ARCHAEOLOGICAL INVESTIGATIONS OF THE LAMB SPRING SITE

by
DENNIS STANFORD, Smithsonian Institution
WALDO R. WEDEL, Smithsonian Institution
GLENN R. SCOTT, United States Geological Survey

INTRODUCTION

Lamb Spring is located two miles east of the Front Range in T6S, R69W in Douglas County, Colorado. It is situated at the head of a small draw which drains westward on the divide between the South Platte River and Plum Creek. After the discovery of Pleistocene faunal remains and chert artifacts, a number of archaeological investigations have taken place at this locality. The first, under the direction of Waldo R. Wedel, with funds from the National Science Foundation (NSF), was conducted during the summers of 1961 and 1962. The second major excavation, funded by the National Geographic Society, took place during the summer of 1980. The purpose of this paper is to describe briefly the results of these studies and to discuss the significance of this locality for the resolution of several major issues in Quaternary studies.

HISTORY AND RESULTS OF THE FIRST INVESTIGATIONS

During the excavation of a stock pond in the summer of 1960, Charles Lamb of Littleton, Colorado, uncovered a number of Pleistocene mammal bones. He called his finds to the attention of G. Edward Lewis of the U.S. Geological Survey in Denver, who visited the location and identified the remains of mammoth, horse, camel, bison, and an antilocaprid, along with some smaller mammalian species. Lewis and Glenn Scott, a U.S.G.S. geologist, made a series of hand-auger tests around the spring to determine the extent and depth of the bone deposits. In the process they found a number of worked flint chips.

The possibility of a direct association between the artifacts and the faunal assemblage was obvious, so they invited the Smithsonian Institution to undertake an interdisciplinary scientific investigation of the site. Support was provided by NSF grant G17609, with W. R. Wedel and C. L. Gazin of the Smithsonian as principal investigators. Wedel, with George Metcalf as field assistant, carried out excavations at the site during 1961 and 1962. Dr. Gazin of the Smithsonian, along with Lewis and C. Bertrand Schultz, University of Nebraska State Museum, was charged with the vertebrate paleontological analysis; Scott and Holmes Semken were the project geologists.

Unfortunately these studies were not completed, thus this important site was never published. However, from Scott's and Wedel's final reports, it is possible to make an assessment of the importance of the site and to give a brief review of their work.

Scott (1964) identified eight geologic units (Figure 1) that represent different events in the geologic history of the site. The lowest unit, Unit 0, is the Dawson Arkose. This formation is Upper Cretaceous to Paleocene in age. In the area of the site, the Dawson bed is a conglomerate that contains tiny pebbles of granitic rocks and quartz in a permeable sandy matrix. Fragments of petrified wood, chalcedony, lignite, and cretaceous fossils are also found in the conglomerate. It is an underground artesian aquifer recharged by water from the high area south of the South Platte River. The Dawson aquifer was an important water source for the people and animals which inhabited this area until 10 years ago when it was apparently pumped dry at the Lamb Spring. Unit 0 is important for the archaeological investigation because it is the basal excavation unit and has affected the composition and color of the Wisconsin deposits.

Unit 1 is a blue-green silty clay made up of sand and pebble-size particles of pink and white feldspar, quartz, muscovite flakes, and granite. Pleistocene faunal remains are relatively abundant in this unit. The excavation of the blue-green silty clay during the 1960s concentrated on the spring vent and westward along the overflow channel. Thus most of the finds could have been mixed by spring action and the microstratigraphy was extremely complex. A bone collagen date of 13,140 ± 1000 B.P. (M-1464) indicates that this level might be pre-Clovis in age. No stone artifacts were found at this level during

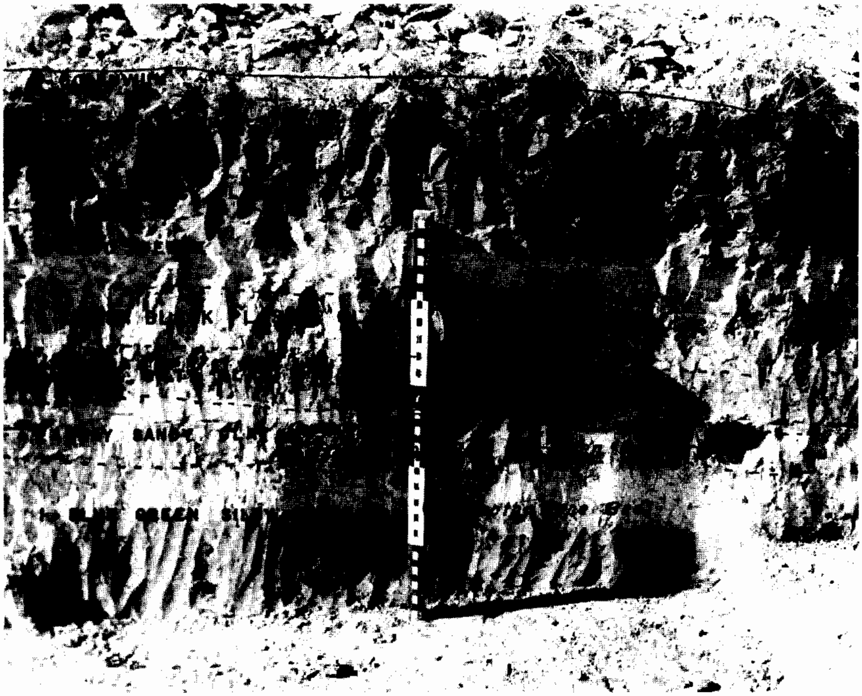

FIGURE 1. Stratigraphic cross-section of Lamb Spring site based on 1961-1962 work. (Scale is in feet.)

the original excavation. However, a number of flaked mammoth and camel bones were recovered. In his report to the National Science Foundation, Wedel (1965) remarked that, while he was not positive that the bone had been butchered, a number of features, such as piled mammoth long bones and some of the bone modification, would suggest human activities.

Unit 2 is a gray sandy clay containing quartz and chert sand, with small quantities of feldspar and limonite which occur only around rodent burrows. A disconformity separates this unit from the blue-green clay of Unit 1. North of the spring vent an extensive bison bone bed was found in the lower portion of this unit on or immediately above the blue-green clay. A midsection of a Cody point (Figure 2a) was found at or near the east edge of the bison bone bed. Another Cody point (Figure 2b) was recovered in the upper part of the unit. Other Cody-age artifacts were found on the spoils piles of Mr. Lamb's excavation (Figures 2c, d, e, and f). South of the vent scattered bison bone occurred in Unit 2. Radiocarbon dates on bone collagen from this level of 6920 ± 350 B.C. (M-1463) and 5920 ± 240 B.C. (SI-45) indicate that this occupation would have been a late Cody complex manifestation.

Unit 3 is a black silty clay containing very few particles larger than fine sand. These particles consisted of quartz and red and white feldspar. A number of chert and quartzite flakes as well as a muller and various non-diagnostic chipped stone cutting and scraping tools were recovered from this unit. A Duncan point (Figure 2g) was found immediately above the

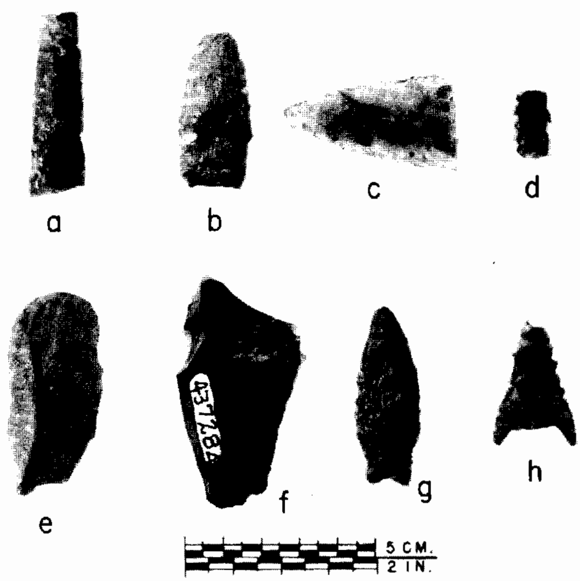

FIGURE 2. Artifacts from Lamb Spring site: (a) Cody projectile point mid-section, (b) Cody projectile point, (c) Cody knife fragment, (d) impact flute from Cody projectile point, (e) plano-convex scraper, (f) multi-pointed graver, (g) Duncan projectile point, (h) serrate-bladed projectile point.

sharply defined lower contact of Unit 3. No dates are available for this unit, but elsewhere in the northwestern plains of Wyoming, Duncan artifacts have been dated at approximately 1500 B.C. (Frison 1978; Wheeler 1954).

Unit 4 is termed the lower black plastic clay. It rests conformably over the black silty clay. Desiccation cracks mark its upper and lower contact. To the east this unit merged at its upper contact with Unit 6 where a sand wedge, Unit 5, pinched out and disappeared. The lower black plastic clay grades horizontally into a black humic horizon which overlies the spring sand to the east. A number of quartzite, chert, and chalcedony flakes were found in this black humic clay.

Unit 5 is a sand wedge which consists of hard, friable, poorly sorted sand with pebble concentrations. It thins from west to east and is represented eastward by a two-inch lag gravel deposit which can be traced into the contact between Unit 6 and Unit 7 on the east side of the spring. At or just below its contact with the overlying Unit 6, a barbed and serrate-bladed projectile point (Figure 2h) and a number of flakes were found in the sand wedge.

Unit 6, a black plastic clay, Unit 7, a brown silty clay, and Unit 8, a colluvium, all contained artifacts which were mixed Archaic, Woodland, and historic in age. These units resulted from sheetwash of the ground surface around the spring in late prehistoric and historic times.

As a result of these studies, the relationships of the various horizons of sheetwash to the mammoth and bison bone beds were well defined. However, since these studies were confined to an area immediately adjacent to the spring with its churned-up gley soils, no correlations could be made with any of the undisturbed zonal soils which exist away from the spring vent.

The reported archaeology defined a long and complex cultural utilization of the Lamb Spring site. However, the major thrust of the recent studies was to establish that Pleistocene hunters were accountable for the faunal remains found in Unit 1, and since the evidence which would support that hypothesis was inconclusive the investigation was terminated.

The recent development of concepts of bone processing (Frison 1970, 1974) and bone flaking technology (Bonnichsen 1979; Morlan 1980; Stanford 1979a; Stanford et al. n.d.) have led to an increased understanding of evidence indicative of human activity without the occurrence of traditionally recognized lithic artifacts. As these concepts were unknown during the first investigations at Lamb Spring, the record of human activity was almost lost. A preliminary reexamination of the original fossil bone collections from the site confirmed Wedel's suspicions and left little doubt that some of these specimens were modified by man. Given these new insights, as well as the early radiocarbon date, there was no question that an extensive examination of the Lamb Spring site might help resolve many late Quaternary problems, especially those concerning the antiquity of human occupation of the New World and the nature of both human and nonhuman modification of bone materials.

In August 1979, permission was obtained from the current landowners, Tirox Investment Corp. of Denver, to conduct preliminary testing at the site. Since time and budget were limited, the testing was restricted to three backhoe trenches cutting north, south, and east of the spring vent. It was hoped that these trenches would show the extent of the various geologic levels and determine if the Pleistocene faunal remains could be found in stratigraphic units which were not associated with the churned-up gley soils of the spring vent.

The results of the test trenching were exciting; parts of at least three mammoths were found in the backhoe trenches. The mammoth limb bones recovered had intersecting radial fractures and impact depressions indicative of fresh bone breakage which would occur when bones were processed by human groups. Associated with the mammoth bones was a large 33-pound river boulder (Figure 3). One surface of the boulder is heavily scarred in a manner similar to the damage which results from battering a hammerstone or an anvil. As boulders do not naturally occur in any geologic unit at the site, it probably originated from the Platte River, which is located over a mile away. In the absence of other explanations for the occurrence of the boulder with the bone, it is thought that it must have been brought to the site and used as a bone-processing tool. Similar sized and shaped boulders were required to fracture elephant long bones in replication studies (Park 1978; Stanford 1979c; Stanford et al. n.d.), and a nearly identical boulder was selected from the Platte River gravels to fracture elephant long bones during the summer of 1979 (Hershey 1979).

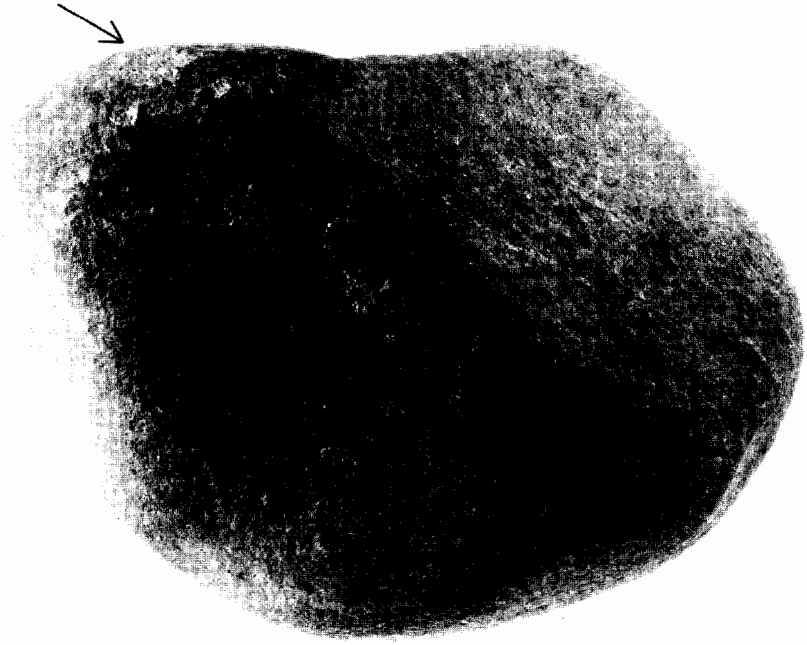

FIGURE 3. Thirty-three-pound boulder found with mammoth bones. Arrow indicates area of use damage. (Boulder is 41 cm wide and 24 cm high.)

The backhoe trenches also revealed that the stratigraphic unit containing these specimens extended away from the spring deposits raising hopes for the discovery of in situ evidence of human activity. Consequently a National Geographic grant (2190-80) was obtained to conduct an interdisciplinary study of the Lamb Spring area.

RESULTS OF THE 1980 INVESTIGATIONS

The 1980 research team was composed of Glenn Scott, who continued geologic studies of the area; Russell Graham, Illinois State Museum, project paleontologist; Jim Rancier, excavation coordinator; and Dennis Stanford, project archaeologist. Additional consultants were Alan Nelson, United States Department of the Interior, conducting amino acid studies of the gastropods; and Robert Stuckenrath, Smithsonian, currently processing new radiocarbon dates.

The excavation concentrated on the area immediately north of the spring vent and consisted of one two-meter-wide trench excavated for a distance of 18 meters to the north of the original excavation. Three two-meter-square

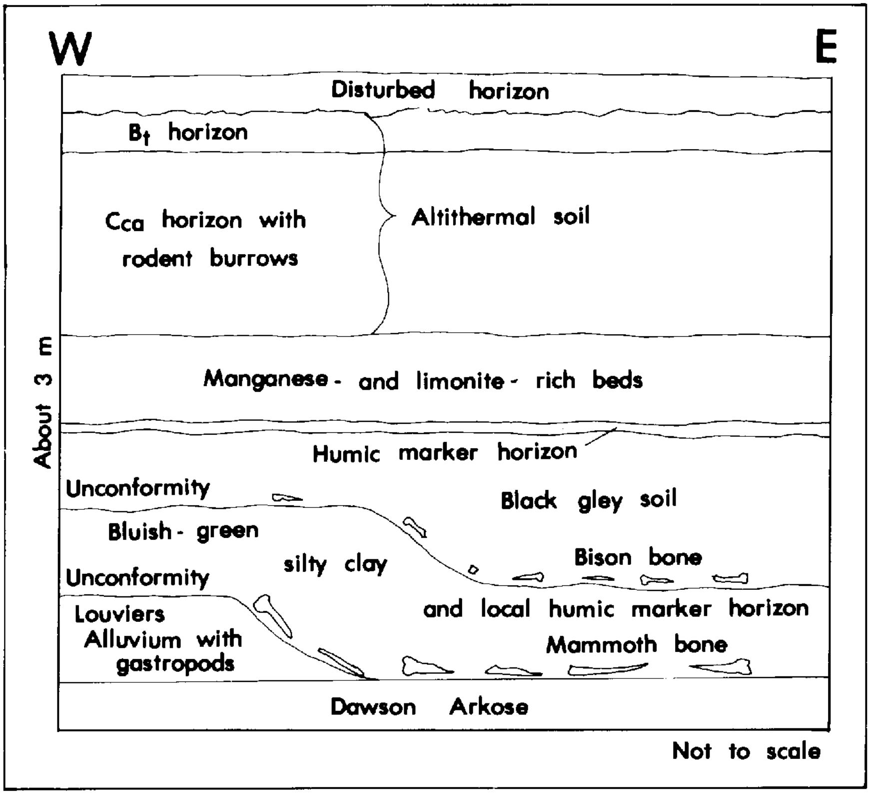

FIGURE 4. Cross-section of stratigraphy of 1980 work.

grids were excavated adjacent to the west side of the main trench. All grids were excavated by hand from the ground surface down to approximately four meters deep. All natural geologic units when identified were treated separately and all soils were screened through quarter-inch screens. Soil samples were wet sieved to recover micro-fossils. All bone and artifacts were mapped and photographed in situ as were all of the stratigraphic profiles. Soil samples, pollen samples, gastropods, organic matter, and seeds were also collected.

GEOLOGY

The reevaluation of the geology resolved several major problems which were apparent during the original excavations but could not be studied because of the completely water saturated soils and muddy conditions. Primarily the relationship between the azonal spring deposits and the zonal soils which were remote from the spring was identified. In addition several unconformities which were noted in the earlier work were defined and an Altithermal soil was exposed (see Figure 4 for stratigraphic profile).

The surficial deposits which overlie the Dawson Arkose are unconsolidated fine-grained sheetwash alluvium rather than the well-washed stratified alluvium of a through-flowing stream. Very likely some of the fine material was derived from eolian deposits that lie west of the site, or the sediment could have been deposited directly by the wind and incorporated into the sheetwash alluvium. The lower part of the sheetwash alluvium is tentatively correlated with Louviers Alluvium, which is thought to be early Wisconsin in age. This is separated by an unconformity from a blue-green silty clay which is correlated with the late Pleistocene Broadway Alluvium. The thick upper part of the sheetwash alluvium is of Holocene age.

The character of the alluvium changes as it is traced toward the former spring and it becomes richer in organic matter, limonite, manganese oxide, and clay. In addition, during withdrawal of the spring, several minerals formed as efflorescenses owing to desiccation of the alluvium. These include needle-like crystals of calcite, feathery crystals of halotrichite, and other sulfate minerals.

Immediately above the spring horizon in the Dawson Arkose are slot-like openings in the alluvium. These are interpreted as former conduits of spring water that apparently flowed from the northwest and southeast along the aquifer until reaching the main outlet at Lamb Spring. The walls of the conduits are strongly impregnated with iron oxide.

Commonly, 12 or more horizontal layers can be differentiated in the sheetwash alluvium on the basis of color, texture, and mineral composition. Several marker horizons are readily recognizable; two of these are black humic compressible silty clay beds that apparently represent times of little erosion or deposition. Other marker horizons are the boundaries between horizons of a well-developed Altithermal soil in the upper part of the sheetwash alluvium. This soil had an A horizon disturbed by plowing and a B_t horizon with coarse columnar structure. It is sticky plastic friable in consistence. Clay films were not observed in the B_t horizon. The upper 85 cm of parent material below the B_t horizon contains a massive but porous concentration of calcium carbonate.

Most of the surficial layers are nearly horizontal and conformable; however, many small unconformities were observed in the excavation. In addition two significant channels were eroded at different times. The first was cut into the Louviers-age deposits forming a channel which trends southeastward, parallel to the strike of the main aquifer in the Dawson. This erosion took place prior to the late Pleistocene. The second channel also parallels the strike of the aquifer and it was formed between the time of the deposition of the mammoth bone and the bison kill. These erosion events are inferred to have resulted from temporarily increased spring flow or from lowered levels of outflow from the spring.

The sheetwash deposits were disturbed again by burrowing rodents after formation of the Altithermal soil. Some burrows are as deep as 140 cm; however, most lie 40-120 cm below the surface, which approximated the C_{ca} horizon of the Altithermal soil.

The latest and least disruptive disturbance of the profile resulted from plowing in historic times. The plow pan generally is thinner than 40 cm.

Levels of the water table around the spring at different times can be inferred from the strong concentration of limonite and manganese in certain horizons. The highest level to which the water table rose was apparently seldom less

FIGURE 5. Partial view of mammoth bone pile with two bone flake concentrations indicated by arrows.

than 120 cm below present ground surface. The water table obviously rose from the time of earliest deposition of sheetwash to the time when the complete section had been deposited. Minor fluctuations undoubtedly took place owing to long-term and seasonal climatic fluctuations.

ARCHAEOLOGY

Within the 1980 test trench, the remains of at least five mammoths were found associated with the unconformity at the base of the blue-green silty clay deposit. Including the specimens which were collected during the prior investigations, over two dozen individual mammoths have been identified. Other mammalian species recovered include horse, camel, and a coyote-sized canid.

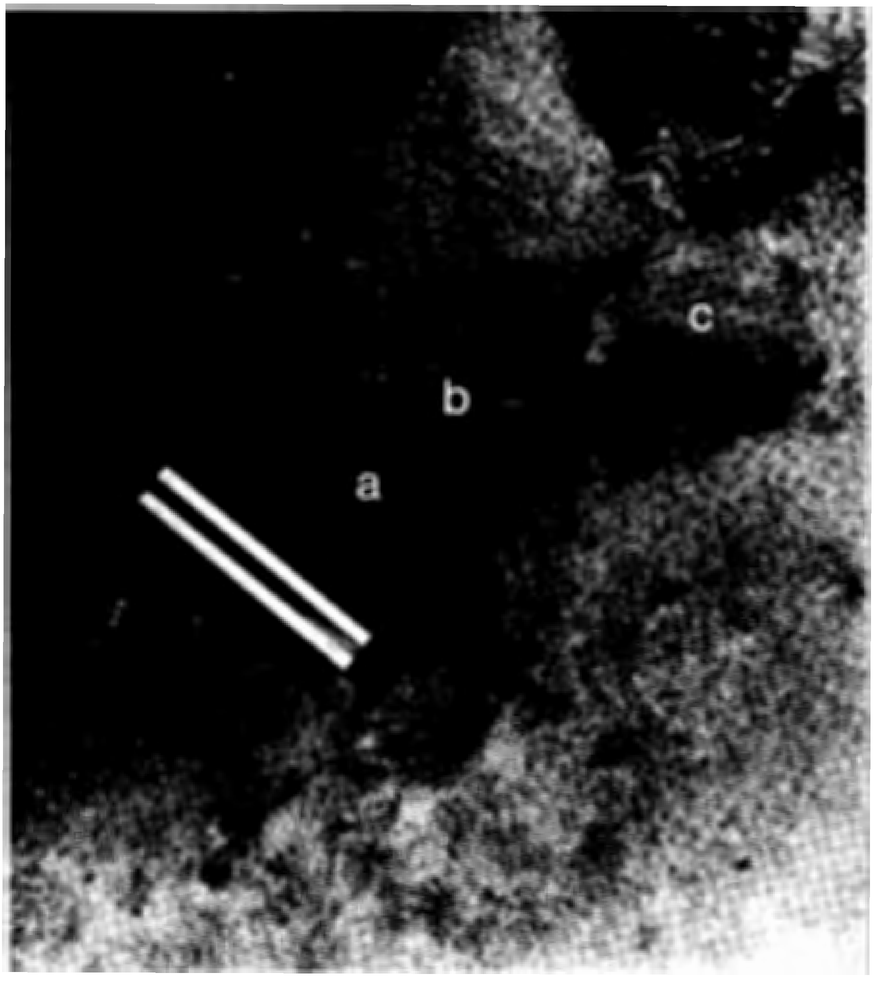

FIGURE 6. Close-up of (a) large bone flake, (b) bone flake with impact depression, (c) bone core.

The age range of the mammoths based on the molars approximates a normal population curve including young and old, but includes primarily mid-aged adults. The mammoth bones were disarticulated but showed little evidence of having been redeposited. All but one of the long bones were fragmented, with intersecting radial fractures, and some had impact depressions. Most of the more fragile bones such as ribs, scapulae, and innominates were complete. One major pile of bone exposed included a skull, three mandibles, for innominates, two tusks, two scapulae, a hyoid, and a number of ribs (Figure 5). Immediately adjacent to this pile were two concentrations of bone flakes and cores (Figure 6). It is our contention that these flakes and cores represent the manufacture and resharpening of bone expediency tools.

At least three bone cores were recovered which had flakes removed from the bone diastima parallel to the long axis of the bone (Figure 7). No bone tools were found which were polished or had other features which are indicative of tool use. Other than the boulder, no stone tools were found associated with the mammoth bone. However, the western edge of the channel in which these bones were found cut at mid-point the long axis of our north-south trench. Further, most of the large bones were left in situ as they intersected the walls of the trench. Therefore, most of the occupation level that would have had the highest potential for the recovery of artifacts could not be examined.

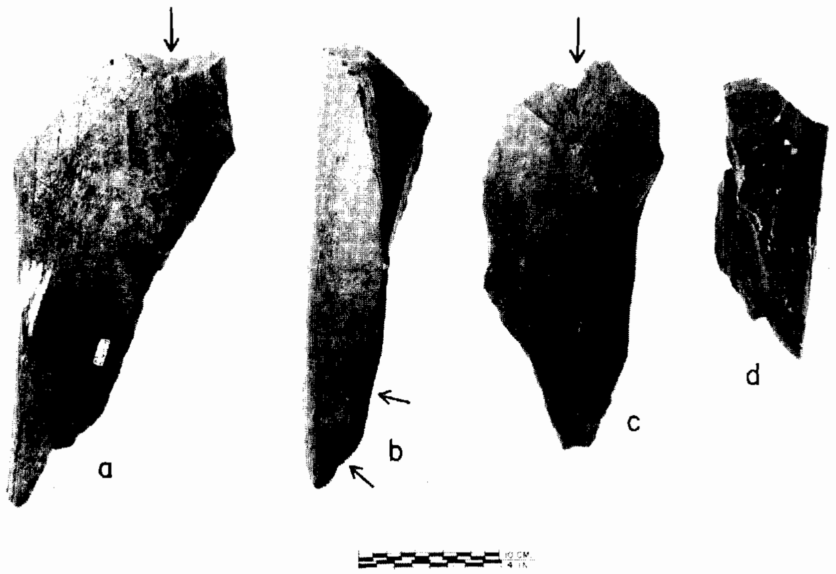

FIGURE 7. Bone artifacts: (a) bone core, found in 1962; arrow indicates flake scar; (b) flaked bone; arrows indicate flake scars; (c) large bone flake; arrow indicates scar of prior flake removal; (d) bone core with flake scars; arrow indicates point of impact depression and damage.

The second (and younger) channel was filled with a black gley soil. Bison bones were scattered throughout the channel fill but were mainly concentrated on the contact between the gley soil and the blue-green silty clay. These bones can be correlated with those associated with the Cody-age artifacts found during the 1960s excavation. The black soil dissipated rapidly on the west side of the test trench where it defined the bank of a shallow stream or pond. The lateral extent of the channel was not determined during this excavation.

Among the bison remains were a number of calf bones which when fully analyzed may indicate that this kill was a summer event. Gley soil in the channel would suggest boggy ground conditions. Thus, the bog may have been utilized as part of the trapping feature. No lithic artifacts were recovered; however, the bone was fully processed and butchered. Burned bones were common in the area, which would have been dry ground on the bank next to the channel.

An occupation level occurred below the C_{ca} horizon of the Altithermal soil but no diagnostic artifacts or features were found. The evidence of human activity consisted of a few bone fragments, less than a dozen flakes, a grinding stone, and several hammerstones. It is not known whether this level can be correlated with the unit that produced the Duncan point in the original excavation.

Archaic and Woodland projectile points, grinding stones, and flakes were found along with historic artifacts such as glass, rusty metal, barbed wire, and harness leather in the upper stratified sheetwash. These units were highly mixed and none of the artifacts was considered as being in its primary context. However, the occurrence of these artifacts indicated that the human utilization of the spring continued from Paleo-Indian through Early Woodland into historic times.

ARCHAEOLOGICAL SIGNIFICANCE OF LAMB SPRING

On the basis of our preliminary investigations, Lamb Spring may be extremely significant for resolving the question of the antiquity of the human occupation of the New World. The archaeologists agree that man entered the New World via the Bering Land Bridge, but the time of the earliest immigration(s) is still in question. The Clovis Complex, ca. 11,500 B.P., is the earliest firmly dated, unquestioned evidence for man in North America. However, two schools of thought have emerged concerning the question of man's antiquity in the New World. One group (e.g., Martin 1967, 1973; Mosiman and Martin 1975) believes that man did not enter North America before 12,000 years ago. The other group (e.g., Adovasio et al. 1980; Bryan 1978; Bonnichsen 1979; Haynes 1970; Irving 1971; MacNeish 1976; Morlan 1980; Stanford n.d.) contends that the first immigration may have taken place more than 30,000 years ago.

To resolve this debate, an archaeological site must be excavated which has unequivocal evidence of a human occupation dating earlier than 12,000 years B.P. From a pragmatic point of view, this hypothetical site should meet the following criteria: (1) clearly defined stratigraphy, (2) reliable and consistent radiometric dates, (3) consonance of the data from various relevant interdisciplinary researches, and (4) unquestionable human artifacts in indisputable association.

The stratigraphy from Lamb Spring is clearly definable and the general sequence of early Wisconsin, late Wisconsin, and Holocene shows a normal superpositional relationship. The geological, faunal, archaeological, and paleoenvironmental data from the site are consistent and complementary. Although there are no absolute dates from the site, the collagen dates of ±13,000, ±8,000, and ±7,000 B.P. support the stratigraphic sequence.

The major problems with accepting Lamb Spring as evidence for a pre-12,000-year-old occupation of the High Plains center on (1) the reliability of the single radiocarbon date and (2) the presumption that the putative artifacts are cultural in origin.

The dating problem will have to be resolved by geochemical research which is currently being conducted. However, it must be pointed out that while bone dates are notoriously unreliable, they are usually much younger than charcoal dates derived from the same geologic horizons. Therefore, the mammoth bone bed at Lamb Spring may be much older than the preliminary evaluation indicates.

The question of the artifactual nature of the presumed tools is a critical issue. The nature and causes of bone fracturing are currently being vigorously debated (Bonnichsen 1979; Morlan 1980; Myers et al. 1980; Stanford 1979b). The arguments center on specimens found at the Old Crow localities in Canada (e.g., Irving 1971; Bonnichsen 1979; Morlan 1980) and at the Selby and Dutton sites in Colorado (Stanford 1979a), where the evidence suggests that bone flaking technology is part of the earliest cultural tradition in the New World (e.g., Bonnichsen 1979; Bonnichsen and Young 1980; Morlan 1980; Stanford n.d.).

To clarify this position, studies have been conducted to identify characteristic features that would allow for the recognition of attributes which would distinguish man-made artifacts. These studies have taken the form of indepth analyses of the archaeological specimens (e.g., Bonnichsen 1979; Morlan 1980), replicative experiments (Park 1978; Hershey 1979; Stanford 1979c; Stanford et al. n.d.), and studies of other natural phenomena which also fracture bones in ways similar to man-made modifications (Haynes 1981).

The common feature which links these studies with Lamb Spring is the modification of proboscidian bone. Consequently through the increase of comparative specimens, especially in the undisturbed context indicated by the bone flake concentrations, the analyses of the Lamb Spring specimens will be extremely significant in resolving this issue.

Through the replicative experiments of elephant bone fracturing it has been demonstrated that large boulders are necessary to break these massive long bones (Stanford 1979c, Hershey 1979). Until the investigation of Lamb Spring, no large boulders have been found in an undisputed association with mammoth bone cores and flakes.

CONCLUSIONS

The excavations at the Lamb Spring site disclosed the presence of a late Pleistocene faunal assemblage which included the remains of mammoth, horse, camel, antilocaprid, bison, and a small canid. Mammoth remains were concentrated on an unconformity which cuts a Louviers-age sedimentary unit as well as the Dawson Arkose. Heavy concentration of bison bone was found above the mammoth deposit in a later sedimentary unit where it occurred as disarticulated elements in a flat-lying bed as well as in channel fill. In the later levels, there was relatively little bone material.

Human activity may account for part or all of the Pleistocene faunal remains, but until future studies are completed the evidence is meager, consisting of a few bone flakes and cores as well as a large river boulder. Man appears to have been on the scene when the bison bone bed was laid down, as is suggested by the presence of Cody artifacts that date back to about seven or eight thousand years before present, at least one specimen of which was associated with the bone bed. In higher levels in the deposits, Archaic artifacts indicate more frequent use of the locality; the scarcity of bone and presence of grinding tools suggest that these people may have been foragers rather than primarily hunters of big game, and that wild seeds from plants growing around the spring played a significant role in their subsistence economy.

REFERENCES CITED

Adovasio, J., J. D. Gunn, J. Donahue, R. Stuckenrath, J. E. Guilday, and K. Volman
1980 Yes, Virginia, it really is that old: a reply to Haynes and Mead. *American Antiquity,* 45(3):588-595.

Bonnichsen, Robson
1979 Pleistocene bone technology in the Beringian Refugium. *Mercury Series: Archaeological Survey of Canada Paper No. 89,* National Museum of Man, Ottawa.

Bonnichsen, Robson and David Young
1980 Early technological repertoires: bone to stone. *In* The Ice Free Corridor and Peopling the New World, Special AMQUA Issue, N. W. Rutter and C. E. Schweger, editors. *Canadian Journal of Anthropology,* 1(1):123-129. Edmonton.

Bryan, Alan
1978 An overview of Paleo-American prehistory from a Circum-Pacific perspective. Pp. 306-327 *in* Alan Bryan, editor, Early Man in America from a Circum-Pacific Perspective. *Occasional Papers No. 1 of the Department of Anthropology, University of Alberta,* Edmonton.

Frison, George
1970 The Glenrock buffalo jump, 48CO304: late prehistoric period buffalo procurement and butchering on the Northwest Plains. *Plains Anthropologist Memoir No. 7.*
1974 *The Casper site.* New York: Academic Press.
1978 *Prehistoric hunters of the High Plains.* New York: Academic Press.

Haynes, C. Vance
1970 Geochronology of the man mammoth sites and their bearing on the origin of the Llano Complex. Pp. 77-92 *in* W. Dort, Jr., and J. Knox Jones, Jr., editors, *Pleistocene and Recent Environments of the Central Great Plains.* Lawrence: The University Press of Kansas.

Haynes, Gary
1981 Bone modifications and skeletal disturbances by natural agencies: studies in North America. Ph.D. dissertation, The Catholic University of America.

Hershey, Sally
1979 The Denver Elephant project: bone breaking experiments. *Megafauna Punchers Review,* 1(1):28-30. Office of the State Archaeologist of Colorado, Denver.

Irving, William
1971 Recent early man research in the north. *Arctic Anthropology*, 8(2):68-83.
MacNeish, Richard
1976 Early man in the New World. *American Scientist*, 64:316-327.
Martin, Paul S.
1967 Prehistoric overkill. Pp. 75-120 *in* P. S. Martin and H. E. Wright, Jr., editors, *Pleistocene Extinctions: A Search for a Cause*. New Haven: Yale University Press.
1973 Discovery of America. *Science*, 179:969-974.
Morlan, Richard
1980 Taphonomy and archaeology in the Upper Pleistocene of the Northern Yukon Territory: a glimpse of the peopling of the New World. *Mercury Series: Archaeological Survey of Canada Paper No. 94*, National Museum of Man, Ottawa.
Mosiman, J. E. and P. S. Martin
1975 Simulating overkill by Paleoindians. *American Scientist*, 63:304-313.
Myers, Thomas, Michael Voorhies, and R. George Corner
1980 Spiral fracture and bone pseudotools at Paleontological sites. *American Antiquity*, 45(3):483-490.
Park, Edwards
1978 The Ginsberg caper: haking it as in stone age. *Smithsonian*, 9(4):85-96.
Scott, Glenn
1964 Geology of the Lamb Spring site. MS on file at U.S.G.S., Denver.
Stanford, Dennis
1979a The Selby and Dutton sites: evidence for a possible pre-Clovis occupation of the High Plains. Pp. 101-123 in R. L. Humphrey and D. Stanford, editors, *Pre-Llano Cultures of the Americas: Paradoxes and Possibilities*. Washington, D.C., The Anthropological Society of Washington.
1979b Afterword: resolving the question of New World origins. Pp. 147-150 in R. L. Humphrey and D. Stanford, editors, *Pre-Llano Cultures of the Americas: Paradoxes and Possibilities*. Washington, D.C., The Anthropological Society of Washington.
1979c Carving up a "mammoth" stone age style. *National Geographic*, 155(1):121.
n.d. A critical review of archeological evidence relating to the antiquity of the human occupation of the New World. *In* D. Ubelaker and H. Viola, editors, *Plains Indian Studies: A Collection of Essays in Honor of John C. Ewers and Waldo R. Wedel*. Submitted to Smithsonian Contributions to Anthropology Series, Washington, D.C.
Stanford, Dennis, Robson Bonnichsen, and Richard Morlan
n.d. The Ginsberg experiment: modern and prehistoric evidence of a bone flaking technology. *Science*, in press.
Wedel, Waldo
1965 Investigations at the Lamb Spring site, Colorado. MS on file at the National Science Foundation, Washington, D.C.
Wheeler, Richard P.
1954 Two new projectile point types: Duncan and Hanna points. *Plains Anthropologist*, 1:7-14.

ACKNOWLEDGMENTS

We thank Tirox Investment Corporation and Donald Cameron and William Hurd for their cooperation with our research; National Science Foundation, National Geographic Society, and the Smithsonian Institution for making funds available to conduct the work; and Tommy Fulgham, Sally Hershey, David Moore, and Ralph Shroba for help with the 1979 testing. A word of appreciation is due to Ellen Heineman and Victor Krantz for the photographic work; Bob Lewis and Richard Schoenfield for the illustrations; and Paula Cardwell and Jean Fitzgerald for typing the manuscript. The field crews from 1961, 1962, and 1980 also deserve recognition for their labors.