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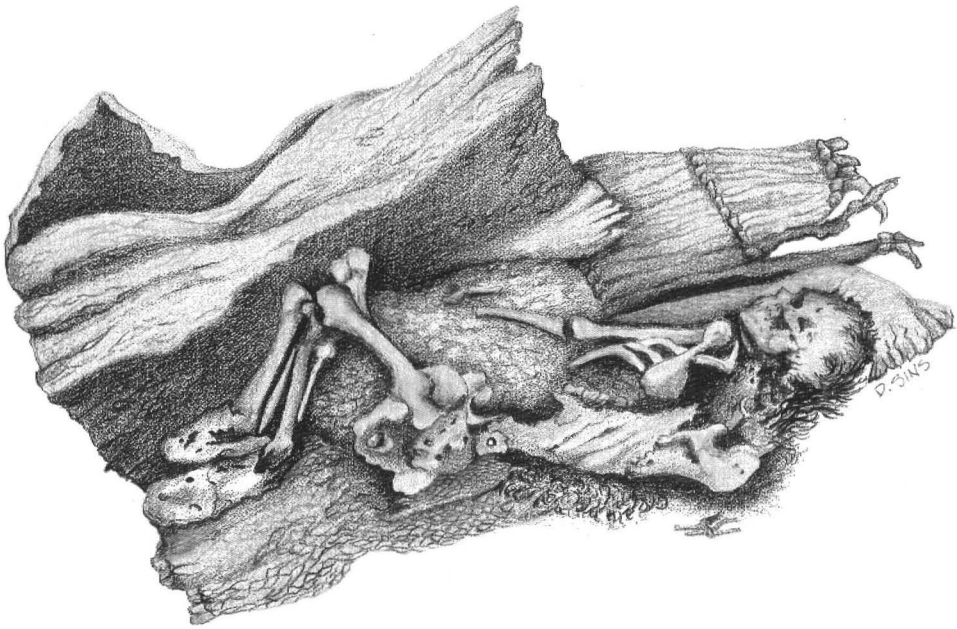

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NEVADA HISTORICAL SOCIETY QUARTERLY

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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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

The author is on the staff of the Desert Research Institue in Reno.

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

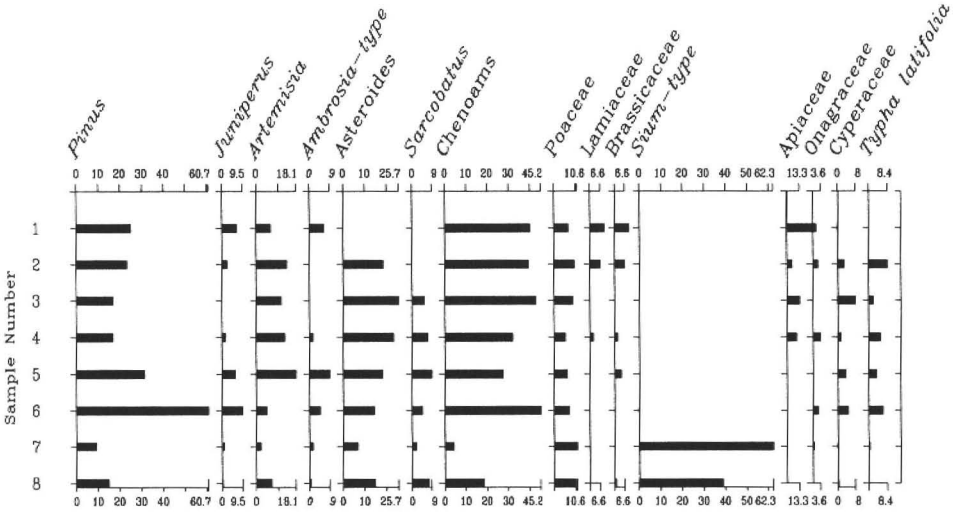

FIGURE 1. Relative percentage diagram of major pollen types from paleofecal material from Spirit Cave and a Winnemucca Lake cave.

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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