and lake/marsh sediment is time-transgressive, varying from ca. 11,000–10,000 yr B.P. (Holliday 1984). Holliday (1984) attributed the hydrologic change from flowing to standing water to reduction in effective precipitation and spring discharge, with local geomorphic conditions causing the depositional response to be time-transgressive. These interpretations of the fill in the draws are based solely on data from the widely scattered archaeological sites.

To provide a more complete picture of the late Quaternary history of the draws a systematic coring program was conducted in 1988 and 1989. There were 176 cores taken and 7 artificial exposures examined along 10 draws in the Brazos and Colorado drainages (Figure 1). Data now available requires some modification of the earlier interpretations. The basal alluvium is one of the most ubiquitous deposits in the draws, found at virtually all localities. The DSM is very rare, however, found at only two localities (in middle Runningwater Draw), in addition to previously reported occurrences at Clovis, Marks Beach, Lubbock Lake, and Mustang Springs (Figure 1). Typically the alluvium is overlain by massive, highly calcareous lake sediment (marl). The occurrence of the DSM appears to be controlled by spring activity. The DSM is found only at localities with documented historic or prehistoric springs, although not all sites with reported springs have late Pleistocene DSM (based on coring at sites reported by Brune 1981).

In the latest Pleistocene, therefore, the draws first carried flowing, and probably fresh water, fed both by runoff and spring discharge. Between 11,000 and 10,000 yr B.P. water ceased to flow and the floors of the draws were covered by hard-water ponds and marshes. Locally, there were soft-water ponds fed by springs. This hydrologic change at the end of the Pleistocene was almost certainly the result of a climate change resulting in reduction of runoff and spring discharge. Timing of the change from flowing to standing water was determined locally, depending on presence or absence of, duration of, and amount of spring discharge.

The above findings are significant archaeologically. All reported sites from the draws with both late Pleistocene and Holocene occupations have evidence of spring activity. This is not surprising as the occurrence of permanent or semi-permanent water was sure to attract people, especially in the semiarid climate of the Holocene. The only excavated, buried site with no record of spring activity is Plainview and it has no evidence of multiple occupation.

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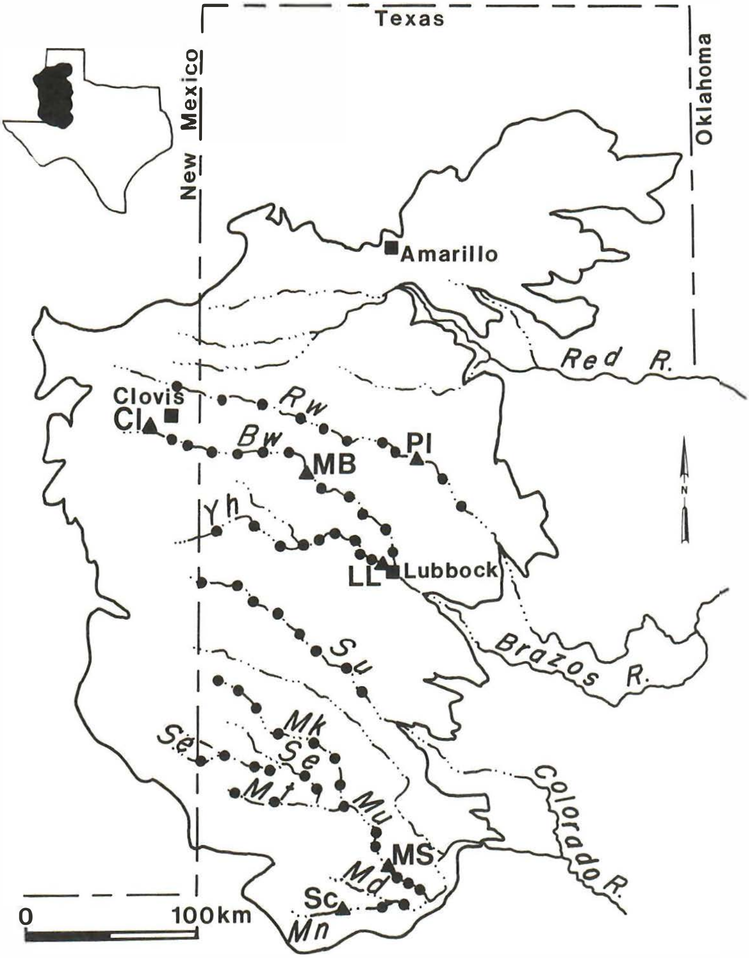

Figure 1. Map of the Southern High Plains showing study draws, coring sites (circles), archaeological sites (triangles), and selected cities (squares). Draws: Rw = Runningwater; Bw = Blackwater, Yh = Yellowhouse; Su = Sulphur; Mk = McKenzie; Se = Seminole; Mt = Monument; Mu = Mustang; Mn = Monahans; Md = Midland. Sites: Pl = Plainview (Sellards et al. 1947); Cl = Clovis (Blackwater Draw Locality 1) (Hester 1972); MB = Marks Beach (Honea 1980); LL = Lubbock Lake (Johnson 1987); MS = Mustang Springs (Meltzer and Collins 1987); Sc = Scharbauer (Midland) (Wendorf et al. 1955). Inset shows the Southern High Plains and Texas.

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Late Glacial Paleoenvironments in the Rocky Mountain, Jasper, Canada: Implications for Human Habitation Sites

Vic M. Levson

Geomorphic, stratigraphic, and sedimentologic evidence obtained from Quaternary sediments in the Athabasca Valley in the Rocky Mountain Front Ranges of Jasper National Park, Alberta (Figure 1) is used to reconstruct late glacial paleoenvironments in the region. A dominant geomorphic feature in

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the Athabasca Valley between Jasper townsite and the Rocky Mountain front is a series of discontinuous, unpaired, terraces rising up to about 200 m above river level. Early investigators (Taylor 1960) related the terraces to beach and deltaic deposits of a large glacial lake. Unlike beach ridges, the terrace surfaces generally dip either up or down valley. Internally, the terraces consist of sediments that typically exhibit pronounce vertical and lateral changes in grain size, sorting, and bed orientation. Sands and gravels are usually interbedded with diamicton. Strata commonly exhibit dips on the order of 20° to 40° and are frequently folded and faulted. These characteristics are typical of ice proximal sediments and their geomorphic association indicates that they are probably lateral kame terrace deposits. The late glacial paleoenvironment of the region thus was characterized by lateral ice-marginal sedimentation along the valley walls and the resultant terraces would not have been habitable landforms as could be suggested if they were beach or deltaic in origin.

Detailed study of several exposures of the scarp of a high terrace west of Jasper townsite supports the above conclusions. A date of 29,100±560 yr B.P. (GSC-3792) obtained on wood found in gravels underlying till near Jasper suggests that ice moved into the region after that time (Levson and Rutter 1989). Ice eventually overrode the entire area forming a near horizontal landscape at about the level of the present upper surface of the high terrace above Jasper townsite. During deglaciation, thick sequences of normally faulted, steeply dipping, sand, gravel, and clast rich diamicton were deposited along the margins of the terrace west of Jasper townsite. These glacial and glaciofluvial environments clearly were not suitable for human habitation.

Ice retreat westward from the Rocky Mountain front to Jasper townsite was continuous and rapid as evidenced by the absence of recognizable terminal or recessional moraines. A glaciofluvial kame terrace origin for the terraces in the Athabasca Valley suggests that large blocks of ice separated from the active glaciers and stagnated in the valley center. In the the Pocahontas area, near the mountain front, a small lake was dammed on a terrace-like landform along the ice margin. Gastropods collected from lake sediments were dated at 11,900±120 yr B.P. (GSC-3885) thus providing an approximate date for deglaciation of that area (Bobrowsky et al. 1987). Late Wisconsin ice had receded out of the main Athabasca Valley to near present limits by about 10,000 yr B.P. (Osborn and Luckman 1988). Rapid ice retreat, probably due to ice stagnation induced by rapid climatic warming, would have allowed human migrants to enter the region shortly after deglaciation about 12,000 years ago.

Clearly these high terraces would not be suitable human habitation sites at the time of their formation. Post-glacial alluvial fans that dissect the terraces are more likely habitation sites. The oldest known site in Jasper, dated at 7,840±70 yr B.P. (TO-1026), is on an alluvial fan near Pocahontas (Pickard in press). The oldest known site in Alberta, Vermillion Lakes site, is on post-glacial alluvial fan sediments near Banff townsite about 250 km southeast of Jasper (Bobrowsky et al. in press). Further archaeological investigations, concerning early man migrations southwards down an ice-free corridor along the eastern front of the Rocky Mountains, should focus on alluvial fan settings and not on high terraces in the Athabasca Valley.

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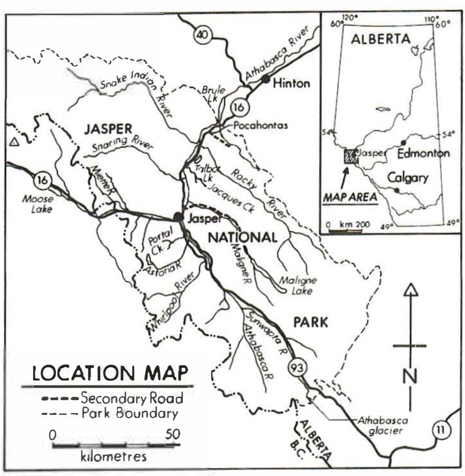

Figure 1.

Regional Focus-Hokkaido

Charles T. Keally

Section Editor

Hokkaido Pleistocene Archaeology and the Earliest Americans: Some Comments

Charles T. Keally

Hokkaido is the large (81,513 km^2) northern island in the Japanese archipelago. The roughly triangular island (locally seen as roughly square) lies between 41°30' and 45°30' north latitude. It is mountainous, with many active volcanoes, small intermontane basins and valleys, and larger coastal plains. Today, boreal conifer-forest vegetation covers much of the northeastern half of the island and temperate deciduous broadleaf-forest vegetation, dominated by oak (*Quercus*), covers the southwestern half, with beech (*Fagus*) dominating the forest in the extreme southeastern tip of the island (Tsukada 1986, figure 7; Yasuda 1978). At the cold peak of the late Pleistocene, tundra covered a wide belt from the eastern tip of the island north along the Sea of Okhotsk in Sakhalin and Siberia. Bordering this was a band of park tundra. The southwestern half of Hokkaido was covered by a boreal conifer forest extending all the way into central Japan (Tsukada 1986, figure 7; Yasuda 1978; figure 18). Hokkaido today, and in the late Pleistocene, is environmentally an extension of southern Siberia. During most of the late Pleistocene, Hokkaido was connected by landbridge to Siberia via Sakhalin Island, but it was always separated by the Tsugaru Strait from the rest of the Japanese islands to the south (Ohshima 1980), although at some point in the late Pleistocene that strait was narrow enough for moose (*Alces*) and brown bear (*Ursus*) to cross (Kamei et al. 1987).

In the past decade or so, the number, size, and quality of the excavations of Pleistocene sites conducted and reported in Hokkaido have increased considerably, making Hokkaido the best studied region in East and Northeast Asia, outside of central Japan, and one of the best studied regions in the world (Keally 1988). The scale of the excavation work is often truly staggering: for example, 3872 m^2 and about 200,000 lithic artifacts from Hattoridai 2 in Shirataki Village (Chiba et al. 1982). Moreover, Hokkaido participated closely in late Pleistocene cultural events in eastern Siberia. It therefore is literally in a position to provide valuable information bearing on the question of the earliest settlement of the Americas. Nevertheless, the Hokkaido (as well as the Japanese) data continue to be largely passed over by American archaeologists working with the earliest Americans question, in favor of the quantitatively and qualitatively inadequate data from Siberia and North China. The following

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reports on recent Hokkaido archaeological work show the need to give more attention to the Japanese material when studying Northeast Asian and American Pleistocene prehistory.

One of the most striking things I have noted about Hokkaido Pleistocene sites is the rarity of stratified, multicomponent sites and of sites older than 15,000 years, on the one hand, and the abundance of 10,000- to 15,000-year-old microlithic sites, on the other. The few sites older than 15,000 years (predating the microlithic) are all in the southern half of the island, and these are also the only clearly stratified sites in Hokkaido. These older occupations date between 15,000 and 24,000 yr B.P. (concentrating at 19,000 to 22,000 yr B.P.), but they are difficult to relate typologically to contemporary occupations on the main Japanese island across the Tsugaru Strait to the South. They seem to reflect a very sparse, and perhaps temporary, early settlement of the Pleistocene boreal forest in the southern part of Hokkaido by people who crossed the strait, expanding their territory northward from Honshu at the peak of the last glaciation when sea levels were lowest. The abundant microlithic sites of Hokkaido are clearly related to eastern Siberian sites and suggest a relatively dense settlement of Hokkaido from the north, beginning about 15,000 or 14,000 years ago.

Another significant point is the fact that the dating of these Hokkaido microlithic sites is not a matter of discussion, interpretation and disagreement, as is the case with many of the continental datings (see Yi and Clark 1985; Clark 1988). In addition to the many dates for sites discussed in this section (Figure 1), there are dozens of other dates that consistently place the Hokkaido microlithic sites in a very narrow band of time between 10,000 and 15,000 yr B.P., with disagreements about the exact dating being on a scale of less than 1,000 years, not 10,000 or more years as happens frequently with the continental sites.

Microlithic, as the term is ordinarily used in Japan, refers to a culture identified by cores and blades produced with a very diagnostic technology, not to any type of very small stone tools, such as small projectile points. In fact, some "microcores" and "microblades" are quite large, especially in sites near Shirataki village, making it clear that the term "micro" is used to identify a technology rather than a size. Japanese archaeologist distinguished several types of microcores, each produced through a different process of reduction: Shirataki, Sakkotsu, Togeshita, Oshorokko, Rankoshi, Horoka, Hirosato, Okedo, and Fukui. The Shirataki and Sakkotsu types fall under the larger grouping called Yubetsu Technique; the Horoka type is often called "boat-shaped tool"; and the Fukui type is found only in eastern Japan. Some archaeologists argue that one or more of these microcore types is in fact a burin type. Also, recent research, at the Pirika and Shinmichi 4 sites in particular, has elucidated the production process of Togeshita microcores and cast some doubt on the validity of the Horoka and Sakkotsu types (Hiroaki Hata, pers. comm. 1989).

Site	Date	Predominant Artifacts
Higashi Rokugo 1	10,700±600 (OB) 10,700±700 (OB)	Tachikawa stemmed points, Araya burins, endscrapers, boat-shaped tools
Sakuragaoka	10,500±600 (OB) 10,700±900 (OB) 11,300±600 (OB)	Togeshita microcores, microblades, scrapers, boat-shaped tools
Yunosato 4 Upper	11,300±600 (OB) 11,500±500 (OB)	Rankoshi microcore, bifacial & stemmed points, ornaments, possible burial
Arashiyama	---	Oshorokko microcores, microblades, Araya burin, boat-shaped tools
Kamiitaira Upper	10,000-12,000 yr B.P.	Togeshita microcores, microblades, Araya burins, foliate points
Higashi Rokugo 2	12,000±600 (OB) 13,700±700 (OB)	foliate points, burins, endscrapers, sidescrapers
Hattoridai 2	---	Togeshita microcores, microblades, bifaces, bificial points, scrapers, stemmed points, boat-shaped tools
Yunosato 4 Lower	13,800±400 (OB) 13,900±700 (OB)	Togeshita microcores, microblades, trapezoids
Nisshin 2	13,800±1,200 (FT) 13,700±1,100 (OB) 14,800±1,100 (OB)	microblades, blades, Araya burins, Shirataki & Sakkotsu microcores, stemmed points, endscrapers, sidescrapers
Kamiitaira Lower	ca. 20,000 yr B.P.	varied flake tools
Obihiro Kuko Minami A	20,000±1,200 (OB) 20,500±1,300 (OB) 19,420±1,770 (Gak-10746) $23,850^{+4,480}_{-2,650}$ (Gak-10747)	varied flake tools

Figure 1. Summary of the sites discussed in this section (OB: obsidian hydration date; FT: obsidian fission-track date; no symbol: date based on numerous age measurements).

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Hattoridai 2: An Exceptionally Productive Togeshita-Microcore Site in Shirataki, East-Central Hokkaido, Japan

Eiichi Chiba

Hattoridai (I-20-2) is one of the many well-known Paleolithic sites in the village of Shirataki. The site is situated on the slope about 400 m from the point of a fingerlike terrace at the confluence of the Yubetsu River and a small tributary. The elevation is 450–465 m and about 45 m above the present Yubetsu floodplain. This terrace is the middle of five terraces recognized in the Shirataki Basin. The Hattoridai site was excavated by Meiji University in 1961 (Sugihara and Tozawa 1975).

The Hattoridai 2 site (I-20-13) is a short distance away, closer to the point of the same terrace and possibly part of the same site. It was excavated in 1981 in conjunction with conversion of the land from tree farming to agricultural use (Chiba et al. 1982). This work unearthed 3,872 m^2 of the site. Artifacts were found scattered through the upper three strata, in the upper 50 cm of soil, but all of them most likely belong to a single occupation originally in the third stratum. An accurate count has not been made, but approximately 200,000 lithic artifacts were recovered, roughly three tons of stone. The 1961 Meiji University excavation recorded 31,693 artifacts from a 364 m^2 excavation.

Tool types are unusually varied (Figure 1): microblades, Togeshita microcores, stemmed points, bifaces and bifacial points, awls, endscrapers, other types of scrapers, burins, boat-shaped tools, spatula-shaped tools, spalls, blades, and blade cores. Most are of obsidian, but some are of siliceous shale, quartzite, sandstone, basalt and shale. Rejoinable pieces have not been fully studied but many have already been found. Some rejoinable pieces were

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separated by over 10 m on the site. Boat-shaped tools are relatively rare here, compared to the quantity found at the neighboring Hattoridai site. No Shirataki or Oshorokko microcores have been identified, but the spatula-shaped tools might be blanks for the latter type. The density of artifacts was high (about $60/m^2$), but not the highest reported in Hokkaido. Okedo Azumi ($139/m^2$), Tachikarushunai V ($94/m^2$), and Hattoridai ($88/m^2$) report higher densities. Significantly, these four sites are all near major obsidian sources—Shirataki and Okedo—in east-central Hokkaido.

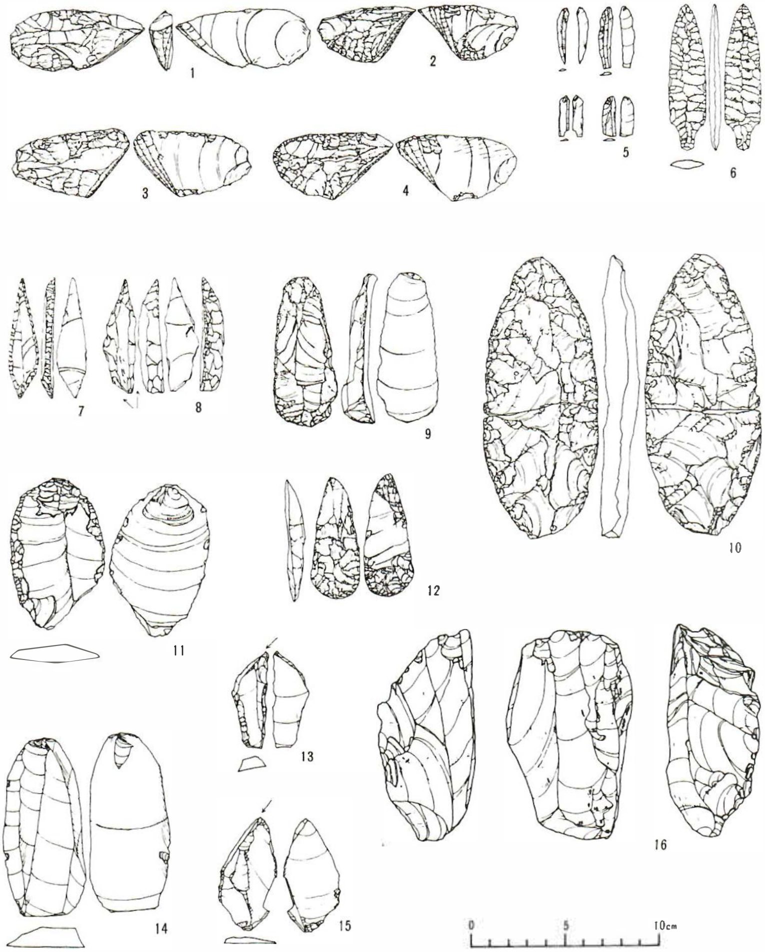

Figure 1. Artifacts from Hattoridai 2, Shirataki Village, central Hokkaido, Japan (1–4: Togeshita microcores; 5: microblades; 6: stemmed point; 7–8: awls; 9: endscraper; 10: point; 11: scraper; 12: spatula-shaped tools; 13 and 15: burins; 14: blade; 16: blade core).

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Obihiro Kuko Minami A: A 20,000-Year-Old Site in Southeastern Hokkaido, Japan

Toshiaki Goto and Toshiharu Tomikawa

The 1982 excavation of the Obihiro Kuko Minami A site (L-01-27) (Obihiro Airport South, Locality A) was relatively very small (200 m^2) and unproductive (about 30 artifacts), but it unearthed one of the rare oldest assemblages in Hokkaido (Goto and Tomikawa 1983). The site spreads across two ancient Spfa-1 (younger Shikotsu pumice fall) dunes on the Kamisarabetsu III (Ks-III) terrace, a short distance from the Kamiitaira site (see description this section), at an elevation of 157 m. The dunes are about 8 m high. The 1982 excavation was conducted on a road right-of-way on the southern slope of the western of the two dunes. The stratigraphy was relatively standard for sites in this part of the Tokachi Plain in southeastern Hokkaido. The lithic artifacts were recovered from Stratum VIII and the upper part of the Stratum IX, both wind redeposited Spfa-1 pumice and lower two of three strata in the dune structure.

The lithic assemblage (Figure 1) consists of 22 tools: 3 scrapers, 3 retouched flakes, 1 blade-flake tool, 11 flake tools, 2 pebble strikers, and 2 flat, stone anvils. Most of the artifacts are obsidian, with a few made of other types of stone. The strikers and anvils are of rhyolite, biotite-granite and biotite-schist.

Charcoal found near an obsidian artifact in the upper part of the Stratum IX provided a radiocarbon age of 23,850+4,480/-2,850 yr B.P. (Gak-10747). This date is consistent with the dates obtained from Stratum VIII during earlier exploration of the site boundaries: 19,420±1,770 yr B.P. (Gak-10746), and two obsidian hydration dates that are 20,000±1,200 and 20,500±1,300 yr B.P. (Akashi

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1982). These dates also are consistent with dates for similar assemblages at Kamiitaira (see description this section) and Sankakuyama (21,450±750 yr B.P. (Gak-4346) and 21,000 yr B.P. (obsidian hydration; Yoshizaki 1974), and with the stratigraphic position of the redeposited Spfa-1 pumice in nearby sites.

Obsidian hydration dating was done by Yuko Kondo, Obihro University of Agriculture and Veterinary Medicine.

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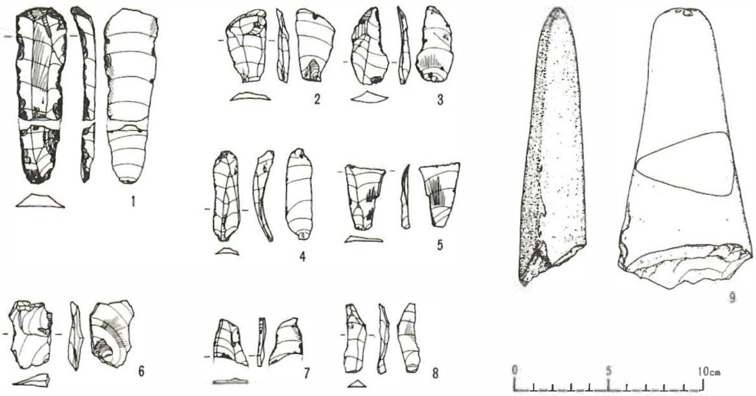

Figure 1. Artifacts from Obihiro Kuko Minami A, Obihiro City, southeastern Hokkaido, Japan (1: scraper; 2–3: rejuvenation flakes; 4–8: flake tools; 9: striker).

Yunosato 4: A Terminal Pleistocene Burial Site in Southwestern Hokkaido, Japan

Hiroaki Hata

Yunosato Locality 4 (B-04-20) is a multicomponent site located on a bluff on the south bank of the Shiriuchi River in the town of Shiriuchi in extreme southwestern Hokkaido (Hata 1985). The present bluff is 10–15 m above the floodplain, and 35 m above sea level. Construction of the approach to the Tsugaru Strait railroad tunnel necessitated excavation of 3,873 m^2 of the site in 1983. Epi-Jomon, Jomon, and Paleolithic artifacts and features were recovered.

Nearly 20,000 Paleolithic artifacts were recorded (Figure 1). Most of these are flakes and chips. There also are 533 microblades, 16 microcores, numerous large blades and cores, 20 bifacial points, 4 stemmed points, 9 awls, 21 endscrapers, 45 other types of scrapers, 20 Araya burins, 2 trapezoids, 1 ax, 2 pounders, and 3 anvils, plus very small numbers of other tools. One microcore belongs to the Rankoshi type (Figure 1:6), one to the Horoka-type boat-shaped-tool type (Figure 1:8), and the rest to the Togeshita type (Figure 1:9). The trapezoids closely resemble the Hyakkadai type characteristic of sites in western Japan between about 13,000 and 16,000 yr B.P.; their presence in a site in Hokkaido is unusual. Shale is the predominant raw material, although some obsidian (especially for microblades), chert, agate, and andesite were used; the pounders and anvils are of sandstone. Roughly 75% of the obsidian was brought from the Tokachi source, 300 km away. Another 13% was identified with the Shirataki source 340 km away, but only 6% appears to have come from the Akaigawa source, which is only 170 km from Yunosato.

The only Paleolithic feature discovered was a shallow pit 0.9 by 1.1 m. This pit contained 3 dunite (olivine) beads and 1 dunite and 1 amber pendant (Figure 1:1–5), a Rankoshi microcore, and a few flakes and large cores. The sources of the dunite and amber are unknown but might be on Sakhalin Island north of Japan. These ornaments and possible burial are comparable in age and type to those from a number of other sites in Northeast Asia: Pirika Locality 1 nearby in southwestern Hokkaido (Naganuma 1985), Zhoukoudian Upper Cave in North China (Chang 1977), Ushiki 1 Layer VII on Kamchatka Peninsula (Chard 1974), Mal'ta near Lake Baikal (Chard 1974), Verkholenskaya Gora in Prebaikal (Chard 1974), and Ust'-Belaya Layer XIII near Lake Baikal (Chard 1974).

Four obsidian hydration dates have been obtained from Yunosato Locality 4: 13,800±400 yr B.P.; 13,900±700 yr B.P., and 11,500±500 yr B.P. for microblades, and 11,300±600 yr B.P. for a flake. The distribution of the artifacts over the excavation surface, and these obsidian hydration dates suggest that most likely the Rankoshi microcore, bifacial and stemmed points, pit, and ornaments represent one occupation of the site around 11,000–12,000 yr B.P., and the

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Togeshita microcores, microblades and trapezoids another around 13,000–14,000 yr B.P.

Obsidian source identification was done by Tetsuo Warashina and Takenobu Higashimura, Kyoto University Research Reactor Institute; obsidian hydration dating was done by Yuko Kondo and Tetsuji Yanagihara, Obihiro University of Agriculture and Veterinary Medicine; and the dunite identification was done by Jun Watanabe, Geology Department, Hokkaido University.

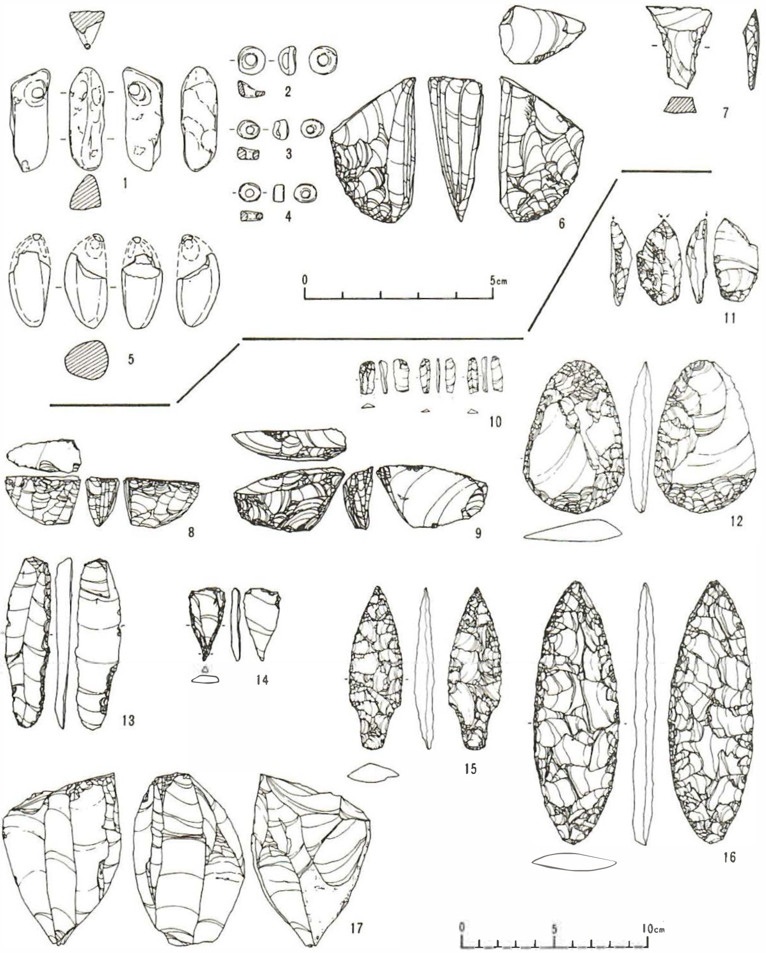

Figure 1. Artifacts from Yunosato Locality 4, Shiriuchi Town, southwestern Hokkaido, Japan (1–5: ornaments; 6: Rankoshi microcore; 7: trapezoid; 8: Horoka boat-shaped tools; 9: Togeshita microcore; 10: microblades; 11: Araya burin; 12–13: scrapers; 14: awl; 15: stemmed point; 16: point; 17: core).

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Survey of Pleistocene Sites in the Village of Shirataki in East-Central, Hokkaido, Japan

Jun'ichi Matsuya

The village of Shirataki (N 43°50', E 143°10') is widely famous for its Paleolithic sites. These sites are unique in their density, productivity, and profligate use of obsidian. The 341-km^2 village lies in an intermontane basin along the Yubetsu River, 52 km from the central Sea of Okhotsk coast. Most of the village is mountainous, with peaks up to 1,000–1,300 m. The small basin is extensively terraced, and the village center is 360 m elevation. The Shirataki obsidian source outcrops on a peak on the northern edge of the village. This source is estimated to have about 500 million tons of high quality obsidian.

The village conducted a survey of all its sites in 1985 and 1986, to confirm site locations and to determine site size for some that were previously recorded only as points (Matsuya 1987a). Fifteen new sites were discovered, bringing the total to 87. Most of these sites yield Paleolithic artifacts, but very few of them yield Jomon or later remains.

Exploratory pits were dug into 10 sites to determine the site boundaries. This work unearthed 1,284 m^2 (1,257 one-meter pits and a trench 27 m long) and recovered around 15,000 lithic artifacts (Figure 1). Only one of these sites appears to have no Paleolithic occupation. Site areas were found to range from 600 m^2 to 45,000 m^2, the latter for Shirataki 30 (I-20-6), which is itself contiguous with Shirataki 4 (I-20-15) which covers another 31,000 m^2. Later, Shirataki 4 was excavated, unearthing another 2,300 m^2 and recovering 70,132 lithic artifacts (Matsuya 1987b).

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Most of the paleolithic sites in Shirataki belong to the microlithic culture, although some of the microcores and microblades are comparatively very large. Only two sites predate the microlithic: Shirataki 13 Lower (I-20-13) and Horokasawa I (I-20-27). These two older sites are thought to date around 16,000 to 17,000 yr B.P. Microcores belonging to the Shirataki, Togeshita, Horoka, Oshorokko, Hirosato, and Sakkotsu types were identified, but none of the Rankoshi or Okedo types. Most sites yielded two or more types of microcores, suggesting these varied types might have at least some temporal overlap. Togeshita microcores were found with Shirataki, Horoka, and Sakkotsu microcores, and Shirataki and Horoka microcores were also found together. Oshorokko microcores were found with Hirosato microcores, but neither type was found with any of the other four types.

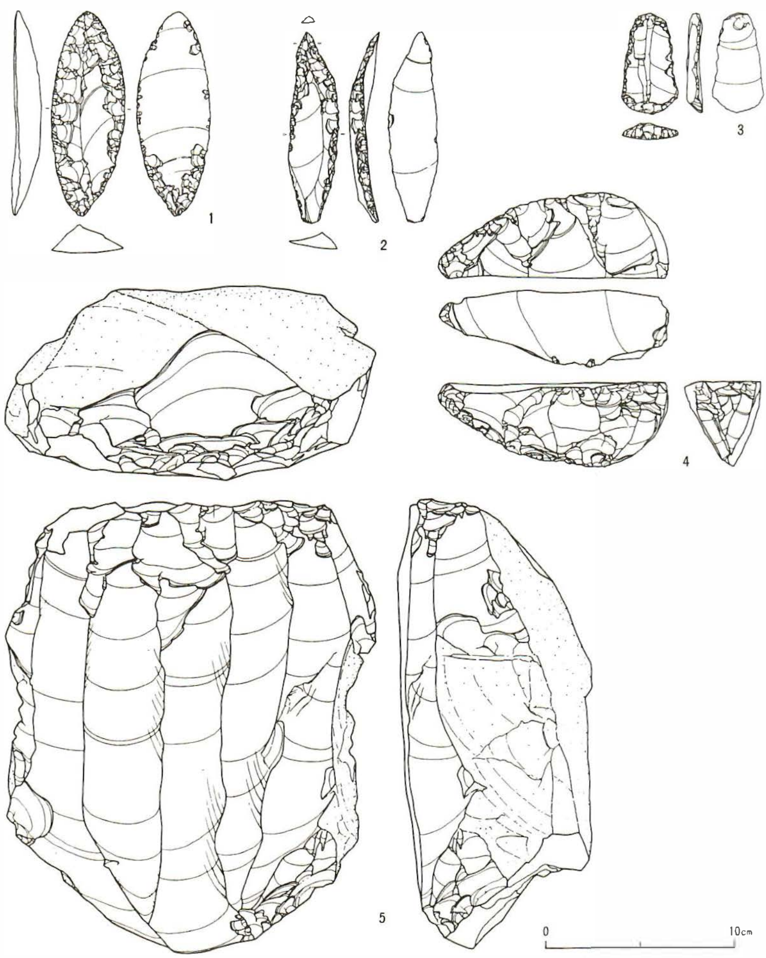

Figure 1. Obsidian artifacts from Paleolithic sites in Shirataki village, east-central Hokkaido, Japan (1: point from Shirataki 33; 2: awl from Shirataki 4; 3: endscraper from Kamishiyubetsu 3; 4: Sakkotsu microcore from Kamishiyubetsu 3; 5: large blade core from Shirataki 13).

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Kamiitaira: Dating a Stratified Site in Southeastern Hokkaido, Japan

Kunitoshi Sato and Minoru Kitazawa

The Tokachi Plain around Obihiro City in southeastern Hokkaido is one of the largest coastal plains on the island. It is a gently rolling plain of many low river terraces and ancient inland dunes. The Kamiitaira site (L-01-04) (149-154 m elevation) spreads across a Spfa-1 (younger Shikotsu pumice fall) dune on the Kamisarabetsu III (Ks-III) terrace not far from the Obihiro Kuko Minami A site (see discussion this section). The site has been excavated twice, once in 1977 (Akashi and Goto 1978) and again in 1986 (Sato and Kitazawa 1987). These excavations unearthed a total of 3,225 m^2 and recovered 669 lithic tools, plus a large number of flakes and pebbles. Two cultural layers were clearly stratified in the dune deposits: an older one estimated to date around 20,000 yr B.P. and a younger one (probably containing two occupations) dating 10,000 to 12,000 yr B.P.

Research at Kamiitaira has contributed much to stratigraphic studies of the Tokachi Plains, and the local geological sequence is now well known and relatively well dated, based on more than 40 generally consistent radiocarbon, obsidian hydration, and fission-track dates. Beginning with the oldest relevant stratum, this sequence and its dates are: older orange pumice (Op-2) about 43,000 yr B.P., younger orange pumice (Op-1) about 36,000 yr B.P., older Shikotsu pumice (Spfa-2) undated, younger Shikotsu pumice (Spfa-1) about 32,000 yr B.P., three phases of Spfa-1 dune formation between 32,000 and 22,000 yr B.P., clayey loam about 22,000 to 14,500 yr B.P., Eniwa-a pumice (En-a) between 15,000 and 13,000 yr B.P., En-a dune deposits about 13,500 to 12,500 yr B.P., En-a loam ("ball loam") about 12,500 to 10,000 yr B.P., and Holocene deposits and soils younger than 10,000 yr B.P.

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At Kamiitaira, artifacts were recorded from the "ball loam" in both the 1977 and 1986 excavations, and from the clayey loam above the Spfa-1 dune deposits only in the 1986 excavation. The younger of these two cultural layers has a consistent set of 17 obsidian hydration dates, 1 fission-track date, and 2 radiocarbon dates that all fall in the range 10,100 to 13,100 yr B.P., with the distribution of obsidian hydration dates suggesting two occupations, one at 10,000–10,500 yr B.P. and the other at 11,000–12,000 yr B.P. The dates for the older cultural layer are inconsistent: the obsidian hydration dates are 14,400±500 and 14,700±600 yr B.P., but the radiocarbon date is 32,500+00/-12,000 yr B.P. (KSU-1336). Typologically this older assemblage compares to the nearby Kuko Minami A (see description this section) and Seo II D (Tsuji 1977) assemblages, which are both dated very closely to 20,000 yr B.P., and the dune deposits below the clayey loam have five radiocarbon and two obsidian hydration dates that all fall between 19,500 and 29,000 yr B.P., giving a no-older-than limit to this cultural layer at Kamiitaira.

The younger cultural layer yield 630 lithic tools and cores, and several thousand flakes. These artifacts, from both possible occupations of this younger layer, belong to the Yubetsu microlithic complex with Togeshita microcores and Araya burins (Figure 1 upper). The artifacts from the older cultural layer are an unvaried assemblage of 41 lithic tools and 218 flakes (Figure 1 lower). Most of the tools are scrapers and utilized flakes. Obsidian is the most common material in both layers, with some quartzite and a few pieces of several other stones. Burnt pebbles were common in both cultural layers, but these were clustered in 2 by 2 m heaps only in the older layer. Such features are known from only a few other sites in Hokkaido, but they are ubiquitous in sites in Kanto dating 13,000–20,000 yr B.P.

Fission-tracking dating was done by Hideharu Matsuura, University of Tokyo, and Mizuo Machida, Gakushu-in University; and obsidian hydration dating was done by Yuko Kondo, Obihiro University of Agriculture and Veterinary Medicine.

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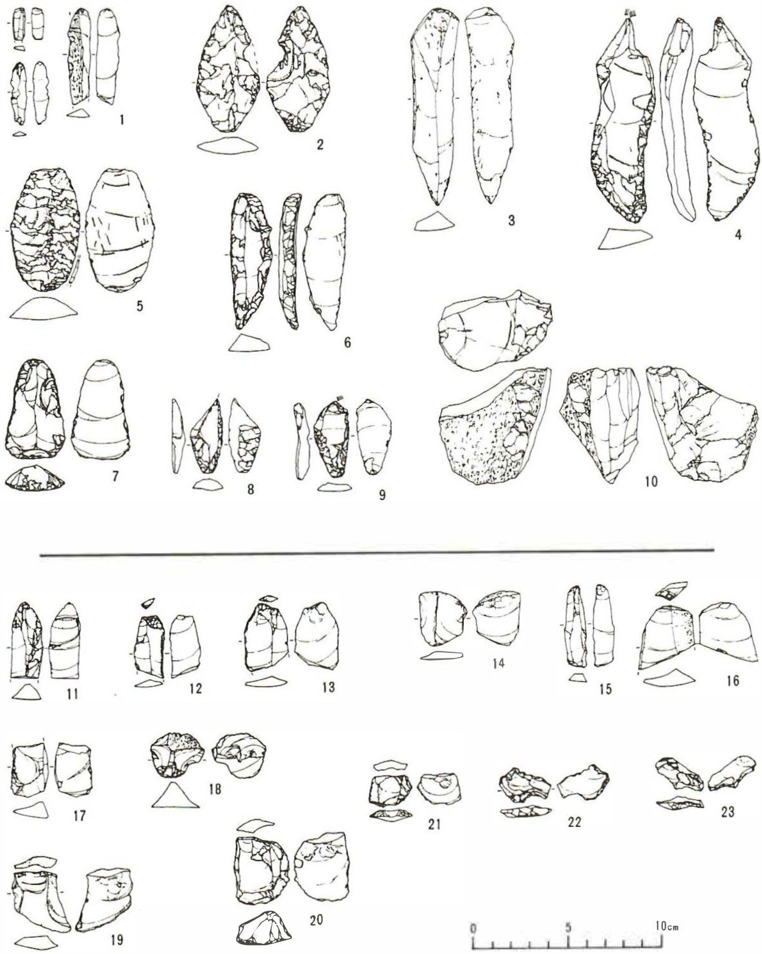

Figure 1. Artifacts from Kamiitaira younger (upper) and older (lower) layers, Obihiro City, southeastern Hokkaido, Japan (1: microblades; 2: foliate point; 3: retouched flake; 4, 8–9: burins; 5–6: sidescrapers; 7: endscraper; 10: core; 11–13, 17–19: sidescrapers; 14–16: retouched flakes; 20–23: endscrapers).

Arashiyama 2: An Oshorokko-Microcore Site Near Asahikawa, Central Hokkaido, Japan

Shigeru Nishida and Akira Ishikawa

Arashiyama 2 (F-05-5) is situated on the slope near the foot of a low mountain, in the town of Takasu, on the western edge of the large, intermontane Asahikawa Basin in central Hokkaido (Nishida 1987); 110–130 m elevation. Arashiyama 2 is one of only a handful of Pleistocene sites known in the basin. The small Osarappe River flows just east of the site and joins the large Ishikari River about 500 m to the south of the site. Highway construction necessitated excavation of the site in 1985 (4,950 m^2) and 1986 (2,925 m^2). Lithic artifacts were found in a thin stratum just under the plow zone and overlying talus with large angular rocks from the mountain slope.

Two seasons of work recovered nearly 1,750 artifacts, mostly in three concentrations spread over the excavation area. Flakes and chips account for 1,601 of the total. Of the tools (Figure 1), microblades are the most common: 75 microblades, 29 scrapers, 8 microcores, 7 burins/awls, 9 points/bifaces, 2 boat-shaped tools, plus 10 burin spalls, 9 microcore spalls, and 2 blades. Obsidian artifacts predominate: 1,717 artifacts of obsidian, 33 of shale, and 2 of chert. The eight microcores, all obsidian, are of the Oshorokko type. Some of the burins resemble Togeshita microcores, and there is one Araya burin in the collection. Some of the microcore spalls can be rejoined to the cores (Figure 1:1–4).

Thirty-two of the obsidian were source identified: 78% are from the Shirataki source, 9% from Chikabumidai, 6% from Okedo, 3% from Tokachi or Akaigawa, and 3% from an unknown source. No obsidian hydration or other scientific dates were obtained for this site, but typologically it is probably older than the stemmed-point assemblage at Higashi Rokugo 1 (see description this section) and younger than the Togeshita-microcore assemblage at Yunosato Locality 4 (see description this section), suggesting an age between 11,000 and 13,000 yr B.P.

Obsidian source identification was done by Tetsuo Warashina and Takenobu Higashiyama, Kyoto University Research Reactor Institute.

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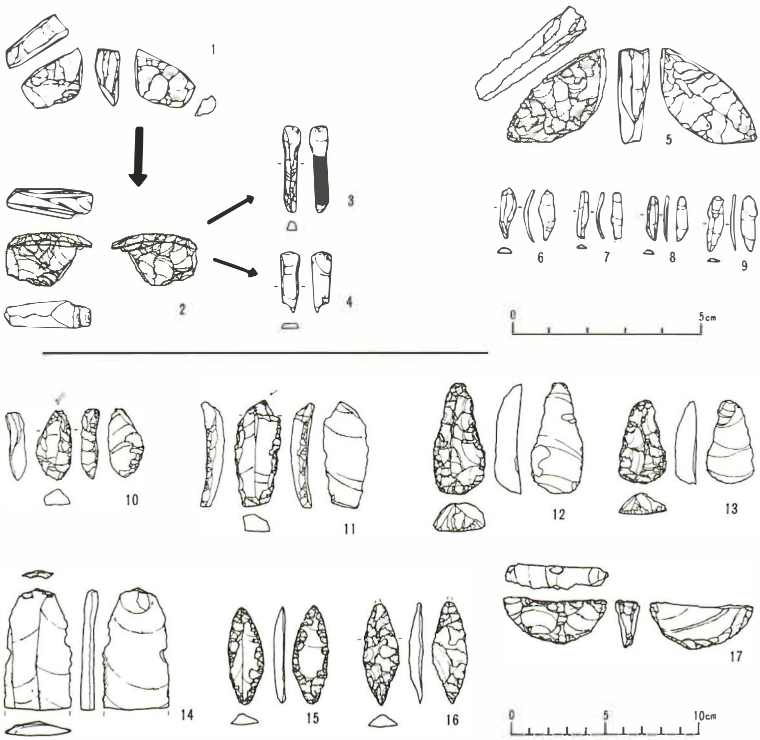

Figure 1. Artifacts from Arashiyama 2, Takasu Town, central Hokkaido, Japan (1: Oshorokko microcore; 2: same core with spalls 3 and 4 rejoined; 3–4: spalls from same core; 5: Oshorokko microcore; 6–9: microblades; 10: burin; 11: Araya burin; 12–13: scrapers; 14: blade; 15–16: bifacial points; 17: boat-shaped tool).

Higashi Rokugo 1 and 2: Stemmed and Foliate Point Sites in Central Hokkaido, Japan

Shigenobu Sugiura

Higashi Rokugo 1 and 2 are different sites about 2.5 km apart in a hilly upland basin just to the east of the Furano Basin in the mountains in central Hokkaido (Sugiura 1987). Site 1 (F-04-77) is on the point of a projecting hill at an altitude of about 355 m, 10–15 m above the surrounding lowland. Site 2 (F-04-85) is on a slightly elevated spot at an altitude of 410 m, about 150 m from the river and about 3–5 m higher. Pollen analysis suggests that at the time the sites were occupied, the area was covered by an open, glacial-cold forest dominated by birch (*Betula*) and alder (*Alnus*), with some larch (*Larix*) and a ground cover mostly of grasses (Gramineae). Conifers are more common in the pollen from Site 1, and fir (*Abies*) and wormwood (*Artemisia*) are notable in the pollen from Site 2. There are seven Pleistocene sites in the city of Furano. Higashi Rokugo 1 and 2 were excavated in 1986 in conjunction with grading of the hills for agricultural improvement. About 350 m^2 of Site 1 were unearthed, and about 600 m^2 of Site 2.

The 2,746 lithic artifacts recovered from Site 1 (Figure 1 upper) were scattered through the three upper strata but were most abundant in the second stratum, suggesting the position of the original surface. Rejoining of many of the flakes and tools indicates that all the artifacts, which were found in a single concentration, belong to the same occupation of the site. One sherd of plain pottery and roughly 80 stone tools were recovered from the site: 31 Tachikawa stemmed points, 23 endscrapers, 7 blades, 11 Araya burins, 1 adz, 3 points, a few other kinds of formal tools, and many utilized flakes. Ninety-two percent of the artifacts are obsidian; the other 8% are of seven different kinds of stone. Notably, the blades, burins and 4 of the stemmed points are the only tools made of siliceous tuff. Eighty of the obsidian artifacts were source identified: 57% are from three previously unknown sources probably somewhere in the Furano Basin, 21% are from Tokachi, 16% from Okedo, 3% from Shirataki, and 4% from an unknown source. A few of the Tokachi pieces provided hydration ages of 10,700±600 yr B.P. and 10,700±700 yr B.P.

Some stemmed point sites in Hokkaido yield microcores, but the younger ones like Higashi Rokugo 1 do not. All of the 45 known stemmed point sites, however, are located inland along the middle and upper reaches of rivers. This is a good setting for salmon fishing and these stemmed points might well have been one of the main tools in early exploitation of this resource (Yokoyama 1986).

The single potsherd is very likely associated with the Tachikawa stemmed points. This type of point in Hokkaido is closely associated with stone adzes of

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the type found at Higashi Rokugo 1 (Figure 1:10). Significantly, comparable adzes are found at Chojakubo and Mikoshiba, and some other sites in northern and central Honshu, all dating between 10,000, and 13,000 yr B.P. A few of these sites also have yielded small plain potsherds.

The lithic assemblage from Site 2 (Figure 1 lower) is quite different from that of Site 1. This assemblage contains 6 foliate points, 6 endscrapers on blades, 9 sidescrapers, 31 blades, 2 burins, and a few other types of tools. Utilized flakes are common. Also, the assemblage contains only 59 tools against 4,544 flakes, and rejoinable pieces are relatively rare. Obsidian is the most common material; 128 pieces were source identified. Unlike Site 1, 80% of the Site 2 obsidian comes from the Shirataki source, but only 3% from Tokachi, 11% from two of the Furano sources, and 5% from an unknown source. Two hydration measurements for pieces from Shirataki gave ages of 12,000±600 and 13,700±700 yr B.P. This spread in ages agrees with the mixed appearance of the lithic assemblage, which shows relationships to several different sites from different periods; no similar assemblage has yet been found in Hokkaido.

Obsidian source identification was done by Tetsuo Warashina and Takenobu Higashimura, Kyoto University Research Reactor Institute; obsidian hydration dating was done by Yuko Kondo, Obihiro University of Agriculture and Veterinary Medicine; and pollen analysis was done by Goro Yamada, Hokkaido Kaitaku Kinen Kan (Hokkaido Development Memorial Hall).

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Figure 1. Artifacts from Higashi Rokugo 1 (upper) and Higashi Rokugo 2 (lower), Furano City, central Hokkaido, Japan (1–2: stemmed points; 3: point; 4–6: scrapers; 7: biface; 8–9: burins; 10: adz; 11–12: points; 13–16: endscrapers; 17–18: sidescrapers; 19–20: burins; 21: spall).

Sakuragaoka and Nisshin 2: Excavated Microlithic Sites in Northern Hokkaido, Japan

Kuniteru Suzuki

The Sakuragaoka site (F-21-14) is located in the town of Shimokawa, in a small intermontane basin along the Nayoro River, in north-central Hokkaido, north of the city of Asahikawa (Suzuki and Uzie 1986). It covers about 10,000 m^2 on the upper terrace, at an elevation of 165–170 m, 40–60 m above the present floodplain. Prefectural road improvement work necessitated investigation of 1,310 m^2 of the Sakuragaoka site in 1985, with full excavation of 850 m^2 of that area. The Nisshin 2 site (F-03-57) is located on a terrace at the base of a hill where the Nayoro River flows into the Teshio River on the northern edge of the city of Nayoro, just west of Shimokawa (Suzuki 1988). The site covers about 40,000 m^2 at an elevation of 97 m. Road work in 1986 necessitated investigation of 900 m^2 of the site, with full excavation of 300 m^2 of that area. These sites are among the few excavated Pleistocene sites in the northern part of Hokkaido.

A large number of Paleolithic stone artifacts (Figure 1) was recovered from the thin upper two strata of Sakuragaoka: many varied scrapers, microblades and blades, several cores, and a few boat-shaped tools and microcores, including a Togeshita microcore (Figure 1:2). Most artifacts were made of quartzite, a useful resource available locally, but many were also made of obsidian from distant sources (not identified), and some were made of siliceous shale, basalt and claystone. There are three obsidian-hydration dates for the site: 10,500±600 yr B.P. and 10,700±900 yr B.P. on flakes and blades, and 11,300±600 yr B.P. on microblades. These dates are close and might indicate that the artifacts all derive from a single occupation of the site. But they can also be interpreted as dating an older microlithic occupation and a younger blade occupation.

There were 1,324 lithic artifacts recovered from Nisshin 2: blades and microblades, Araya burins, stemmed points, drills, endscrapers and sidescrapers, pounders, and spalls produced by the Yubetsu technique. No microcores were recovered this time, but an excavation in 1964 found both Shirataki and Sakkotsu type microcores. Obsidian accounted for 50% of the lithic material, and quartzite for another 44%. Most of the obsidian came from the Shirataki source, with some also from the Akaigawa, Tokachi, Okedo, and Nayoro sources, and possibly also from the Furano source. There are two obsidian hydration dates (13,700±1,100 and 14,800±1,100 yr B.P.) and one fission-track date (13,800±1,200 yr B.P.) for the Nisshin 2 assemblage.

Pollen from Nisshin 2 shows that, at the time that site was occupied, the local forest was beginning to respond to warming conditions. Birch (*Betula*), alder

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(*Alnus*), and linden (*Tilia*) had become the dominant trees, but fir (*Abies*) and spruce (*Picea*) were still common in the area. Grasses (Gramineae) dominated the herbaceous vegetation, with considerable numbers of sedges (Cyperaceae), asters/thistles (Carduoideae), buckwheats (Polygonaceae) and other plants mixed in. Ferns and mosses were common on the site.

For the Sakuragaoka site, obsidian hydration dating was done by Yuko Kondo, Obihiro University of Agriculture and Veterinary Medicine; and lithic identification was done by Takashi Fukuoka, Nayoro High School. For the Nisshin 2 site, obsidian hydration and fission-track dating were done by Satoshi Koshimizu, Hokkaido University; obsidian source analysis was done by Tetsuo Warashina and Takenobu Higashimura, Kyoto University Research Reactor Institute; and the pollen was studied by Goro Yamada, Hokkaido Kaitaku Kinen Kan (Hokkaido Development Memorial Hall).

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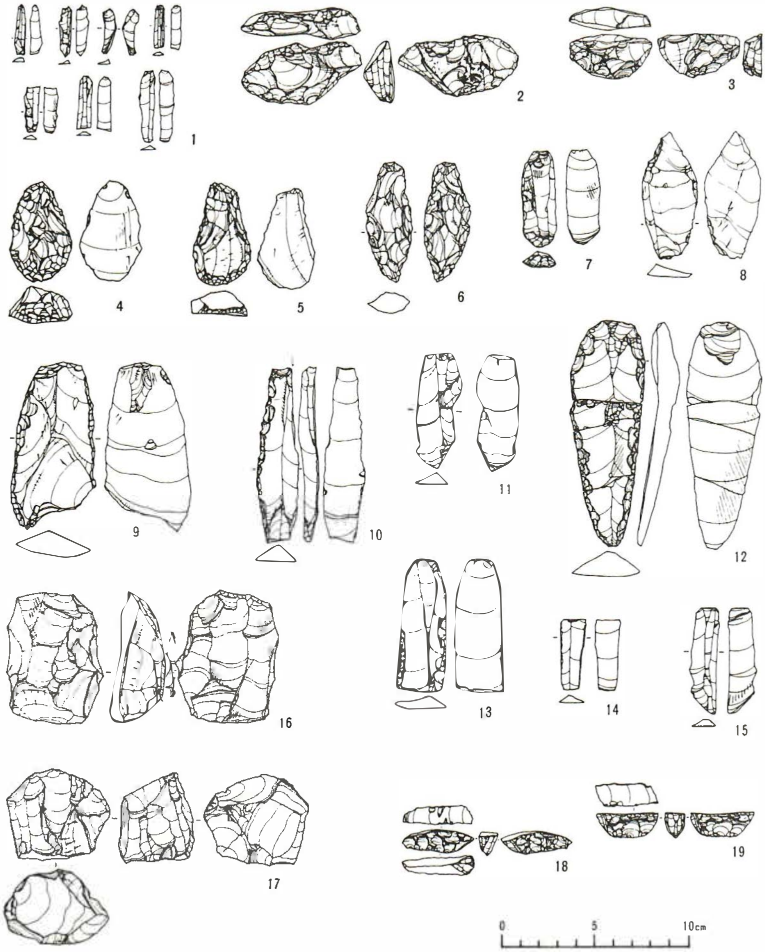

Figure 1. Artifacts from Sakuragaoka, Shimokawa town, north-central Hokkaido, Japan (1: microblades; 2–3: microcores; 4–9: scrapers; 10–15: blades; 16–17: cores; 18–19: boat-shaped tools).

Author Index

Information for Contributors

GENERAL INFORMATION

Categories of notes will be: 1) Archaeology, 2) Physical Anthropology, 3) Lithic Studies, 4) Taphonomy-Bone Modification, 5) Methods, 6) Paleoenvironments (which includes the subsections: Plants, Invertebrates, Vertebrates, and Geosciences), and 7) Special focus. The last category is reserved for a pre-selected topic; articles are submitted by authors at the request of the Center. Usually no more than 65 unsolicited papers for the regular sections and 5 solicited papers for the Special Focus section will be accepted. No more than 2 papers will be accepted from any one senior author. Time being of the essence, the earlier a paper is received, the better its chance of being published. Manuscripts concerned with any of the above categories should include research dating ≥10,000 yr B.P. or have direct implications for research of that time period.

Manuscripts should be of note length, ≤1000 word, or 400 words with one figure and caption, plus references. They should be current, original, not be or have been submitted to another journal, and may cover any aspect of the above-mentioned categories. All notes will be published in English. Authors submitting manuscripts in a language other than English may either submit their manuscript also in English or request the editorial staff to provide a translation (final decision will be left to the editorial board). In either case, both accepted manuscripts will be published. Manuscripts submitted in a language other than English should be typed double-spaced throughout and be legible. If a manuscript is found to require extensive editing or if a meaning is unclear, the author will be contacted—this could delay the printing of the manuscript.

Manuscripts are first read by the editorial staff to ensure the minimum requirements are met, as outlined above. All manuscripts are edited for style and general grammar. Because one of the practical goals of the journal is to provide quick turnaround time for the printing of manuscripts, authors do not review galley or page proofs. The editor staff compares the submitted manuscripts with the style-edited page proofs. Thus it is imperative that authors carefully proof their manuscripts for content, journal style, and grammar. It is suggested that all manuscripts be reviewed by a colleague of the author prior to submission. All manuscripts receive peer reviews.

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Manuscripts should be concise but detailed enough to permit critical appraisal. They must be typewritten and DOUBLE-SPACED THROUGHOUT (i.e., entire manuscript, references, and figure caption) on one side of 22 by 28 cm (8-1/2 by 11 inch) paper with no less than 4 cm (1-1/2 inch) margins.

If a word processor is used, use the following specifications in preparing and printing your manuscript. Use letter quality or near letter quality printing. Align text to the left margin only—do not justify. Underline any words that should be italicized in the final typeset galleys. DO NOT hyphenate words at the right margin. Manuscripts should be submitted in both printed form and as an ASCII file on disk (IBM or Macintosh format). The ASCII file will be transferred to a computer for typesetting. It is important to ensure the disk contains an **ASCII** version of the manuscript, not the original word processing format, as the computer will not be able to translate the text. Manuscripts that conform to these specifications will allow us to fully utilize the technology we have available in preparing manuscripts for publication, and to keep the cost of the journal down.

Space will not permit the inclusion of tables. Materials that normally would be placed in a small table should be placed in the text (e.g., "There are five radiocarbon dates from this site (15,000±100 yr B.P. (A-000),...11,000±100 yr B.P. (A-0000))"). One figure is permitted; the caption should be typed on a separate page using all above-mentioned specifications for text preparation. All pages should be numbered consecutively starting with the first page of text. The title page should include an informative title, author(s), affiliation(s), and complete mailing address(es), which must contain your zip code or postal district, when applicable. It would help to include your telephone number and your BITNET number, if possible, on your cover letter, should there be any questions by the editor. Avoid titles with interrogative form, abbreviations, and formulae. Submit three (3) copies of each manuscript and at least one PMT or glossy print of the figure, if one is included. Authors should keep original art.

Standardized words or spellings that do not need to be underlined or described: in situ; et al.; pers. comm.; Paleoindian; archaeology; CRM (for cultural resource management); MNI (for minimum number of individuals); TL (for thermoluminescence dating); yr B.P. (for years before present); and AMS or TAMS (for accelerator mass spectrometer technique of radiocarbon dating). Do not italicize words in the manuscript, only underline (Ficus not *Ficus*). The use of either Latin or common names is fine, but include the other (common or Latin) name in parentheses following the first time use (e.g., "..recovered the dung of the Shasta ground sloth (*Nothrotheriops shastensis*"). If technical jargon or abbreviations are to be used, and possibly are not well known to all readers, provide a more common term or explanation in parentheses.

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Metric units should be used throughout and be abbreviated when appropriate. Examples of the abbreviation style used include: i.e.; e.g.; cf.; cm; m; km; ha; yr B.P.; and sp. Numbers will be written out when they start a sentence or when they are the numbers one through nine (exception: "...20 choppers, 10 burins, and 2 knives were recovered."); numbers greater than nine are written as numerals (e.g., 10, 11, 1,000). All numbers greater than 999, including radiocarbon ages, should use a comma 22,200-1,210 yr B.P.; 1,000 years ago; 12,000 mollusks).

Radiocarbon dates should be expressed in ^{14}C years before present (yr B.P.) and should include the standard error and the laboratory number (e.g., 11,000±140 yr B.P. (A-1026)). International notation should be employed in all cases of chemical notations.

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If a figure is used, it must be cited in the text; e.g., "...as can be seen in Figure 1.," "...as is illustrated (Figure 1)." Line drawings ONLY (no color or continuous tone photographs). Submit at least one glossy photographic or PMT print of the figure, **10 by 12.5 cm** (4 by 5 inch) maximum image size. Photocopies and Polaroids are not acceptable quality for reproduction (because they are often gray—not true black as needed). Do not send the original artwork.

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