PART III: PRELIMINARY PALYNOLOGICAL ANALYSIS OF HUMAN COPROLITES FROM LOVELOCK CAVE, NEVADA

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Palynology, the science of pollen analysis, has developed in recent years into one of the most useful methods of establishing relative chronologies (Dimbleby 1963:139-149), reconstructing environments (Kurtén and Vasari 1960; Bent and Wright 1963:491-500; Martin 1963; Schoenwetter and Eddy 1964; Watts and Wright 1966:202-210) and investigating details of climate and ecology (Deevey 1944; Brown 1949; Sears and Roosma 1961; Butzer 1964; Potter 1964; Mehringer 1967; Bryant and Holz 1968).[1]

The desiccated deposits found in many of the cave and rockshelter archaeological sites located in western America are often suitable for the preservation of ancient vegetal material, and the middens of many of these sites also contain human and animal coprolites (desiccated excrement). Samples of coprolites found in Danger Cave (Sperry 1957:302; Fonner 1957:303; Jennings 1957; Fry 1968a) and Lovelock Cave (Loud and Harrington 1929; Heizer et. al. 1967) have been analyzed in order to investigate, and if possible reconstruct, prehistoric diets. Recently, Mehringer (1967: 130-200) reviewed the potentials and limitations of pollen analysis for this purpose and discussed the general relation of palynology and archaeology in the arid and semi-arid western United States.

Preliminary analysis of samples of coprolites from Lovelock Cave (NV-Ch-18) indicated that some of the fecal specimens contained sufficient pollen to permit comparison with paleoenvironmental reconstructions based on analysis of the floral, faunal, and cultural remains. Palynological samples were taken (prior to rehydration) from each of the fifty coprolites analyzed by Cowan and Ambro (1967) and from the group of Lovelock coprolites studied by Roust (1967). A suite of ten samples was sent to Dr. P. S. Martin, University of Arizona, who turned them over to the junior author for analysis.[2] Eight of these coprolites contained abundant macroscopic floral remains, while the remaining two included large amounts of fish bone and scales. All but three of the ten samples proved to be virtually devoid of pollen, but this was not surprising; about half of the Glen Canyon human coprolites analyzed by Martin (personal communication, 1967) were practically sterile. The scarcity of pollen grains in the majority of the ten Lovelock coprolites is interesting in view of the fact that almost all of the extractions from these specimens contained well-preserved plant tissue. The apparent discrepancy could be due to seasonal variation in the amount of free pollen present in the air and in the local water supply.[3]

Pollen counts from feces provide seasonal samples rather than mixtures of pollen accumulated during several years, as might be expected in alluvial and lacustrine deposits. (Martin and Sharrock 1964:171). There is a slight possibility that this might be due to sampling error, as a result of the fact that the Lovelock coprolite palynological samples were only about one cubic centimeter in size and were taken from a single locus in the interior of each specimen. Martin and Sharrock (1964:171) have recorded what may be significant changes in pollen proportions within a sample human coprolite from Bernheimer Alcove in Glen Canyon, Utah. It might prove profitable to investigate the possibility that differential amounts of pollen may occur within human and animal coprolites.[4]

Extraction, Identification, and Analysis

Extraction of pollen from the Lovelock coprolite samples was accomplished by the following technique, as suggested by Dr. Peter J. Mehringer, University of Arizona:

1. Preliminary hot 5% NaOH soak.
2. Sample sieved through 100-mesh screen.
3. Treatment with HF 50% and HF 70%.
4. HNO_3 30% solution treatment.
5. Concentrated HCl wash.
6. Acetylation.
7. Final hot 5% NaOH wash.
8. Sample transferred to silicone oil via alcohol and benzene washes.

Two of the suite of ten Lovelock coprolite samples (I-55 and I-36) contained sufficient pollen for 200-grain counts, while E-52 provided only enough pollen for a 100-grain count. The following pollen types were represented in the three samples:

Typha: *Typha* sp. pollen was dominant (exceeding fifty percent of the total count) in coprolites I-36 and I-55, and took the form of monads, dyads, and tetrads, indicating, apparently, a hybrid population of *Typha angustifolia*, which releases single pollen grains, and *Typha latifolia*, which releases its pollen in fused groups of four. Hybrids of these two species produce pollen in monads, dyads, and tetrads (Smith 1962; Mehringer 1967:171). The species in question have different ecological requirements, but the difference in the appearance of these plants is slight and it is doubtful that the relative frequencies of monads and tetrads in the pollen count is of any significance in reconstructing the prehistoric Lovelock diet. It should be kept in mind, however, that monads and dyads are difficult, if not impossible, to distinguish from broken tetrads.

Martin (1963:39, 42, 47, 60) has recorded *Typha* from palynological investigations at a number of localities in the American Southwest, and Schoenwetter (Hester and Schoenwetter 1964:51) mentions the recovery of *Typha* pollen from a cultural context:

> In Northern Arizona, with pollen from room dwelling units, I found a consistent time period in which the proportion of cattail and sedge pollen increased greatly.

Martin and Sharrock (1964:177) found *Typha* grains "only once or twice" in the Glen Canyon coprolites, while Bryant and Larson (1968:68), in investigating coprolites from caves in Amistad Reservoir, Texas, found either sedge or cattail plant fragments, but little pollen of these plants. Kelso's preliminary analysis of coprolites from Danger Cave, Utah (Jennings 1957) disclosed only very minor quantities of *Typha* pollen. The occurrence of *Typha* pollen in the late Quaternary of the Mojave Desert and the distribution of cattails in the arid and semi-arid western United States has been discussed by Mehringer (1967:171-172).

Historically, the Northern Paiute prepared *Typha* seed for consumption by spreading cattail "fluff" on a hard, smooth surface and exposing it to flame (Loud and Harrington 1929:159). This practice might account for the high percentages of *Typha* pollen in the Lovelock coprolites; however, since no *Typha* seeds or plant fragments were identifiable in the specimens, it is quite possible that flower parts or pollen grains themselves were intentionally ingested. This is probably the best explanation for the fact that coprolite I-55 was composed exclusively of *Typha* pollen. The extraction contained no plant tissue or debris of any kind. The pollen was unusual for its gray, "charred" appearance and its resistance to basic fuchsia stain. The screenings from the extraction were also unique, consisting of a light yellow, powdery material containing very little fiber and no seeds. Occasional "charred" *Typha* monads were also encountered in coprolite I-52.

The possible significance of the burned *Typha* pollen is apparent in the light of ethnographic data. Loud and Harrington (1929) state:

> After the Northern Paiute had obtained a supply of ground squirrels in the mountains, they returned to Humboldt lake in late spring to secure bird eggs, and young ducks before they were able to fly...At this season also pollen from the cat-tail rush was gathered to make candy (1929:156).
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> The pollen, tsima, is gathered, inclosed in the leaves of the rush and roasted in the ashes, causing it to become hard and sweet like candy. Pollen is also used for face paint (1929:158).

Heizer (n.d.) recorded additional information on the Northern Paiute practice of collecting and roasting pollen:

> Pollen was collected in large quantities from the flowering tule (toi). A fire was built in a dug pit, the hot coals removed, and the bottom of the pit was lined with green tules. The pollen was placed on the rushes, covered with more rushes, and then earth. After roasting for two hours, it was dug up and eaten.

It is evident that palynological analysis of only three coprolites from Lovelock Cave has disclosed archaeological evidence of prehistoric dietary practices that were strikingly similar to certain ethnographically documented food-collecting techniques of the Northern Paiute, who occupied the Humboldt Basin in Historic times (Hopkins 1883:5). The fact that baked pollen is found in an interior coprolite, dated _circa_ A.D. 740, suggests that the practice of eating baked _Typha_ pollen may have considerable time depth in the Lovelock area.

Gramineae: Grass pollen was well represented in coprolites E-52 and I-36. Presumably, various species of grass were deliberately ingested; that is, the seeds and pollen were not fortuitously collected with other species of flora, as would have been the case, for example, if the plants had been collected in baskets or harvested with horn sickles (Heizer and Krieger 1956:16; Loud and Harrington 1929:112). The Lovelock coprolites contained some seeds (e.g. _Chaenactis_ sp.) that might have been collected with other types of seeds (cf. Martin and Sharrock 1964:175, Fig. 2:j).

The occurrence of grass stems and leaves in a few Lovelock coprolites (Cooney, personal communication, 1967) suggests that some portions of these plants were eaten by the inhabitants of the cave. Martin and Sharrock (1964:175) came to a similar conclusion concerning the dominance of grass pollen in some of the Glen Canyon coprolites. Several of the Danger Cave fecal specimens contained significant amounts of grass pollen. Stewart (1941: 374-376) lists several grasses used by the Northern Paiute; however, neither the pollen from the Lovelock coprolites nor the diminutive grass seeds found in E-52 could be identified as to species (Cooney, personal communication, 1967).

Cyperaceae: The species represented by Cyperaceae pollen found in the Lovelock coprolite samples could not be identified through palynological techniques. Several members of this family are present in the contemporary floral assemblage of the Humboldt Basin. The principal genus represented by the Cyperaceae pollen may be _Scirpus robustus_, the seeds of which were found in almost all of the fifty coprolites, including E-52 and I-36, analyzed by Cowan and Ambro in 1965. _Scirpus_ fiber was present in about half of the fifty specimens (Cooney and Schwartzkopf, personal communication, 1967). Loud (1929:159) states that the Northern Paiute ate seeds of _Scirpus nevadensis_, the triangular-stemmed tule, and Stewart (1941:428) notes that 12 of 14 Northern Paiute bands consumed siavö (Scirpus acutus), while 9 of 14 bands ate avi (Scirpus americanus).

Polygonaceae: Some of the pollen found in the coprolites could be attributed to the Polygonaceae family, but could not be identified as to genera.

Low-spine Compositae: The pollen of this family is anemophilous and is identified by its typically reduced spines, which are less than 3 microns in length. The pollen of only a very few Low-spine genera show sufficient distinctive, morphological features to permit identification. Plant fiber from Elymus sp., one of the Low-spine Compositae, was recognized in coprolite I-52 by Cooney and Schwartzkopf (personal communication, 1967). The Compositae pollen, seeds, and fiber present in the Lovelock coprolites could be the result of either deliberate or accidental ingestion.

Artemisia: Several species of Artemisia, the pollen of which is distinguishable from other genera of the Low-spine Compositae, flourish in the Humboldt Basin. In 1912 Artemisia tridentata composed nine-tenths of the ground cover in the vicinity of Lovelock Cave (Loud and Harrington 1929:28). Artemisia pollen was present in several human coprolites from Glen Canyon and in several fecal specimens from Danger Cave.

The presence of Artemisia pollen in the Lovelock coprolites and the absence of sagebrush leaves and seeds could indicate that the pollen was accidentally ingested; however, there are ethnographic accounts of the use of Artemisia as a food plant (Yanovsky 1936:59-60). Loud and Harrington (1929:157) state that Artemisia tridentata was used for sandal padding, and Hopkins (1883:47) mentions the use of sagebrush in Northern Paiute ceremonies. Thus, sagebrush pollen could have been ingested, even though the plant might not have served as a primary food source. The relative scarcity of Artemisia pollen in the Lovelock coprolites may indicate that these specimens were not deposited during the late summer or fall, when Artemisia and other composites shed their pollen (Martin and Sharrock 1964:173).

Cheno-ams: The term "Cheno-am" refers to the pollen or most of the genera of Chenopodiaceae (Goosefoot family) and Amaranthus, which have very similar pollen types. The Lovelock coprolites contain seeds and plant fragments representing several members of the Cheno-am group, including Suaeda, Atriplex and Amaranthus. It is difficult, however, to distinguish between the seeds of the first two genera, and many seeds from the Lovelock coprolites were provisionally identified as Atriplex, but are in fact Suaeda sp. (Browning, personal communication, 1967; Sharsmith, personal communication, 1968). On the basis of their studies of human coprolites from the Amistad, Texas, region, Bryant and Larson (1968:167) concluded that Chenopodium seeds were one of the main dietary staples during portions of the post-Altithermal period. They further noted that coprolites containing many Chenopodium seeds also yielded high percentages of Chenopodium pollen. All but a single sterile specimen of the Danger Cave feces that have been examined by Kelso are dominated by Cheno-ams. The Cheno-ams recovered from the Lovelock samples could well be the result of accidental ingestion, rather than reflecting cultural or dietary practices. Martin and Sharrock (1964:174) note that Cheno-am pollen is abundant in the pollen rain in many parts of the arid southwestern States, and "during the season of flowering, a large number of Cheno-am pollen grains would inadvertently be swallowed by people living out of doors."

Pinus: The single grain of pine pollen found in coprolite I-36 is probably the result of wind transportation from a considerable distance and probably was accidently ingested, perhaps not even during the pine flowering season. Martin and Sharrock (1964:173) note that pine pollen can be refloated by high winds at almost any time of the year. The small amount of Pinus pollen recovered from the Lovelock coprolites is concomitant with the scarcity of Pinus monophylla seeds in the coprolites. The nearest pines at present grow on the Stillwater Mountains about thirty miles south of the cave.

Discussion: We have made only a modest beginning in the palynological analysis of Lovelock Cave coprolites. Only three of ten palynological samples from Lovelock Cave coprolites contained consequential amounts of pollen, however, even these limited data provide some useful information. Radiocarbon dating of representative coprolites indicates that the Lovelock interior coprolites are ten centuries older than the exterior coprolites, yet grass and Typha pollen were the most important components in the counts from both interior sample I-36 and exterior sample E-52. Coprolite I-55, composed almost exclusively of Typha pollen, apparently provides palynological corroboration of the ethnographically documented practice of consumption of baked Typha pollen by the Northern Paiute. These facts strongly suggest a long-term continuity in certain aspects of human subsistence patterns in the Humboldt Basin. Consumption of baked Typha pollen, known to have been part of the recent dietary practices of the Northern Paiute, evidently has been a feature of the dietary regime of the Lovelock Cave populations since A.D. 740. Concomitant dietary and cultural practices may be of equal or greater antiquity.

It is evident that further palynological analysis of ancient human excrement from Lovelock Cave will provide considerable useful information, particularly when the data from the coprolites are placed in perspective by investigation of the local pollen rain, the pollen content of associated non-human feces, and identification of pollen and plant macrofossils from the site midden.

NOTES

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[2] Palynological and chemical samples of an average weight of two to three grams were removed,prior to rehydration, from each of the fifty Lovelock coprolites analyzed by Cowan and Ambro (cf. Heizer 1967:1-20).

[3] The presence or absence of pollen grains in the coprolites might be due to seasonal variation in the amount of free pollen in the air or in the local water supply. Heizer (personal communication, 1967) suggests that the principal source of water for the Lovelock population was undoubtedly Humboldt Lake. At certain times of the year the pollen of many species of aquatic flora accumulated on the surface of the lakes in western Nevada, and large quantities of pollen grains could have entered the digestive tract of the Lovelock Cave occupants when they drank the lakewater (cf. Davis and Goodlet 1960; Davis 1968).

[4] Martin (1965:747-759) found that in some cases, seeds and other particles contained in human feces may be thoroughly mixed in the colon.

TABLE 1

POLLEN PERCENTAGES FROM THREE LOVELOCK CAVE COPROLITES

Pollen Type	Interior Group (A.D. 740)		Exterior Group (A.D. 1800)
	E-52	I-55	I-36
Typha (Total %)	33.0	100.00	60.5
Monads	27.0	68.0	38.0
Dyads	-	-	1.0
Tetrads	6.0	32.0	21.5
Gramineae	35.0	-	27.5
Cyperaceae	6.0	-	3.0
Polygonaceae	7.0	-	0.5
Low-Spine Compositae	3.0	-	0.5
Artemisia	2.0	-	1.5
Cheno-ams	9.0	-	2.5
Pinus	-	-	0.5
Unknowns	2.5	-	3.5
N =	100	200	200