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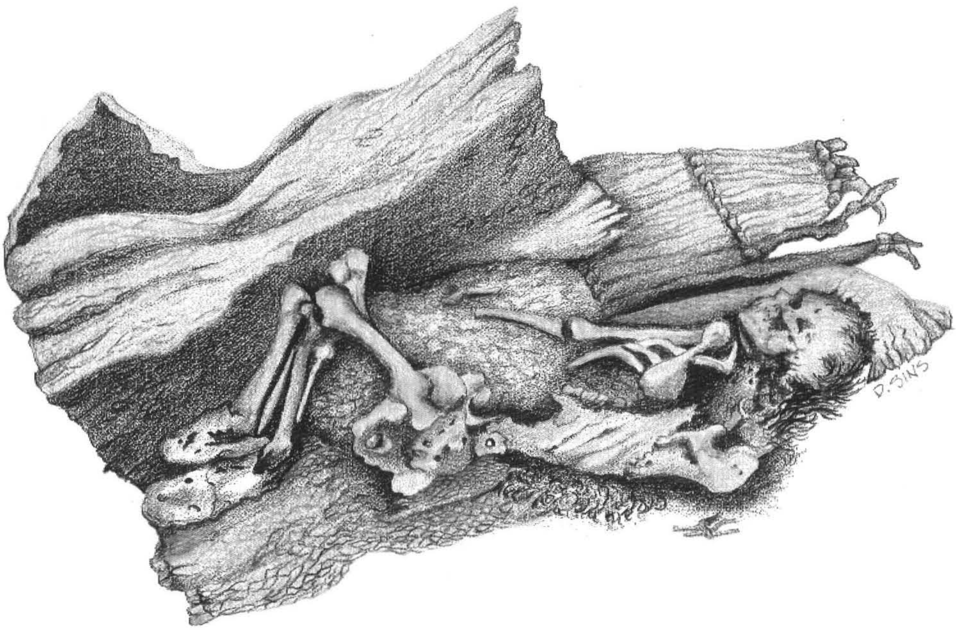

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NEVADA HISTORICAL SOCIETY QUARTERLY

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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 $\pm$ 80 years (UCLA 1071-E) to 1830 $\pm$ 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 $\pm$ 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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