

**ANALYSIS OF ANCIENT FECES:  
A DISCUSSION AND ANNOTATED BIBLIOGRAPHY**

**By**

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**Berkeley, CA 94720**

**1975**





**Facsimile Reprint by**

**Coyote Press  
P.O. Box 3377  
Salinas, CA 93912**

**<http://www.CoyotePress.com>**

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## ANALYSIS OF ANCIENT FECES: A DISCUSSION AND ANNOTATED BIBLIOGRAPHY

Analysis of archaeological fecal remains, or coprolites as they are often called, is not a new subject of inquiry; such investigations date back nearly to the turn of the century. Studies have been made of the intestinal contents of mummified bodies and of fecal remains recovered from refuse deposits. Recent summaries of the application of coprolite analysis to archaeological research (e.g., Bryant 1974d) have emphasized the history of investigations, the diversity of analytic methods and techniques now employed, the problems inherent in such studies, and the increment of useful information that can be obtained through analysis of ancient feces when such material is preserved in archaeological contexts. Coprolites contain recoverable information on ancient diets and subsistence patterns, technology, season of site occupation, nature and extent of parasitic infestation, and a variety of other aspects of paleoecological adaptation.

### HISTORY AND DEVELOPMENT OF RESEARCH

A realization of the potential for recovery of useful information from ancient feces existed already in the 1890s when Harshberger (1896: 150) reasoned that identifiable seeds consumed as food might be recovered from excrement. Some of the early studies were little more than incidental observations on the contents of samples encountered in caves, broken open, and examined briefly. For example, Young (1910: 324) commented briefly on the contents of excrement from Salts Cave, Nevada indicated a rather coarse diet on the part of the prehistoric cave inhabitants. These early studies occurred coincident with a growing realization among mammalogists such as E. T. Seton that important information on the feeding habits of wild animals could be learned from an examination of feces. Not all early studies, however, were made on coprolites which sporadically occurred in cave deposits. Warren (1911) examined the material from the visceral region of a skeleton of probable Bronze Age which was found exposed in a tidal flat at Walton-on-Naze, Britain, and found a quantity of blackberry, rose, and Atriplex seeds which were probably the contents of the decomposed intestine. He concluded that these were the remains of the food the individual had consumed shortly before death.

Just a few years earlier, in the course of salvage excavations in Nubia prior to the building of the dam on the Nile at Aswan, pre-dynastic naturally mummified bodies were found and the intestinal contents studied (F. W. Jones 1908: 55-64, 1910: 189, 191). Other cemeteries examined at this time dated from early Christian times, and the salt-mummified bodies exhumed from them were found to have well-preserved internal organs with the intestines containing barley husks and melon and grape seeds. Some of the material recovered in Nubia was studied by Fritz Netolitzky (1911, 1912) in Germany. Most of these early studies were primarily concerned with obtaining information on prehistoric and early historic diets, but the

work of Netolitzky especially shows concern, already at that date, with ancient medical practices, extent of domestication of plants, and the occurrence of both domestication of plants, and the occurrence of both domesticated and wild plant foods in the same diet. As early as 1912, Netolitzky reconstituted dried intestinal contents with hydrogen peroxide, a technique "developed" nearly a half-century later by Callen and Cameron (1955, 1960) using trisodium phosphate.

In the 1930s certain advances in paleofecal research were made in the United States. Volney Jones (1936: 147-167) examined feces from Newt Kash Hollow Shelter, Kentucky, and compared the vegetal contents with plant materials recovered directly from the midden of the shelter (see also Goslin 1957). His study is important because it emphasized fecal analysis as an adjunct to, and supplemented by, analysis of zoological and botanical remains in archaeological refuse. Jones was also observant of the fact that certain seeds, notably those of Chenopodium cf. nuttalliae and Iva cf. ciliata, were considerably larger than normally occur in wild populations of these plants. He concluded that these species must have been cultivated with artificial selection for seed size. His realization of the indigenous domestication of these plants in eastern North America, and the subsequent loss of them as domesticates, is still accepted; and Callen (1967a) later found a similar one-time domesticate in Setaria geniculata, the caryopses of which he noted in coprolites from the Ocampo Caves, Tamaulipas, Mexico. Wakefield and Dellinger (1936) appear to have been the first to study the fecal contents of a New World mummy, their sample originating in a rockshelter in the Ozark Mountains. They also attempted to culture micro-organisms from the prehistoric feces, an effort which has subsequently been repeated and always resulted in failure (Tubbs and Berger 1967; Sneath 1962; Dunn and Watkins 1970).

By far the most studies of ancient feces, involving a variety of specialized methods and objectives, have been undertaken within the past two decades. Among the more significant advances were the development of practical methods of analysis. Callen and Cameron (1955, 1960) showed the value of rehydrating coprolites with trisodium phosphate. Their 0.5% w/v aqueous solution of trisodium phosphate reconstituted coprolites and caused them to gently break apart, thus eliminating the need to mechanically fragment them in order to see what they contained. The method had earlier been used for rehydrating desiccated zoological specimens by Van Cleave and Ross (1947), and proved more satisfactory than other solutions such as peroxide and lye (Colyer and Osborne 1965). Trisodium phosphate reconstitutes desiccated tissues to their original size and shape, and in some cases also re-establishes the odor. It is widely used today in coprolite research, although some investigators (e.g., Yarnell 1969) still use the dry separation method.

Pollen analysis of coprolites has its roots in paleozoology, and was first applied to human excrement by Martin and Sharrock (1964). It has now achieved considerable sophistication, and through distinguishing background pollen from economic pollen, analysts have added much new information on both the environment of early man, and on economically important plant foods such as insect pollinated flowers, which

otherwise leave little or no trace of their existence in the macroscopic contents of excrement (Bryant 1974a, 1974c, 1974d, Bryant and Williams-Dean 1975). Palynology of coprolites is best used in conjunction with analysis of the macroscopic fraction of the same specimens.

Coprolites and latrine residues also contain evidence of the parasites which infested ancient human populations. Methods of rehydrating and concentrating parasite ova have been devised and favorable results obtained by Hall (1969) and Fry and Hall (1969) on samples from Utah spanning 10,000 years of time. Their method is adapted from those of Callen and Cameron (1960) and Ritchie (1948). Parasitological investigations of ancient excrement are discussed below.

Biochemical, physiological, and nutritional analyses have not progressed to the extent that those of palynology and parasitology have, but some attempts along these lines have been made by Fry (1970a), Napton (1970), and others. Napton (1970: 330) pointed out that nutritional studies of coprolitic material are made difficult by the fact that the analyst is attempting to reconstruct the nutritional value of food assimilated by the body from the residue which was not assimilated. Nevertheless, we can assume that this next logical step in dietary reconstructions will receive further attention in future studies.

Perhaps the one thing which distinguishes most of the recent detailed studies of ancient feces is that they are directed at broad ecological reconstructions of prehistoric human lifeway. Inasmuch as these derive their conclusions directly from human waste, instead of trying to infer them from artifacts (the function of which is often uncertain), bone scraps, and plant remains found in excavations, coprolite analyses can avoid many problems of interpretation which traditionally plague archaeological investigations (Heizer and Napton 1969: 563).

#### STUDIES OF PALEOECOLOGY AND ANCIENT DIETS

Analyses of ancient feces for the purpose of reconstructing ancient dietary practices generally also yield a wealth of information on the environment in which the former human populations lived. High frequencies of seasonally specific food items or pollen grains also can give evidence of the season in which particular archaeological sites were occupied. Extensive studies of this kind have been conducted in the Great Basin of western North America on material from dry caves. In the arid eastern portions of the Great Basin human coprolites have been found in Danger, Juke Box, and Hogup Caves on the margins of the Bonneville Desert. The Danger Cave sequence spans the greater portion of the last 10,000 years, and that from Hogup Cave is nearly as long. Together the coprolites from these caves show a long-time reliance on arid land resources, although it appears that the caves were occupied primarily or only in the fall. The diet was primarily vegetal, and the most common species represented in the coprolites and cave deposits is pickleweed (Allenrolfea occidentalis). The studies,

reported by Jennings (1953), Fonner (1957a, 1957b), Sperry (1957), Fry (1968, 1970a, 1970b), and Kelso (1970), show what appears to be a gradual trend from xeric to more mesic environmental conditions as indicated by decreases of pickleweed seed and increases in grass seeds and pollen over time. There is also an increase in the kinds of foods eaten over time. The overall adaptation seems to have remained remarkably conservative, although at Hogup Cave there is evidence of maize agriculture during the Fremont occupation in the first millenium A.D.

While it is grouped within the same natural and cultural province, the better watered Humboldt Sink-Carson Sink region of west-central Nevada yielded evidence of sharply contrasting paleoecological conditions. Over six thousand human coprolites were recovered from Lovelock Cave by R. F. Heizer and his associates. These coprolites date from around 2500 B.C. to the historic period. Additional specimens were also collected from Hidden Cave, Humboldt Cave, and several other cave and shelter sites in this region, and from caves near Pyramid Lake 60 miles to the west. Analysis of these specimens shows that in the western Great Basin there was a strong reliance on lacustrine resources perhaps as early as 3000 B.C., and that this pattern persisted with increasing intensity to about A.D. 1800. The reports of Heizer (1967, 1970), Roust (1967), Cowan (1967), Ambro (1967), Heizer and Napton (1969, 1970), Napton (1969a, 1969b, 1971), Napton and Brunetti (1969), Napton and Heizer (1970), Napton and Kelso (1969), Follett (1967, 1970), etc., detail the extremely diversified western Great Basin diet, which consisted largely of aquatic items. There was much use of fish, cattail and bulrush seed. Waterfowl and other aquatic birds were also important in the diet. While the material from Lovelock Cave, which represents the largest increment of data from the western Great Basin (or anywhere else, for that matter), almost certainly represents a fall and winter diet, it is apparent that the pattern represented at these saline lakes and marshes was one of fairly stable year-round reliance on wetlands resources.

Several studies have been made of Southwestern coprolites. The sample from Clyde's Cavern in eastern Utah (Hall 1972; Winter and Wylie 1974) reveals the transition from a hunting and gathering economy in late Archaic times to an emphasis on maize agriculture during the Fremont period, or roughly during the first millenium A.D. Sites in the Glen Canyon region yielded evidence of a mixed diet of agricultural crops and wild plant and animal foods, a pattern which characterized Southwestern culture in general (Martin and Sharrock 1964; Callen and Martin 1969; Fry 1970a). Other studies of Southwestern coprolites are those of Colyer and Osborne (1965) and Rohn (1971) on material from Wetherill Mesa, Colorado, and two reports by Fry and Hall (1973;n.d.) on material from Inscription House and Antelope House, pueblo ruins in Arizona.

Coprolites from cave and rockshelter sites in the Amistad Reservoir region of southwestern Texas have been studied by Riskind (1970) and Bryant (1969, 1974a), and reveal a diversified diet of both plant and animal foods, but no evidence of agriculture. A collection of coprolites spanning the period 7500 B.C. to A.D. 300 from

Frightful Cave, Coahuila, Mexico has been studied by Bryant (n.d.) and Fry (n.d.a). The diet of Frightful Cave became increasingly diversified through time, and a total of 37 identifiable seed taxa was recovered. Prickly-pear cactus was a staple throughout the occupation of the cave. Pollen data indicate that it was occupied in the summer and fall.

Wakefield and Dellinger's (1936) study of the intestinal contents of an Ozark mummy, and Jones' (1936) study of excrement from Newt Kash Hollow Shelter, Kentucky have already been alluded to. A large sample of coprolites from Salts Cave, Kentucky has been analyzed (Yarnell 1969; Watson and Yarnell 1966; Schoenwetter 1974; Stewart 1974). The Salts Cave studies show that achenes of sunflower and marsh-elder, maygrass and chenopod seed, and hickory nuts were important in the diet of the cave inhabitants. Much of the plant remains represent cultivated plants, including gourd, squash (erroneously reported as watermelon by Young /1910/), sunflower, marsh-elder, and probably also chenopod. The study of Salts Cave feces is especially thorough, and shows that the cave was well explored in antiquity. Radiocarbon dates on feces range from 710 to 290 B.C. The samples occurred in passages as much as two miles from the entrance of the cave, and were apparently left there by miners seeking mirabilite and gypsum. These minerals are known to have a cathartic effect on the human intestinal tract. Robbins (1971) and Yarnell (1974) also reported on the intestinal contents of a mummified body found in Salts Cave. Findings similar to those at Salts Cave were reported from nearby Mammoth Cave (Marquardt 1974; Bryant 1974; Watson 1974a).

Nissen's (1973) study of a small sample of late prehistoric or historic coprolites from Bamert Cave, Amador County, California is also of interest.

Among Eric Callen's significant contributions to the study of human coprolites are his reports on material from the Ocampo Cave, Tamaulipas (1965, 1967a, 1968), and from caves in the Tehuacan Valley, Puebla, Mexico (1965, 1967b, 1968). These reports detail the transition from hunting and gathering to agriculture in Mesoamerica. Earlier, Callen collaborated with Cameron (1955, 1960) on similar studies of the mixed agricultural/hunting and gathering diet of the prehistoric inhabitants of the site of Huaca Prieta, Peru. The Huaca Prieta studies were the first analyses of human coprolites using the trisodium phosphate method. Williams (1971, n.d.) reported on an analysis of coprolites from northern Chile.

Some interesting studies have been conducted on intestinal and stomach contents of Iron Age human bodies discovered in the course of peat cutting in the bogs of Denmark (Brandt 1951; Helbaek 1950, 1958, 1961). These strange bodies, which come to light from time to time, show evidence that the last meal consisted of a gruel of many different kinds of seeds. The body from Grauballe, Jutland contained the remains of over 60 species of plants, both wild and cultivated. Glob (1969) made a special study of the bog bodies from northwestern Europe, and presented a convincing argument that they represent ritual human sacrifices. This would in turn suggest that the last meals represented in the stomach and intestines of these individuals may not accurately reflect

the diet of Iron Age man in northwestern Europe.

Troels-Smith (1959) analyzed deposits from a Neolithic site on a once-floating peat island in the Aamosen Bog in Denmark. Clusters of strawberry and raspberry seeds are interpreted as the remains of human excrement. In Denmark, these species could be eaten fresh together only in early July. This seasonal dating of the occupation of the peat island is thus independently supported by additional biological information.

Alice Hall (1974) presented a popularized account of the discovery and autopsy of a 2100 year old high status human burial from Ch'angsha, Hunan Province, People's Republic of China. A quantity of melon seeds, the remains of the last meal, was found in the intestine, stomach, and esophagus of this well preserved human body.

Several studies are important in that they have resulted in new information on insects and other arthropods. Radovsky (1970) studied mites found in a Lovelock Cave coprolite and in the intestinal contents of a mummy from Pyramid Lake, Nevada, and discovered a previously unreported mite of the genus Lardoglyphus. Marsh and Callen (1964) studied insects found in human coprolites from Peru and Mexico, and, in view of the age of the samples, concluded that certain unspecified insects previously thought to have been introduced into the New World in historic time are actually indigenous.

Not all fecal remains are of such recent origin as the one heretofore discussed. Henry de Lumley (1966, 1969a, 1969b) reported what he believes are coprolites from the Acheulean sites of Terra Amata and Lazaret, France. He cited a pollen analysis of samples from Terra Amata which suggests that the site was occupied in the spring. Additional information on these 400,000 year old specimens appears in papers by Callen (1969) and Bryant (1974d). Bryant (1974d: 7, 11) reported that the coprolites from Terra Amata contain fragments of marine shell, flecks of charcoal, and a few animal hairs, but little other identifiable material. On the basis of what we have seen reported on these specimens, we are inclined to withhold considering them the coprolites of Homo erectus until further information is available.

Even older evidence of possible hominid paleofecal remains is reported by Leakey (1971) from Upper Bed I, Olduvai Gorge, Tanzania. Small patches of bones found at the site where Olduvai Hominid 10 ("Homo habilis") was recovered include fragments representing rodents, insectivores, birds, and chameleons. Such animals are eaten whole by certain African hunter-gatherer groups today. The lack of decomposition and erosion of the bone fragments, which might occur if the feces were those of carnivorous animals, leads to the conclusion that they are the feces of early hominids. If this reasoning is correct, these are the earliest hominid fecal remains yet reported.

## STUDIES OF ANCIENT PARASITISM

Endoparasites common to the intestinal tract of man can often be detected by analysis of feces for evidence of ova or cysts. Such evidences are also present in coprolites, latrine residues, and intestinal contents of ancient bodies. Samuels (1965) rehydrated coprolites from Wetherill Mesa in a solution of sodium hydroxide and disodium EDTA and noted the presence of pinworm ova (Enterobius vermicularis) in one sample. A large sample of coprolites from the eastern Great Basin and from the Glen Canyon region has been studied by Hall (1969) and Fry and Hall (1969). They report the presence of Acanthocephala eggs (thorny-headed worm, probably Moniliformis clarki) in samples from Danger Cave dating to 9500 B. C. (see also Morre, Fry, and Englert 1969). Further occurrences of this parasite were noted in samples from Hogup Cave, and from Anasazi sites in the Glen Canyon which date to about A. D. 1300. The significance of the Acanthocephala eggs is uncertain, since they may not indicate actual parasitism, but rather false parasitism as a result of eating the viscera of infected rodents, which the worm is known to parasitize. Of more certain significance is the occurrence of pinworm ova in cave samples dating from 8000 B. C. to A. D. 1 (Fry and Moore 1969). The pinworm is an exclusively human parasite. The ova of pinworms and Acanthocephala at Danger Cave are the earliest known evidences of human parasitism yet reported from analysis of fecal remains. Both of these types of ova were also reported in coprolites from Clyde's Cavern, Utah (Hall 1972). The pinworm seems to have been a fairly common parasite in the North American Southwest since evidence of it was also found in coprolites from the Anasazi sites of Inscription House (Fry and Hall 1973) and Antelope House (Fry and Hall n. d.). Moore et al (1974) described a possible human fluke egg in an Anasazi period coprolite from Glen Canyon.

Parasitological analyses were also conducted on large numbers of coprolites from the western Great Basin. Dunn and Watkins (1970) examined 268 samples from Lovelock Cave, as well as the intestinal contents of a mummy from Pyramid Lake, Nevada, and found no clear evidence of endoparasitic infestation. They conclude that at least during the period represented by the dated samples (ca. 250-800 years ago) the human populations from the western Great Basin were apparently free of such afflictions. They did note crystals of the Charcot-Leyden type in one sample, which might have been indicative of infection with the protozoan Entamoeba histolytica, the causative agent of amebic dysentery. However, inasmuch as no cysts of this organism were reported, the crystals may represent an anemic condition on the part of the individual whose feces were analyzed.

Samples of paleofeces from Salts Cave, Kentucky were examined for parasites. Unidentified larval nematodes occurred in one sample (Dusseau and Porter 1974); another contained several ova closely resembling those of the common intestinal roundworm (Ascaris lumbricoides) (Fry 1974). McClary (1972) examined coprolite fragments recovered from a late Middle Woodland context at the Schultz site in Michigan. He found ova tentatively identified as those of the hydatid worm (Echinococcus granulosus) and the fish tapeworm (Diphyllobothrium latum). Since these parasites occur in both

dogs and humans, and since the coprolites could not positively be identified as of human origin, the significance of the findings is difficult to determine. Ova of the fish tapeworm were also tentatively identified in a sample from Huaca Prieta, Peru (Callen and Cameron 1955, 1960), but this identification was never verified. More recently, Allison *et al* (1974) reported finding hookworms (*Ancylostoma duodenale*) in the intestines of a Tiahuanaco (A.D. 890-950) mummy from coastal southern Peru. The study established hookworm infestation in Pre-Columbian South America.

Another parasitological study from the New World is that of Pizzi and Schenone (1954; see also Pizzi 1957) on the mummified, frozen body of a young boy found in a stone structure at an elevation of nearly 18,000 feet in the Andes near Santiago, Chile. This human sacrifice is thought to date just after the Spanish conquest of South America. The intestine of the body contained ova of the whipworm (*Trichuris trichiura*) and possible cysts of *Entamoeba coli*. It was first thought that the whipworm might have spread from the New World to the Old after the discovery of America, but it is now known to have been widespread in the Old World in pre-Columbian times. Witenberg (1961) reported it in coprolites 1800 years old from a cave near the Dead Sea. These samples also contained cysts of *Entamoeba histolytica*, *E. coli*, *Giardia lamblia* and *Chilomastix mesnili*. All of these parasites are still found in modern Israeli populations. *Trichuris* was also found in eleventh century A.D. deposits at Winchester, England, along with eggs of *Ascaris* and *Dicrocoelium dendriticum* (Pike and Biddle 1966; Pike 1967; Taylor 1955). These parasite ova were isolated from material recovered from a wood-lined cesspit.

Parasite ova have been found in the intestinal contents of bog bodies. Helbaek (1958) found whipworm ova in his examination of the Iron Age body from Grauballe, Jutland. Szidat (1944) studied the Dröbnitz Girl (600 B.C.) and the Karwinden Man (A.D. 500), bog bodies from East Prussia. Both of these bodies contained eggs of the common intestinal roundworm (*Ascaris lumbricoides*) and the whipworm. The latter also contained possible eggs of the fish tapeworm (*Bothriocephalus latus* / = *Diphyllobothrium latum* /). The well-preserved body from Ch'angsha, China described by Hall (1974) contained whipworms, pinworms, and schistosomes.

Jansen and Over (1962) reported a long list of parasites in material of human origin from northwestern Germany dating from 100 B.C. to A.D. 500. These included the common intestinal roundworm, whipworm, other *Trichuris* of the species *T. ovis* or *T. globulosa*, sheep liver fluke (*Fasciola hepatica*), pork tapeworm (*Taenia solium*) or beef tapeworm (*T. saginata*), and fish tapeworm (*Diphyllobothrium latum*). Other parasite ova found at the site included those of *Toxocara canis* and *Oxyuris equi*. They also investigated material from a first century A.D. Roman fort at Valkenburg-on-Rhine, Netherlands (Jansen and Over 1966), where ova of whipworm, intestinal roundworm, and *Oxyuris equi* were found. From these data it is apparent that human populations in northwestern Europe in the early centuries A.D. were host to a variety of endoparasites. Middle Age samples from the Netherlands have yielded

evidence of whipworm, either Trichuris ovis or T. globulosa (Jansen and Over 1966), the common intestinal roundworm, and unidentified species of Trichuris and Capillaria (Jansen and Boersema 1972). An annotated bibliography of helminths recovered in archaeological and other ancient contexts has been compiled by Gooch (1972).

The fact that parasite ova can survive in an identifiable state for long periods in archaeological sediments suggests that routine analyses for their recovery can greatly broaden our knowledge of ancient parasitism in man. However, the problem of whether or not such occurrences can be attributed to human origin is not easily settled. The human origin of feces cannot always be readily determined, and the same parasites can often have both human and non-human hosts. For these reasons, studies of parasite ova recovered from archaeological refuse deposits, but attributed to non-human origin (e.g., Grzywinski 1960), may warrant further consideration.

#### PROBLEMS OF METHOD AND INTERPRETATION

In spite of the advances made within the past two decades in analysis of ancient feces, there are certain problems of method and interpretation which remain to be solved. The first of these problems was raised in the preceding paragraph, namely that of determining the human origin of the sample. In the case of material recovered directly from the intestinal tract of preserved bodies, there is no question as to its human origin; however, it is not so easy to make such judgment on coprolites recovered from midden deposits in caves and other dry places. Ever since Callen and Cameron developed the method of rehydrating coprolites with trisodium phosphate, analysts have placed strong emphasis on observations on the behavior of the sample during rehydration. Conventional wisdom held that if the sample is of human origin it will turn the solution a dark opaque brown or black and the original odor will be re-established. These conditions are said not to occur with non-human paleofecal material, and specimens not reacting accordingly have often been rejected from further archaeological consideration. Based on our own experience, we are hesitant to rely on these considerations alone in determining which samples are of human origin and which are not.

A series of coprolites from archaeological sites along the shore of now-dry Lake Cahuilla in the Salton Basin of southeastern California, dating to the interval A.D. 1000-1500, are currently under study by the senior author. The largest samples of these are from sites at the Myoma Dunes, and during rehydration these samples behave in one of two ways. Those which contain large quantities of both burned and unburned fish bones and charcoal, but little or no other identifiable macroscopic plant material, turn the trisodium phosphate solution a light translucent yellow. Others which contain copious amounts of grass seed (Panicum urvilleanum, P. capillare), cattail seed (Typha sp.), sedge seed (Scirpus sp.), mesquite pods (Prosopis juliflora), screwbean pods (Prosopis pubescens), and remains of other plant foods, turn the solution an opaque brown or black, often within a matter of minutes. Of approximately

100 coprolites analyzed to date, none of them has regenerated the characteristic fecal odor which other investigators have often reported to be nearly overpowering. Yet the same coprolites occur abundantly together in the same clearly defined latrine deposits atop the shoreline sand dunes; and virtually all of them contain evidence of food preparation in the form of charccal fragments (which are a result of either roasting food items or parching seeds), burned fish bones, parched and/or milled seeds, etc. Morphologically, all analyzed specimens from the Myoma Dunes resemble human feces. The only domestic animal this prehistoric human population would have possessed is the dog, which admittedly could eat "table" scraps and defecate feces containing similar evidences of food preparation as those of their masters. But there is little reason to believe that domestic dogs would defecate in discrete latrines, and that human feces would be absent. It must therefore be concluded that the coprolites are largely, if not entirely, of human origin.

Parasitological analysis of the Myoma Dunes coprolites is now being undertaken, and perhaps after all is said and done, this will be the most reliable means of determining that certain specimens are definitely of human origin. Man is the only host of the human pinworm (Enterobius vermicularis); the presence of these ova in a coprolite indicates it is of human origin. The problems with parasitological analyses are that not all individuals (or populations) are parasitized by the pinworm; evidence of pinworms in human feces is not expected given the egg laying habits of the parasite (although eggs are frequently reported in coprolites of prehistoric human populations living under apparently unsanitary conditions); a number of common parasites occur in both man and other animals; and both man and other carnivorous animals can display apparent, or false, parasitism. Each of these must be considered.

The absence of regenerated fecal odor in the reconstituted specimens from the Myoma Dunes cannot presently be explained. The coprolites occurred just below the surface of the sand, and were exposed by deflation of the dune surface. Perhaps exposure to an annual average of three inches of rain for more than 400 years leached out the odor-causing agent. Many coprolites were so decomposed as to be unrecoverable, even when carefully exposed with a camel's hair brush; and the fact that all of them have undergone some degree of decomposition is evident both by their friable condition and by the large amounts of fungal spores they contain (P.J. Mehringer, personal communication to P.J. Wilke, March 28, 1975). The partial decomposition of the sample may account for the absence of odor. The analysis of the Myoma Dunes coprolites will be reported elsewhere.

In any event, there is clearly a need for more precise means of determining whether or not coprolites are of human origin. According to R.C. Green (personal communication to P.J. Wilke, March 13, 1975), a recent study by Byrne (1972) includes a discussion of the problems of distinguishing the coprolites of man from those of dogs, and more investigations of this kind are anticipated.

Once the decision is made that the sample is of human origin, and the investigator proceeds to analyze it and separate it into its constituents, the problem arises of determining the significance of those constituents in the former diet. There has never been a consensus of how this problem will be dealt with. After the sample is passed through graded sieves, the greater or lesser fraction of it consists of "fines" that are usually not readily identifiable. In the case of diets wherein cereal grains were thoroughly milled, most or all of the seeds might be so reduced so as to be unrecoverable in an identifiable state. This in no way implies that the unrecoverable item was any less important in the diet than the twenty-odd seeds of Chenopodium or some other species recovered from the same coprolite. One can only assess the importance of items recovered; however there must be a realization that many items are simply not represented or are otherwise not recoverable. Striated muscle fiber, for instance, seldom survives the digestive process to be recoverable in feces. Helbaek (1961) has shown the utility of microscopic examination of intestinal contents for recovery of otherwise undetectable plant remains. Vaughn Bryant, Jr., at Texas A&M University, employs a scanning electron microscope to aid in analysis and in obtaining detailed photographs of minute remains such as pollen grains, phytoliths, etc.

The problem of non-representation of some items closely parallels that of over-representation of others. Inefficient milling, referred to above, is an example of this. Another is the presence of such items as pronghorn antelope hairs, which were common in the Hogup Cave coprolites (Fry 1970b). In terms of weight, which is the way food items are often tabulated, hairs, even when quite abundant, weigh almost nothing. Yet, they might imply conspicuous consumption of meat, or, more likely, they might represent accidental contamination of food with hairs. Among coastal populations feeding on thick-shelled clams and seeds, the clams might be of greater significance on a day-to-day basis than seeds, but they might not be represented in the contents of coprolites except by grains of sand. Problems such as these can often be addressed more satisfactorily with consideration of the floral and faunal remains occurring in the midden, in addition to data derived from coprolites. Bryant's studies (e.g., 1974a) have shown that consumption of flowers, which would be otherwise undetectable, is clearly indicated by high counts of zoophilous (insect borne) pollen.

Diets may vary considerably during different times of the year. This is especially true of seasonally-nomadic hunters and gatherers. Coprolites from seasonal campsites would therefore only document the diet for the segment of the year in which the site was occupied. This seems to be the case at Danger Cave and Hogup Cave in Utah, and for Lovelock Cave in Nevada. We do not at present know where the occupants of Danger and Hogup Caves spent the remainder of the year when they were not in the caves, and the diet during the yet missing portion of the seasonal round may have differed remarkably from that represented in coprolites from the caves, especially if the seasonal round took them to higher elevations in the surrounding mountains. At Lovelock Cave, it would appear that people resorted to the cave for shelter in times of severe winter cold, and that at other times they resided on the shore of nearby Humboldt Lake (Napton

1971). If this population was more sedentary than seasonally nomadic, and relied on lakeside resources throughout the year, the apparent winter diet represented in the coprolites may to a considerable degree apply to other portions of the year as well. Many of the food items represented in coprolites, such as seeds, small fish, etc., can be dried and stored for long periods of time, and therefore the season in which they were the most readily obtained need not be the season in which they were consumed. In such cases, the season of consumption is sometimes reflected in the seasonal variation in the background pollen in the coprolites. Most palynological studies of coprolites (e.g., Bryant 1974a) yield important information on seasonality, and where occupation may be limited to part of the year, they suggest which portions of the seasonal round remain to be investigated.

Some investigators have attempted to interpret the significance of coprolite components by means of statistical manipulations of the data (Fry 1970a; Fry and Adovasio 1970; Marquardt 1974). When such studies are based on the weights of coprolite constituents, they reflect to some degree food preparation habits, such as milling efficiency (or lack of it), as well as dietary habits, and may result in some confusion. It may be more desirable to treat the constituents in terms of presence or absence in the various coprolites in the sample, with allowances for relative abundance of the items represented. Regardless of how sophisticated the manipulations are, there remains the problem of whether or not the sample adequately represents the prehistoric diet. Discussions of this nature are presented by Napton and Heizer (1970: 110-112) and Napton (1971: 242-246). Napton and Heizer compiled a table of archaeological sites from which coprolites have been analyzed, the number of coprolites analyzed, number of years of occupation represented by the sample, and the average number of years represented by each analyzed coprolite (1970: Table 5). Their figures indicate the following: Tehuacan Valley, Mexico, all phases, 1 coprolite per 60 years of occupation; Danger Cave, Utah, 1 coprolite per 230 years of occupation; Salts Cave, Kentucky, 1 coprolite per 9 years of occupation; Hogup Cave, Utah, 1 coprolite per 365 years of occupation; Lovelock Cave, Nevada, 1 coprolite per 12 years of occupation. In assessing the adequacy of the sample from a given site, it is evident that considerably less reliance can be placed on some analyses than others in terms of how well they may reflect day to day dietary practices of a prehistoric population.

At this point, among the most useful studies which might be undertaken are qualitative experiments involving consumption of aboriginal food items and observations of how these are represented in excrement. Much of our present interpretation of aboriginal dietary practices based on paleofecal analyses may in fact be conjectural, since we have little knowledge of the relationships between that consumed, that assimilated during the digestive process, and that eliminated as feces. A useful study along this line is that of Stapleton (1969). This is a study of Maori food habits and the representation of particular food items in feces. Under controlled conditions, specific food items were eaten along with sweet corn as a stool marker to insure that the analyzed feces represented the Maori food items previously consumed. Recovery of food residues

was accomplished by means of flotation with solutions of different specific gravities. Most of the plant and animal food items were recovered in the feces, but scales of sole and flounder were completely lost in the digestive process. In regions wherein comprehensive ethnobotanical and ethnozoological studies have been made, controlled experiments such as this would provide a most objective background for analysis of human coprolites.

#### A NOTE ON THE BIBLIOGRAPHY

Our attempt here has been to draw together the available but often obscure literature on analyses of ancient human feces, and present it as a general summary of the information derived from such studies and the problems inherent in them. The following section lists substantive papers treating analysis of archaeological feces, those which contain significant new data or are of importance to the historical development of human paleofecal research. Abstracts of papers presented at professional meetings have generally been omitted from the listing on the grounds that the pertinent data have subsequently been published. The listing is sufficiently brief that arrangement by category or topic was not considered essential, and the majority of the entries would have had to be included under several topics. Arrangement is alphabetically by author.

We wish to acknowledge our debt of gratitude to colleagues who assisted us in assembling this bibliography by providing references, copies of papers, or translations: R. D. Ambro, V. M. Bryant, Jr., H. Caylor, G. F. Fry, P. S. Gooch, R. C. Green, C. F. W. Higham, R. Jones, S. Lerman, C. W. Meighan, C. Ogilvie, J. P. White, and L. R. Williams. We especially thank R. F. Heizer for his helpful comments and suggestions.

#### ANNOTATED BIBLIOGRAPHY

Aikens, C. Melvin

1967 Excavations at Snake Rock Village and the Bear River No. 2 Site. Salt Lake City: University of Utah, Anthropological Papers 87.

One coprolite from a Fremont cultural assemblage at the Bear River No. 2 site was reconstituted with trisodium phosphate and found to contain seeds of Scirpus and either Amaranthus or Chenopodium, fish bones, and quartz crystals, the latter of which are thought to have come from milling stones.

Allison, Marvin J., Alejandro Pezzia, Ichiro Hasegawa, and Enrique Gerszten

1974 A Case of Hookworm Infestation in a Precolumbian American. American Journal of Physical Anthropology 41: 103-106.

Parasitological examination was made of intestines and feces of a Tiahuanaco

mummy from coastal southern Peru dating from about A. D. 890-950. Hookworms (Ancylostoma duodenale) were found in the small intestine. The feces contain corn, beans, unidentified vegetable material, and meat which had been infested with mites prior to consumption. The food items had been prepared by crushing in a mortar, as indicated by minute silica grains, the condition of the constituents themselves, and the crushed mites. The study establishes hookworm infestation in South America in pre-Columbian times.

Ambro, Richard D.

1967 Dietary-Technological-Ecological Aspects of Lovelock Cave Coprolites. Berkeley: University of California Archaeological Survey, Reports 70: 37-47.

The paper provides a good discussion of the implications of constituent elements of Lovelock Cave coprolites with consideration of artifacts and refuse found at Lovelock and Hidden Caves, Nevada.

Anonymous

1955 Trichuris in an Inca. Tropical Medicine and Hygiene News 4 (2): 6. See listing under Pizzi and Schenone (1954).

Brandt, Inger

1951 Planterester fra et Moselig fra aeldre Jernalder (Borremose) / Piant Remains in the Body of an Early Iron Age Man from Borre Fen. Aarbøger for Nordisk Oldkyndighed og Historie 1951.

A study was made of the plant remains in the intestine and stomach of the body of a man from Borre Fen, northern Jutland. The body dates to the early Iron Age, and was found in 1946. A long list of plant species was represented, the most common being corn spurrey and knotweed. It is thought that the last meal was exclusively vegetarian, and was consumed as a gruel.

Bryant, Vaughn M., Jr.

1969 Late Full-glacial and Postglacial Pollen Analysis of Texas Sediments. PhD dissertation, University of Texas, Austin.

This paper was not examined. It contains information on analysis of 44 human coprolites from southwestern Texas.

Bryant, Vaughn M., Jr.

1974a Prehistoric Diet in Southwest Texas: The Coprolite Evidence. American Antiquity 39: 407-420.

The major emphasis of this contribution is on palynological analysis of coprolites. The sample consisted of 43 specimens dated at 800 B. C. - A. D. 500 from

a rockshelter (41 VV 162) in southwestern Texas. The coprolites reflected a varied diet, including Opuntia, Allium, Chenopodium, Setaria, insects, mammals, reptiles, fish, and other assorted remains. Palynological analysis of the coprolites was directed at discerning which pollens represent ingested food items and which represent normal pollen rain, and to determine the season of site occupation. High pollen frequencies of zoophilous plants (those whose pollen is dispersed by insects) are interpreted as evidence of the consumption of flowers, and occur frequently in the samples. This fact was not apparent from an examination of the macrofossils represented in the coprolites. A spring and summer occupation is inferred.

Bryant, Vaughn M., Jr.

1974b The Eric O. Callen Collection. American Antiquity 39: 497-498.

The extensive collection of slides, comparative specimens, photo-micrographs, line drawings, index cards, etc., of the late Eric O. Callen is now housed at the Laboratory of Anthropology, Texas A&M University, College Station, Texas, 77843, and is available for use by students of coprolite research.

Bryant, Vaughn M., Jr.

1974c Pollen Analysis of Prehistoric Human Feces from Mammoth Cave. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., pp. 203-209. New York: Academic Press.

Seventeen coprolites from Mammoth Cave were analyzed for pollen content and the results compared with macrofossil plant content. Data indicate use of the cave at various seasons. High counts of Cheno-Am pollen correlate with presence of chenopod seed. Similar correlation is suggested with regard to certain Compositae. High counts of zoophilous pollen representing sweetflag, dandelion, and an unidentified member of the Liliaceae point to consumption of flowers.

Bryant, Vaughn M., Jr.

1974d The Role of Coprolite Analysis in Archeology. Austin: Texas Archaeological Society, Bulletin 45: 1-28.

This is perhaps the best recent summary of the methods and applications of coprolite analysis in archaeology.

Bryant, Vaughn M., Jr.

n.d. Pollen Analysis of Prehistoric Human Coprolites from Frightful Cave. To be published in a volume on the archaeology of Frightful Cave, Coahuila, Mexico, edited by W.W. Taylor. (In press).

This paper describes the results of pollen analysis of 47 human coprolites from Frightful Cave, Coahuila, Mexico. The samples span the period from 7500 B. C.

to A.D. 300. Pollen data suggest that during the first 2500 years of occupation the cave was inhabited during the summer and fall, and thereafter during the summer and early fall. Economic pollens present in significant counts supplement dietary information derived from plant macrofossils in the coprolites, point to otherwise undetected consumption of flowers, and suggest differing emphasis on certain plant foods during the span of cave occupation. The paper provides a good discussion of the problems encountered in the interpretation of coprolitic pollen data.

Bryant, Vaughn M., Jr., and Glenna Williams-Dean

1975 The Coprolites of Man. Scientific American 232(1): 100-109.

The authors present a general, readable overview of coprolite analysis, including discussions of the problems, techniques, and potentialities for archaeological research. Many of the points raised in the article are exemplified by data from southwestern Texas coprolite research. The emphasis is on palynological analysis.

Byrne, Denis R.

1972 Prehistoric Coprolites. MA thesis, Department of Anthropology, University of Auckland, Auckland, New Zealand.

This paper was not examined. According to R. C. Green (personal communication to P.J. Wilke, March 13, 1975) it largely concerns analysis of dog coprolites from early sites in New Zealand, but one section is devoted to a discussion of distinguishing the coprolites of dogs from those of humans.

Callen, E.O.

1963 Diet as Revealed by Coprolites. In Science in Archaeology (first edition), Don Brothwell and Eric Higgs, Eds., pp. 186-194. New York: Basic Books.

This article is augmented and updated in the second edition of Science in Archaeology (see Callen 1970).

Callen, E.O.

1965 Food Habits of Some Pre-Columbian Mexican Indians. Economic Botany 19: 335-343.

This synthetic paper traces the development of agriculture in the New World by drawing on data from the author's research on coprolites from Huaca Prieta, Peru, and from caves in Tamaulipas and in the Tehuacan Valley, Puebla, Mexico.

Callen, E.O.

1967a The First New World Cereal. American Antiquity 32: 535-538.

Important data on early cultivation and processing methods were derived from

a comparative study of the contents of coprolites from the Ocampo Caves, Tamaulipas, and from caves in the Tehuacan Valley, Puebla, Mexico. It was found that seeds of Setaria geniculata, a perennial grass, were larger in samples from Tamaulipas than from Puebla during earlier time periods. Maize, however, had appeared earlier in Puebla, and the data are interpreted to indicate that prior to maize cultivation in Tamaulipas, Setaria was cultivated as a cereal crop with selection for larger-seeded varieties. Introduction of maize agriculture apparently brought an end to the cultivation of Setaria in the Tamaulipas region, as indicated by a reduction in seed size. Replicative experiments further indicated that there was a change from milling with the mortar and pestle to the mano and metate with the introduction of maize, a fact which is evident in the condition of the milled Setaria seed fragments in samples dating before and after the beginning of maize agriculture.

Callen, E. O.

1967b Analysis of the Tehuacan Coprolites. In The Prehistory of the Tehuacan Valley, Vol. 1: Environment and Subsistence, Douglas S. Byers, Ed., pp. 261-289. Austin: University of Texas Press.

A total of 237 coprolites recovered from the Tehuacan caves, Puebla, Mexico, was analyzed by the trisodium phosphate method. These were considered to include 116 of human origin and 121 of non-human origin. The results are presented by cultural phase from the earliest, El Riego (pre-5000 B. C.), to the latest, Venta Salada (A. D. 700-1500), with a hiatus from 2300-1500 B. C. Constituent elements are evaluated as they relate to changes and/or continuity in the diet, with special reference to the development of agriculture and changes in method of food preparation over time. The results for the later time periods are slightly misleading in terms of the apparent importance of agricultural crop plants in the diet. This may indicate that the diet revealed in the cave refuse is not reflective of regional subsistence practices for the majority of the population.

Callen, E. O.

1968 Plants, Diet, and Early Agriculture of Some Cave Dwelling Pre-Columbian Indians. Actas y Memorias del XXXVII Congreso Internacional de Americanistas 2: 641-656.

The dietary evidence documenting the transition from hunting and gathering to agriculture in Mexico is described, based on analysis of human coprolites from caves in Tamaulipas and the Tehuacan Valley, Puebla.

Callen, Eric O.

1969 Les Coprolithes de la Cabane Acheuleene du Lazaret, II: Analyse et Diagnostic. In "Une Cabane Acheuleene dans la Grotte du Lazaret," by Henry de Lumley, pp. 123-124. Paris: Société Préhistorique Française, Memoires 7.

Callen describes five of the six coprolites recovered from the Acheulean site of Lazaret (Nice, France). Analysis of their contents leads to the conclusion that one specimen (P15, H3) is probably of human origin, while another (Q12, EAS #1) may be. Two specimens come from carnivores while the remainder (Q12, EAS #2) may not be a coprolite at all.

Callen, E. O.

1970 Diet as Revealed by Coprolites. In Science in Archaeology (second edition), Don Brothwell and Eric Higgs, Eds., pp. 235-243. New York: Praeger Publishers.

An extensive history of coprolite analysis prior to 1970 is presented. The results of Callen's analysis of specimens from Huaca Prieta, Peru, are reviewed, and those from work on coprolites from caves in Tamaulipas and the Tehuacan Valley, Mexico, are discussed in detail.

Callen, Eric O. and Thomas W. M. Cameron

1955 The Diet and Parasites of Prehistoric Huaca Prieta Indians as Determined by Dried Coprolites. Ottawa: Royal Society of Canada, Proceedings June 7, 1955, V: 51-52.

This brief abstract is the initial published report of Callen and Cameron on analysis of coprolites by the trisodium phosphate method. The coprolites were from Huaca Prieta, Peru, and date from about 2500-1200 and 800-500 B.C., and revealed a varied diet consisting of beans, peppers, cucurbits, mussels, fish, clams, sea urchins, crabs, and various fruits. Numerous eggs tentatively identified as of the tapeworm Diphyllobothrium were also noted. It might be noted that this identification has been questioned elsewhere.

Callen, E. O., and T. W. M. Cameron

1960 A Prehistoric Diet Revealed in Coprolites. The New Scientist 8 (190): 35-37, 39-40.

In this pioneer study the authors describe the first rehydration of human coprolites and intestinal contents with trisodium phosphate, using specimens from the Huaca Prieta, Peru. The analysis revealed a diverse diet of cultivated and wild plants and seafoods including cucurbits, beans, peppers, remains of various tubers and other plant materials, clam, mussels, crabs, sea urchins, fish, etc. One specimen contained many objects identified as probably eggs of the fish tapeworm (Diphyllobothrium sp).

Callen, Eric O. and Paul S. Martin

1969 Plant Remains in Some Coprolites from Utah. American Antiquity 34: 329-331.

Eight coprolites from Pueblo III deposits in the Glen Canyon region of southern Utah, previously analyzed for pollen content, were rehydrated with trisodium phosphate and the results of the two analyses compared. One sample had a high percentage of Cleome pollen. This may represent an economically important plant, but was otherwise not represented by other plant parts in the coprolite. In general the pollen analysis did not closely reflect the nonpalynological content of the samples.

Cockburn, Aidan, Robin A. Barraco, Theodore A. Reyman, and William H. Peck  
1975 Autopsy of an Egyptian Mummy. Science 187: 1155-1160.

An autopsy was performed on an Egyptian mummy designated Pum II, radiocarbon dated at 170 B. C. One of the visceral packages contained a portion of the intestine, which was in turn found to contain partially digested meat (striated muscle) fiber and an egg of Ascaris cf. lumbricoides.

Colyer, Marilyn, and Douglas Osborne  
1965 Screening Soil and Fecal Samples for Recovery of Small Specimens.

Samples of soil and human feces from archaeological sites at Wetherill Mesa were analyzed. The procedures employed are discussed, but interpretation of recovered items is not presented. Fecal samples were soaked in a 2% lye solution for 24 hours or more, and then washed through graded brass screens. The residues were then examined under magnification and sorted.

Cowan, Richard A.  
1967 Lake Margin Exploitation in the Great Basin as Demonstrated by an Analysis of Coprolites from Lovelock Cave, Nevada. Berkeley: University of California Archaeological Survey, Reports 70: 21-35.

The author reconstructs lake margin subsistence adaptation in the western Great Basin from analysis of 50 coprolites from Lovelock Cave, Nevada. Data indicate a heavy reliance at Lovelock Cave on fish, birds, and seeds of aquatic plants, a diet which was generally well balanced, including both plant and animal foods. The archaeologically-reconstructed lake margin subsistence pattern is contrasted with the disrupted pattern indicated by Great Basin ethnographies.

Douglas, Charles L.  
1969 Analysis of Hairs from Lovelock Cave Coprolites. In "Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada," Lewis K. Naption, Ed., pp. 1-8. Berkeley: Kroeber Anthropological Society, Special Publications 2.

Reference is made to earlier research on the structure and identification of hairs, both human and non-human. The methods and results of examination of 43 hairs

from Lovelock Cave coprolites are presented. The results are evaluated in terms of the dietary significance of individual hairs as they may or may not represent the use of a given species for food. While the evaluation is in some cases subjective, it might be made more empirical by a consideration of other lines of evidence, such as whether or not the same species are represented by bones in the coprolites or by burned bones occurring in the deposit.

Dunn, Frederick L.

1968 Epidemiological Factors: Health and Disease in Hunter-Gatherers. In Man the Hunter, Richard B. Lee and Irven DeVore, Eds., pp. 221-228. Chicago: Aldine Publishing Company.

Parasitological analysis of Lovelock Cave (Nevada) coprolites is discussed. No eggs or larvae of endoparasitic helminths were found, leading to the conclusion that the prehistoric population was free from such infections. These findings are cast within a discussion of health and disease of hunter-gatherers the world over.

Dunn, F. L. and R. Watkins

1970 Parasitological Examination of Prehistoric Human Coprolites from Lovelock Cave, Nevada. In "Archaeology and the Prehistoric Great Basin Lacustrine Subsistence Regime as Seen from Lovelock Cave, Nevada," Robert F. Heizer and Lewis K. Napton, Eds., pp. 176-185. Berkeley: University of California Archaeological Research Facility, Contributions 10.

A sample of 168 coprolites (ca. 250-800 years old) from Lovelock Cave, and the reconstituted intestinal contents of a mummified body (age unspecified) from a cave at Pyramid Lake, Nevada, were examined for evidence of human endoparasites. Forty-three of the coprolite samples were rehydrated and examined; the remainder consisted of previously rehydrated fine screenings, from which smears were made. Sixteen samples were cultured in an attempt to isolate viable bacteria, with negative results. One coprolite yielded crystals of the Charcot-Leyden type, suggestive of infection with the intestinal protozoan Entamoeba histolytica, but no cysts were found. Sarcoptiform mites were present in dry screenings of one coprolite and are described elsewhere (Radovsky 1970). Unidentified rhabditoid nematodes were encountered in six coprolites, but these do not represent endoparasitic infestation. No common parasitic helminth eggs were found, but unidentified eggs, one of which was of an apparent fasciolid trematode, were seen in small numbers in three samples. The reconstituted fecal material from the mummy yielded evidence of rhabditoid nematodes and an apparent new species of mite. The authors conclude that the Lovelock population was largely free of most common endoparasitic infections.

Dusseau, Elizabeth M., and Richard J. Porter

1974 The Search for Animal Parasites in Paleofeces from Upper Salts Cave. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., p. 59. New York: Academic Press.

Thirteen fecal specimens from Upper Salts Cave, Kentucky were examined for evidence of parasites; larval nematodes were found in one. It was determined that these were not Enterobius, but no positive identification was possible. They may represent a species of the genus Strongyloides or a hookworm.

Follett, W.I.

1967 Fish Remains from Coprolites and Midden Deposits at Lovelock Cave, Nevada. Berkeley: University of California Archaeological Survey, Reports, 70: 93-116.

Fish remains were recovered from both coprolites and midden deposits. Tui Chub (Gila / Siphateles/ bicolor), Lahontan Speckled Dace (Rhinichthys osculus), and Tahoe Sucker (Catostomus tahoensis) were present in coprolites. The remains recovered from the midden included Cui-ui (Chamistes cujus), Tahoe Sucker, and Tui Chub. The sources of these fish for the prehistoric cave inhabitants are discussed, with the conclusion that some of them were probably secured at remote localities, such as Winnemucca Lake, Pyramid Lake, and the Truckee River. No evidence of trout was found.

Follett, W.I.

1970 Fish Remains from Human Coprolites and Midden Deposits Obtained During 1968 and 1969 at Lovelock Cave, Churchill County, Nevada. In "Archaeology and the Prehistoric Great Basin Lacustrine Subsistence Regime as Seen from Lovelock Cave, Nevada," Robert F. Heizer and Lewis K. Napton, Eds., pp. 163-175. Berkeley: University of California Archaeological Research Facility, Contributions 10.

Fourteen coprolites yielded more than 5800 remains of at least 98 fish, all but one of which was identified as the Tui Chub (Gila / Siphateles/ bicolor). These were probably swallowed whole. The other fish was a Tahoe Sucker (Catostomus tahoensis). Tui Chub and Cui-ui (Chamistes cujus) were identified from remains recovered in the midden.

Fonner, Robert L.

1957a. Mammal Feces from Danger Cave. In "Danger Cave," by Jesse D. Jennings, p. 303. Salt Lake City: University of Utah, Anthropological Papers 27.

This brief paper reports the analysis of four specimens tentatively identified as bear feces. The diet revealed in each sample was omnivorous, but in each case

contained seeds of Allenrolfea occidentalis. In three of the samples the seeds appeared to have been lightly milled, as only about fifty percent of the seed was intact. The samples are probably of human origin, and the study serves to illustrate the ongoing problem of separating human from non-human coprolites.

Fonner, Robert L.

1957b Mammal Feces from Juke Box Cave. In "Danger Cave," by Jesse D. Jennings, p. 304. Salt Lake City: University of Utah, Anthropological Papers 27.

Ten coprolites from Juke Box Cave, Utah, were analyzed by dry separation. The samples all contained seeds of Allenrolfea occidentalis, and all but one contained bone fragments also. The diet represented in the samples is that of the western Archaic foraging pattern. The seeds of Allenrolfea in the samples appeared to have been milled slightly, as about fifty percent of them were ground or broken. This would seem to rule out the possibility of non-human origin for the coprolites.

Fry, Gary F.

1968 Prehistoric Diet at Danger Cave, Utah as Determined by the Analysis of Coprolites. Salt Lake City: MA thesis, Department of Anthropology, University of Utah.

This preliminary study of prehistoric diet at Danger Cave is based on a sample of 43 specimens. The samples spanned more than 9500 years of time, and there is evidence of increasing diversity in the diet over time. The study is augmented and expanded in a later work (Fry 1970a).

Fry, Gary F.

1970a Prehistoric Human Ecology in Utah, Based on the Analysis of Coprolites. PhD dissertation, Department of Anthropology, University of Utah, Salt Lake City.

A total of 146 human coprolites from sites in the Glen Canyon and from Danger and Hogup Caves, spanning the period from 10,000 B.C. to A.D. 1850, were analyzed for dietary, chemical, and pollen content, and for evidence of parasitic infestation. Evidence suggests that human lifeway during Archaic time in the desert regions of northwestern Utah may have remained essentially unchanged for 10,000 years. A partial shift toward grassland conditions and use of grassland resources occurred thereafter. The Glen Canyon sites were occupied by Anasazi populations, and coprolite evidence indicates diverse environmental conditions and patterns of exploitation. The prehistoric Utah populations were parasitized by the human head louse, pinworm, and perhaps the thorny-headed worm and a species of tapeworm.

Fry, Gary F.

- 1970b Preliminary Analysis of the Hogup Cave Coprolites. In "Hogup Cave," by C. Melvin Aikens, Appendix III, pp. 247-250. Salt Lake City: University of Utah, Anthropological Papers 93.

In this preliminary analysis of coprolites from Hogup Cave, a total of 27 specimens was studied for dietary information. These represent most of the recognized strata in the cave and span nearly all of the 8500 years of occupation. Long-term trends in the diet are seen as a general decline over time in the use of pickleweed (Allenrolfea occidentalis) seed, consumption of generally unidentified grass seeds only during the later Fremont and Shoshoni occupations, and the presence of maize only during Fremont time. Seventy-five specimens representing the entire period of cave occupation were analyzed for evidence of endoparasitic infestation. Eggs of the thorny-headed worm, probably the species Moniliformis clarki, were found in one sample dating between 6400 and 4865 B. C., and in another dating to about 2000 BC. The author discussed the problem of interpreting whether such eggs indicate actual parasitism or false parasitism. Eggs of the human pinworm (Enterobius vermicularis) occurred in samples from 2000 to 4500 years old.

Fry, Gary F.

- 1974 Ovum and Parasite Examination of Salts Cave Human Paleofeces. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., p. 61. New York: Academic Press.

Eight paleofecal samples from Upper Salts Cave, Kentucky, were examined for evidence of human endoparasites. One sample contained several eggs that closely resemble those of the genus Ascaris, and probably indicate infection with the common intestinal roundworm, Ascaris lumbricoides.

Fry, Gary F.

- n.d. a Analysis of Human Coprolites from Frightful Cave. In Excavations in Coahuila, Mexico, Vol. II: The Excavation of Frightful Cave, W. W. Taylor, Ed. Carbondale: Southern Illinois University Press (in press).

Some 32 human coprolites were recovered from 3 stratigraphic units of Frightful Cave, Coahuila, Mexico, the occupation of which spanned the period ca. 7500 B. C. to A. D. 300. The feces were analyzed for dietary and parasite information. The dietary analysis supports the concept of broad spectrum resource utilization with over 37 identifiable seed taxa being recovered. Prickly pear cactus appears in greatest abundance, being a staple throughout the cave's occupation. Roots and tubers are also well represented. Meat was supplementary to this vegetal diet. An expansion of the food base is indicated after 2000 B. C. (top level) by an addition of regular diets of mixed seeds, many of which appear first in this level. Thus the established resource

base is added to rather than changed. The investigation for intestinal parasites yielded negative results.

Fry, Gary F.

n.d.b Prehistoric Diet and Parasites in the Desert West of North America. Paper read at the IXth International Congress of Anthropological and Ethnological Sciences (Aug.-Sept., 1973), Chicago. (ms 1973, in press).

The author provides a general summary of coprolite work in the Desert West on samples from the Glen Canyon and from Danger and Hogup Caves, Utah, and from caves in western Nevada. Dietary differences through space and time are described. Evidence of prehistoric parasitic infestation in human populations in the Desert West is reviewed.

Fry, Gary F.

n.d.c Prehistoric Diet. In "The Great Basin," Warren L. D'Azevedo, Ed. Vol. IX of Handbook of North American Indians. Washington: Smithsonian Institution. (ms 1972, in press).

The dietary data available from these two Archaic sites were subjected to Factor Analysis, Stepwise Discriminant Analysis, and Mean Linkage Cluster Analysis. The results, in combination with intestinal parasite data for both sites, support the authors' contention that, despite geographical proximity, contemporaneity of occupation, and the cultural and ecological similarities of the two sites, the sociopolitical groups inhabiting each seldom, if ever, inhabited the other.

Fry, Gary F. , and Henry J. Hall

1969 Parasitological Examination of Prehistoric Human Coprolites from Utah. Utah Academy of Sciency, Arts, and Letters, Proceedings 46 (2): 102-105.

Samples of 193 coprolites from Danger Cave, Hogup Cave, and sites in Glen Canyon, Utah, were rehydrated with trisodium phosphate and examined for evidence of parasites. Ova were concentrated using a modified formalin-ether concentration technique. Eggs of Acanthocephala were present in samples from all three localities, but whether actual parasitism or false parasitism is indicated could not be determined. The samples dated from ca. 9500 B. C. to A.D. 1300. Evidence of pinworm (Enterobius vermicularis) was found in the cave samples dating from ca. 8000 B. C. to A.D. 1.

Fry, Gary F. , and Henry Johnson Hall

1973 The Analysis of Human Coprolites from Inscription House: Preliminary Report. Report to the National Park Service, Arizona Archaeological Center, Tucson.

Sixteen human coprolites recovered from three excavated rooms of Inscription House, Nitsin Canyon, Arizona, and culturally affiliated with the Anasazi Tsegi Phase (A. D. 1250-1300), were analyzed for dietary and parasite information. The diet proved to be composed of a wide range of plant foods. Zea predominated and beans occurred in four specimens, but squash was absent. Zea, peppergrass, and cactus composed the major meal type, although 10 other seed genera are well represented. Evidence suggests a sparse intake of meat. Fine grit in quantity indicated the practice of seed milling while the general occurrence of charcoal points to seed roasting. The parasite investigation yielded large numbers of ova of the human pinworm (Enterobius vermicularis).

Fry, Gary F., and H. J. Hall

n.d. Human Coprolites from Antelope House: Preliminary Analysis. Kiva (ms 1974, in press).

Forty-six human coprolites from Pueblo II and III levels of two rooms excavated at Antelope House, Canyon de Chelly, Arizona, were selected for dietary and parasite analysis. More than twenty plant taxa were identified, most of them represented by seeds. Zea predominated, but other domesticates, squash and cotton, were well represented. Meat intake, indicated by bone, turkey feathers, animal hair, and in one instance grasshopper, was relatively substantial. Dietary complexity differed significantly between the two rooms, and appears to increase from P-II to P-III times. The population at this site was parasitized quite heavily by the human pinworm (Enterobius vermicularis).

Fry, Gary F., and John G. Moore

1969 Enterobius vermicularis: 10,000 Year-old Human Infection. Science 166: 1620.

Eggs of the pinworm (Enterobius vermicularis) were found in coprolites from Danger Cave and Hogup Cave, Utah, in samples with radiocarbon ages of from  $650 \pm 100$  to  $7837 \pm 630$  years. Since the pinworm is found only in man, the eggs represent actual parasitic infection. The incidence of infection in the prehistoric populations of the caves is believed to be generally comparable with that in contemporary human populations.

Glob, P. V.

1954 Lifelike Man Preserved 2000 Years in Peat. National Geographic Magazine 105: 419-430.

This article deals primarily with the bog body referred to as the Tollund Man, but includes reference to other similar finds. It also includes a discussion of the stomach and intestinal contents of bog bodies.

Glob, P. V.

1969 The Bog People. Ithaca: Cornell University Press.

This summary work on the bog bodies from northwestern Europe contains much valuable information on analysis of the contents of the stomach and intestines of these uniquely preserved bodies.

Gooch, P. S.

1972 Helminths in Archaeological and Prehistoric Deposits. St. Albans, U.K.: Commonwealth Institute of Helminthology, Annotated Bibliography No. 9.

Thirty-two papers treating ancient helminth remains, both archaeological and non-archaeological, are listed and annotated. The archaeological helminths are from coprolites, intestinal contents of bodies, and latrine deposits.

Goslin, Robert M.

1957 Food of the Adena People. In The Adena People No. 2, by William S. Webb and Raymond S. Baby, pp. 41-46. Columbus: Ohio State University Press. (Published for the Ohio Historical Society).

Brief consideration is given to analysis of coprolites from Newt Kash Hollow Shelter, Kentucky, within the context of a discussion of Adena food items.

Grzywinski, Leszek

1960 Analysis of Feces from the Middle Age Period. *Zoologica Poloniae* 10 (3): 195-199.

Ova of Fasciola hepatica were found in fecal samples recovered from a settlement occupied from the eleventh to the thirteenth century A.D. on an island in the Odra River, Poland. The samples are thought to be from feces of domesticated animals, but the reference is included here because it illustrates the problems of interpretation which arise in instances where the same parasite occurs in both humans and other animals.

Hall, Alice J.

1974 A Lady from China's Past. National Geographic Magazine 145: 660-681.

A well-preserved 2100 year-old high status human burial from Ch'angsha, Hunan Province, People's Republic of China was recovered and subjected to detailed autopsy. The intestine, stomach, and esophagus contained 138 melon seeds, the remains of the last meal. Parasites recovered from the internal organs were whipworms, pinworms, and schistosomes.

Hall, H. J.

- 1969 Rehydration and Concentration of Parasite Ova in Human Coprolites from the Great Basin. Unpublished manuscript on file at the Department of Anthropology, University of Utah, Salt Lake City.

Methods for the recovery of parasite ova from human coprolites are discussed. Satisfactory results were obtained by rehydration with trisodium phosphate and concentration of the ova by means of a modified version of the formalin-ether technique of Ritchie (1948). The procedure for rehydration, concentration, preparation of microscope slides, and obtaining photomicrographs is described. The method was used successfully for recovery of ova of thorny-headed worm (*Acanthocephala*) and pinworm (*Enterobius vermicularis*) from Great Basin coprolites.

Hall, Henry Johnson

- 1972 Diet and Disease at Clyde's Cavern, Utah, as Determined via Paleoscatology. MA thesis, Department of Anthropology, University of Utah, Salt Lake City.

Twenty human coprolites from Clyde's Cavern, Utah, spanning a 2300 year period, were analyzed for dietary components and evidence of endoparasites. Eighty percent of the coprolites were assigned to the Fremont occupation (A.D. 400-1200). The provenience of five samples could not be determined, and these were excluded from the discussion of diet. The reconstructed diet included a variety of seeds and non-seed plant materials, but little evidence of animal foods was found. Corn became a staple item in the diet only in the later occupational levels. Pinworm (*Enterobius vermicularis*) ova were found in four coprolites. Eggs of what appeared to be the thorny-headed worm (Phylum *Acanthocephala*) were found in two coprolites; and probable larval threadworms (*Strongyloides* sp.) occurred in one. Both of these tentative identifications were on material from Fremont levels.

Häntzschel, Walter, Farouk El-Bax, and G. C. Amstutz

- 1968 Coprolites: An Annotated Bibliography. Geological Society of American, Memoirs 108.

While this bibliography is largely devoted to studies of non-human coprolites occurring in older geological deposits, there are also a few references to work on material of human origin.

Harshberger, J. W.

- 1896 The Purposes of Ethno-botany. Botanical Gazette 21: 146-154.

Harshberger suggested (p. 150) already in 1896 that examination of human fecal material might lead to identification of seeds consumed as food.

Heizer, Robert F.

1960 Physical Analysis of Habitation Residues. Viking Fund Publications in Anthropology 28: 93-157.

Attention is drawn (pp. 108-109) to early work in analysis of prehistoric feces.

Heizer, Robert F.

1967 Analysis of Human Coprolites from a Dry Nevada Cave. Berkeley: University of California Archaeological Survey, Reports 70: 1-20.

The paper provides a good general summary of early coprolite work at Berkeley utilizing reconstituted material from Lovelock Cave, Nevada. Matters of analytical procedure, dietary constituents, seasonality of diet represented, investigations for parasites, and problems of interpretation of results are treated. The results are presented as they relate to the cultural ecology of the western Great Basin, and to prehistoric lifeway of hunter-gatherers in general.

Heizer, Robert F.

1970 The Anthropology of Prehistoric Great Basin Human Coprolites. In Science in Archaeology (second edition), Don Brothwell and Eric Higgs, Eds., pp. 244-250. New York: Praeger Publishers.

This article discusses the relative merits of the dry and wet analytic procedures and summarizes the results of early coprolite research on materials from Lovelock Cave, Nevada. It also provides a discussion of the "second harvest," as practiced by Indians of Baja, California, which is probably the earliest form of coprolite analysis.

Heizer, Robert F. and Lewis K. Napton

1969 Biological and Cultural Evidence from Prehistoric Human Coprolites. Science 165: 563-568.

A comprehensive summary of early work on coprolites is presented, tracing the development of research methods and their application in archaeology. This is followed by a discussion of Lovelock Cave (Nevada) coprolite research and its significance for a reconstruction of prehistoric subsistence patterns in the western Great Basin.

Heizer, Robert F., and Lewis K. Napton (Eds.)

1970 Archaeology and the Prehistoric Great Basin Lacustrine Subsistence Regime as Seen from Lovelock Cave, Nevada. Berkeley: University of California Archaeological Research Facility, Contributions 10.

The volume presents background data for analysis of coprolites from Lovelock Cave, and also from Humboldt Cave and caves near Pyramid Lake, Nevada. It includes

an excellent summary paper on the coprolite analysis (Napton and Helzer 1970), and papers on fish remains in the coprolites (Follett 1970), analysis for parasites (Dunn and Watkins 1970), and mites (Radovsky 1970).

Helbaek, Hans

1950 Tollund Mandens Sidste Maaltid /Tollund Man's Last Meal/. Copenhagen: Aarbøger for Nordisk Oldkyndighed og Historie 1950: 311-341.

This paper describes the contents of the last meal of the Tollund bog body from Denmark. The food remains in the stomach and intestine were strictly vegetable, and a long list of plant remains is presented and described. (Text in Danish; English summary.)

Helbaek, Hans

1958 Grauballemandens Sidste Maaltid /The Grauballe Man's Last Meal/. Kuml 1958: 83-116.

This paper describes the contents of the stomach and intestines of a well-preserved body found in a bog at Grauballe, central Jutland, in 1952. The 610 cc. of food remains consisted mostly of plant material representing over sixty different species. There were both cultivated cereal grains (hulled barley, rye, spelt, oats, emmer), and a great many species of wild herb and grass seeds. Polygonum lepathifolium was particularly abundant. The data are interpreted to indicate that the last meal was consumed as a gruel. The fact that the plant remains were all storable and the lack of seasonally available vegetables, berries, and pot herbs suggest that it was eaten during the winter. The contents are compared with those from the body of Tollund Man (early Iron Age), which included many of the same species. It is thought that both of these bodies, and one from Borremose, represent Iron Age Midwinter Festival ritual sacrifices. Numerous eggs of Trichuris trichiura were also found in the intestine of Grauballe Man, indicating parasitic infestation. (Text in Danish; extensive summary in English.)

Helbaek, Hans

1961 Studying the Diet of Ancient Man. Archaeology 14: 95-101.

Available evidence and methods of studying ancient diets are summarized. Consideration is also given to analysis of intestinal contents of the Grauballe bog burial from Jutland, which dated from the 5th or 6th century A.D. The intestinal tract contained the remains of 66 species of plants, of which only seven were cultivated, as well as bone splinters and large numbers of intestinal worm eggs.

Jansen, J., Jr., and J.H. Boersema

1972 De Wormeieren uit de Latrines van het Poorthuis /Helminth Eggs from the Latrines of Olofskapel Gatehouse, Amsterdam/. In "Vondsten Onder

de Sint Olofshapel," p. 41. Stadskernonderzoek in Amsterdam. Amsterdam: University of Amsterdam, Institute of Pre- and Proto-history.

Samples from the latrines of the Olofshapel Gatehouse in Amsterdam, dating to the period A.D. 1370-1425, were examined for parasites. One sample contained about 150 eggs of Trichuris trichiura per gram, and the other about 780 per gram, plus about 20 Ascaris lumbricoides per gram and other unidentified Trichuris and Capillaria. Taenia may also have been present originally but deteriorated. (Text in Dutch.)

Jansen, J., Jr., and H.J. Over

1962 Het Voorkomen van Parasieten in Terpmateriaal uit Noordwest Duitsland / Findings of Parasites in Protohistoric Material from Northwest Germany/. Tijdschrift voor Diergeneeskunde 87: 1377-1379.

Material of human origin from a site in northwestern Germany which was occupied from about 100 B.C. to A.D. 500 contained ova of Ascaris lumbricoides, Trichuris trichiura, T. ovis or T. globulosa, Fasciola hepatica, Taenia solium or T. saginata, and Diphyllobothrium latum. The site also yielded ova of Toxocara canis and Oxyuris equi. (Text in Dutch; summary in English).

Jansen, J., Jr., and H.J. Over

1966 Observations on Helminth Infections in a Roman Army Camp. Rome: International Congress for Parasitology I, Proceedings II: 791.

A first century A.D. Roman fort at Valkenburg-on-Rhine, Netherlands, yielded material containing ova of Trichuris trichiura, Ascaris lumbricoides, and Oxyuris equi. Middle Age deposits at the same site yielded samples containing ova of T. trichiura and T. ovis or T. globulosa.

Jennings, Jesse D.

1953 Danger Cave: A Progress Summary. El Palacio 60: 179-213.

The author gives a preliminary assessment of coprolites from Juke Box Cave, western Utah. These were considered by another investigator to be of non-human origin, but close observation revealed that seeds in them had been parched and milled, and they were thus human coprolites. This was the first serious attempt at human coprolite analysis in the Great Basin.

Jones, F. Wood

1908 The Pathological Report. The Archaeological Survey of Nubia, Bulletin 2: 55-64. (Dec. 1, 1907- March 31, 1908). Cairo: National Printing Department.

Wood Jones briefly refers to dietary items identified in the preserved intestines of salt-mummified bodies. Among the most common were melon and grape seeds and barley husks.

Jones, F. Wood

- 1910 Mode of Burial and Treatment of the Body. In "Report on the Human Remains," by G. Elliott Smith and F. Wood Jones, Chapt. V, pp. 181-220. Volume II of the Archaeological Survey of Nubia, Report for 1901-1908. Cairo: National Printing Department.

This is one of the extensive volumes treating salvage of Nubian antiquities prior to construction of the dam at Aswan, and contains early, although brief, observations on the contents of human feces. On pages 189 and 191 the author describes fecal casts of the rectum sometimes preserved in Predynastic bodies (ca. 1000 B. C.). There were found to contain husks of barley and other coarse vegetal ingredients. Well preserved salt-mummified bodies were recovered from early Christian cemeteries of the Byzantine Period. The intestines of these contained barley and vegetable fibers, melon and grape seeds.

Jones, Volney H.

- 1936 The Vegetal Remains of Newt Kash Hollow Shelter. In "Rock Shelters of Menifee County, Kentucky," by W. S. Webb and W. D. Funkhouser, pp. 147-167. Lexington: University of Kentucky, Reports in Archaeology and Ethnology 3.

Vegetal remains from human feces recovered at Newt Kash Hollow Shelter, Kentucky, and those taken directly from the midden, are described. Common plant remains in the feces were seeds of goosefoot (Chenopodium cf. nuttalliae), marsh elder (Iva cf. ciliata), canary grass (Phalaris caroliniana), and nut shell, including that of the hickory nut (Carya spp.). Some of the seeds, particularly those of the goosefoot and marsh elder, were much larger than normally occur in wild populations, and are considered to have been cultivated with selection for larger seed size.

Kelso, Gerald

- 1970 Hogup Cave, Utah: Comparative Pollen Analysis of Human Coprolites and Cave Fill. In "Hogup Cave," by C. Melvin Aikens, Appendix IV, pp. 251-262. Salt Lake City: University of Utah, Anthropological Papers 93.

This palynological investigation of thirty-seven coprolites representing a time period from ca. 7000 B. C. to ca. A. D. 1500 revealed a high percentage of Chenocams (probably pickleweed). Artemisia and other Compositae, as well as Gramineae, became more prominent after A. D. 400. In general, the results reflect

a shift from xeric to more mesic conditions, with a concomitant dietary shift from halophytic to grassland species. The pollen record of the coprolites is compared with that of the cave fill and with that of coprolites from Danger Cave located across the salt flats to the southwest.

Leakey, Mary D.

1971 Olduvai Gorge, Volume 3: Excavations in Beds I and II, 1960-1963.  
Cambridge: Cambridge University Press.

Excavations at site FLK N I, upper Bed I, Olduvai Gorge, Tanzania, revealed a living floor on which were found a fossil big toe bone (designated Olduvai Hominid 10, and classified as Homo habilis) and small patches of minute bone fragments believed to be the remains of feces. Associated fauna is of Upper Villafranchian age. The bone fragments in the presumed fecal remains include those of rodents, insectivores, birds, and chameleons. Such vertebrates are eaten whole by some African hunter-gatherer groups today; and the lack of decomposition of the bones which might occur if the feces were of carnivore origin leads to the conclusion that they are the remains of feces of early hominids (p. 67).

Loud, Llewellyn L., and M. R. Harrington

1929 Lovelock Cave. Berkeley: University of California Publications in American Archaeology and Ethnology 25(1).

The authors dwell briefly (p. 35) on the contents of human excrement in Lovelock Cave, Nevada, noting that it represents a coarse diet of seeds, hulls, and plant fibers.

de Lumley, Henry

1966 Les Fouilles de Terra Amata á Nice. Bulletin de Musée D'Anthropologie Préhistorique de Monaco 13: 29-52.

The excavations of the Acheulean site of Terra Amata yielded what are thought to be human coprolites in abundance. The author cites a pollen analysis of these specimens by Jacques-Louis de Beaulieu, wherein a spring occupation of the site is suggested by the presence of broom (genista) pollen. (Text in French; English summary.)

de Lumley, Henry

1969a Les Coprolithes de la Cabane Acheuleene du Lazaret, I: Etude Morphologique. In "Une Cabane Acheuleene dans la Grotte du Lazaret," by Henry de Lumley, pp. 121-122. Paris: Société Préhistorique Française, Memoires 7.

Six coprolites recovered from the Acheulean site of Lazaret (Nice, France) are morphologically described.

de Lumley, Henry

1969b A Paleolithic Camp at Nice. Scientific American 220(5): 42-50.

Analysis of pollen from 400,000 year old coprolites recovered from the paleolithic site of Terra Amata on the Mediterranean coast of France showed that early occupation there occurred primarily during the spring and summer.

Marquardt, William H.

1974 A Statistical Analysis of Constituents in Human Paleofecal Specimens from Mammoth Cave. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., pp. 193-202. New York: Academic Press.

Dietary data from 27 human coprolites from Mammoth Cave, expressed as weights of dietary components per specimen, were subjected to contingency, correlation, and factor analytic statistical techniques. The results of each technique were compared with the other two and also with the results obtained from a contingency analysis of coprolites from Salts Cave. The correlation technique is preferred to the contingency method, while factor analysis adds detail to the variation.

MacNeish, Richard S.

1958 Preliminary Archaeological Investigations in the Sierra de Tamaulipas, Mexico. Washington: American Philosophical Society, Transactions 48(6).

A superficial analysis of some 11 human coprolites recovered from La Perra deposits provided supporting evidence to the conclusion that this was primarily a food-gathering culture. Grasshoppers, snails, agave fibers, and possibly squash seeds were represented in the feces and thus in the diet.

Marsh, D. C.

1965 Some Insects and Vertebrates Recovered from the Coprolites of Prehistoric Indians of Southwestern Tamaulipas, Mexico. MSc thesis, McGill University, Montreal, Canada.

Not examined. According to Hantzschel, El-Baz, and Amstutz (1968: 74), the paper treats faunal remains in coprolites mostly of human origin from the Ocampo Caves, Tamaulipas, excavated by R. S. MacNeish. The samples date from the period 7000 B. C. to A. D. 1700.

Marsh, D. C., and E. O. Callen

1964 Pre-Columbian Insects from Tamaulipas. Phytoprotection 45: 134 (abstract).

Coprolites from Peru and Mexico, upon rehydration, yielded insect remains.

coprophagous insects, those trapped accidentally, and those ingested with food, such as the fruit fly (Drosophila sp.), are represented. In view of the antiquity of some of the coprolites, certain /unspecified/ insects heretofore thought to have been introduced to the New World are considered indigenous.

Martin, Paul S., and Floyd W. Sharrock

1964 Pollen Analysis of Prehistoric Human Feces: A New Approach to Ethnobotany. American Antiquity 30: 168-180.

Feces of both human and non-human origin from Basketmaker and Pueblo archaeological sites in the Glen Canyon region of southern Utah were examined for pollen. Comparison of the pollen types in human vs. non-human feces aided in determining which pollens represented economically important plants in the aboriginal diet. The coprolites in general showed a wide range of variation in pollen content.

McClary, Andrew

1972 Notes on Some Late Middle Woodland Coprolites. In "The Schultz Site at Green Point: A Stratified Occupation Area in the Saginaw Valley of Michigan," James E. Fitting, Ed., pp. 131-136. Ann Arbor: University of Michigan, Museum of Anthropology, Memoir 4.

Twenty apparent coprolite fragments from a late Middle Woodland context at the Schultz site, Michigan, were examined for evidence of endoparasites. It was not possible to determine definitely if the coprolites were those of humans or of dogs. One coprolite contained an object that was tentatively identified as a taeniid egg, possibly Echinococcus granulosus, the hydatid worm, which infests dogs and sometimes humans. Another coprolite yielded several eggs which closely resemble those of Diphyllobothrium latum, the fish tapeworm, which also infests both man and dogs.

McFadden, Max W.

1966 Discovery of Fossils of Hermetia illucens (Linnaeus) in Mexico, Washington: Entomological Society of Washington, Proceedings 68: 56.

Examples of larval (early instar) soldier fly (Hermetia illucens) were found in coprolites 260-4300 years old from unspecified caves excavated by R. S. MacNeish in Tamaulipas, Mexico.

Moore, J.G., G. F. Fry, and E. Englert, Jr.

1969 Thorny-headed Worm Infection in North American Prehistoric Man. Science 163: 1324-1325.

Eggs of Acanthocephala, probably of the species Moniliformis clarki (thorny-headed worm) were found in coprolites from Danger Cave, Utah, with radiocarbon ages of the order of 2000 to 4000 years. The life cycle of the parasite involves an arthropod intermediate host, and at present rodents in the vicinity of the cave are definitive hosts.

The prehistoric human populations could have become definitive hosts by ingesting the arthropod intermediate host, or the eggs may indicate false parasitism, a result of the ingestion of the viscera of infected rodents.

Moore, J.G., A.W. Grundmann, H.J. Hall, and G.F. Fry

1974 Human Fluke Infection in Glen Canyon at A.D. 1250. American Journal of Physical Anthropology 41: 115-118.

A human coprolite dating from A.D. 1250 yielded a single egg resembling those of flukes of the genera Opisthorchis, Clonorchis and Heterophyes. Whether the egg represents true parasitism, i.e., ingestion of flukes by eating the viscera of game animals, could not be determined.

Napton, Lewis K., Ed.

1969a Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada. Berkeley: Kroeber Anthropological Society, Special Publication No. 2.

This volume is a compendium of several papers on coprolite analysis and inferences drawn therefrom. It includes a preface (Napton and Heizer 1969), an analysis of hair recovered from coprolites (Douglas 1969), analysis of avian remains (Napton and Brunetti 1969), a palynological analysis (Napton and Kelso 1969), and a synthetic paper on the reconstructed subsistence pattern (Napton 1969b). The papers are based on earlier work on Lovelock Cave coprolites, and further analysis of a large number of specimens, reported in later works, provided much additional information not reported herein.

Napton, Lewis K.

1969b The Lacustrine Subsistence Pattern in the Desert West. In "Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada," Lewis K. Napton, Ed., pp. 228-98. Berkeley: Kroeber Anthropological Society, Special Publication 2.

The paper provides a reconstruction of a lacustrine-oriented subsistence pattern in the western Great Basin, based in large part on evidence derived from analysis of coprolites from Lovelock Cave, Nevada.

Napton, Lewis K.

1971 Archaeological Investigations in Lovelock Cave, Nevada. PhD dissertation, Department of Anthropology, University of California, Berkeley.

In this volume Napton presents the results of extensive investigation of the archaeological deposits in Lovelock Cave, Nevada. The emphasis is on analysis of coprolites and reconstruction of the lacustrine-oriented subsistence pattern in the Desert

West. A variety of analyses, many reported elsewhere, are synthesized with reference to previous studies in the well-watered portions of west-central Nevada. Three hundred-fifty coprolites from Lovelock Cave were examined for dietary information, as well as additional specimens from nearby Humboldt Cave, and from caves near Pyramid Lake about 60 miles to the west. The list of food items identified in the coprolites is exhaustive and varied, with 95% of the plant items being aquatic forms. Waterfowl and fish are well represented. The subsistence pattern reflected in the deposits at Lovelock Cave began by 2750 B. C., and persisted with increasing reliance on wetlands resources until historic time.

Napton, L.K., and O.A. Brunetti

- 1969 Paleo-ornithology of Coprolites from Lovelock Cave, Nevada. In "Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada," Lewis K. Napton, Ed., pp. 9-18. Berkeley: Kroeber Anthropological Society, Special Publication 2.

Paleo-ornithological remains consisted of feathers of waterfowl. Bone fragments were too small to permit positive identification. The feathers represented Coot (Fulica americana), duck (?), grebe, goose, and heron(?). These are in turn represented (with but two exceptions) by decoy heads found in the deposits of Lovelock and Humboldt Caves, Nevada, are in general represented by feathers found in the caves, and still inhabit the Stillwater Marsh.

Napton, Lewis K., and Robert F. Heizer

- 1969 Introduction. In "Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada," Lewis K. Napton, Ed., pp. i-v. Berkeley: Kroeber Anthropological Society, Special Publication 2.

The essay provides brief background information on human coprolite studies conducted at the University of California, Berkeley, on material from Lovelock Cave, Nevada.

Napton, Lewis K., and Robert F. Heizer

- 1970 Analysis of Human Coprolites from Archaeological Contexts, with Primary Reference to Lovelock Cave, Nevada. In "Archaeology and the Prehistoric Great Basin Lacustrine Subsistence Regime as Seen from Lovelock Cave, Nevada," Robert F. Heizer and Lewis K. Napton, Eds., pp. 87-129. Berkeley: University of California Archaeological Research Facility, Contributions 10.

The analysis of 300 coprolites, mostly from Lovelock Cave, but also some from Humboldt Cave and caves at Pyramid Lake, Nevada, is described. Data on sample provenience, radiocarbon age, and identification of dietary constituents are presented in detail. The analysis indicates an over-riding reliance on lake margin,

riverine, and other wetlands food resources in the western Great Basin, a pattern which began as early as 2,000 B. C., and persisted with increasing intensity until the historic period (early nineteenth century). A critical assessment of adequate sample size in relation to the number of years of occupation the sample represents, with reference to studies in available literature, is also presented.

Napton, Lewis K., and Gerald K. Kelso

- 1969 Preliminary Palynological Analysis of Human Coprolites from Lovelock Cave, Nevada. In "Archaeological and Paleobiological Investigations in Lovelock Cave, Nevada," Lewis K. Napton, Ed., pp. 19-27. Berkeley: Kroeber Anthropological Society, Special Publications 2.

Ten samples taken from the interior of coprolites were analyzed; only three contained sufficient pollen for a count. Most abundant of the pollen grains present were those of cattail (Typha spp.) and various Gramineae. One coprolite consisted almost exclusively of Typha pollen, providing of the ethnographically-recorded consumption of Typha pollen by the Northern Paiute. The pollen represented in the samples is evaluated in terms of dietary significance with reference to ethnographic reports, plant macrofossils present in the coprolites, plant remains in the cave deposits, and the normal pollen rain in the vicinity of Lovelock Cave.

Netolitzky, Fritz

- 1906 Die Vegetabilien in den Fäces: Eine Mikroskopische-Forensische Studie / The Vegetable Matter in Fecal Matter: A Microscopic-Forensic Study/ Vienna: Moritz Perles.

This study dealt with contemporary fecal material, but it is important because it laid the groundwork for Netolitzky's later analysis of prehistoric Egyptian feces. (German).

Netolitzky, Fritz

- 1911 Nahrung- und Heilmittel der Urägypter / Food and Medication of the Ancient Egyptians/. Die Umschau 46 (1911): 953-956.

Mummified bodies recovered in upper Egypt by Elliot Smith and dating to around 3500-4000 B. C. had well-preserved internal organs, and the contents of the intestines were studied. Identified remains included bone fragments, mouse teeth, scales of the Nile fish Tilapia nilotica, barley chaff, remains of Cyperus esculentus tubers, and seeds of Echinochloa (Panicum) colonum. (German).

Netolitzky, Fritz

- 1912 Hirse und Cyperus aus dem Prähistorischen Ägypten / Millet and Cyperus from Prehistoric Egypt/. Beihefte zum Botanischen Centralblatt 29: 1-11.

This is one of several early papers treating analysis of intestinal contents of mummified bodies from a cemetery at Girga, upper Egypt, dating to about 3500-4000 B. C. Basic data for this paper was presented elsewhere (Netolitzky, Zeitschrift fur die Untersuchung der Nahrungs- und Genussmittel 21/1911/: 607), but we have not had the opportunity to examine them. A total of 70 fecal samples was provided for examination by G. Elliot Smith, and the material was obtained by the Hearst Egyptian Expedition in 1902-1904. The samples were rehydrated with hydrogen peroxide. A varied diet was represented including the remains of Cyperus tubers, Echinochloa (Panicum) crusgalli and E. (P.) colonum seeds, fish (Barilius niloticus) bones, mouse bones, plant crystals, and seeds of various unidentified cereal grasses. The author suggests that some of the plants consumed may once have been cultivated, but that an abundance of identified material represented non-cultivated species. (German).

Nissen, Karen

- 1973 Analysis of Human Coprolites from Bamert Cave, Amador County, California. In The Archaeology of Bamert Cave, Amador County, California, Robert F. Heizer and Thomas R. Hester, Eds., Appendix V, pp. 65-71. Berkeley: University of California Archaeological Research Facility.

Four coprolites from a Late Horizon deposit in Bamert Cave were reconstituted with trisodium phosphate, revealing a mixed diet of small rodents, grasses, seeds of several species, and insects, notably larvae of the crane fly (Tipulidae). The results are discussed in relation to local ethnographic accounts.

Pike, A. W.

- 1967 The Recovery of Parasite Eggs from Ancient Cesspit and Latrine Deposits: An Approach to the Study of Early Parasite Infections. In Diseases in Antiquity, Don Brothwell and A. T. Sandison, Eds., pp. 184-188. Springfield: Charles C. Thomas.

The potential for recovery of evidence of parasitic infections from human waste is discussed, and results of research are reviewed. The author points out that one of the most significant problems yet to be resolved is that of determining human origin of the samples analyzed.

Pike, Alan W., and Martin Biddle

- 1966 Parasite Eggs in Medieval Winchester. Antiquity 40: 293-296.

Excavations at Winchester, England, resulted in the recovery of the contents of a wood-lined cesspit, probably dating to the 11th century A.D. Samples of this material were subjected to zinc sulfate flotation for recovery of parasite eggs, and large numbers of them identified as Ascaris, Trichuris, and Dicrocoelium dendriticum

were obtained, along with numerous minute plant remains. It was not possible to determine whether or not the parasite eggs were of human origin.

Pizzi, T.

- 1957 Estudio Parasitologico. [Parasitological Study] In "La Momia del Cerro el Plomo," Grete Mostny, Ed., pp. 22-23. Santiago: Museo Nacional de Historia Natural, Boletin 27(1).

An examination was made of fecal material taken from the naturally mummified body of an Inca boy of eight or nine years found frozen in a tomb on Cerro el Plomo (Lead Mountain), near Santiago, Chile. Plant fibers and other tissue, remains of an unidentified mushroom, and undigested striated muscle fiber were found. Eggs of Trichuris trichiura (whipworm) were present, along with cysts that may have been of Entamoeba coli, but the latter could not definitely be identified to species. (See also Pizzi and Schenone [1954].)

Pizzi, T., and H. Schenone

- 1954 Hallazgo de Huevos de Trichuris trichiura en Catenido Intestinal de un Cuerpo Arqueologico Incaico [The Finding of Trichuris trichiura Eggs in the Intestinal Contents of an Inca Body]. Boletin Chileno de Parasitologia 9(3): 73-75.

The body of an Inca child eight or nine years old and apparently dating from just prior to the Spanish Conquest was found frozen in a stone structure high in the Andes (17,658 feet) near Santiago, Chile. Feces taken from the body contained large numbers of Trichuris trichiura ova and possible cysts of Entamoeba coli, although specific identification of the latter is not certain. No evidence of Ascaris was found. The authors speculate that T. trichiura may have spread from the New World to the Old after the discovery of America. (For evidence to the contrary see Witenberg [1961]. Text in Spanish. An English summary of this paper also appears in Tropical Medicine and Hygiene News 4(2): 6 (1955).)

Radovsky, Frank J.

- 1970 Mites Associated with Coprolites and Mummified Human Remains in Nevada. In "Archaeology and the Prehistoric Great Basin Lacustrine Subsistence Regime as Seen from Lovelock Cave, Nevada," Robert F. Heizer and Lewis K. Napton, Eds., pp. 186-190. Berkeley: University of California Archaeological Research Facility, Contributions 10.

A coprolite from Lovelock Cave, and intestinal contents of a mummy from Pyramid Lake, Nevada, were rehydrated with trisodium phosphate. Both samples produced non-parasitic mites whose origin in the samples is due either to their saprophagous habits or to a phoretic association with insects that commonly invade carcasses or dung. Mites of the genera Myianoetus, Anoetostoma, and Lardoglyphus

are represented. The Lardoglyphus represents a new species.

Riskind, David H.

- 1970 Pollen Analysis of Human Coprolites from Parida Cave. In "Archaeological Excavations at Parida Cave, Val Verde County, Texas," by Robert K. Alexander, Appendix A, pp. 89-101. Austin: Papers of the Texas Archeological Salvage Project 19.

Eleven human coprolites recovered from three levels of a test excavation of Parida Cave were examined for pollen content. Economic pollens were separated from background pollens in order to better investigate past human diet and the climate/pollen frequency interaction for this region. Of the 32 pollen types recovered, 7 taxa (esp. Agave and Mammillaria) were thought to be of economic significance while 7 other taxa, previously held to be economically important in the area, were shown to be merely part of the background pollen spectrum. Pollen types indicate a mid- to late summer deposition of the feces. No change in diet through time was apparent.

Ritchie, Lawrence S.

- 1948 An Ether Sedimentation Technique for Routine Stool Examinations. U. S. Army Medical Department, Bulletin 8: 326.

The sedimentation technique described by Ritchie is useful for recovery of endoparasitic protozoan cysts and helminth ova from human feces. With minor modifications, the technique is used for recovery of parasite ova and cysts from rehydrated coprolites (see Fry and Hall 1969).

Robbins, Louise M.

- 1971 A Woodland "Mummy" from Salts Cave, Kentucky. American Antiquity 36: 200-206.

Examination of "Little Al," a mummified body recovered in 1875 in Salts Cave, Kentucky included analysis of the intestinal contents. In addition to a quantity of mirabilite ( $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ ), a naturally cathartic or laxative mineral, the intestine contained marshelder seed, hickory nut shell, brubs, and chenopod seed. These plant materials are also represented in coprolites from Salts Cave. (See also Yarnell 1974).

Rohn, Arthur H.

- 1971 Mug House. Washington: U.S. Department of the Interior, National Park Service, Archeological Research Series No. 7-D.

The results of analysis of 32 human fecal samples from Mug House, a Pueblo ruin at Wetherill Mesa, Colorado are presented (p. 97). The samples date from the 11th to the 13th Centuries A.D. Analysis followed the method of Colyer and Osborne (1965). Food remains included seeds of corn, beans, squash, pigweed (Amaranthus sp.)

goosefoot (Chenopodium sp.), groundcherry (Physalis sp.), skunkbush (Rhus trilobata) miner's lettuce (Montia sp.), prickly pear (Opuntia sp.), and beeplant (Cleome sp). Prickly pear spines and epidermis, vegetable tissues, animal bone fragments, egg shell, insect (cicada) parts, human hair, and charcoal were also present.

Roust, N. L.

- 1952 A Preliminary Scatologic Examination of Prehistoric Human Coprolites Found in Western Nevada. Unpublished manuscript on file at the Archaeological Research Facility, University of California, Berkeley.

This detailed study is summarized in Roust 1967.

Roust, Norman Linneaus

- 1967 Preliminary Examination of Prehistoric Human Coprolites from Four Western Nevada Caves. Berkeley: University of California Archaeological Survey, Reports 70: 49-88.

A preface to this work, conducted in the early 1950s, is provided by R. F. Heizer. Provenience of the 149 coprolites examined, which span several thousand years of time, is as follows: Lovelock Cave, various locations (51); site NV-Pe-8 (12); Granite Point Cave (1); Hidden Cave, rat nest deposits (11); and "32-inch midden" (74). All of the sites are in west-central Nevada. Analysis was by dry separation and yielded abundant evidence of use of nearby aquatic food resources. This preliminary study initiated the extensive research in western Nevada coprolites by R. F. Heizer and his associates at the University of California, Berkeley.

Samuels, Robert

- 1965 Parasitological Study of Long-dried Fecal Samples. In "Contributions of the Wetherill Mesa Archaeological Project," assembled by Douglas Osborne, Bernard S. Katz, Ed., pp. 175-179. Society for American Archaeology, Memoirs 19.

Human feces from sites at Wetherill Mesa in the Four Corners region of the Southwest were rehydrated with a solution of 2% (w/v) sodium hydroxide plus 0.5% (w/v) ethylenedinitrilo tetraacetic acid disodium salt (disodium EDTA) and examined for evidence of parasites. The only positive evidence noted was the presence of pinworm (Enterobius vermicularis) ova in one sample. Other recovered organisms which are probably non-parasitic in humans included rhabditoid nematodes and mites.

Schoenwetter, James

- 1974 Pollen Analysis of Human Paleofeces from Upper Salts Cave. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., pp. 49-58. New York: Academic Press.

Nine coprolites from Upper Salts Cave, Kentucky were analyzed for pollen content. In general, the evidence supports conclusions derived from macrofossil analysis, which places site utilization between October and April. Some inferences concerning economic base, menus, group size, group organization, and medicines are derived from the pollen analysis.

Sneath, P. H. A.

1962 Longevity of Micro-organisms. Nature 195: 643-646.

Within the context of a larger study, bacteriological analysis was performed on coprolites from 3500 year-old deposits in Tamaulipas, Mexico. No viable bacteria were found.

Sperry, Charles C.

1957 Mammal Feces. In "Danger Cave," by Jesse D. Jennings, p. 302. Salt Lake City: University of Utah, Anthropological Papers 27.

A brief analysis of feces that are largely of non-human origin is presented. The question of human origin is raised by several samples, including one ascribed to coyote (?) (Canis sp.) which contained seeds of burro weed, (Allenrolfea occidentalis), remains of deer and rabbit (Lepus sp.), and a fragment of cordage.

Stapleton, A. M.

1969 The Survival of Organic Residues after Human Consumption. Unpublished manuscript on file at the Department of Anthropology, University of Otago, Dunedin, New Zealand.

This imaginative study was designed to determine the feasibility of recovering known Maori food items by coprolite analysis. Under controlled conditions specific food items were eaten along with sweet corn as a stool marker, and recovery of food residues attempted by means of flotation with solutions of different specific gravities. Konini berries, fern root, mamaku fern, shark, limpet, winkle and mussel were successfully recovered; however, scales of sole and flounder were lost in the digestive process.

Stewart, Robert B.

1974 Identification and Quantification of Components in Salts Cave Paleofeces, 1970-1972. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., pp. 41-47. New York: Academic Press.

Stewart presents in tabular form some four pages of information on components recovered from a wet analysis of coprolites from Salts Cave and Mammoth Cave. Five samples were taken from each specimen, soaked in water, and separated into constituent items, the dry weights of which were recorded.

Szidat, Lothar

- 1944 Über die Erhaltungsfähigkeit von Helmintheneiern in Vor- und Frühgeschichtlichen Moorleichen /On the Preservation of Helminth Eggs in Pre- and Early Historical Bog Corpses/. Zeitschrift für Parasitenkunde 13: 265-274.

An examination was made of the intestines of two bog corpses, the Dröbnitz Girl, dated to about 600 B. C. , and the Karwinden Man, dated to about A. D. 500, from East Prussia. The intestinal contents of both bodies contained eggs of Ascaris lumbricoides and Trichuris trichiura, and the latter also contained mite eggs, a plant nematode, and possible eggs of the fish tapeworm Bothriocephalus latus.

Taylor, E. L.

- 1955 Parasitic Helminths in Mediaeval Remains. Veterinary Record 67 (12): 216-218.

Fecal material dating to around A. D. 1100 was recovered at Winchester, England, and analyzed for evidence of parasites. Eggs of Trichuris trichiura, Ascaris lumbricoides, and Dicrocoelium dendriticum were found. It could not be determined whether the feces were of human origin, but the proportion of Trichuris to Ascaris eggs suggests that they were.

Trevor-Deutsch, Burleigh

- n. d. L'Etude des Coprolites. In Methods en Prehistoire, H. de Lumley, Ed. Marseille (In press).

Listed by Bryant (1974d). Not examined.

Troels-Smith, J.

- 1959 The Muldbjerg Dwelling Place: An Early Neolithic Archaeological Site in the Aamosen Bog, West-Zealand, Denmark. Washington: Smithsonian Institution, Annual Report 1959: 577-601. (Condensed and translated from the original Danish article which appeared in Naturens Verden, July, 1957.)

Muldbjerg is a Neolithic occupation site on a once floating peat island in the Aamosen Bog, dating from about 2830 B. C. Clusters of strawberry and raspberry seeds are interpreted as the remains of human excrement. The larger raspberry seeds were crushed, apparently as a result of chewing. In Denmark, the season in which both of these fruits are available is limited to early July, suggesting a season for the deposition of the feces and hence the occupation of the peat island (pp. 593-594). The seasonal dating thus derived from the fecal material agrees well with other data on seasonality of floral and faunal remains.

Tubbs, Deborah Y., and Rainer Berger

1967 The Viability of Pathogens in Ancient Human Coprolites. Berkeley: University of California Archaeological Survey, Reports 70: 89-90.

Attempts to culture viable microorganisms from a Lovelock Cave coprolite, with a radiocarbon age of 1210  $\pm$  60 years, were negative.

Van Cleave, H.J. and J.A. Ross

1947 A Method for Reclaiming Dried Zoological Specimens. Science 105: 318.

The method of rehydrating desiccated animal tissues with trisodium phosphate is described. This process is essentially that used in rehydration of coprolites.

Wakefield, E. F., and S. C. Dellinger

1936 Diet of the Bluff Dwellers of the Ozark Mountains and its Skeletal Effects. Annals of Internal Medicine 9: 1412-1418.

Feces recovered from a mummified body found in a rockshelter in the Ozark Mountains was analyzed to supplement data derived from cached food stores for a reconstruction of the diet and health of the prehistoric human population. Food remains included fruits of sumac, acorns, and insects. Charcoal was also present. Attempts to culture microorganisms failed.

Warren, S. Hazzledine

1911 On a Prehistoric Interment near Walton-on-Naze. Essex Naturalist 16: 198-208.

The visceral area of a presumed Bronze Age burial found in a tidal flat at Walton-on-Nazewas found to contain about a pint of seeds, which were identified as blackberry, rose, and Atriplex.

Watson, Patty Jo

1966 Prehistoric Miners of Salts Cave, Kentucky. Archaeology 19: 237-243.

The article includes a discussion of coprolites from Salts Cave and their contents, which included sunflower, marsh elder, chenopod, hickory nuts and acorns.

Watson, Patty Jo, Ed.

1974a Archeology of the Mammoth Cave Area. New York: Academic Press.

Included in this volume are eight papers treating various aspects of analysis of ancient feces from the Mammoth Cave, Kentucky area.

Watson, Patty Jo

- 1974b Theoretical and Methodological Difficulties in Dealing with Paleofecal Material. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., Appendix, pp. 239-241. New York: Academic Press.

While pointing out that coprolites present archaeology with the most direct and reliable source of past human dietary patterns and habits, the author is quick to admit that there are serious basic problems inherent in their analysis. How does one derive actual meals from that which is not digested; how does one quantify fecal constituents; and more importantly, how does one assess the relationships among various constituents? While not really attempting to resolve these problems, the author outlines a 4-step approach to the difficulty of assessing the amounts of various seeds ingested. This approach seeks the determination of seed/weight and ingestion/excrement ratios.

Watson, Patty Jo and Richard A. Yarnell

- 1966 Archaeological and Paleoethnobotanical Investigations in Salts Cave, Mammoth Cave National Park, Kentucky. American Antiquity 31: 842-849.

Part of the post-test excavation and surface collecting at Salts Cave included an analysis of human fecal material for dietary evidence. Preliminary results demonstrate that squash, maygrass, sunflower, chenopod, and hickory were included in man's diet at this site.

Webb, W. S., and W. D. Funkhouser

- 1936 Rockshelters in Menifee County, Kentucky. Lexington: University of Kentucky, Reports in Archaeology and Ethnology 3.

See Volney Jones (1936).

Williams, Leonard Roy

- 1971 Laboratory Procedures, Methods, and Analysis of Northern Chile Coprolites. MA thesis, Department of Anthropology, University of California, Davis.

This paper is given over to a discussion of the methods and results of analysis of 26 coprolites from 5 sites in northern Chile.

Williams, L. R.

- n.d. Analysis of Coprolites Recovered from Six Sites in Northern Chile. (MS 1973, in press).

Forty-three coprolites from six sites in the province of Tarapaca, northern Chile were analyzed. Samples from hunter-gatherer camps of unspecified age showed a heavy reliance on pods of Prosopis sp., and seeds of Calandrinia sp., with a variety of other plant and animal items represented in lesser quantity. The samples from village sites, two of which are said to be around 2000 years old, contain quantities of maize suggesting a strong reliance on maize agriculture. The latter economy may also have involved llama herding.

Williams-Dean, Glenna, and Vaughn M. Bryant, Jr.

n.d. Pollen Analysis of Prehistoric Human Feces from Antelope House, Arizona. Kiva (MS 1974, in press).

Not examined.

Winter, Joseph C., and Henry G. Wylie

1974 Paleocology and Diet at Clydes Cavern. American Antiquity 39: 303-315.

This paper synthesizes paleoecological data derived from the site of Clydes Cavern in central Utah, including dietary data from analysis of human coprolites presented by Hall (1972). The deposits document the shift from hunting and gathering to part-time agriculture in the Archaic-Fremont transition.

Witenberg, G.

1961 / Human Parasites in Archaeological Findings/. Jerusalem: Israel Exploration Society, Bulletin 25: 86).

Two coprolites approximately eighteen hundred years old were recovered from a cave in the Nahal-Mishmar Valley, not far from the Dead Sea. They contained eggs of Trichuris trichiura and cysts of protozoans identified as Entamoeba histolytica, E. coli, Giardia lamblia and Chilomastix mesnili, all of which are still present in Israel. (Text in Hebrew).

Yarnell, Richard A.

1969 Contents of Human Paleofeces. In "The Prehistory of Salts Cave, Kentucky," by Patty Jo Watson, pp. 44-55. Springfield: Illinois State Museum, Reports of Investigations 16.

One hundred coprolites of Early Woodland origin from Salts Cave, Kentucky, were analyzed by dry separation and revealed a diverse diet of plant, and fewer animal, remains. Most abundantly represented were sunflower achenes, chenopod seeds, marsh-elder achenes, and hickory nut shell. Fish were also regularly eaten. Between 45% and 66% of the total feces bulk was made up of cultivated plant remains. Discussions of the question of cultivation of non-domesticated plants, and seasonality of cave use as indicated by the coprolite contents with other cave refuse, faunal and

radiocarbon analyses, and palynological, bacteriological, and parasitological investigations (the latter two with largely negative results).

Yarnell, Richard A.

1974 Intestinal Contents of the Salts Cave Mummy and Analysis of the Initial Salts Cave Flotation Series. In Archeology of the Mammoth Cave Area, Patty Jo Watson, Ed., pp. 109-112. New York: Academic Press.

As the title indicates, a portion of this paper is given over to a discussion of analysis of the intestinal contents of a mummy ("Little Al") recovered in Salts Cave, Kentucky. These were found to include seeds of sumpweed or marsh-elder (Iva sp.), hickory nut shell, carbonized material, and small quantities of insect cuticle, chenopod seed, and amaranth seed. These items are generally representative of the diet revealed through analysis of the Salts Cave coprolites.

Young, Bennett H.

1910 The Prehistoric Men of Kentucky. Louisville: Filson Club Publication No. 25.

A brief examination was made (p. 324) of coprolites from Salts Cave, Kentucky. The contents were tentatively identified as hickory nut shell and the seeds of sunflowers and watermelon. The latter were apparently those of squash.