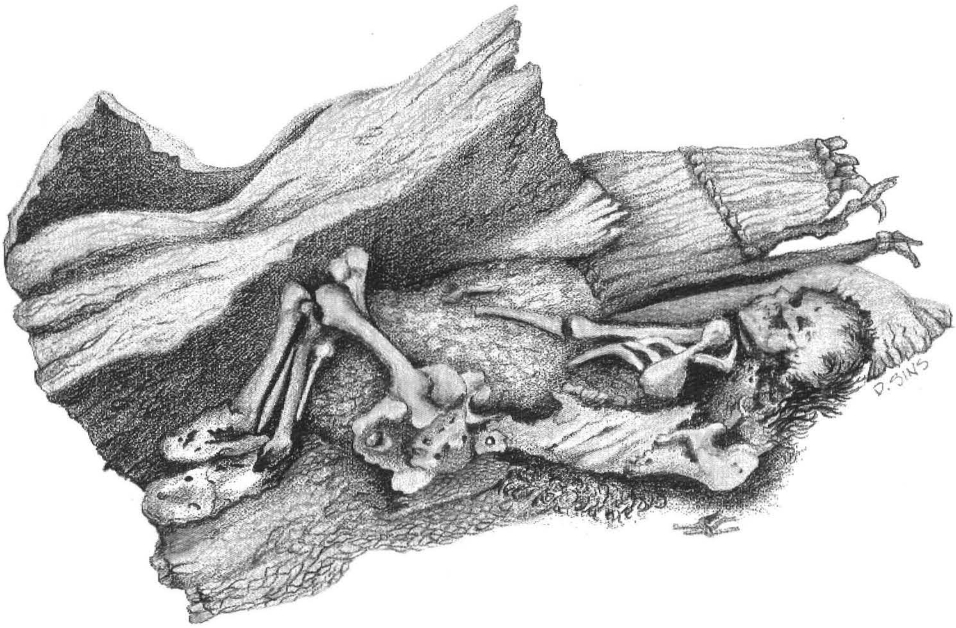
Nevada
Historical Society Quarterly



SPRING 1997

NEVADA HISTORICAL SOCIETY QUARTERLY

The *Nevada Historical Society Quarterly* solicits contributions of scholarly or popular interest dealing with the following subjects: the general (e.g., the political, social, economic, constitutional) or the natural history of Nevada and the Great Basin; the literature, languages, anthropology, and archaeology of these areas; reprints of historic documents; reviews and essays concerning the historical literature of Nevada, the Great Basin, and the West.

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Nevada

Historical Society Quarterly

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Contents

Front Cover: The Spirit Cave Man as he was found. (*Denise Sins, Nevada State Museum*)

PAPERS ON HOLOCENE BURIAL LOCALITIES PRESENTED AT THE TWENTY-FIFTH GREAT BASIN ANTHROPOLOGICAL CONFERENCE, October 10-12, 1996

Donald R. Tuohy and Amy Dansie

The majority of the following papers were delivered at the Twenty-fifth Great Basin Anthropological Conference at Symposium 15, which was chaired and organized by Amy Dansie and Donald R. Tuohy of the Nevada State Museum. The symposium abstract stated the following:

> The Accelerator Mass Spectrometry radiocarbon dates recently obtained on burials housed in the Nevada State Museum revealed two burial assemblages over 9,000 years old. The Spirit Cave mummy has received wide attention, but the other burials in the cave are also significant. A skeleton from Wizards Beach, Pyramid Lake, Nevada was also dated between 9,225 and 9,515 years B.P. Research on these two assemblages will be presented in the context of Great Basin prehistory and the issues relating to the peopling of the New World. The session will be concluded with open discussions on the issues of tribal affiliation and repatriation under "NAGPRA," an abbreviation that stands for the Native American Graves Protection and Repatriation Act of 1990.

This was not the first time an aboriginal burial in the Great Basin dated in excess of 9,000 years ago. L. S. Cressman's radiocarbon-dated sagebrush fiber sandals from Fort Rock Cave in the northern Great Basin in Oregon (Cressman 1977:frontispiece) dated just over 9,000 years ago at 9,053$\pm$350. But in our case, we had a mummy with hair on his head. At about 9,415 years old, the mummy turned out to be the oldest in North America. He was excavated in the Grimes Point foothills near Fallon, Nevada, in 1940 by Sydney M. and Georgia Wheeler.

Interest in Sydney Wheeler was revived recently in a paper by Alvin McLane entitled "S. M. Wheeler, Nevada Test Site's First Archaeologist," presented at the

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Twenty-first Great Basin Anthropological Conference in Park City, Utah. The Southern Branch of the Desert Research Institute (DRI), having taken over nearly all of the archaeological research in southern Nevada, became interested in Sydney Wheeler and his wife, Georgia. Sydney did not live very long; he died in 1959 when he was only fifty-seven years old. The Nevada State Museum at first assumed that Georgia was dead too, but after the radiocarbon dating of the Wheelers' mummy had been announced, we found out that Georgia (Wheeler) Felts was still alive and living with her husband in Nashville, Tennessee. The DRI chose her biographer, Diane L. Winslow, for a trip east to interview Georgia Felts, who was ninety-three in 1996.

In choosing articles for this publication, we added three studies not presented at the GBAC symposium, including one by Sydney M. Wheeler titled "Cave Burials Near Fallon, Nevada." Published in 1944 by the Nevada State Park Commission, it was written four years after the excavation of the male mummy from Spirit Cave and was based on two short papers written by Wheeler in 1940. We also chose to add "Georgia Wheeler Is Still Alive (And We Have Her Voice on Tape)," by Diane L. Winslow and Jeffrey R. Wedding. A preliminary report on investigations of the Spirit Cave mummy by Richard Jantz and Douglas Owsley and his team from the Smithsonian Institution is included to provide an update on analysis conducted since the conference.

Of the twelve papers scheduled for the Great Basin Anthropological Conference, two, those by Rebecca Lemon and Fred L. Nials, were not delivered, and a third, by Robson Bonnichsen, was a repeat of an earlier paper given elsewhere. The first paper, by Amy Dansie, sets the stage for the following eight studies of Early Holocene burials in Nevada, i.e., papers by S.M. Wheeler, Donald R. Tuohy, D. L. Kirner (*et al.*), Heather B. Edgar, Richard Jantz and Douglas Owsley, Frederika Kaestle, L. Kyle Napton, Peter E. Wigand, Sunday Eiselt, and Diane Winslow, and her partner, Jeffrey R. Wedding. Gentry Steele was not able to submit his paper for this publication.

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EARLY HOLOCENE BURIALS IN NEVADA
Overview of Localities, Research and Legal Issues

Amy Dansie

INTRODUCTION

Although we have known for years that human occupation started in the Great Basin before 11,000 years ago (Orr 1974:50; Hattori 1982:13), possibly even 12,000 (Bryan 1974), human bones known to be older than 8,000 years have included only small fragments. The Early Holocene Burial symposium presented at the 1996 Great Basin Anthropological Conference focused on recent advances in knowledge regarding a critical time period in Great Basin anthropology, between 9,000 and 9,500 years ago, based on new dates on human remains in the Nevada State Museum collections. I will provide an introduction to the archaeological localities dating to this time period (Figure 1), and an overview of the current research and legal status of the finds that were covered in this symposium. The articles presented herein are updated and expanded versions of the conference papers, with a few pertinent additions.

THE DISCOVERY

While completing research on Pyramid Lake archaeology, Donald Tuohy submitted samples of several burials for radiocarbon analysis to the Geochron laboratory in 1994, identifying several burials of significant antiquity. That same year, R. E. Taylor from the University of California at Riverside (UCR) was calibrating a new method of dating hair, and requested hair and bone samples from the mummies housed in the Nevada State Museum. Tuohy also resubmitted bone from the oldest Pyramid Lake skeleton, from Wizards Beach, to UCR in order to cross-check the date from the Geochron laboratory. Donna Kirner, of the UCR

The author wishes to thank Donald Tuohy for his unending support and guidance throughout the preparation of this issue. She also wants to thank Donna Kirner for expediting the dating of the materials discussed here and in the next article, above and beyond the call of duty. Finally, she wishes to thank all the authors included in this issue of the *Quarterly* for their cooperation and contributions, fitting this unexpected research into their busy schedules.

radiocarbon lab, describes the methods used in these dating studies in this issue, and in Kirner *et al.* 1996.

These two dating projects produced the oldest dates on intact human remains from Nevada--the oldest known mummy in North America at 9,415±25, and two of the fourteen known measurable crania in North America more than 8,000 years old. The hair dating project also produced the first recognized documentation of a new and very ancient textile type, diamond-plaiting, and pushed back the dates of other textile attributes several thousand years from previously known chronologies. Because both of these collections had been in the museum for many years, they emphasize several important issues: (1) the importance of reexamining previous collections, (2) the value of museums for long-term preservation of materials salvaged from destructive activities until resources are available for proper analysis, and (3) a vivid reminder that we should not assume major new discoveries can only happen with new field work. The significance of the dates for diamond-plaited matting and observed skeletal variations has stimulated research designs for a new synthesis of textile, genetic, osteological, archaeological, geographic, and chronometric data for the Great Basin using all the new tools available (Dansie 1997).

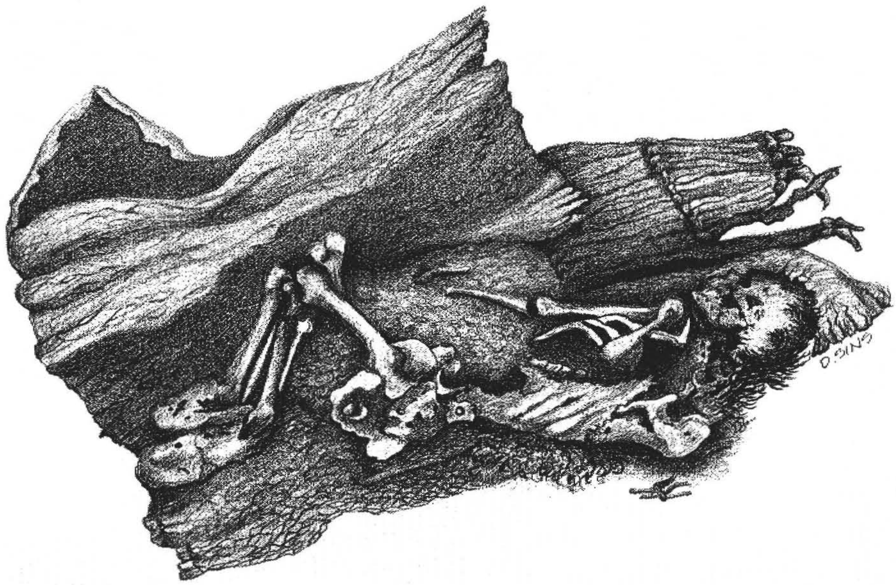
While there is much more to learn from these remains, the studies in this issue summarize what we have been able to learn from these and related early Holocene burials in Nevada. I will provide the background details for the collections that serve as the focus for this symposium, specifically the Spirit Cave and Pyramid Lake assemblages.

SPIRIT CAVE

In the early part of this century, guano miners and private collectors were rapidly destroying the extraordinary dry cave sites around the Lahontan Basin. The rich prehistoric record of Lovelock Cave was discovered through guano mining (Loud and Harrington 1928). Noting this threat, the State of Nevada developed a salvage archaeology program in the early 1940s.

Spirit Cave was found and excavated by Sydney and Georgia Wheeler in 1940 while conducting salvage archaeology among the dry caves of western Nevada for the Nevada State Parks Commission (Wheeler and Wheeler 1969). Sydney had injured his leg dodging a rattlesnake, causing them to change their plans for a few days. They decided to investigate a small shelter they had noticed from the road near Grimes Point, Churchill County, Nevada. What they found was a remarkable example of arid-climate preservation. As Wheeler's report (reprinted in this issue) describes, they found only a foot below the surface a large piece of matting associated with a set of disturbed human bones. They designated this first burial as Burial no. 1. The Wheelers recorded that they collected the matting, and reburied the human bones in the shelter. Below Burial no. 1 was another, completely intact burial wrapped in the same type of split-tule and cordage matting. Burial no. 2 is the now famous Spirit Cave mummy, carefully exposed, photographed, and recorded by the Wheelers. Wheeler described the inner matting as twined, but was mistaken, as we shall see. The illustration shows the posture and associated matting of the Spirit Cave mummy.

Near the two burials, Georgia Wheeler found two fine bags carefully placed one on top of the other. One of these bags contained a second bag inside, and both bags contained human cremations. Wheeler described in some detail a feature he believed was the cremation pit where both of the bodies were burned to small fragments. Radiocarbon dates on textile fragments confirm all four of the originally recognized burials are from the same time period, all older than 9,000 years, the cremations dating 375 years younger than the Spirit Cave mummy (see Table 1, Tuohy and Dansie, this issue).



An artist's rendering of the Spirit Cave burial. (*Denise Sins, Nevada State Museum*)

Although Georgia Wheeler, interviewed by phone in May of 1996, claims that she always suspected the mummy was very old, no one else suspected its great age. Sydney published M. R. Harrington's estimate of 1,500-to-2,000 years of age. After Wheeler's brief publication, the mummy was placed in a custom made wooden box, and was eventually stored in the Nevada State Museum. All of Wheeler's records are exceptional in their clarity and systematic organization, despite a few weaknesses in level of detail recorded. The records and other artifacts were placed into general collections storage with the rest of the museum's archaeological system, awaiting further research.

I had often looked at the box, clearly labeled, as it rested in the museum storage facility, knowing the mummies would be studied when scientific methods had advanced enough to do them justice. I had read Wheeler's report, and knew its age estimate. When I opened the box in 1994 for the hair study, I noticed that the interior matting was not twined, as Wheeler stated, but was made with a plain weave or plaiting. I had just read James Adovasio's overview of Great Basin textiles where he said the only plain weave was Lovelock Wickerware. A perusal of the literature revealed that Charles Rozaire (1974) had recognized this type of weave as plaiting in a small piece from Crypt Cave, at Winnemucca Lake, and Stacy Goodman (1985) had noted an even smaller piece in Hidden Cave, at Grimes Point. No one had pursued its significance beyond a sentence or two. We obtained permission from the Bureau of Land Management (BLM) to date textile fragments in 1996, and found that all the Nevada diamond-plaiting is older than 9,000 years.

STATUS OF SPIRIT CAVE RESEARCH

The new research activity stimulated by the dating projects would have happened eventually anyway, but the timing of this new discovery has important consequences for the future of the archaeological collections associated with human remains. Many of the Spirit Cave artifacts are grave goods, and may be reburied in the future. The textiles are currently being studied in detail by Catherine Fowler and Eugene Hattori; results were presented at the 1997 Society for American Archaeology meetings (Fowler *et al.* 1997). Donald Tuohy and I will summarize the textiles and all the other artifacts from Spirit Cave elsewhere in this issue, followed by Donna Kirner's report on the dates of the bone and other textiles associated with Spirit Cave. She will also discuss the different dates for Wizards Beach.

GRIMES BURIAL SHELTER, 26Ch1C

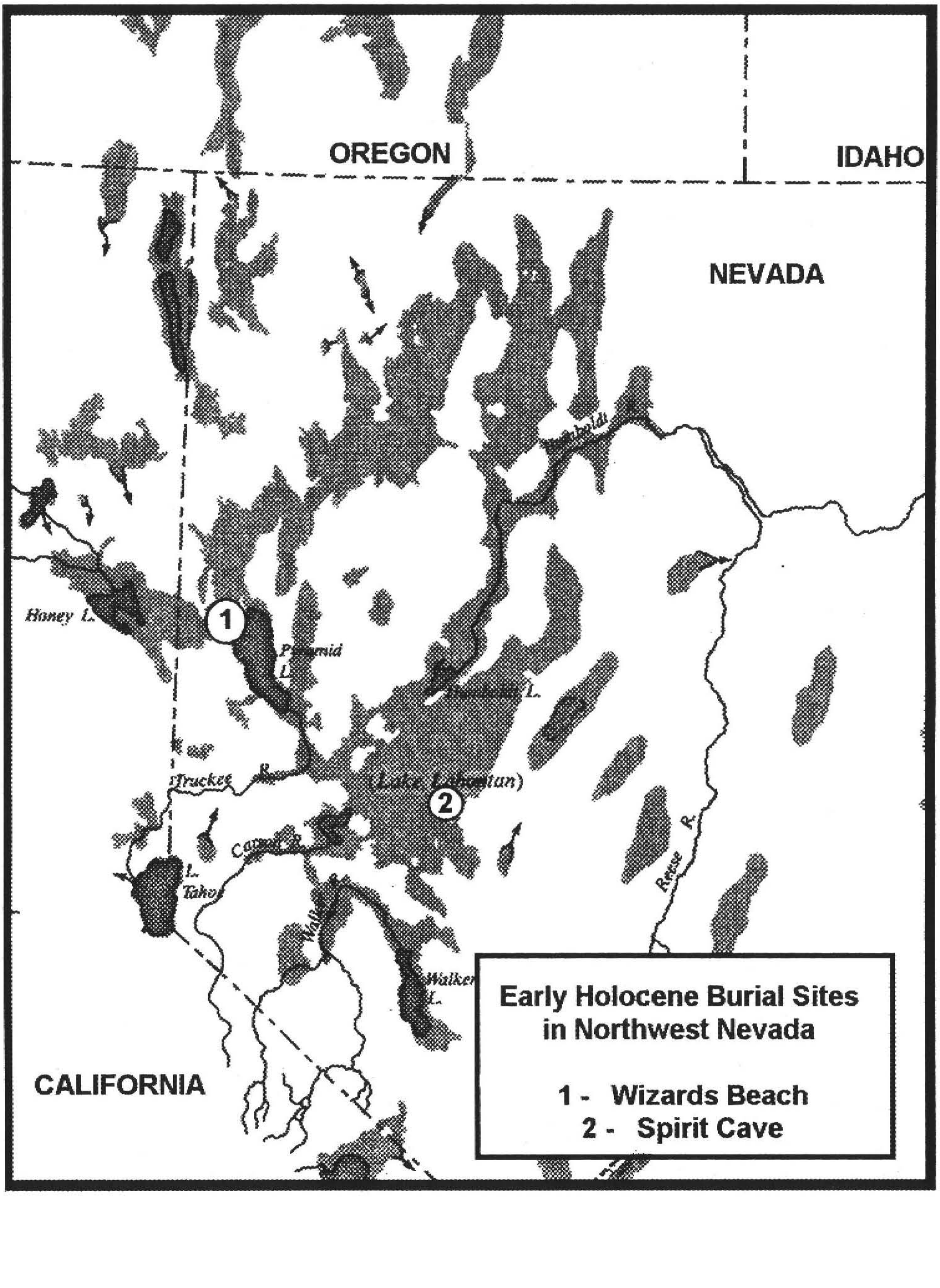
Another guano-miner discovery related to these early Holocene burials was collected from a small rock shelter on Grimes Point, near Spirit Cave; it was given to Margaret Wheat in 1939, who in turn reported it to Wheeler. He examined the small burial shelter, found only a few more fragments, recorded the site as 1-1C (Cave no. 16), and turned over the matting and human bone to the Nevada State Museum along with the other Nevada State Parks Commission collections in the early 1940s. The site was named Grimes Burial Shelter by Wheeler, and assigned the site number 26Ch1C by the Nevada State Museum. Despite being in plain sight in the museum collections, the matting was not recognized as the diamond-plaiting type until after the dating of the Spirit Cave mummy heightened our awareness of this unique weave. During our search for additional plaiting samples to date in 1995, we discovered the large fragment of matting, and submitted a small piece of it to UCR. The date is slightly older than those from Spirit Cave, 9,470±60 (UCR-3477/CAMS-33691). Associated with the matting are the well-preserved remains of a child, about ten years old, and small fragments of an older individual.

Further studies will be published later, after Richard Jantz and Douglas Owsley complete their analysis of the Nevada State Museum collections, but this child apparently represents an additional individual from the early Holocene population from western Nevada. The records described the cranium as broken by the guano miners, but it is only cracked, and not significantly damaged. The mandible and about half of the postcranial skeleton were not found in the site by the guano miners or by Wheeler. This site is not to be confused with the Grimes Burial Crevice, 26Ch11, which dates to historic times, the remains of which will be repatriated to the Fallon Paiute-Shoshone Tribes.

WIZARDS BEACH

The skeletons from Wizards Beach, on the northwest end of Pyramid Lake, Nevada, were found by avocational archaeologist Peter Ting during a low lake stand in 1968 and were reported to the University of Nevada, Reno. Robert Stevenson of the Nevada Archaeological Survey recorded and collected the exposed bones. His map shows the relationship of the two skeletons and an isolated femur, Burials A, B, and C, about 80 yards apart. The bones suffered significant wave erosion as the lake lowered. Four radiocarbon assays on Burial B dated between 9,100 and 9,500 years ago, but only two dates on total amino acids were used to determine the average age, 9,250±60 and 9,200±60 obtained by Richard Burky at UCR (Tuohy and Dansie, Table 1, this issue). The more complete Burial A was dated to almost 6,000 years. Those of you familiar with Wizards Beach may recall that this same setting produced two 24,500-year-old *Camelops* skeletons and a complete Pleistocene horse, now on display at the Nevada State Museum (Dansie *et al.* 1988).

No artifacts were found with the Wizards Beach skeletons. A reported "effigy" was a natural lump of tufa, the same calcium carbonate material that coats the Needles and the Pyramid. The bones were disarticulated when found, and unfortunately no reliable indicators of specific mortuary behavior were preserved. Other artifacts from Wizards Beach include finely crafted obsidian Northern Side notched points, Pinto points, and large bone spear points, with a length of sagebrush fishing cordage dated at 9,660±170 B.P. (Tuohy 1988:212). Bone fish gorgets and hooks and stone sinkers of unknown age are also common in this corner of Pyramid Lake. All these data suggest a possible early Holocene fishing economy developing, or surviving, around the remnant lakes as they receded from Lake Lahontan levels.


OREGON
IDAHO
NEVADA
CALIFORNIA
Honey L.
Pyramid L.
Truckee R.
(Lake Lahontan)
Carson R.
L. Tahoe
Walker L.
Reese R.
Early Holocene Burial Sites
in Northwest Nevada
1 - Wizards Beach
2 - Spirit Cave

ISSUES AND CURRENT RESEARCH

Grimes Point is on BLM land and all its archaeological resources are subject to federal laws protecting America's prehistoric heritage. Because of the sensitive political climate surrounding the Native American Graves Protection and Repatriation Act (NAGPRA) and the international publicity the Spirit Cave dates generated, in 1996 the Bureau of Land Management decided that further consumptive analysis of burials from BLM land should be processed under tribal consultation, citing the federal curation regulations which require written permission to perform consumptive analysis on collections falling under the Archaeological Resources Protection Act of 1979 (ARPA). Representatives of the Northern Paiute have asserted that all of the burials are Paiute regardless of age, and expressed strong objections to conducting DNA analysis of the burials. The Nevada State Museum request for BLM permission to conduct DNA analysis on the Spirit Cave remains was neither approved nor denied, pending completion of the official NAGPRA inventory publication in the Federal Register. That stage has now been completed, and no action has been taken as of this writing (March 1997). The Spirit Cave and Grimes Burial Shelter burials are inventoried as unidentified, with ethnic affiliation undetermined. Jantz and Owsley (this issue) document why affiliation of the early Holocene remains is uncertain. Legally, all non-consumptive analyses are allowed to proceed, and this issue reports all such studies completed to date.

Several years ago, the Nevada State Museum had already submitted samples for DNA analysis from non-BLM land in western Nevada, including the Pyramid Lake Reservation, as part of Tuohy's long-term study of Pyramid Lake prehistory conducted under Tribal Council approval. These DNA analyses were conducted under the NAGPRA provision for completion of studies of major importance. Fredrika Kaestle's article will report on the DNA studies of the non-BLM burials. The issue of affiliation between the ancient burials and the modern tribes is a complex one, both legally and scientifically, as well as emotionally and spiritually, and it remains to be seen if genetic studies will be included in such evaluations.

Additional studies of the early Holocene burials include analysis of materials found in the associated sediments. Samples of organic matter from the sediments around the skeletal (non-mummified) lower part of the Spirit Cave mummy were determined during analysis to be human coprolites. Peter Wigand and Sunday Eiselt will report on these studies in this issue. In a related vein, Lew Napton will present an overview of coprolite studies that will compare the Spirit Cave remains with other Lahontan basin studies.

Immediately after the dates of the Spirit Cave and Pyramid Lake burials were known, I contacted Gentry Steele, a specialist in Paleoindian physical anthropology. Through a generous grant from the Calhoun Foundation (formerly the Truman Orr foundation) we were able to bring Steele to Nevada for a thorough examination of these two ancient people. As part of our long-term documentation of Nevada burials, we were also able to bring Heather Edgar, physical anthropologist and former student of Sheilagh Brooks, to do a comparative study of a series of forty-four burials, including the Spirit Cave and Wizards Beach burials. Her travel was also supported by a Calhoun Foundation grant.

When the news of the Spirit Cave mummy's age was published in the national press, Douglas Owsley of the Smithsonian Institution read with interest about the Paiute claims of ancestry. His work with Richard Jantz on the craniofacial structure of Native American populations showed that known populations can be distinguished based on statistical analysis of cranial measurements. He offered to examine our series of human remains to evaluate affiliation with living tribal groups. One more Calhoun Foundation grant brought him and his team of experts to Nevada in 1996 and in 1997. We are pleased to be able to include their summary of findings in this issue.

These burials are potentially subject to repatriation under the Native American Graves Protection and Repatriation Act of 1990. After the presentations in October, Alan Schneider, a lawyer with extensive experience in NAGPRA matters, presented an overview of legal issues. There is no avoiding the complex and sensitive issues regarding Native American spiritual values and legal rights under current legislation. Although NAGPRA provides for the transition from science to repatriation, there are issues of critical importance to the study of human occupation of the New World to which these and other early Holocene burials are pivotal. The recent find of the Kennewick Man skeleton, about 9,000 years old, on the Columbia River is directly relevant to these early Nevada burials. Although the Kennewick Man was found after the passage of NAGPRA, and hence falls under different provisions of the law, the question of affiliation remains a key issue. The affiliation of these ancient people, with compellingly Caucasoid traits, will be a topic of debate, and court action, for some time. While these ancient humans may be ancestors of living Indians, they are physically different enough that it has not yet been established to whom they are most closely related, nor if they left any descendants. Because of these preliminary findings, Schneider pointed out that it remains to be established whether NAGPRA even applies to such ancient remains.

While the legal resolution of these issues remains unclear, it is quite apparent that a serious conflict between cultures has developed. At the heart of the issue are basic definitions of humanity and spirituality. On the one hand, scientists feel the destruction of rare and irreplaceable information from ancient times violates the right to learn about human origins. On the other hand, many Native Americans are more concerned about additional profanations of their ancestors. Yet it is too simple to reduce the discussion to a choice between treating human remains as simply objects for study or as vessels for departed spirits. As we go to press, the United States District Court case in Oregon regarding Kennewick Man remains open after a second hearing. The judge denied two motions: by the Army Corps of Engineers for summary judgment to dismiss and by the scientists involved to allow immediate access to the remains for further study. The court seems intent on developing the record fully in this complex case, leaving open the possibility for later study, once the issues are more clearly delineated.

Although NAGPRA conveys rights to demonstrable descendants to rebury their ancestors, establishing and verifying lines of descent through thousands of years of human movements and cultural change has been difficult, if not impossible. Reburial after scientific study is a compromise most archaeologists seem willing to make, albeit reluctantly. Many Native Americans, however, remain opposed to further study, believing it is disrespectful, regardless of affiliation. In the case of the scientific analysis of ancient Nevadans presented in this issue of the *Nevada Historical Society Quarterly*, we offer these studies in sincere respect, recognizing the unique identity and history of departed persons and hoping to learn from them.

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CAVE BURIALS NEAR FALLON, NEVADA

S. M. Wheeler

During the 1940 field season, my wife and I investigated, for the Nevada State Park Commission, more than a score of caves near Fallon, Churchill County, Nevada. In the course of this work, we uncovered two burials and two cremations which greatly increased our meager store of information regarding the mortuary customs of the prehistoric inhabitants of the area.

On the 11th of August, we decided to check a cave we had seen many times but had not explored. The mile walk through the hot, loose sand and the climb over the rocky terraces of ancient Lake Lahontan justified a rest at the entrance to our objective. This proved to be a rockshelter, facing west, about 25 feet wide, 15 feet deep and averaging about 5 feet high. From the northeast corner an opening led into a small chamber. The ceiling and walls, covered with tufa deposited by the prehistoric lake, showed little remaining trace of the fires which later excavation revealed had been built within the shelter.

On the left, as we looked in, a slightly raised portion of the floor was bordered by a quarter-circle of rocks which extended from near the center of the rear wall to the north wall just inside the entrance. The shelter was so situated that it appeared that little, if any, rain or runoff water could enter, an opinion later confirmed by the dryness of the deposit and the excellent state of preservation of the perishable materials.

It had not been planned to make any test excavation during this first visit but, at my wife's insistence, I pointed to the area enclosed by the line of rocks. She commenced to dig near the rear wall while I explored the inner room. The first foot revealed no evidence of occupancy, just dry, windblown sand. Under this she laid bare a portion of what had been a large mat, very finely twined, with the warp of spit tules and the weft of native hemp cord. When completely uncovered, this was found to be wrapped around a few human bones, all that remained of some early Nevada inhabitant.

Immediately under this was another large mat of tules, the warp held together with rows of tule twining about 5 inches apart. When the pit was enlarged to uncover the complete mat, we saw we had a second burial, the more important of the two because the wrappings were nearly perfect.

This is the first version of the report S. M. Wheeler made on the discoveries at Spirit Cave.

The burial pit consisted of an excavation 6 feet long, 4 feet wide and 3 feet 9 inches deep. It was lined with sagebrush on which the mortuary bundle was deposited and then covered with more brush. The head, at a depth of 2 feet 4 inches and slightly higher than the hips was oriented 55 degrees east of true north. The upper part of the pit had been filled with rocks which the wind eventually concealed with fine sand. Later, the intrusive upper burial was laid on the first.

The necessary photographs taken and data recorded, we were faced with the difficult problem of transferring the bundle to our bed in the station wagon. With the assistance of Fallon residents, we were able to accomplish this without doing any damage to the specimen.

The next few days were spent in cleaning and studying the bundle. It was possible to open it, without injury, in order to determine the method of preparing the body for burial. It lay on its right side on a fur blanket, the legs being semi-flexed, with the knees opposite the hips. The upper half was wrapped in a close-twined mat of the type found with the intrusive burial. This was sewn together around the head. A similar mat was wrapped around the balance of the body and the large mat of tules, 35 inches by 50 inches, was laid over the entire bundle, the lower corners being tied together under the feet. All these mats were of types found elsewhere in the caves of the Fallon area and in Lovelock Cave, about 40 miles to the north (L.L. Loud and M. R. Harrington 1929).

[Wheeler was wrong in his identification of the mats. Amy Dansie was the first to point this out. Both burials were wrapped, not in twined mats, but in matting which we called *diamond-plaiting* after the technique first described by Charles Rozaire (1974:69). See Dansie's notes at the end of this article.]

The bones of the lower portion of the body were exposed but, from the hips upward, it was partly mummified. The scalp was complete with a small tuft of hair remaining. Within an hour after exposure to the light and air the black hair became reddish. The clothing consisted of a pair of leather moccasins and a breech-cloth of fiber. There were no other accompaniments with the burial.

The body was identified by Dr. [Harry] Sawyer of Fallon, as that of a young adult male. Mr. M. R. Harrington, Curator of the Southwest Museum, after examining the bundle, concurred in placing the age of the burial at approximately 1500 to 2000 years. . . .

. . . Five days after the removal of the Spirit Cave burials, we returned to make an additional test excavation. On our previous visit we had noted several interesting-looking places that might hold other burials. My wife selected the location for her work against the rear wall at a point about 10 feet south from the initial discovery. She soon reported finding a small unshaped metate leaning against the wall at a depth of 20 inches. Four inches under this, she uncovered a small twined bag of split tules from beneath which protruded the edge of a close-twined bag of native hemp. These lay on the bottom and at the rear end of a pit 5 feet wide, 6 feet long and 2 1/2 feet deep which had been used for crmatory purposes and then filled in.

The upper bag was of split tules closely twined with weft of native hemp string. It had been made flat, like a rectangular mat, folded in half and the sides overcast to form a container 14 1/2 inches long and 9 inches deep. At the top, 3 3/4 inches from each end, were two pairs of tie strings. On the reverse side there were three of these strips, the middle one being 6 1/4 inches from the end.

This bag contained a side-opening open-twined bag [made] of hemp with a 4 inch fringe made by extending the warp elements at either end. This inner bag, which held cremated human bones, was 12 inches long (less fringe) and 9 inches deep. It, too, had been made as a mat and folded and sewn. A carrying handle was made of 1/8 inch native hemp cord tied to the fringe at either end of the opening.

The lower bag, also containing burnt fragments of human bones, was 15 3/4 inches long and 8 inches deep and originally had a 6 3/4 inch fringe of native hemp cord on each end. In construction it was the same as the inner bag described above.

From the specimens themselves there is no evidence on which to base a determination of their age. Both were definitely buried at the same time. If the cremations actually took place in the trench (and the evidence all led to that conclusion) they are at least of sufficient ages that nearly all trace of the fire has disappeared from the wall and low ceiling of the cave.

Complete excavation revealed that the Spirit Cave had not been inhabited but the shelter had been used for burial and the small inner chamber for storage.

NOTE ON TEXTILES ASSOCIATED WITH THE SPIRIT CAVE BURIALS

Amy Dansie

Burial no. 1. When the Wheelers first excavated Spirit Cave they encountered a disturbed burial about a foot below the surface. It was represented by a large piece of matting that Wheeler called *twined*, but which is in fact diamond-plaiting. This matting dates to 9,270±60 B.P. (UCR-3480). A few disarticulated human bones were found with the matting, and Wheeler claimed to have reburied the bones in the cave, collecting only the matting. Scattered human bone of a young male and an adult female was collected from the site deposits, and the female bone dates to 9,300±70 B.P. (UCR-3475), statistically identical to the Burial no. 1 matting. (The male bone is much more recent, at 4,640±50 B.P. (UCR-3473).

Burial no. 2, The Spirit Cave Mummy. Directly below Burial no. 1 was the undisturbed, partially mummified body of a 35-to-55-year-old male, wrapped in two large pieces of diamond-plaiting matting, and covered with a large open-twined tule mat. He was also wrapped in a rabbit-skin blanket which retained a significant amount of fur, and had well-constructed hide moccasins on his feet. No other diagnostic artifacts were associated with the mummy. The following article by Tuohy and Dansie lists (Table 1) the seven radiocarbon assays run on hair, bone, twined tule matting, and diamond-plaited matting, with a weighted mean of 9,415±25 radiocarbon (uncalibrated) years B.P. It is important to note that Charles Rozaire mentioned a "distinctive kind of plaited matting. . . composed of string wefts and tule warp," from Crypt Cave. He noted that "the warps form their unique diamond pattern as a result of the spacing of the wefts" (Rozaire 1974:69). He compared it to a similar piece in L. S. Cressman (1942: figure 89i), which will be discussed later. Since then, only one other Nevada reference has appeared, a brief note in the Hidden Cave report of a small fragment with no context within the cave. Based on Rozaire's description, the Nevada State Museum adopted the term *diamond-plaiting* to describe this weave to highlight its distinctive technical features.

Cremations no. 1 and no. 2. About ten feet from the mummy, Georgia Wheeler uncovered a pair of finely woven bags containing thoroughly cremated human bones. They were lying on top of each other, with no sediment between them. The top bag, Cremation no. 1, was made of diamond-plaited matting very similar to the maummy wrappings. Within that bag was a twined hemp cordage bag with long fringes which contained the human remains. The bottom bag, Cremation no. 2, was a twined hemp bag with damaged fringes, also containing human remains. Damaged but attaced cords from Cremation no. 2 yielded a radiocarbon date of 9,040±50 B.P. Because the original provenience is so well documented, there is no doubt the bags are contemporaneous, and the date is applicable to both bags.

Other textiles from the cave have been dated to more recent times. The coiled basket dates to 2,200±60 B.P., and the twined grass matting fragment dates to 1,700±60.

FIGURES

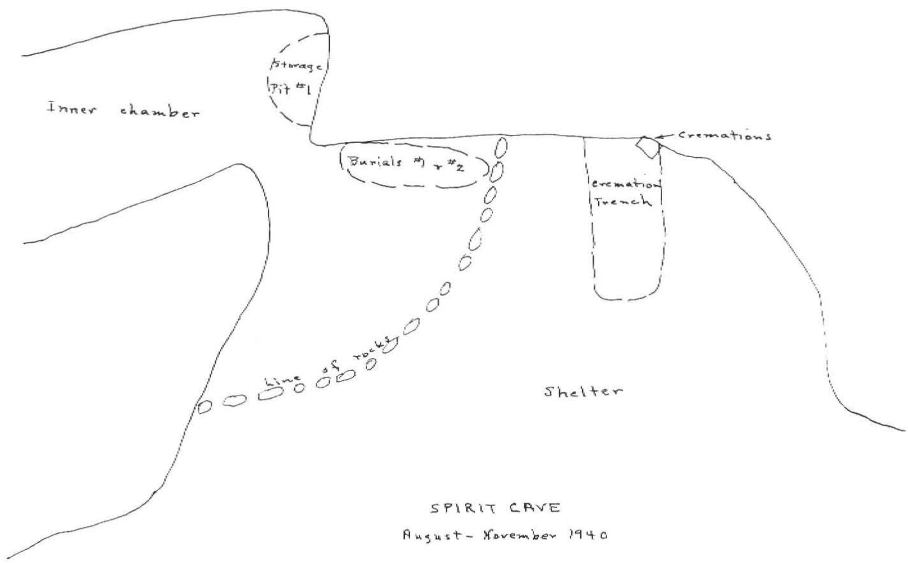

FIGURE 1. Plan of Spirit Cave showing where the two burials and the two cremations were found (*S. M. Wheeler, Nevada State Museum*)

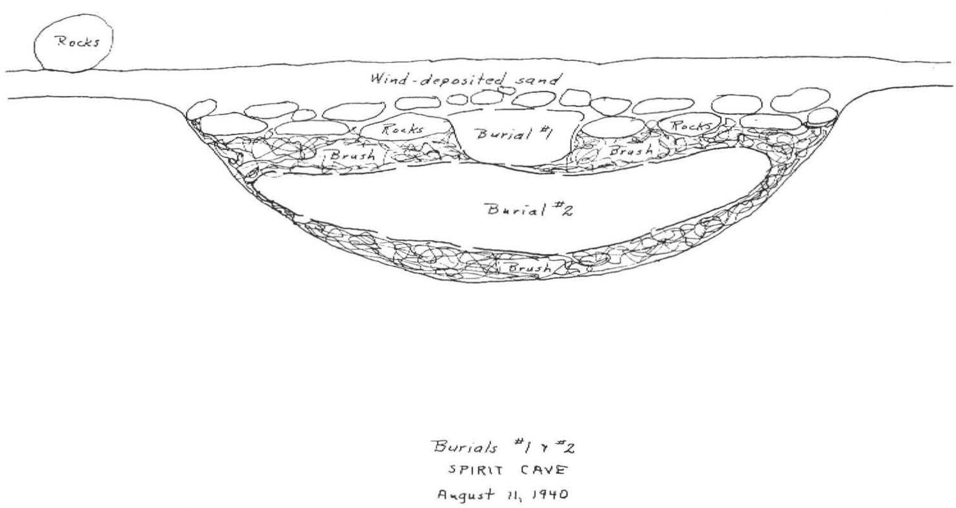

FIGURE 2. Cross section of Spirit Cave showing the position of the two burials, Burial no. 1 and no. 2. (*S. M. Wheeler, Nevada State Museum*)

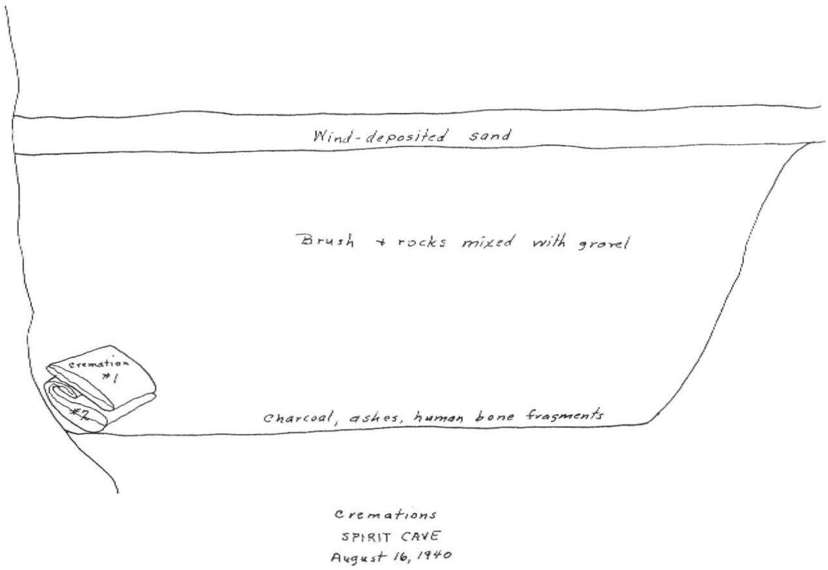

FIGURE 3. Cross section of Spirit Cave showing the position of the two cremations, Cremation no. 1 and Cremation no. 2 (*S. M. Wheeler, Nevada State Museum*)

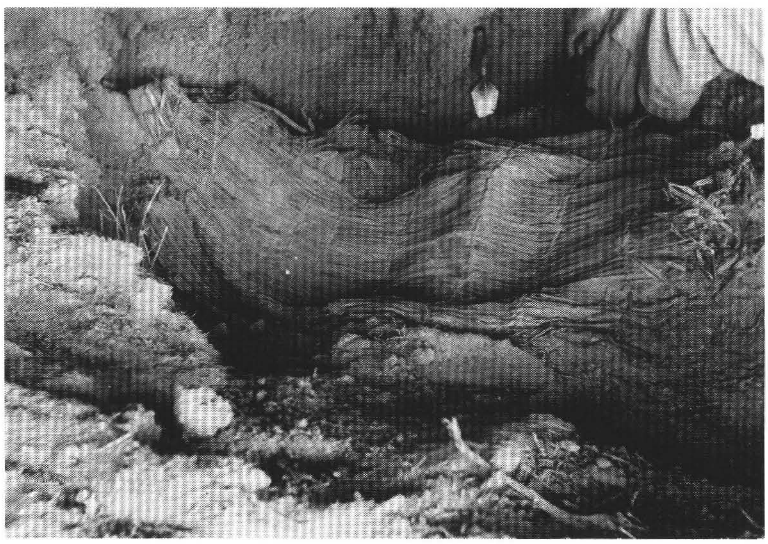

FIGURE 4. Spirit Cave, showing the tule mat covering Burial no. 2, *in situ*. (*S. M. Wheeler, Nevada State Museum*)

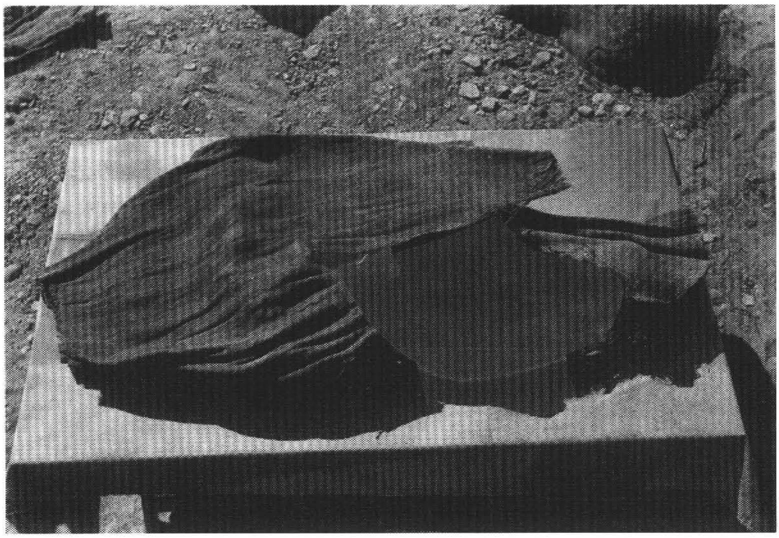

FIGURE 5. Burial no. 2, with the outside tule mat removed, showing the two inner diamond-plaited mats (*S. M. Wheeler, Nevada State Museum*)

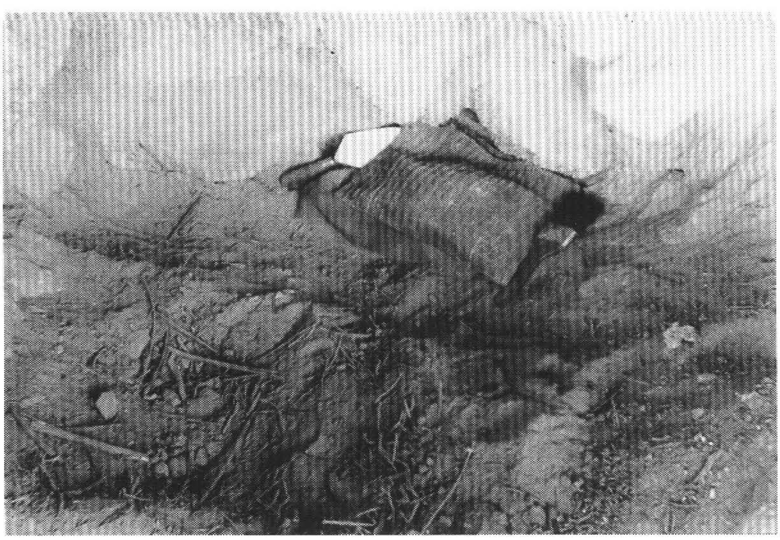

FIGURE 6. Spirit Cave, showing the two cremations in their respective bags. (*S. M. Wheeler, Nevada State Museum*)

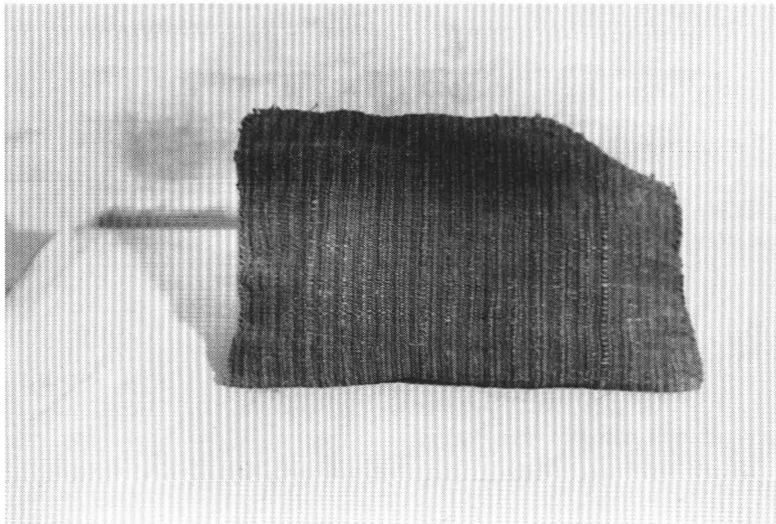

FIGURE 7. Spirit Cave, showing the exterior bag which held an interior bag with the bones of Cremation no. 1. The exterior bag is re-enforced with leather straps and it is made by the diamond-plaiting method (*S. M. Wheeler, Nevada State Museum*)

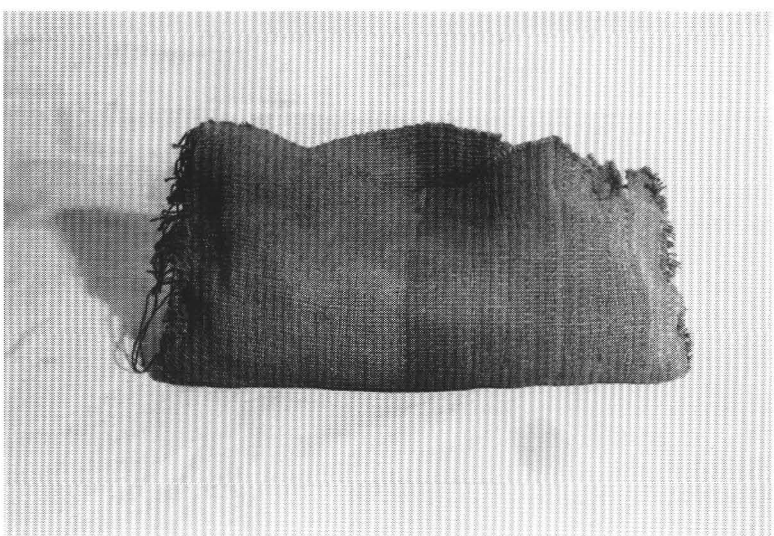

FIGURE 8. Spirit Cave, showing the close-twined bag which held the bones of Cremation no. 2 (*S. M. Wheeler, Nevada State Museum*)

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NEW INFORMATION REGARDING EARLY HOLOCENE MANIFESTATIONS IN THE WESTERN GREAT BASIN

Donald R. Tuohy and Amy J. Dansie

INTRODUCTION

This article describes the sixty-seven artifacts which were found in Spirit Cave. Fifty-three artifacts were catalogued on five-by-seven inch cards by S. M. Wheeler, and the additional artifacts were found with the mummy, such as the remnants of the fur robe and the pair of moccasins. We start first with the ground stone, then the chipped stone, then the artifacts made of wood, fiber, animal skin, and hair, in that order. The dating of the artifacts and the radiocarbon laboratory numbers are shown in Table 1. The dimensions of the artifacts are given in Table 2, and the artifacts are shown in Figures 1-17. Catherine Fowler and Eugene Hattori whose paper was presented at the Sixty-second Annual Meeting of the Society for American Archaeology, April 2-6, 1997 (Fowler, *et al.* 1997), are conducting further study of the artifacts.

Not only do Donald R. Tuohy and Amy J. Dansie comprise the Anthropology Department at the Nevada State Museum, they also serve as co-editors of this special issue of the *Quarterly.*

Table 1. Spirit Cave and Related Dates

Lab Sample #	Material	Date	Notes
Spirit Cave Mummy Dates, 26Ch1f (AHUR 2064)			
UCR-3324-1/ CAMS 24194	Twined tule mat	9,410±60	total amino acids; 1-20-2
UCR-3324-2/ CAMS 24197	Twined tule mat	9,460±60	total amino acids
UCR-3323/ CAMS 24199	Diamond plaited mat	9,430±70	total amino acids; 1-20-2
UCR-3261-2/ CAMS 12353	hair AHUR 2064/1-20-2	9,360±60	water only
UCR-3261-4/ CAMS 12354	hair AHUR 2064/1-20-2	9,350±70	total amino acids
UCR-3261-2	hair AHUR 2064/1-20-2	9,440±60	water only
UCR-3260/ CAMS 12352	bone AHUR 2064/1-20-2	9,430±60	total amino acids
		9415±25	weighted mean
Other Spirit Cave Dates			
UCR-3480/ CAMS- 30558	Diamond plaiting	9,270±60	Burial #1; 1-20-60
UCR-3475/ CAMS- 33690	human bone, female	9,300±70	Burial #1 AHUR 770, scattered bone in site
UCR-3478/ CAMS -30557	Twined cordage bag	9,040±50	Cremation #2, 1-20-5 AHUR 752
UCR-3474/ CAMS- 33689	human bone, male	4,640±50	AHUR 748 scattered bone in site
UCR-3479/ CAMS-3479	Coiled basket	2,200±60	1-20-7
UCR-3481/ CAMS-30738	Twined grass mat	1,700±60	1-20-65
Relevant Dates from Other Sites			
UCR-3477/ CAMS- 3691	Diamond plaiting	9,470±60	Grimes Burial Cave, CM-13-G-8; Bone AHUR 743, 744=CM-13-G-2
UCR-3483/ CAMS -30739	Diamond plaiting	9,120±60	Crypt Cave, 26Pe3a/111
UCR-3482/ CAMS- 33669	Twined tule, cordage matting	180±50	Lovelock Cave, 1-20181, 26Ch5
UCR3445/ CAMS-28124,29810	human bone, male	9,225±60	Wizards Beach, Pyramid Lk. 9,250±60 / 9,200±60

The Wheelers only rarely kept notes on where the artifacts were found in the excavation, but the burials were handled with exceptional care. Of the five human burials they encountered, they re-buried part of one, and the rest they brought to the Nevada State Park Commission. They were incorporated in the State Museum collections after 1941 when the Nevada State Museum was founded. The Wheelers apparently were not aware that among the scattered human bones they collected from the cave fill were two individuals, one of which is probably a remnant of their Burial number 1, as the date on the female bone and the Burial number 1 matting are essentially identical (Table 1).

In 1994, R.E. Taylor from the University of California, Riverside, asked D.R. Tuohy for some examples of human hair and bone from the mummies housed at the Nevada State Museum to calibrate his new method of radiocarbon dating hair (Taylor *et al.* 1995). While opening and examining each mummy for the presence of hair, Amy Dansie opened the Spirit Cave mummy box which had been sealed since its arrival at the museum in the 1940s. Because Tuohy (1969) had published Wheeler's paper on the Spirit Cave mummy, the mummy was generally known to exist, but it had not been studied since the 1940s. Upon removal of the outer open-twined tule matting, we both noted that the second matting down was plaited, not twined as Wheeler had stated repeatedly (see the article by S.M. Wheeler in this issue).

After the astonishing date on the mummy was obtained, and a flurry of preliminary studies was made on the associated materials in the cave, it became clear that we had essentially a newly discovered major textile type in our collections. Far from a small fragment easily forgotten without a date or context, the Spirit Cave diamond-plaiting examples were large, beautifully woven mats and bags with radiocarbon dates consistently exceeding 9,000 years ago (Tuohy and Dansie 1996:4-5). In the process of confirming the bone and hair dates in 1995, other samples were submitted to UCR for radiocarbon Accelerator Mass Spectrometry (AMS) dating. In 1996, permission to date additional textiles from the Lahontan Basin was obtained from the Bureau of Land Management (BLM), the agency with jurisdiction over most of the dry caves in western Nevada. The results of all these assays are listed in Table 1. Because of the importance of each specimen, a summary of each is presented in Table 2.

THE ADDITIONAL ARTIFACTS FROM SPIRIT CAVE

There were found in Spirit Cave three ground stone tools, five chipped stone artifacts, one mountain sheep horn pendant, three wood artifacts, four baskets, three burial mats, one rabbit-skin robe, one pair of moccasins, and one twined-grass mat, plus a variety of fragments of the above. The list of artifacts and their dimensions is shown in Table 2.

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada

Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-1	Burial No.1; most bones reburied	1'		2'3"	On top of Burial No.2 assoc., finely woven tule mat (1A)
1-20-2	Burial No.2, male mummy			2'3" to 3'8"	Under Burial No.1 on right side, semi-flexed position
1-20-3	Metate, found above cremations 1 & 2	?	?	?	It was "exchanged."
1-20-4 a,b	Cremation, No.1 in a close-twined bag	trench	---	2'3"	Cremation bags (outer bag)& (inner bag)
1-20-5	Cremation, No.2 in a close-twined bag	trench	---	2'6"	Hemp bag containing cremation
1-20-6	Plaited-tule matting,frags.	176	---	47	Burial No. 2
1-20-7	Basket, fragment, coiled, coiled basketry	51+	77	10.7	clockspring start, miniature size
1-20-8	Bone, frags., human female	--	---	---	30-35 year old female vertebrae, ribs, feet, pelvis
1-20-8 a,b,c	animal bones	---	---	---	bobcat calcaneus, coyote nasal/frontal bone, long bone shaft splinters
1-20-9	coyote mandible	109	35	?	mummified
1-20-10	Pelvic bone, human	---	--	---	15 yr. old male
1-20-11	Stone ball, black scoria	46	46	32	one face used for rubbing

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada

Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-12	Worked stone, brown scoria	75	64	50	two faces used for rubbing
1-20-13	Knife, fragment, biface scraper	27	38	08	opaque obsidian biface
1-20-14	Scraper, fragment, pointed scraper	36	28	09	keeled, "wonderstone"
1-20-15	Flake, flake graver	39	15	04	heat-treated(?) chert
1-20-16	Proj. pt., fragment, proj. pt., blade, broken	39	21	04.5	banded b/w obsidian; central part
1-20-17	Proj. pt., fragment, proj. pt., base	34	26	03	Humboldt Basal-notched point, clear obsidian
1-20-18	Tule matting, frag.	100	36	16	probably from Burial 2
1-20-19	Tule matting, frag.	111	105	20	probably from Burial 2
1-20-20	Twined tule, from matting	52	16	7	z-twisted, probably from Burial 2
1-20-21	Tule matting, frag.	68	28	14	z-twisted, probably from Burial 2
1-20-22	Grass knot	67	32	27	s-twisted overhand knot
1-20-23	Knotted buckskin	33	13	4	tied in a square knot
1-20-24a	Bent grass in a loop	42	27	5	4 stalks, z-twisted
1-20-24b	Bent grass in a loop	84	---	2	U-shaped grass loop

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada

Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-25	Dung containing string	---	---	---	coyote (?) dung
1-20-26	String; 4 cords, in 2 pairs	65	---	1	from fur skin robe
1-20-27	String; 4 cords, in 2 pairs	52	---	1	from fur skin robe
1-20-28	String, 2 ply	140	---	2	Apocynum z-twisted
1-20-29	Braid, 3 elements	33	5	5	
1-20-30	String, Apocynum	112		2	Two ply, z-twisted
1-20-31	String, ?	310	---	2	Two ply, s-twisted
1-20-32	Rope, z-twisted				
1-20-33	String, z-twisted	75	---	3	Apocynum
1-20-34	String, z-twisted	34	---	5	Two ply
1-20-35	Twisted rushes				
1-20-36	String, Apocynum	52	---	2	z-twisted
1-20-37	String, 2 ply	120	---	4	z-twisted
1-20-38	Twisted & knotted twigs	220	---	7	overhand knots
1-20-39	Arrow cane, fragments (1)				"Hemp Stalk" Apocynum? (2)

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada

Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-40	Knot, made out of tule	63	52	10	2 overhand knots
1-20-41	Grass knot	155	45	24	4 overhand knots
1-20-42	Grass rope, 3 pieces	120 to 150	15 avg.	12	
1-20-43	Tule knot	90	30	24	1 overhand knot
1-20-44	Looped and twisted tule	250+	?	10	---
1-20-45	Fur string, rabbit	140	---	17	z-twisted fur
1-20-46	String, 2 ply	80	---	4.5	z-twisted
1-20-47	Dung containing string	---	---	---	coyote dung
1-20-48	Worked wood, knife handle	155	38	23	hardwood branch
1-20-49	Worked stick; foreshaft to arrow	122	---	07	greasewood
1-20-50	Foreshaft; foreshaft to arrow	152	---	09	greasewood
1-20-51	Quill	174	---	06	
1-20-52	Feather, 3 groups matted				
1-20-53	Tule, 2 pieces	210	---	20	seed pods from tule

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada

Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-54	Group of tules tied in knot, for storage	300	80	80	Pit #1 untwisted
1-20-55	Group of tules tied in knot, for storage	300	80	80	Pit #1 untwisted
1-20-56	Tule braid	230	20	15	Pit #1, 3 elements
1-20-57	Tule braid	165	7	7	Pit #1, 3 elements
1-20-58	Tule braid	175	10	10	Pit #1, 3 elements
1-20-59	Tule Matting, 2 PCs.	167 114	160 68	33 9	Pit #1
1-20-60	Tule matting, frag.	214	60	27	General diggings
1-20-61	2 pieces plant stem, triangular	90 85	55 55	55 55	*Scirpus nevadaensis*
1-20-62	Sheep pendant	93	22	3	Pit #1, Mtn. sheep
1-20-63	Ball of fur (?) material	---	---	---	Pack rat nest
1-20-64	Ball of fur (?) material	---	---	---	Pit #1
1-20-65	Matting, fragment made out of six grass warps and 5 to 6 tule wefts	920	120	25	Made of bundles of grass twined together, Pit #1
1-20-66	Matting fragment, pit lining				

Table 2. Artifacts and Dimensions from Spirit Cave, Nevada					
Number	*Original Description, Material*	*l. mm*	*w. mm*	*Th.mm or prov*	*Notes*
1-20-67	Rt. & Lft. moccasins on Burial #2's feet				Eaten by rodents, 3/4 of rt. still there, less than ½ of left

Ground Stone (1-20-3)

One ground-stone metate was found in Spirit Cave above the cremations. A later note on Wheeler's card said "exchanged." We do not know what was "exchanged" for the metate.

Two Ground -stone Tools (1-20-11 and 1-20-12)

Two other ground stones were used (Figure 1). Both were made out of scoria. The black smaller one has one face which was used for rubbing. The small rubbing stone can be held between the fingers. The larger one was made out of red scoria and it has two ground faces which are convex in shape. The larger one can be held by one hand. The Wheelers called the smaller one a "stone ball" and the larger one a "worked stone." The larger scoria has a ring around it formed by calcium carbonate, as though it had lain close to the water's edge (a stream or a lake).

Chipped Stone Artifacts (five)

Projectile point parts (2), (1-20-16 and 1-20-17). There were two parts of projectile points found in Spirit Cave (Figure 2). Number 1-2016 was part of a projectile-point blade minus the tip end and the base. It is made out of banded obsidian, and both sides of it have diagonal parallel flaking which meet in the center of the artifact. This manner of flaking is common on Humboldt Series points in western Nevada (Thomas 1985:201).

Point 1-20-17 is a resharpened projectile point made out of clear obsidian. It shows considerable reworking along both edges. The edges are slimmer than the original design, which was a Humboldt Basal-notched point. The original point had diagonal parallel flaking which in part extended across the blade. The point may have served as a scraper after it served as a projectile point. The deeply notched Humboldt Basal-notched point, and the present radiocarbon dates from Spirit Cave give more credence to Early Holocene usage of this point and one other from Hidden Cave (specimen 20.4/973) found in Stratum VII, a pre-Mazama layer that may be as old as 7,500 B.P. (Thomas 1985:368). This artifact from Hidden Cave is a fine percussion obsidian biface.

Two chipped-stone scrapers (1-20-13 and 1-20-14). The first scraper was made on a plano-convex flake with a central keel on the convex side (Figure 3). It was made of "wonder stone" common in the Fallon area. Both convex edges show use wear.

The second scraper is made on a piece of opaque obsidian biface. S.M Wheeler called it a piece of a "knife," but I think it would fit into Lorann Pendleton's (1985:207) "pressure flaked biface fragments" of which six tips, eight mid-sections and two bases were found in Hidden Cave.

One flake graver (1-20-15). There was one keeled-flake graver made from chert from Spirit Cave (Figure 3). Wheeler called it a "waste flake," but we noted the graving tip and the edge opposite the platform have been, indeed, reworked, showing the scars of flake removal.

Mountain Sheep (Ovis canadensis) Horn Pendant, (1-20-62).

One pendant is made out of horn from a young mountain sheep (Figure 4). The pendant was drilled on one end with a 4-mm hole. The other end is broken. The bighorn prefers the roughest country on or near the mountain tops, and if the animal were taken in the Stillwater Range, you can be certain the Paleo-Indians knew how to hunt by digging a large hole in the ground or by going higher than the sheep and ambushing it from above.

Wood Knife Handle (1-20-48) .

One knife handle is made out of a branch burned at both ends and scraped clean for the sinew or buckskin wrapping, which is now almost gone, but the impressions still remain (Figure 5). The knife handle is tapered to a roundness at the butt end, and the other end is split to receive the knife. Both ends are fire hardened. S. M. Wheeler noted that the knife handle was found "on matting besides the left ribs" of his Burial number 1, which was reburied by him.

Two Wood (Sarcobatus) Foreshafts, (1-20-49, 1-20-50).

There were two wooden (*Sarcobatus*) foreshafts with the Wheeler collection (Figure 6). One, number 49, looks freshly made, with one pointed end and the other end broken. The other, number 50, looks as though it had been used as an arrow point for a long time. It also has one pointed end, and the other end is tapered. There are forty-eight foreshafts from Hidden Cave (Pendleton 1985:251), where greasewood (*Sarcobatus*) was the favorite material.

Four Baskets

There were four baskets found in Spirit Cave, two made by twining, one made by diamond-plaiting and one made by coiling. The two twined and one plaited baskets were used as cremation bags.

One coiled basketry fragment (1-20-7). One coiled basketry fragment was recovered from the excavation of Spirit Cave (Figure 7). A piece of it was dated recently by Donna Kirner of the University of California, Riverside, at 2,200$\pm$60 (UCR-3479). This was the only coiled basket which was found, and it features a Miwok basketry start known as "a clockspring start." As Craig Bates and Martha

Lee (1990:52) explain "a clockspring start" is where one sewing strand is coiled around itself until it resembles a wound-up clockspring. The coiled basketry walls have split stitches both on the inside and the outside, too. It was made on a three-rod foundation and it features a self-rim. The date on the coiled basket makes us wonder if the Miwok traded the basket to western Nevada or if they, the Miwok, preceded the Paiute in western Nevada.

Two close-twined and one diamond-plaited cremation baskets, (1-204A&B, 1-20-5A). Two close-twined and one plaited cremation baskets were used as human burial bags (Figures 8, 9, 10). The Wheelers dug a five-by-six-foot trench in Spirit Cave after they found two close-twined and one diamond-plaited bags with two cremations in them, numbered one and two. Cremation one, whose adult human bones were contained in an inner bag, had an outer, side-opening bag which we called "diamond-plaited matting" after Charles Rozaire (1974:69). The outer bag, 1-20-4A, which is closed by a two-ply z-twisted string on each side, has three animal-skin strips stained with red ochre woven into the bag. The three animal-skin strips, two of which extend almost the full length of the bag, average about 5 mm wide and about 444 mm in length. The bag also has four cordage closures attached to the open end with overhand knots acting as stops to the z-twisted cordage. The bag has three warps and five wefts to one centimeter, and the wefts conceal the warps.

The interior bag, 1-20-4B, which held the human bones, is a close-twined, side-opening bag with fringes on both sides. The fringe on one side at the very end is tied with an overhand knot, and averages about 114 mm. The folded bag itself is 508 mm long and between 304 and 317 mm wide excluding the fringe. The bag was made by using two-ply z-twisted cords exclusively as warps and wefts. The warps were placed closely together, averaging 4.5 to 5 cords to one centimeter, while the weft elements are placed farther apart, at 3 cords to one centimeter. An interesting feature of the inner cremation bag is the bird feathers caught up in 4 of 74 rows of weft elements. Counting from the right, the bird feathers occur in rows 14, 22, 42 and 56 of the total of 74 rows of weft elements. The small feathers appear to be from various migratory waterfowl, but also from the American coot known as the mudhen. The Pacific Flyway covers all of western Nevada; thus, the migratory waterfowl were available in the spring and fall seasons. There is another feature on one side of the side-opening twined bag, and that is four strings made out of s-twisted animal (rabbit?) hide which were used as strengtheners for the center part of the bag; an additional three strings were used to tie something to it.

The third basket, 1-20-5A, is a close-twined, side-opening bag with the weft rows completely concealing the warps, which are two-ply z, single-ply s cords. The original bag was fringed on both sides, but both fringes were eaten away by rodents. There are three warps and five wefts per centimeter on this bag. In addition, there are five small dark brown and light brown and yellow bird feathers caught in the wefts of this bag. One supposes that the original bag when placed in Spirit

Cave held many more feathers than the total of five. This cremation bag contained a twenty-five-year-old female.

Besides the two cremations, the Wheelers uncovered two more burials, Burials numbers 1 and 2. Burial number 1 was disarticulated when found and associated with a large diamond-plaited mat. Wheeler reburied the bones of Burial number 1, but he kept the mat. In addition to the mummy, which he called Burial number 2, and the two cremations, there were portions of two individuals in the cave collections. These were identified by Sheilagh Brooks as a fifteen-year-old male and a thirty-to-thirty-five-year-old female, the latter of which probably represents Burial number 1 (see dates on Table 1), making a minimum total of five individuals from Spirit Cave.

We shall continue by describing the three mats wrapped around the mummified remains of Burial number 2, and the moccasins which were on the feet of the mummy. The last mat wrapped around the mummy was made of tule, *Scirpus lacustris* (1-20-59), and it was approximately 137.8 cm long, 119.3 cm wide, and about 20 mm thick (Figure 11). This tule mat had seven whole tule warps to 10 centimeters, and seven wefts to 10 centimeters. The tule mat was dated to 9410$\pm$60 (UCR-3324-1) (see Table 1).

The second mat down is made up of two pieces of diamond-plaited matting. One piece, which was wrapped around the head and shoulders of the mummy, consists of a *doubled* piece of matting approximately 75.5 cm in length and 60 cm wide (Figures 12 and 13). The two halves of the mat are sewn together by a two-ply cord which is z-twisted, and made of two single-ply s-twisted cords. The matting which enveloped the lower half of the body of the mummy is also a square-shaped diamond-plaited mat approximately 121.92 cm in length, and in width, too. It is not sewn like the upper mat. This mat yielded a date of 9430$\pm$70 (UCR-3323) (see Table 1).

Rabbit-skin Robe; Not in Wheeler's Catalogue

Right next to the body was a rabbit-skin (?) robe (Figure 14). It was made by twining s-twisted pieces of skin and fur between two pairs of cords, z-twisted, spaced approximately 1 cm apart. The fur, by and large, has disappeared from the blanket, leaving the twisted (rabbit?) skin as warps and the four cords as weft elements. It is believed that the fur robe together with the doubled diamond-plaited mat and the upper tule mat preserved the flesh on the upper half of his body. Thus, the cover of the upper three robes made a mummy out of the 45$\pm$10-year-old man, who lived a hard life, as Douglas Owsley says in one of the following articles.

The Pair of Moccasins, Not in Wheeler's Catalogue.

The Wheelers' Burial number 2 had a pair of moccasins still attached to the feet (Figures 14 and 15). The pair were well used, the right one having two patches (toe and heel) on the bottom side with the artiodactyl (antelope?) hair on the outside. Each moccasin originally was made of three parts, a sole, one side piece or vamp, and an ankle wrap. They were sewn together very carefully by a simple running stitch or a blanket stitch made of two-ply cordage (two-ply z, single-ply s). The bottom side of the left one was worn through, but the sole extended over the toes, and the ankle wrap was missing. On the right foot, the vamp was made out of a hide with yellow fur, and the ankle wrap was made out of thick hide folded over at the top. Both moccasins had woven tule acting as "duffel" or "socks" for the wearer.

The moccasins do not resemble those found at Danger Cave in Danger V (Jennings 1957:221), nor do they resemble the two leather moccasins ornamented with *Olivella*-shell beads or the leather moccasin of deer fur found at Lovelock Cave (Loud and Harrington 1929:46, plates 21, 22). They are completely different from the one-piece "hock" moccasin and the Fremont-style moccasin (Morss 1931:64-65) known from the eastern Great Basin (Aikens 1970:102-103). But they do resemble the Hogup-style moccasin made to a three-piece pattern. Differences are apparent between the Spirit Cave right moccasin and the Hogup Cave moccasins (Aikens 1970:108-109) and the Wilson Butte Cave moccasin (Conn 1961:196-200), and there should be differences. The Hogup Cave moccasins date from Unit II which runs from 1250 B.C. to A.D. 400, and the Wilson Butte moccasin dates to the "Dietrich Phase" which dates from about A.D. 1300 to around A.D. 1700-1750. The radiocarbon dates stretch the time backward for the Spirit Cave three-piece moccasins to ca. 9,400 years ago.

The Spirit Cave right moccasin was puckered around the toes and on the side piece too, where the ankle wrap was joined to the vamp. The hide of the sole was turned so that the hair side was out; the patches were the same, and the man's foot measured 21.2 cm. Two-ply woven fiber cordage was used extensively on both mocasins to the exclusion of other materials, such as rawhide or buckskin thongs. This is an unusual feature for the Spirit Cave moccasins. L. S. Cressman (1981:28) states that almost no leather clothing, including sandals, was worn in the northern Great Basin where he dated the well-known fiber sandals from Fort Rock Cave at 9,053±350 years ago (see the introductory paper, this issue). In this regard, note that the three-piece Spirit Cave sandals were sewn together by woven-fiber cordage, not sinew or buckskin.

Twined Grass Matting (1-20-65)

A fragment of twined grass matting was found in the Spirit Cave collections. There is no information in the Wheeler catalogue regarding provenience or direct associations, other than "Pit number 1." It appears to be made from Great Basin wild rye, or similar heavy grass, with six large bundles of grass warps with five to six tule wefts, made by simple twining. It is unusual for western Nevada assemblages. It was dated by Donna Kirner at 1,700±60 (UCR 3481). This is the second date younger than the hair or bone dates. The other was on the coiled basket which yielded an AMS date of 2,200±60 (UCR 3479).

Faunal Remains

In addition to the fauna which was used to manufacture artifacts, there were five faunal specimens saved by the Wheelers for identification (Figures 16 and 17). These were identified by Amy Dansie and are shown in Table 3. Unknown to the Wheelers, but included with the mummy, were fish remains which included the bones from the tui chub, sucker, and other minnow bones. These fish remains are analyzed in Sunday Eiselt's article, this issue. All of the faunal species found in Spirit Cave are surviving and thriving today in the Carson Desert and nearby environs.

Table 3. Identification of Faunal Remains from Spirit Cave

Catalog Number	Bone	Identification	Comments
1-20-8 a*	long bone splinters	probably artiodactyla	
1-20-8 b*	calcaneus	bobcat (*Lynx rufus*)	exact match in all attributes, 1.3 mm longer than comparative specimen
1-20-8 c*	frontal, nasal, maxilla joined	coyote (*Canis latrans*)	exact match, slightly larger than comparative specimens, but suture shape is identical
1-20-9	anterior 2/3 of mandible, right and left	coyote (*Canis latrans*)	dried skin and ligaments remain, articulated, juvenile (molars are just emerging)
1-20-51	Quill	Unidentified	(with feathers still on it)

* associated with AHUR 770, a 30-35 year old female, represented by vertebrae, ribs, feet and a pelvis fragment, dated 9,300±70.

COMPARISONS

There are a few Western Great Basin sites of the same age or younger than the tule matting and the diamond-plaited mat from Spirit Cave.

1. *Grimes Burial Shelter, Carson Sink.* This small rock shelter in the vicinity of Spirit Cave was disturbed by guano miners, and the matting and fragmentary human bones were given to Margaret Wheat, who reported the site to Sydney Wheeler. He investigated the site, finding little else, catalogued the finds, and recorded the site. During the search for additional examples of diamond plaiting in 1996, this essentially forgotten collection was discovered by Amy Dansie to have a large fragment of diamond-plaiting. The textile was dated a little older than the Spirit Cave mummy, at 9,470±60 B.P. (UCR3477).

2. *Lake Winnemucca, western Nevada.* Hester (1974:2) who reported on archaeological materials recovered by amateurs from a tufa stack located at the southwestern end of Lake Winnemucca, western Nevada, had this to say about the date:

> An atlatl or spearthrower was discovered by the excavators near the base of the cave deposits, approximately 16 feet below the surface. At this approximate depth, lying just above the spearthrower, were several twined baskets. The group of baskets and the spearthrower appear to be two separate caches. A portion of one of the baskets has been radiocarbon-dated at 7,980±610 B.P. (I-6873). The radiocarbon determination suggests that the atlatl is at least 8000 years old, and given its stratigraphic position below the dated basketry, it is possibly even older.

The twined baskets were not illustrated, so we have nothing to compare Spirit Cave textiles with those from the tufa stack which was given a Berkeley site number of NV-Wa-197.

3. *Crypt Cave, located at the north end of Lake Winnemucca, western Nevada.* Charles Rozaire had noticed the distinctive weave of the diamond-plaited matting fragment from Crypt Cave. He also mentioned Chimney Cave, but it has not been confirmed that such a textile is present in the collections. Both sites are among the dry caves excavated by Phil Orr in the middle 1950s. Radiocarbon results yielded a date of 9,120±60 B.P. (UCR-3483). The Crypt Cave specimen is shown in Figure 16.

4. *Fishbone Cave, Winnemucca Lake, western Nevada.* Two dates from Fishbone Cave, east side of Winnemucca Lake, on a bed of shredded bark associated with human bone fragments, bones of a marmot, horse, and camel, some basketry fragments, and two large chert knives were dated at 11,250±250 B.P. (L-245) and 10,900±300 B.P. (L-245) (Orr 1956).

5. *Shinners Site A, Falcon Hill, Winnemucca Lake , western Nevada.* A z-twined basketry from Shinners Site A, on Falcon Hill, was radiocarbon dated at 9,540±120 B.P. (UCLA 675) (Hattori 1982:14). Eugene Hattori says open-twining is the earliest

technique present at Falcon Hill (Hattori 1982:96). Although his date is a little older than the dates on the cremation bags, the several dates are comparable.

6. *Pyramid Lake, western Nevada.* A two-ply sagebrush fishing line from the north end of Pyramid Lake dated to 9,660±170 B.P. (GX-13744) (Tuohy 1988:212). Northern Side notched points from Wizards Beach also suggest significant time depth of human occupation at the north end of Pyramid Lake.

7. *Pyramid Lake, western Nevada:.* A partial skeleton at the north end of Pyramid Lake found by Peter Ting, an amateur, dated at 9515±155 B.P. (GX-19422-G), and at 9110±60 and 9225±60 B.P. (UCR3445).

CONCLUSION

The first radiocarbon dating of Spirit Cave artifacts was explained by Kirner *et al.* (1996) and Burky (1995-1996:126-133), and we have included the Accelerator Mass Spectrometry dates presently available in our Table 1. The AMS dating done so far confirms an age of 9,000 to 9,400 years for the mummy, Burial number 1, and the two cremations from Spirit Cave, Wizards Beach Man and Grimes Burial Shelter.

The Spirit Cave mummy, Wizards Beach Man, and the Kennewick Man (who was found by two young men near Kennewick, Washington on the banks of the Columbia River and was studied by James C. Chatters and dated by Donna Kirner of the University of California, Riverside, at 8,410±60 B.P. [UCR-3476]), all exhibit "Caucasoid traits," particularly on features of the skull (Chatters 1997:9-10). As R. L. Jantz and Douglas Owsley discuss in this issue, there may be a relationship between these ancient Americans and the ancient Ainu of Japan, a Caucasoid group predating the arrival of oriental traits of the modern Japanese. Modern American Indians have distinctly "Mongoloid genes" expressed in their make-up. There are five tribes and bands of Native Americans who are claiming Kennewick Man for reburial, as opposed to the physical anthropologists and archaeologists who want to study him further scientifically. The Kennewick Man case will be settled in a court-of-law. The Kennewick Man only had one artifact inside him, a projectile point, a leaf-shaped serrated Cascade point, partially healed within the ilium.

Further research on the diamond-plaited mats will be done by Catherine Fowler and Gene Hattori, who want to know the relationship of the mats to woven textiles in Hokkaido, Japan. They will send black-and-white photographs of Spirit Cave textiles to Japanese anthropologists to see if there are any similarities between Spirit Cave textiles and those of the ancient Ainu of Japan of 9,400 years ago. Genetic studies are under way in Japan, and the debate centers around the extent to which the ancient Ainu (Jomon culture) did or did not contribute genetically to the modern Japanese (Powledge and Rose 1996:36-44). A list of twenty-seven plants used by the Ainu was mentioned by Hitashi Watanabe (1964:38039), but how they used the plants to make textiles was not mentioned by the author.

The artifacts were compared with those from Hidden Cave, and the lithics, what few of them were found in Spirit Cave, compare favorably with those found in the Stillwater Range caves (Thomas 1985). The only exceptions are the diamond-plaited matting, (the second mat down when the mummy was opened for the second time), which is rather rare in western Nevada archaeology, and the three-piece moccasins which do not resemble any others found in the Great Basin. One of these artifacts, the diamond-plaited matting, can be used as a time marker when, if ever, in these days of NAGPRA, excavations are resumed in those remarkable caves and rockshelters in the foothills of the Stillwater Range of mountains in Nevada.

NOTE: All the figures and photographs included with this article are by S. M. Wheeler and are in the collections of the Nevada State Museum.

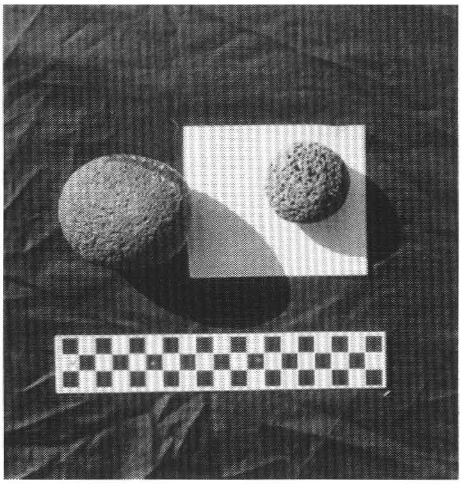

FIGURE 1. Two ground stone tools made out of scoria. Wheeler called the larger one"a worked stone," and the smaller one, a "stone ball."

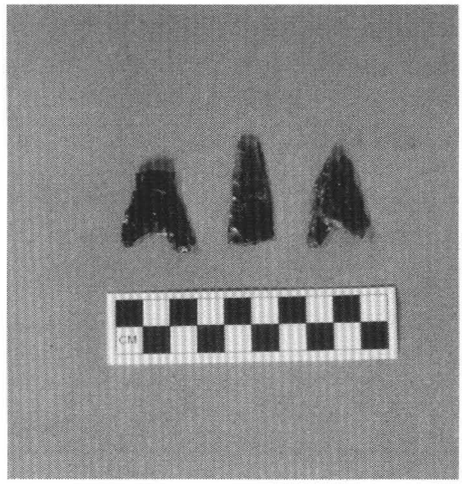

FIGURE 2. Two projectile point which were found in Spirit Cave are located to the left in the photo. The other projectile point came from the sand dune 1/4 of a mile in front of the cave.

FIGURE 3. Two chipped stone scrapers and one flake graver are shown in this photo. The graver is on the extreme right.

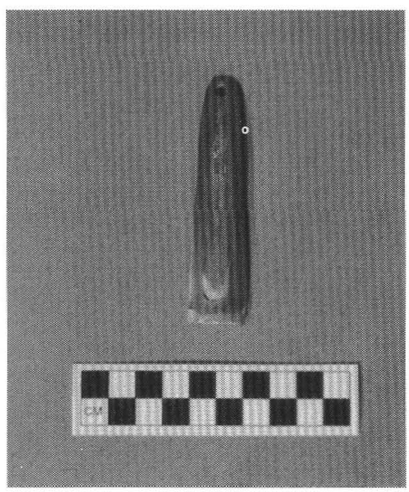

FIGURE 4. One Mountain Sheep (*Ovis canadensis*) horn pendant was recovered. It was drilled near one end.

FIGURE 5. One wooden knife handle was found with Burial no. 1, which was re-buriedby Wheeler.

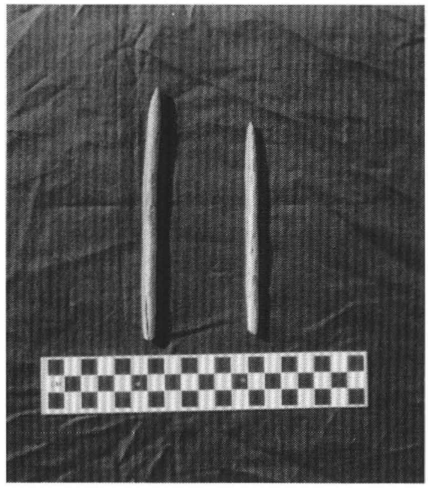

FIGURE 6. Two wood (*Sarcobatus*) foreshafts from Spirit Cave.

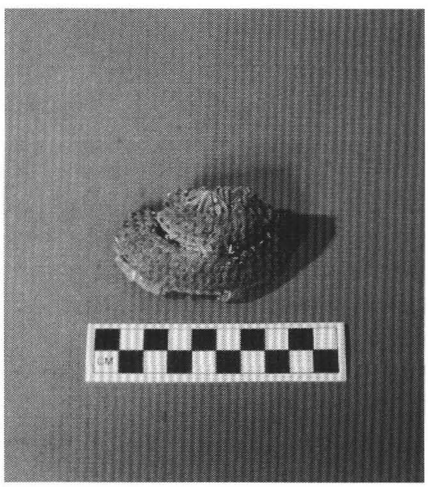

FIGURE 7. One coiled basket with a "clockspring start" was recovered from Spirit Cave. It was younger than other textiles at 2,200±60 (UCR-3479).

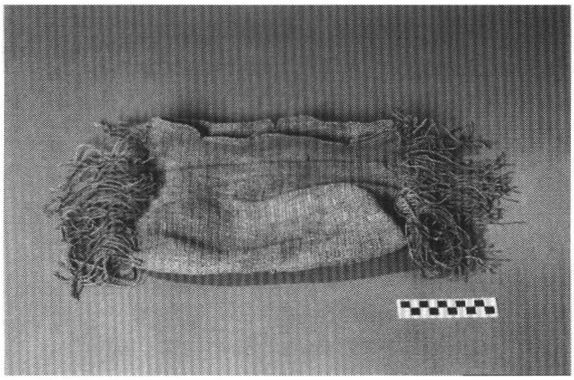

FIGURE 8. One close-twined cremation bag which was found inside the diamond-plaited-bag shown in Figure 10.

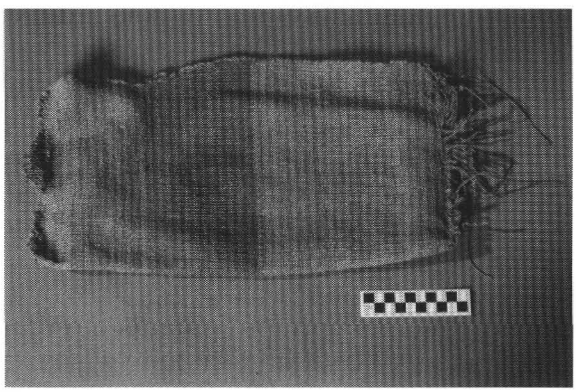

FIGURE 9. The other close-twined bag which contained the bones of a 25-year-old female.

FIGURE 10. The diamond-plaited bag which held the bones of Cremation no. 1 inside the inner close-twined bag shown in Figure 8.

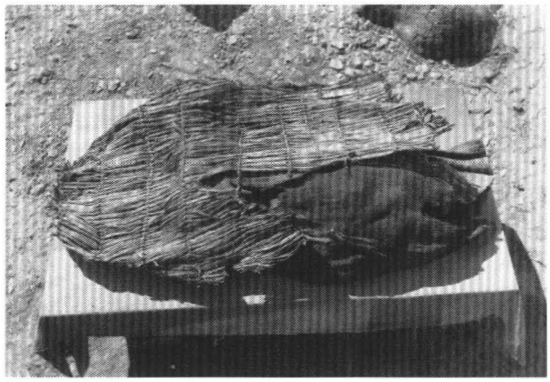

FIGURE 11. The last mat found around Burial no. 2 was made of tule, *Scirpus lacustris*, and it is shown here in a picture taken by S.M. Wheeler.

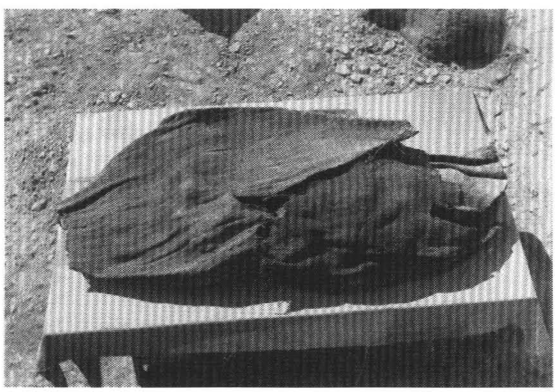

FIGURE 12. The second mat down was in two pieces. The doubled-up piece of diamond-plaited matting covered the head and the upper trunk of the Burial no. 2 body, and a single long piece of the same weaving covered the lower half.

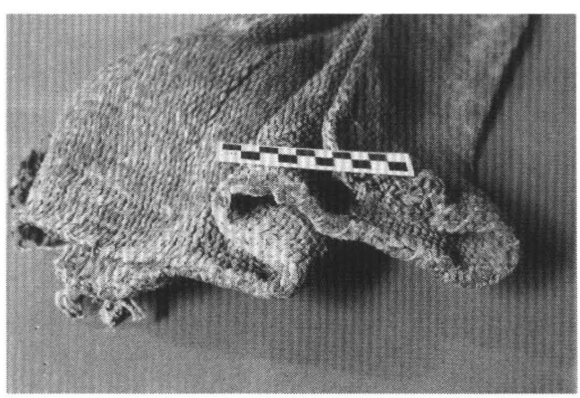

FIGURE 13. The doubled-up piece of the diamond-plaited matting which covered the top half of Burial no. 2, the male mummy of Spirit Cave.

FIGURE 14. Remnants of the rabbit skin robe may be seen in this photograph which shows the pair of moccasins. Note the remnant of the rabbit skin robe on the top moccasin next to the scale.

FIGURE 15. Note that the right moccasin has two patches on the toe and on the heel. The left one is almost all eaten away.

FIGURE 16. This is the coyote mandible (*Canis latrans*) which was saved by the excavator, S.M. Wheeler.

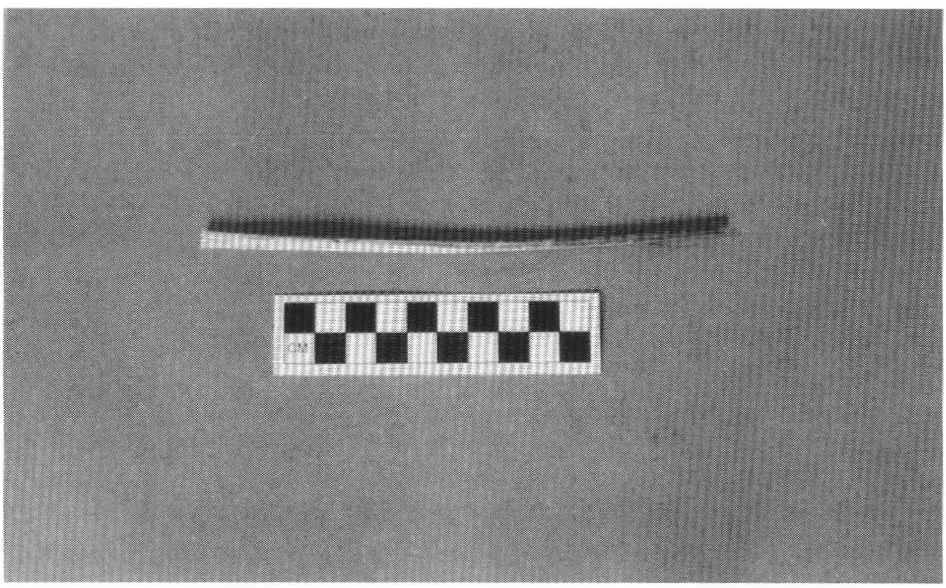

FIGURE 17. This is the quill of an unidentified bird which was catalogued in the collection of S.M. Wheeler.

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DATING THE SPIRIT CAVE MUMMY
The Value of Reexamination

D. L. Kirner, R. Burky, K. Selsor, D. George and R. E. Taylor and J. R. Southon

INTRODUCTION

During the summer of 1940, S. M. and G. N. Wheeler conducted archaeological field work for the Nevada State Parks Commission in Churchill County, Nevada. They investigated a number of caves in the vicinity, hoping to find evidence of man's presence during the period when prehistoric Lake Lahontan was receding, approximately 10,000 years ago (Aschmann 1958). The summer's field work resulted in the documentation of twenty-six caves and shelters, most of them containing archaeological remains (Wheeler and Wheeler 1969). The remains were cataloged and stored at the Nevada State Museum in Carson City.

While conducting a collaborative research effort with the Nevada State Museum in 1994, the radiocarbon laboratory at the University of California, Riverside obtained radiocarbon age determinations on the hair and bone from the Spirit Cave mummy, one of the archaeological finds made by the Wheelers in 1940 (Kirner *et al.* 1996). Originally, the mummy was thought to be 1,500 to 2,000 years old. When the first two accelerator mass spectrometer (AMS) radiocarbon dates were done, the Spirit Cave mummy was discovered to be more than 9,400 years old. This article will focus on new data from Spirit Cave, as well as data from the surrounding area. The goal of this study is to demonstrate the value of reexamining existing museum collections using AMS radiocarbon dating.

METHODS

Donald Tuohy and Amy Dansie of the Nevada State Museum submitted a total of seventeen samples for radiocarbon age determinations between 1994 and 1997 from a variety of archaeological projects. The material included textiles, human bone, human hair, wood, and dog pads from a dog burial. Preservation of the material to be dated was good to excellent.

The pretreatment and processing varied according to the material being dated.

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The wood from an arrow shaft fragment from eastern Nevada was subjected to acid-base-water-acid treatment, and dried overnight in a drying oven. The dried wood was then placed in a combustion tube with copper oxide and silver powder and combusted overnight at 900°C. The resulting CO_2 was graphitized on a vacuum line and sent to Lawrence Livermore National Laboratory for analysis.

All of the textile age determinations were performed on the total amino acids. The textile samples were cut into small pieces and sonicated in hydrochloric acid. The material was rinsed with distilled water and dried overnight. The proteins were hydrolyzed in hydrochloric acid, then isolated and purified on an ion exchange column. The total amino acids were collected in a combustion tube and combusted with the appropriate reagents. The CO_2 was graphitized and analyzed in the same manner as the wood samples.

The radiocarbon age determinations on the bone, hair and dog pads were also performed using total amino acids. The material was physically cleaned, then hydrolyzed in hydrochloric acid. The total amino acids were assessed using high performance liquid chromatography (HPLC), then collected and purified on an ion exchange column. The amino acids were combusted, graphitized and analyzed employing the same methods used on the wood and textiles.

DISCUSSION

The radiocarbon age determinations on the Spirit Cave bone range from 9,430±60 to 1,490±50 years B.P. (see Table 1 in Tuohy and Dansie, and background details in Dansie, this issue). Statistically, the radiocarbon age determinations on the hair from the mummy are the same as the associated bone dates. The textiles from Spirit Cave demonstrate a similar pattern, ranging from 9,460±60 to 1,650±60 years B.P. The concordance is striking between associated specimens. These dates identified Burial no. 1 as the adult female, and demonstrated the much later date of the young male individual, from the commingled fragmentary bone of two individuals collected by the Wheelers. In addition, the coiled basket fragment from the cave, similar to Lovelock Culture coiling in other sites, dates to 2,210±60 years B.P. This agrees well with the basketry sequence of the area. The twined grass matting date demonstrates a later visit to the site by an unknown group, and provides a time frame for this unusual specimen.

Crypt Cave, near Winnemucca Lake, Nevada, yielded radiocarbon dates that paralleled those of Spirit Cave. Diamond plaited matting from Crypt Cave was dated at 9,120±60 years B.P. The Crypt Cave dog burial radiocarbon age determination was 6,360±60 years B.P. Diamond-plaited matting was also found in Grimes Burial Shelter, not far from Spirit Cave. It yielded an age of 9,470±60 years B.P.

The Wizards Beach skeleton was dated twice by our laboratory, with consistent results, but somewhat younger than the original date of 9,515±155 by Geochron

(GX19422-G). The UCR results are 9,250±60 and 9,200±60, which average to 9,225±60 (Tuohy and Dansie, Table 1, this volume).

This series of seventeen age determinations demonstrates the value of using AMS radiocarbon dating to reexamine existing museum collections with minimal damage or impact to the specimens. The remains from Spirit Cave were thought to be only 1,500 to 2,000 years old at the time of their discovery. Thus, for over half a century their value to archaeologists had gone unrecognized. Utilizing modern technology we are able to contribute a major new data set to the chronology of the western Great Basin. This provides the archaeologist with the opportunity to make fresh inferences about the prehistory of the area. Clearly, it is possible that existing museum collections may hold important answers to questions about our human past.

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PALEOPATHOLOGY OF THE WIZARDS BEACH MAN (AHUR 2023) AND THE SPIRIT CAVE MUMMY (AHUR 2064)

Heather Joy Hecht Edgar

In January of 1996 a study was made of remains from forty-nine individuals housed at the Nevada State Museum. Of these forty-nine, only forty-five are from the permanent collection and four were from a possible forensic investigation that turned out to be historic burials. The study included analysis of age, sex, morphometrics, and dental and osteopathology, as well as complete photo documentation.

This article is of narrow focus. It describes the pathological changes evidenced in the remains of two of the forty-nine individuals, AHUR 2023 and AHUR 2064, known as the Wizards Beach Man and the Spirit Cave Mummy, respectively. Although it is generally more informative to describe paleopathology in terms of an entire skeletal series (giving information about the over-all lifestyle of a group of people) the uniqueness of these two individuals warrants a complete, detailed description of the observable pathological changes. Indeed, the informational value of these remains is evidenced by the Twenty-fifth Great Basin Anthropological Conference, and dedicated to their analysis.

THE WIZARDS BEACH MAN FROM PYRAMID LAKE, NEVADA

Preservation

Analysis of AHUR 2023, the Wizards Beach Man, is complicated by the pattern of its burial. It may have been commingled with the remains of another burial, AHUR 2022. Dates for AHUR 2023 range from 9,200+60 (UCR-3445) to 9,515+155 (GX-19422G) years B.P. Ribs from AHUR 2022 dated at 5,905+125 (GX-19421-G). The age difference between these remains ranges between 3,370 and 3,800 years. Obviously, the two did not live contemporaneously. Both skeletons appear to be males, although this can be said securely about only one of them, as there is only one pelvis, the area of the body that provides the most reliable sexual indicators.

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Curation

A separation of the two individuals has been made. Fortunately, there is a duplication of all the bones assigned to AHUR 2023 in AHUR 2022, except for seven bones of the left hand. The only secure way to separate all the bones from the two individuals would be to date each one individually, thereby destroying, or at least limiting, their scientific value. For purposes of this analysis, the remains stored in the box labeled 2022 will be ignored, and the bones included under the number 2023 will be described as the Wizards Beach Man. The bones represented are a skull and mandible, one cervical vertebra, the left shoulder and arm complex, parts of the left hand, the right forearm, the left thigh, and the right lower leg.

Sex

While the lack of a preserved pelvic girdle makes definite sex assignment impossible, the skull, which is the second best sexual indicator, is masculine in form. A central ridge over the nose and eyes is pronounced, as are the mastoid processes, the bony protuberances behind the ears. The shape of the lower jaw is very masculine, with a square chin and flaring gonia, the angles of the jaw.

Age

The estimate of age in the Wizards Beach Man is based mainly on the amount of external cranial suture closure. During one's life, these sutures are obliterated at a fairly measurable rate. In most cases, the more obliteration of sutures observed on a skull, the older the individual was at the time of death. Application of this method produced an age in this individual of 32 years, with a standard deviation of 20-42 years. The wear of the teeth may indicate that this person was in the older part of this estimate, between 32 and 42 years. The lack of a complete skeleton prevents a more specific estimate.

Pathological Conditions

First, it should be mentioned that this description is based on the observable remains only. It may not fully describe all the disease processes the individual suffered. For example, only one vertebra is present. It is a cervical, or neck vertebra. Therefore, if 2023 had any lower back disease, it was not observable.

Osteopathology. This individual is very robust, with well marked muscle attachments throughout the preserved remains and especially at the shoulder. There is evidence of osteoarthritis at the left elbow and both wrists. Some of the joint surfaces show enlargement, porosities, and osteophytic bone growth, all signs of degenerative joint disease. These changes are not severe, but probably caused some discomfort.

New bone laid down by the periosteum, the sheath that covers all bones, is present on the left and right radii, the left femur, and the right tibia and fibula. The collateral lower limb bones are not observable. Some of the new bone is remodeled into fine striae paralleling the main axis of the bones, and some is newly applied and disorganized. Bone laid down on the cortex of long bones like this indicates a periosteal reaction to infection. The presence of remodeled as well as new bone indicates that the infection lasted for some duration and was active at the time of death. The infection is not necessarily in the affected bones, but is rather diffuse throughout the system. People can live with such infections for extended periods of time, so this may or may not give some indication of the cause of death.

Dental pathology. There are seventeen teeth observable, out of the total thirty-two in the average adult. The rest are either missing due to post mortem loss or are present, but broken. All the teeth present have heavy wear. Almost all the crowns are obliterated, so that the occlusal, or chewing, surface at the time of death was root stubs. This amount of wear is not uncommon for prehistoric specimens. There are no caries present, but this is associated with the heavy wear: In life, the teeth are worn too fast to allow caries to form. There is, however, one abscess on tooth number 30, the lower right first molar. This abscess was due to direct infection of the bone through the open pulp chamber of the tooth. Also associated with heavy wear, this condition, too, was common in prehistory, and it can be a cause of death.

THE SPIRIT CAVE MUMMY FROM THE FOOTHILLS OF THE STILLWATER RANGE NEAR FALLON, NEVADA

The dates on this individual range between 9,350±70 (UCR-3261-4) and 9,460 ±60 B.P. (UCR-3324-2). Its completeness, provenience, and associated artifacts give us an incredible opportunity to learn about the past in the Great Basin, and all of North America.

Preservation

The bones of this mummy were in excellent condition. Some observations were impeded by mummified tissue. To limit the destruction of the mummy, the bones of the exposed left arm were analyzed, but the embedded right arm was not exposed.

Sex

The pelvis is masculine, with narrow sciatic notches and subpubic concavities. The skull is somewhat masculine, with large mastoids and glabella, although the chin is pointed, a more feminine trait. Over-all, it can be said with assurance that these remains are those of a male, although not a very robust one.

Age

In the pelvis, age estimates were made using the pubic symphyses (the bony joint at the front of the pelvic girdle), and the auricular surfaces (which connect the pelvis to the spine). These figures were reinforced by examination of the external cranial suture closure. A consensus age of 45 + 5 was reached. It should be noted that the observed dental wear seemed a little light for this age when compared to the over-all series of forty-nine analyzed in this study.

Pathological Conditions

Osteopathology. First, it is interesting that there is a general absence of osteoarthritis at joints in the appendages. While there may be some slight degeneration of the distal humerus at the left elbow, this seems to be the only degenerative joint disease outside the spine.

The spine itself, however, presents a very different picture. There are some genetic anomalies present that led to degenerative processes. The average person has thirty-three vertebrae, seven cervical, twelve thoracic, five lumbar, five sacral, and four coccygeal. The Spirit Cave Mummy has thirty-four, the extra one being an atypical thirteenth thoracic. It has one rib present, although there may have been two with only one observable. Anomalies continue down the spinal column. The last lumbar vertebra, the fifth, looks on the left somewhat like the first sacral vertebra, the one below it. However, there are still five complete sacral elements. The fifth lumbar articulates with the left os coxa, or pelvic bone, an abnormal condition. The fifth lumbar also exhibits incipient spondylolysis at the left pars interarticularis. This is a stress fracture of the arch of the vertebra. The fracture is surrounded by osteophytic bone growth. In addition to these abnormalities, the superior sacral facets, the ones that join the sacrum to the spinal column above, are at irregular angles. The left facet is smaller and at a much flatter angle than the right. Over-all these variations led to instability in the spine, as evidenced by the spondylolysis of the fifth lumbar. Although these conditions were not life threatening, they certainly would have made day-to-day activities more uncomfortable.

One other major pathological condition will be described: a well-healed fracture of the skull. The point of impact, though obscured by the dense bone associated with a healed fracture, can be described as being on the frontal bone, just anterior to the coronal suture, 30 mm left of bregma. There are two radiating fractures from the point of impact. The first is directed posteriorly for 35 mm. The second descends for 83 mm from the impact to the temporal suture. The amount of remodeling indicates that the individual lived at least for more than a year after the injury. The most common cause of this type of fracture is interpersonal violence. It is not possible to determine what type of object caused these fractures.

Dental pathology. All thirty-two teeth are available for study, a rarity in prehistory. In addition to pathological analysis, morphometric observations were made, and are available on request. The anterior teeth show linear indentations, evidence that the teeth were used for processing sinew. There are three abscessed teeth, the upper right and left first molars (numbers 3 and 14) and the lower right 1st molar (number 30). It is likely that the infection related to these abscessed teeth led to the death of this individual.

Conclusion

AHUR 2023, Wizards Beach Man, lived around 9,225 years ago. He was a robust man, between 40 and 45 years old when he died. He suffered from mild osteoarthritis in his elbows and wrists, and had some sort of diffuse infection in his body. His teeth were very worn, and he had one abscessed molar, not atypical for a prehistoric man. Because of incomplete preservation, we cannot know all of the disease processes that may have affected his bones .

AHUR 2064, the Spirit Cave Mummy, lived about 9,400 years before the present. He lived to around the age of 45, and was not very robust or muscular. He had many genetic abnormalities of the spine that lead to some pathological changes and probably caused him quite a bit of lower back pain. However, he had little or no osteoarthritis in his arms or legs. Some time before his death the front of his head was fractured, possibly by the action of another person. He survived this injury, but may have died because of three severely abscessed teeth.

PATHOLOGY, TAPHONOMY, AND CRANIAL MORPHOMETRICS OF THE SPIRIT CAVE MUMMY

R. L. Jantz and Douglas W. Owsley

INTRODUCTION

The Spirit Cave Mummy was examined by scientists from the Smithsonian Institution and the University of Tennessee as part of a systematic survey of the human skeletal collection curated by the Nevada State Museum. The archaeological collection was inventoried to determine the number of individuals represented, completeness of each set of remains, and demographic information concerning age, sex, and population affiliation. Evidence of skeletal and dental pathology, taphonomic observations, and osteometric data including both cranial and postcranial measurements were recorded using a standardized format that allows comparison with historic and prehistoric groups from North America and other areas of the world. The data are a basis for documenting temporal trends and regional patterns in longevity, health, physical exertion and activity, robusticity and stature, and mortuary practices. The cranial measurements can be used to assess group identification and trace ancestral/descendent relationships through morphometric comparisons using multivariate, biological distance statistics. Craniofacial morphology is strongly determined by the genetic makeup of the individual, and groups that are closely related through common ancestry share similar features and dimensions.

This presentation highlights a few of the observations recorded for the Spirit Cave Mummy with primary emphasis placed on the craniometric data. Comparison

R.L. Jantz is in the Department of Anthropology at the University of Tennessee, and Douglas W. Owsley is in the Department of Anthropology in the National Museum of Natural History, a part of the Smithsonian Institution.The authors are grateful to Amy Dansie of the Nevada State Museum for her willingness to have the museum's collections documented and for making their visits to the museum so productive and enjoyable. They also thank Shannon Novak and Kari Sandness for their considerable assistance in data gathering, and Chip Clark for the excellent photographic record. They also thank the James W. Calhoun Foundation for providing the funds for two visits to the Nevada State Museum. Finally, they thank Steve Wallmann for his fine drawings of the Spirit Cave bones.

to North American and world population data illustrates the application of modern databases to questions of morphometric affinity and population relationships.In order to demonstrate the potential of this approach, the analysis is advanced in greater detail than is normally the case through analyses that consider specific dimensions of the total craniofacial complex.

GENERAL DESCRIPTION AND TAPHONOMY

At the time of discovery, the body was positioned on the right side with the bones of the right arm flexed at the elbow and wrist such that the hand was placed under the chin. The left arm was extended and placed in front of the pelvis.Both legs were placed in a loosely flexed position. The flexure angle of the right femur was approximately 120 degrees relative to the pelvis and spinal column, and the angle at the knee was about 70 degrees.

The remains of this 40-to-44 year-old male comprised a complete skeleton with head hair, desiccated skin, and ligaments preserved in some areas, including dried articular cartilage on most of the joint surfaces. The bones of the face, the frontal bone, parietals, and the occipital squamous are partially covered with mummified skin and scalp tissue, although the posterior occipital and the base of the cranium are bare (Figure 1). Both eye orbits contain remnants of eye tissue and associated musculature. Patches of hair are present on the left frontal near the coronal suture, the left parietal, and the right side of the cranium. The hair is medium brown in

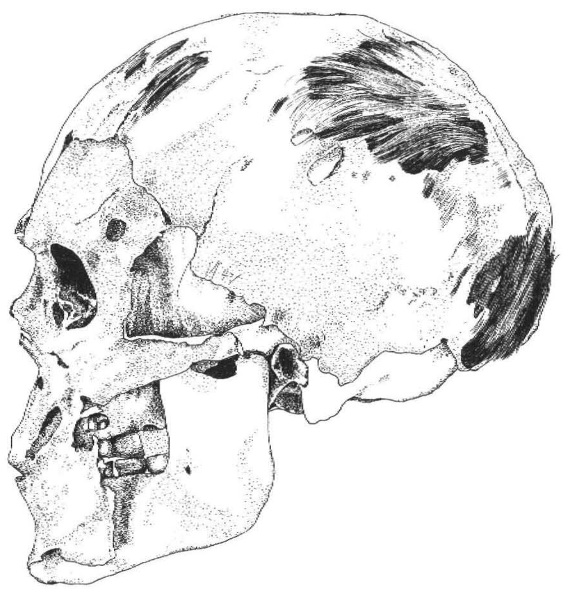

FIGURE 1. Lateral view of Spirit Cave skull showing morphological features and dessicated skin and hair. (*Drawing by S. Wallman*)

color with reddish tones (C. Lahren 1996), although at the time of recovery it was described as being darker prior to being exposed to the sun (Wheeler and Wheeler 1969). Some of the longer strands are 150 to 198 mm long, indicating that it was at least shoulder length. Some of the hair was cut angularly, which suggests that some type of blade was used to groom the hair (Lahren 1996). The mandible contains only small fragments of dried tissue.

Desiccated skin is present on the left scapula and ribs, and small patches are also present on the right ribs. The internal organs have decomposed although remnants of the large intestine and colon are present in the lower abdomen.

The postcranial skeleton is relatively gracile with only moderate development of the muscle attachments sites on the bones of the arms and legs. The cranial vault is long and narrow with a moderate vault height. The brow ridges are only moderately developed, and the frontal bone is long and curved. The height of the face is relatively short, lacks alveolar prognathism, and is fairly gracile, especially considering the large size of the skull. The nasal aperture has well defined inferior margins. The malars are not flared, but expand posteriorly, reaching their maximum width at the zygo-temporal suture.The palate is small and somewhat elongated.

BONE AND DENTAL PATHOLOGY

At the time of his death, this individual was recovering from an injury to the left temple that is evidenced by a circular impact site with radiating fractures extending superiorly and inferiorly away from the margin of the defect (Figure 2). This small indentation in the left, posterior frontal has a slightly darker color than the surrounding bone. The superior fracture travels superiorly along the coronal suture and crosses into the middle of the left parietal. This fracture has begun to unite along its inferior aspect on the frontal bone and where it crosses the coronal suture, although it was not completely healed at the time of death.

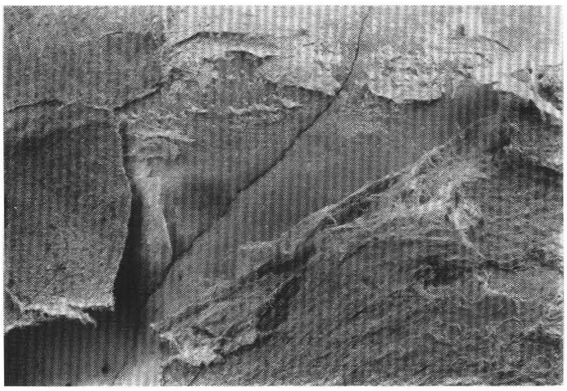

FIGURE 2. Close up view of the small impact indentation on the left frontal with radiating fractures.

Other injuries are evident in the bones of the right hand and the fifth lumbar vertebra. The fourth metacarpal has an old, healed fracture, and the right third metacarpal has a pronounced ridge on the palmar surface, which may be an old fracture line.

This individual has unilateral spondylolysis of the fifth lumbar vertebra with complete fracture of the left pars interarticularis (i.e., partial separation of the neural arch). There is slight bridging of the fracture on the inferior margin of the defect suggesting some degree of healing. From a posterior view the vertebral laminae are asymmetrical in their superior-inferior heights. At the midpoint of each lamina, the left side measures 13.6 mm; the right measures 16.8 mm. This asymmetry indicates a lack of development of the left side of the neural arch, which may be related to the timing of the fracture (i.e, occurring before the lamina was fully formed), or, conversely, the reduced size on the left side may be the reason for vulnerability to fracture of this side of the neural arch. The right side of the vertebra is normal, whereas the left transverse process shows sacralization, indicating another type of asymmetry in the development of this vertebra. Separate neural arches are often the result of fatigue fracture from stress on the lower vertebral column.

Another unusual anomaly of the spinal column is the presence of thirteen thoracic vertebrae, instead of the usual twelve. The thirteenth thoracic is lumbar-like in its morphology, and on the left side the transverse process is fused to the pedicle. The right side has a distinct, detachable, vestigial rib that measures 21 mm in length.

The spinal column shows changes due to minor arthritic degeneration. The first cervical vertebra (the atlas) has slight lipping around the margin of the facet for the dens process, and the corresponding dens process on the axis (C2) also displays slight lipping. The articular facets for the cervical vertebrae display slight cupping and lipping along with moderate porosity. Also, the vertebral bodies (i.e., the centra) of cervicals 3 through 7 show moderate lipping of the margins with slight porosity, particularly C3, C4, and C5. C5 has a small osteophyte that extends away from the inferior endplate for a distance of 4 mm and is 9 mm in width. Thoracic vertebrae 1 through 9 display slight lipping on the margins of the centra and on the articular facets. This condition on the centra is slightly more pronounced on the lower thoracics and thoracics 10-12 display slight to moderate levels of arthritic lipping of the centra and the facets. The articular facets of thoracic 10-12 display moderate lipping, but with no visible surface porosity.

A small Schmorl's node was present in the inferior endplate of the tenth thoracic vertebra (i.e., as evidenced by concavities resulting from herniation of disc material into the centrum). This shallow depression has an anteroposterior orientation and is linear in shape, measuring 2.5 mm in width by 8 mm in length. Similarly, the twelfth thoracic vertebra has small depressions in both the superior and inferior endplates of the centrum, and the first lumbar has a large Schmorl's node on its superior endplate. This depression is linear in shape with a transverse orientation across the endplate. The transverse measurement is 22 mm, the length is 5 mm, and the depth is 3 mm.

Three thoracic vertebrate (10-12) show slight anterior wedging of the centra, producing an insignificant amount of anterior curvature (i.e., kyphosis) of the spinal column at this location.

The lumbar vertebrae have slight lipping on the margins of the centra accompanied by slight porosity on the margins.The articular facets show no evidence of degeneration with the exception of the left inferior articular facet of L5, which shows remodelling due to the spondylolysis.

The left proximal radius and ulna have minor porosity and lipping of the joint surfaces, and the distal right femur was also scored for slight lipping.

The dentition exhibits moderately heavy wear due to attrition. The occlusal surface wear planes are flat for the anterior teeth, but have a lingual slope in the maxillary molars and a buccal slope in the mandibular molars. Especially heavy wear of the maxillary first molars has exposed the pulp chambers, resulting in active periapical abscessing at the time of death. The right mandibular first molar also had an active abscess that had spread to the second molar.

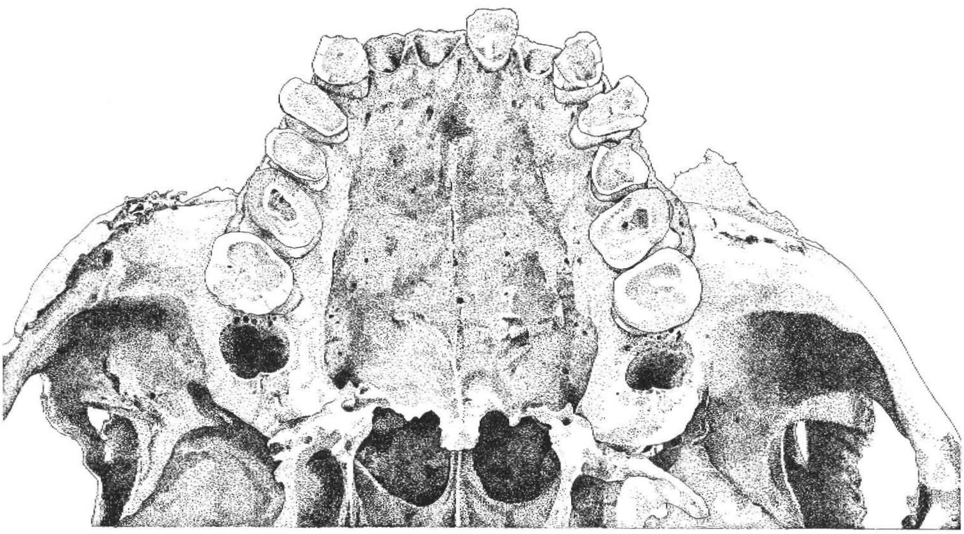

FIGURE 3. Maxillary dentition. (*Drawing by S. Wallmann, dedicated to Bob Elston*)

MORPHOMETRIC ANALYSIS OF THE CRANIUM

Analyses of Paleoamerican skeletal morphology have been based on the few existing dated remains (Steele and Powell 1992; Lahr 1995; Neves and Puciarelli

1991). Remains are often fragmentary and analyses are sometimes based on published measurements, which limits the number of measurements that can be included. For example, D. G. Steele and J. F. Powell's (1992) analysis of available North American crania was based on only eight measurements. Howells (1995) recently conducted a wide-ranging classification study of crania from many parts of the world, including a number of specimens representing early modern *Homo sapiens*. No Paleoamerican crania were included in Howells's sample. Morphometric studies of this type allow extraction of maximum information from individual specimens, and the Spirit Cave remains provide a case study that can used to illustrate this approach.

Samples

The data base consists of Howells's world-wide samples (Howells 1989) with the addition of several historic American Indian tribal samples from our data base. Table 1 presents the samples, sample sizes and region of the world from which each comes. Great Plains samples include the Blackfeet, Cheyenne, Crow, Sioux, Pawnee, and Historic Arikara (designatedHARIKARA in Table 1) from the Leavenworth archaeological site, and Cheyenne.We were able to assemble a small sample of Great Basin Numic speakers consisting of crania from the collections of the National Museum of Health and Medicine, the University of Utah, Brigham Young University, and other museum collections.

Table 1. List of world samples to which Spirit Cave Cranial dimensions were compared.

Group	N	Region	Source	Group	N	Region	Source
AINU	86	E Asia	Howells	HAINAN	83	E Asia	Howells
ANDAMAN	70	SE Asia	Howells	MOKAPU	100	Polynesia	Howells
ANYANG	42	E Asia	Howells	MORIORI	108	Polynesia	Howells
PARIKARA*	69	N America	Howells	N Japan	87	E Asia	Howells
HARIKARA	51	N America	Jantz/Owsley	NORSE	110	Europe	Howells
ATAYAL	47	E Asia	Howells	PAWNEE	27	N America	Jantz/Owsley
AUSTRALIA	101	SW Pacific	Howells	PERU	110	S America	Howells
BERG	109	Europe	Howells	PHILLIPIN	50	E Asia	Howells
BLACKFEET	66	N America	Jantz/Owlsey	S JAPAN	91	E Asia	Howells
BURIAT	109	Siberia	Howells	SANTA CRUZ	102	N America	Howells
BUSHMAN	90	S Africa	Howells	SIOUX	28	N America	Jantz/Owsley
CHEYENNE	22	N America	Howells	TASMANIA	87	SW Pacific	Howells
DOGON	99	W Africa	Howells	TEITA	83	E Africa	Howells
EASTER I	86	Polynesia	Howells	TOLAI	110	SW Pacific	Howells
EGYPT	111	N Africa	Howells	ZALAVAR	98	Europe	Howells
ESKIMO	108	Greenland	Howells	ZULU	101	S Africa	Howells
GUAM	57	Micronesia	Howells	NUMIC	22	N America	Jantz/Owsley

The American samples in Howells's database are from Santa Cruz Island, California; Peru; Eskimos from Greenland; and Protohistoric period Arikara (designated PARIKARA in Table 1) from the Sully site in South Dakota. Altogether, there are ten Amerindian samples among a total of thirty-four population samples.

Variable Selection

Howells's (1973, 1995) database contains sixty-one variables for most groups. Table 2 presents Howells's three letter abbreviations, along with a brief description of the measurement. Several analyses were conducted using various subsets of these measurements. These subsets were chosen to illustrate the relationships of the Spirit Cave individual to modern populations based on specific dimensions that have been defined through factor analyses of cranial measurements (Howells 1973; Key 1983). These studies have identified several complexes representing sets of dimensions that covary more strongly with each other than with other dimensions. The main cranial complexes are facial height, forwardness, prognathism, and vault breadth and height. Other important complexes include orbit horizontal profile, frontal flatness, upper facial breadth and midfacial size. These complexes were used as a guide to identify subsets of measurements incorporated into different analyses. These smaller analyses allow us to focus on relationships reflected by these cranial complexes, and to provide a metric description of the Spirit Cave male stated in terms of the patterns of variability seen in modern crania.

It was also necessary to exclude certain variables from all or most analyses. Excluded measurements include (1) those that could not be obtained from the Spirit Cave Mummy (because of adhering tissue it was not possible to obtain measurements to dacryon, asterion or the nasal region), (2) those possessing high interobserver variation (these consist of small measurements such as WNB, SSS [also excluded because of No. 1 above], IML, XML, MLS, GLS, and SOS, (3) measurements which mainly reflect robusticity, such as MDH, MDB and WMH, and (4) measurements whose primary purpose is the calculation of angles (FRF, PAF, and OCF).

Statistical Methods

Two analyses were run in parallel. In one, the raw measurements were used with sex differences in the reference samples removed by first centering on sex-specific means. In the other analysis, the raw variables were first converted to shape variables by dividing each by size. Size is defined as the geometric mean of all variables (Darroch and Mosimann 1985; Jungers, Falsetti, and Wall 1995). A size variable defined in this way removes isometric size. It differs from the approach taken by J. Kamminga and R. V. S. Wright (1988), who define size as the first principal component. Excluding the first principal component also removes some shape information. Unlike the first principal components, shape variables as de-

Table 2. Measurement Abbreviations and Descriptions. See Howells (1973;1989) for additional details.

Abr.	Description	Abr.	Description
GOL	glabello-occipital length	XML	maximum malar length
NOL	nasion-occipital length	MLS	malar subtense
BNL	basion-nasion length	WMH	minimum cheek height
BBH	basion-bregma height	SOS	supraorbital projection
XCB	maximum cranial breadth	GLS	glabella projection
XFB	maximum frontal breadth	STB	bistephanic breadth
ZYB	zygomatic breadth	FRC	frontal chord
AUB	biauricular breadth	FRS	frontal subtense
WCB	minimum cranial breadth	FRF	frontal fraction
ASB	biasterion breadth	PAC	parietal chord
BPL	basion-prosthion length	PAS	parietal subtense
NPH	nasion-prosthion height	PAF	parietal fraction
NLH	nasal height	OCC	occipital chord
JUB	bijugal breadth	OCS	occipital subtense
NLB	nasal breadth	OCF	occipital fraction
MAB	palate breadth	FOL	foramen magnum length
MDH	mastoid height	NAR	nasion radius
MDB	mastoid breadth	SSR	subspinale radius
OBH	orbital height	PRR	prosthion radius
OBB	orbital breadth	DKR	dacryon radius
DKB	interorbital breadth	ZOR	zygoorbit radius
NDS	Naso-dacryon subtense	FMR	frontomalar radius
WNB	simotic chord	EKR	ectoconchion radius
SIS	simotic subtense	ZMR	zygomaxillare radius
ZMB	bimaxillary breadth	AVR	M1 alveolar radius
SSS	zygomaxillary subtense	BRR	bregma radius
FMB	bifrontal breadth	VRR	vertex radius
NAS	nasio-frontal subtense	LAR	lambda radius
EKB	biorbital breadth	OSR	opisthion radius
DKS	dacryon subtense	BAR	basion radius
IML	inferior malar length		

fined here are not necessarily orthogonal to size. After carrying out the above operations, the following steps were taken: (1) Calculate Mahalanobis distances among the samples using principal components derived from the pooled within class covariance matrix. (2) Get principal coordinates from this matrix as described by Gower (1972). (3) Get distances of the Spirit Cave individual from each of the samples and calculate its principal coordinates. The distances of the Spirit Cave male from other groups can be used to assess which groups it most closely resembles and whether it falls within the range of variation of those groups. The principal coordinates allow a visual picture in reduced dimensions of its relationships on axes defined by the world samples.

The analyses including and excluding size generally yield similar results. Here we present the results which include size for the various cranial complex analyses, and the shape results for the general analysis.

RESULTS

Vault Profile

Vault profile measurements were selected to express the size and shape of the cranial vault in the sagittal plane. They express the complexes seen in vault height, frontal bone size and flatness, parietal size and profile, and cranial base flatness. There are twelve dimensions; six are radii from the transmeatal axis to various points on the vault, and six are chords and subtenses of the frontal, parietal and occipital. The Spirit Cave male classifies as Ainu on these twelve variables. Table 3 gives the four closest and the four most distant samples in the comparative database. The four closest populations are dominated by Asian/Pacific populations, but include the Zulu of Africa. The typicality probabilities show that the Spirit Cave male could easily be a member of any of these groups. The Bushman is the most distant population, but the next three are American Indians. The Spirit Cave male would be an atypical member of any of these populations.

Table 3. Distances, posterior and typicality probabilities of the four closest and four most distant populations based on sagittal vault dimensions.

	Four closest			Four most distant		
Group	D^2	Post	Typ		D^2	Typ
Ainu	10.31	0.47	0.59	Bushman	33.61	0.00
Moriori	12.14	0.19	0.43	Sioux	29.54	0.00
Zulu	13.55	0.10	0.34	Pawnee	26.06	0.01
N Japan	13.79	0.08	0.31	Harikara	25.76	0.01

Figure 4 shows the three-dimensional plot of the comparative samples (73 percent of dispersion) and the position of the Spirit Cave male. Its affinity to Ainu, the Pacific, and secondarily to East Asia, is evident in the plot. Table 4 gives the among structure coefficients which permit interpretation of the principal coordinate axes. The first axis reflects vault size with emphasis on height and posterior projection. The low American Indian scores on this axis reflect their low and relatively small vaults. Groups with high scores are Polynesians, and East Asians, including Ainu. The Spirit Cave male is clearly aligned with this last group of populations and not with American Indians. The second axis is primarily frontal curvature and an associated location of nasion. High scores reflect strongly curved frontal and posterior placement of nasion, low scores the reverse. Both American Indians and Polynesians exhibit flat frontals, as has been previously pointed out by Howells (1978). Unlike Indians, the Spirit Cave cranium does not have a flat frontal configuration. It is most similar to East Asian and Europeans in this regard. The third axis reflects frontal and parietal bone size and placement of nasion. High scores reflect large frontal and parietal and anterior placement of nasion. The Spirit Cave male has a high score most similar to certain Polynesians, Ainu and Zulu, but is in contrast to American Indians who score low.

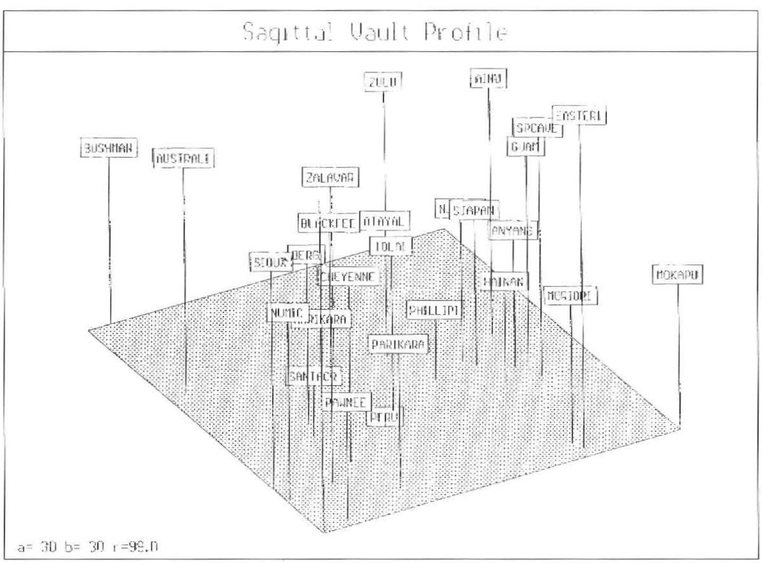

FIGURE 4. Three-dimensional plot showing the relationship of the Spirit Cave Male to world populations using sagittal vault variables.

Vault and Face Breadth

Vault and face breadth reflect the pattern of breadth variation. The variables are those which define vault breadth, upper facial breadth, and midfacial size. Table 5 shows the four closest and four most distant population samples in the

Table 4. Among Canonical Structure Coefficients for Vault Dimensions

	Can 1	Can 2	Can 3
FRC	0.372	-0.111	0.254
FRS	0.195	0.411	0.246
PAC	0.340	0.242	0.253
PAS	0.293	0.046	0.012
OCC	0.465	-0.172	-0.021
OCS	-0.345	-0.063	0.154
NAR	-0.013	-0.360	0.401
BRR	0.456	-0.221	0.147
VRR	0.499	-0.199	0.056
LAR	0.474	0.031	0.058
OSR	0.162	0.044	0.259
BAR	0.441	0.020	0.157

database. The Spirit Cave male is closest to Atayal in its pattern of breadths, but falls comfortably within the range of variation of Numic, Northern Japanese, and Zalavar.

Table 5. Distances, posterior and typicality probabilities of the four closest and four most distant populations based on vault and face breadths.

Four closest				Four most distant		
Group	D^2	Post	Typ	Group	D^2	Typ
Atayal	8.23	0.46	0.69	Moriori	32.81	0.00
Numic	10.80	0.13	0.46	Andaman	27.85	0.00
N Japan	12.20	0.06	0.35	Buriat	26.82	0.01
Zalavar	12.48	0.05	0.33	Bushman	26.82	0.01

Figure 5 shows the three dimensional plot of the comparative samples and the position of the Spirit Cave male on these axes. Table 6 shows the canonical structure coefficients. The first axis is an expression of general breadth, with a contrast to nasal breadth. All Amerindians possess low scores resulting from their wide faces and vaults and narrow noses. The second axis expresses a contrast between face breadth, especially in the orbital region, and vault breadth. Indians score high on this axis by virtue of relatively wide faces. The Spirit Cave male is similar to American Indians on the first two axes. Axis three is orbit breadth, nasal and maxillary breadth, and vault breadth. The Spirit Cave male is low on this axis, falling below most Amerindians (exceptions are Numic and Cheyenne) and closer to many South Asian populations.

Table 6. Among Canonical Structure Coefficients for Vault and Face Breadths

	Can 1	Can 2	Can 3
XCB	-0.415	-0.316	0.238
XFB	-0.303	-0.357	0.247
ZYB	-0.556	0.227	0.198
AUB	-0.613	0.059	0.151
WCB	-0.521	-0.109	-0.072
NLB	0.240	0.086	0.308
MAB	-0.360	0.162	0.236
OBB	-0.232	0.277	0.405
ZMB	-0.493	0.228	-0.006
FMB	-0.174	0.363	0.315
EKB	-0.225	0.341	0.295

Facial Forwardness and Prognathism

These variables reflect variation in the facial forwardness and prognathism complexes, which express the forward projection of the face and maxilla. Table 7 shows the four closest and four most distant populations. The two closest are both European, but Norse has a much higher posterior probability than any other group. The typicality probability indicates that the Spirit Cave male is less typical than 89 percent of Norse crania and less typical than over 95 percent of the other three closest groups.

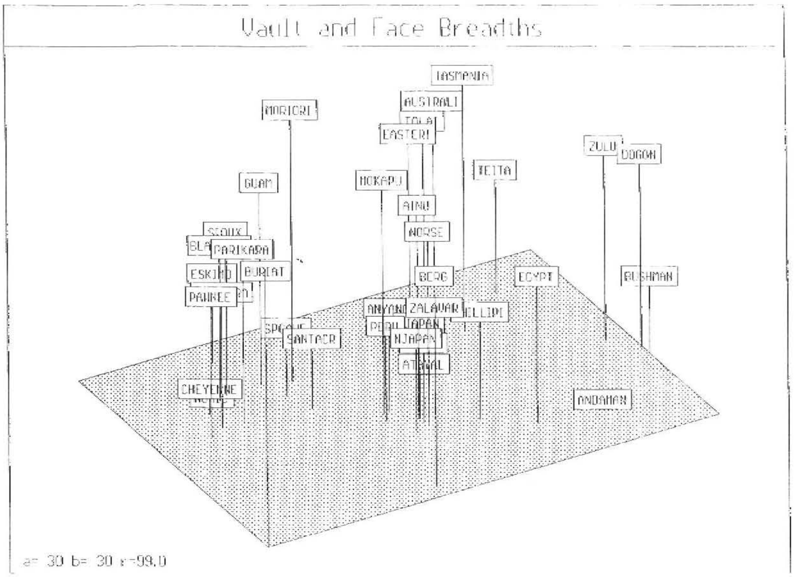

FIGURE 5. Three-dimensional plot showing relationship of the Spirit Cave male to world populations using vault and face-breadth variables

Table 7. Distances, posterior and typicality probabilities of the four closest and four most distant populations based on facial forwardness and prognathism dimensions.

	Four closest			Four most distant		
Group	D^2	Post	Typ	Group	D^2	Typ
Norse	18.10	0.78	0.11	Arikara	49.49	0.00
Zalavar	22.54	0.08	0.03	Andaman	48.12	0.00
Egypt	23.13	0.06	0.03	Eskimo	47.07	0.00
Bushman	25.02	0.02	0.02	Mokapu	45.62	0.00

Figure 6 shows the three-dimensional plot of the comparative samples and Spirit Cave, and Table 8 the canonical structure coefficients. The first axis is mainly prognathism and separates Southwest Pacific groups, the most prognathic, from East Asians, the least prognathic. The second axis reflects upper facial forwardness. Eskimos and Polynesians have high facial forwardness; Andaman Islanders have the least facial forwardness, although certain Amerindians (Peru and Santa Cruz) and certain Africans (Dogon and Bushman) also score low. The third axis, which is primarily cranial length, is the only one that systematically differentiates Amerindians from most other groups. Amerindians possess low scores, meaning they have short vaults. The Spirit Cave face's score on the first axis characterizes it as mildly prognathic, more like the Southwest Pacific than East Asia. On the second axis it exhibits little facial forwardness, less than that seen in most Amerindians. It is most differentiated on the third axis, where, because of its vault length, it scores high, along with Eskimo, Ainu, Australian, and Bushman.

Table 8. Among Canonical Structure Coefficients of Facial Forwardness/Prognathism

	Can 1	Can 2	Can 3
GOL	0.356	0.349	0.298
NOL	0.295	0.348	0.289
BNL	0.183	0.530	0.034
BPL	0.352	0.313	0.178
NAR	0.263	0.519	-0.051
SSR	0.435	0.385	-0.016
PRR	0.373	0.345	0.118
ZOR	0.164	0.525	0.156
FMR	0.115	0.572	-0.001
EKR	0.037	0.580	0.032
ZMR	0.204	0.486	0.185
AVR	0.390	0.365	0.118

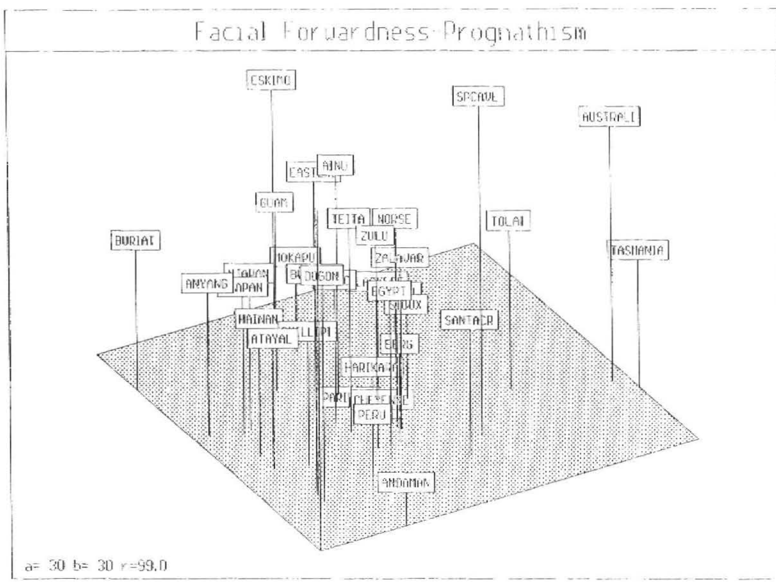

FIGURE 6. Three-dimensional plot showing relationship of the Spirit Cave male to world populations using prognathism and facial forwardness variables

Face Height, Breadth, and Projection

Face variables were selected to express variation seen in face height, face breadth, and facial projections. Face height appears on a separate factor in Howells's (1973) analysis. Face breadths are contained in his upper-face-breadth and midfacial-size factors. Facial projections are measured from various facial planes. T. L. Woo and G. M. Morant (1934) define four facial triangles designed to measure facial flatness and which exhibit marked variation among populations. Howells's measurements allow calculation of three of the four facial triangles, and Howells defined another. The dimensions defining these facial triangles appear in factor analyses as subnasal flatness, nasialia prominence and orbit horizontal profile, and interorbital prominence (Howells 1973; Key 1983). Unfortunately, because of inability to measure dacryon and the nasal bones on the Spirit Cave individual, we could use only two of the facial triangle variables, bifrontal breadth (FMB) and its subtense to nasion (NAS) and bimaxillary breadth (ZMB) and its subtense to subspinale (SSS). These will reflect orbit horizontal profile and subnasal flatness. Table 9 shows the four closest and four most distant populations. The Spirit Cave male clearly has a very strong European resemblance on the facial variables. The four most dissimilar populations are a mixture of the world's most morphologically extreme populations.

Figure 7 shows the position of the world samples and the Spirit Cave male on the first three principal coordinates, and Table 10 gives the structure coefficients for these axes. The first axis is an expression of general face breadth with a contrast

Table 9. Distances, posterior and typicality probabilities of the four closest and four most distant populations based on face height, breadth and projections.

	Four closest			Four most distant		
Group	D^2	Post	Typ	Group	D^2	Typ
Berg	13.77	0.34	0.32	Bushman	36.22	0.00
Norse	14.81	0.21	0.25	Tasmania	35.79	0.00
Zalavar	16.36	0.10	0.18	Andaman	32.81	0.00
Sioux	16.95	0.07	0.15	Buriat	30.59	0.00

to nose breadth. It reflects some of the same things seen on the first axis in the vault and face breadth analysis presented above. Amerindians have high scores reflecting their wide faces and narrow noses. On this axis the Spirit Cave individual aligns with populations of more moderate face breadth, such as Europeans, Polynesians and East Asians. The second axis reflects orbital width and orbit profile and subnasal flatness. The Spirit Cave face is distinguished from both the flat, broad-faced East Asian populations and from Southwest Pacific populations which have narrow, angular faces. Here it aligns with populations exhibiting only moderate orbit width and facial projections such as Europeans, Polynesians and Amerindians. The third axis reflects specifically orbit horizontal profile, and nasal and palate breadth. Here Spirit Cave has a high score, reflecting receding orbits and narrow nose and palate. This also places it close to Europeans and many American Indians.

Size Analysis

Size is often considered a nuisance variable to be eliminated if at all possible. Size has been included in the analyses presented here, but it is instructive to examine size alone. Separate size variables, as previously defined (Darroch and Mosimann 1985), were constructed for the face and vault. The size analysis was limited to males. Vault size is defined as the geometric mean of eleven vault dimensions, and face size as the geometric mean of ten face dimensions. Figure 8 shows the plot of vault size and face size of the comparative samples and the Spirit Cave male.

Table 10. Among Canonical Structure Coefficients face heights, breadth and projections

	Can 1	Can 2	Can 3
ZYB	.567	-.218	-.183
NPH	.604	-.057	-.080
NLH	.596	-.064	-.113
NLB	-.249	-.072	-.437
MAB	.357	-.204	-.362
OBH	.562	-.048	-.049
OBB	.265	-.402	-.164
ZMB	.551	.028	-.138
SSS	.038	-.492	.068
FMB	.183	-.408	-.101
NAS	.126	-.388	.422
EKB	.248	-.321	-.193

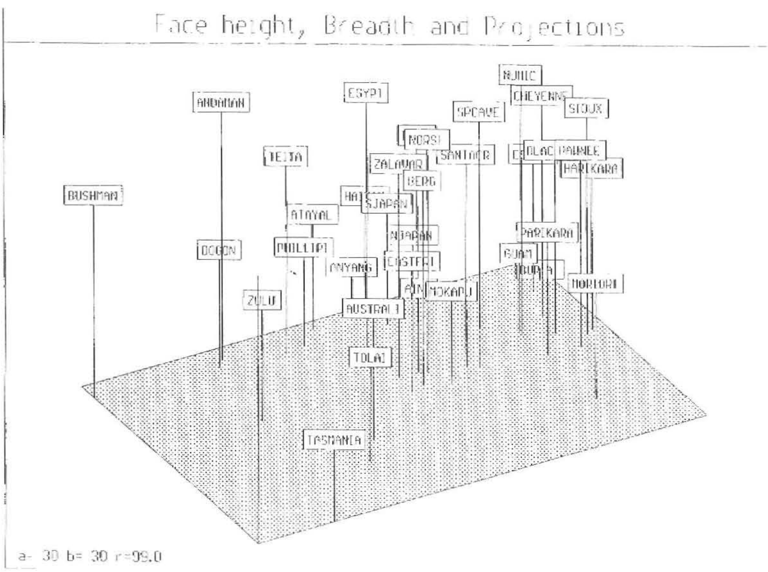

FIGURE 7. Three-dimensional plot showing relationship of the Spirit Cave male to world populations using face height, breadth, and projection variables.

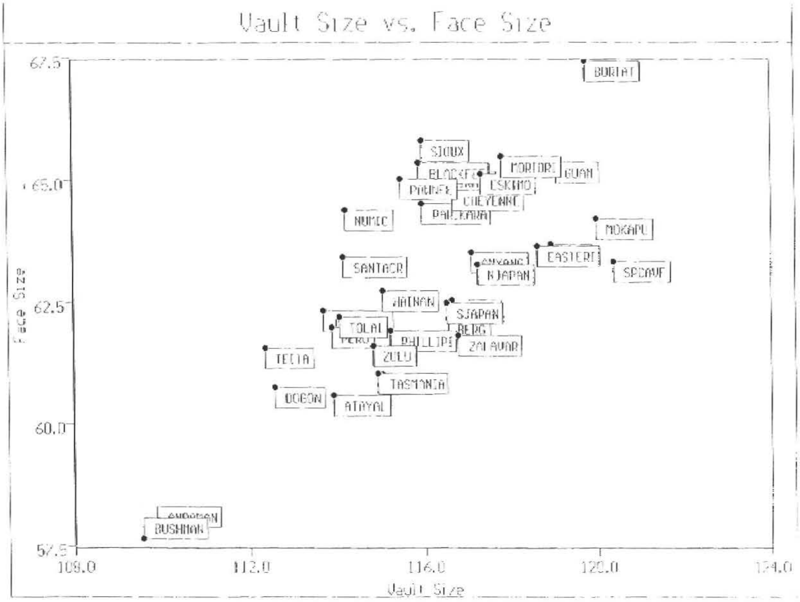

FIGURE 8. Plot of cranial vault and face size showing relationship of the Spirit Cave male to world male sample

There is a positive relationship between vault size and face size evident in the plot, but some independent variation as well. Amerindians can be characterized as possessing large faces and about average vaults. In contrast, the Spirit Cave individual has a large vault and an average sized face. Spirit Cave is most similar to Polynesian populations in vault and face size relationships.

General Analysis

The foregoing provides similarities of the Spirit Cave individual to world populations based on specific morphological complexes. The final stage in the analysis is to obtain an overall assessment. Table 11 gives the distances and the posterior probability of those distances of the Spirit Cave individual from all samples in the world data base, sorted from smallest to largest distance. There is a distinct pattern to be seen in these distances. Two of the three closest populations (Norse and Zalavar) are European. Ainu, the second closest, shares some of the morphometric features attributed to Europeans. In fourth and fifth position are two Amerindians, Blackfeet and Numic respectively. The next set, except for Egypt, consists of East or Southeast Asians. The posterior probabilities indicate that the only reasonable classifications are Norse, Ainu or Zalavar. However, the typicality probability for Norse is 0.00084, and all other populations are of course lower. Therefore the major conclusion is that the skull falls outside the range of variation of any modern population represented by currently available samples.

Table 11. Distances of Spirit Cave from all comparative samples, sorted from smallest to largest, and posterior probabilities.

NORSE	AINU	ZALAVAR	BLACKFEE	NUMIC	ATAYAL	EGYPT	HAINAN	NJAPAN
65.883	68.599	71.229	72.145	73.830	74.621	74.802	74.862	75.604
0.694	0.178	0.048	0.030	0.013	0.009	0.008	0.008	0.005
SJAPAN	ZULU	ANYANG	BERG	TEITA	CHEYENNE	MORIORI	PHILLIPI	DOGON
76.259	79.774	79.800	79.832	81.383	81.960	82.692	85.681	86.790
0.004	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
PERU	SANTACR	TOLAI	GUAM	ESKIMO	EASTERI	MOKAPU	39CO9	ARIKARA
87.242	87.407	87.510	88.066	89.561	91.803	92.071	92.657	93.484
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TASMANIA	AUSTRALI	PAWNEE	ANDAMAN	BUSHMAN	SIOUX	BURIAT		
94.054	96.880	96.943	97.416	99.088	110.437	115.464		
0.000	0.000	0.000	0.000	0.000	0.000	0.000		

DISCUSSION

The analysis has provided the basis for characterizing the Spirit Cave male's metric features, using the range of variation in modern *Homo sapiens* as the framework. The Spirit Cave specimen presents a mosaic of similarities and differences to the modern morphometric pattern, depending upon which craniofacial complex is used. For sagittal profile of the vault, it is most similar to Ainu, for vault and face breadths, to Atayal, for facial forwardness and prognathism to Norse, for the face variables to Europeans. In the general analysis, the vault profile, facial forwardness and prognathism components dominate, resulting in Norse and Ainu as the two populations to which Spirit Cave is most similar.

In the general analysis and most of the specific cranio-facial complex analyses, the Amerindian samples cluster rather tightly. The majority of Amerindian samples are from the Plains region, but Santa Cruz and even Peru are more similar to other Amerindians than to populations from other parts of the world. The Spirit Cave male does not show affinity to any Amerindian sample used here.

What should also be emphasized is that the Spirit Cave male falls outside the range of variation of all the samples used here. This is mainly due to its greater length; the parietal dimensions in particular contribute to Spirit Cave's uniqueness. We cannot conclude that the Spirit Cave individual falls outside the range of variation for modern Homo sapiens. The samples available, while extensive, do not begin to cover the range of variation present in modern Homo sapiens.

Hrdlicka's (1937) early contention that early Americans exhibit no difference from modern Indians may be responsible for much of the historical indifference accorded early American skeletons. The recent metric analyses have demonstrated that early American crania differ systematically from modern Amerindian crania. Compared to modern Indians, the Paleoamerican cranial vaults are longer and narrower, faces are shorter and narrower, and orbits are narrower and higher (Steele and Powell 1992). Steele and Powell (1992) have shown that their Paleoamerican sample fell outside the range of means defined by modern Amerindians. They conclude that Paleoamericans are more similar to South Asians and Europeans than they are to modern Indians.

In South America the differences may even be greater. Neves and Puciarelli (1991) place early South Americans nearest Australian Aboriginals and other populations of the Southwest Pacific. Even recent South Americans exhibit these relationships, which Lahr (1995) attributes to retention of robusticity rather than phylogenetic resemblance.

Our analysis of the Spirit Cave Mummy agrees with features attributed to early Americans in a number of respects, including long narrow, cranium, low face combined with high orbits, and narrow orbits. The Spirit Cave Mummy bears a number of similarities to European populations, as Steele and Powell (1992) observed in their sample. The South Asian similarity observed by Steele and Powell (1992) is weaker in the Spirit Cave individual, although the similarity to Ainu, which shares morphometric features with Polynesia (Brace and Hunt 1990), might be viewed in this way.

It is clear that any general extrapolations from our findings to peopling of the New World would be premature at this point. The findings are in line with some of the general ideas extracted from cranial analyses so far. It is fairly well established that the late Pleistocene populations of eastern Asia were not morphologically similar to the populations of the present who occupy the area. The Spirit Cave mummy's morphology shows little resemblance to any of the modern Mongoloids. It is also not very similar to any modern Amerindians, at least as they are represented by our samples. Even though modern North American Indians lack many of the features associated with modern East Asians, it is clear they have been influenced by recent dispersals. Lahr (1995) has argued that the early dispersal into East Asia consisted of people showing incipient Mongoloid features, such as facial flatness and a broad vault. It does not appear that the Spirit Cave mummy was drawn from a population exhibiting these incipient Mongoloid features. Our evidence would be more consistent with the proposition that the source population in Northeast Asia exhibited few of the features commonly associated with contemporary people of Northeast Asia.

The major problem facing synthesis of Paleoamerican craniometric variation concerns lack of comparable data. There has not yet been any systematic metric analysis of early American cranial or skeletal remains using a comprehensive set of variables. It is with this goal in mind that we are attempting to incorporate data from early Americans into our cranial data base. Application to the Spirit Cave skeletal remains has shown how informative such analyses can be.

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MOLECULAR ANALYSIS OF ANCIENT NATIVE AMERICAN DNA FROM WESTERN NEVADA

Frederika Kaestle

Anthropological interest in the peopling of the Great Basin has a long history. By now we are all aware of the debate regarding the Numic expansion hypothesis (Madsen and Rhode 1994). There are many arguments regarding how, when, and where the Numic spread occurred. A central problem remains: Was the Numic spread a spread of people, or simply a spread of language and technology? This article will address this question with some new data — mitochondrial DNA (mtDNA) from both modern and ancient Native American groups.

First I will give some general background about mtDNA and the techniques involved, and then the actual data. MtDNA is found in cells, but not in the nucleus, where most DNA is located. The mtDNA is found in the mitochondria, which are organelles found in the cytoplasm of the cell which help the cell produce energy. MtDNA is maternally inherited. Males and females both inherit mother's mtDNA, but only females pass it on to their children. MtDNA also mutates at a much faster rate than nuclear DNA, and so is informative on questions of recent prehistory, such as the peopling of the Americas and prehistoric movement in the Americas.

MtDNA is a circular molecule. We can detect the mutations in mtDNA in several ways. The first is by using restriction enzymes. A restriction enzyme is an enzyme that recognizes a very specific series of nucleotides (usually four to eight), and then cuts at that site. The presence of a restriction site that is normally absent, or the absence of a restriction site that is normally present, is indicative of a mutation in that region of DNA. Another type of mutation is the actual loss or gain of some number of nucleotides, such as the 9 base pair deletion.

New technology now allows us to access even small amounts of DNA, for example, the damaged DNA that survives in ancient individuals. This process, called the polymerase chain reaction, or PCR, uses the same mechanisms that your body uses to copy DNA when cells divide. With PCR, we can make millions of copies of a short segment of target DNA in a few hours.

The author is at the University of California, Davis. She wishes to thank Amy Dansie and Donald Tuohy of the Nevada State Museum for the opportunity to be involved in this research.

Using these techniques we can identify many mitochondrial lineages around the world. If we examine modern Asians, the putative ancestors to Native Americans, we can see that there are many different "versions" of mtDNA in Asia, but we are specifically interested in the four lineages that also appear in modern Native Americans. The more generally accepted labels for these four lineages are A, B, C, and D. Each lineage is united by a single mutation found in all individuals possessing that mitochondrial lineage.

We detect these mutations, in three cases, by cutting with a restriction enzyme. Figure 2 shows PCR products, which are DNA fragments, that have been separated in an electric current through a gel matrix. The fragments move through the gel at a rate that is dependent on their size: the larger the fragment, the slower it moves. Thus, fragments that have been cut can be seen as two small bands, while those that have not been cut are seen as one larger band. As can be seen in Figure 2, lineage A is identified by a HaeIII site gain at nucleotide position (np) 663, lineage C by a HincII site loss at np 13259, and lineage D by an AluI site loss at np 5176. Lineage B is identified by the loss of nine nucleotides in a row (a 9 bp deletion).

As can be seen in the world-wide distribution, shown in Figure 3, these four lineages are not present in the same frequencies in all groups. In Asia, although lineages A, B, C, and D are present in many groups, other mitochondrial lineages predominate. Not all contemporary Native American groups have these four lineages in the same frequencies (Figure 4). In fact, some tribes lack one or more of the lineages completely. This variation in frequency of the four lineages, or haplogroups, allows us to explore questions of relatedness between tribes, and also ancestor-descendant relationships between ancient and modern populations. Groups that are closely genetically related should have similar frequencies of the four lineages, while groups with very different frequencies are probably not closely related to each other.

The PCR technology allows us to examine the DNA of ancient individuals. For this study, we focused on twenty-one prehistoric individuals from the Pyramid Lake region in Western Nevada. These individuals have been ^{14}C dated to between 860±75 and 9,2225±60 B.P. Thus far, I have successfully extracted and amplified mtDNA from twenty of these individuals, identifying the mtDNA lineage in fifteen of them. Figure 5 shows the distribution of the four lineages in the Pyramid Lake individuals. All four lineages are present in our sample. Note that the oldest individual, from Wizards Beach and dated to 9225±60 B.P., belongs to the C lineage. This lineage identification can be seen on this electrophoretic gel photo (Figure 6). No other individual in this sample belongs to that lineage (see Figure 6). The frequency of that lineage in the modern inhabitants of the area, the Northern Paiute, is about 11 percent. Because we, to date, have only one sample from this time period in this area, a statistical analysis of lineage affinity is not possible. However, I also plan to sequence another portion of the mitochondrial DNA, called the D-loop, which is hypervariable. This means that the mutation rate for this region is much higher (10X) than elsewhere in the mtDNA. I can then compare the sequence of this ancient individual with those of the other ancient individuals from the area, and also with modern Native Americans at a level that may allow finer resolution.

We can also look at the Pyramid Lake individuals as one group for analysis. Obviously, since the sampled skeletal material spans thousands of years, this is an artificial population. However, if we look at the temporal distribution of the mitochondrial lineages (Figure 7), no clear pattern emerges, except that the only individual possessing the lineage C marker is the oldest individual in the sample (9,225 B.P.). I have tried dividing the samples into two groups by age at 2,000 B.P., 3,000 B.P., and 4,000 B.P. and see no obvious discontinuities. To my knowledge, these represent the oldest examples of all lineages except B. In addition, if we accept the hypothesis of the recent Numic expansion, none of the samples should post-date this expansion. The frequencies of the four mitochondrial lineages in the ancient Pyramid Lake samples can be compared with those in modern Native American groups. This might clarify the identity of the pre-Numic inhabitants of the Great Basin if the frequencies of the lineages in modern tribal groups are similar to those of their ancestors. It seems unlikely that the pre-Numic population from Pyramid Lake is ancestral to any modern population from which its frequencies of the four mitochondrial lineages differ significantly.

The distribution of modern tribes in western North America that have been tested for these four mtDNA lineages can be seen in Figure 8. For analysis these had to be grouped in some way. The modern samples were sorted into both language groups and geographic regions for estimating and comparing frequencies of the four mitochondrial lineages (Figure 9). This was done because the relationship between genes and language or geography is often complicated. Populations may share genes with other groups in a geographic region, with other groups that speak related languages, or some combination. The patterns seen here may give us clues to the direction of gene flow in prehistory. Language groups consist of eight subsets of three larger groups: Penutian, Hokan and Uto-Aztecan. The samples were also sorted into the following four geographic regions: California, Baja, the Great Basin, and the Southwest.

Figure 10 shows the frequencies of the four lineages in the modern language groups and those in the ancient Pyramid Lake individuals. I have also included another ancient population, the Fremont. This data was generated in Dennis O'Rourke's laboratory at the University of Utah at Salt Lake. Those samples are from archaeological sites on the margin of the Great Salt Lake in Utah and have been dated to between 730 and 1,500 B.P. As can be seen, some language groups completely lack one lineage. Some geographic relationships may also be seen here (e.g., most language groups lacking lineage D are found in the Southwest). A comparison can be made more easily with Figure 11. The most obvious similarity is seen between the Pyramid Lake individuals and the modern California Penutian language group. However, the next two groups, the Northern Uto-Aztecan and

Northern Hokan language groups, although lacking lineage A do possess similar frequencies of the remaining three lineages. It is interesting that the prehistoric Fremont individuals appear quite distinct from any of the modern samples.

Figure 12 compares the frequencies of the four lineages in the modern geographic groups with those in the ancient samples. Again, differences between some modern groups and the ancient Pyramid Lake sample can be seen, and become more apparent when depicted in chart form (Figure 13).

I plan to add more samples to both the ancient and modern groups. I will then apply statistical tests to hypotheses of the relationships between these ancient and modern groups. For example, I will also be sequencing the hypervariable D-loop region for many of the ancient samples and doing a phylogenetic analysis of the ancient and modern sequences. This more detailed analysis may provide more information regarding patterns of prehistoric population movement in the Great Basin.

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FIGURES

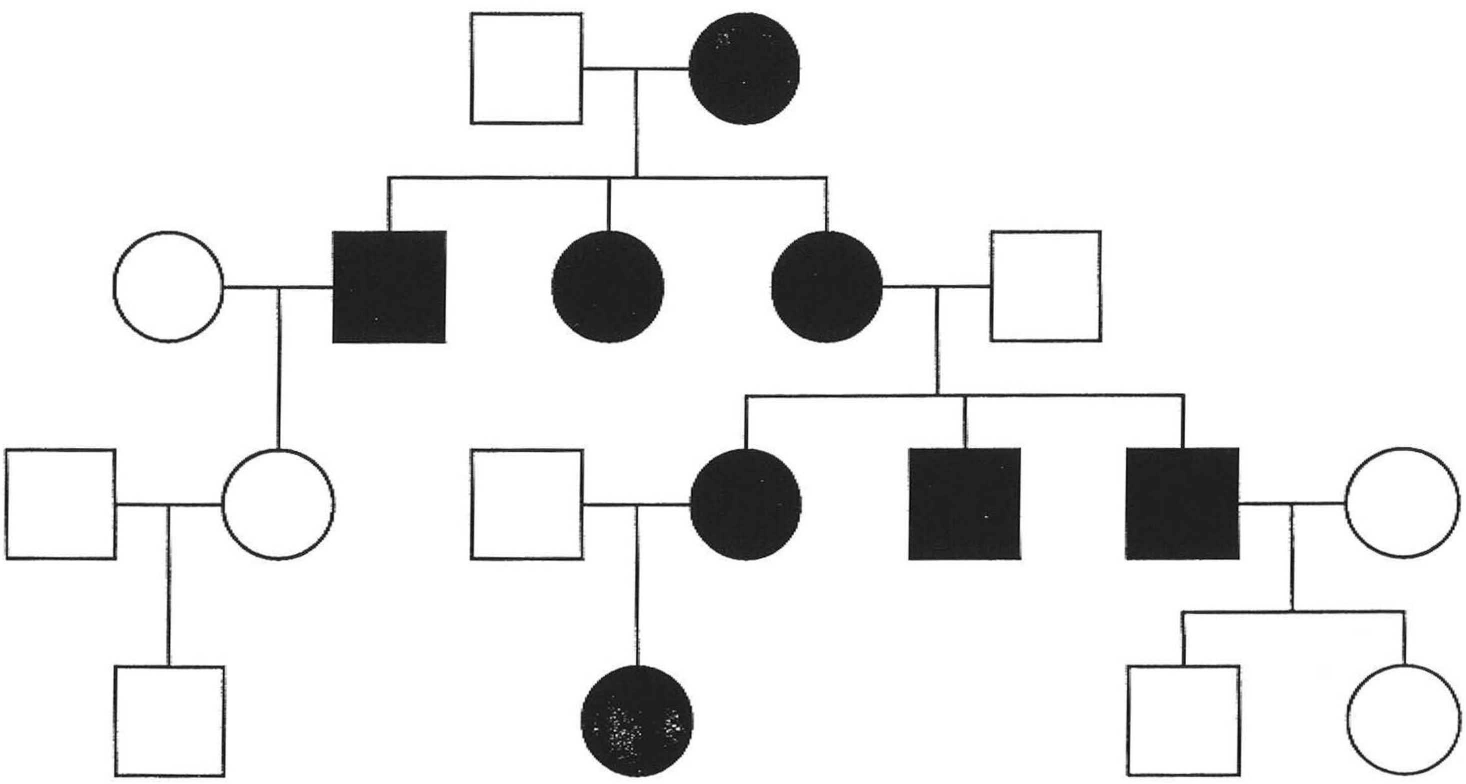

FIGURE 1. Mitochondrial DNA inheritance.

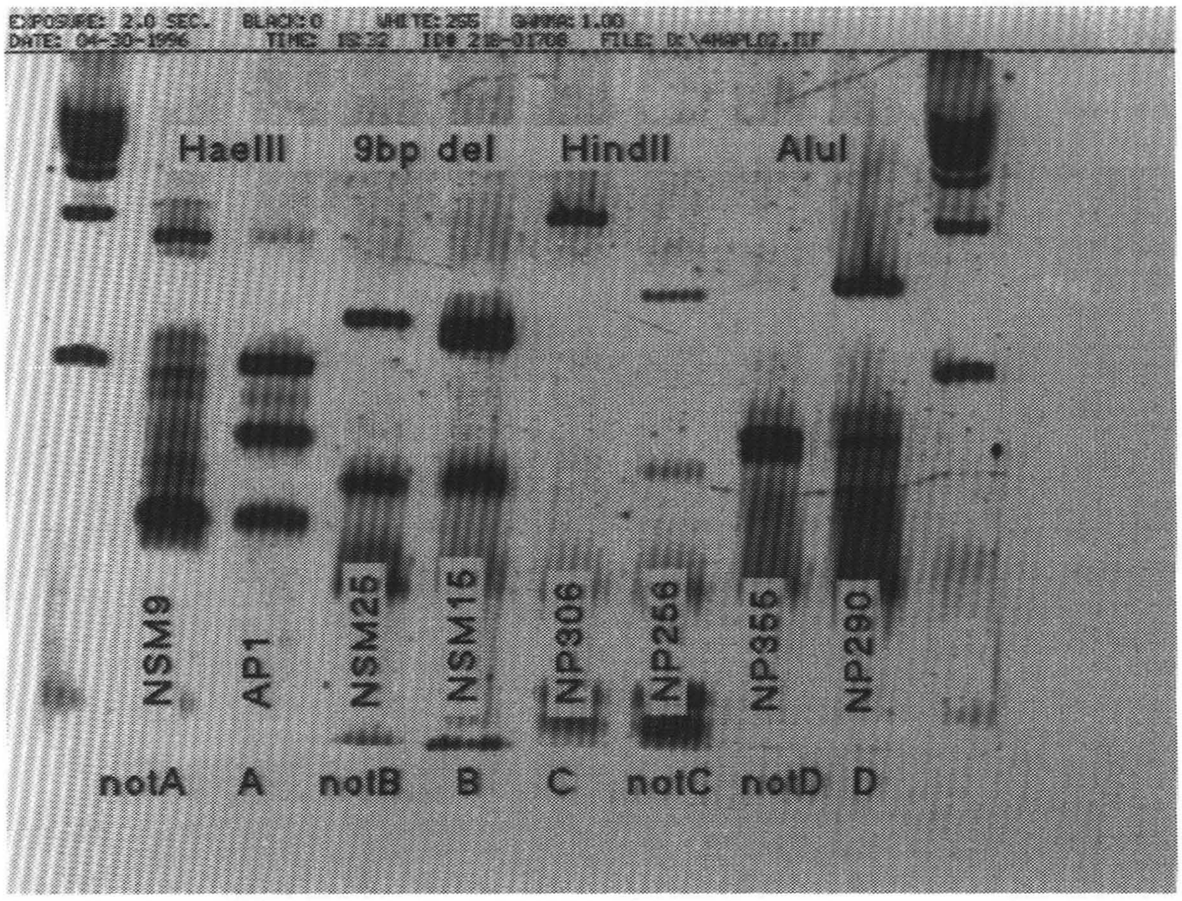

FIGURE 2. Identification of the four Native American mitochondrial lineages. Lanes one and ten contain size markers. In lanes two and three are the PCR products for the fragment containing the marker for lineage A, exposed to the HaeIII restriction enzyme. Note the Apache individual in lane three possesses the HaeIII restriction site (was cut) and thus belongs to lineage A. In lanes four and five are the PCR products for the fragment containing the marker for lineage B. Note the ancient individual from Pyramid Lake in lane five possesses the 9 bp deletion (the fragment is 9 nucleotides shorter than a non-lineage B fragment) and thus belongs to lineage B. In lanes six and seven are PCR products for the fragment containing the marker for lineage C, exposed to the HincII restriction enzyme. Note the modern Northern Paiute individual in lane six was not cut by the HincII enzyme, and thus belongs to lineage C. Lanes eight and nine contain the PCR products for the fragment containing the marker for lineage D, exposed to the AluI restriction enzyme. Note the modern Northern Paiute individual in lane nine does not possess the AluI site (did not cut) and therefore belongs to lineage D.

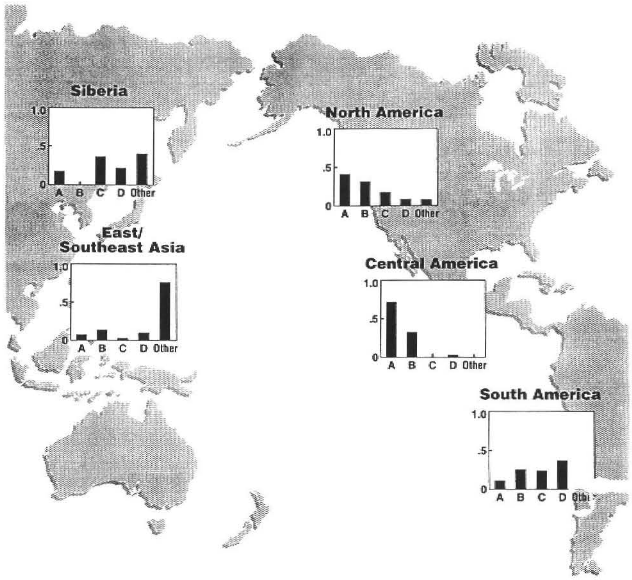

FIGURE 3. Frequency distributions of mtDNA haplogroups in Asia and the New World (after Lorenz and Smith 1996:318).

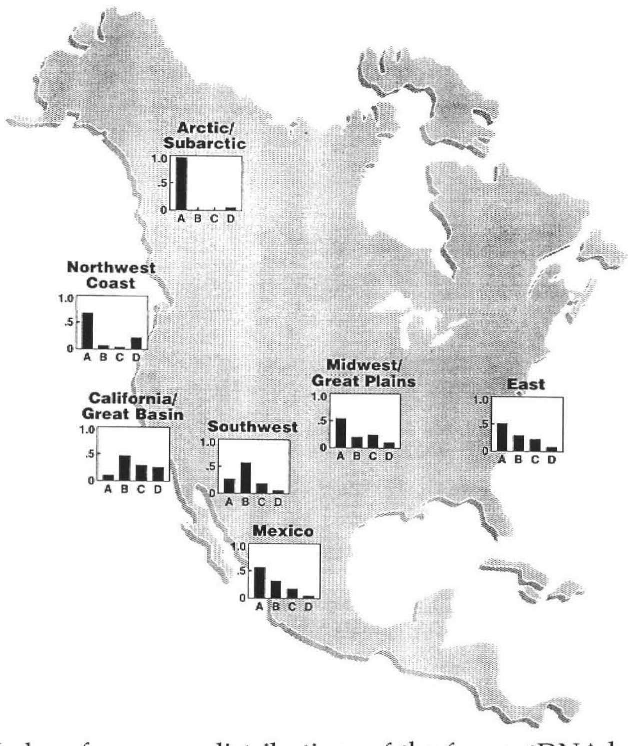

FIGURE 4. Modern frequency distributions of the four mtDNA haplogroups by geographic region in North America (after Lorenz and Smith 1996:314).

Lineage assignment of Prehistoric western Nevada samples

ID	date in yBP	# extractions	HaeIII (A)	9 bp del (B)	HindII (C)	AluI (D)	Lineage
NSM-1	3725 +/- 105	3	+	-	+	+ , -	**?**
NSM-2	860 +/- 75	2	-	+	+	+	**B**
NSM-6	2935 +/- 140	2	-	-	+	-	**D**
NSM-7	4745 +/- 115	2	-	-	+	-	**D**
NSM-8	2735 +/- 100	2	-	-	+	-	**D**
NSM-9	2435 +/- 85	2	-	-	+	-	**D**
NSM-10	1620 +/- 50	2	-	-	+	-	**D**
NSM-11	1490 +/- 50	2	-	-	+	-	**D**
NSM-12	1820 +/- 180	3	-	+	+	+	**B**
NSM-13	1360 +/- 80	2	-	+	+	+	**B**
NSM-14	1520 +/- 90	2	+	-	+	+	**A**
NSM-15	5905 +/- 125	2	-	+	+	+	**B**
NSM-16	9200 +/- 60	2	-	-	-	+	**C**
NSM-17	3630 +/- 60	3	-	-	+	-	**D**
NSM-18	2430 +/- 100	2	-	-	+	-	**D**
NSM-19	3165 +/- 370	1	-	-	+	-	**D**
NSM-20	1500	2	-	-	+	-	**D**
NSM-21	1950 +/- 100	2	-	+	+	+	**B**
NSM-22	3540 +/- 95	2	-	+	+	+	**B**
NSM-23	4505 +/- 105	2	+	-	+	+	**A**
NSM-25	4435 +/- 110	2	-	-	+	+	**other**

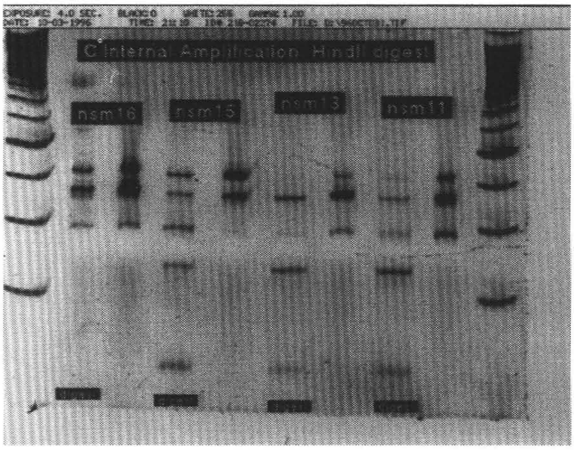

FIGURE 6. Identification of lineage C in Pyramid Lake individuals. Lanes one and ten contain size markers. Lanes three, five, seven, and nine contain the PCR product for the fragment containing the HincII marker for lineage C for individuals nsm-16, nsm-15, nsm-13, and nsm-11 respectively. Lanes two, four, six, and eight contain the same PCR product after exposure to the HincII restriction enzyme. Note that the fragments from individuals nsm-15, nsm-13, and nsm-11 all were cut by the HincII, while the fragment from individual nsm-16 was not. The lack of the HincII site is the marker for lineage C. Thus only nsm-16 belongs to lineage C.

FIGURE 7

Chronological Patterning of Lineage Distribution in Pyramid Lake Samples?

	A	B	C	D
Oldest	4505	5905	9515	4745
Youngest	1520	1360		2435

Ages of samples by lineage:

A: 1520, 1820, 3165, 4505 yBP

B: 1360, 3540, 5905 yBP

C: 9515 yBP

D: 2435, 2735, 4745, (and two undated, probably between 2000 and 5000 yBP)

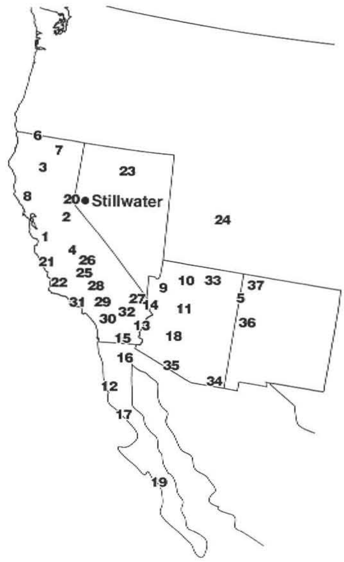

FIGURE 8. Modern tribes in western North America that have been tested for mtDNA lineage.

group	subgroup	sub-subgroup	number tribal members sampled	geographic group
Penutian	California Penutian		5 Costanoan (Ohlone)	California
			1 Miwok	California
			1 Maidu	California
			1 Wintun	California
			9 Yokuts	California
	Zuni		20 Zuni	Southwest
Hokan	Northern Hokan		1 Karok	California
			1 Achumawi	California
			3 Pomo	California
	Yuman		5 Walapai	Southwest
			5 Havasupai	Southwest
			5 Yavapai	Southwest
			8 Paipai	Baja
			19 Quechan	Southwest
			3 Mojave	Southwest
			16 Kamia (Tipai)	Baja
			3 Cocopa	Baja
			3 Kiliwa	Baja
			13 Cochimi	Baja
	Washo		28 Washo	Great Basin
	Central Coast Hokan		2 Salinan	California
	(Salinan-Seri)		9 Chumash	California
Uto-Aztecan	Northern Uto-Aztecan	Numic	98 N. Paiute/Shoshone	Great Basin
			1 Kawaiisu	Great Basin
			4 Tubatulabal	California
		Takic	4 Kitanemuk	not included
			1 Gabrielino	not included
			1 Luiseno	not included
			1 Juaneno	not included
			1 Fernandeno	not included
			1 Cahuilla	not included
		Hopi	4 Hopi	Southwest
	Southern Uto-Aztecan (Sonoran)		37 Pima	Southwest

FIGURE 9. Modern samples sorted by language groups and geographic regions for estimating and comparing the four mitochondrial lineages.

Group	Subgroup	N	%A	%B	%C	%D
Ancient	**Ancient Western Nevada**	19	10	36	5	53
	Fremont	30	0	83	10	7
Penutian	**California Penutian**	17	12	41	6	41
	Zuni	20	20	70	10	0
Hokan	**Northern Hokan**	5	0	40	20	40
	Yuman	80	4	63	34	0
	Washo	28	0	54	36	11
	Central Coast Hokan	11	46	18	9	27
Uto-Aztecan	**Northern Uto-Aztecan**	116	0	42	15	43
	Southern Uto-Aztecan	37	5	57	38	0

FIGURE 10. Frequencies of the four lineages in the northern language groups and in the ancient western Nevada indivisual.

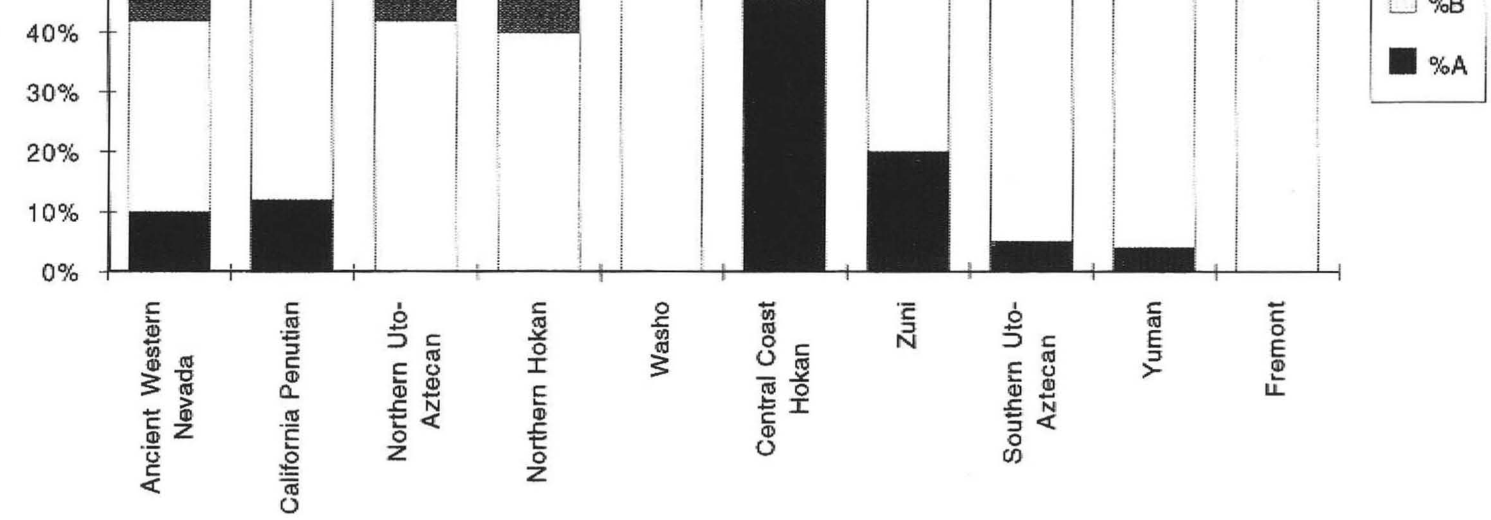

FIGURE 11. Lineage frequencies in ancient populations and modern language groups.

Geographic Group	N	%A	%B	%C	%D
Ancient Western Nevada	19	10	32	5	53
Fremont	30	0	83	10	7
California	37	18	35	11	35
Baja	43	2	67	30	0
Southwest	98	8	61	31	0
Great Basin	127	0	44	17	39

FIGURE 12. Comparison of the frequencies of the four lineages in the modern geographic groups to those in the ancient samples.

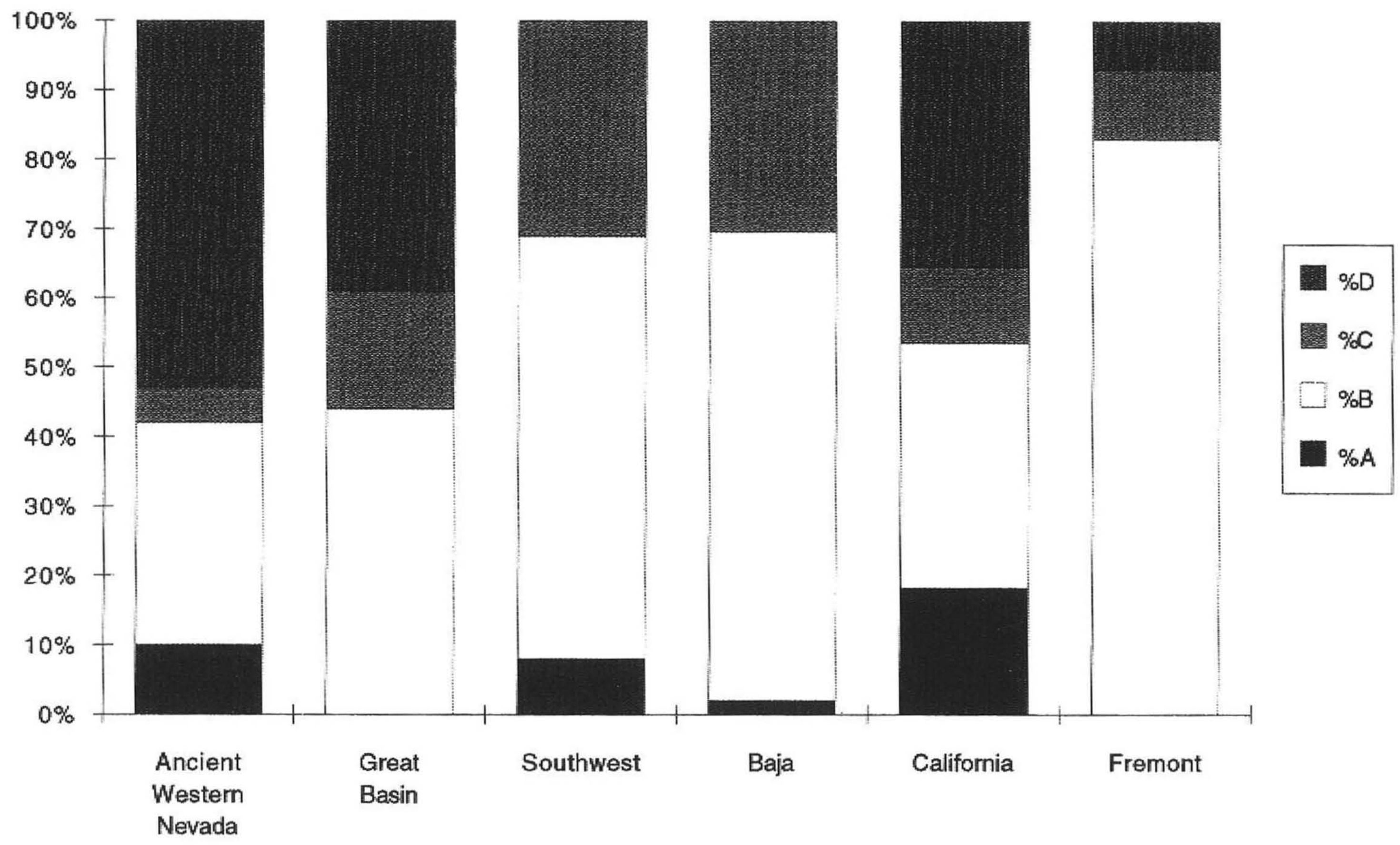

FIGURE 13. Lineage frequencies in ancient populations and modern geographic groups.

THE SPIRIT CAVE MUMMY
Coprolite Investigations

L. Kyle Napton

Despite its great antiquity, as revealed by the enlightening series of radiocarbon assays made by R. E. Taylor and his colleagues at the University of California, Riverside, the Spirit Cave individual is sufficiently well preserved that remains found with the partially mummified body can be identified with certainty as desiccated human excrement, often referred to as coprolites or paleofeces. This sample of human excrement is unequivocally associated with the mummified human remains from Spirit Cave, which are dated by radiocarbon: "A suite of seven dates on the mummy [are] all within 210 years of each other, with a mean date of 9,415 $\pm$ 25 years ago" (Tuohy and Dansie 1996:4-5). Radiocarbon assay of a sample of bone yielded a radiocarbon age of 9430 $\pm$ 60 years: 7480 B.C. (CAMS 12352/UCR 3260). Consequently, the coprolite samples are of unprecedented importance and interest to the archaeological, biological, biomedical and genetic scientific communities. At the present time the Spirit Cave coprolite samples are being studied prior to analysis. Therefore this article reports only our preliminary findings.

As many students of Great Basin prehistory are well aware, the study of coprolites has a long history in the Great Basin and elsewhere. In 1912, during his explorations at Lovelock Cave, L. L. Loud found examples of desiccated prehistoric human excrement in the unspeakably dusty depths of that remarkable site. Loud broke up a few coprolites, examined their contents, and observed: "The human excrement in the cave reveals, on the part of the ancient inhabitants, an incredibly coarse diet of seeds, hulls, and tough plant fibers. Some of the excrement was over 2 inches in diameter" (Loud 1929:35). Loud did not further investigate the Lovelock coprolites, although it would not have been surprising had he done so, since elsewhere (for example, Kentucky), B. H. Young (1910) had studied prehistoric human excrement, and there were other studies as well, notably by E. W. Jones (1910) involving Egyptian mummies. At about the same time, Warren (1911:198-

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208) reported his studies of coprolitic material from a prehistoric burial in England. (Coprolites produced by extinct ancient reptiles were identified and described as early as 1829 by W. Buckland [1829:233-236]).

In the late 1960s, motivated by E. O. Callen's research on coprolites from Mexico (Callen 1967:261-289; Callen and Cameron 1960:35-40), teams from the University of California, Berkeley, led by Robert Heizer and the writer, analyzed samples of coprolites obtained from various parts of Lovelock Cave (Heizer 1967:1-20). These, we assumed, were deposited at various times during human occupational or visitational events at the cave; this supposition was later verified by radiocarbon dates obtained by direct assay of the organic components of individual coprolites. Since coprolites consist of organic remains they are highly amenable to dating by radiocarbon. Thus, we were able to obtain a suite of dates ranging from a radiocarbon age of 145 ± 80 years (UCLA 1071-E) to 1830 ± 60 years (UCLA 1459-A) (Heizer and Napton 1970:39). The oldest reliable radiocarbon date obtained from organic materials (not from a coprolite) considered to pertain to human occupation of the cave is 4,690 ± 110 or 2,740 B.C. (I-3962) (Heizer and Napton 1970:39).

During the course of the University of California, Berkeley, coprolite investigations in the late 1960s we found, as Loud had deduced, that the prehistoric human inhabitants (or perhaps visitors) who contributed to the bevy of coprolites had a dietary regime that included fiber, seeds, fish, feathers (the last representing mudhens [*F. americana*]), and other wildfowl, as well as a variety of other edibles. The results of our studies are reported by Heizer (1967, 1969), Heizer and Napton (1969; 1970), D. S. Lin *et al.* (1978), Napton (1969, 1970), and others.

Even at such a remote date in the history of Great Basin archaeology (the late 1960s) we were aware that doubtless much more could be learned from coprolites beyond what might be referred to simply as "food-habits" studies. There is no question, of course, that information about what the inhabitants of the cave ate is important and interesting. By means of coprolites we have an opportunity rather unique in archaeology--an opportunity to ascertain what *individuals* ate, rather than trying to deduce such information from the collective faunal and floral assemblages that represent only a portion of the communal dietary signature (Fry 1985:127-154). Hence, while food habits or dietary regimes are of great interest, we thought that contained in the coprolites was other, rather more illusive information, and this we very much desired to obtain. Accordingly, Heizer enlisted the aid of many of his colleagues, including, at the University of California, Los Angeles, D. Y. Tubbs and R. Berger (1967:89-92), and at the University of California School of Medicine, San Francisco, F. Dunn and R. Watkins (1970:176-185), who analyzed some of the Lovelock coprolites for viable pathogens (none was found, perhaps fortunately). With D. S. Lin and W. E. Conner of the University of Oregon Department of Medicine, we were able to demonstrate the presence of steroids in the Lovelock coprolites. Some of the coprolites contained surprisingly high percentages of unmodified cholesterol--22 percent of the total neutral steroids--even after 2,000 years of opportunity for bacterial alteration.

Taking the research a step further, we considered (rather naively, as we later discovered) that we could obtain modern samples of dietary items characteristic of Lovelock coprolites and feed the "Lovelock diet" to human subjects. We soon learned, however, that the use of human subjects in such experiments is (to put it mildly) complex. The results of ingestion and biomedical studies of sample Lovelock diet items have been reported (Poovaiah *et al.* 1977:49-57). Analyses of the biomedical experiments revealed that many dietary items were poorly represented in the donated excrement, or in some cases not represented at all. This conclusion was reached years before by P. J. Watson (1974) in the course of her investigations of human coprolites from Salts Cave, Kentucky, and much earlier by Adolf Schmidt (1909) in Germany. (The history of coprolite research has been summarized ably by C. J. Reinhard and V. M. Bryant [1992]).

Other lines of inquiry initiated by the Berkeley team included study of different segments of coprolites in an effort to ascertain whether a given coprolite was homogenous, so to speak, or represented various food-intake events--meals, if you like--and whether coeval coprolites were more or less homogenous. Homogeneity might be interpreted as indicating communal food preparation, whereas highly varied constituents in contemporary coprolites might indicate that they were produced by individual hunters or nuclear families that visited the cave on their own--all of which, we hoped, would tell us something about prehistoric social organization and/or food sharing, seasonality of occupation, and other sociocultural factors pertaining to Lovelock Cave and the adjacent Humboldt Lakebed sites.

Today we find (not to our surprise) that there are many additional types of analyses that can be performed beyond the food-habits studies referred to above. For example, the study of DNA contained in ancient remains was of course unknown in the 1960s. As E. Hagelberg (1994) has pointed out, it was not until 1984 that Russell Higuchi, the late Alan Wilson and their associates at the University of California, Berkeley, succeeded in extracting DNA from the muscle tissue of a quagga, a now-extinct zebra-like species. The team cloned and sequenced two short segments of mitochondrial DNA (Higuchi et al. 1984:282-284). In 1985 Pääbo sampled twenty-three different Egyptian mummies and from one, a 2,400-year-old mummy of a child (radiocarbon age 2430 $\pm$ 120: 480 B. C.) was able to clone a 3.4 kilobase segment of DNA, demonstrating that original human DNA had survived, although it was damaged and contaminated, mostly from microbial contamination (Pääbo 1985:644-645). In 1994 Pääbo and colleagues extracted and sequenced uncontaminated mtDNA from the 5,000-year-old mummified human body found in the Alps--the so called Iceman (Spindler 1994). Other researchers have analyzed DNA from pre-Columbian Amerind populations (Richards *et al.* 1993:18-28; Stone *et al.* 1993:463-471) (See also Herrmann and Hummel [1994].)

Through DNA analysis we may be able to determine the gender of coprolite donors. The subject coprolite, referable to an individual of known sex, may prove valuable in this regard. We have hopes--however unrealistic they might be--of determining through DNA some idea of the number and sex of *individuals* that contributed to a given coprolite assemblage. This concept of course embodies many assumptions that lie beyond the present research. Yet it is germane to our discussion, because it is for precisely this reason--the research potential of this single, irreplaceable specimen from Spirit Cave--that we are developing analytical protocols most cautiously.

We are very grateful to Donald Tuohy and Amy Dansie for asking us to undertake study of the specimen; yet, as they are well aware, it is undesirable to rush into a hasty or perfunctory study of the gross food remains contained in the coprolite using routine protocols, accomplishing only this at the possible expense of failing to ascertain many other things of equal or greater importance--these we would refer to as being generally of biomedical interest. It will require the efforts of well-qualified medical personnel (as was the case with the steroid studies) to undertake investigation of several promising avenues of research. Analysis of the internal organs of the Spirit Cave individual in tandem with coprolite studies might reveal some interesting information, perhaps, for example, evidence of dietary deficiency, notably in the form of protein malnutrition, which frequently presents a disturbance of the intestinal flora as part of its pathogenesis (Smythe 1958).

In summary, we are adopting a very conservative stance regarding the Spirit Cave coprolitic material. Visual (external) examination of the specimen permits us to observe that portions of the Spirit Cave coprolite samples are composed of dense masses of diminutive bone, provisionally identified as representing at least two kinds of fish bone--one species probably the Lahontan chub (*Sipateles bicolor*) and seed fragments that appear to be bulrush (*Scirpus cf. acutus*). These items, which we interpret as food remains, are entirely consistent with the environmental context of the cave, located near the former shores of Stillwater Marsh.

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NATIVE AMERICAN DIET AND ENVIRONMENTAL CONTEXTS OF THE HOLOCENE REVEALED IN THE POLLEN OF HUMAN FECAL MATERIAL

Peter E. Wigand

INTRODUCTION

Pollen from human fecal material has provided a variety of data regarding past diets including their composition (Kelso 1970), their preparation (Napton and Kelso 1969), and the season and area of their collection (Heizer and Napton 1967; Fry 1977). In addition, fecal materials have yielded information regarding the paleoenvironmental contexts of native peoples at the time the foods were ingested (Wigand and Mehringer 1985). Human fecal analysis has been particularly important in the region of the Carson and Humboldt sinks of the Lahontan Basin, in west central Nevada. Most of this information covers Native American diets and their environmental contexts for the late Holocene, the middle and late Archaic periods of the archaeological record, or the last 3,000 years. The caves and shelters of the Lahontan Basin have been the primary source of these fecal materials.

The materials currently being analyzed include several fecal boluses recovered from the abdominal cavity of a partially mummified individual (AHUR 2064, 26CH1F) from Spirit Cave, Grimes Point promontory, dating to ~ 9,400 years, and two boluses from another partially mummified individual (AHUR 919/730, 26Pe3b, 196 burial 1) from Chimney Cave, located along Winnemucca Lake northeast of Reno, Nevada, dating to ~3,160 years. These analyses (as yet incomplete) will make up part of a comparison of early and late Archaic diets.

METHODS

When first viewed by investigators the fecal boluses had already been removed from the abdominal cavity. Although the body had been subjected to significant

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disturbance since its discovery, removal from Spirit Cave, and transport to the Nevada State Museum, the six boluses appeared to form a contiguous cluster that seemed to correspond to the order of the boluses in the intestinal tract. However, we could not determine which end of the cluster was first and which was last.

Samples of the fecal boluses were taken by sectioning the boluses parallel to the longest axis and removing a piece representing about 35 to 45 percent of the volume of the bolus. The subsamples were washed with triple distilled water to remove dust adhering to the surface, placed in a weighing pan, and then oven dried at 105° for at least forty-eight hours. The weighed specimens (see Table 1) were placed in 150 ml glass beakers, and 140 ml of normal saline (.9% sodium chloride) solution was added to the beakers. Normal saline solution was used so that intestinal parasites that migh be present in the feces would not be destroyed through the use of other disaggregating solutions. Samples were covered and left standing for about a week to disaggregate.

TABLE 1

Human Fecal Samples Extracted for Pollen and Macrofossil Analysis

AHUR 2064, 26CH1F, Spirit Cave, Grimes Point, Nevada. Age~9.4 ka				
Bolus #	Sample #	Pan&sample wt (gr)	Pan wt (gr)	Sample wt(gr)
Bolus A	1	3.215	.670	2.545
Bolus B	2	4.189	.677	3.512
Bolus C	3	3.371	.666	2.705
Bolus D	4	2.873	.664	2.209
Bolus E	5	3,128	.680	2.448
Bolus F	6	5.099	.661	4,438
AHUR 919/730, 26Pe3b, Chimney Cave, 196 burial 1, Winnemucca Lake, Nevada. Age ~3.16 ka				
Bolus #	Sample #	Pan&sample wt (gr)	Pan wt (gr)	Sample wt (gr)
Bolus A	7	7.429	.668	6,761
Bolus A	8	7.556	.675	6.881

Samples were then passed through a 100-mesh screen. Residue on the screen was split into two equal portions. One was retained at the Desert Research Institute for analysis and the other was sent to P. J. Mehringer, Jr., at Washington State University for other analyses. Fish scales and bones, and occasional seeds were noted in the screen residue. Of the material that passed through the screen, about .25 cc was removed from each sample with sterile pipets and placed in labeled vials for future parasite analysis. Four *Lycopodium* tracer tablets (batch #710961; 13,911±2.2 percent per tablet) were added to the residues of each of the eight samples as a check on the relative abundance of pollen during analysis. A few drops of 5 percent HCl were added to each sample to dissolve the tablets. Samples were centrifuged and decanted. They were transferred to 40-ml test tubes and treated with HF to remove inorganic materials (primarily silicates) and left to stand overnight. Additional treatment with HF the following day and distilled water rinses were followed by a 37 percent HCl treatment and distilled water washes to remove silica gels generated during the HF treatment. The samples were then left in a 20 percent HNO_3 solution for ten minutes to oxidize organic materials. Following two distilled water washes and another HCl treatment to remove residues generated during the HNO_3 treatment the samples were prepared for the acetolysis process. Samples were first dried using a glacial acetic acid treatment. They were then treated with a solution consisting of nine parts acetic anhydride and one part H_2SO_4. This procedure removed more of the organic material, including any residual cytoplasm in the pollen grain. Neutralization of this process using glacial acetic acid was followed with two distilled water washes to remove residues. Treatment of the samples with 5 percent KOH in order to remove soluble carbon was followed by additional distilled water washes to neutralize the procedure and remove residues. Finally, drying with alcohols, followed by staining (safranin O) of the pollen, the addition of a mounting medium (silicone oil), and evaporation of the alcohols from the sample on a hot plate completed the process. One half of all eight pollen samples was sent to Dr. Mehringer at Washington State University to conduct parallel counts of the pollen.

Pollen samples were mounted on glass slides and pollen was counted in parallel rows across the slide. Because pollen was sparse at least two slides or more were counted. Raw counts were converted to percentages of total pollen and plotted.

RESULTS

The preliminary microfossil counts are presented below (tables 2, 3 and 4).

TABLE 2

Spirit Cave, NV.: Preliminary Raw Counts of the Microfossils from the Fecal Material.

Microfossil Type	Bolus A	Bolus B	Bolus C	Bolus D	Bolus E	Bolus F
Lycopodium intro.	55,644	55,644	55,644	55,644	55,644	55,644
Lycopodium recvrd.	393	1,693	1,188	561	405	895
Pollen sum	20	56	42	164	48	107
Pollen total	20	71	50	187	56	125
Pinus undifferentiated	0	7	4	12	7	30
Pinus 2/3	2	1	0	5	5	9
Pinus 1/3	2	7	3	12	5	45
Pinus hap	2	2	2	2	1	2
Pinus dip	1	1	0	6	2	12
Juniperus	1	1	0	2	2	4
Pinus total	5	13	7	27	15	65

Cercocarpos	0	1	0	1	0	0
Alnus	0	0	0	1	0	0
Artemisia	1	6	4	18	6	2
Ambrosia-type	1	0	0	2	3	2
Tubuliflorae-type	0	8	9	32	6	6
Liguliflorae-type	0	0	0	1	0	0
Sarcobatus	0	0	2	10	3	2
Chenopodiineae	6	17	15	44	9	19
Poaceae	1	4	3	7	2	3
Lamiaceae	1	2	0	2	0	0
Brassicaceae	1	2	0	2	1	0
Phlox	0	0	0	0	0	1
Sium-type	0	0	0	0	0	0
Apiaceae	2	1	2	6	0	0
Onagraceae	0	1	0	5	0	1
Convolvulaceae	0	0	0	0	0	1
Amsinckia	0	0	0	0	0	0
Crossamataceae-type	1	0	0	2	1	0
Eriogonum	0	0	0	2	0	1
Cyperaceae	0	2	4	3	2	6
Typha latifolia	0	6	1	10	2	8
Unknown Pollen	0	1	0	5	2	1
Indeterminable Pollen	0	6	3	5	2	3
Sporomiella (fungus)	0	0	0	3	0	2
Undifferentiated Spore	0	0	0	0	0	1
Botryococcos (algae)	1	1	0	1	0	3
Spirogyra (algae)	0	0	0	0	0	0

TABLE 3

Spirit Cave, Nevada: Relative Percentages of the Pollen Recovered from the Fecal Material.

Pollen Type	Bolus A	Bolus B	Bolus C	Bolus D	Bolus E	Bolus F
Pinus	25.00	23.21	16.67	16.63	31.25	60.75
Juniperus	6.67	2.33	.00	1.46	6.06	9.52
Cercocarpos	.00	2.33	.00	.73	.00	.00
Alnus	.00	.00	.00	.73	.00	.00
Artemisia	6.67	13.95	11.43	13.14	18.18	4.76
Ambrosia-type	6.67	.00	.00	1.46	9.09	4.76
Tubuliflorae-type	.00	18.60	25.71	23.36	18.18	14.29
Liguliflorae-type	.00	.00	.00	.73	.00	.00
Sarcobatus	.00	.00	5.71	7.30	9.09	4.76

Chenopodiineae	40.00	39.53	42.86	32.12	27.27	45.24
Poaceae	6.67	9.30	8.57	5.11	6.06	7.14
Lamiaceae	6.67	4.65	.00	1.46	.00	.00
Brassicaceae	6.67	4.65	.00	1.46	3.03	.00
Phlox	.00	.00	.00	.00	.00	2.38
Sium-type	.00	.00	.00	.00	.00	.00
Apiaceae	13.33	2.33	5.71	4.38	.00	.00
Onagraceae	.00	2.33	.00	3.65	.00	2.38
Convolvulaceae	.00	.00	.00	.00	.00	2.38
Crossamataceae	6.67	.00	.00	1.46	3.03	.00
Eriogonum	.00	.00	.00	1.46	.00	2.38
Cyperaceae	.00	2.82	8.00	1.60	3.57	4.80
Typha latifolia	.00	8.45	2.00	5.34	3.57	6.40
Unknown pollen	.00	1.41	.00	2.67	3.57	.80
Indeterminable pollen	.00	8.45	6.00	2.67	3.57	2.40

Raw counts from the Spirit Cave fecal material range from 20 to 164 terrestrial pollen grains, and those from Chimney Cave range from 197 to 198. The raw counts above consist only of the counts that have been completed at the Desert Research Institute and do not include the counts that are being conducted at Washington State University. Those counts will eventually be combined with the ones above and should reduce the relative percentage error that exists because of the small sample size, especially for some of the Spirit Cave samples. Pollen abundance in the Chimney Cave samples is much greater than that in the Spirit Cave samples. Pine (*Pinus*), sagebrush (*Artemisia*), saltbushes (Chenopodiineae), and parsley family (Apiaceae) pollen predominate the Spirit Cave record. The Chimney Cave record appears quite different upon initial analysis with pine, Tubuliflorae-type (aster), saltbush, grass (Poaceae) and a particular parsley family (*Berula/Sium*-type) pollen being abundant.

TABLE 4

Chimney Cave, Winnemucca Lake, Nevada: Preliminary Raw Counts of Microfossils from the Fecal Material and Relative Percentages of the Pollen Recovered from the Fecal Material.

	Raw Counts		Relative Percentages	
Microfossil type	Bolus A	Bolus B	Bolus A	Bolus B
Lycopodium Intro.	55,644	55,644		
Lycopodium Recvrd.	273	1,062		
Pollen sum	198	197		
Pollen total	205	203		

Pinus undifferentiated	14	14		
Pinus 2/3	1	6		
Pinus 1/3	2	16		
Pinus hap	0	0		
Pinus dip	3	6		
Pinus total	18	29	9.24	14.86
Juniperus	2	1	1.01	.51
Cercocarpos	0	0	.00	.00
Alnus	0	0	.00	.00
Artemisia	4	12	2.03	7.14
Ambrosia-type	3	1	1.52	.51
Tubuliflorae-type	13	25	6.59	14.88
Liguliflorae-type	0	0	.00	.00
Sarcobatus	4	13	2.03	7.74
Chenopodiineae	8	31	4.05	18.45
Poaceae	21	17	10.64	10.12
Lamiaceae	0	0	.00	.00
Brassicaceae	0	1	.00	.51
Phlox	0	0	.00	.00
Berula/Sium-type	123	65	62.33	38.69
Apiaceae	0	0	.00	.00
Onagraceae	1	0	.51	.00
Convolvulaceae	0	0	.00	.00
Amsinckia	0	1	.00	.51
Crossamataceae	0	1	.00	.51
Eriogonum	1	0	.51	.00
Cyperaceae	0	1	.00	.49
Typha latifolia	1	0	.49	.00
Unknown pollen	2	1	.97	.49
Indeterminable pollen	4	4	1.95	1.97
Sporomiella	0	1		
Undifferentiated spore	0	0		
Botryococcus	0	0		
Spirogyra	0	0		

However, when the *Berula/Sium*-type pollen is removed the resulting percentages are similar except for the higher occurrence of Tubuliflorae pollen (possibly rabbitbrush pollen).

DISCUSSION AND CONCLUSIONS

The low pollen abundance of the Spirit Cave fecal materials suggests that the pollen that is present is background pollen (the pollen that blows around the landscape throughout the year and represents the accumulation of the current and often previous blooming seasons). It was incorporated into the fecal boluses because it (1) may have been lightly coating something that was eaten by the individual, (2) may have been inside something that was eaten (such as a fish), or (3) may have become incorporated into food during processing. In general, the airfall background pollen and fish remains in the fecal boluses from the Spirit Cave individual evidence the presence of both nearby marsh (cattail [*Typha*] and sedge [Cyperaceae pollen]), and desert shrub (comprising both shadscale [chenoams] and greasewood [*Sarcobatus*]) communities (Tables 3 and 4, Figure 1).

The high incidence of *Berula/Sium*-type (water parsnip) pollen in the fecal boluses from the Chimney Cave individual suggests that this pollen may actually have been a component of one of the plant species that was eaten. The values are

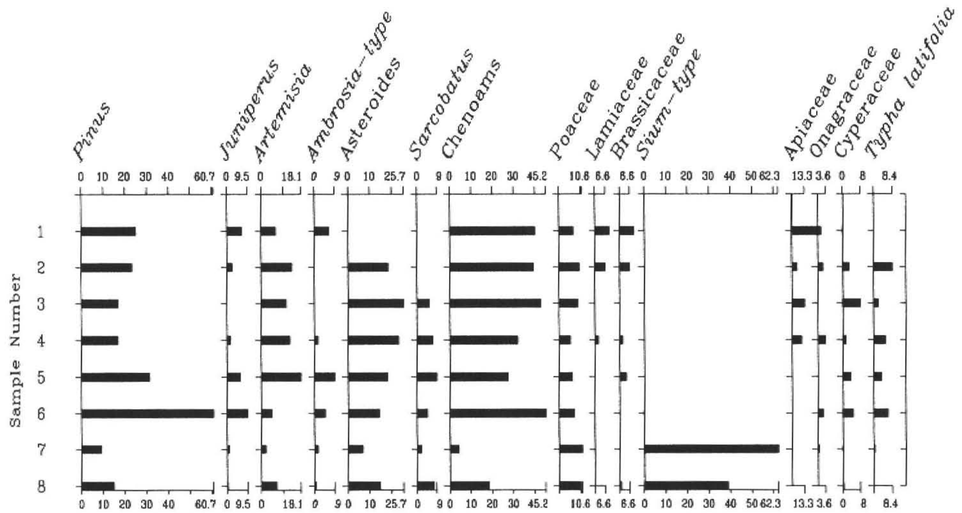

FIGURE 1. Relative percentage diagram of major pollen types from paleofecal material from Spirit Cave and a Winnemucca Lake cave.

not high enough to suggest that the flowers were intentionally eaten, *e.g.*, as in the case of the Typha pollen at Hidden Cave (Mehringer and Wigand 1985), but they are high enough to suggest that they do not simply represent background pollen. The *Berula/Sium*-type (members of the Apiaceae or parsley family) pollen comes from a plant that has a root that may have been eaten. Members of the Apiaceae family bloom briefly in the spring, form seeds quickly, dry up, and are usually not evident the rest of the year. The plant would have been collected during the blooming season when it was easily detectable, and was probably dried whole. Pollen from the flowers may simply have become attached to the root during the drying process because plants may have been stacked upon one another, and in that way the pollen could have been incorporated into food during cooking.

Although the same pollen types appear in the Spirit Cave fecal boluses as in those from Chimney Cave, there is considerable variation in the relative percentages from one bolus to the next (Figure 1). In part this may be due to the difference in the pollen count size. Only two of the pollen counts from Spirit Cave boluses exceed 100 grains. The other four boluses have counts that are fewer than 60 grains. Statistically the raw counts of the individual pollen types (and their relative percentages) will vary considerably until the total count of the sample begins to approach 250 to 300 grains (Maher 1972). Only the total pollen count of Bolus D (Sample 4) is large enough that the actual values of the relative percentages of the various pollen types in the sample are probably approached. It is this sample that can be used for comparisons with pollen samples from other contexts.

Because it seems that the pollen from the Spirit Cave fecal boluses was derived primarily from airfall pollen it was decided that a comparison with other records of airfall pollen in the area would prove useful. The closest record is one that was obtained on the same promontory (Grimes Point) from Hidden Cave during the late 1970s (Wigand and Mehringer 1985). A square-chord distance comparison (Table 5; Overpeck *et al.* 1985) of the pollen from the fecal boluses from Spirit Cave with the pollen obtained from Hidden Cave stratigraphic units ranging in age from about 12,000 to 8,000 years reveals that the best comparison is with a stratigraphic unit that was assigned an age of from 9,000 to 9,500 years by J. O. Davis (1985). A critical value of .10 is used as the break point between similar and dissimilar plant assemblages based upon the pollen content of the sample (Overpeck *et al.* 1985). If the critical value is greater than .10 the plant communities are dissimilar, if it is less than .10 they are similar. A comparison of stratigraphic units IXa, IXb, X and XIc indicates that strata IXa, IXb and X are similar to each other, while stratum XIc is dissimilar to each of the other three strata. The Spirit Cave fecal bolus pollen is dissimilar to the pollen found in Hidden Cave stratum XIc, but shows some similarity to the pollen from strata X, IXa and especially to Stratum IXb. The similarity is strongest to the fecal bolus with the largest pollen count, Bolus D (Sample 4). This may be because that bolus has the best population estimates of the component pollen types because of its larger total pollen count.

Table 5. Matrix of the square chord distance comparison of the Spirit Cave fecal materials and the pollen from Hidden Cave strata XIC-IXB

	Unit XIC	Unit X	Unit IXA	Unit IXB	Bolus A	Bolus B	Bolus C	Bolus D	Bolus E	Bolus F
Unit XIC	.000000	.258974	.486591	.291448	.413558	.477607	.496220	.369680	.270900	.404944
Unit X		.000000	.081542	.077544	.399419	.254855	.122185	.074450	.135581	.376700
Unit IXA			.000000	.076810	.464258	.178371	.039446	.066951	.230739	.434636
Unit IXB				.000000	.330702	.139517	.091915	.052884	.119341	.342293

The bolus showing the least similarity is Bolus A (Sample 1), the sample with the smallest pollen count and thus the poorest estimates of the proportions of the component pollen types (Table 5).

Of additional value in this correlation is the occurrence of evening-primrose (Onagraceae) pollen (Figure 1). Onagraceae pollen occurs in three of the six fecal boluses from Spirit Cave. It also occurs in the pollen record from Hidden Cave. However, in only two places, (1) the top of stratum XII and (2) the bottom of stratum IX, does its percentages approach those found in the Spirit Cave boluses (Wigand and Mehringer 1985, figure 36). The relatively greater abundance of Onagraceae pollen at these times may relate to eolian activity. Today, evening primrose commonly grows in the eolian dunes of the Carson Sink. It blooms in the spring, dries up, and disappears by summer. It survives only as long as there is still some moisture available in the dunes. The Onagraceae pollen in the Hidden Cave strata and in the Spirit Cave fecal boluses may evidence periods of dune activity related to fluctuating lake levels in the Carson Sink. In southern Nevada the period between 9,500 and 9,000 years (the age assigned to the Hidden Cave strata and the Spirit Cave fecal boluses) seems to correspond to incursions of monsoonal rains during the summer (Quade 1986; Quade and Pratt 1989). Such incursions could result in fluctuating lakes and subsequent eolian activity.

The persistent occurrence of both cattail (*Typha*) and sedge (Cyperaceae) pollen, except in the fecal bolus with the lowest pollen counts (the pollen counts were probably too small for the presence of these two pollen types to be detected in these samples) evidences the presence of marsh in the area. As with the other pollen types that occur in the fecal boluses the pollen was probably ingested with food that was eaten but was not itself intentionally eaten.

As indicated in the article by B. Sunday Eiselt (this issue), fish formed a major component of the fecal boluses from Spirit Cave. Some of the pollen that appear in the pollen record of the Spirit Cave fecal boluses may have been ingested by the fish that were in turn eaten during the last meal of the Spirit Cave individual (Mehringer, personal communication).

Except for Bolus F (Sample 6) the occurrence of pine (*Pinus*) pollen is within expected ranges for mean annual pollen rain. Its abundance in Bolus F (Sample 6) probably reflects its abundance on something that was ingested during the last meal of the Spirit Cave individual. The pollen could have been in the stomach of one of the fish that were eaten as well. Its abundance and the occasional occurrence of clumps of pine pollen might suggest that pine was in bloom when the meal was eaten or that the food had been collected. This would suggest a spring or at the very latest an early summer date for the death of the Spirit Cave man. However, the data are currently not robust enough to confirm such a suggestion.

With regard to the pollen from the Chimney Cave fecal boluses, if the great abundance of *Berula/Sium*-type pollen is taken into account, proportions of other pollen types approach those found in the Spirit Cave fecal materials. This suggests that, with the exception of the *Berula/Sium*type pollen, the pollen found in these fecal boluses also reflects primarily airfall background pollen.

Comparisons of the Spirit Cave fecal material with other late Archaic (*i.e.*, Lovelock Period) human fecal material are difficult to make. Six boluses from a single individual representing a single meal are insufficient to formulate generalities concerning early Archaic diet. The meal probably represents a seasonally (late winter or spring) biased food selection. In addition, its composition may have been influenced by the terrible condition of the Spirit Cave individual's teeth. It is clear, however, that, as in late Archaic times, although desert shrub communities were well established, marshes were present and resources harvested from them were an important component of the diet.

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FISH REMAINS FROM THE SPIRIT CAVE PALEOFECAL MATERIAL
9,400 Year Old Evidence for Great Basin Utilization of Small Fishes

B. Sunday Eiselt

INTRODUCTION

Paleofecal Studies

The analysis of human paleofecal material[1] is an exercise in dietary reconstruction rarely available to most researchers interested in human subsistence patterns. It provides direct evidence of the types of plants and animals eaten by people in the past, and reveals the interaction of humans with their environments through the accidental or purposeful ingestion of seasonal pollen, trace minerals, insects, and other chemicals. Paleofecal research also leads to the assessment of the physiological health of past individuals through the analysis of parasites, bacteria, and viruses. It should be noted, however, that paleofecal analysis provides an understanding of these conditions of past human lives at the individual level only. As such, this type of research should be articulated with paleoethnobiological studies of nonfecal archaeological deposits and paleoenvironmental reconstructions.

The analysis of human paleofecal material has a history beginning in the late 1800s. Harshberger (1896), commenting on the potential value of paleofecal analysis, was the first to suggest that seeds and bone found in prehistoric feces

Special thanks go to Gary Vinyard, professor of Biology and Ichthyology, University of Nevada, Reno for assisting in the identification of fish otoliths and eye lenses, and Dr. Peter Wigand for providing laboratory space at the Desert Research Institute Paleobotany Laboratory. This paper has benefited greatly from the constructive commentary of Catherine Fowler, Don Fowler, Gary Haynes, Peter Wigand and Stephanie Livingston.

could offer clues to ancient diet. According to Reinhard and Bryant (1992), paleofecal analysis has gone through three historical phases. The first began in 1829, when the term *coprolite* was coined and ended in the 1960s with the standardization of analytical techniques by E. O. Callen.[2] Callen, being almost single-handedly responsible for the next phase, extending from the 1960s till his death in 1970, brought about the standardization of techniques and initiated specialized studies of pollen, parasites, and macrofossils. It was during this time that widespread interest in the analysis of human fecal matter began. From the 1970s to the present, paleofecal studies are characterized by a refinement in techniques and broader applications of analysis to archaeological questions (Reinhard and Bryant 1992:246). Today, researchers continue to push the boundaries of fecal analysis by extracting and analyzing levels of testosterone and estradiol in modern and prehistoric feces in order to address issues of prehistoric diet related to biological sex (Sobolik *et al.* 1996).

There are several advantages and limitations to paleofecal research related to preservation and the individual nature of the data recovered. Gasser's (1982) work showed that many fragile items susceptible to decomposition in an open site are better preserved in fecal material simply because of the context of preservation. Miksecek (1987) conversely showed that differences between paleofecal contents and bulk sample data may also relate to increased difficulty in identifying damaged food fragments that have passed through a human digestive tract. Miksecek (1987) also showed the necessity of analyzing fecal and bulk samples in tandem since many items not ingested will become discarded as the result of food preparation and consumption. The combined sets of data are more effective when contrasted, revealing additional aspects of prehistoric diet not readily apparent when each is analyzed separately.

Regarding recovery, fecal matter may be difficult to distinguish during excavations. Decomposed fecal pieces may appear merely as clusters of organic material, and can be destroyed or missed while digging. If they are recovered decomposed, their identity as fecal matter is ambiguous. Research documenting the characteristics and structure of fecal organic assemblages therefore should be pursued in a continued effort to separate fecal (individual) from non-fecal (aggregate) data. Finally, fecal data, because it represents individual meals consumed in specific seasons, may provide insights into the seasonality of past human behavior. Storage of foods gathered in one season and ingested in another can be a source of interpretative error, but determining the harvest season of ingested foods is possible and can be helpful for economic analyses relating to seasonal exploitation of resources.

Fish Bones and Fecal Matter in the Great Basin.

The interaction of humans with wetland environments in the high desert of the Great Basin has been a topic of some interest in regional anthropological research for many years. Loud and Harrington (1929) first suggested the importance of marshes to the people represented by the Lovelock Culture. Later work (Heizer and Kreiger 1956; Heizer and Napton 1970) served to raise general questions about the utilization of prehistoric Great Basin marsh resources in relation to Jennings's (1957; 1964) desert culture concept. Bedwell's (1973) western pluvial lakes tradition (WPLT) hypothesis likewise implies that early Great Basin cultures focused on lacustrine and grassland resources. This in turn suggests we should find faunal evidence supporting marsh and grassland exploitation in early archaeological contexts.

Fish remains have been reported from several central and western Great Basin archaeological sites including Hidden, Lovelock, and Falcon Hill caves, the Stillwater Marsh in western Nevada, and the Karlo Site in California (Follett 1967, 1970, 1974, 1977, 1980; Greenspan 1988; Raymond and Sobel 1990). One way, therefore, to assess the contribution of wetland resources to prehistoric diets is through the analysis of fish bones from these and other such sites. Fish bones found in paleofecal material, in particular, can offer direct evidence of aquatic resource utilization in the past.

These anthropologically oriented questions regarding lacustrine resource utilization have led to new and innovative research projects attempting to find ways of distinguishing cultural from natural fish bone assemblages in the Great Basin (Butler 1996; Greenspan and Raymond 1996) and elsewhere (Stewart and Gifford-Gonzalez 1994; Butler 1993; Wim Van Neer and Muniz 1992; Stewart 1991). Although these studies have been effective at finding differences between natural and cultural assemblages, considerably less attention has been given to documenting the range of variation within and between different types of culturally produced collections. In this article, fish remains found in paleofecal material from Spirit Cave, western Nevada, and those recovered from the Peninsula Site, an open-air archaeological site in Warner Valley, southeastern Oregon, will be compared in order to document the range of variability in fish assemblage structure possibly attributable to different paleoenvironments, capture strategies, and taphonomic histories. The Spirit Cave paleofecal materials represent direct evidence of the effects that human procurement and consumption have on fish bone during processing and digestion. The open-air archaeological site has been interpreted as representing cultural discard patterns related to fish processing, but not ingestion (Eiselt, in preparation).

A comparative collection of fishes captured from a stream in Murrer's Meadow, northeastern California, provides the basis for making taxonomic identifications and allows for the assessment of the relative live sizes of the fishes represented in the archaeological materials. It also enables an estimate of the hydrological environment from which the archaeological specimens were procured. With the Murrer's Meadow fishes, an attempt was made to replicate indigenous mass-capture strategies in order to understand species selection and economic issues.

MATERIALS

Spirit Cave

Six boli recovered from the abdominal cavity of the Spirit Cave mummy were processed for fish bone prior to extraction of pollen (see Wigand, this issue). An additional two samples, taken from sediments above the interred individual, were inspected using a 10-micron dissecting scope, but no bones were observed. Bone from the fecal matter was separated as light fraction organic material during the rendering and cleaning of the boli prior to pollen extraction. This material was further rinsed, dried, then screened through 24-, 42-, and 60-mesh U.S.A. standard sieve brass screens for identification. The contents of the 24-mesh screens were identified, and the remaining finer screen contents were scanned for identifiable elements. Two of the six samples from the 24-mesh screen contained high amounts of bone. Because of time constraints only 50 percent of each of these was analyzed. The 24-mesh screen contents for the remaining four samples were identified completely. Identifications were made with the aid of a 10-micron dissecting scope. Taxon, element, side, burning, and degree of fragmentation (represented as a percentage of the whole) were noted during analysis.

Of 697 elements identified to taxon from all six boli of the paleofecal material, 640 or 91.82 percent of the assemblage was identified to indeterminate cyprinidae, 3.73 percent of the assemblage to tui-chub, 0.43 percent to an indeterminate redside/dace category, and 4.01 percent of the assemblage was identified as suckers (Table 1, Appendix 1). All of the Spirit Cave fish elements are extremely small, which reduces the ability to distinguish between larger and smaller minnows, thereby increasing the indeterminant cyprinid count.

TABLE 1

Spirit Cave Paleofecal Material, Number of Identified Specimens

Taxon	Count	Percentage
Cyprinidae		
Gila sp.	26	3.73
cf. *Rhinichthys/Richardsonius* sp.	3	0.43
Indeterminant	640	91.82
Catostomidae		
Catostomus sp.	28	4.01
Total NISP	697	100

In addition to the fish bone specimens, fish eye lenses, otoliths, and possible animal fibers also were noted. These specimens are not included in the Number of

Identified Specimens (NISP) count because they cannot be referred to at the family level, but are mentioned here because they clearly represent ingested fishes. Fish eye lenses are characterized by their density and hardness, spherical shape, amber color, and translucence when light is passed through them from below. A slight pucker can occur on the surface possibly related to digestive or post-depositional effects on the lenses, and these were noted on the paleofecal specimens. The upper left quadrant of Figure 1 shows an example of a fish lens.

FIGURE 1. Spirit Cave fish bone. Fish eye lens is present in upper left quadrant, Scale bar = 1 cm intervals

Twenty-one otoliths were identified. Otoliths are characteristically flat, disc-shaped calcium-carbonate nodules with visible ridges in the shape of rings. Possible animal fibers were also present in the fecal matter (see Appendix 1), the identification of which was made by a visual comparison with modern sinew samples.

The Peninsula Site

Results of the paleofecal analysis were compared to 4,442 identified fish bone elements recovered from the Peninsula Site (35LK2579), an open-air village site in southeastern Oregon, for the purposes of addressing questions of differential bone survivorship, species selection, and paleohydrological interpretations. The Peninsula Site is located along the eastern shore of Hart Lake in Warner Valley, southeastern Oregon (Figure 2).

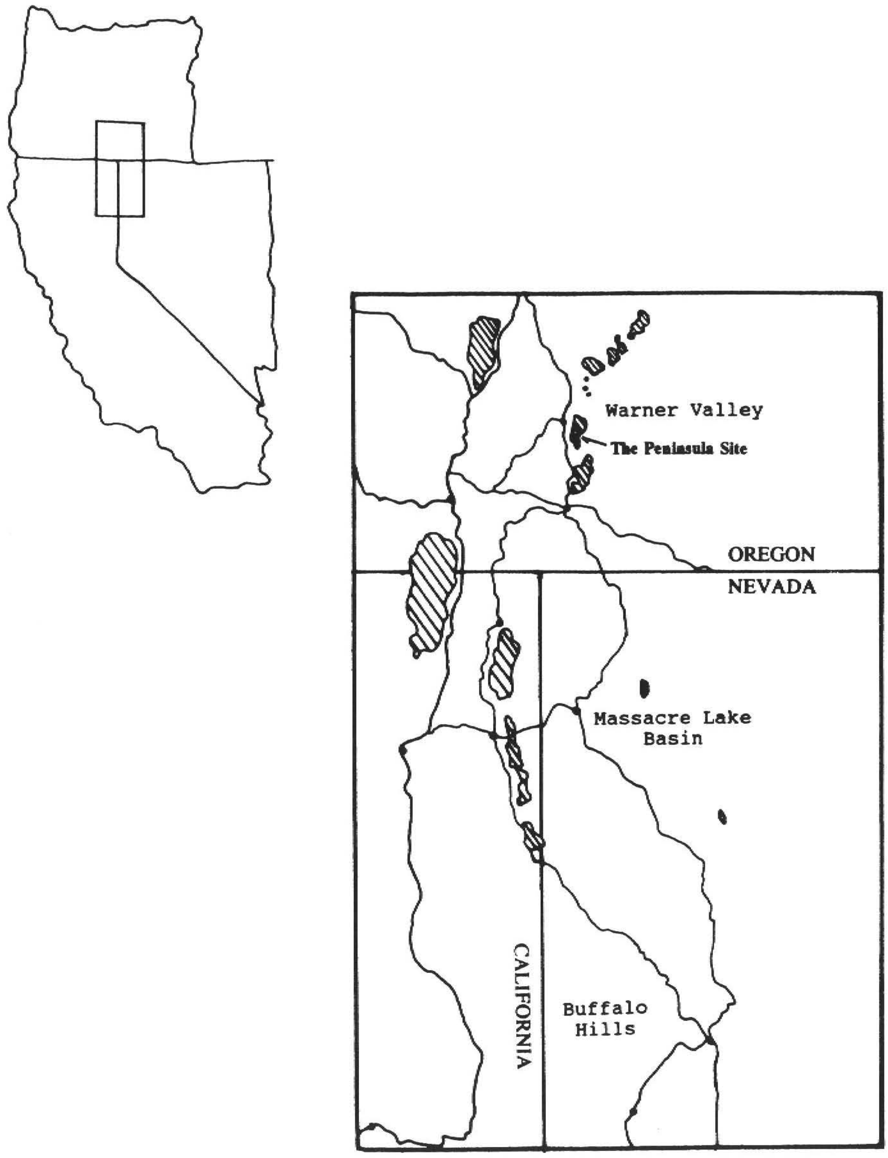

FIGURE 2. The Peninsula Site, Warner Valley southeastern Oregon

The site is interpreted as having been a Late Archaic, possible winter village site dating to between 700 and 400 B.P. This interpretation is based on a valley-bottom location, the presence of numerous and large depression features, and associated domestic debris including evidence of intense and prolonged occupation. Artifacts found on the site include Rosespring, Desert Side Notch, and Elko projectile points; groundstone mortars, metates, and manos; possible net sinkers;

tabular basalt knives; stone balls; bone beads and pendants; and basketry (Young 1993).

Several depressions located at the site were excavated by the University of Nevada, Reno, in cooperation with the Lakeview District Bureau of Land Management for several sessions during the summers of 1990, 1995, and 1996. One depression contained a well-preserved burned structure in which earthen covering, matting layers, wood structure elements, and domestic debris were recovered *in situ*. Spatial patterning of objects recovered from the floor reveal activity areas related to lithic production, fish processing or consumption, hide working, and bone ornament production (Eiselt, in preparation). To achieve this level of spatial integrity, the structure was probably buried rapidly after abandonment and burning.

The Peninsula Site fish elements were recovered from cultural fill above depression floors, on depression floors, and in trash midden deposits associated with depressions. These fish bones are interpreted as culturally derived and not natural accumulations based on the integrity and type of the context in which they were found (Moore 1995). Burned elements were present, and these were located on the depression floor that was overlain by the burned structure (Figure 3). Other burned elements were found in artifact-rich middens located adjacent to depressions. The Peninsula Site fish bone material is therefore thought to be the result of indigenous discard patterns.

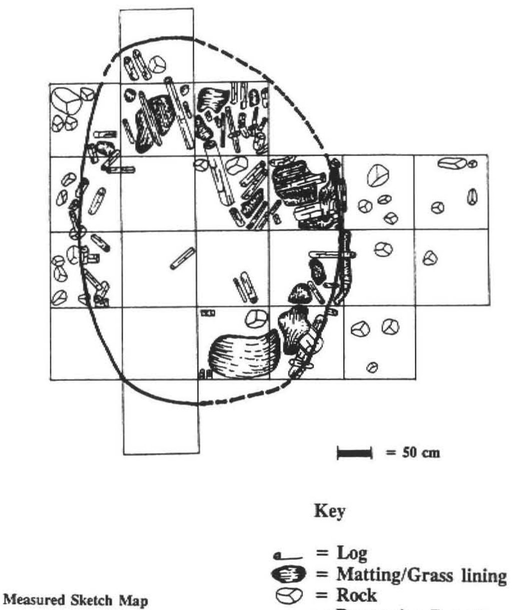

FIGURE 3. Depression Feature 304. Pit house feature showing structure element arrangement and plan view definition

Recovery of fish bone from the Peninsula Site was achieved using 1/8-inch mesh screen. Block soil samples were collected in the field and these were processed using 60- mesh (.250 mm) dry screening techniques and a Lux magnifying lamp in the laboratory. The use of this smaller mesh did not produce appreciably better recovery rates for identifiable fish bone, although more unidentifiable small bone fragments were collected.

Of the 7,784 fish bones recovered from the Peninsula Site, 4,442 were identifiable to element and 1,850 were identifiable to taxon. In the Peninsula Site assemblage, cyprinid bones were large enough to discount the possibility of confusing tui-chub with dace or redsides, but dental formulas from Peninsula Site pharyngeals were checked in the case of smaller specimens. Of the total assemblage 5,934 (76.2 percent) specimens were identified to an indeterminant fish category, 1,493 (19.1 percent) were identified as tui-chub (*Gila* sp.), and 357 (4.5 percent) were identified as sucker (*Catostomus* sp.) (Table 2).

TABLE 2

Peninsula Site Fish Material, Number of Identified Specimens

Taxon	Count	Percentage
Unidentifiable Fish	5934	76.2
Cyprinidae		
Gila sp.	1493	19.1
cf. *Rhinichthys/Richardsonius* sp.	0	0.0
Catostomidae		
Catostomus sp.	357	4.5
Total NISP	7784	100

Murrer's Meadow Fishes

Fish captured from Willow Creek near Eagle Lake, Lassen County, California were used during the zooarchaeological analysis of the Spirit Cave material as a comparative collection to make distinctions between tui-chub (*Gila* sp.), sucker (*Catostomus* sp.), redsides (*Richardsonius* sp.), and speckled dace (*Rhinichthys* sp.). The collection was also used to assess relative sizes of fossil specimens recovered from the Spirit Cave boli. Murrer's Meadow is located approximately 100 miles northwest of Spirit Cave at an elevation of 5,000 feet. Studies conducted by Moyle *et al.* (1991:268) show that Willow Creek is characterized by high conductivity, high water hardness, and total alkalinity. Summer water temperatures range near 21 degrees Celsius. Fish were collected from Willow Creek as it flows through Murrer's Meadow to Susan River. Although the area sits near a major transition zone between Great Basin, Cascade Range and Sierra Nevada biomes, Willow Creek contains the same fish species as commonly found throughout the Great Basin (Table 3).

At extremely small size ranges, tui-chub, redsides, and dace can be separated only by using the dental formula from the pharyngeal bone. Dace and redside have two rows of teeth resulting in a 2442 or 1441 dental formula, tui-chub have only one row. Although these cyprinids are difficult to distinguish, suckers are easily separated using distinctive morphological characteristics of elements related to their movements, habitat, and feeding preferences. Suckers are bottom-dwelling fishes that forage from rocks and floor debris. Sucker bone morphology can be characterized as dense, curvate, and extremely rugulate, serving to increase bone tensile strength. In addition, since suckers are bottom feeders, their mouths are positioned more ventrally on the fish head. This causes distinctive osteological features in the bones related to feeding. Sucker pharyngeals likewise reflect their trophic status since teeth are rake-like, acting as sieves to catch vegetal debris. In contrast, minnows feed in the water column primarily on drift consisting of invertebrates and zooplankton. Pharyngeals of these taxa contain graduated and curvate teeth ending in sharp points used for processing hard-bodied food materials. Cyprinid mouthparts are also positioned more forward on the fish head as the result of their foraging strategies. Cyprinid elements are more gracile presumably since they are not bottom dwelling fish.

TABLE 3

Species Composition Murrer's Meadow
Data taken from Moyle *et al.* (1991:269)

Taxon	N	Average Standard Length (cm)
Lahontan Redside *Richardsonius egregius*	50	5.9
Speckled Dace *Rhinichthys osculus*	55	3.8
Tui-Chub *Gila bicolor*	18	5.7
Tahoe Sucker *Catostomus tahoensis*	24	7.0
Rainbow Trout *Oncorhynchus mykiss*	0	0
Paiute Sculpin *Cottus beldingi*	21	5.1

Specimens collected from Murrer's Meadow were also used to estimate the approximate size of the fish found in the paleofecal material. Exact measurement of elements was not possible given their small size, but Figure 4 shows the pharyngeal of a captured Speckled Dace measuring 3.2 cm live length (on the left) as compared to several of the paleofecal pharyngeals considered to be typical for the Spirit Cave assemblage.

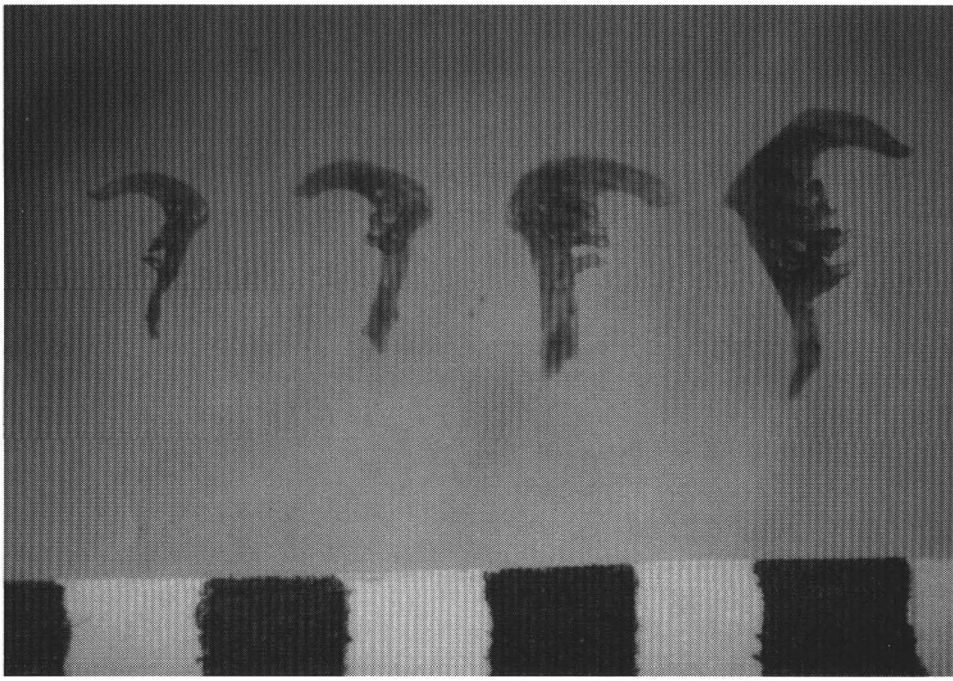

FIGURE 4. Comparison of Murrer's Meadow fish pharyngeal (on the left) to several from the Spirit Cave assemblage, (modern specimen measures 3.7 cm live length)

METHODS

Habitat Preferences

Habitat preferences of the taxa represented in the Spirit Cave and Peninsula Site assemblages are inferred from published descriptions (Moyle *et al.* 1991; Sigler and Sigler 1987; Moyle 1976), and from comparative specimens from the Murrer's Meadow collection. Relative sizes of fish found in the archaeological material were determined loosely by visual inspection. As such, comparisons of size are made by rough estimate. Future research will include the quantification of live captured fish sizes and specific element measurements to obtain more accurate results. Most of the Spirit Cave specimens represent fish sizes in the range of 3-7 cm live length.

Little variation was seen in the sizes of these bones. The Peninsula Site specimens represent fish sizes ranging from 10-30 cm live length, with more variation in bone sizes occurring in this assemblage.

Specific taxa present in the Spirit Cave material and the relatively small size of the elements identified suggest a shallow, moderately swift moving water environment possibly connected to a larger benthic system, at least intermittently (Sigler and Sigler 1987). Redsides and dace inhabit cool flowing streams, with rocky substrates primarily, but they also occur in large and small lakes, warm permanent and intermittent streams and outflows of desert springs (Moyle 1976). Tui-chub are found in most water regimes in the Great Basin, as are suckers. Based on this, a shallow water habitat may have existed around, or very near Spirit Cave (Figure 5).

FIGURE 5. Carson Lake, Nevada. This photograph may be a fair representation of the water habitat surrounding Spirit Cave 9,400 B.P.

The modern habitat preferences of the taxa found at the Peninsula Site and the larger size of the elements identified suggest the presence of a moderately large body of water with associated shorelines, some of which may have contained moderate marsh development (Sigler and Sigler 1987). Further evidence of a well-developed marsh at the time of site occupation is found in the house remains.

House matting from the large depression was constructed from large Poacea (grass) and Cyperaceae (sedge) type stem fragments, both of which are common marshland plants.

Taphonomy

Fish specimens from both Spirit Cave and the Peninsula Site samples also provide evidence of taphonomic trajectories that led to their preservation, recovery and thereby to the cultural behavior of the people who are responsible for the sites. In addition, decomposed fecal matter can be missed during excavation. Documenting the structure of fish assemblages that have passed through a human digestive tract provides a potential avenue for identifying fecal contents in the absence of well-formed boli.

Paleofecal contents represent discrete units in which post-burial depositional processes have minimally affected the original material, but subtractive forces may include mechanical damage due to mastication and gastrointestinal acids. These processes produce distinctive damage patterns on fish bone including pitting, warping, and fragmentation (Butler 1996). Crazing of the enamel on the pharyngeal teeth may also provide further evidence of digestive processing (Smith 1985). It was therefore expected that the paleofecal material from the Spirit Cave boli would contain more of the smaller bones, with warpage and breakage the result of mastication or digestion. Although charred fish bones were commonly encountered in the open-air archaeological assemblage, only three burned fish elements were noted in the Spirit Cave materials.

Taphonomically, the Peninsula Site fish assemblage should have experienced a different origin and history than that of the Spirit Cave material. The Spirit Cave samples contain ingested bone consumed at a specific point in time. The Peninsula Site assemblage represents an aggregate of behaviors resulting from human discard patterns. Expected subtractive forces in the Peninsula assemblage therefore include processing techniques spread over a period of time, trampling, diagenesis, and burning. Warpage and breakage, due to these processes, should be present. It was also expected that the recovery of small cranial bones from the open-air assemblage would be additionally reduced due to screen size.

To facilitate the Spirit Cave and Peninsula Site comparison, the numbers of identified specimens were tallied by element. Elements were then grouped according to fish-body regions recognized by ichthyologists (Wheeler and Jones 1989). These include the hyoid, neurocranium, branchiocranium, vertebral, and appendicular regions. An "other" category includes fin rays and ossified cartilage pieces. Rib counts were not included as part of this analysis due to problems estimating the number of identifiable specimens using extremely fragmented bone (Thomas and Mayer 1983). Frequency counts for each grouped set of elements were then transformed into percentages of the whole assemblage.

In the paleofecal material, 5.9 percent of the assemblage comes from the appendicular region, 16 percent from the hyoid region, 43.8 percent from the vertebral, 11.87 percent from the neurocranium, and 20 percent from the branchiocranium region (Figure 6).

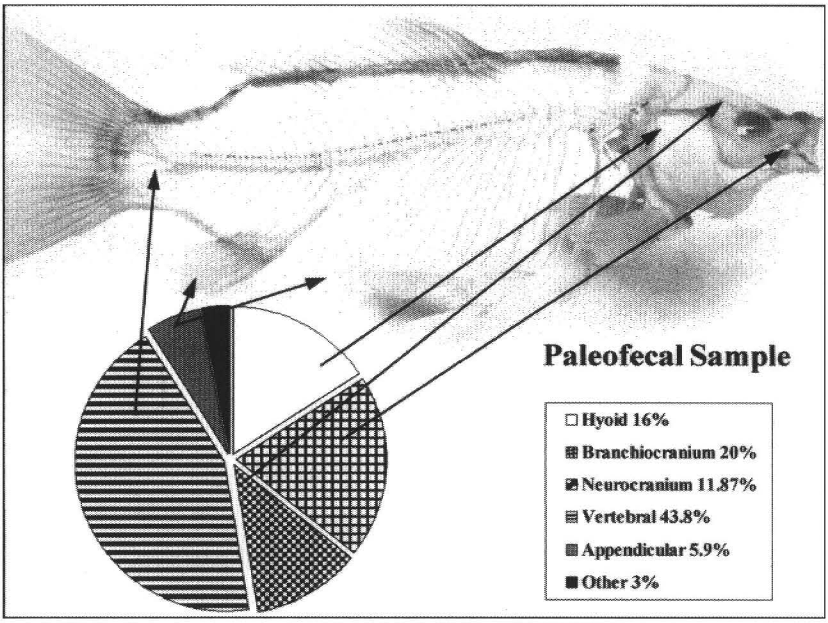

FIGURE 6. Bone survivorship percentage, Spirit Cave

This grouping shows that the percentages of mouth and vertebral bones are higher for the total assemblage. External, protruding bones such as those from the hyoid and neurocranium regions make up less of the assemblage. The positions of these bones externally on the fish body may make them more susceptible to the processes of digestion (including mastication and the action of gastrointestinal acids) that mechanically and chemically render bone unidentifiable. Internal bones may be better protected from these processes because of their shape, bone density, and tensile strength.

Only three burned fish elements were noted in the Spirit Cave material--one dentary, one rib, and one unidentifiable bone. The two identifiable burned bones are found externally in the fish skeleton, and if roasted, these external elements should be easily charred. Given the small number of charred bones, however, roasting was probably minimally applied to the Spirit Cave material. Instead, the small fishes may have been boiled or eaten raw.

In the 4,442 specimens identified to element in the Peninsula Site, 26.9 percent came from the appendicular region, 22 percent from the hyoid region, 17.2 percent from the vertebral region, 14.8 percent from the neurocranium, and 16 percent from the branchiocranium (Figure 7). The Peninsula Site yielded slightly more of the large, flat facial bones of the hyoid region, as well as more appendicular (fin girdle) bones when compared to the Spirit Cave material (applying Spearman's rank correlation coefficient shows a slight negative correlation of .3 with an associated probablility of .9, alpha = .05). These hyoid and appendicular areas include most of the external, or protruding bones of the fish.

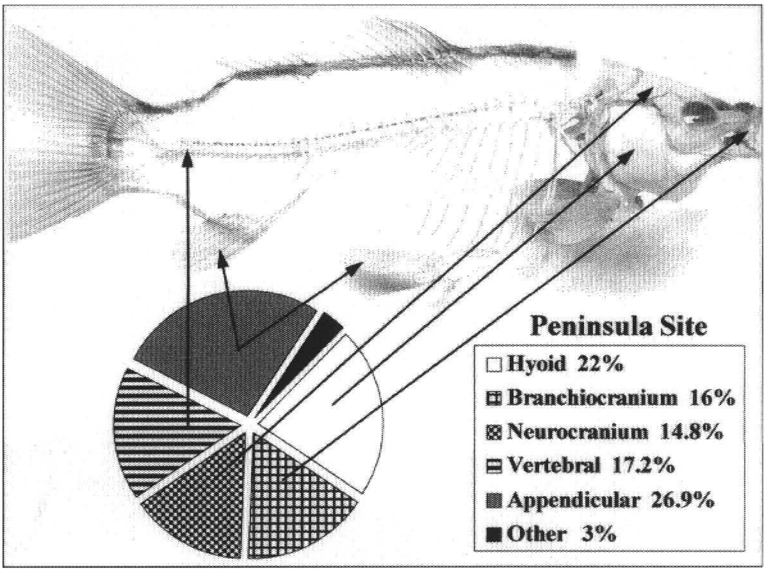

FIGURE 7. Bone survivorship percentages, the Peninsula Site

Fish bone derived from open-air and paleofecal samples experience different taphonomic histories related to their origins, preservtion, and recovery. Differential bone survivorship for the fecal material therefore includes a loss of identifiable external bones on the fish body possibly related to processes inherent in digestion. A more even recovery of fish body parts is seen with the open-air materials, but slightly fewer internal bones were identified.

Capture Strategies

Fish bone sizes varied between the two assemblages with larger elements coming from the open-air site. This difference is most likely the result of the hydrographic environments exploited (previously discussed) and capture strategies. Peninsula Site inhabitants probably exploited a larger benthic system with associated marshes, and the Spirit Cave individual probably drew from a smaller water system containing some moderately swift-moving currents. Likewise, the greater variety in fish sizes found at the Peninsula Site suggests these people used a variety of techniques to capture fish, but both sites show evidence of mass-capture strategies. This fishing strategy is noted ethnographically for several Great Basin groups (Fowler and Bath 1981; Fowler 1990, 1989; Evans 1990; Kelly 1932; Lindstrom 1992; Stewart 1941), and there also is indication that mass capture techniques may be more common than we think in the archaeological record (Greenspan and Raymond 1996; Raymond and Sobel 1990).

Variability in fish size is greater in the Peninsula Site assemblage than in the Spirit Cave materials. The majority of fishes represented at the Peninsula Site probably ranged from 10 to 15 centimeters in length, but approximately 20 percent of the assemblage contained larger fish ranging from 15 to 30 centimeters. This, in combination with the presence of possible net sinkers at the Peninsula Site, indicates that a variety of capture strategies were practiced there. Smaller fishes may have been captured using dipping or basketry trapping techniques, whereas larger fishes would have been more easily taken with net or spear technology. Most of the Spirit Cave specimens represent fish sizes ranging from 3 to 7 cm live length. There was less variability in fish element sizes, and the elements were consistently smaller. This indicates that they may have been mass-captured using finely woven basketry dip or net technology.

The fish captured from Murrer's Meadow were used to assess the effort needed to mass-capture small fishes using net and dip technology. To do this, a small dip net, constructed from a 6-by-4 foot nylon net with one-inch mesh, was strung between two 6-foot poles. Several solitary and paired-person techniques for capturing fish were attempted. These included team herding, single person dipping maneuvers, and a lie and wait strategy using a submerged net. All produced positive results. Within forty-five minutes of mock foraging, .562 kg, or eighty-two small fishes were recovered. The only limiting factor experienced was in selecting resource-rich pools.

The Murrer's Meadow fishing trip demonstrates that fish can be readily captured in a short period of time using dip technology. Diet breadth analyses such as those provided in foraging theory (Smith and Winterhalder 1992; Simms 1987) might initially predict that small minnows should not be taken by foragers because of low energetic returns, but when mass capture strategies and behavioral attributes of schooling populations are considered, net return rates probably do increase appreciably. Initial research by Raymond and Sobel (1990) and Lindstrom (1992) show dipping and netting to be very effective ways to acquire food with minimal effort (once a net is constructed), thereby increasing the economic ranking of small fish in the human diet at times when fish are schooling or otherwise concentrated.

Foraging technology and the division of labor is another source of variability attributable to cultural fish assemblages. As part of a recent analysis of Klamath basketry at the Phoebe Hearst Museum in Berkeley, Samuel Barrett's field notes on his turn-of-the-century ethnographic work with the Klamath Indians of central Oregon were reviewed for information related to fish mass capture practices. In these notes, Barrett refers to a twined, conical burden basket as a fish scoop used by women near the marshland tules where fish nets could not reach. Barrett's work shows that if the ethnographic record is used as a guide for archaeological research, the interpretation of small and large fish present in an archaeological assemblage should involve discussions of both prehistoric netting and dipping technologies. The two activities are, however, different strategies involving different costs and benefits for male and female foragers.

There also may be a relationship of fish size to capture strategy and technology not readily apparent in the archaeological record without more detailed work with fish bone (Ruth Greenspan, personal communication 1996). This type of relationship between size and capture or processing strategy could in fact account for some of the patterning in the Spirit Cave materials.

CONCLUSION

Comparing two culturally derived fish bone samples documents the range of variability in these collections that may be attributable to different paleoenvironments, capture strategies, and taphonomic histories. The Spirit Cave materials represent a set of discrete, well-preserved events involving an individual's final meals before death. The Peninsula Site assemblage represents an aggregation of activities relating to the consumption and disposal of fish remains through time. Although several studies have been conducted with the intent of finding ways to distinguish natural from cultural assemblages (Butler 1996, 1993; Greenspan and Raymond 1996, Stewart and Gifford-Gonzalez 1994; Wim Van Neer and Muniz 1992; Stewart 1991), considerably less attention has been given to documenting the range of variation between different types of culturally produced collections.

The Spirit Cave materials contain the remains of tui-chub, speckled dace or Lahontan redsides, and suckers. This indicates that the water regime surrounding the cave 9,400 years ago included some moderately swift and some benthic water habitats. The small size of the fish captured also implies that they were taken in a shallow water system, possibly with basketry or very fine net-mesh dip techniques. The Peninsula Site fishes included only two taxa, the tui-chub and sucker. The relatively larger sizes of many of these elements indicates that the area surrounding the site 700 to 400 years ago contained a relatively large body of water, although streams and marshes were probably also present. The variability in fish sizes found at the Peninsula Site indicates that several capture strategies were possibly used to obtain fish. The percentages of sucker bones in the assemblages were essentially the same, and this could be related to similarities in water environments or exploitation strategies.

The Spirit Cave material contains a higher number of internal bones relative to the Peninsula Site assemblage, which includes more of the external flat bones of the facial and pectoral region. There may be some sampling bias related to recovery techniques between the two sites, but this is thought to be a minor factor in accounting for differences in bone survivorship. A possible interpretation for the patterning therefore involves considering processes of mastication and digestion which served to render external fish bone unidentifiable in the Spirit Cave assemblage.

One limitation of paleofecal research involves the individual nature of data obtained. Organic contents represent food items ingested in specific seasons, and some of these may in addition have been stored foods. Seasonally specific data are likewise difficult to articulate with research into general patterns of prehistoric subsistence economies, but the first step in overcoming these limitations is to specify the season in which resources may have been harvested. To this end, future research with the Spirit Cave materials might include investigating the season of fish mortality.

Twenty-one otoliths were identified from the Spirit Cave material. Since otoliths contain annular rings that are commonly used to determine the season of death for wildlife fishes, the Spirit Cave otoliths could be used to determine season of death (but not the season of ingestion) for the Spirit Cave fishes. Determining the season of death for the Spirit Cave otoliths requires a representative sample of modern specimens captured in each of the four seasons (minimal samples should be taken at first to avoid unnecessary killing of fish). If modern otoliths of this small size yield discernable seasonal rings, then the fossil specimens could be considered for analysis.

Another avenue for future research involves taking bone measurements of the Murrer's Meadow comparative collection in order to determine the live lengths of fishes from the archaeological material. It is expected that information such as live length and size will refine paleoenvironmental interpretations and enable the reconstruction of prehistoric subsistence technology related to fishing.

Taphonomic interpretations presented here are based on a comparison between two types of cultural assemblages that show differences in bone survivorship possibly related to human capture and processing strategies. External bones were under-represented, and internal bones were over-represented in the paleofecal material. Fecal fish bone sizes were also much smaller than those from the open-air archaeological specimens, indicating a fine net or basket dip technique for fish capture.

The paleofecal material may represent the terminal meals of an individual unable to process food normally due to a maxillary abscess, thereby making the fish assemblage anomalous, or the contents of the paleofecal specimens may be indicative of common resource exploitation practices during the early Holocene. Although more data are needed to address this problem, it can be argued, with the data at hand, that the people who used Spirit Cave 9,400 years ago probably did, based on the taxa and size ranges of fish found in the paleofecal material, exploit a marshland or meandering stream environment. Fish also were probably mass captured and eaten with little preparation.

NOTES

[1] During the first phase of paleofecal research, several contributions to the field came from the Great Basin. Loud and Harrington (1929) reported on the analysis of fecal remains found in Lovelock Cave, Nevada, where they revealed a prehistoric diet of various wild seeds and plant fibers for the inhabitants of that cave. In the 1950s Sperry and Fonner (Jennings 1957) completed the first study of paleofecal matter to include hair and feather analysis. In 1967, the Seventieth Report of the University of California Archaeological Survey contained six articles on various aspects of Lovelock, Humboldt, Hidden, and several other dry caves in Pershing County, Nevada (Heizer 1967). Cowen contributed to this volume which can be characterized as a pioneering interdisciplinary effort to incorporate several aspects of paleofecal research, including pathogen analysis, fish identification, and macrobotanical identification.

[2] The term *coprolite* was first coined by W. Buckland (1829) to refer to lithified dinosaur feces from paleontological contexts. More recently, the term has been used to refer to both lithified material and to human feces or mummy intestinal contents preserved by desiccation (Heizer and Napton 1969). Although this latter usage of the term is common in much of the literature today, for the purposes of this paper, desiccated human feces deposited in archaeological contexts will be referred to as *paleofecal matter* or *fecal matter* to distinguish it from lithified, non-human material (after Yarnell 1969).

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GEORGIA WHEELER IS STILL ALIVE
(And We Have Her Voice on Tape)

Diane Lynne Winslow and Jeffrey R. Wedding

FOREWORD

The authors' first entanglement with S. M. and Georgia Wheeler was during the summer of 1995. I was deciding on a topic for my M.A. thesis and working for the Desert Research Institute (DRI). While searching through mounds of what seemed to be ancient field records written in hieroglyphics or some ancient script, I discovered S. M. Wheeler. After breaking down numerous walls of opposition regarding his name, I eventually discovered that Wheeler had been quite an influential early Great Basin archaeologist. This evolved into my thesis, *Restricted Reconnaissance: The History and Archaeology of S. M. Wheeler in Nye County, Nevada.*

Those who have read S. M. Wheeler's publications are familiar with his casual narrative style. The present writers thought it fitting to adopt that style, and have written this essay straight from our field journals. For continuity, it is presented from Diane's perspective. Jeff's personal comments appear in italics.

Diane asked me to accompany her to the Nevada State Museum for a few weeks during the summer of 1995, where she analyzed a portion of the Wheeler collection applicable to her thesis. During the early part of 1996 I spent time in the field with Diane as she attempted to relocate Wheeler's Nye County sites. At this time I began to take a sincere

First I would like to thank Claude Warren, had he not have sent his message I might have missed this interview. Next, I would like to thank Georgia Felts for the wonderful three days and the information she shared. In addition, I would like to thank Ben Felts, Loraine and Jim Beasley, and Rebecca Felts for their gracious southern hospitality. I would also like to thank the Desert Research Institute, the Landers Endowment, the Nevada State Museum, and the James Calhoun Foundation for funding my research. Last, but most certainly never least, I want to thank my colleague and co-author Jeffrey Wedding for everything.

— Diane Winslow

I would like to thank Diane for letting me join her in her research. I would like to thank the Desert Research Institute, particularly Collen Beck, and Donald Tuohy and the staff of the Nevada State Museum. Finally, I would like to thank the Feltses and the Beasleys for letting a couple of ragtag archaeologists into their homes.

—Jeff Wedding

interest in her thesis as the history of an archaeological forefather began to surface. Today's professional archaeologists frequently dismiss the work of pioneering "amateur" archaeologists as lacking in theory and method. However, Wheeler's work showed a competent methodical avocationalist performing at a level equal to that of contemporary professionals.

Throughout his career S. M. Wheeler was accompanied by his wife, Georgia. Together they surveyed and excavated at numerous archaeological sites between 1933 and 1956 throughout the Great Basin. Projects included such prominent archaeological sites as Little Lake, Borax Lake, Etna Cave, Pueblo Grande de Nevada, Tule Springs, and Spirit Cave. At the time I wrote my thesis, Georgia's whereabouts were unknown and many presumed she had passed away shortly after her husband's death in 1959. I finished my thesis and received my degree from the University of Nevada, Las Vegas (UNLV), in May of 1996. Within a week of semester's end, Jeff and I departed for fieldwork with DRI. After two weeks of survey, I returned to my office to find a surprise.

ARCHAEOLOGISTS TURN TO ETHNOGRAPHY

Early on the afternoon of May 23, 1996, I discovered that Georgia Wheeler Felts was alive. Sitting in my office reading through two weeks of back mail I found a message from Claude Warren of UNLV. The message read:

> Diane, Georgia Wheeler Felts is 93, in a seniors home in Nashville, Tenn. Furthermore she says the people at the Nevada State Museum are wrong in their statement that the Wheelers never realized the significance of their work. Georgia claims that she and S. M. knew they had an old mummy and that they hoped it would be as old as it has proved to be. She says their contemporaries also thought that it was old. "We didn't go into that cave accidentally," she said. "This was my husband's profession . . ." They knew then that it was an old discovery. It is said that the Wheelers were dissuaded by other experts who put its age at not more than 3,000 years. Diane, get to it! Call her and make an appointment to go interview her with lots of tapes. This is a major person in the history of Great Basin Archaeology.

Having been in the field, I had missed several news releases the previous two weeks. The Nevada State Museum had released data on a mummy excavated in 1940 by the Wheelers. The mummy was uncovered in Spirit Cave, and, at the time, M. R. Harrington of the Southwest Museum suggested a date of approximately 2, 000 years. The new radiocarbon date of 9,415 years came as a great surprise, making it the oldest mummy found in North America (Dansie 1996; Tuohy 1996; Tuohy and Dansie 1996; Kirner *et al.* 1996).

The Nevada State Museum's initial press release went around the world. The article stated that unfortunately the Wheelers had passed away not knowing the significance of their discovery. The release appeared in a paper in Murfeesboro, Tennessee, where it was read by Loraine Beasley, Georgia's step-daughter. Loraine began to make phone calls to spread the word that her step-mother was in fact still alive, living with her second husband, Ben Felts. These phone calls resulted in the second press release read in *The Las Vegas Review-Journal* by Dr. Warren (Associated Press 1996). In the days that followed I contacted the Associated Press as well as Donald Tuohy and Amy Dansie of the Nevada State Museum, who provided me with Georgia's address and telephone number.

On the possibility of an interview I wrote a research proposal which would get me to Nashville, Tennessee. I gave the proposal to Colleen Beck, deputy director at the Quaternary Sciences Center of the Desert Research Institute. After telling me that everything looked great, she passed it onto the center director, Steven G. Wells. I quickly got on the phone and called Loraine. To my surprise, she was overwhelmed and explained the entire family would love to have me come out and interview Georgia as the basis for a biography, the archaeological careers of the Wheelers.

Within twenty-four hours I had my answer. Steven Wells had arranged for me to utilize moneys provided to the institute by the Landers Endowment. The only things lacking were airline tickets, a book outlining tape recorded interview methods (I had never done an oral history), and a helpful colleague.

The helpful colleague was simple. Since I am a fellow DRI employee, UNLV graduate student, and already quite familiar with the subject. I have convinced myself that Diane thought of no other. I don't even remember her asking me if I wanted to go. I recall getting back to the office after a week in the field and Diane walking into the lab babbling something incoherent at me like "George is still benign." I wasn't quite sure what she was trying to tell me. Finally she took a deep breath and said,"Georgia Wheeler is still alive." This prompted me to say, "When are we leaving?" Diane started writing for grant money and I started rolling pennies. Somehow we both managed to get on a red-eye heading east.

I turned to Edward Ives's 1995 book, *The Tape-Recorded Interview, A Manual for Fieldworkers in Folklore and Oral History,* to answer my questions about ethnographic methods. As for arrival dates, I called Loraine. She explained to me that I should come as soon as possible as Georgia was not necessarily in the best of health. I suggested the following week. This was problematic and thus the week of June 24 was chosen.

At this point, I spent my days preparing questions and gathering knowledge about oral histories. At 1:30 A.M. on June 25, 1996, Jeff and I boarded a plane to Nashville. I had agreed to call Loraine at 9:00 on the morning of our arrival to set a time for an initial contact with Georgia. When I called, Loraine informed me that Georgia would be expecting us at 2:00 that afternoon. I almost collapsed! I was so tired with jet lag that I thought I would never make it through the day. Jeff and I discussed strategies over lunch. I explained that everything should be fine as I only wanted to introduce ourselves and explain exactly how the interview would take place. I figured we would be at the Felts home for approximately an hour and then we could return to the hotel and sleep.

INTERVIEW: DAY ONE

When we arrived at the Feltses' apartment, Georgia, Ben, and Ben's daughter Rebecca Felts all began talking at the same time. Before I could even ask permission to tape record, Georgia was explaining how pleased she was that we had come and began recounting stories of her husband and their lives together.

I went to Texas Women's University at Denton. When I graduated, I didn't want to. .. teach or anything, and dad said you choose what you want. . . I went to Mount Sinai Hospital in New York City for a six-month internship on institutional management and special dietary treatments and came back to San Antonio where I was one of four dietitians . . . all with the same training and I had charge of the special dietary department . . . Wheeler, I met in the hospital, he was in temporarily, I do not remember for what. But, . .. they used to come to the dining room when they were able to, the officers and their wives who were in a unit in the main building, and I met him there . . .
. . . Well, we were in Texas for quite awhile, . . . I started working for . . . the University of Nevada . . . and we moved to Nevada. And, I worked [with] 4H Club leaders and 4H Club member activities and so forth. (Felts 1996a)

The afternoon was going quite well. While conducting my thesis research, I discovered that the Wheelers and M. R. Harrington had worked together on numerous projects. One of the questions asked was when the Wheelers had first met Harrington. According to Georgia they met during a trip to California during the late 1920s.

. . . while we were there, they had this special exhibit at the Southwest Museum . . . and [we] met Dr. Harrington . . . he never had a doctorate. Mark Raymond. Everyone called him Mark Raymond, and a lot of people called him doctor, but he wasn't. But, he was a wonderful man and very thorough and very professional in all his work in the field of archaeology. (Felts 1996a)

The Wheelers' initial relationship with Harrington was that of protégés. This relationship grew over the years into a life long friendship.

Well, of course, we were working under Dr. Harrington more or less, he urged us that facts were the important thing, and that in caring for anything that we discovered we should use the best method of preserving it for future generations and not just to take something you found out and show it, exhibit it for everyone to see, but properly exhibited, yes. And this . . . neither one of us had any training except the advice that he has given us and he was a dedicated . . . archaeologist himself and I feel if I have made any contribution, I am just glad (Felts 1996a).

After approximately two hours of talking (only one hour on tape) I ended the afternoon interview. Before leaving I explained to Georgia exactly what type of information we were seeking. She hoped that the next day we would have more specific questions for her, feeling that approach would help her remember. She also proceeded to invite Jeff and me to join her and Ben for lunch the following day. We agreed and said we would meet them at 11:30 A.M.

To clarify a point here, we were actually invited to dinner. My first real translation and protocol efforts were required. My family is from Kentucky so I was familiar with the region's jargon. I explained to Diane that arriving at 11:30 a.m. for dinner was the proper time since food would be served at noon. Most southerners know that there are actually two big meals a day, dinner and supper. Dinner, unlike Out West, is served at noon and supper about sixish. Diane, having grown up Out West, was unaware of this and was operating on the familiar breakfast, lunch, and dinner terms and was rightfully confused. This would not be the last time I would have to remind her of this. However, Diane did get it figured out by the time we left Tennessee, and was acting and speaking almost like a native.

On the return trip to the hotel Jeff and I stopped at a local Shoney's restaurant for dinner *[that should be supper]*. During supper we discussed strategies for the next day's interview. Utilizing the well-documented anthropological method of writing questions down on napkins, we were able to arrive at a nice chronological sequence of questions. Following our meal we returned to the hotel and finally got a chance to sleep. Prior to collapsing into deep slumber, one of us had enough strength to set the alarm clock for 8:00 A.M. as we needed to get up early and prepare for the interview.

INTERVIEW: DAY TWO

Spontaneous cannon fire from one of the nearby Civil War battlefields would not have awakened us from our jet-lagged exhaustion, so the small travel alarm went off for two hours. We finally woke around 10:00 A.M. and quickly showered and prepared ourselves.

Jeff and I were again greeted graciously. We followed Ben downstairs to the dinning room, where Georgia was waiting. She immediately began to introduce us to everyone in the room as "the people from Nevada who are interviewing me for a book. You know I was an archaeologist at one time, with my late husband and these young people are going to tell our story," Dinner was filled with light conversations surrounding the Feltses' life in the retirement home. After finishing our meal the four of us returned to the Feltses' apartment.

Jeff and I began preparing our notes and cassettes while the Feltses got comfortable. Before we could begin there was a knock at the door; Loraine had arrived to do the weekly shopping. We immediately got up and introduced ourselves as Loraine had been our main contact person from the very beginning, and we were quite excited to meet her. We talked for a few moments, and then Loraine departed for the store. Georgia, Jeff, and I sat down to the interview.

Georgia Wheeler, prior to 1940, at an historic site near Tippapah Springs, Nevada Test Site, Nevada. (*Georgia Wheeler Felts*)

Questioning began with "when did you first become interested in archaeology?"

Well, I guess I was interested in it from the first . . . Wheeler was interested in it and naturally I was interested in it. And when we got into Nevada and into Clark County I was interested, I worked at the county hospital, I was in charge of the dietary department there, but I, um, kept up with everything and I was just as interested as he was, but I didn't give any time to research or anything of that kind . . . .
. . . Well, he was interested in archaeology . . . when he accepted his appointment to West Point [but] he wanted to finish [school]. He felt like he had a commitment, and after they graduated, many of the graduates were given trips to Europe . . . he was given money. He went to England, France, and Italy, and then across to Egypt, and he became fascinated with the archaeology . . . So, this developed a desire in him to go into this field of work (Felts 1996b).

Wheeler's first excavation work in Nevada was in 1933. With the assistance of the Civilian Conservation Corps unit Wheeler was attached to, M. R. Harrington conducted the excavation of Pueblo Grande de Nevada.

[Wheeler] supervised the work and he was interested in the excavations that were being done. [H]e worked out the grid system, or a means of recording your findings so that you could go back at a future date because your area was mapped. [A]s far as I know, Dr. Harrington never told him anything about it, but [Wheeler] organized this grid system of being able to locate certain points of interest, or something that was found at that area (Felts 1996b).

Following the excavations at Pueblo Grande de Nevada Wheeler continued to work in archaeology, increasing his field experience.

Well, you know a lot of [Wheeler's work] was volunteer[ed] . . . he had worked profitable with Dr. Harrington [although] it was a small income but we were doing very well. It was enough that we could follow the chosen profession (Felts 1996b).

By 1940, the Wheelers were considered professional archaeologists. They were employed by the Nevada State Parks Commission, assigned to investigate the cave area near Fallon, Churchill County, Nevada. This reconnaissance resulted in the testing of Spirit Cave and discovery of the Spirit Cave Man (Tuohy and Dansie 1996). During the interview Georgia stressed the attention they paid to archaeological methods.

[We] had very few workers that worked with us because you couldn't have people come in there and just shovel 'cause we did things carefully with trowels and brushes . . . because you could find [something significant] like when we found the mummy. We worked for days and we realized that something was there, but we did not, we did not go into it with a shovel and pick . . . .
. . . [We were] convinced that this was an important thing . . . we delighted in doing it (Felts 1996b).

We interviewed Georgia for approximately two hours that day, getting a tremendous amount of data. Finishing the interview we began showing Georgia photographs taken by S. M. Wheeler in 1940 during their reconnaissance into Nye County, Nevada. Unfortunately, she remembered very little about the expedition. She remembered the places and the people who had accompanied them, but was unable to remember specific details about the work. I found this to be a little disappointing. I was hoping to get more information since I have been working specifically on this particular reconnaissance and its findings for over a year. Georgia confirmed most everything I had previously written about her and her late husband in my thesis. Prior to our departure Loraine invited us to supper at her home the following evening. She informed me that she had found several books and some miscellaneous items that had belonged to Wheeler. After accepting Loriane's invitation, we returned to our hotel for the evening.

INTERVIEW: DAY THREE

Jeff and I arrived at the apartment on Thursday, June 27, with a small bouquet of flowers as a token of thanks. We had already decided that this would be the last day of interviews as Georgia was becoming frustrated with the fact that she was unable to remember specific details. With this in mind we decided to focus our questioning on how Georgia and Ben found each other.

According to Ben, he and his first wife, Vera, had five children. Originally from Tennessee, the family moved to the arid Southwest after one of the children contracted rheumatic fever. The family settled in Hawthorne, Nevada, and Ben worked at the naval depot located there. Ben and Vera were living in Hawthorne when she died in 1960. Wheeler and Georgia had moved to Ely, Nevada, in the late 1950s. He passed away in their home the night of September 11, 1959. Georgia, still having ties to the University of Nevada, Reno (UNR), remained.

Ben and Georgia, both active in their local Baptist churches, would be introduced by conspiring church members. Ben traveled much of Nevada in the early 1960s as a missionary helping to organize new churches and share program ideas. The two married in 1962.

Ben's family [has] been wonderful to me--you know sometimes a second marriage just isn't accepted by the children. But they have accepted me from the first (Felts 1996c).

The couple remained in Ely for seven years following their marriage. During this time, Georgia finished her remaining years of work with UNR and retired. No longer bound by work, they moved back to Ben's home state of Tennessee, where

Georgia Wheeler Felts (age 94) and Ben Felts (age 103), at home in Nashville, Tennessee, June 27, 1996. (*Authors' photograph*)

Ben (now age 103) and Georgia (age 94) reside in a retirement home in Nashville.

During the interview an announcement came over the intercom system. They were having a birthday party for all the June birthdays in the recreation room. Georgia quickly reminded us that she had been born June 14, 1902, and it was decided that we would attend. Entering the colorfully decorated room filled with lively elderly folks ready to party, Georgia again introduced us as "those young people from Nevada who are writing a book about me." We had cake and punch, sang "Happy Birthday," and then Jeff and I made our goodbyes and headed to Murfeesboro.

We arrived in Murfeesboro--which incidently, was once the capital city of the state of Tennessee--as scheduled. Arriving at the home of Loraine and her husband, Jim Beasley, we were greeted warmly. The evening centered around Georgia and Wheeler's archaeological careers. Prior to all the recent publicity, the family knew little of their step-mother's endeavors. We spent the evening recounting stories of early archaeology in Nevada. Loraine also bought out several books and a small wooden box which had belonged to Wheeler.

The small wooden box was unfinished. Wheeler was apparently in the process of wood-burning Indian designs on the sides representing his archaeological interests. I carefully opened the box and found the contents to be an array of minerals, crystals, projectile points, and mementos Wheeler had treasured.

The books themselves were also treasures. One, titled *The Wheeler Family of Rutland, Massachusetts, and Some of Their Ancestors,* is self-explanatory. By the way, S. M. Wheeler's father and grandfather were surveying engineers. Wheeler's grandfather Daniel Merrick Wheeler devised an invention which would have an impact on all archaeologists for years to come.

> Engineering has little, if anything, to do with women's fashions. Yet it was from an article of apparel once in great vogue that there was devised an item of equipment now universally used by engineers. Back in the days of crinoline and hoop skirts, wire manufacturers were called upon to produce a type of wire for making frames that could be flexed but not bent out of shape. The wire that was developed was termed hoopskirt wire, and its flexibility suggested to Daniel M. Wheeler of Worcester, Mass., a surveyor, the possibility of using it for making measuring tape. He obtained 100 feet of it, and ran solder on at intervals of one foot, the graduations and numbers being marked on the solder. This tape, which was made in 1870, was the first practical steel tape ever devised, and proved to be far superior to the chain in use at that time (Chicago Steel Tape Co. 1941).

We were also shown Wheeler's West Point annual, dated 1926 (the year he graduated), and a scrapbook of articles and photographs Wheeler had saved from their various projects. As the evening came to a close, Loraine's husband asked when the book would be published and if they would get copies. I replied sometime next summer, and yes they would get copies.

GOING HOME AND CONCLUSIONS

Jeff and I returned to our hotel room in high spirits. I felt quite thankful in that I had being given the opportunity to meet these very special people. I sat down and began writing in my field journal; I did not want to forget a moment. The next day, Jeff and I did some sightseeing as our flight did not leave until the following afternoon. We took in all the sights around the city of Nashville and caught a showing of the Grand Ole Opry.

At 4:00 P.M. the following day, we boarded our plane home. Thus, our story is told. Why is this important to archaeology? The walls that separate the fields of anthropology need to come down. We as anthropologists can learn from each other. I learned more about the history of Great Basin archaeology in those few days with Georgia Wheeler Felts than I did in any classroom. The history of archaeology is just as important as the history of the Americas. We need only to listen.

The archaeological careers of S. M. Wheeler and his wife, Georgia, were both influential and contributed to the discipline. They touched the lives of all Great Basin archaeologists past and present, whether they acknowledge it or not. The Wheelers' numerous archaeological investigations have provided foundations for future research. This is easily seen in the recent analysis by the Nevada State Museum of the Spirit Cave mummy. Many early collections remain curated in museum facilities awaiting the light of inquiry. I believe that the archaeological research of the Wheelers is a shining example of what could be found by digging in the museum's archives and collections. With the current directions of cultural-resource-management archaeology and the over-all lack of funding, "basement archive archaeology" could become a new trend. The potential data to be gained should be enough to inspire any archaeologist to get out of the trenches and into the museum's archives.

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