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ARCHAEOLOGY AND THE PREHISTORIC GREAT BASIN LACUSTRINE SUBSISTENCE REGIME AS SEEN FROM LOVELOCK CAVE, NEVADA

Robert F. Heizer and Lewis K. Napton
with major contributions by
F. L. Dunn, W. I. Follett, Mary Ellen Morbeck,
Frank Radovsky, and R. Watkins

REPORT NO. 1 TO THE NATIONAL SCIENCE FOUNDATION
ON GRANT GS 2297

UNIVERSITY OF CALIFORNIA
DEPARTMENT OF ANTHROPOLOGY
BERKELEY, CALIFORNIA

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Department of Anthropology
Berkeley

PREFACE

The papers in this volume represent 20 percent of the total which have been written by us or contributed by specialists on the matter of prehistoric coprolites from Nevada caves. The coprolite analysis program at Berkeley has been in progress since 1965. Research materials studied have come mainly from Lovelock Cave (site NV-Ch-18). Lovelock Cave was first excavated by L. L. Loud in 1912 and revisited in 1924 by Loud and M. R. Harrington. Brief visits to the cave site have been made since 1950 by University of California field parties. The most intensive recent work was carried out in September 1968 and April 1969, at which time over 4000 human fecal pellets were collected. In the course of the 1969 excavations a map of the cave was made, stratigraphic excavations were carried out, and numerous organic samples were collected for radiocarbon age determinations. We report here on our interpretation of the chronology and occupational history of Lovelock Cave. A revised interpretation of the culture history of the cave is needed to correct what is surely an incorrect picture presented by Harrington (in Loud and Harrington 1929:119-123), but this is not yet complete and will be presented at some future time.

The present volume may be considered as the first of a series of projected reports on coprolite analyses carried out at Berkeley 1968-date. Earlier results have been published by Ambro (1967), Cowan (1967), Follett (1967), Roust (1967), Tubbs and Berger (1967), Heizer (1967a, 1967b, 1969a, 1969b), Heizer and Napton (1969a, 1969b), Napton (1969), Napton and Brunetti (1969), Napton and Kelso (1969), and Douglas (1969).

We list in the section of this report which follows immediately individuals and organizations who have provided us with financial support or expert assistance in identification of coprolite components. Here, however, we wish to single out the following and to thank them for assistance which was of a nature so essential that the program could not have otherwise been carried out.

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CONTENTS

I.

ARCHAEOLOGICAL INVESTIGATIONS IN LOVELOCK CAVE, NEVADA

Robert F. Heizer and Lewis K. Napton

It is a remarkable circumstance that one of the most widely cited and important archaeological sites in western North America--Lovelock Cave, in west-central Nevada--had until 1969 been visited by only two archaeological expeditions, consisting of a party of one in 1912 and a party of five in 1924. In the intervening decades the cave's contents and history, as interpreted by the 1912 and 1924 excavators, has been the subject of countless references and inferences. As other archaeological sites in the western Great Basin have been excavated, we have witnessed the gradual disclosure of an entire culture that has taken its name from this site, which contained one of the most detailed and best preserved records of prehistoric life ever found in western America.

The principal purpose of this report is to assemble and integrate the salient facts of the archaeology of Lovelock Cave in the light of excavations recently conducted there by the authors. It is our hope that this report will at least partially satisfy the need for a synthesis of the early work in the cave and the recent excavations that have been made there in connection with the Lovelock Cave Coprolite Research and Analysis Project, which has been carried on by us since 1965.

Lovelock Cave was the first major Great Basin archaeological site to be excavated. Unfortunately, from the point of view of procedure, the initial explorations in the cave were the antithesis of even the relatively unsophisticated archaeological methods practiced at the beginning of the present century. The first digging in the cave was the wholesale removal, by pick and shovel, of some 250 tons of bat guano, which was dug from the upper cave deposits, screened on the hillside outside the cave, and shipped to a fertilizer company in San Francisco. The extent of the damage to the archaeological strata and artifacts will never be known, but some idea of its magnitude may be gained from the fact that after cessation of guano mining operations, L. L. Loud (1929:29) salvaged from the guano dump in front of the cave "several thousand specimens," consisting mainly of human skeletal material and artifacts made of vegetal material. In 1965 and 1969 we screened portions of the same dump and recovered flaked implements of stone as well as objects of ground stone, bone and shell, numbering in all about 200 specimens.

It is probably fair to say that the guano mining activities in 1911 nearly destroyed Lovelock Cave as an archaeological site. Subsequent excavations, including those conducted by Loud in 1912, Loud and Harrington in 1924, and by us, have been essentially salvage operations--efforts to reconstruct, insofar as possible, the remarkably detailed record of prehistoric occupation that was preserved in the cave. The excavations made by us during 1968 and 1969, nearly six decades after the first exploration of the site, may prove to be one of the last attempts that can be made to investigate some of the unanswered problems that have obscured many important aspects of Lovelock prehistory. Lovelock Cave is situated on lands administered by the Bureau of Land Management and our work at the site is authorized by a Federal permit. To our knowledge the site is wholly without protection from vandalism, and relic collectors have carried out their burrowings (often with great success) with impunity, another example of the fact that failure to protect archaeological sites on Federal lands is the rule and not the exception.

The Site

Lovelock Cave (latitude 39°57'42" N, longitude 118°33'25" W), located in Churchill County, Nevada, occurs in the hinge fold of a massive limestone unit of middle Jurassic age, identified as unit Jal (R.C. Speed, personal communication, 1970), which is discontinuously exposed along the slopes of the West Humboldt Range, located in west-central Nevada.[1]

The outcrop containing the cave is an intricately foliated limestone unit locally containing quartzite, gypsum, and dolomite breccia. The limestone unit dips at an angle of 65 degrees to the northeast, and has been subject to extensive tectonic stress, which contributed to development of the cave in the north-trending hinge fold. The cave was further modified by wave-action of Pleistocene Lake Lahontan, as well as by recent seismic activity, the effects of which may be seen in several locations along the flanks of the Humboldt Range and nearby Stillwater Mountains. The limestone unit containing the cave rises some 150 feet above the dissected mountain slopes and alluvial fans that lie on either side of the outcrop. The cave entrance (elevation 4240 feet) faces north and commands a panorama of the desolate Humboldt Sink, the "lower valley area," and the distant Trinity and Eugene Mountains rising to the north on the far side of the valley. Behind the cave formation, to the south, is the low summit ridge of the West Humboldt Range (average elevation 4700 feet), beyond which lies the extensive, nearly barren desert of the Carson Sink, bordered on the south by the Stillwater Range (fig. 1). Eight miles northeast of Lovelock Cave is the massive igneous dike forming Leonard Rockshelter (NV-Pe-14) (Heizer 1951:89-98), while some ten miles to the southeast, on the same flank of the Humboldt Range as Lovelock Cave and at about the same elevation, are Humboldt Cave (NV-Ch-35) (Heizer and Krieger 1956) and Ocala Cave (NV-Ch-24) (Loud 1929:150-151). (See fig. 2).

At one or more times in the geologic past Lovelock Cave was inundated by the waters of Pleistocene Lake Lahontan, and the wave-action of the receding lake was one of the principal factors contributing to the development of the cave. It is probable, however, that the cave is not entirely wave-cut, but was developed by fracturing and shearing of the folded limestone unit (fig. 3).

An extensive deposit of tufa accumulated on the rock surfaces outside the cave (pls. 3, 5) and on the walls inside the cave (pls. 9, 10), unmistakable evidence of the fact that the cave portal was open during the periods when the outcrop was inundated by Lake Lahontan.[2] Wave cuts and depositional features created by the receding stages of Lake Lahontan may be seen at locations that are at least 100 feet higher than the cave entrance. In this vicinity the highest shoreline of Lake Lahontan was 4380 feet above sea level (Tatlock, personal communication, 1969); hence, at lake maximum, the cave may have been covered by as much as 140 feet of water. Following the final withdrawal of Lake Lahontan, as Harrington (1929:1) has pointed out, the cave was probably a long, shed-like rockshelter which was easy of access along almost its entire length, forming, one would suppose, an inviting abode for man (fig. 5, event I).

Harrington (1929:120) believed that the earliest human occupation of Lovelock Cave occurred _circa_ 1000 B.C. This estimate, made on the basis of his excavations in the cave in 1924, seemed to be verified in 1956 by a radiocarbon date obtained from fragments of basketry found in level 5 of lot 15, a test unit that had been dug by Harrington in the west end of the cave. The radiocarbon age of the basketry is 1218 B.C.±260 (C-735, Libby, 1954:733-742), and this date has long been accepted as marking the approximate beginning of human occupation of the cave. However, the date is much later than the probable date of the earliest known human occupation of nearby Leonard Rockshelter (9249 B.C.±570; Heizer, 1951:89-98), and is considerably short of the date of 5088 B.C.±350 (C-298, Arnold and Libby, 1950:111-120), which was obtained by radiocarbon analysis of three atlatl dart shafts found in the middle levels of the same site. It is difficult to understand why Leonard Rockshelter (4175 feet) was apparently occupied as early as 9249 B.C., while Lovelock Cave, located eight miles west, at an elevation of 4240 feet, seems not to have been occupied prior to _circa_ 3000 B.C. Some of the ramifications of this problem will be discussed in the following synopsis of the excavations made in the cave between 1911 and 1967.

SUMMARY OF PREVIOUS INVESTIGATIONS ON LOVELOCK CAVE

1911-1912; Hart and Pugh, Guano Mining

James Hart and David Pugh of Lovelock, Nevada, filed a mineral location on Lovelock Cave (then known as "Horseshoe Cave" or "Sunset Guano Cave") and mined the guano deposits from the fall of 1911 to the spring of 1912 (Loud and Harrington 1929:168). In order to facilitate removal of the guano, the miners used explosives to open a tunnel through the rubble left by a large rockfall at the northeast end of the cave (fig. 7, event VI) and laid a track for mine cars which were used to haul the guano to a tipple built on the hillside in front of the cave (see Clewlow and Napton, this volume).

The guano and assorted cave debris was dumped onto a large screen, and the materials held by the 3/4-inch mesh, including sticks, rushes, stones, Indian artifacts, pieced of mummies, and bone fragments, were discarded on the hillside, forming what has been termed the "miners' dump."

Harrington (1929:2) states: "It was during removal of this guano that the first Indian objects were found in the cave..."; whereas, according to Hart (Loud and Harrington 1921:168): "All the Indian objects began to appear about four feet below the surface of the guano." The guano layer apparently thinned out near the original cave entrance, a narrow, slanted crevice at the southwest end of the cave (fig. 6, event IV; see pl. 5).

Hart and Pugh may have dug in some places to a depth of as much as 20 feet. Baskets, nets, sandals, 13 mummies (Loud 1929:31), and numerous other specimens were found. Hart and Pugh, probably acting on the suggestion of John T. Reid of Lovelock, reported their finds to the Nevada Historical Society, to C. Hart Merriam of the Smithsonian Institute, and to J. C. Merriam of the University of California, Berkeley, who made arrangements with A. L. Kroeber of the University of California for L. L. Loud of the Museum of Anthropology to conduct excavations in the cave.

Comments: Hart (Loud and Harrington 1929:168) stated that Indian artifacts "began to appear about four feet below the surface of the guano." This remark induced later observers to conclude that the entire site had been abandoned during the lengthy period of time required for deposition of such a thick layer of guano. Grosscup (1960:5,6,12,60,65,66) speculated that the cave was not used during this guano-deposition period, and that the site had in fact been abandoned by the Lovelock population *circa* A.D. 900. However, as he points out (*ibid*:6):

> The accounts relate that artifacts were not encountered in the top 4 feet of deposits, but the guano miners did expose numerous artifacts.

Nevertheless, he does not deny (*ibid*:60) that "decisive evidence for a break or a continuum is still lacking." Recent excavations in the cave have provided new evidence, which, in our opinion, helps to clarify the problem of the proto-historic occupation of the cave.

1912; L. L. Loud, Salvage Excavations and Collection of Specimens

L. L. Loud, employed by the Museum of Anthropology, University of California, was sent by A. L. Kroeber to Lovelock in the spring of 1912 in order to salvage whatever materials might be secured following cessation of commercial exploitation of the guano deposit (see Kroeber 1947:180). Unassisted, Loud conducted excavations in the cave from April to August, 1912, and collected approximately 10,000 archaeological specimens, most of which came from three locations: the refuse dump left outside the cave by the guano miners; the remnants of the lower level deposits in the northeast end of the cave; and the scattered pockets of undisturbed refuse remaining in situ along the peripheral edges of the cave.

Comments: It is impossible to provide detailed information concerning Loud's excavations, since he devotes less than a paragraph to this topic in his published report (Loud 1929:29). Loud did not establish a grid system of the type presently used in recording the depth and provenience of the specimens. Instead, he designated each of his digging locations as "lots," of which there were 41. It has been stated (Loud and Harrington 1929:vii) "that one of the joint claimants of the cave prohibited work in his end of the cave;" however, the map prepared by Loud and Harrington (1929, pl. 2) shows that Loud dug in a number of locations in both ends of the cave. Lots 1,2,4,5,7,15,20,21, and 24 are not marked on the map referred to, nor do these locations appear on Loud's field map, copies of which are in the files of the Lowie Museum, and none of the artifacts described in the report of his excavations are attributed to these lots. However, a partial list of the contents of these lots is given on the original museum accession sheet prepared by Loud.

It is a matter of historical interest that Loud's report of his work at the cave was not published until 1929, 17 years after his first visit to the cave. His description of the artifacts found in the cave is quite detailed (Loud 1929:31-109), but in only a few instances were the specimens located by "lot"--information that would have provided at least the approximate horizontal provenience of the specimens.

Many of the specimens illustrated in the report are located as to "lot" in the explanatory notes accompanying the plates (ibid:172-181). Using this information and the sketchy notes in the museum catalog cards, we have attempted to determine the quantity and type of artifacts found in each of the lots designated by Loud--bearing in mind, of course, that the vertical or stratigraphic provenience of the material is unknown. We hoped that in spite of the deficiencies in Loud's methods of recording data, it might be possible to discern a few details of the prehistoric occupational uses or "activity-facies" that might have been manifested in the cave, based on the number and distribution of various types of artifacts. Unfortunately, because some of the lots (e.g., lot 9) cover as much as 20 feet horizontally, the attempt was unsuccessful.

It is evident, however, that lots 19,33,34,37, and 44 are the deepest in the cave, and, with the exception of the deep cache pits (which Loud failed to find or did not recognize) probably contained some of the oldest cultural material found in the cave. This possibility is all the more likely in view of the fact that the upper stratigraphic layers, which may have been as much as six feet thick, were removed by the guano miners, and the deeper deposits were worked by Loud.

The material collected by Loud does not form a single collection. The bulk of it is housed in the Lowie Museum, University of California, Berkeley, and a lesser proportion is in the Nevada State Historical Society building in Reno. Detailed restudy and functional analysis of this material, in the light of the considerably expanded knowledge of the chronology and stratigraphy of the cave, would probably provide new insights into the prehistory of the cave and of the Lovelock Culture.

Loud visited another cave located on the north slope of the Humboldt Range. This is Ocala Cave (NV-Ch-24) situated about ten miles west of Lovelock Cave, at an elevation of 4370 feet. The cave yielded two tons of bat guano in 1911, and Loud (1929:150-151) found 77 artifacts. Several specimens, including part of a mummy, several baskets, and some well-preserved nets are said to have been found there recently by a Lovelock pothunter.

Loud examined the former shore of Humboldt Lake and located 17 occupation sites, from which he collected 1464 artifacts and the bones of 16 humans (see Gifford 1926:382). The material was briefly described by Loud without comment as to the possible relationship of the open-air lakeshore sites and the nearby caves.

One of the open-air occupation sites near the lake (NV-Pe-67) has been excavated and reported upon by Cowan and Clewlow (1968:195-236), and NV-Ch-15, the principal lakeshore site, is now under investigation by P.H. Hallinan.

1924; M. R. Harrington and L. L. Loud, Heye Foundation Expedition

Excavations in Lovelock Cave: In July, 1924, Harrington, Loud and several Northern Paiute Indian assistants began a season of excavation in Lovelock Cave for the Museum of the American Indian, Heye Foundation, New York. During the three-month field session, Harrington's party dug to the base of the deep deposits in the west end of the cave, and also excavated in the center and east end of the cave a few remnants of the original deposit that had been overlooked by relic collectors.

Harrington elected to follow Loud's method of collecting artifacts by "lot" rather than by use of a controlled grid system. Fortunately, Harrington paid much more attention to stratigraphy than had Loud, and recorded the vertical provenience of some (but by no means all) of the material that came to light in the course of the digging.[3] Harrington also recognized and mapped 40 cache pits (ibid:9-14; pl. 2), eight burials (ibid:14-18), and observed at least three occupational "floors" (ibid:7; fig. 2) in the southwest end of the cave. The specimens found in 1924 were briefly reported upon (ibid:110-118), but the collection as a whole was not studied until 1959, when G. L. Grosscup visited the Heye Foundation and described most of the specimens of known stratigraphic provenience.

The major accomplishment of Harrington and Loud in 1924 was their controlled test of the deep deposits located in the west end of the cave. Part of the deposits in this location seemed to be intact, and Harrington laid out a trench six feet wide and eight feet long. This was the famous "lot 15" test pit, by means of which Harrington (1929:18-28) hoped to demonstrate some of the existing stratigraphy of the cave (fig. 23). Lot 15 was divided into six arbitrary levels representing three equally arbitrary "phases" of occupation:

Later Period: Level 1 (0"-18") (1'6" thick) consisted mostly of stones and ashes. Level 2 (18"-48") (2'6" thick) was mostly grass, stones, and rushes with few artifacts. A hard packed floor occurred 48 inches below the surface.

Transitional Period: Level 3 (48"-72") (2' thick) contained grass, rushes, and dust, but "many more artifacts" than had level 2. These specimens were described in some detail by Harrington (*ibid*:20-21). Level 4 (72"-96") (2' thick) was of the same general composition as level 3, but had been penetrated by two cache pits (numbers 38 and 39). Harrington (*ibid*:22) found numerous artifacts:

> The arrow fragments and foreshafts typical of the upper levels were not found in this one, but instead a *single* pointed foreshaft so large that it probably belonged to an atlatl dart rather than to an arrow, and also part of a typical atlatl dart foreshaft [Emphasis ours].

Older Period: Level 5 (96"-120") (2' thick) contained "a deposit of basketry and other articles." A sample of this material gave a radiocarbon age of 1218 B.C.±260 (C-735, Libby 1954:733-742).[4] The grassy refuse in this level gave way to guano "with a slight admixture of grass and rushes," followed by ashes resting "on the white lacustrine deposit forming the bottom of the cave." Level 6 (120"-148") (2'4" thick) was mostly guano with "some admixture of stones, grass, rushes, and on the very bottom, ashes." Harrington notes (*ibid*:23);

> Of weapons we found only a large, heavy, pointed foreshaft of greasewood, larger than those commonly used for arrows, which *may* have been part of an atlatl dart [emphasis ours].

Comments. In his description of level 5, Harrington refers to the "white lacustrine deposit" which apparently formed the bottom of the cave. This same deposit was encountered by us beneath the cultural deposits in five widely separated locations (fig. 22). This deposit is an important feature of the cave and is discussed in detail below.

Harrington's principal contribution to archaeology of Lovelock Cave was his excavation of lot 15. The relative importance of this test unit has been over-emphasized because of the fact that it is the single unit in the cave for which any stratigraphic data have been available. The potential value of lot 15 was somewhat diminished by the excavation procedures used by Harrington. The lot was dug in arbitrary levels, rather than by removal of each successive stratigraphic level. The artifacts found in this unit constitute the only reasonably well documented sample from the cave, but these specimens comprise only a very small percentage of the total Lovelock Cave artifact inventory. Lot 15 is located in an area close to the inward-sloping southwest wall of the cave. Consequently, as excavation proceeded, the length of the test pit increased under the sloping wall, until, at the bottom of the deposit, the original pit (six by eight feet) was nearly 16 feet long (Harrington 1929:19, fig. 5). Because of the reduced headroom provided by the overhanging cave wall, it is possible that lot 15 did not contain a "representative" sample of the occupational midden. It is likely that a better sample could have been obtained by excavation of a more suitable habitation area located near the center of the cave, or near the entrance.

Harrington (ibid:24-28) believed that the artifacts found in lot 15 gave evidence of the shift from the use of the atlatl to the bow and arrow. It is probable that his interpretation of the limited evidence from lot 15, supplemented by information from other lots in the cave, is generally correct, but students of Great Basin prehistory who assert that Harrington's Lovelock Cave material provides a well-documented demonstration of the transition from the atlatl to the bow and arrow should note the paucity of the actual evidence--lot 15 contained a single probable atlatl shaft in level 4 and another possible dart in level 6. We believe that Harrington classified shaft sections of *Phragmites* as arrows or atlatl darts on the basis of shaft diameter. Atlatl darts with very small diameters are known from caves in the lower Humboldt Valley. It is because we find the actual evidence of the atlatl-bow succession in Lovelock Cave to be tenuous that we consider Harrington's conclusions on the matter not acceptable.

The deposit of basketry found in the gradational contact between levels 5 and 6 in lot 15 may have been contained in the "older guano layer," as Harrington calls it, but it is equally possible that the basketry might have lain in an undetected cache pit that had been dug into the guano layer from an upper and later occupation level. This is further attested, perhaps, by the fact that the basketry cache was found in an out-of-the-way area against the cave wall. In any case, this cache of basketry provided a radiocarbon age of 1218±260 (C-735), which has been interpreted as being the approximate date of the earliest human occupation of the cave. However, it is evident that the older bat guano is stratified, and contains occupational debris that is considerably older than 1218 B.C.

Harrington photographed a few of the more important finds in the cave in situ, and in the summer of 1969, through the courtesy of Dr. Frederick J. Dockstader, one of us (Napton) examined Harrington's negatives and contact prints which are filed in the Museum of the American Indian, Heye Foundation, New York.[5] One of the photographs gives the viewer an idea of the quantity of material, some of it undoubtedly cached, which was found in lot 15 under the inclined cave wall. The photograph is imperfect, but is reproduced here for its documentary value (pl. 7).

Many of the photographs taken by Harrington in 1924 are reproduced in the 1929 report. One of these (1929; pl. 7,b) shows Harrington holding the famous bundle of 11 duck decoys found in cache pit 12. Loud was photographed in the same pose. With the kind permission of Dr. Dockstader, we have reproduced this hitherto unpublished picture, one of the few existing photographs of Loud (pl. 6). Other unpublished photographs taken by Harrington in 1924 appear in plates 2 and 7.

Excavation of lot 15, discovery of the duck decoys, and the careful recovery of several inhumations were the most important features of the excavations made by Harrington. One of the human bodies found by Harrington had been mummified by natural desiccation and was quite well preserved. It was photographed in situ (see Loud and Harrington 1929, pl. 9a,b) prior to its removal from the cave and subsequent shipment to the Heye Foundation in New York, where it reposed in the museum's annex until the summer of 1969, when it was located by Vincent Wilcox and studied by Napton and Dr. John Budinger. Laboratory photographs of this specimen were taken and a detailed paleoautopsy is now in progress.

Other Work by Harrington in 1924: Loud and Harrington (1929:8-9) investigated at least three other locations; the outer rockshelter of Lovelock Cave, the Humboldt Lakebed site (NV-Ch-15), and Ocala Cave (NV-Ch-24). Their excavations in the outer rockshelter of Lovelock Cave, which is 65 feet long and 25 feet wide, evidently failed to disclose any evidence of post-contact occupation--or, if such evidence was found, it was not reported. Harrington described the deposits in the outer rockshelter as being about two feet deep at the back of the overhang in an area located immediately north of rock C (fig. 12), which blocks the cave portal. Harrington (ibid:8) states that the dry deposit of occupational refuse lay "just northeast of the slope leading down into the southwest entrance of the cave...." The upper four or five inches of this deposit was limedust and rock fragments; beneath this was charred grass contained "many small round charred seeds, doubtless used as food by the Indians." Below this was a layer containing grass, feathers, human hair, rushes, cattail spikes, felted cattail down, two sandals, and the feathered end of a wooden arrow.

Comments. This was the only reported test ever made of the rockshelter deposit. We believe that most of the deposit excavated by Harrington in 1924 accumulated after the fall of rock C and must therefore represent very late use of the cave (see pl. 5; see also Napton 1969:90, pl. 2). In 1968 we discovered in the "west alcove" of the outer rockshelter an intact section of stratified midden that probably constitutes a small remnant of the original outer rockshelter deposit.

Harrington and Loud found some duck decoys and other artifacts in Ocala Cave (NV-Ch-24). These are undescribed. They also examined the Humboldt Lakebed site (NV-Ch-15). The extent of their work at this site is unknown, but Harrington subsequently published a brief report of the salient features of this site and pointed out the possible significance of the juxtaposition of the lakebed site and the cave (Harrington 1927:40-47). Harrington's photographs of the lakebed area include a good view of a dense stand of *Phragmites communis*, now totally extinct in the immediate vicinity of the site. The photograph is instructive in demonstrating the deterioration through desiccation of the floral cover at this location in the years since 1924 (see pl. 2; compare pl. 1 taken in 1968).

Investigations in Lovelock Cave, 1924 to 1960

1936; Nels Nelson, Surface Collection: Nels Nelson, sponsored by the American Museum of Natural History, visited Lovelock Cave for a brief period in 1936, according to Grosscup (1960:2), to whom we are indebted for some of the data in these pages. All of the specimens collected by Nelson were surface finds, some of them probably came from backdirt left by relic hunters.

1936; R.F. Heizer, Surface Collections: Heizer, Krieger and their work crew visited Lovelock Cave and Leonard Rockshelter in the summer of 1936 (see Heizer 1938:68-71; 1967b:49-52; Heizer and Krieger 1956). A small number of specimens found in crevices and under rockfalls were contributed to the Lowie Museum, Berkeley.

1949, R.F. Heizer and J. Mills; Collection of Samples for Radiocarbon Determinations: Heizer and Mills obtained several samples of organic materials to be used for the radiocarbon dating process then being applied by Willard Libby at the University of Chicago. The locations of these samples and the radiometric data have been reviewed by Heizer (1956:50-57) and Cressman (1956: 311-312).

1950, R.F. Heizer and Field Party, Surface Collections: Heizer, E. Antevs, N. L. Roust, and a large group of Berkeley students excavated Leonard Rockshelter (Heizer 1951:89-98), Granite Point cave (Roust 1966: 37-72), NV-Pe-8 (Baumhoff 1958:14-25), and surveyed surface sites in the lower valley (fig. 2). A visit was made to Lovelock Cave for the purpose of collecting grab samples of numerous coprolites (desiccated human feces), which were in evidence on the surface and in the spoil dirt that had been dug from various locations in the cave. (See Heizer and Krieger 1956:33; Heizer 1967b:50.) Fifty-one of these coprolites were analyzed by N. L. Roust (1967:49-88).

G.L. Grosscup, 1960, Synthesis of Culture History of Lovelock Cave: Grosscup's reconstruction of the culture history of Lovelock Cave was based on his study of Lovelock Cave artifacts collected by Loud and Harrington for the Museum of the American Indian, Heye Foundation, New York. Grosscup (1960:13) is explicit in stating that his reconstruction of the culture history of Lovelock Cave is based on examination of only those artifacts "for which a depth has been recorded or for which some other associational data are available," but he does not give the total number of specimens examined by him for which such data exist.[6] His interpretations of the culture history of the cave have helped to define some of the problems that have been investigated by recent fieldwork at the site.

One of the principal conclusions reached by Grosscup was that Lovelock Cave had been abandoned *circa* A.D. 900, and that an occupational hiatus of some 800 years duration occurred between the departure of the prehistoric Lovelock population and the arrival in the area of the numic-speaking Northern Paiute. This postulate is stated several times by Grosscup (1960: 5,6,12,60, 65,66) and is the principal theme of a later article (Grosscup 1963:67-71). The "occupational hiatus" theory has been discussed in some detail in another publication (Napton 1969:28-97), and at this time we can only reiterate our opinion that there is no demonstrable hiatus, either cultural or chronological, between the Lovelock Cave populations and the Northern Paiute of the Historic Period. The problem of the putative linguistic discontinuities in the Great Basin during this period continues to be a matter for speculation (see Lamb 1958:95-100; Taylor 1961:71-81; Swadesh 1964:527-556; Miller 1966: 75-112; and Goss 1968:1-42). The latter has summarized the major arguments advanced by the principal protagonists in the dusty arena of Great Basin lexiostatistics. Unfortunately, linguistic problems do not lend themselves to solution by archaeological investigation, no matter how detailed. The linguists have formulated a very interesting problem, and they must shoulder the burden of devising tests for its solution.

An important contribution made by Grosscup (1960:3-4) was to point out the fact that if the white "lacustrine deposits left by the waters of Lake

Lahontan" (Harrington 1929:9) are really lacustrine in origin, they are "unlike other Lahontan deposits in caves in this area." This remark by Grosscup was prompted by his first-hand observation of the deposits in Hidden Cave (Roust and Grosscup n.d.). Further excavation would be needed, he believed, in order to solve the problem of whether the white deposit consisted of lacustrine sediments laid down over 14,000 years ago (ibid:62), or was a diaphragm of decomposed cave material.

1965; Heizer and Field Party, Collection of Human Coprolites: In the summer of 1965 members of a new group of Berkeley graduate students were being introduced to Great Basin archaeology, and the Lovelock valley was selected as a training area. The field party visited Lovelock Cave and from two locations collected some 500 human coprolites. One series, the "crevice" or "entrance" coprolites, came from the area between rocks A and B (pl. 5). (The grid coordinates of this locus are N50/W55; see fig. 9.) These specimens were found on the surface of refuse contained in a crevice under the inner edge of rock B (see Heizer 1967a:12, fig. 1). It is likely that the crevice was used as a latrine by some of the latest occupants of the outer rockshelter. One of the entrance samples yielded a radiocarbon date of A.D. 1805±80 (UCLA-1071-E, Tubbs and Berger 1967:89-92).

A second group of human coprolites was found in an abandoned cache pit (designated pit No. 48, following the numbering system used by Harrington [1929:14]). The pit was against the north wall of the cave, grid coordinates N30/W5; see fig. 9; see also Heizer 1967a:12, fig. 1). A few artifacts and other specimens found in the cache pit have been accessioned by the Lowie Museum, Berkeley. The radiocarbon age of a sample "interior" coprolite was A.D. 740 ±60 (UCLA-1071-F, for additional information see Tubbs and Berger 1967:89-92).

Twenty entrance and thirty cache or "interior" coprolites were analyzed in 1966-1967 by R. Ambro (1967:37-47) and R. Cowan (1967:21-35). Additional reports based on analysis of these specimens are by Heizer (1967a:1-20), Follett (1967:93-116), Napton and Heizer (1969:i-v), Douglas (1969:1-8), Napton and Brunetti (1969:9-18), Napton and Kelso (1969:19-27), Heizer and Napton (1969:563-568), Napton (1969:28-97) and Heizer (1969:244-250). (See also the additional articles in this volume.)

Another location examined in 1965 was the "guano miners dump" on the slope in front of this cave. Salvage screening of part of this deposit produced 73 projectile points, including specimens of Desert side-notched, Rose Spring corner-notched, and Cottonwood triangular types, all of which were in use during the Late Period in the Great Basin (see Clewlow 1968:89-101). Other types of artifacts found in the dump are described by Clewlow and Napton (this volume).

Summary

Thousands of perishable artifacts have been collected during the sporadic excavations made in Lovelock Cave during the half-century from 1912 to 1967. It is probable that more than 20,000 specimens have been found, exclusive of coprolites, of which there are now an estimated 6000 whole and fragmentary specimens in the collections of the Lowie Museum, University of California, Berkeley. Our interest in disclosing some of the vast amount of information contained in the Lovelock coprolites led us to conclude, in 1967, that while preliminary analyses of the Lovelock Cave coprolites had produced very interesting information concerning the dietary regimes of the Lovelock population, we lacked an adequate chronological framework for correlation and comparison of these data. Our assessment of the condition of the site, following a brief visit to the cave in the spring of 1968, encouraged us to plan a further program of excavations.

RECENT EXCAVATIONS IN LOVELOCK CAVE

The excavations made by us during 1968 and 1969 at Lovelock Cave, NV-Ch-18 (legal location SE 1/4 of the SW 1/4 of the NE 1/4 of section 12, T24N, R30E, Churchill County, Nevada) were conducted under authority of a U. S. Department of Interior excavation permit, with the cooperation of the Bureau of Land Management, Reno and Winnemucca, Nevada. Field work was accomplished in two stages, beginning with pilot tests during the week of September 13 to 19, 1968. The field party was composed of seven Berkeley students (K. Nissen, P. Hallinan, C. Johnson, R. Ambro, J. O'Connell), Dr. Albert Elsasser, and the authors. The second phase of the project was carried out during a six-week period from April 14 to May 20, 1969, by a group of 22 undergraduate students enrolled in an experimental course in field methods in archaeology (pl. 4).

The field party camped at the old Ragucci ranch on the east edge of the Humboldt lakebed, now maintained as a line camp by Mr. John Froelich and Mr. Leon Anderson, whom we thank for allowing us to use the ranch building, and for granting us access to the cave via their lease holdings in the lower valley. The 1969 field crew was divided into two groups, one of which, supervised by P. Hallinan, carried out mapping and excavations at the Humboldt Lakebed site (NV-Ch-15). The remainder of the crew, supervised by Napton, worked in the cave.

The 1969 excavations in Lovelock Cave, particularly those in the west alcove and in the "LX" (Lot X) area, were largely direct continuations of the probes begun in 1968; hence, instead of describing the work season by season, we will summarize the cumulative results of excavations completed in each unit.

Conditions inside the cave were more or less the same during both field seasons. Protective "hard-hats" and respirators (Agri-Tox dual cartridge type) were mandatory. Goggles would have been desirable, but were impractical in actual use. Some relief from breathing the dust-laden atmosphere was obtained in 1969 by means of ventilating equipment loaned by the Pacific Telephone Company, San Francisco. Illumination was provided in 1968 by a small portable power plant. In 1969 an 1100 watt alternator was used to provide power for suction fans and for electric lights. In spite of their relatively short life, photoflood lamps were quite useful in illuminating the excavations in the poorly ventilated west end of the cave, where clouds of dust often achieved an almost unbelievable density.

The general appearance of the interior of the cave has apparently remained almost unchanged since 1924 (pls. 8,9,10,11) except for the fact that at present the chamber is the home of a large flock of feral pigeons, whose nests, feathers, and droppings are highly deleterious to the remaining occupational deposits in the cave. Relic collectors have dug in the cave for years, and continue to do so, but casual diggers are usually discouraged by the extremely dangerous condition of parts of the cave roof, by the obnoxious odor of the cave, by the fact that few good specimens have been found in recent years, and by the fact that the clouds of dust produced by even the most casual disturbance of the deposits rapidly clogs the air intake valves of gasoline lanterns--to say nothing of the respiratory apparatus of the diggers themselves. Carbide lamps, used by Harrington in 1924, have the potential hazard of producing a flash explosion of the thick clouds of organic cave dust. Ventilation is inadequate throughout the cave, although a "venturi" effect resulting from strong westerly winds provides limited air circulation. (The same effect would have helped to draw off the smoke produced by the Indians' campfires.)

We established a uniform grid system designed to be expanded over the entire site (fig. 9). The principal datum, referred to here as UCB datum A, was located inside the cave in an area where it would be readily accessible for measurements in the areas to be excavated. The coincidence of the north/south and east/west grid coordinates is marked by this datum. From this point it is possible to see the east and west ends of the cave, and instrument sightings can be taken through the guano miners tunnel and through a narrow gap between rocks B and C to points located in the outer rockshelter (fig. 10). An auxiliary datum, designated UCB datum B, was established on the tabular summit of massive rock F, located on the floor of the outer rockshelter, approximate grid location N30/W40. We cleaned the rock surface and chiseled into it a cruciform index mark, the center of which is the zero point of UCB datum B. This point is also considered to mark the mean elevation of the entrance of Lovelock Cave, which is approximately 4240 feet above sea level.[7]

From UCB datum B one may see most of the outer rockshelter, Humboldt Lakebed, and various landmarks to the north, such as the Toulon tungsten mill, the BLM windmill on the Humboldt lakebed, and the buildings at the old Ragucci Ranch. Bearings were taken intersecting the center of the Derby Field airway rotating beacon (No. 26-A) located near the site of U.S. Geological Survey bench mark No. 317 (elevation 3899.802 feet), and on the center of the dome of the Lovelock VOR (Vortack) radio range 54-A on Derby Field. The assumed elevation of UCB datum B, 4240 feet, may be subject to correction. Therefore, datum B, the highest elevation with which we were to be concerned during excavation of the cave, was given an arbitrary elevation of 100.00 feet. A preliminary map of the site was prepared by Napton, using a Gurley high-standard alidade and Johnson plane table (fig. 9). The rockshelter was mapped and some of the more important landmarks in the lower valley, including datum One, established by P. Hallinan on NV-Ch-15, the lakebed archaeological site, were plotted in reference to datum B. From this datum it is possible to sight on UCB datum A, located at floor level inside the cave. The distance between datum A and datum B, corrected to the horizontal, is 51'3"; the difference in elevation is 14'3", giving UCB datum A a reference elevation of 85.70 (or 4225.7 feet). The latter figure coincides with an estimate of the elevation of the cave made in 1950 by Ernst Antevs (personal communication to Heizer, 1950), who used a Paulin altimeter calibrated on the U.S. Coast and Geodetic Survey Lovelock south base, elevation 3908 feet. The elevation of other cave features of interest are given in the text, or are plotted on the preliminary site map (fig. 9).

The site grid is laid out in increments five feet square, with the north-south grid axis oriented on magnetic north (declination 17 1/2 degrees west, 1969), so that each test unit is aligned with the cardinal points of the compass. All measurements made to determine horizontal and vertical provenience of an artifact or feature found within each grid unit were taken from the center of the southwest grid stake, so that all internal data were recorded as distance <u>north</u> and <u>east</u> of the southwest control stake (Heizer 1958: 54, fig. 9).

The following "areas" and grid units were selected for excavation in 1968-1969 (see Heizer 1969a:3-4). The year of excavation is given in brackets; all grid locations refer to UCB datum A:

1. Lot "LX," a deposit of midden trash located between rocks B, C, and D (grid location NS0/W30) [1968].

2. Grid unit NS0/W35, an extension of the "LX" area [1969].

3. Grid unit N5/W25, a deposit of disturbed refuse near the cave entrance [1969].

4. Grid units S5/W10; S5/W15 ("miners entrance") a test entry made for the purpose of sounding the deep white "lacustrine" deposit forming the apparent basal stratum of the cave [1969].

5. Lot "AN" (grid units S10/W50; S10/W55), first explored in 1967, and entirely covered by massive rock B [1968].

6. West crevice area ("WC"), approximate grid location S40/W95, UCB datum A, a nearly vertical chute leading down from the west alcove into the deep west end of the cave (the chute is actually a narrow passage between massive rock A and the inward-tilting north wall of the cave [1968, 1969].

7. The west end area ("WE"), grid location S40/W80 and S40/W85, UCB datum A, a deposit of refuse adjacent to Harrington's lot 15 dug in 1924 [1969].

8. The west alcove ("WA") the hitherto unexcavated extreme west end of the cave (grid location approximately S10/W95; S15/W100), the north portal of which lies some 60 feet southwest of UCB datum B [1968, 1969].

9. The east alcove area ("EA"), in grid location N40/W25, an unexcavated area almost completely covered by rubble [1969].

10. The guano miners dump ("MD") (approximate grid location N100/W100) situated on the steep hillside in front of the cave. Debris and rubble from the interior of the cave was discarded here by the guano miners in 1911, forming a loose, sliding mass some 200 feet long and 40 feet wide. Part of this mantle of debris had been screened by us at an earlier date [1965, 1968, 1969].

The excavation of these ten locations will be described in some detail, in view of the paucity of such information for previous excavations in Lovelock Cave.

Lot "LX", Grid Location NS0/W30, UCB Datum A

The purpose in excavating "Lot X" was to recover from this part of the cave further specimens of desiccated human excrement, samples of which were analyzed in order to supplement the data from the "entrance" and "interior" samples previously described. The surface of the deposit in this area was tested by Harrington (Loud and Harrington 1929, pl. 2), but we hoped to find some undisturbed remnants of the midden. The test unit was approximately five feet long, east to west, narrowing in the center due to a projection of rock D. The deposit was excavated in arbitrary six-inch levels from the surface to a depth of 72 inches, at which point we encountered the powdery-white "lacustrine" substrate deposit. The test was successful in its primary purpose: 52 coprolites were found in the unit and all of these were subsequently analyzed.

The upper three levels of the test unit consisted of fragments of grass, dust, rocks, twigs, pieces of rush or tule, and other organic debris, all of which was thoroughly mixed. The middle levels (levels 3 to 5) had been disturbed in prehistoric times by construction of a cache pit (No. 49, feature No. 1), which (unfortunately) was empty. The basketry lining of one wall of the pit was well preserved, and a pile of rushes and grass served as the bottom of the pit. A sample of this material (LX-56) gave a radiocarbon age of A.D. 50±60 (UCLA-1417, see table 1), which dates the construction of the pit. The refuse deposits enclosing the pit must of course be older (fig. 16).

Samples for palynological analysis were taken at six-inch intervals from the bottom to the top of the entire test unit. The "LX" test unit could not be expanded due to the mounting danger of further undermining rock D, upon which rests (in a most precarious fashion, as it appears when viewed from beneath) the 20 ton mass of rock C (fig. 11).

Levels 4 and 5 consisted almost entirely of bat guano, probably the "older guano" found at about the same depth by Loud and Harrington in lot 15 (1929:22-23). The lower part of the layer is interfingered by thin strata of sand, dust, and at least one layer of vegetal material, consisting of _Scirpus_ sp. and other species of aquatic vegetation. The presence of this material as an integral member of the guano layer suggests that Lovelock Cave was occupied by man, if only intermittently and briefly, during part of the time in which the bat guano layer was forming. The gradational contact of the surface of the early guano and the base of the overlying layers of midden trash is only moderately well defined, but there is an abruptly well-defined transition from the early guano to an underlying white ash layer. The ash layer is about two inches thick. Under this is a stratum of crystalline white-colored material. We were able to penetrate this deposit to a depth of 12 inches, at which point several very large rocks were encountered. None of these could have been extracted from the pit without the use of heavy equipment.

The north profile of this unit, as depicted in Figure 16, was recorded by J. O'Connell and P. Hallinan. The section is quite similar to a somewhat idealized profile-section prepared by Loud and Harrington (1929:7, fig. 2; compare _ibid_:11, fig. 3).

Part of the LX or NS0/W30 unit lies within Harrington's lot 4 (Loud and Harrington 1929; pl. 2). We have no way of knowing how deep Harrington dug in lot 4, but he discovered five cache pits (Nos. 9,10,11,12, and 13). Harrington (_ibid_:12) states that pit 10, found in lot 4, belonged either to the "transitional" or "older" period of cave occupation. The bottom of the pit was "6 feet 1 inch below the surface." Unfortunately, it contained little of interest, although Harrington noted that a grass layer in the bottom of the pit was covered by a layer of bat guano approximately one inch thick, "showing that the pit had lain open awhile," and also indicating, of course, that bats had occupied the cave either during or after human use of the site.

A section transecting pits 9 and 10 from east to west was sketched by Harrington (1929:11, fig. 3; see fig. 15, this volume). The west side of the profile is on the right side of the illustration, so the viewer is looking north toward the "LX" profile, which is about six feet farther north of the section recorded by Harrington. The rock shown at the right hand side of Harrington's drawing (1929, fig. 3) is omitted on his plan map of the site (1929, pl. 2), but a large rock does exist at this location (rock E; see fig. 6, event IV). Loud and Harrington (1929, pl. 2) place pit 12 in lot 4, whereas, in the text Harrington (1929:12) states that pit 12 is in lot 7. The latter location is probably erroneous, for in his figure 4 (ibid:13), pit 12 is shown next to pit 11, and is also shown in Plate 2 as occurring in lot 4 with pits 9, 10, 11, and 13. Pit 12 is of more than routine interest, since it contained the remarkable cache of 11 duck decoys. The bottom of this pit was five feet below the surface, according to Harrington, indicating that his excavations in this area reached at least that depth. Pit 12 was apparently situated just beyond the south wall of the LX unit.

Grid Unit NS0/W35, UCB Datum A

In 1969 we continued exploration of the LX area by excavating unit NS0/W35, a sloping mass of refuse located under the edge of massive rock C and just west of unit LX in the narrow passage between rocks B, C, D, and E. The upper layers of the east end of this unit had been excavated by Harrington in 1924. We could not extend the test unit to the west since this would undermine a group of poorly supported rocks lying in the passage between rocks B and C.

The test unit was excavated in six-inch levels, but very little was found, other than the usual fragments of twine, quids, feathers, etc. (feature No. 2). At a depth of 30 inches we found a mass of rushes and grass (*Distichlis* cf. *spicata*) (feature No. 4). A piece of fox skin (*Vulpes* sp.) was found at a depth of 50 inches (feature No. 7), under which was a large, fragmentary tule mat (feature No. 8). Crushed bulrush culms were observed adhering to the underside of rock E, an indication that this boulder was part of the massive Event IV rockfall (fig. 6).

The principal value of this unit is the excellent display of the cave strata in the north profile, extending from the surface under rock C to a depth of at least 72 inches. The profile was brushed and dusted with the aid of a small bellows. When this was done it was possible to see that the deposit sectioned by the profile is undisturbed, and is a good sample of the original stratigraphy of Lovelock Cave. The strata to the north of the profile, extending into the area covered by massive rock C (units N5/W35, N5/W40, N10/W30, N10/W35) are probably undisturbed, in view of the fact that they are capped by at least 20 tons of limestone.

Most of the internal features recorded by Harrington for lot 15 in the west end of the cave apparently also occur in the north profile of NS0/W35, with the important difference that in the latter unit the strata are a good deal thinner. The minimum depth of lot 15, according to Harrington (1929: 19, fig. 5), is ten feet. In NS0/W35 the same strata are six feet thick, and probably become progressively thinner under rock C as one ascends the slope toward the mouth of the cave. It might be possible to excavate part of the deposit under rock C, depending on the engineering problem involved in working under this monolith, which appears to be poorly supported on the south (the downhill side of the slope). We surmise that most of rock C rests on cultural midden trash, but this possibility must of course be demonstrated by excavation, which could be accomplished by extending a lateral cut under rock C to the outer rockshelter, revealing at the same time the relationship of the white "lacustrine" stratum and the basal strata of the outer rockshelter.[8]

Stratigraphy of the test unit: The NS0/W35 test unit is overlain by rock C, which, if we correctly interpret the apparent situation, fell on the deposits during the time that the cave was occupied by the Indians (fig. 11). The approximate date of the fall of massive rock C (event IV) can be estimated by obtaining the radiocarbon age of a sample of the uppermost cultural material found under the rock. One such sample gave a radiocarbon age of A.D. 440±90 (I-4629), but this date is probably somewhat short of the actual occurrence of the rockfall, due to the fact that there is a gap between the surface of the deposit and the under side of the rock, as shown in Figure 12. The gap is partially filled with packrat nest and midden material, and a date for the occurrence of the rockfall based on a radiocarbon determination of this debris would almost certainly be erroneous. Because of this, the sample for radiocarbon dating was taken from the uppermost integral member of the stratified deposit (fig. 13). A more precise date for the rockfall could probably be obtained by determining the radiocarbon age of organic material which was crushed when the rock fell.

The uppermost part of the deposit under rock C could not, of course, have been removed by the guano miners, but one should note that the profile NS0/W35 indicates that the rock does not seem to rest on a layer of bat guano, which, as Harrington (1929:1) describes it, was "3 to 6 feet deep" elsewhere in the cave. It would appear that two possibilities obtain: the thick "Later Guano" removed by the guano miners may have been deposited after the Event IV rockfall; or perhaps the Later Guano deposit never existed in this locality, near the mouth of the cave. However, a deposit of guano about one foot thick is indicated by Harrington (*ibid*:11, fig. 3) as a feature near the surface of the cross-section between lots 9 and 10. It is possible that most of the thick Later Guano layer was deposited after the Event IV rockfall nearly closed the cave portal, an occurrence that might have made the cave less suitable for human occupation, but probably improved it as a colony site for bats. Hence, in our view, it is likely that most of the Later Guano unit, said to be three to six feet thick, was deposited during the period between A.D. 440 and A.D. 1911, a period of about 1500 years, indicating that estimates of cave chronology based on the assumption that the cave debris accumulated at a constant rate are likely to be erroneous (fig. 14).

The radiocarbon determinations of samples taken from the north profile NS0/W35 are given in Figure 13. Because of the varying (and unknown) amounts of midden removed from the surface of the cave deposit by the guano miners, and because of the slope of the cave floor in this vicinity, the total thickness of the NS0/W35 unit is greater than that of the "LX" units. However, the buried surface of the white "lacustrine" deposit forms a stratigraphic marker throughout the cave, and the various strata can be correlated approximately, using this feature as a common reference (fig. 23).

Additional details of the stratigraphy of the NS0/W35 profile are given in the caption of Figure 13. (See also pl. 7.) Particle-size fractionation, identification, analysis of organic material, and palynological studies of 30 samples, which were taken from the profile at six-inch intervals, remain to be completed. A rough analysis of the samples is given in Table 2. The stratigraphy of unit NS0/W35, from the top to the bottom of the deposit, consists of the following components:

The surficial deposits are composed of packrat nest and midden debris. Packrats, or wood rats (Neotoma cf. cineria), tend to defecate in specific locations in their middens, and part of the uppermost deposit of this test unit consisted of a compact mass of rat dung. A slab of this material (field specimen 65:1427) was removed for laboratory examination, and was found to contain a quantity of mudhen feathers (Fulica americana) which was once part of a garment similar to one found in lot 12 (Loud and Harrington 1929, pl. 18). The surficial layers also contained bits of twine and several human coprolites. Beneath the rat nest was a thin layer of aeolian sand, followed by a layer of vegetal material, dated by sample I-4629. Below this were layers of sand, dust, and limestone spalls, interspersed with distinct layers of rushes. It is possible that some of these layers of organic materials represent occupational "horizons" or single occupations. In a site as large as Lovelock Cave, different areas may have been occupied at different times.

The layers of dust, sand, and rushes cease abruptly at a depth of 40 inches below the surface, at the contact of the underlying "Older Guano." The buried surface of the Older Guano strata is so compact that it can hardly be penetrated with a pointing trowel. The hard surface is probably an occupational floor, but only a small segment of this feature was found to be intact in this test unit (fig. 17). On the hard surface of the "floor" were found quids, strands of human hair, and other evidence of human occupation (pl. 13).

The "Older Guano" layer, previously described, is about 12 to 16 inches thick in this location. The upper part of this deposit, consisting of approximately 90 per cent bat guano, is superimposed on a thin cultural stratum, under which is a six-inch thick deposit of sand, guano, and dust. A single quid was found in the occupation layer. The basal portion of the Older Guano layer has been burned, either by man or as a result of spontaneous combustion. In this test unit, the burned guano is superior to a thin layer of white ash, beneath which, as might be expected, is the white lacustrine deposit.

N5/W25

The upper part of the refuse deposit in this test unit was found to be badly disturbed. The loose debris contained modern trash and very few artifacts. An empty cache pit (feature 9) came to light at a depth of 12 to 18 inches below the existing surface. The test unit location is covered by Harrington's lot 11 and perhaps by part of his lot 9. Pit 46, which contained the partially desiccated body of an adult male, was found by Harrington near this location.

S5/W10, S5/W15; Miners Entrance Pit ("ME")

This test entry, located approximately in the center of the cave near the guano miners entrance (fig. 10), was the scene of our ambitious but abortive effort to reach the bottom of the white "lacustrine" deposit--the "lime-powdered bottom of the cave," as it was described by Harrington. The deposit had been exposed to view in this vicinity by the guano miners and by Loud, during his excavations in 1912. Harrington (1929:4) gives this description of the exposed deposit:

> Here could be seen its general character--higher in the center of the cave and sloping gradually downward from the northeast end toward the southwest, and sharply downward 2 or 3 yards from the wall everywhere. This condition is doubtless due to rockfalls from the roof when the cave was forming, the fallen material creating a pile higher in the center than around the edge. The bottom was composed of such limestone from the roof, cemented together with a rather soft, white mineral substance which crumbles into fine granules when dug.

If this feature is a lacustrine deposit it is a very unusual one, as Grosscup (1960:3-4) has pointed out, for no comparable stratum is known to have been found in any of the excavated cave and rockshelter sites located in the Humboldt-Carson Sink area. Some of these sites, such as Humboldt Cave, approximate elevation 4065 feet (Heizer and Krieger 1956); Leonard

Rockshelter, elevation 4175 feet (Heizer 1951:89-98); and Hidden Cave, elevation 4104 feet (Roust and Grosscup n.d.), contain strata that can be correlated with one or more stages of Lake Lahontan, but none of these lacustrine strata resemble the white deposit which uniformly underlies the midden and older guano deposits in Lovelock Cave (fig. 22).

Excavation of test unit S5/W10 disclosed an apparently stratified deposit some six feet thick. The stratification is spurious, because the crossbedded debris found here is for the most part spoil dirt derived from numerous pits dug in this part of the cave by relic hunters. Pieces of newspaper, discarded cigarette butts and other modern trash attest to the recent disturbance of these layers. The older guano layer, which elsewhere usually occurs under the midden trash, was not present in this test unit.

The white deposit was encountered at a depth of six feet, as expected. The stratum contained several large rocks, greatly reducing the already limited work space in the bottom of the pit. The white deposit was anything but the "soft and powdery" material which Harrington (1929:4) described. Excavation could be continued only by means of railroad picks and pry bars. We removed from the pit several large slabs of material composed of a very hard, crystalline-mineral substance, usually grey-white in color, but not infrequently having a faint pink or green tinge. We were able to detach hand specimens with the aid of a sledge hammer. As the pit deepened it became increasingly difficult to penetrate the stratum, and work was finally discontinued at a depth of three feet into the white deposit, the test unit having been carried to a total depth of nine feet. There was no indication, of course, that we had reached the bottom of the white deposit, nor was there the slightest clue as to what lay beneath this stratum. It was obvious, however, that the white deposit was the product of phenomena very dissimilar to those responsible for the development of the stratigraphically superior deposits. Inspection of the crystalline structure of the deposit suggested that water had played a major part in its formation. In fact, the deposit seemed to be a precipitate resembling silicious sinter; however, its true nature was revealed only by spectroscopic analysis.

It is unfortunate that we were unable to reach the bottom of the white deposit, for it will be necessary to do so before this feature of the cave can be said to have been adequately examined. This particular location was probably a poor choice for a deep probe of the white deposit: much more could have been learned by excavation of a unit located adjacent to the cave wall, where the contact between the bedded limestone and the white stratum could be examined. There is an indication, in unit N25/E25, that the white deposit covers some of the tufa that adheres to the cave wall (fig. 21), but it will be necessary to expose a much better preserved contact.

Lot "AN", Grid Units S10/W50, S10/W55

This test unit is situated entirely under massive rock B, which is some 20 feet long, 12 feet wide, and is about six feet thick along the edge visible inside the cave. Rock B weighs approximately 20 tons, and, if nothing else, at least provided a reassuringly solid ceiling over the heads of the excavators of the underlying deposit. Due to the presence of this monolith, it was necessary to enter the "AN" unit laterally, from the south. Some of the refuse under the edge of the rock had been removed by Loud and Harrington as part of their lots 7 and 18. Pit 42, in lot 18, is shown by Loud and Harrington (1929, pl. 2) as having been located just under the edge of rock B, but the construction and contents of the pit are not described in the text.

The surface of the deposit beneath the rock rises steeply from the lower (south) edge of rock B to the "Entrance" coprolite crevice (grid location NS0/W55), which is formed by the north edge of rock B and several rocks resting against it (fig. 18). Between the surface of the deposit and the underside of rock B is an unobstructed space which was about ten inches high and four feet wide. On either side of this unobstructed passage, as viewed from the excavation entrance, rock B is supported by tightly packed occupational debris and rocks. The underside of rock B is smoke-stained, but much of the stain has exfoliated from the rock cortex due to the admission of moisture into this part of the cave via the access passage. The underside of the rock is embellished by graffiti, which include the legend "VC 1949" executed in carbide lampblack, mute testimony to the presence of relic collectors two decades ago in even this relatively inaccessible part of the cave.

As the details given in Figure 18 indicate, excavation of the "AN" unit proceeded through the remains of Harrington's lot 18, which had been almost completely refilled by debris sliding down from the "entrance" crevice. The northernmost extent of the lot 18 excavation pit was readily apparent. Beyond the edge of the pit, farther under rock B, lay the usual compact mass of rushes, rocks, sand and dust. Our hope that part of this deposit might be undisturbed failed to materialize, for we soon found evidence of an ancient cache pit (No. 50; feature 3), which had two separate bottoms formed by large pieces of tule mat. The mat fragments were very damp, and by Lovelock Cave standards, were very poorly preserved.

Below the cache pit, as indicated in Figure 19, was a layer of dry bat guano recognizable as the Older Guano layer described by Harrington (1929:18-28). This is the same layer that we found in the lower levels of units NS0/W30 and NS0/W35.

The upper portion of the Older Guano layer consists almost entirely of "pure" bat guano. It is "pure" in the sense that by visual inspection its principal component appears to be bat guano. Miscroscopic examination, however, reveals that it contains hair, sticks, fragments of insects, bones of bats, and numerous other types of organic and inert debris (table 2).

The lower part of this layer is composed of several thin members of sand, grass, and guano. Dividing the layer is a thin but well-defined cultural stratum consisting of bulrush and other vegetal matter, which occurs at a depth of seven inches within the guano layer, or 78 inches below the surface of the test unit. This stratum of vegetal material could be traced throughout the profile of the Older Guano layer, wherever the latter was exposed in the walls of the test unit. A sample of the vegetal component of this stratum produced a radiocarbon date of 2740 B.C.±110 (I-3962; our sample AN-16). The fact that the vegetal material in this stratum consists of aquatic plants--the nearest source of which would have been Humboldt Lake, located 2.0 miles northwest of the cave--indicates that the lake was in existence at this time and that the cave was occupied by man, for it is unlikely that any other animal would transport large quantities of aquatic vegetation from the lake to the cave. This supposition is fully confirmed, in our opinion, by the presence in the layer of pieces of twine, human hair, bulrush quids (Scirpus sp.), and other cultural materials (pl. 14). The overlying guano was compact and undisturbed, giving satisfactory evidence of the fact that the vegetal and cultural material dated at 2740 B.C. ±110 (I-3962) is not intrusive in the guano, but represents an occupational horizon occurring as an integral member of the Older Guano layer. (As we noted in the preceding section, samples of the older bat guano obtained in 1949 gave radiocarbon ages of 2498 B.C.±250 [C-277] and 4054 B.C.±250 [C-278].) Sample I-3962 is bracketed by these determinations and by the interally consistant series of radiocarbon dates from the N50/W35 profile, as shown in Figure 23 and Table 2.

The lowest part of the guano stratum had been charred and was black or cherry-red in color. An abrupt contact separates the guano and an underlying powdery ash layer of a grey-white or dark grey hue. The ash layer gave way to a powdery crystalline substance, which is the same deposit that occurred at the base of the preceding units, with the difference that in this location it is somewhat more soft and powdery than it was in any other location. The white deposit contained several rocks of the 200 pound variety (fig. 18). There was no possibility of moving these rocks in the restricted confines of the test location. In summary, the AN excavation provided a well-defined profile of the cave deposit. From top to bottom the stratigraphy consists of rushes, grass and dust, the older bat guano, grey ash, and the white crystalline basal deposit.

The north profile of the "AN" unit was sketched by R. Ambro (fig. 19). Palynological samples (field catalog numbers 71:1486-71:1503) were taken at six-inch intervals following the procedure outlined by Bryant and Holz (1968: 11-19).

The surface of the slope under rock C was littered with large human coprolites, some of which were of the same age and general composition as the

"Entrance" coprolite series. Ten coprolites were found in situ in the midden debris superior to the Older Guano.

Lot "WC", Grid Location S40/W95, UCB Datum A

The west crevice area is a nearly vertical chute descending from the back of the west alcove into the deep west end of the cave. The crevice is formed between the back, or south side, of rock A and the inner wall of the cave (fig. 9). When we first examined the crevice, it was full of debris of all kinds, mostly sticks, stones, grass, dust, and sand that had fallen from the west alcove (pl. 10). Several large boulders were wedged in the chimney-like upper end of the crevice, and excavations in 1968 were limited to removal of the lower portions of the refuse located beneath these rocks.

Three hundred human coprolites, 30 cane arrows with greasewood fore-shafts, and a number of feathered arrow shafts were found in the debris. Other artifacts found in the west crevice included several sections of a string of beads described by J. Carroll (in press, 1970).

It was apparent that the west crevice is stratified, albeit on a very steep incline (fig. 10). Removal of part of the debris in the lower depths of the crevice exposed a small remnant of the midden in the west end of the cave.

West End Area ("WE"), Grid Location S40/W80; S40/W85

The major effort of the 1969 season was an attempt to excavate part of the deep midden deposits in the west end of the cave near the location of lot 15, dug by Harrington (1929, pl. 2). Here we hoped to find undisturbed remnants of the original cave deposit. Excavation proceeded very slowly--more than 800 man hours were expended before we reached the bottom of the midden deposit.

The excavation area was partially covered by colluvial debris derived from the west crevice, and the upper levels of the test unit area may have been removed as part of Harrington's lot 16. The deposits included reeds, grass, occasional coprolites, and a few small artifacts which were doubtless overlooked by previous diggers. Stratified layers, such as those observed in N50/W35, were not present. An occasional find of modern trash, including a pipe tobacco tin bearing a tax stamp issued in 1924, gave evidence of disturbance in this area.

At a depth of seven feet below the surface we found an assortment of human bones representing three adults and one child (M. E. Morbeck, this volume). This assemblage, which we designated Feature 5, included a tibia and fibula, a large clavicle, a very large femur (the head and greater trochanter is visible; see Morbeck, this volume), the mandible of a subadult, and about 100 other human bones. A single calcined skull fragment lay amid the mass of unburned bones. The dry refuse immediately above the bones contained a few pieces of decayed matting and a single Olivella bead. The loose sand matrix around the bones contained pieces of wood, fragments of reed (Phragmites sp.), and hundreds of small insect pupae cases. The bones were not found in anatomical order, although the individual represented by the large femur and other appendicular bones may have been buried in a flexed position prior to being placed in this common ossuary. A few of the bones bore remnants of cartilage. Part of a femur and a tibia sacrificed for radiocarbon determinations produced a date of 1450 B.C.±80 (UCLA-1459-C, Berger, personal communication, 1969).

The bones were removed from the excavation pedestal, which was composed of a six-inch thick layer of sand and cave debris. Beneath this we encountered the now-familiar, pavement-like layer of crystalline material that forms the floor of the cave beneath the midden trash.

We surmise that the bones comprising Feature 5 were the remains of several inhumations that at some time in the past had been exhumed by coyotes during a period when the cave was unoccupied by man. When the Indians reoccupied the cave, they probably collected the scattered bones and made a common burial of them in this location. It is probable that these events occurred early in the occupational history of the site, since the bones lay in such close proximity to the basal white deposit. An alternative explanation of the presence of the several lots of buried bones in the west end of the cave is that the cave was early used as a place to deposit corpses. When large-scale human occupation occurred (circa 1300 B.C.), the exposed human bones were collected and buried in the west end of the cave in order to clean up the living area. This hypothesis could be true only if the age of the bones is older than the age of the earliest layers of living debris indicating occupation of the cave by large numbers of people. According to radiocarbon age determinations now in hand, the bones in the secondary burial just described, which date from 1450±80 B.C. (UCLA-1459-C), are slightly older than the lowest levels of lot 15 which date at 1218±260 B.C. (C-735).

Harrington (1929:17-18) found an almost identical cache of bones under rock A in this same area. The numerous calcined inhumations and the several discrete caches of extraneous bones found in the west end of the cave demonstrate that this part of the cave was used as a general bone disposal area. Many of the human bones found in the cave by Loud (1929:31-32) were calcined. It would be desirable to secure radiocarbon dates for these bones. Loud apparently believed that most of the human bones that he found had been burned by a conflagration in the cave refuse. It is likely that these human bones are not evidence of intentional cremation, but have been carbonized through burning of the guano-refuse deposits in which they lay. The Wheelers (Wheeler and Wheeler 1944) recovered from a cave near Grimes, southeast of Fallon, two twined wallets containing cremated human bones. These are atypical, perhaps unique, for the western Great Basin.

One hundred and fifty coprolites were found in the west end area, 50 of which have been analyzed.

West Alcove ("WA"), Grid Location S10/W95, S15/W100, UCB Datum A

The west alcove, a hitherto unexcavated area located in the western extremity of the outer rockshelter of the cave, can be entered from the rockshelter via either of two apertures located some 60 feet west of UCB datum B. The west alcove deposit is perched on the summit of massive rock A, which detached from the ceiling at an unknown, but probably early, date. The deep west end of the cave (S40/W80) at the base of the west crevice, is about 35 feet lower than the entrance of the west alcove. It is evident that rock A blocked most of the west end of the cave portal (fig. 10). Rock A, which is 50 feet long, 25 feet wide, and about 15 feet thick, is displaced into the cave a distance of about eight feet. The summit of the west end of rock A is approximately flush with the surface of the outer rockshelter; thus, the debris found on its summit constitutes an extension of the outer rockshelter deposit. Midden trash composed of rushes, sticks, stones, and sand covered the top of rock A and completely filled the crevice between it and the west wall of the alcove, forming a mass of debris at least 35 feet deep.

The west alcove deposit was excavated in six-inch levels, beginning at the north entrance and descending toward the upper part of the west crevice. The surface deposit consisted of sand and stones, and from this stratum, at a depth of six inches, came several interesting specimens, including a bullet mold and some associated gun parts (pl. 15).

These specimens were examined by C. E. Hanson Jr. and we are indebted to him for the following observations. According to Dr. Hanson (personal communication, 1970), three of the parts are the sear, bridle, and mainspring of a good quality percussion lock. Miscellaneous parts include a long screw (possibly a tang screw to fasten the breech of a barrel to the trigger plate). These parts were manufactured during the years 1830-1870, most probably circa A.D. 1850. Dr. Hanson states that the bullet mold is a cheap commercial mold made during the middle half of the nineteenth century. The number "46" refers to the size of the bullet (46 balls to the pound or about 45 caliber). The mold shows extensive use: the center pin has been hammered to tighten the joint, and the cutting edges to trim balls show extensive nicks and the ends of the handles have been sharpened to facilitate driving on wooden or horn handles. The ball is of the size which could be used in an Indian trade rifle. The good quality parts and the worn tang screw and bullet mold seem to suggest the presence in the cave of two separate guns.

Another interesting specimen found in the west alcove (S15/W100, depth 36") was a pouch or "kit" made of fox skin which contained three awls, some coiled vegetal fiber, and a piece of chert.

Beneath the recent surficial strata of sand and stones lay a quite remarkable series of cultural strata, some of which consisted of inch-thick layers of charred bulrush seeds (*Scirpus* cf. *nevadensis* and *Scirpus robustus*) (fig. 20). Detailed examination of a sample containing thousands of these charred seeds revealed that the seeds had not been burned as the result of a general fire in the strata, for intermixed with the burned seeds were twigs and fragments of other materials that had not been burned. The evidence suggests that these seeds were discarded in this area after having been charred on seed roasting trays. Bulrush seed (*Scirpus* sp.) found in level 7 of this unit (S10/W95, depth seven inches) gave a radiocarbon age of A.D. 1430±95 (I-4672). Fish bones, such as the bones of tui chub (*Gila robustus*) found in the Lovelock coprolites (Follett 1967:93-116), were scarce in the burned deposit, although a few cui-ui bones (*Chasmistes cujus*) were found in the surface sand layers (W.I. Follett, this volume). Samples of a successive series of 15 of these strata were secured in 1968 and 1969 by Napton and P. Healy. Five of these samples have been processed by application of the micro-analytic techniques used in the analysis of the Lovelock Cave coprolites (table 1). These 15 discrete strata were superimposed on a deep deposit composed of aeolian sand and pebble-sized fragments of rock scalings derived from the walls and ceiling of the cave (fig. 20). The deposit is yellow in color, in marked contrast to the dark organic layers superior to it, and is apparently devoid of cultural material. The sand contained a large number of tiny bones probably derived from decomposed owl pellets. The bones include the remains of pocket gophers, microtines and other rodents (Douglas, personal communication, 1970).

Table 1

Lovelock Cave, (NV-Ch-18) West Alcove, S10/W95, Microanalysis and Composition (estimated volumetric percentage) of Five Midden Samples

	Typha Latifolia	Panicum Capillare	Scirpus Robustus	Atriplex	Charcoal	Twigs	Vegetable	Insect	Fish Bone	Bird Bone	Mammal Bone	Rock
S-6 WA	tr	tr	80	tr	tr		tr			tr	tr	20
S-7 WA	5		70	tr	tr	tr	tr	tr	tr		5	20
S-8 WA	tr	tr	60	tr	tr			tr			tr	30
S-11 WA		tr	90		tr	tr	tr				tr	10
S-15 WA	tr	tr	70	tr	tr	tr					tr	25

In the spring of 1969, we excavated the deeper deposits in the west alcove. Excavations were resumed at a depth of three feet below the surface, in an area extending from the inclined summit of rock A to the back of the cave, and thence downward into the west crevice (S20/W100). This test unit was dug to a depth of 12 feet below the surface.[9] The strata became progressively damper in the lower levels, but moisture had not seriously effected preservation of perishable specimens such as coprolites, of which more than 1500 were found. We attribute the large number of coprolites found in the west alcove to the fact that the crevice at the back of the alcove is the sort of place to which *Homo sapiens* characteristically retires for such purposes. One hundred and thirty-five of the west alcove coprolites have been analyzed at this writing. Two human coprolites from this unit were dated by radiocarbon. Coprolite WA-21, from a depth of 11 feet, S20/W100, has a radiocarbon age of A.D. 120±60 (UCLA-1459-A). Coprolite WA-20-A, found 12 feet below the surface in the same unit was processed for comparison. This specimen gave a date of A.D. 300±60 (UCLA-1459-B, Berger, personal communication, 1969).

Three artifacts of more than routine interest were found in the deeper deposits. A container made of bulrush culms was discovered tucked away in the sand at the rear wall of the cave (S15/W100, depth 48", feature 6, pl. 16). The tule parcel, which appears to contain a large quantity of loose bird feathers, is unopened, pending special laboratory studies to be made of its undisturbed contents.

The principal west alcove excavation units were located about eight feet west of the nearly vertical "chimney" of the west crevice. We had by this time constructed a bulkhead in the upper end of the west crevice in order to give some protection to personnel working in the deep west end of the cave some 35 feet below. The west alcove test penetrated the uppermost part of the west crevice fill. All excavation was by troweling; the backdirt was screened and was dumped *inside* the cave against the south wall of the alcove, rather than being disposed of on the slope outside the cave--a common practice that has little to recommend it. The cave earth, even though mixed, could yield additional information. Merely because the arrowshafts, coprolites, basketry fragments and other materials have been removed does not thereby make this earth valueless. It doubtless contains a great deal of material that could provide additional information about ancient cultural practices. For this reason we elected not to dump the spoildirt outside the cave. Excavation was discontinued at a depth of 14 feet beneath the original surface. At this point the crevice had narrowed to a width of 16 inches, and the backdirt had to be handled three times on the stepped levels ascending the slope of rock A.

East Alcove "EA" area, Grid Location N40/W25

The east alcove of Lovelock Cave is approximately 25 feet east of UCB datum B. The east alcove is part of the outer rockshelter, and is formed on the axial plane of the hinge fold oriented roughly east-west along the face of the cave outcrop. The east end of the alcove converges to form a narrow, nearly vertical chimney or cleft. The opposing faces of the rock walls, which are well protected from weathering, support a deposit of tufa some four inches thick. The exposed surfaces of the outer rockshelter are almost entirely devoid of tufa. The presence of tufa in the east alcove suggests that the outer rockshelter had assumed its present configuration prior to the last inundation of the cave by Lake Lahontan. Samples of the east alcove tufa were taken for radiometric dating.

Most of the floor of the east alcove is covered by large pieces of limestone from the alcove roof. A few artifacts, including several wooden firehearths (see Loud and Harrington 1929:96-97), were found in interstises of the rubble in grid unit N40/W25.

An area on the east edge of the alcove produced at least one notable artifact--a carved wooden grasshopper found in June, 1965 (Jones, Weaver and Stross 1967:123-128). This specimen is said to have come from a crevice located between the east alcove and the east abutment of the cave portal. The locus of the find, as it was indicated to us by Mrs. Ethel Hesterlee of Lovelock, is in grid unit N30/W20. The cave wall in this area is smoke-stained, and it is evident that it is part of the original cave portal.

Miners Dump (N100/W100)

The last area examined by us in 1969 was the guano miners dump ("MD") located on the hillside below the edge of the outer rockshelter. Part of this mantle of debris had been screened earlier (see Clewlow 1968:89-101), but the balance of the deposit had not been examined. The results of the recent work are reported by Clewlow and Napton (this volume).

This concludes our summary of the 1968-1969 excavations in the interior and outer rockshelter of Lovelock Cave. These data permit us to offer, as the concluding section of this report, a tentative synthesis of the stratigraphy and chronology of Lovelock Cave.

THE STRATIGRAPHY OF LOVELOCK CAVE

The discovery of an undisturbed remnant of midden or cultural material under massive rock C in grid unit NSO/W35 and made available for the first time abundant stratified materials that can be used for isotopic age determinations, palynological analysis, particle-size fractionation, and other types of analyses. The following synthesis of the stratigraphy of Lovelock Cave is based primarily on data from the above location and from Harrington's excavations of 1924.

Figure 23 depicts a cross section of the cave along a transect designated by us as section I-J, following Loud and Harrington (1929, pl. 2). The axis of this section roughly parallels their reference line A-B, which describes a transverse line NW to SW about 20 feet north of line I-J. The upper contact surface of the white lacustrine deposit is used by us as a common reference marker in the six enlarged cross-sections appearing in Figure 23. The deposits found in the course of our excavations in Lovelock Cave are described below, beginning with the uppermost layers.

Upper Guano Layer: We were unable to find any trace of the upper, or "Later Guano" layer, which was the deposit mined in 1911, although some remnants of it may exist under various rocks. This stratum, described by Hart (Loud and Harrington 1929:168), is apparently not present under rock C, which probably fell before the guano layer began to accumulate.

Midden Strata: The strata, from the surface of test unit NS0/W35 to the abrupt contact with the buried surface of the "Older Guano", consist of several discrete layers of midden trash interfingered by layers of sand, dust, and rubble. Unit NS0/W35 contains at least three discernible trash layers, each of which could represent an occupation horizon. The vegetal component of these strata is remarkably well preserved (pl. 12). Radiocarbon determinations were made on several samples of this material (table 4).

Older Guano Layer: We have continued to employ Harrington's term for this deposit in order to facilitate comparison of the stratigraphy of lot 15 and other units in the cave. The Older Guano seems to have occurred throughout the cave, except in the central part of the chamber, where it was removed by the guano miners. The characteristics of the various organic samples are given in Table 2.

Samples of the Older Guano layer were taken from the north profile of grid unit NS0/W35 at two-inch intervals. The existing surface of this stratigraphic unit is formed by a layer of rat nest material which accumulated under rock C. Each sample of the stratified debris under rock C weighed about 400 grams.

In the laboratory the samples were poured onto a large grid ruled in centimeter squares, and the composition of each sample was estimated as a volumetric percentage, using the same techniques employed in analysis of the Lovelock Cave coprolites. The data given in Table 2 indicate that this technique is useful in providing a rapid means of assessing the organic and inorganic contents of the midden. There are, of course, other techniques, such as sieving and gravimetric quantification, that yield much more precise data, and these procedures will be applied when larger samples of the test unit are obtained in 1970.

Table 2

Composition (estimated volumetric percentage) of Sediment Samples from Lovelock Cave and Radiocarbon Determinations, Grid Location NS0/W35, Samples 64:1428 - 68:1466, Collected in 1969 (Approximate Weight 400 gms. per Sample)

Depth (Inches)	Tule	Quids	Grass	Charcoal	Wood	Shell	Insects	Guano	Bones	Feathers	Fur	Bat Fur	Hair	Human Hair	Sand	Rock	Artifacts
1 - 2			tr	tr						tr					80	10	
2 - 4	5		tr	tr					tr	tr					90	5	
4 - 6	tr		5		tr				tr	1					80	5	
6 - 8	5		20	tr	tr					3					65	10	***
6	66:1432 A.D. 440 (I-4629)																
8 -10	5		5					tr		tr					90	tr	
10-12		tr	tr												90	tr	
12-14			tr		tr					tr					90	5	
14-16			tr		tr				tr	tr					90	5	
16-18	tr		30		tr				tr	tr					60	5	***
19	66:1438 660 B.C. (I-4630)																
18-20	tr		30		tr				tr	tr					60	tr	
20-22	tr		35	tr	tr					tr					65	tr	
22-24			10		tr			tr[a]	tr	tr			tr		80	5	
24-26			tr		tr			20	tr	tr		tr			70	5	
26-28			tr					25	tr	tr					70	5	
28-30			tr	tr	tr			15	tr	tr		tr			80	5	
30-32			tr	tr	tr			20	tr	tr			tr		80	tr	
32-34			tr	tr	tr			10	tr	tr			tr		90	tr	
34-36	tr		tr	tr	tr			5	tr	tr					90	5	
36-38	tr		30	tr	tr			tr	tr	tr		tr	tr		65	5	
38-40	10		40	tr	5			5	tr	tr			tr		25	tr	
40-42	tr		tr	tr	tr			90	tr	tr			tr		tr	5	
42-44	tr		tr		tr			95	tr	tr		tr	tr		tr	tr	
43	68:1453 2320 B.C. (I-4632)																
44-46	tr		tr	tr	tr			95	tr	tr		tr			tr	tr	
46-48	tr		tr	tr	tr			95	tr			tr			tr	tr	
48-50	tr		tr	tr	tr			95	tr	tr		tr			tr	tr	tr[b]
50-52	tr		tr	tr	tr			90	tr	tr		tr			10	tr	
52-54	tr		tr	tr	tr			95	tr	tr		tr			5	tr	
54-56	tr		tr	tr	tr			95	tr	tr		tr			5	tr	tr[c]
56-58	tr		tr	tr	tr	tr		95	tr	tr				tr	tr	tr	
58-60			tr	tr	tr		tr	95	tr	tr		tr			tr	tr	
60	68:1464 2570 B.C. (I-4633)																
60-62	tr		tr	tr	tr		tr	95	tr	tr		tr			tr	tr	tr[b]
62-64			tr	tr			tr	95	tr	tr		tr			tr	tr	
64-66				tr			tr	15	tr			tr			80	05	

*** = occupation level
a = owl pellet
b = cordage
c = net fragment

The guano layer is composed of fecal pellets deposited by cave-dwelling bats. Guano layers are found in many of the archaeological cave sites in the Great Basin, and the mere occurrence of these layers is often taken as evidence in support of various conjectures (which ultimately become someone elses' "facts") concerning supposed environmental alterations that might have occurred in the vicinity of the site. The well preserved guano layer in Lovelock Cave afforded a very good opportunity for us to attempt to determine the species of bat living in the cave, and its environmental and food requirements.

A mummified bat (22:391) found in the guano has been identified as an immature individual, probably two or three weeks old, of the genus Myotis cf. yumanensis (Pearson, personal communication, 1970). Hair samples from the "Older Guano" layer are from bats belonging to the cave dwelling genus Tadarida cf. brasiliensis. (For information on generic identification of bats by hair structure, consult Benedict[1957:285-548]. Background information on the bats of Nevada will be found in Hall [1946:127-171] and Cockrum and Musgrove [1964:636-637].) Dr. Pearson states that various species of Myotis gather in warm caves in groups called "nursery colonies." Myotis yumanensis has a wide range, extending from Lake Tahoe down to the Colorado River; therefore, its environmental constraints are not very specific. Dr. Pearson states:

> While both species would have needed water to drink every day, even a small puddle is enough to water a large number of bats. Neither Myotis or Tadarida require water to breed insects for a food supply.

One might theorize that the bats colonized Lovelock Cave following amelioration of ecological conditions in the immediate vicinity of the site. It is essential to bear in mind the fact that Humboldt Lake, located about two miles from the cave, could have been converted, in a matter of a few years or even during a single year, from a desolate, wind-scoured playa totally devoid of vegetation (pl. 1), to a comparatively lush, well-vegetated lacustrine environment of potentially high carrying capacity (pls. 17 and 18). This transformation could have been achieved without drastic climatological change, merely by maintenance, for a few consecutive seasons, of an adequate water supply in Humboldt Lake, located 2.0 miles northwest of the cave (pls. 19, 20). It is possible that the lake was dehydrated during the Altithermal (Antevs 1948). By Medithermal times, however, it might have rejuvenated sufficiently to support a colonial growth of vegetation, and, eventually, an extensive growth of hydrophytes and a large insect population, which in turn, provided food for the bat population of the cave. Jennings (1957:92) has advanced a similar explanation for the occurrence and development of the thin guano layer in level III of Danger Cave. Leonard Rockshelter, not far north of Lovelock Cave, contains a depositional layer attributed to the Altithermal climate period of the Postglacial which is interpreted as reflecting a long period of desiccation of Humboldt Lake (Heizer 1951:89-98).

It is true, of course, that many species of bats feed over water (Hall 1946:128-129) and it is likely that the older and later guano layers in Lovelock Cave formed as a result of conditions such as those outlined above. However, one of the most knowledgable students of the bats of Nevada pointed out to us that the two largest known colonies of cave-dwelling bats now extant in Nevada are located at least 50 miles from the nearest large body of water (Alcorn, personal communication, 1969). This information does not, of course, refute the possibility that the explanation given above is the correct one. However, in an effort to resolve the problem we processed a large sample of the older bat guano and isolated the insects that it contained. The insects in the guano layer came from three sources: (1) insects ingested by the bats and contained in fecal pellets; (2) insect parts that were not ingested, but were dropped from the roost sites on the cave ceiling; and (3) bodies of various insects that might have lived in the guano. The guano layer contained an incredible quantity of insect remains, and it is of considerable interest to discover that almost all of the insects deposited in the guano by the bats are desert-dwelling, non-aquatic species (Chemsak, personal communication, 1970). Dr. Chemsak states that very few of the insects represented species usually associated with aquatic habitats.

Additional information on food habits of Nevada bats is given by Fautin (1946:277), who counted the remains of 43 scorpions and 17 sand crickets which had been consumed by bats (Antrozous pallidus) over three successive nights. Hall (1946:152) examined food remains on the floor of charcoal kilns and found insects, camel crickets, and elytra of Scarabaeid beetles. (See also Hatt 1923: 260-261.)

In summary, we can say that the development of the Older Guano layer and the beginning of human occupation of the cave occurred at about the same time, but the occurrence of guano layers in cave sites does not necessarily give evidence of local or regional climatic alterations. Study of the insect parts in the bat guano is continuing.

Ash Stratum: The ash stratum located between the older guano and the white deposit probably resulted from charring of the guano, but additional study will be needed to confirm this opinion.

White Deposit: We have quoted or cited most of the statements made by Loud and Harrington (1929) in reference to the "lime" or "lacustrine" deposit found beneath the cultural stratum of the cave. In his description of level 5 of lot 15, Harrington (1929:22) mentions the "white lacustrine deposit" forming the bottom of the cave. Elsewhere (ibid:4,9,15, and 17), in referring to this feature, it was his tacit assumption that the "white deposit" is lacustrine in origin, probably consisting of sediment deposited by the receding waters of Pleistocene Lake Lahontan. If this is true, the white deposit was laid down circa 12,000-10,000 years ago (Morrison 1965, table 1; fig. 4D, see also Broecker and Kaufman 1965, table 1). Broecker and Orr (1958:1027) state:

> Thus far no evidence for a major post-11,000 year oscillation [of Lake Lahontan] has been found in the sediment sections.

The strata above the white deposit were laid down in the last 6000 years, if the isotopic dates of the guano strata are any criteria, indicating that there is a disconformity of some 6000 years duration between the two layers, if the lower white deposit does in fact refer to the recession of Lake Lahontan. The surface of the white deposit dips toward the west end of the cave, and it is difficult to believe that a deposit of lacustrine origin would assume an incline tangential to the water surface level. The entire limestone unit containing the cave could have been tilted by faulting. However, the Lahontan shorelines above and below the cave are nearly horizontal.

The chemical composition of the white deposit has recently been established by spectroscopic analysis of three samples, one each from the "AN" area (S10/W50, depth 76.4, sample No. 71:1503), "ME" area (S5/W10, depth 78.7, sample No. 22:400), and "WE" area (S35/W70, depth 69.0, sample No. 69-1469). These samples were processed in the laboratories of the U.S. Geological Survey, Menlo Park, California. The analyses demonstrate that the material in question is mostly sodium chloride and potassium chloride, forming a mineral commonly known as "halite" (Tatlock, personal communication, 1969), which is usually formed by precipitation of minerals from standing water, or by cyclic evaporation and rejuvenation of mineral-charged waters. There are large deposits of halite, anhydrites, and other evaporites on the surface of playas near Lovelock Cave. Another occurrence of a halite-like deposit is in Danger Cave, Utah (Jennings 1957:62,73-75,92-93) between levels II and III, the second and third depositional units above level I, the basal strata of the cave. Level II in Danger Cave has an isotopic age determination of 7839 B.C.±630 (C-6111); level III dates are 5150 B.C.±150 (GaK-1897) and 4620 B.C.±110 (GaK-1901) (Jennings, personal communication, 1969). The level III dates in Danger Cave are approximately concordant with the date of 4054 B.C.±250 (C-278) obtained from the unburned guano layer situated immediately above the Lovelock halite stratum. It may be mere coincidence that the dates are nearly synchronous, but the chemical compositions of the halites from each cave are remarkably similar (table 3).

Table 3

Chemical Analyses of Evaporites from Lovelock Cave, Nevada (NV-Ch-18)

Lovelock Cave Evaporite[a] (S5/W10) (64:1424)		Danger Cave Chemical Analyses of Salts[b] 1950		1951[d]	
C	0.51	Free H_2O	5.56	NaCl	21.42
H	0.29	Insoluble acids	8.56	KCl	6.42
Ca	8.8	$CaCO_3$	19.85	Na_2SO_4	13.75
SO_4	4.08	KCl	7.36	MgCl	1.04
Cl	3.58	NaCl	28.21	$NaNO_3$	1.73
		Na_2SO_4	18.09	Na_2CO_3	10.19
		NA_2SO_3	5.74	S_1O_2	7.96
		$NaNo_3$	.374	$CaCO_2$	18.74
		P_2O_5	.34	$MgCO_3$	2.11
			94.084[c]	Fe_2O_3	1.95
				$Ca_3(PO_4)_2$	1.05
				H_2O	5.78
				Organic (Soluble)	4.70
				Organic (Insoluble)	.40
					99.72

a. Analysis by H. Rapoport, Department of Chemistry, U.C.B.
b. After Jennings (1957, Table 9).
c. Balance was probably water and organic matter.
d. A 1953 sample virtually duplicated the 1951 specimen.

The "Salts" in Danger Cave did not uniformly overlie the level II strata, but occurred as a small "dike" or discrete member near the cave entrance. Jennings believed that the salts resulted from alternate periods of wet and dry conditions perhaps produced by sheetwash or groundwater which entered the cave, ponded, and eventually evaporated. We believe that the evaporites in Lovelock Cave probably had a similar origin. This deposit should be explored to a sufficient depth to expose the limestone bed of the cave.[8]

CONCLUSIONS

Hypothetical Sequence of Events in Lovelock Cave

The massive bed of Jurassic limestone in which Lovelock Cave is situated has been subjected to a variety of seismic and tectonic forces, including severe local folding and extensive erosion produced by wave action of Pleistocene Lake Lahontan. The collective effects of these forces has brought the cave to its present configuration. Some of these events, although very recent in terms of the geological time scale, have drastically effected human occupation of the cave. The hypothetical sequence of some of these events is outlined in the following section.

In our introductory comments we stated that the earliest geological event of immediate concern in studying the archaeology of Lovelock Cave is the initial development of the cave in a massive unit of Jurassic limestone. Dr. R.C. Speed (personal communication, 1970) has suggested that the cave was formed as an opening between a flexed upper unit which was thrust over unflexed subjacent strata. It is possible that the hinge region was strongly strained or fractured; therefore, the exposed hinge region was rapidly eroded by Lake Lahontan.

L. L. Loud (1929:30) states that the cave was located just above the Dentritic terrace of Lake Lahontan (see Russell 1885), and asserts that at one time the cave was "perhaps a hundred feet high". This is doubtful in view of the geomorphology of the site, but at the same time it is evident that wave action played a major part in its formation. Strand lines are visible both above and below the cave.

Tufa layers occur both inside and outside the cave (fig. 5, event 1). The tufa deposits inside the cave were not mentioned by previous investigators. The west end of the cave, which is more stable and is less subject to shearing than the roof of the east end, still supports a deposit of tufa eight to ten inches thick, and the opposing faces of some of the vertical fissures in the ceiling of the east end of the cave are covered with tufa. Much of the tufa deposit inside the cave has been destroyed by collapse of the cave ceiling. Large slabs of limestone with adhering tufa must lie buried in or beneath the white deposit in the east end of the cave.

Not long after Lake Lahontan finally withdrew below the level of Lovelock Cave, a huge block of limestone detached from the cave roof near the portal and fell into the west end of the cave. This block (fig. 5, event II, rock A) is some 50 feet long, 25 feet wide and 15 feet thick. Excavation demonstrated that the outer surface of the rock, which once formed part of the overhanging cliff above the cave portal, bears the weathered remnants of tufa, but nearly all traces of tufa have long since been eroded away from the cliff above the fallen rock. The west end of rock A is situated in such a way as to form two important features of the cave: a discrete chamber or "alcove" in the upper west end of the cave, and the "west crevice," the narrow, constructed passage between rock A and the west wall of the cave (fig. 10). Both of these features contain cave debris of various kinds, including twigs, grass, aeolian sand, and roof scalings. Harrington (1929:17-18) found several artifacts and some human bones under the inner edge of rock A inside the cave, but these specimens surely were cached after the rock fell, rather than having formed part of an old midden deposit that had been laid down before the rock fell. The underside of this monolith is free of smoke-stain and cave varnish, the absence of which is important, in view of the fact that a thick deposit of hydrocarbons occurs on the undersides of rocks B and C in the northeast end of the cave.

It is possible that the initial occupation of the cave began soon after the fall of rock A. The central and east end of the cave remained open, with an estimated floor-to-ceiling clearance of at least 15 feet and a proscenium some 50 feet long, extending from the east end of rock A to the solid rock abutment at the east end of the cave portal (fig. 5, event II).

The depositional occurrences of "Event II" are as yet almost wholly unknown, and can be revealed only by extensive deep-probing tests of the white evaporite deposit. We do not know what kind of strata occur under the evaporite, nor do we know why the water-formed evaporite deposition ceased, to be succeeded by the older guano deposit, unless this occurrence represents the last recession of Lake Lahontan. It is possible that a temporal discontinuity of considerable magnitude is indicated between cessation of evaporite deposition and the beginning of guano accumulation. On the other hand, there may be no disconformity, but the problem cannot be settled without further excavation of the evaporite deposit.

The cave was occupied by bats at a date coinciding with the estimated end of the Altithermal (Antevs 1948), perhaps as a direct result of rejuvenation of Humboldt Lake. The problem could be investigated by study of an extensive series of core samples taken from the bed of Humboldt Lake. The initial buildup of the older bat guano layer may have begun <u>circa</u> 5000 B.C. A radiocarbon date (C-278), obtained in 1948 by solid carbon analysis, indicates that the lower part of the layer had begun to accumulate at least by 4000 B.C. (table 4).

Table 4

Radiocarbon Age Determinations, Lovelock Cave, Nevada (NV-Ch-18)

Sample No.	Material	δ - C^{14}	Age B.P.	B.C./A.D. date	UCB Grid Location & Identification No.
UCLA 1071-E	Human Coprolite		145 ± 80	A.D. 1805	NSO/W55 (ENT-R.C.1)
I-4672	*Scirpus* seed	63 ± 11	520 ± 95	A.D. 1430	S10/W95 (82:1577)
UCLA 1071-F	Human Coprolite		1210 ± 60	A.D. 756	N30/W5 (INT-R.C.2)
I-3963	Human Coprolite	167 ± 9	1470 ± 90	A.D. 480	NSO/W30 (LX-10)
I-4629	Vegetal Material	171 ± 9	1510 ± 90	A.D. 440	NSO/W35-6 (66:1432)
UCLA-1418	Human Coprolite		1600 ± 50	A.D. 350	NSO/W30 (LX-16)
UCLA-1459-B	Human Coprolite		1650 ± 60	A.D. 300	S20/W100 (WA-20-A)
C-728,729,730	Basketry		1672 ± 220	A.D. 268	*
UCLA-1459-A	Human Coprolite		1830 ± 60	A.D. 120	S20/W100 (WA-21)
UCLA-1417	Vegetal Material		1900 ± 60	A.D. 50	NSO/W30 (LX-56)
C-276	Vegetal Material		2481 ± 260	531 B.C.	*
I-4630	Vegetal Material	277 ± 11	2610 ± 120	660 B.C.	NSO/W35-19 (66:1438)
C-735	Basketry		3168 ± 260	1218 B.C.	*
I-4758	Human Muscle Tissue	343 ± 8	3370 ± 100	1420 B.C.	*** (13-4954)
UCLA-1459-C	Human femur		3400 ± 80	1450 B.C.	S40/W85 (F-5 Femur)
I-4631	Vegetal Material	391 ± 9	3980 ± 120	2030 B.C.	NSO/W35-37 (67:1448)
I-4632	Bat guano	412 ± 8	4270 ± 110	2320 B.C.	NSO/W35-43 (68:1453)
I-4634	Bat guano	424 ± 9	4430 ± 130	2480 B.C.	NSO/W35-64** (68:1465)
C-277	Bat guano(B)		4448 ± 250	2498 B.C.	*
I-4633	Bat guano	430 ± 8	4520 ± 110	2570 B.C.	NSO/W35-60** (68:1464)
I-4673	Bat guano(B)	435 ± 8	4580 ± 120	2630 B.C.	S35/W70 (121:1654)
I-3962	Bat guano, veg.	442 ± 8	4690 ± 110	2740 B.C.	S10/W50(AN-16)(80:1556)
C-278	Bat guano		6004 ± 250	4054 B.C.	*

Notes to Table 4 on following page.

Notes to Table 4

* Original sample identification number not given.

** The apparent inversion of the ages of NSO/W35 sample 64 and NSO/W35 sample 60 is due to an error made in recording depths when the samples were collected; however, both samples are from the same stratigraphic component of the Older Guano layer; depth about 60 inches below the surface of the test unit.

*** Mummy found in Pit No. 35 (Loud and Harrington 1929:16).

The earliest evidence of human occupation that we have found up to the present time occurs in the Older Guano layer, age circa 2700 B.C.; however, at this time the cave was only intermittently occupied by man. Bats and other creatures continued to inhabit the cave until about 2500 B.C., when human occupation increased. We do not know why the cave suddenly (as it seems) became such a popular occupation site, circa 1500 B.C. One of the inhumations on the Humboldt Lake site (NV-Ch-15) has been dated at 733 B.C.±250 (M-649), so it is evident that the lakeshore was occupied at this time, but, as in the case of Lovelock Cave, we do not know the reason for the dramatic increase in occupation of this site.[10] It is evident that the fluctuations of human occupation of the cave and lakeside sites probably coincided with the oscillations of Humboldt Lake.

By the time of Event III (fig. 6), a considerable deposit of cultural material began to accumulate above the Older Guano. According to Harrington (1929), the midden deposits were 10 to 15 feet thick in the west end of the cave. We believe that intensive occupation of the cave began circa 1500 B.C. and continued until about A.D. 500. At this time, certainly no earlier, occurred Event IV (fig. 6), a massive rockfall probably triggered, as Harrington (1929:120) remarks, by some forgotten earthquake. Five or six extremely large blocks of limestone were dislodged from the ceiling of the cave and crashed down upon the occupational refuse left by the Indians. One hopes that no one was in residence in the cave at that exact moment. We say this charitably, because the value of any human casualties as subjects for paleopathological study would be considerably diminished by the impact of several tons of limestone. The nether side of rock C is thoroughly smokestained. The approximate date of the rockfall (A.D. 440±90) is indicated by radiocarbon sample I-4629, but this date is obtained from vegetal material that had accumulated prior to the rockfall. The exact date of the rockfall probably can be determined by isotopic analysis of samples taken from the impacted vegetal debris under rock C. It is likely that rocks B, C, and D fell at the same time. All are smokestained; all came from the same shear-zone; all rest directly on masses of occupational debris. The east and central part of the cave portal was gradually being reduced in height by the slow accumulation of occupational trash and other cave debris, but prior to the Event IV rockfall the entrance was probably wider, and part of the human activity in the cave probably took place in this area.

The massive rockfall of Event IV (fig. 6) wrought great changes in the cave. Rocks B and C virtually sealed the cave portal, restricting access to the interior of the cave to a narrow, slanted cleft between rocks A and B. It is possible to theorize that since access to the interior of the cave was greatly impeded by the rockfall, the Indians began to occupy the outer rockshelter (fig. 7, event V). The interior of the nearly closed cave was quite dark, particularly in the center and east end of the chamber, but the site continued to be used as a repository for the dead and for caching valued articles.[11] Human occupation of the interior of the cave was drastically curtailed, and this, together with reduced illumination and air circulation, made it all the more attractive as a dwelling place for bats. Thus, between A.D. 700 and A.D. 1911, a thick deposit of bat guano accumulated over the cultural deposits, reaching, according to Hart (1929:168), depths of four to six feet. Human occupation of the outer rockshelter and infrequent use of the cave interior probably continued, if we correctly interpret the results of our recent excavations, until 1829, when Peter Skene Ogden and his comrades, the first white men to explore the lower reaches of the Humboldt River, arrived at Humboldt Lake, signalling the beginning of the end of the long history of exclusive Indian occupation of the lakeshore open-air and cave sites.

The date of abandonment of Lovelock Cave can probably be estimated, but it is difficult to do this because of the lack of post-contact European goods in the cave midden. The apparent absence of post-contact goods in the artifact inventory of this site has contributed to the widely-held belief that the cave was abandoned prior to 1829, when Ogden and his party reached Humboldt Lake (Cline 1963). However, in 1833, near Humboldt Lake, members of the Bonneville-Walker expedition encountered a large group of Indians--33 of whom were slaughtered as a punitive measure. The following year, on their return trip from California, members of the same expedition killed another 14 Indians, setting the stage for long-term Indian-white hostilities.

These events, augmented by the rapid westward spread of disease in 1849, led to abandonment of the lakeshore sites (Hopkins 1883; Scott 1966). By 1849, of course, the Big Meadows northeast of Lovelock Cave had become a staging area for the California-bound emigrants, prior to their trek across the dreaded Forty-mile Desert that lay west of the Humboldt Sink. In 1869, less than 40 years after the first exploration of the valley, permanent settlers took up residence near the town of Lovelock. A few Indians continued to camp near the lake (Loud 1929:152-164), and to the present day a small "colony" of Northern Paiute live in the town of Lovelock--the last remnant of the once large Indian population of the valley (Heizer n.d.).

It would appear, on the basis of the evidence now at hand, that Lovelock Cave was not totally abandoned circa A.D. 900, as Grosscup (1960:12) suggested, but was visited until as late as 1829, and perhaps until as late as 1849, although there is no firm evidence for use of the cave at that late date. The gun parts found in the west alcove of the cave suggest late use of the site, but additional evidence has not been found--or has never been reported. We allude to the fact that when Loud catalogued the first of his finds in Lovelock Cave (Lowie Museum accession No. 443), he recorded three pieces of "white man's cloth" found in lots 6, 8, and 11. These specimens may be merely scraps of material left by the guano miners who quit the cave a few months prior to Loud's arrival. However, the wording used by Loud would seem to imply that the cloth might have been used by the Indians. The specimens have not been located for study. In any case, the fact remains that there is virtually no evidence of post-contact occupation in either the cave or the outer rockshelter.

Accounts of the emigrant travel across the Forty-mile Desert describe the incredible litter of abandoned goods that had been strewn along the route. The remains of this debris can still be found, 120 years later, on the lakebed near site NV-Ch-15. If the cave were in use after 1849, when the bounty of abandoned goods became available to the Indians, it is likely that some of this material would have been retrieved by the Indians and cached in the cave. That such evidence has not been found in Lovelock Cave is probably a very good indication of the fact that the site had been abandoned prior to 1849. In this connection, Stewart (1939:139) states of the Kupadokado band who occupied the Humboldt Sink region:

> This band, being along the old immigrant road, was one of the first Northern Paiute groups to feel the disasterous effects of Caucasian contact. It was in the Kupa territory that members of Walker's exploring party (1834) shot an Indian for the fun of seeing him fall, an event that was followed by a battle in which more than twenty others were slaughtered. Since the early contact proved so calamitous, the Indians soon left Humboldt Meadows to the immigrants. Consequently, later travelers reported few or no Indians there for a number of years.

It is probable that the area was abandoned by the Northern Paiute as a result of a combination of circumstances (see Cowan 1967:21-35). We suggest 1835 as the terminal date of Lovelock occupation.

Event VI occurred in 1911, when Hart and Pugh began mining the guano deposits (fig. 7). Events VII and VIII are Loud's excavations in 1912 and Harrington's work in 1924 (fig. 8, events VII, VIII).

Lovelock Cave and Humboldt Valley Sites

One of the most important aspects of Lovelock Cave, but one of the least emphasized in most of the early publications, is the relationship of the cave to the several large open-air occupation sites that occur along the former shore of Humboldt Lake (Loud 1929:129-133; Elsasser 1968:26-51). It has been our opinion (Heizer and Krieger 1956; Heizer and Clewlow 1968:59-88; Napton 1969:28-97) that one of the largest of the lakeshore sites (Loud's site 15, now NV-Ch-15, commonly known as the Humboldt Lakebed site, located some 2.0 miles northwest of the cave at an elevation of approximately 3900 feet) was occupied during a span of time roughly coeval to the occupational span evidenced at Lovelock Cave. The extent and former importance of the Humboldt Lakebed site has never been demonstrated adequately. Loud (1929:132) devotes a single paragraph to descriptions of this site and the other Humboldt Valley sites which he examined.

Recently, having completed extensive re-investigation of these sites, we have suggested that Lovelock Cave may have been more or less ancillary to the Humboldt Lakebed site. The elucidation of the relationship of NV-Ch-15--with its numerous house and storage pits, hundreds of milling implements, and thousands of projectile points--and Lovelock Cave, which lacks significant quantities of milling implements and other lithic materials, is of great importance in the broad picture of human occupation of the Desert West. If Lovelock Cave is a satellite of a larger, nearby, open-air site, perhaps other Great Basin caves that have been treated as discrete manifestations should be viewed in terms of their possible association with adjacent open-air occupation sites.

If we suggest that the occupants or users of Lovelock Cave were also residents of the lakebed sites, it is of course necessary to demonstrate this by means of the available evidence. The comparable radiocarbon dates of specimens from NV-Ch-15 and NV-Ch-18 furnish an important clue (see note 10), but we believe that the most obvious evidence pointing to the relationship between the lakeshore and cave sites is the fact that the caves contain great quantities of materials such as bulrush, cattails, remains of mudhens, fish, etc., which could have been obtained only at the lake. The famous decoys found by Harrington (1929:12-31;114) could have been used on the lake, of course, and the same is true of the fishnets, fishhooks, and other artifacts used in exploitation of lacustrine resources.

Lovelock Cave has long been known for the well-preserved materials that it contained. Many specimens found in the cave were obviously worn-out discards, but a tremendous number of functional artifacts were found in cache pits dug in the cave midden. The enormous mass of artifacts from Lovelock Cave, probably amounting to more than 20,000 specimens, is an impressive collection. However, in examining the cave midden, we are equally impressed with what is <u>not</u> present. Absent, or nearly so, are the ash lenses that are almost invariably found in large rockshelters and caves, absent also are large amounts of flint debitage, discarded bones of large fauna, and many other kinds of debris that were usually produced in the course of daily living in prehistoric Great Basin occupation sites. The cave might have been used seasonally, or as a cold weather retreat, or in spring, during periods when the lakebed sites were flooded (see Napton 1969:28-97).

In short, there are enough anomalies in the Lovelock Cave occupational debris to suggest that part of the daily human activity that usually occurred in this type of Great Basin occupation site probably took place at some other location--most probably at the lakeshore villages.

Summary

Recent excavations in Lovelock Cave, Nevada (NV-Ch-18) were made to obtain additional human coprolites and archaeological data that would provide, for coprolite data previously published and for the new data appearing in this volume, a well-defined frame of reference. The excavations led to the recovery of materials that have provided the oldest radiocarbon date of culturally *associated* vegetal material--2740 B.C.±110 (I-3962)--and the earliest *absolute* cultural dates: 1450 B.C.±80 (UCLA-1459-C) and 1420 B.C.±100 (I-4758), based on radiocarbon determinations of human remains. A series of internally consistent radiocarbon determinations was produced by analysis of samples taken from one of the last existing remnants of the original cave midden.

Recent occupation of the site is evidenced by additional finds of Desert Side-notched and Rose Spring Corner-notched points. Possible post-contact occupation is indicated by gun parts found in the hitherto unexcavated west alcove of the outer rockshelter. Thus, the known occupational history of the cave has been extended to include the time from *circa* 2500 B.C. to *circa* A.D. 1835. New geological information clarifies the tectonic development of the cave and the composition of the deepest non-cultural strata in the cave. Ecological studies made in conjunction with the excavations have been helpful in reconstructing the vegetational and faunal subsistence resources exploited by the prehistoric inhabitants of the cave.

We have summarized the history of excavations in Lovelock Cave and have discussed the important relationship between Lovelock Cave and the Humboldt lakebed archaeological sites. The full significance of this relationship will be investigated during the course of further fieldwork in the lower Humboldt Valley.

Notes

1. The latitude and longitude coordinates given here are based on observations made in the fall of 1969.

2. Tufa is calcium carbonate ($CaCO_3$) formed as an incrustation on the shore of most of the Pleistocene Great Basin lakes.

3. Between 1912 and 1924 N.C. Nelson had (in 1916) at Tano, New Mexico, presented American archaeologists with the archaeological principle of stratigraphy. Harrington, and other workers such as A. V. Kidder and L. Spier, learned the lesson of how to trace cultural change by stratigraphic digging. It was this principle, unknown to Loud in 1912, which Harrington applied in 1924.

4. The date of radiocarbon sample C-735, which is 1218 B.C.±260, was originally calculated by taking the date A.D. 1954 as "present." By accepted convention (Deevey, Flint, and Rouse 1967), the year A.D. 1950 is arbitrarily assumed to be the "present" date, so the date of sample C-735 would actually be 1222 B.C., if it is to agree with the other dates given in Table 4. However, the figure 1218 B.C. is entrenched in the literature, and to avoid additional confusion we must continue to use it here.

5. The emulsion of these negatives is supported on a base of highly inflammable cellulose nitrate. Most of these negatives have been copied in order to minimize the possibility of their loss through combustion (Guadagno, personal communication, 1969).

6. There are at least 556 Lovelock specimens in the Heye Foundation collections, but only a few of these are of known stratigraphic provenience.

7. Grosscup (1960:1) gives the elevation of Lovelock Cave as "4240±20 feet above sea level," but he does not state how this figure was determined. Napton and Heizer (1969:i) and Heizer and Napton (1969:563-568) give the elevation of the cave as 4240 feet, an estimate based on the apparent elevation indicated on the U.S.G.S. Carson Sink quadrangle map, 15' series, 1951. The common corner of sections 1, 2, 11, and 12, T24N, R30W, located about one mile northwest of the cave, which was located by the U.S.G.S. field survey, is given as 3941 feet. The cave entrance is about 350 feet higher than the surface of Humboldt Lake (3889 feet).

8. This project is scheduled for June, 1970.

9. The depth scale is marked on the west wall of the west alcove.

10. The date of 733 B.C.±250 (M-649) is based on carbonized twined basketry fragments from a burial pit on the Humboldt Lakebed site (NV-Ch-15), collected in 1956. Another storage pit on the Humboldt Lakebed site is dated A.D. 1400±60 (UCLA-1071-A, Berger, personal communication, 1968).

Charcoal from an unexcavated housepit at NV-Pe-67 gave a date of A.D. 1630±50 (UCLA-1071-D, Berger, personal communication, 1968). We are reluctant to place too much confidence in the isolated radiocarbon date of 733 B.C. ±250 (M-649), since the only other date from the Humboldt Lakebed site (A.D. 1400) is considerably later.

11. The area that had been covered by rocks B and C, located just inside the cave portal, should contain evidence of domestic activity preceding the rockfall, but probably few inhumations, which, one would imagine, would have been made in the less-used east and west ends of the cave or at the back of the cave in the crevice between the midden deposit and the cave wall. After the Event IV rockfall, however, this part of the cave was a dark, out-of-the-way area; therefore, the duck decoys cached in pit 12 and the inhumation in pit 46 probably post-date the Event IV rockfall (see fig. 7).

Explanation of Figures

Figure 1. The Great Basin region and Nevada. Danger Cave, in western Utah, is located a short distance from the Humboldt River Basin in Nevada.

Figure 2. Principal archaeological sites in the Lovelock Sub-Basin, lower Humboldt River Valley, Nevada. Area of map is inset, lower right.

Figure 3. Geological map of a section of the West Humboldt Range, western Nevada, from data prepared by R. C. Speed and R. Willden. Lovelock Cave is situated in unit Jal, a Jurassic limestone outcropping discontinuously along the north face of the range.

Figure 4. Simplified schematic diagram of the tectonic development of Lovelock Cave in limestone unit Jal, West Humboldt Range, Churchill County, Nevada. The cave chamber is formed between flexed unit Jal and an unflexed substrate. The cavern is exposed in the fractured hinge fold. Tertiary colluvium covers the lower part of the limestone unit.

Figure 5. Lovelock Cave, hypothetical development. Event I: The cave is exposed (as in fig. 4), wavecut, and tufa is deposited. The hatchure denotes existing layers of tufa. Presumably, the evaporite deposit is laid down in the cave during this time.

Event II: Massive rock A falls in the west end of the cave; the cave is open to occupation by terrestrial fauna. Gauno begins to accumulate; initial human occupation occurs in the west end of the cave.

Figure 6. Event III: Principal period of human occupation of Lovelock Cave, beginning *circa* 2000 B.C. Minor rockfalls, much use of the cave by local fauna, continuing until A.D. 500.

Event IV: Massive rockfall (seismic activity?) closes part of cave entrance, restricts access to passage between rocks A, B, and C. Rockfall between rocks C, F, and G (indicated by dotted line) was dynamited by guano miners in 1911.

Figure 7. Event V: Rate of deposition of occupational litter in the interior of the cave is reduced as human occupation shifts to the outer rockshelter. Interior of the cave used as repository for the dead (pit 46) and for storage of valuables (decoys, pit 12). "Later Guano" layer accumulates in the interior of the closed cave.

Event VI: Guano mining, A.D. 1911. Tunnel (indicated by broken lines) is driven through rockfall. Stipple indicates extent of removal of "Later Guano" deposit. Note "ramp" left by guano miners. This feature was excavated by Harrington in 1924.

Figure 8. Event VII: Excavations in Lovelock Cave, Nevada by Llewellyn L. Loud (after Grosscup 1960, fig. 2). Note the lateral extent of lots 9 and 38. The location of lots 1, 2, 4, 5, 7, 15, 20, 21, and 24 were omitted on all known maps of the cave prepared by Loud.

Event VIII: Excavations in Lovelock Cave, Nevada in 1924 by M. R. Harrington and L. L. Loud, sponsored by the Museum of the American Indian, Heye Foundation, New York. Cache pits recognized by Harrington are indicated by dots, burials by squares.

Figure 9. Event IX: Excavations in Lovelock Cave, Nevada, 1968-1969, by University of California field parties supervised by R. F. Heizer and L. K. Napton. Grid orientation is magnetic north. The principal datums (UCB-A; UCB-B) are indicated. Contour interval is one foot.

Figure 10. Interpretive isometric projection of Lovelock Cave indicating approximate location of major rocks A-H, test units of 1968-69, and other features of importance. The drawing is not to scale.

Figure 11. Lovelock Cave, Nevada (NV-Ch-18), "LX" area and massive rock C. Grid location NSO/W35 is indicated under rock C.

Figure 12. Lovelock Cave, Nevada (NV-Ch-18), cross section, grid unit NSO/W40 and rock C. The sketch depicts the "hinge-effect" fracture of rock C, which detached from the cave roof and rests on the underlying midden debris. The approximate of the outer rockshelter deposit, excavated by Harrington in 1924, is indicated in the upper right corner.

Figure 13. (See Explanation of Plates, pl. 12.)

Figure 14. Lovelock Cave, Nevada (NV-Ch-18), location NSO/W35. Graphic projection of radiocarbon date determinations plotted against chronology and stratigraphy. The exponential curve indicates that a sample of organic debris from 30 inches below the surface in this part of the cave might date circa 1600 B.C.

Figure 15. Lovelock Cave, Nevada (NV-Ch-18), section showing pits 9 and 10. (Loud and Harrington 1929, fig. 3). The sketch depicts, in an idealized cross-section, the north profile of the midden deposit near massive rock E.

Figure 16. Lovelock Cave, Nevada (NV-Ch-18), "LX" area, NSO/W30, west and north profiles, showing location and shape of empty cache pit No. 49 (feature No. 1).

Figure 17. Lovelock Cave, Nevada (NV-Ch-18), unit NS0/W35, hardpacked "floor" on the surface of the Older Guano layer, depth 41 to 43 inches.

Figure 18. Lovelock Cave, Nevada (NV-Ch-18), "AN" area, S10/W50, unit profile, view west. Note the relationship of the "Entrance" coprolite crevice and the slope under rock B.

Figure 19. Lovelock Cave, Nevada (NV-Ch-18), "AN" area, S10/W50, north profile.

Figure 20. Lovelock Cave, Nevada (NV-Ch-18), "WA" area, S10/W95, upper level, stratigraphic profile. View north, surface to 18 inches below the surface. Bulrush seed from Layer III provided a radiocarbon date of A.D. 1430±95 I-4672).

Figure 21. Lovelock Cave, Nevada (NV-Ch-18), "EE" area, N25/E25, contact of tufa layer and evaporite stratum. View east.

Figure 22. Lovelock Cave, Nevada (NV-Ch-18). Reported or observed occurrences of white evaporite deposit, showing source of samples used in chemical analyses.

Figure 23. Lovelock Cave, Nevada (NV-Ch-18). Stratigraphic schematic profile of cave deposit with cross sections of test units and sources of radiocarbon samples collected between 1948 and 1969. The "culture-chronology" of the cave, as proposed by Grosscup (1960) and Loud and Harrington (1929) is indicated on the left hand side of the diagram.

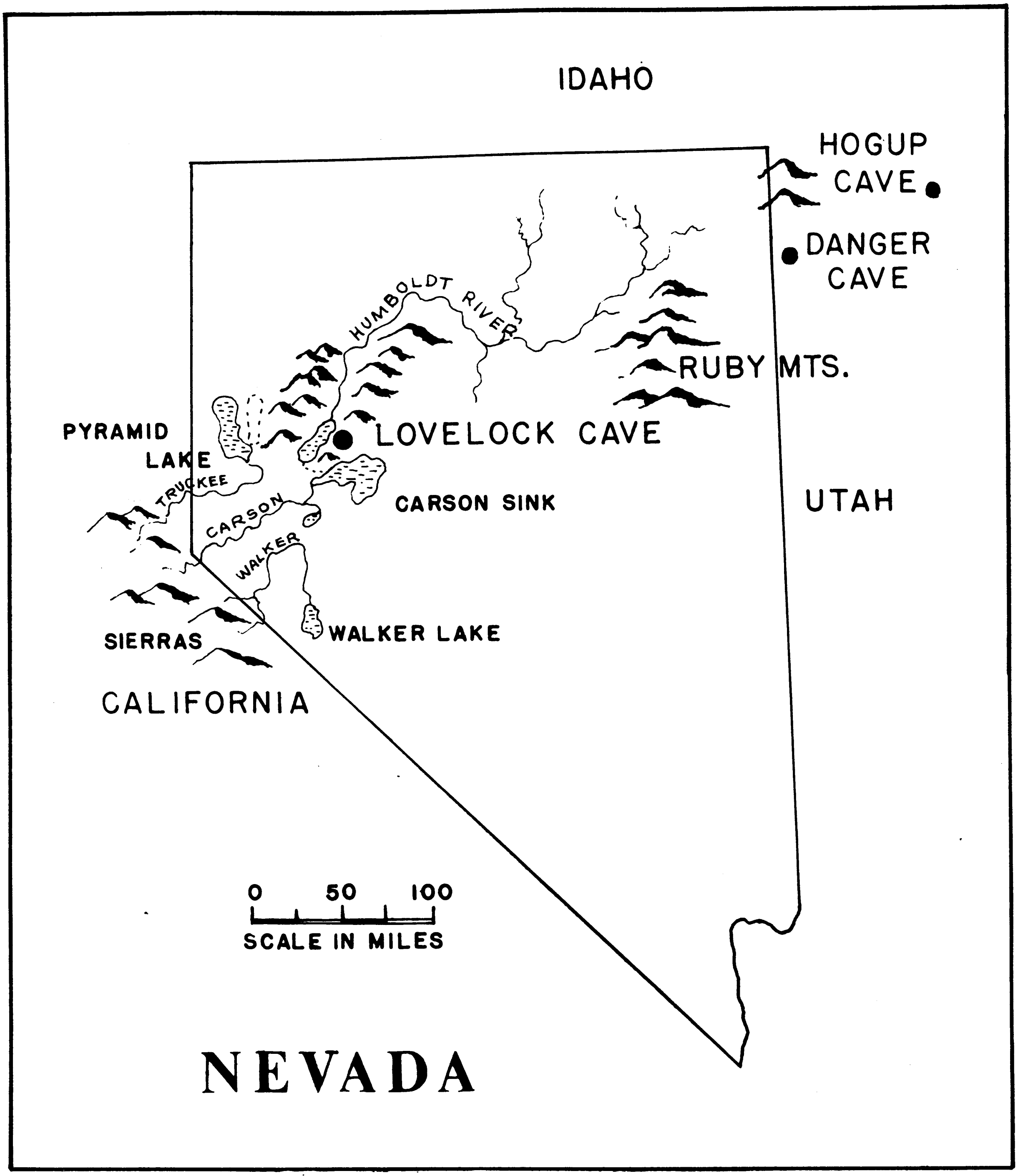


Figure 1. Location of Lovelock Cave (NV-Ch-18), Nevada

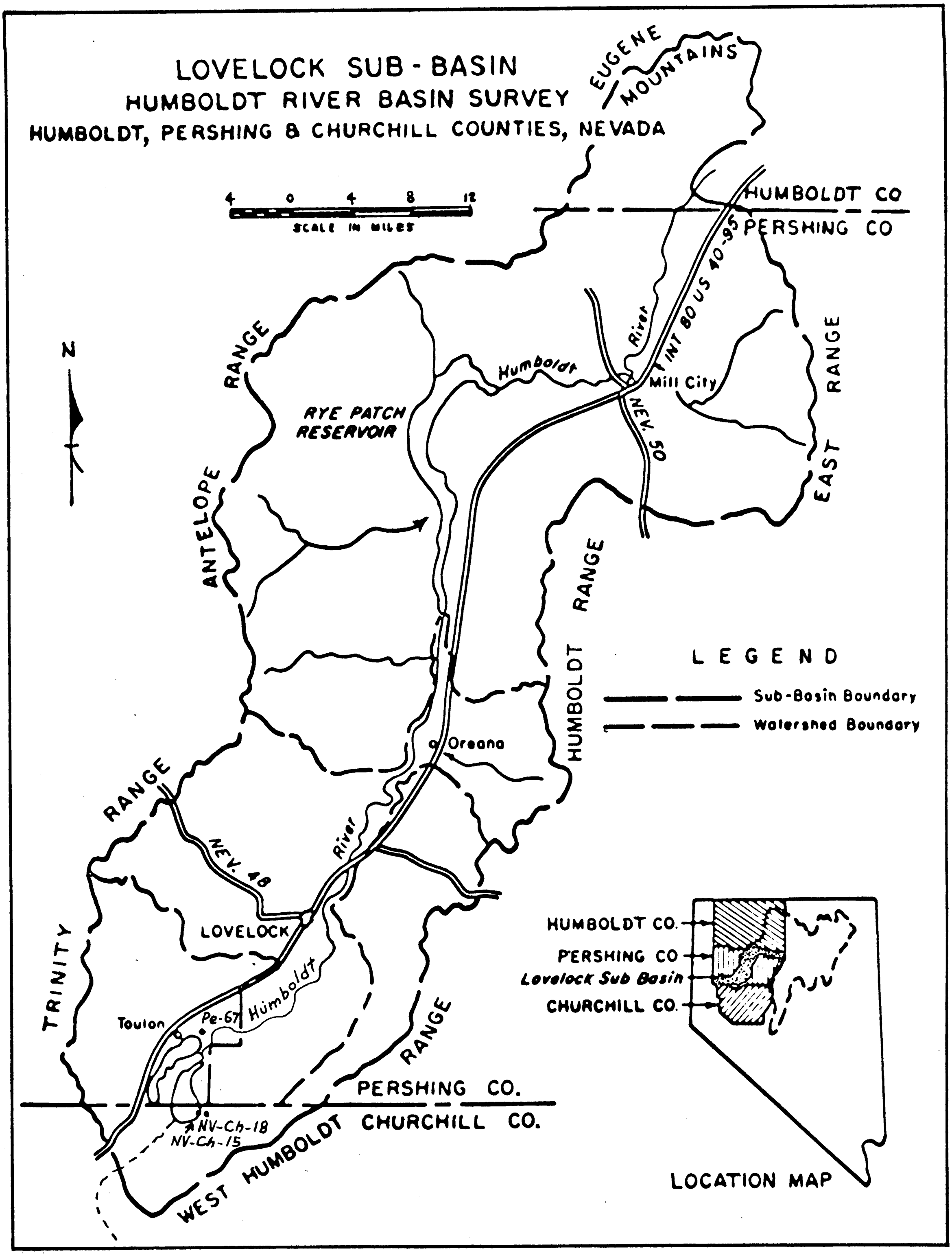


Figure 2. Lovelock Sub-Basin, Nevada, showing location of Lovelock Cave and the Humboldt Lakebed site (NV-Ch-15)

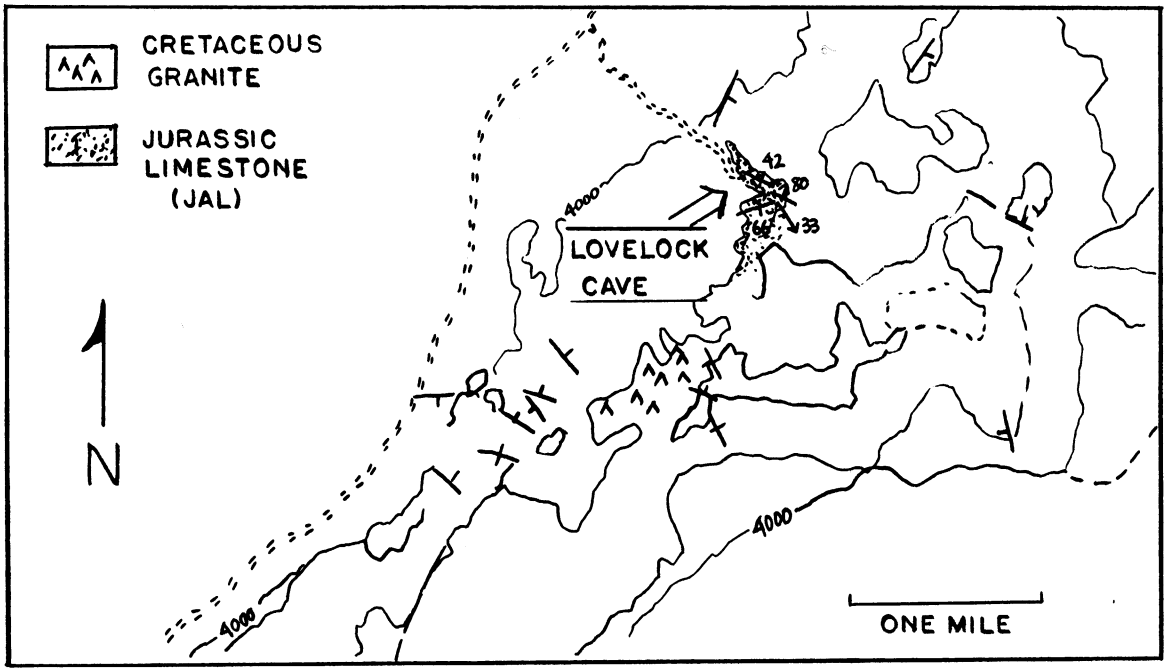


Figure 3: Geology of the vicinity of Lovelock Cave (NV-Ch-18), Nevada, showing portion of the West Humboldt Range. (Data from Speed and Willden n.d.).

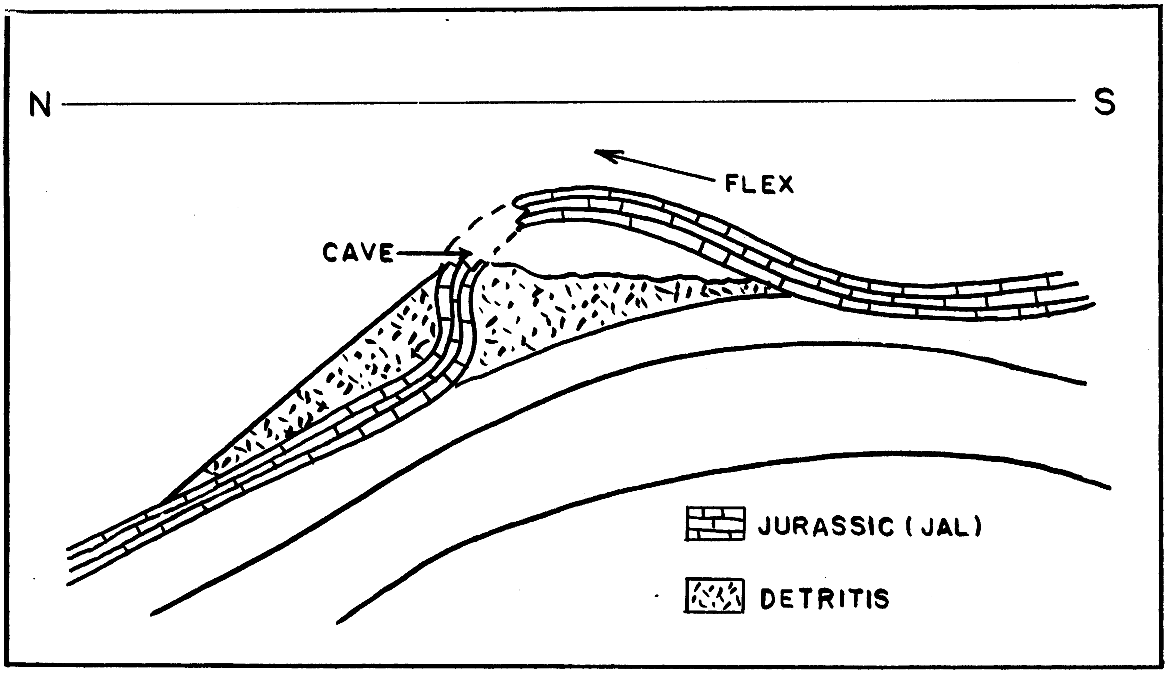


Figure 4: Structural geology of Lovelock Cave. Interpretation by the author, based on observations made by R.C. Speed.

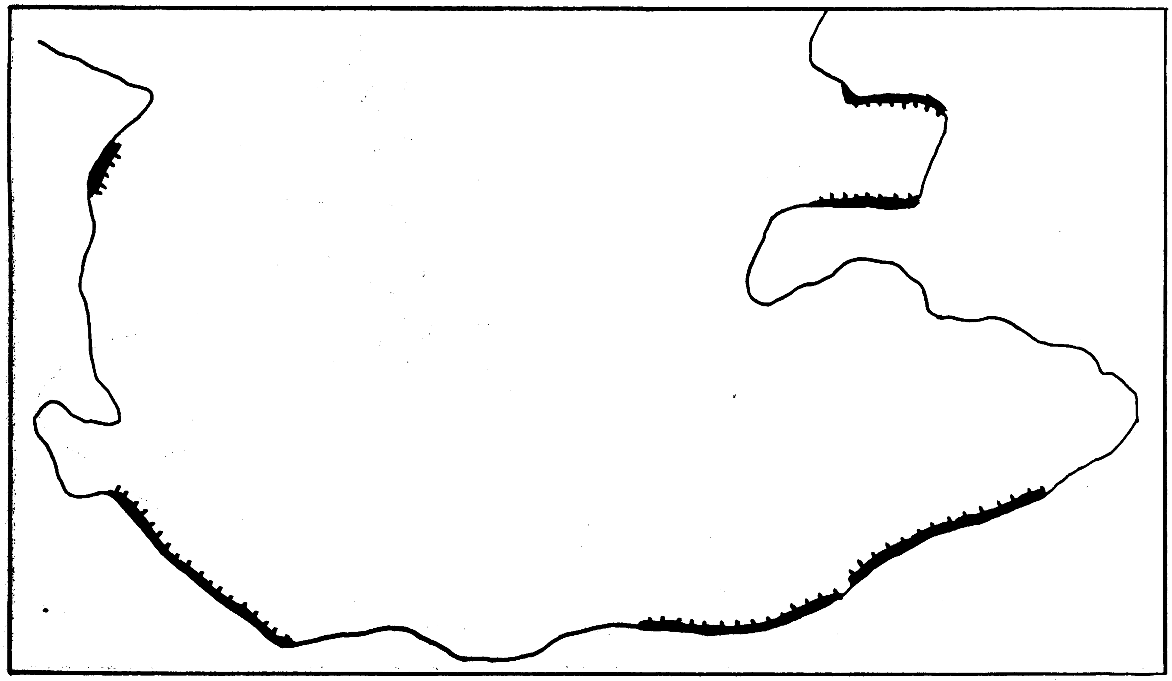


Figure 5: Lovelock Cave, Events I and II. Cave chamber exposed, wave erosion; tufa layers formed. = Existing tufa

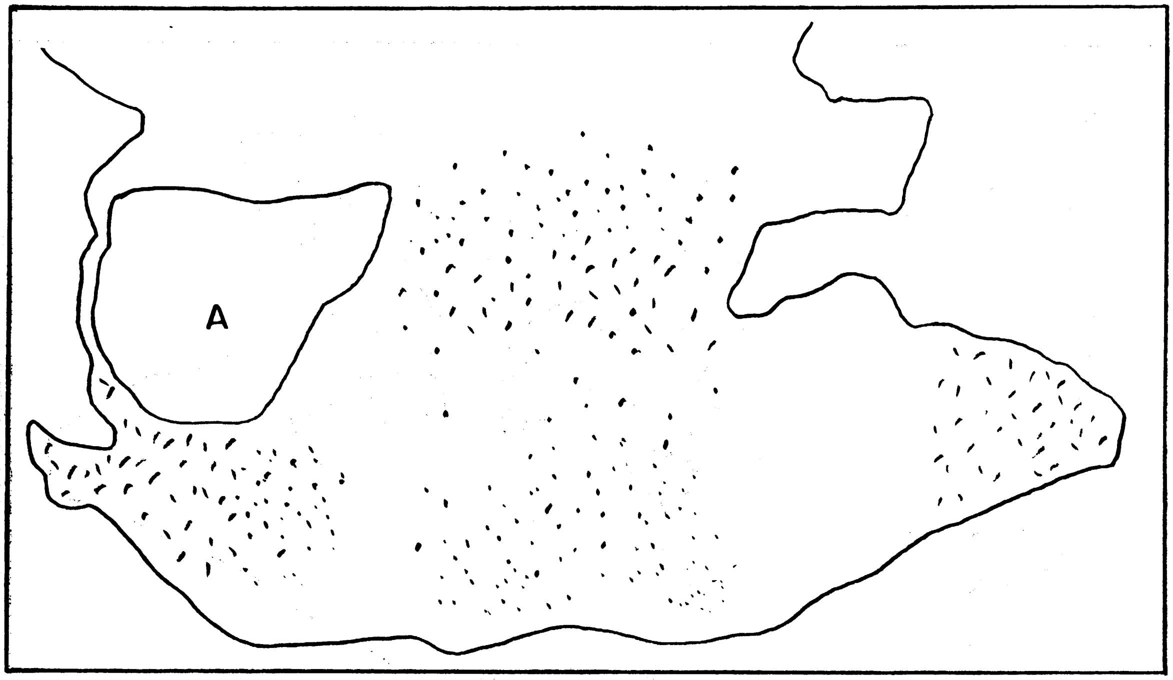


Figure 5: Event II. Rock A detached from cave ceiling, Older Guano deposition, initial occupation. = Occupation
= Guano deposit

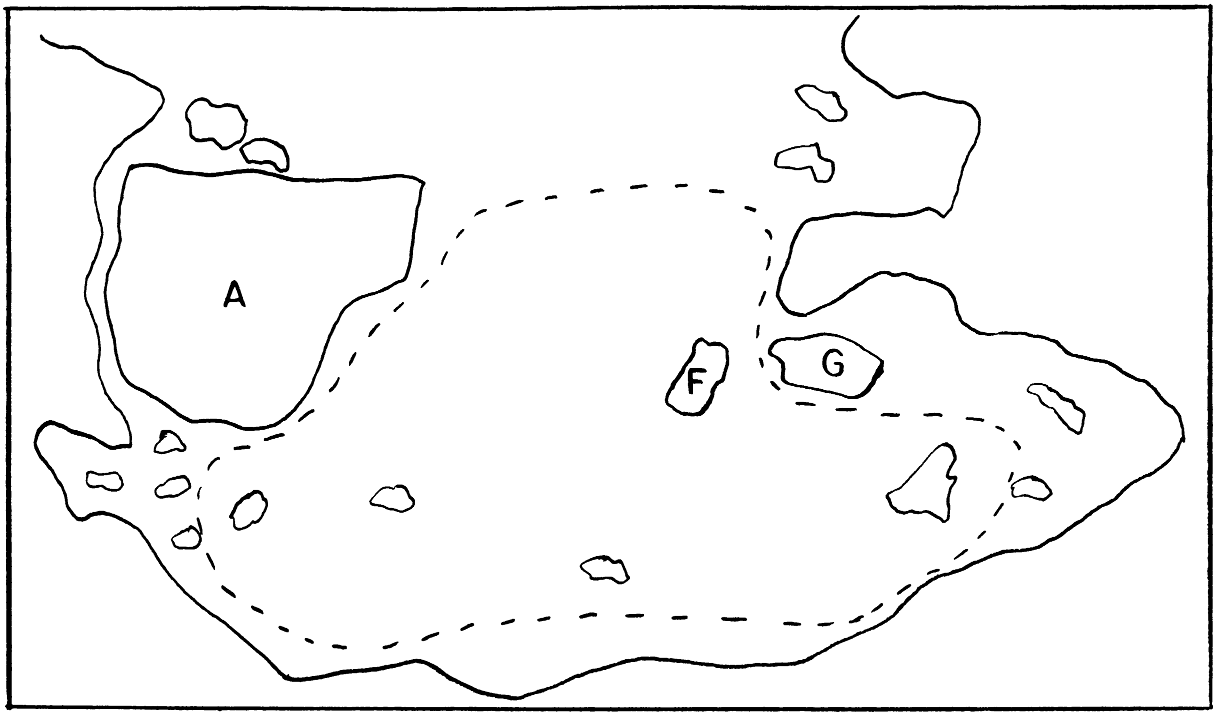


Figure 6: Lovelock Cave, Event III. Principal period of human occupation of cave, beginning <u>circa</u> 2000 B.C. Rockfalls occur.

----- = Main occupation

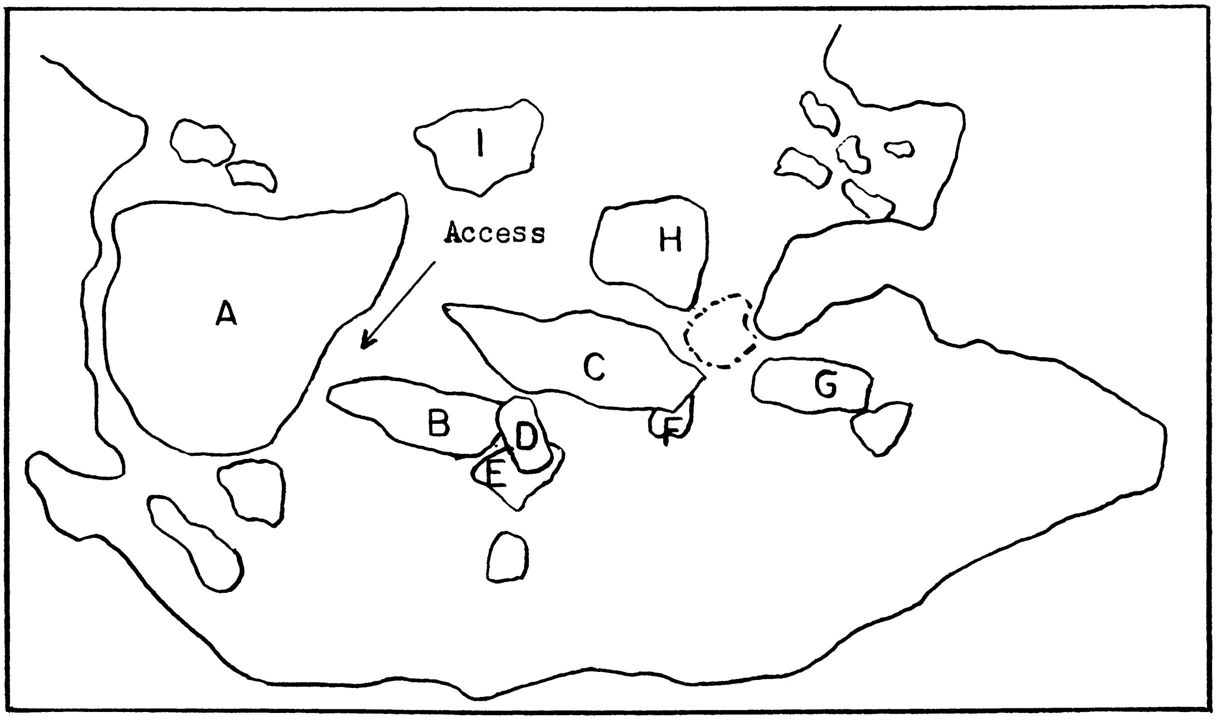


Figure 6: Lovelock Cave, Event IV. Massive rockfall, rocks B,C,D,E,G. Rock indicated by dotted line blasted by guano miners in 1911.

—·—·— = Rock rubble

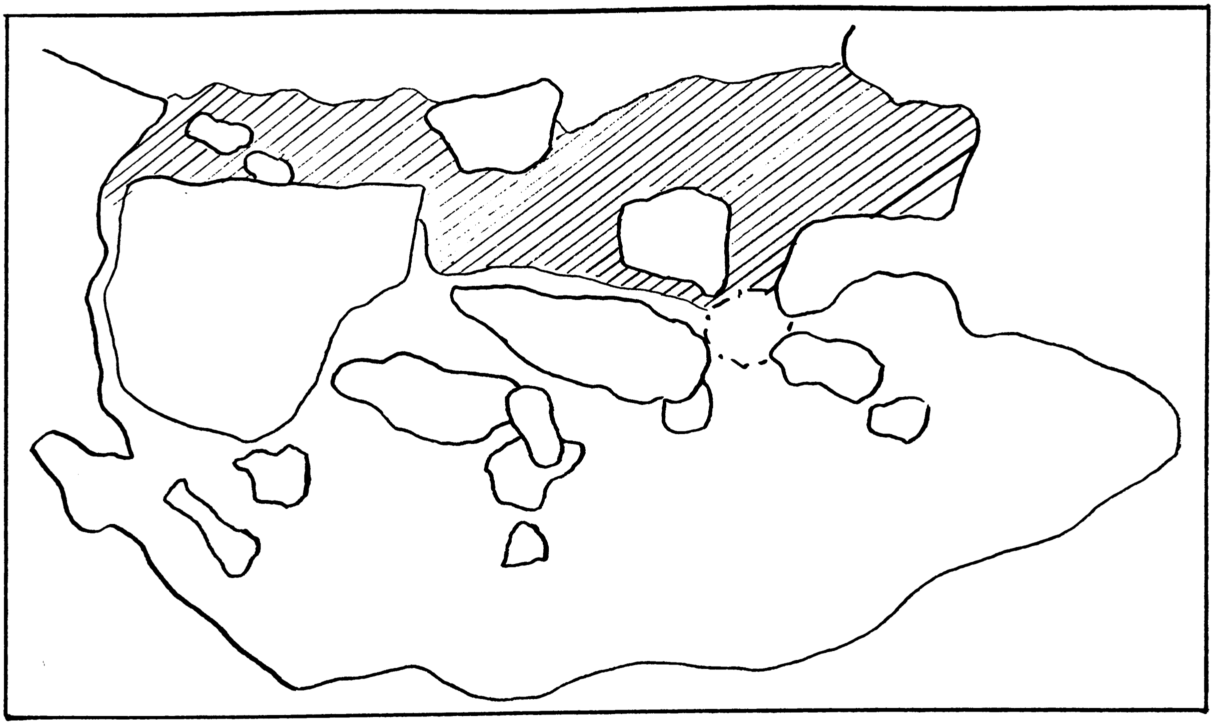


Figure 7: Lovelock Cave, Event V, circa A.D. 500. Human occupation shifts to outer rockshelter. "Later Guano" accumulates in interior of cave.

///// = Occupation

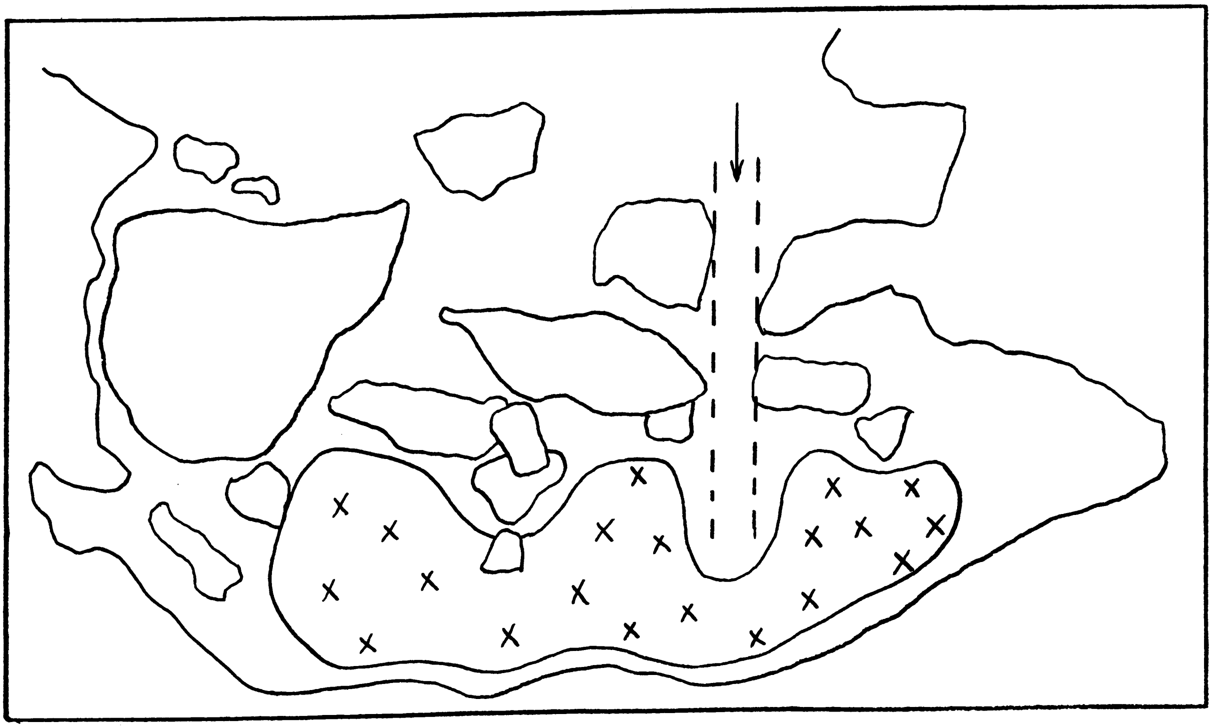


Figure 7: Event VI, A.D. 1911. Guano miners construct tunnel (indicated by dotted lines). Major part of cave deposit mined for guano. Note "ramp" left by miners.

x x x = Guano area excavations

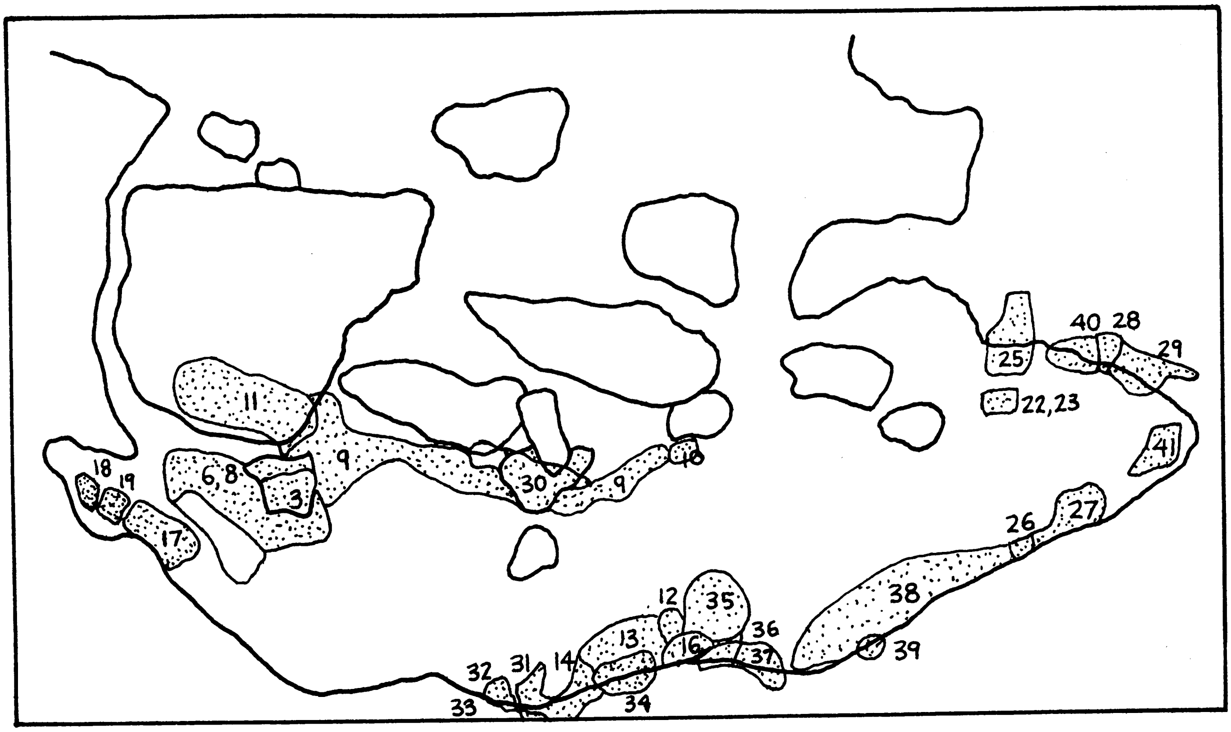


Figure 8. Lovelock Cave, Event VII. A.D. 1912, Excavations in cave by L.L. Loud (after Grosscup 1960, Figure 2). Note the lateral extent of lots near entrance rockfall.

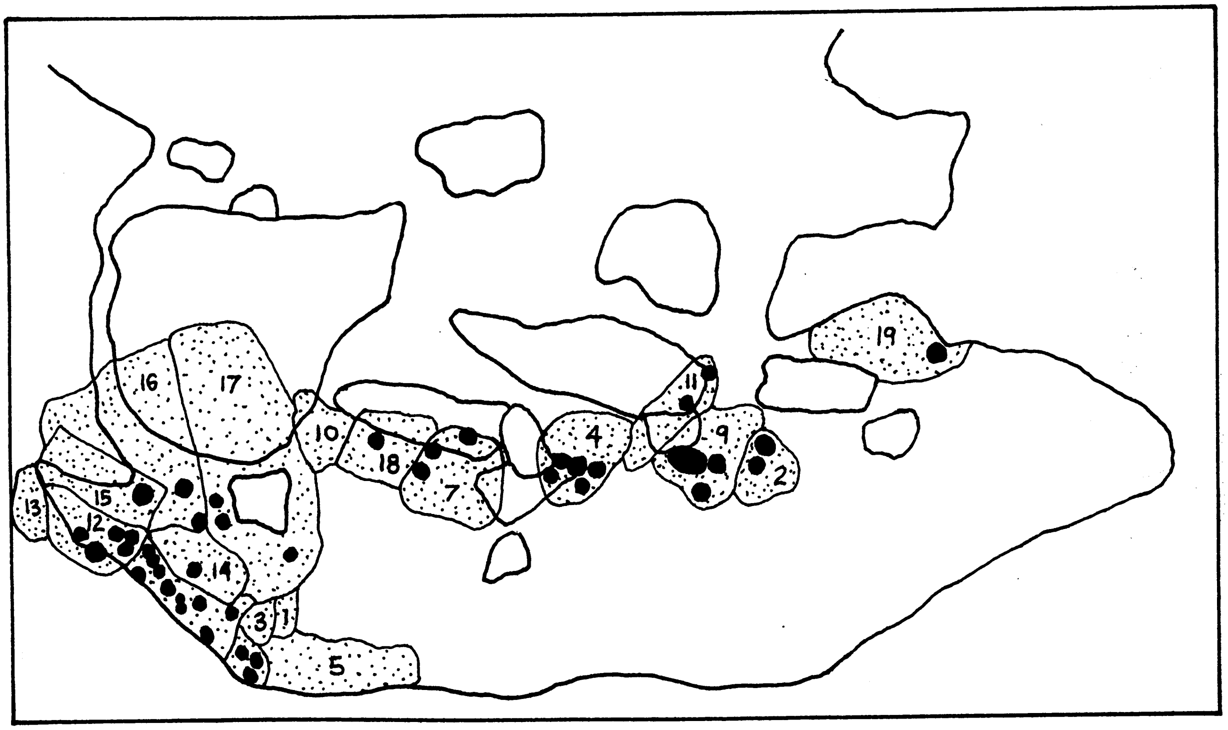
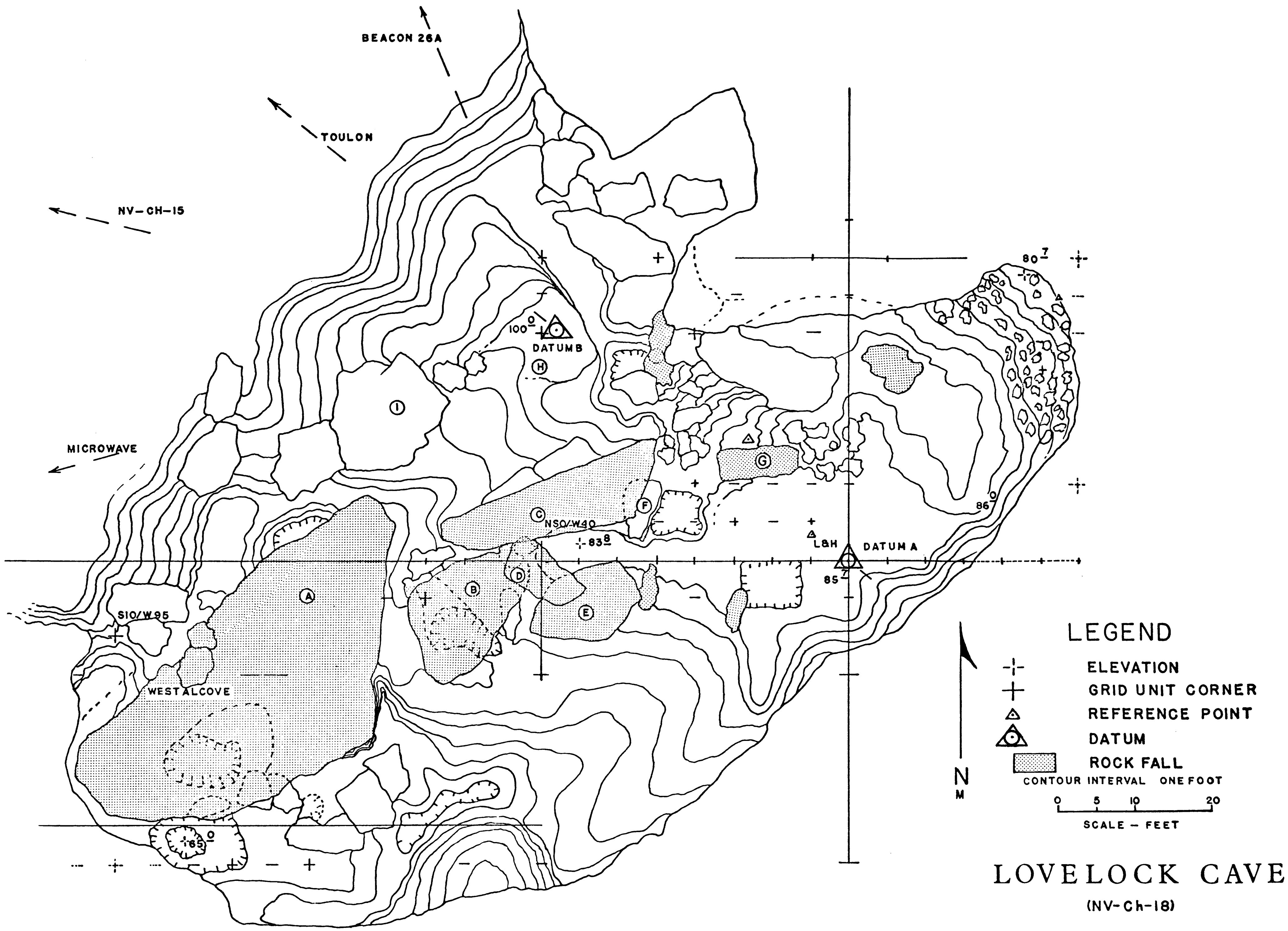


Figure 8. Lovelock Cave, Event VIII. A.D. 1924. Excavations in cave by M.R. Harrington and L.L. Loud. Cache pits recognized by Harrington are indicated by black dots. ● = Cache pits



LOVELOCK CAVE

(NV-Ch-18)

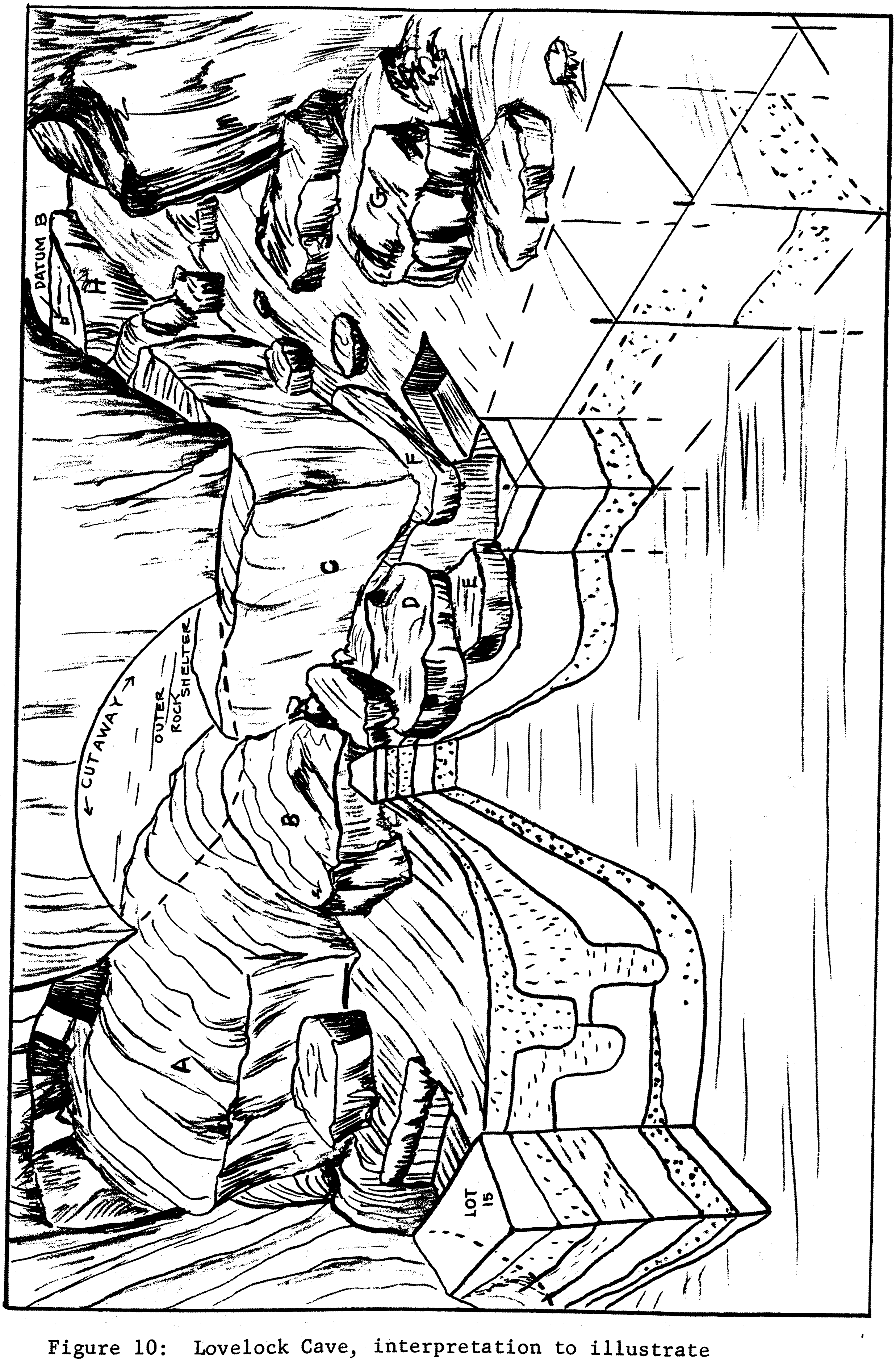


Figure 10: Lovelock Cave, interpretation to illustrate stratigraphy and relation of cave features.

Figure 11: Lovelock Cave, NSO/W35; NSO/W40.

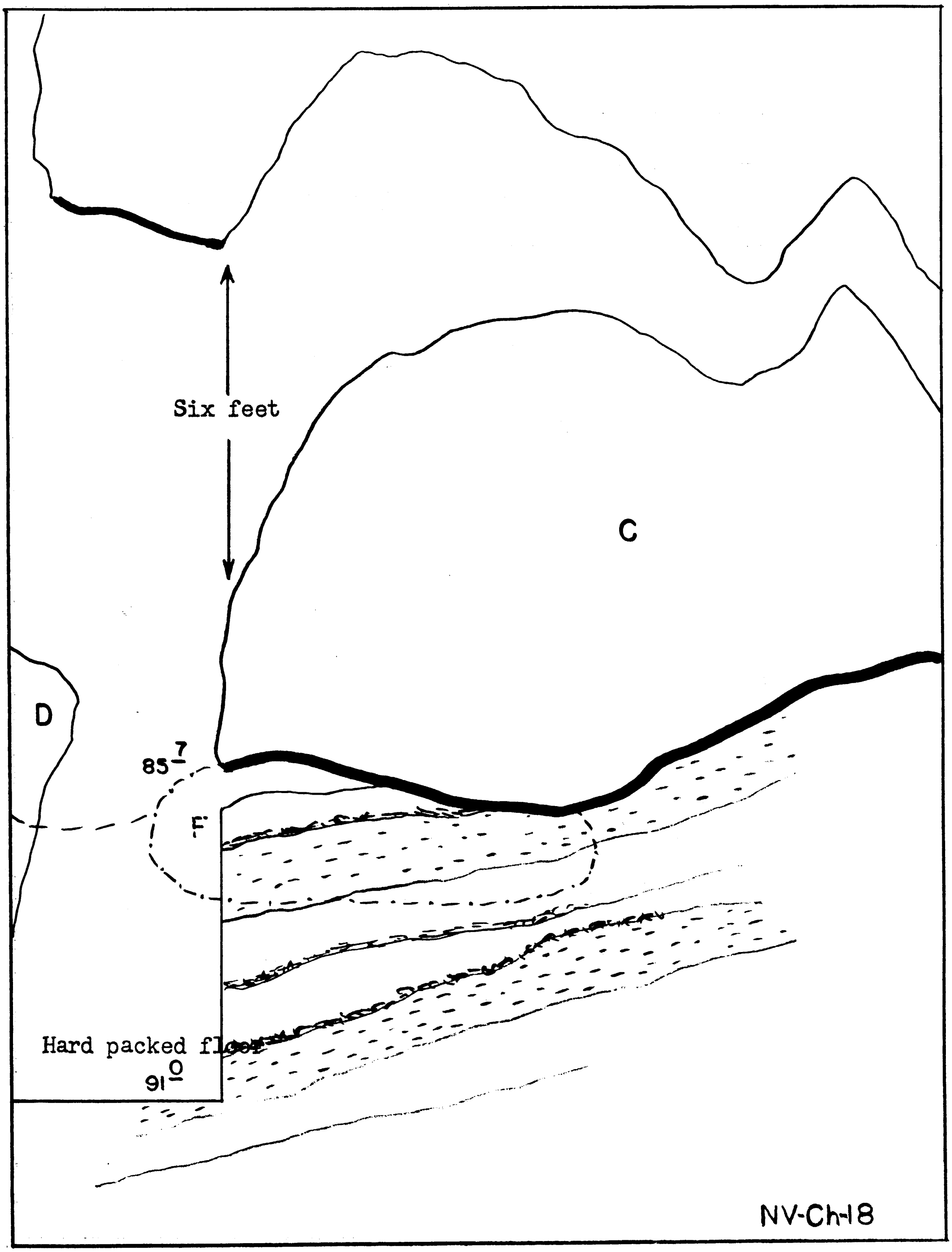


Figure 12: Lovelock Cave (NV-Ch-18) NS0/W40 and rock C, view west showing hinge displacement of rock C, which is resting on midden deposit.

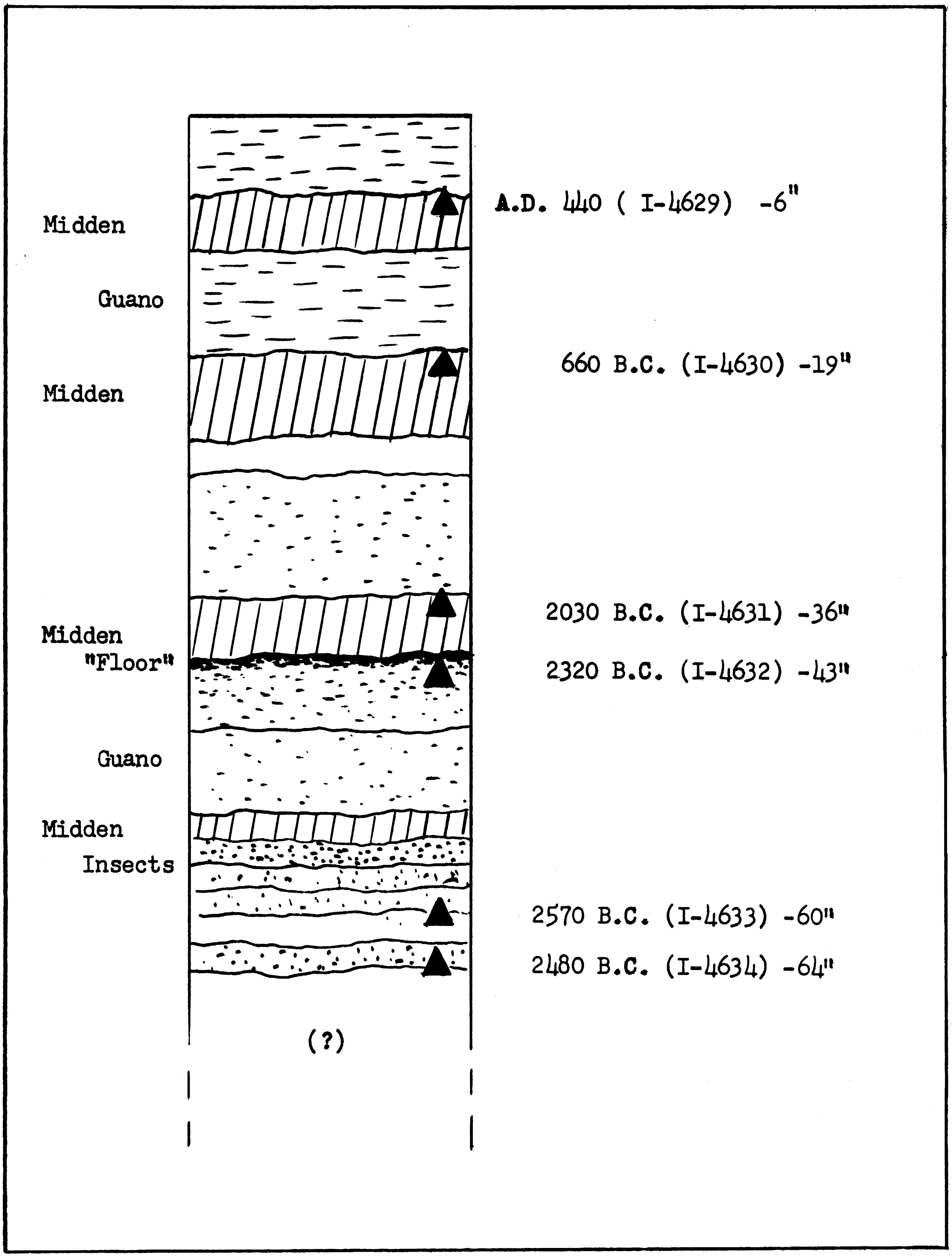


Figure 13: Lovelock Cave (NV-Ch-18) NS0/W35, depth 6-64", general stratigraphy and radiocarbon determinations.

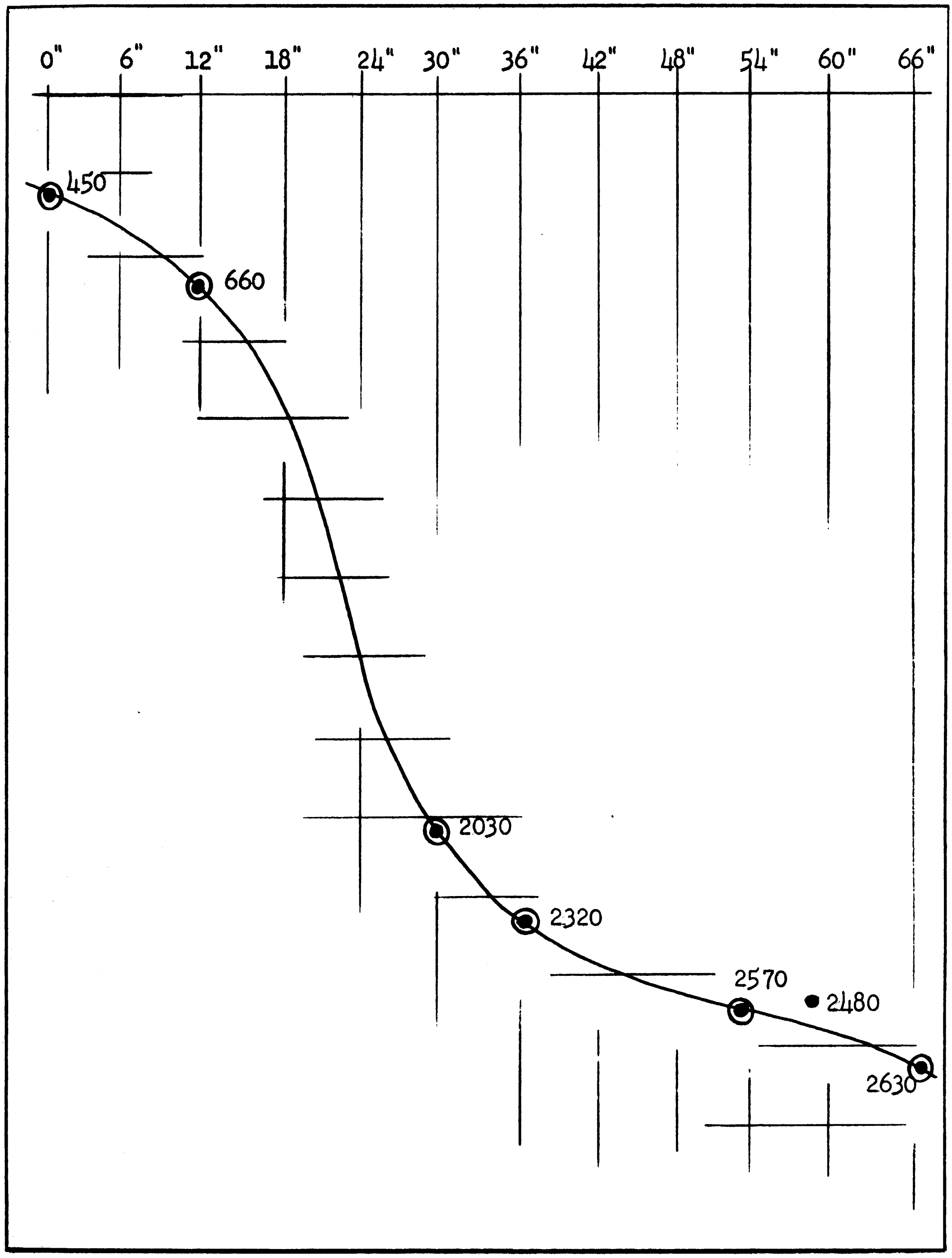


Figure 14: Graph of radiocarbon determinations, NSO/W35, Lovelock Cave, Nevada

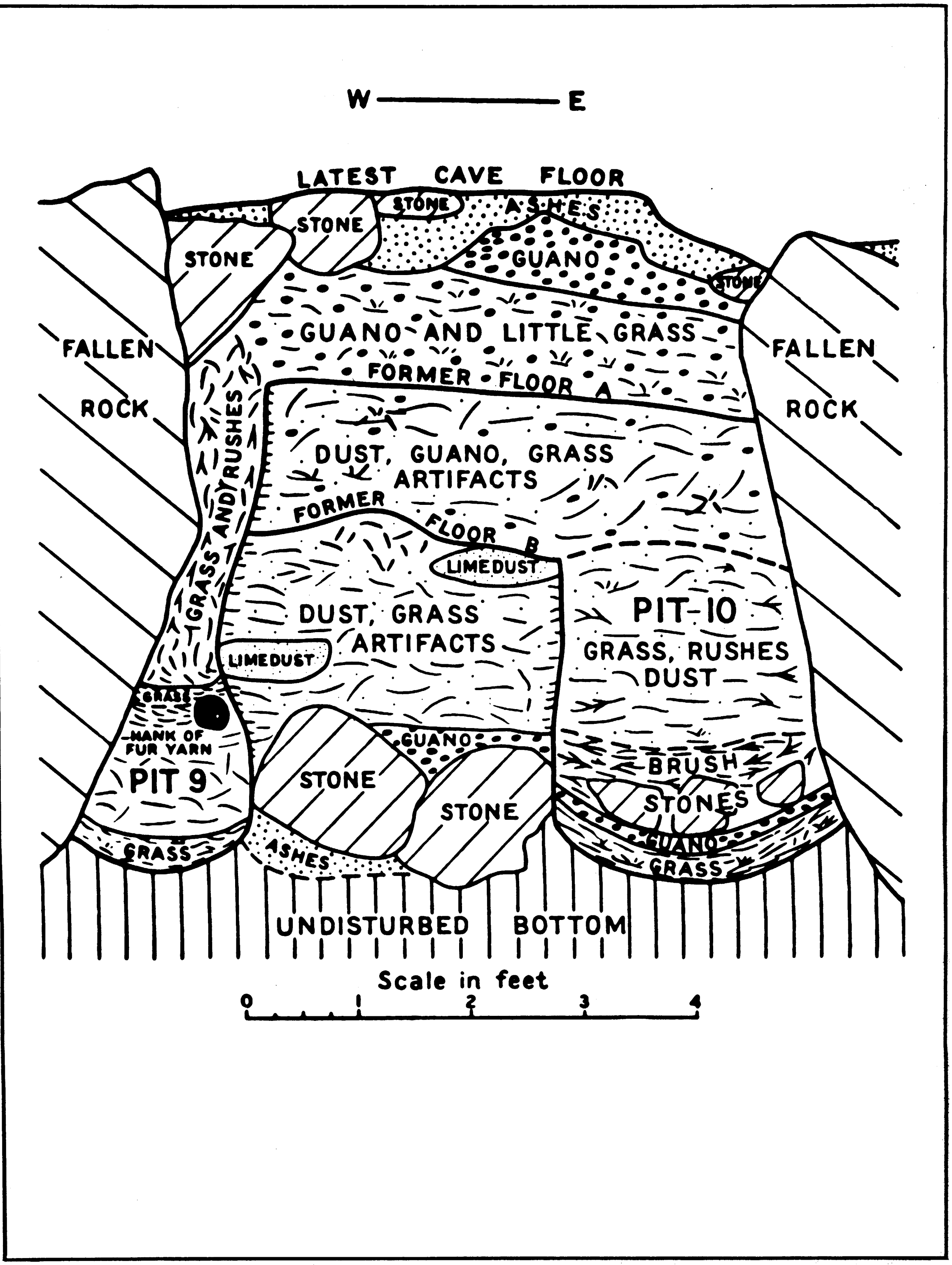


Figure 15. Lovelock Cave section showing Pits 9 and 10
(From Loud and Harrington 1929, Fig. 3)

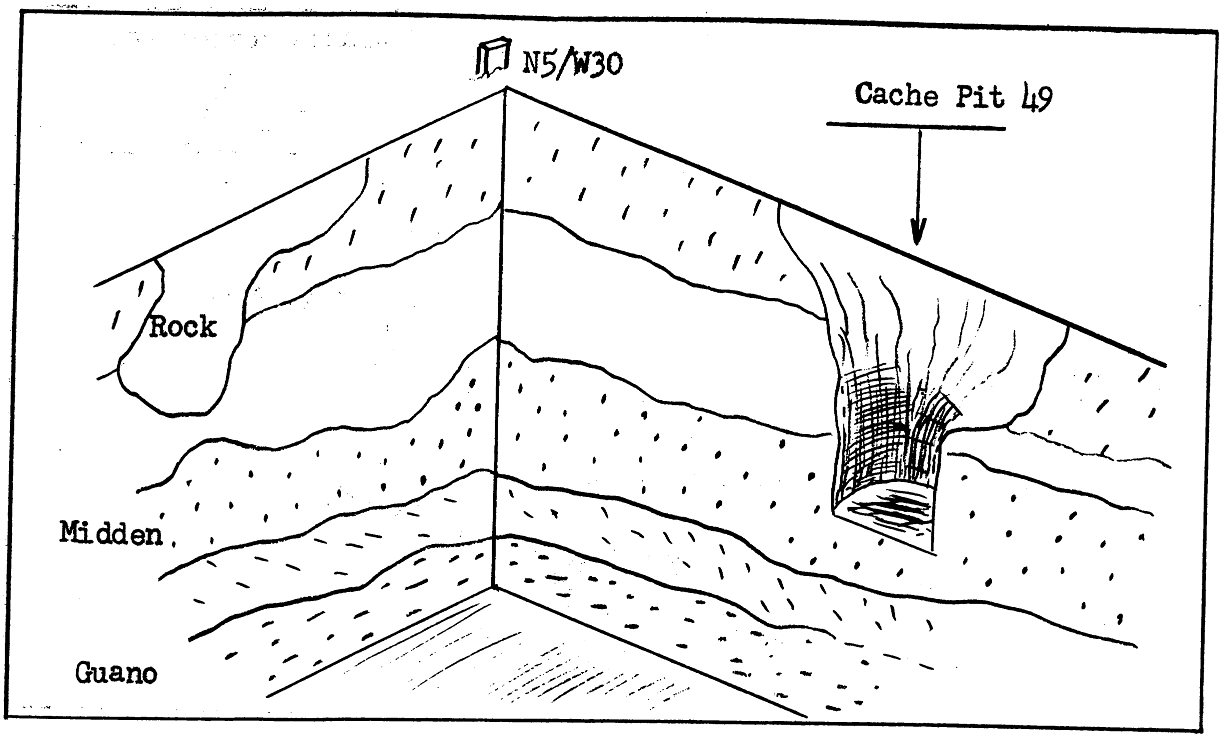


Figure 16: Lovelock Cave, NS0/W30, 1968 test unit.

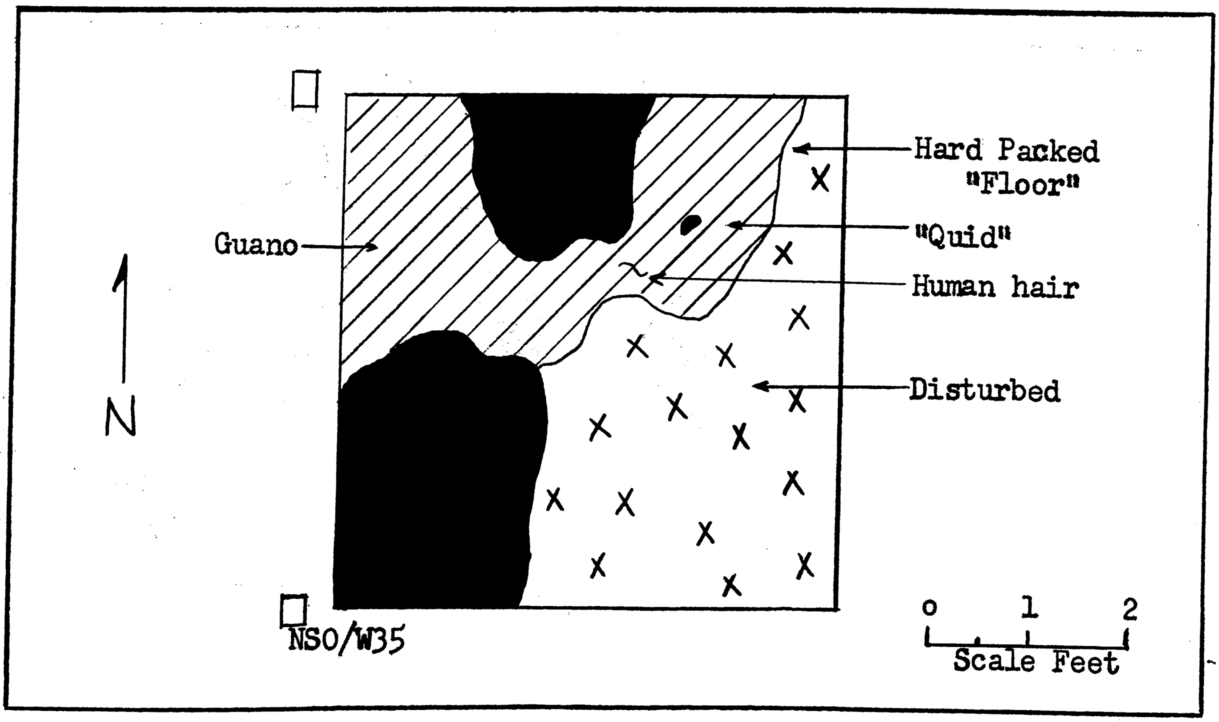


Figure 17: Lovelock Cave, NS0/W35, plan view, hard packed surface of Older Guano, depth 41-43".

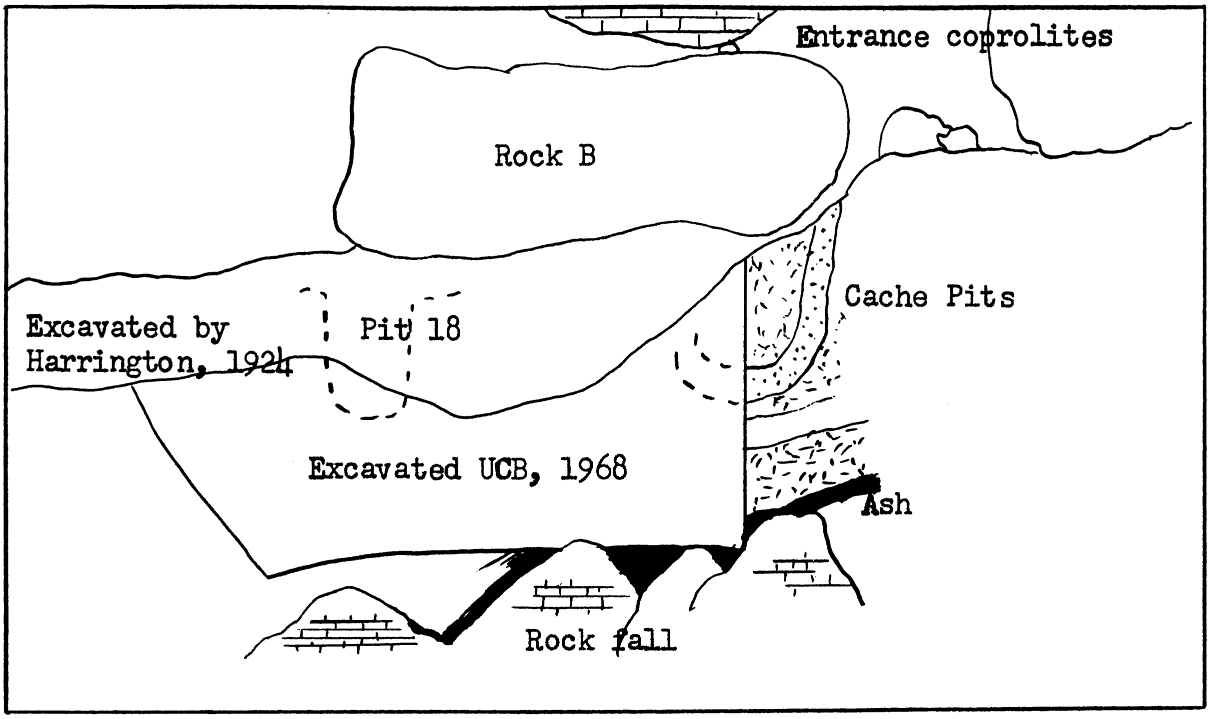


Figure 18: Lovelock Cave, S10/W50, west profile showing excavations in 1968.

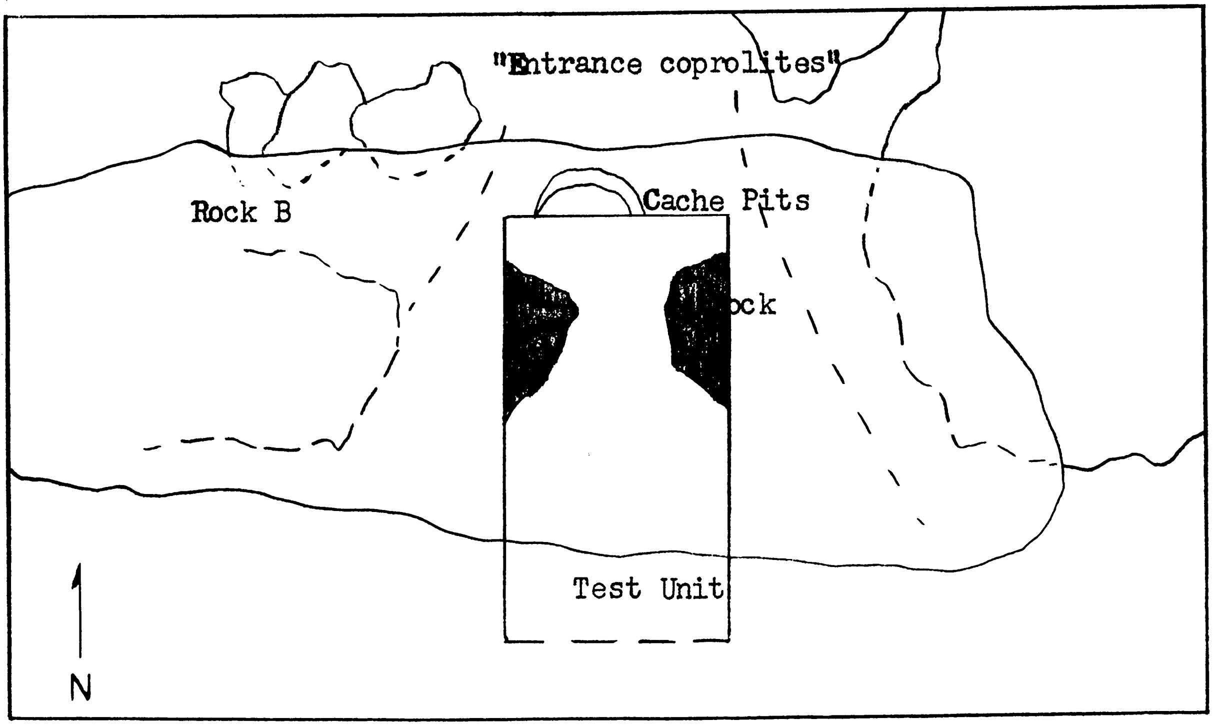


Figure 19: Lovelock Cave, S10/W50, plan view, excavations of 1968-69.

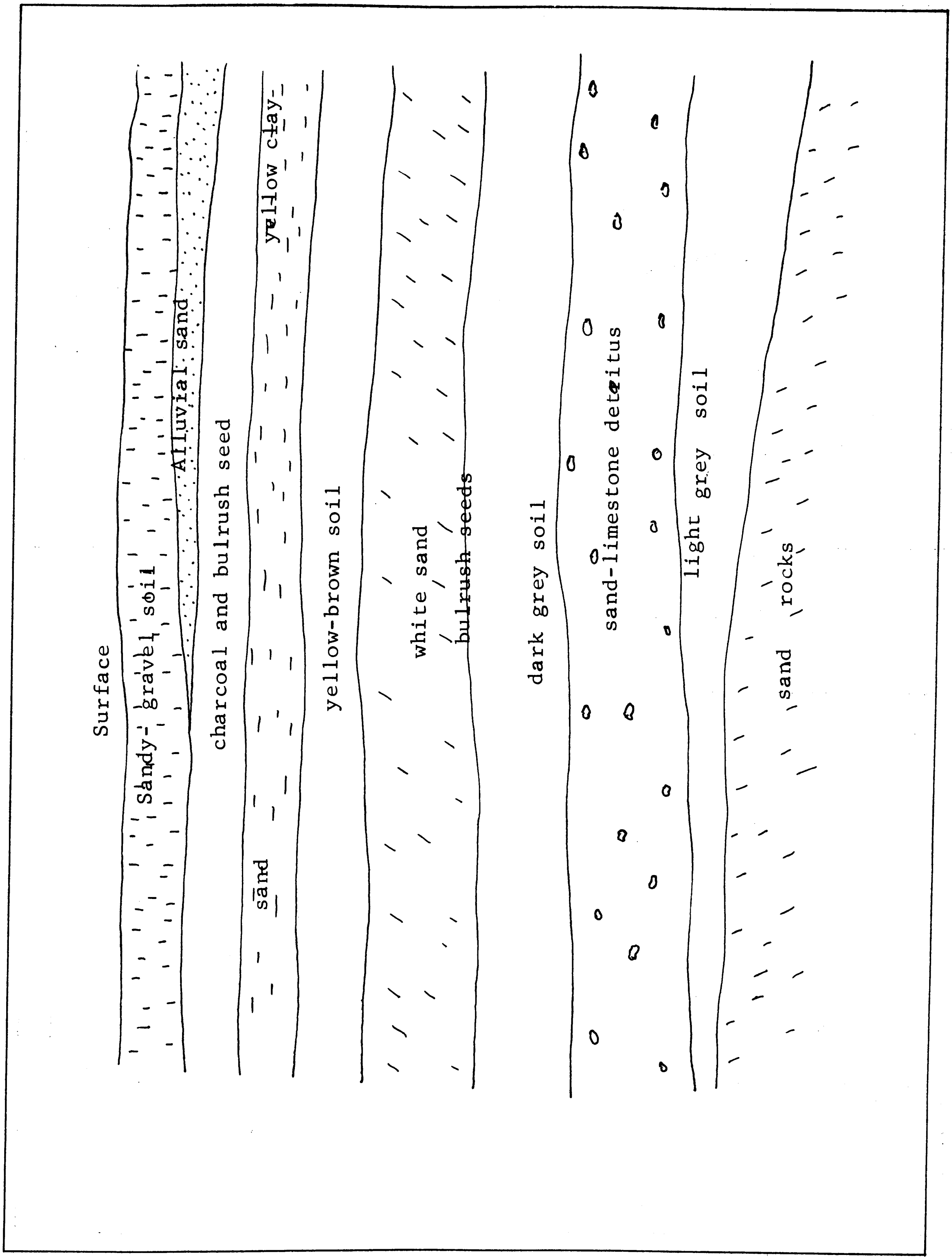


Figure 20: Lovelock Cave, WA area, S10/W95, west profile.

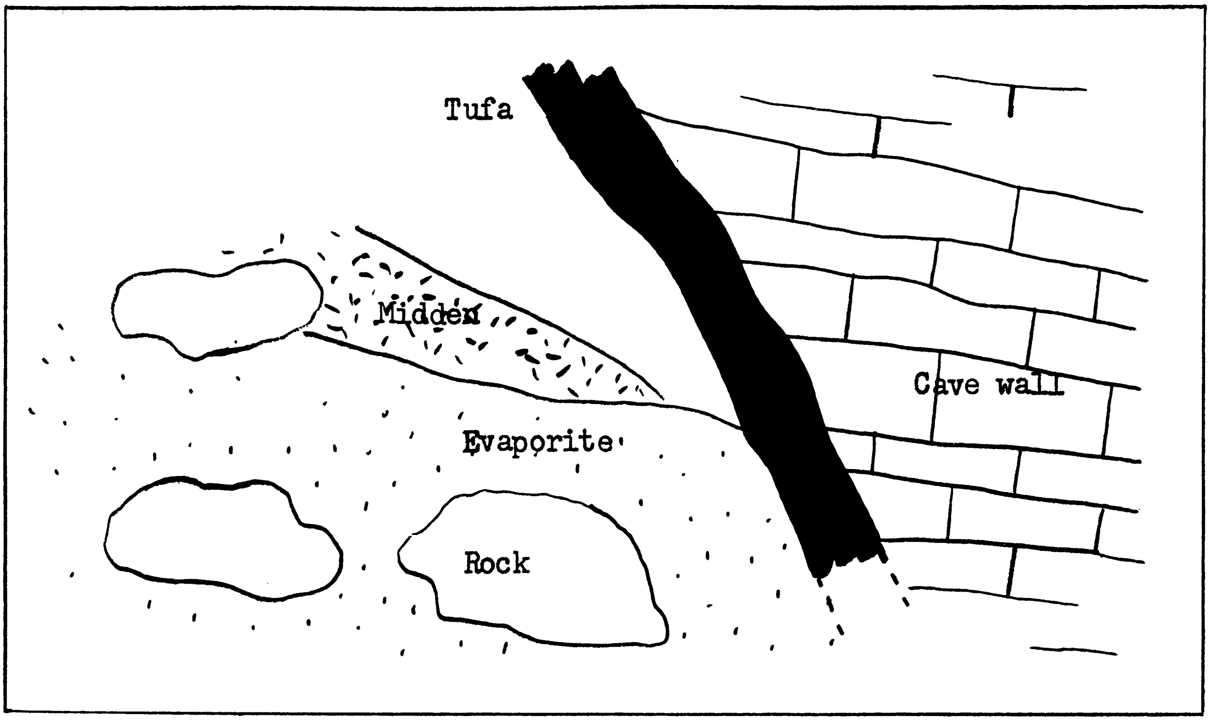


Figure 21: Lovelock Cave, N25/E25, contact of tufa and evaporite stratum.

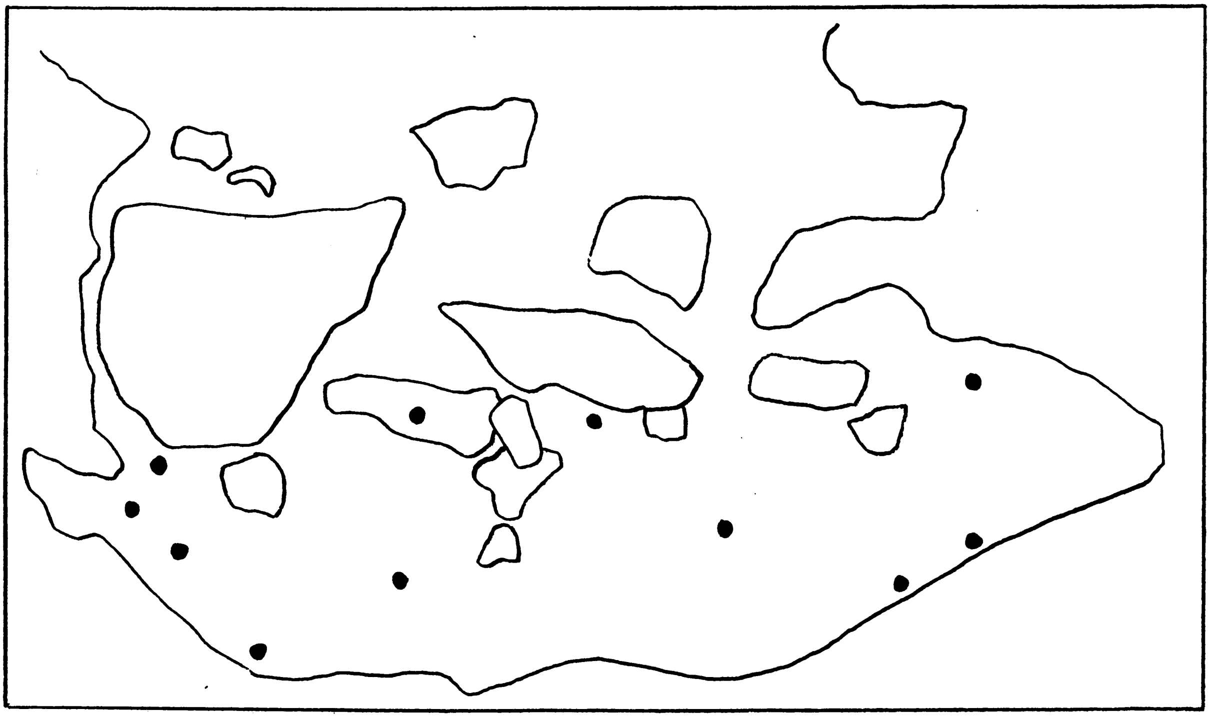
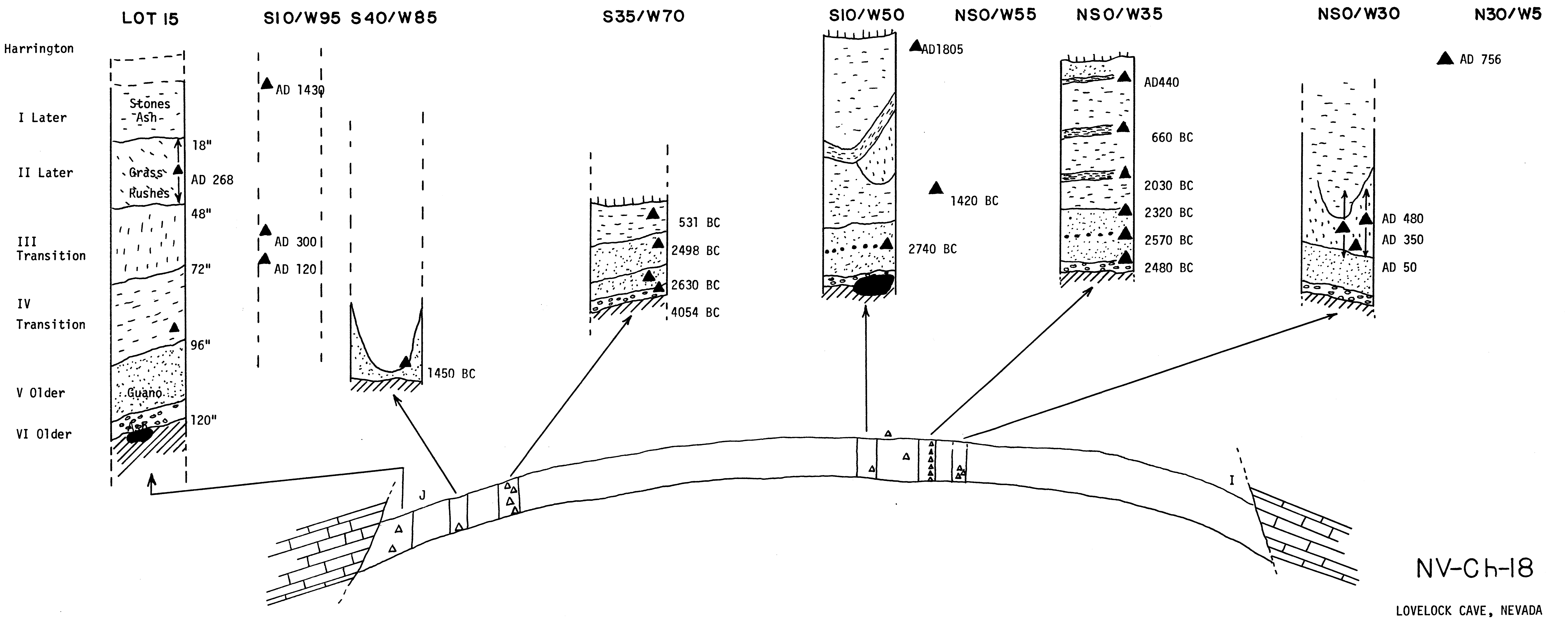


Figure 22: Lovelock Cave, occurrence of evaporite stratum, plan view. Samples obtained from sites indicated by dots.



NV-Ch-18

LOVELOCK CAVE, NEVADA

TEST UNITS

Explanation of Illustrations

(Photographs by L.K. Napton, unless otherwise credited)

Plate 1 Lovelock Cave and West Humboldt Range, Nevada, looking southwest from the Humboldt lakebed toward the cave formation, which is visible in the center of the photograph. Five distinct wavecut terraces are discernible on the mountain slope above the cave. The vegetation in the foreground (_Atriplex_ and _Distichlis_) is typical of the lakebed area at present. The elevation of the peak, left center, is 4770 feet.

Plate 2 Lovelock Cave and the West Humboldt Range, Nevada, looking west toward Lovelock Cave from the Humboldt lakebed site (NV-Ch-15), photograph taken in 1924 by Mark R. Harrington. The vegetal cover aspect was significantly different than it is at present. Note the large stand of reeds (_Phragmites communis_) (below center), no longer extant in this vicinity. The Lovelock Cave formation is visible, left center. (Photograph courtesy of Dr. F. J. Dockstader, Museum of the American Indian, Heye Foundation, New York.)

Plate 3 Lovelock Cave, Nevada (NV-Ch-18), in Jurassic limestone unit _Jal_. Note the foliation of the unit. Wave erosion produced by Lake Lahontan is visible on the formation, to the left of center. The remains of the guano miners' dump, composed of material mined from the cave in 1911, are visible below the mouth of the cave. The West Alcove area of the cave is situated behind a rockfall, to the right of the cave portal.

Plate 4 Members of the University of California, Berkeley, field session in archaeology (Anthropology 196-B) reposing on rock H (the location of UCB datum B) during excavation of Lovelock Cave, spring 1969. Left to right: Dr. Albert Elsasser, David Clement, Professor R. F. Heizer, Gary Encinas, Monica Ley, Suzanne DeAtley, Ethel Chang, Jennifer Scharetg, Mark Estis. (Photograph courtesy Dr. F. H. Stross.)

Plate 5 Lovelock Cave, Nevada (NV-Ch-18), eroded face of hinge fold in limestone unit _Jal_. Note massive, detached lithic unit in upper right corner of the photograph. Beneath this rock unit is the north portal of the West Alcove. Rock A is situated below center, right, and rock I is in the lower center. The ancient Indian entrance to the cave (the source of the Lovelock Cave "Entrance" coprolites) is to the left, lower center. (Photograph courtesy Dr. F. H. Stross.)

Plate 6 Mr. Llewellyn L. Loud photographed with the remarkable find of 11 duck decoys from Pit 12, Lovelock Cave, Nevada. (Compare Loud and Harrington 1929, pl. 7.) This picture, taken by Mark Harrington in 1924, is one of the few existing photographs of Mr. Loud. (Photograph courtesy Dr. F. J. Dockstader, Museum of the American Indian, Heye Foundation, New York.)

Plate 7 Photograph identified "Deposit under large rock, Lot 15" taken in Lovelock Cave, Nevada, by Mark R. Harrington in 1924. Note the profusion of basketry, poles, vegetal debris, and artifacts. The area is under the edge of rock A, approximate grid location S35/W80. (Photograph courtesy Dr. F. J. Dockstader, Museum of the American Indian, Heye Foundation, New York.)

Plate 8 Lovelock Cave, Nevada (NV-Ch-18), in 1965, looking from the end of the guano miners tunnel toward the west end of the cave, both the tufa layers and smoke-stained ceiling. Part of the Jal. limestone hinge fold is visible in the cave ceiling. The large rock situated below center is located in grid unit S5/W15.

Plate 9 Lovelock Cave, Nevada (NV-Ch-18), cave midden. West end of cave and west crevice, prior to excavation, April 1969. Professor R. F. Heizer stands at the outfall of the west crevice. The base of massive rock A is visible, upper right. The area of Harrington's Lot 15 is in the lower left of this view.

Plate 10 Lovelock Cave, Nevada (NV-Ch-18), west end of the cave, excavations of 1969, in same view as Plate 9. Electrical apparatus and ventilating equipment is visible near grid unit S40/W85, in the process of excavation.

Plate 11 Lovelock Cave, Nevada (NV-Ch-18), "LX" area, grid location NS0/W35, photographed during excavations, 1969. Note stratification of deposit under massive rock C. Rock D is visible, lower left. Note smoke stain on the underside of rock C, which rests on rock F.

Plate 12 Lovelock Cave, Nevada (NV-Ch-18), grid location NS0/W35, west and north profiles. Length of rod, three feet. At the top of the slate is the first occupation midden layer, with successive alternating cultural and detrital strata. The Older Guano layer is visible at the base of the profile. (See Figures 13 and 16 for details of this section.) (Photograph by John Carroll.)

(Figure 13) Lovelock Cave, Nevada (NV-Ch-18) NS0/W35, north profile. Surface is base of rock C (85.7 feet), base is 90.0 feet, in reference to UCB datum A. The strata are underlain by the white evaporite deposit (not shown in pl. 12).

Plate 13 Lovelock Cave, Nevada (NV-Ch-18), NS0/W35, possible occupation level or "floor," depth 41-43 inches (see fig. 13), macerated vegetal fiber ("quid") (UCB 58:1302) _in situ_ in the occupational level (see fig. 17) in the Older Guano layer, age _circa_ 2000 B.C.

Plate 14 Lovelock Cave, Nevada (NV-Ch-18), west alcove, test excavations of 1968. The restricted occupation space on the top of rock A is demonstrated in this photograph. View looking south, into the alcove, grid location approximately S10/W95.

Plate 15 Lovelock Cave, Nevada (NV-Ch-18), west alcove, grid location S10/W95, depth six inches. Gun parts found in midden. Left to right: bullet mold, mainspring, tang screw, sear and bridle of percussion lock (photograph by R.F. Heizer).

Plate 16 Lovlock Cave, Nevada (NV-Ch-18), west alcove, S15/W100, depth 48 inches, Feature 6. Bulrush parcel containing feathers, _in situ_ against the rear wall of the alcove. Note the carrying handle (lower right). (Photograph by John Carroll.)

Plate 17 Stillwater National Wildlife Refuge, near Fallon, Nevada, on the Truckee River. Photograph taken in 1952, showing aquatic vegetation in large, shallow lake typical of the Humboldt-Carson Sink wetlands in well-watered years. Looking east-northeast toward the Stillwater Range. (Photograph courtesy L. Worden, Manager, Stillwater Wildlife Refuge.)

Plate 18 Stillwater National Wildlife Refuge, near Fallon, Nevada. Millers Channel, August, 1952. Note the very dense, high stands of cattail (_Typha latifolia_) and roundstem bulrush (_Scirpus acutus_). This aspect is probably similar to conditions at Humboldt Lake (located some 25 miles north of this area) prior to dewatering in 1915. (Photograph courtesy of L. Worden, Manager, Stillwater National Wildlife Refuge.)

Plate 19 Humboldt Lake, Nevada, as it appeared in 1868, probably in July. This is the earliest photograph of the lake known to the authors. View is south-southeast from the vicinity of the present site of Toulon, Nevada, looking toward Lovelock Cave, located in the right middle distance at the foot of the West Humboldt Range. The wet plate negative from which this reproduction was made is believed to be one of a series taken by photographers who documented the eastward progress of construction of the Central Pacific Railroad, built by indentured Chinese laborers. The townsite of Lovelock was reached in August, 1868, and the station was named "Lovelock's" in honor of George Lovelock, who donated land for the station. (Photograph courtesy Nevada Historical Society and Southern Pacific Railway.)

Plate 20 Humboldt Lake, as it appeared in late May or early June, during the floods of February-June, 1952. This remarkable oblique aerial photograph (view north-northeast) shows the natural dam (foreground) and the drain channel cut in 1915. The lake reached flood stage in spite of the fact that a large amount of water passed through the drain channel, which was deepened in 1915, and inundated the flatlands below (west of) the natural dam. In prehistoric times, of course, prior to deepening of the drain channel, flooding would have been far more extensive. The flooded area of the Humboldt Lakebed site (NV-Ch-15), is visible in the upper right center. Lovelock Cave formation is located in the upper right center. The West Humboldt Range flanks the lake on the right, and the fringe of the Carson Sink and the Stillwater Mountains appear on the upper right skyline. (Photograph courtesy of Nevada State Fish and Game Commission.)

Plate 1

Plate 2

Plate 3

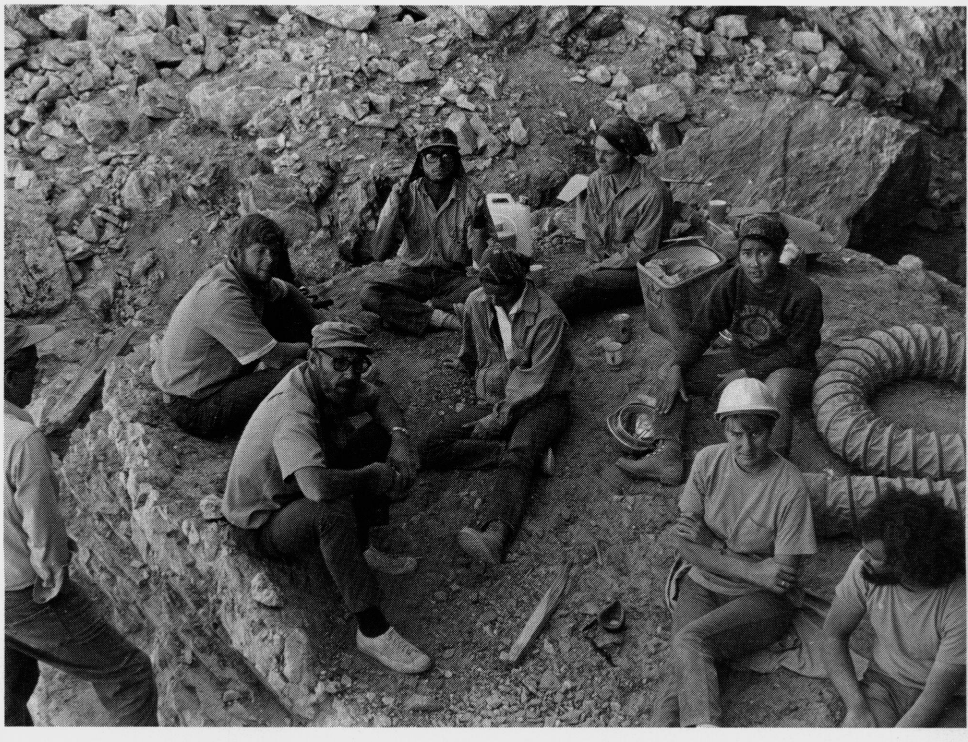


Plate 4

Plate 6

Plate 7

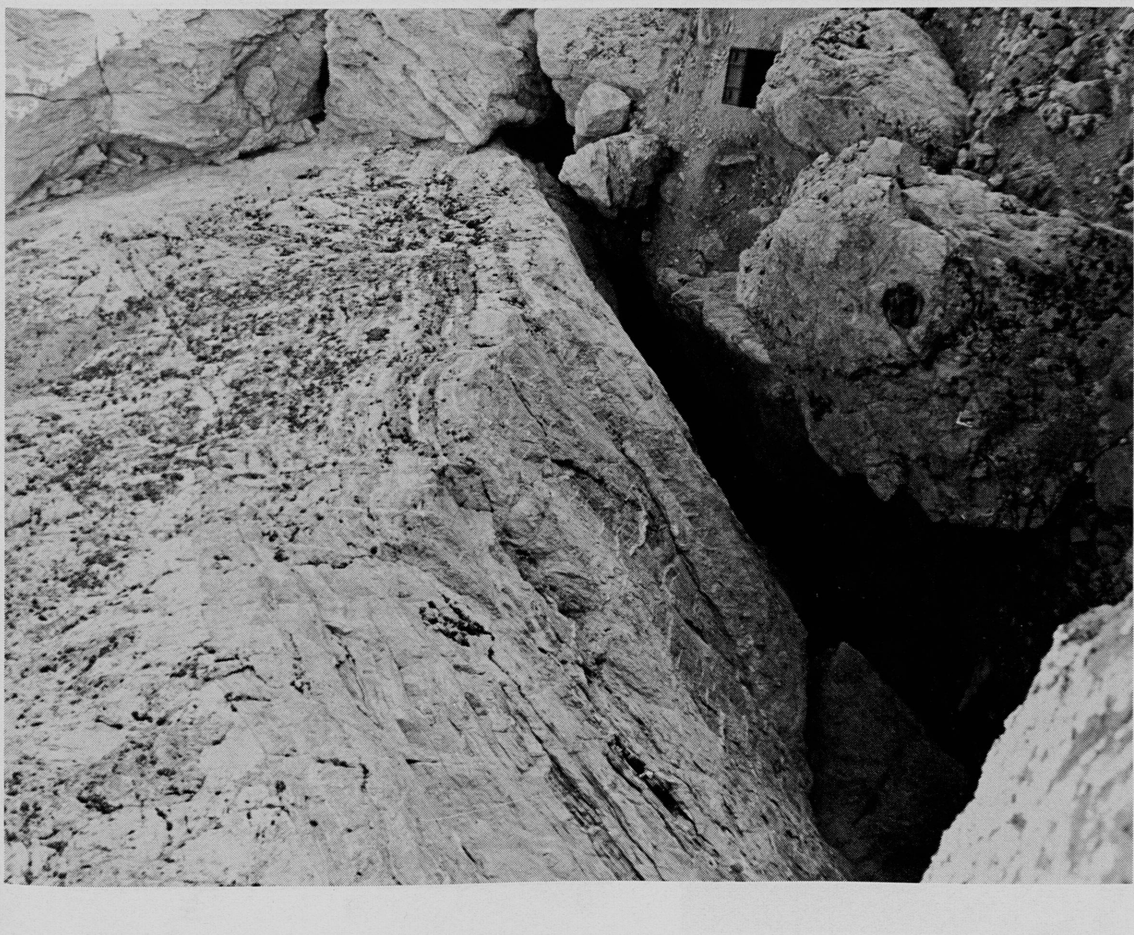


Plate 5

Plate 8

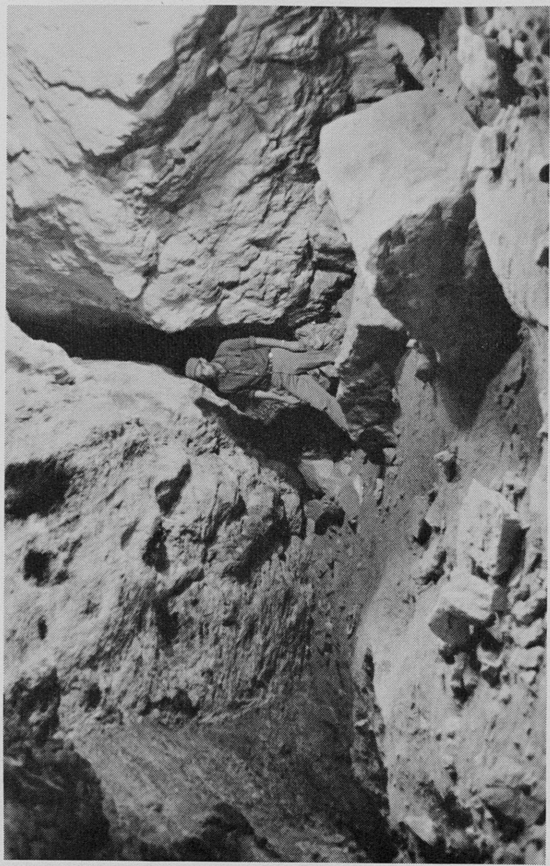


Plate 9

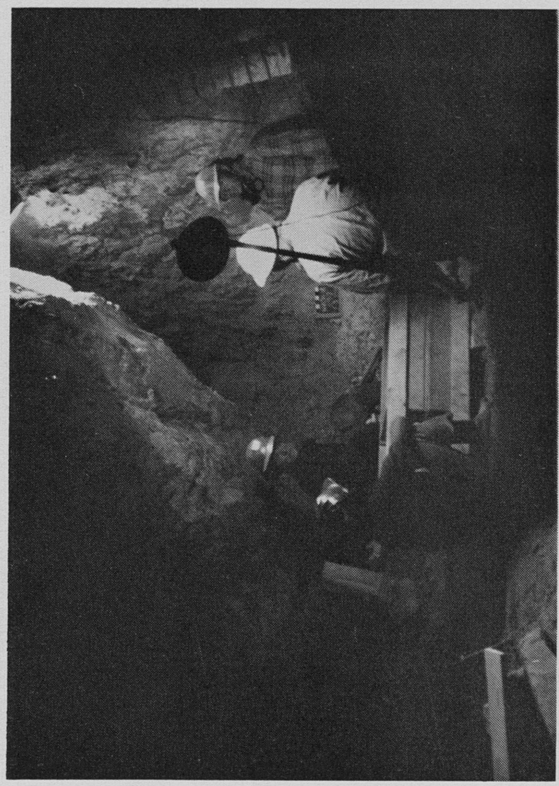


Plate 10

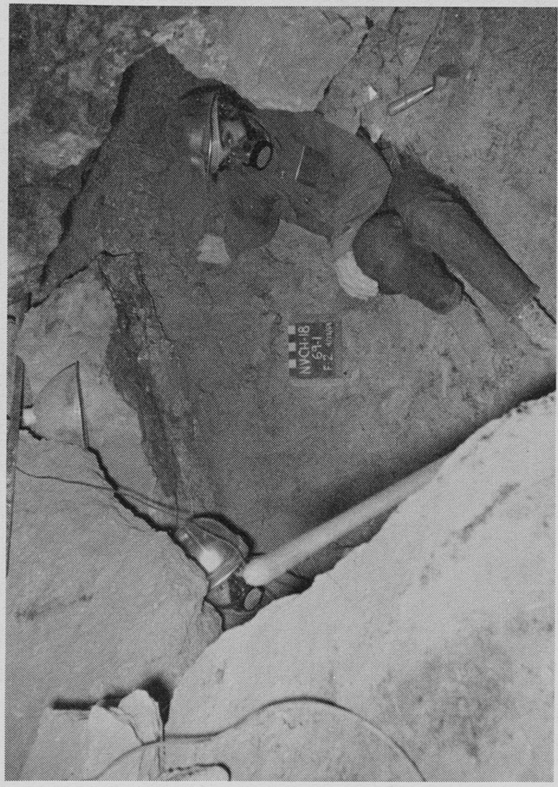


Plate 11

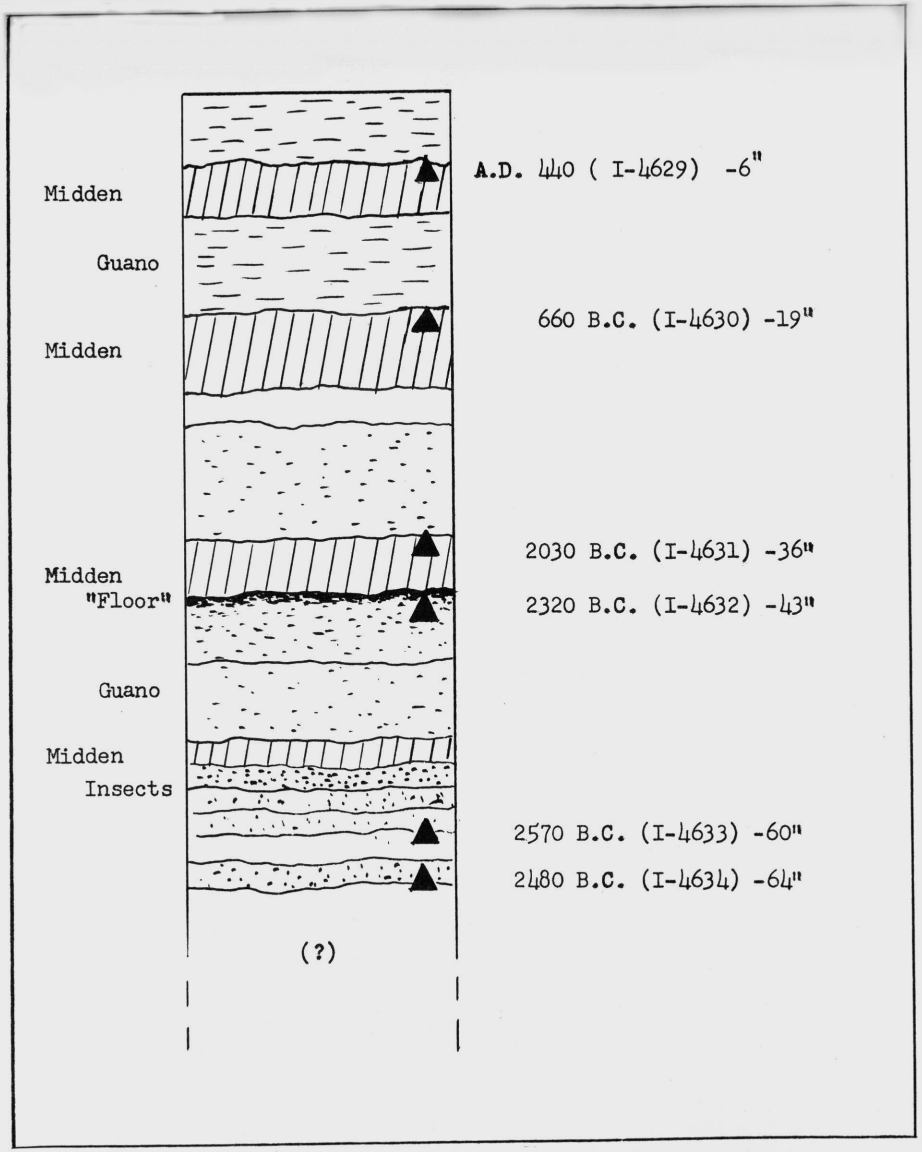


Figure 13: Lovelock Cave, NV-Ch-18, NS0/W35, depth 6-64", general stratigraphy and radiocarbon determinations.

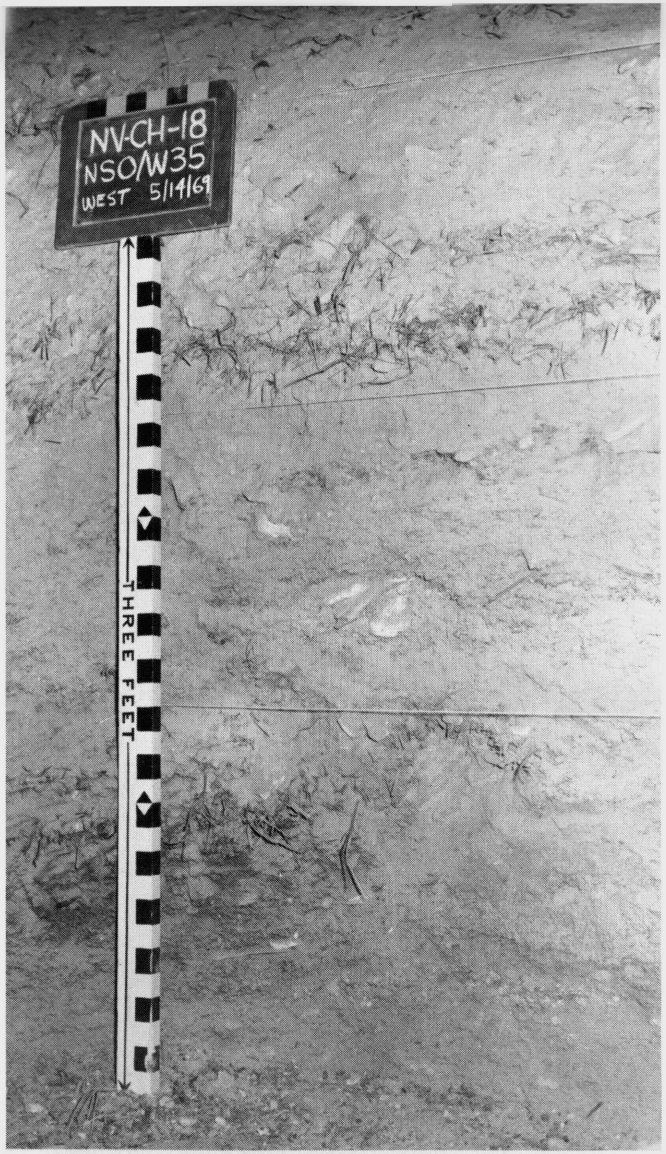


Plate 12

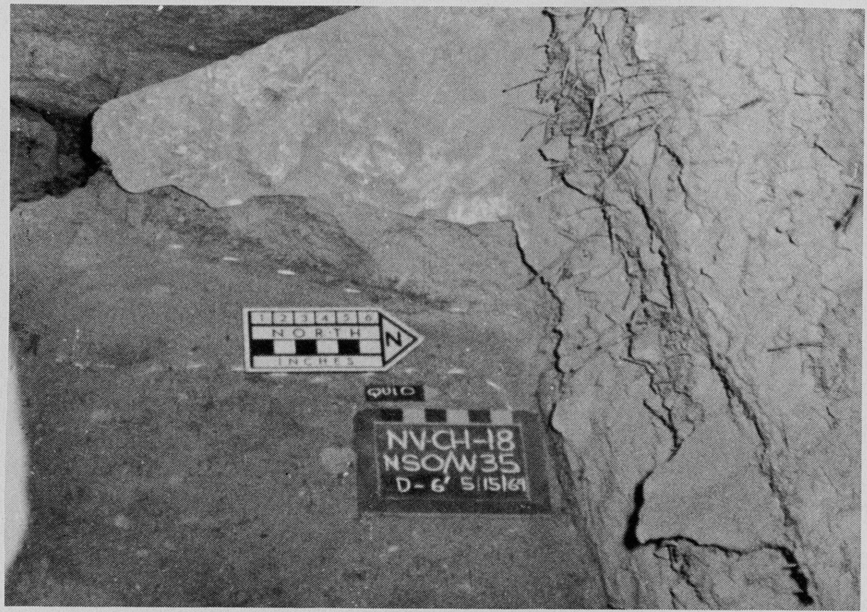


Plate 13

Plate 14

Plate 15

Plate 16

Plate 17

Plate 18

Plate 19

Plate 20

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Abbreviations Used

AA	American Anthropologist
AAnt	American Antiquity
DRI	Desert Research Institute
-SSHP	Social Sciences and Humanities Publications
GSA	Geological Society of America
-B	Bulletin
IJAL	International Journal of American Linguistics
ISUM	Idaho State University Museum
-OP	Occasional Papers
JM	Journal of Mammalogy
KAS	Kroeber Anthropological Society
-SP	Special Papers
MAIHF	Museum of the American Indian, Heye Foundation
-INM	Indian Notes and Monographs
NASR	Nevada Archaeological Survey Reporter
NMA	New Mexico Anthropologist
SAA	Society for American Archaeology
-M	Memoir
UC	University of California
-AR	Anthropological Records
-ASR	Archaeological Survey Reports
-PAAE	American Archaeology and Ethnology
-PZ	Zoology

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II.

ANALYSIS OF HUMAN COPROLITES FROM ARCHAEOLOGICAL CONTEXTS, WITH PRIMARY REFERENCE TO LOVELOCK CAVE, NEVADA

Lewis K. Napton and Robert F. Heizer

Introduction

Archaeologists spend a good deal of time trying to determine the dietary regimes of the people who lived before the beginning of recorded history. A great variety of methods have been devised to collected information which will help to ascertain the economic basis of the society under study (Clark 1952, 1953; Heizer 1960; Gabel 1967). Direct evidence of hunting, fishing, collecting, cultivating, or herding may come from faunal remains, carbonized seeds, pollen grains, or from artifacts identifiable as having served as food collecting or food producing devices.

Under certain favorable conditions, organic materials such as the bog bodies of Europe (Glob 1954:419-430; 1969) and the desiccated or "mummified" human bodies found in cave sites or in very dry open air occupation sites--such as those in the coastal desert regions of Peru and in the Great Basin of the western United States--will be extraordinarily well preserved, and it is possible to study the stomach and intestinal contents of these individuals and learn a great deal about what they had eaten as a "last meal" (Helbaek 1950; 1951; 1958). These instances, however interesting they may be, are nonetheless only individual, isolated examples of the human diet of ancient times. To generalize on the basis of evidence representing only a few meals could lead to serious errors of interpretation about the subsistence basis of the prehistoric population.

When the archaeologist has available large numbers of naturally desiccated or intentionally mummified human bodies it may be possible to identify many of the dietary elements consumed by a large sample of a contemporaneous population. However, to our knowledge, no such studies have been carried out. Another possible means of obtaining information about the foods that were eaten by a group of prehistoric people is provided when human fecal pellets (coprolites) have survived in their original form as the result of preservation by desiccation. It is this approach to the study of ancient dietaries with which we are presently concerned.

One of the first such studies of the contents of human coprolites found in an American archaeological site was made in 1912 by Llewellyn L. Loud. Other examinations of coprolites or stomach contents of human bodies found in archaeological sites were made at about the same time in Egypt (Wood Jones 1910: 215-220), in England (Warren 1911:198-208), and in southeastern United States

(Young 1910). Loud examined several specimens of desiccated human excrement which he had collected in the course of his salvage excavations in Lovelock Cave, Nevada, carried out on behalf of the Museum of Anthropology, University of California, Berkeley. His unprecedented, if somewhat perfunctory inspection of Lovelock Cave coprolites was not reported upon until seventeen years later (Loud and Harrington 1929). The background of Loud's work at Lovelock Cave is given by Heizer and Napton (this volume). The history of subsequent investigation of archaeological and coprological remains from Lovelock Cave and other prehistoric occupation sites has been reviewed by Heizer (1967a: 1-20; 1967b:49-52; 1969b:244-250; see also Heizer and Napton 1969:563-568). Investigations at Lovelock Cave and other Great Basin archaeological sites were made between 1937 and the present date. This research may be briefly summarized as follows:

(1) [1937]: Heizer and Krieger (1956) excavated Humboldt Cave, Nevada, (NV-Ch-35) and found several dozen coprolites (ibid:33). They endeavored to have the contents of sample specimens studied and identified; however, this was one of the first attempts to enlist the aid of specialists in studying the food habits of American Indians by analysis of ancient excrement, and there was no precedent for this type of research. Samples of the desiccated human excrement found in the cave were sent, intact, to various botanists, but this largesse was apparently unappreciated, for the specimens were never studied nor returned.

(2) [1950-1967]: Norman L. Roust (1967:49-88) analyzed 51 Lovelock Cave coprolites which had been collected in 1950 at random from the surface of the cave midden and from the screened debris left by relic collectors. Needless to say, there was no way of determining the stratigraphic provenience or exact age of these coprolites, short of radiocarbon analysis of each specimen. However, the coprolites processed by Roust provided at least an indication of the types of foods that were eaten by members of the Lovelock population. Roust also dissected and examined 85 coprolites from Hidden Cave (NV-Ch-16), one specimen from Humboldt Cave (NV-Ch-35), and 12 coprolites from NV-Pe-8).

(3) [1966-1967]: Richard Ambro (1967:37-47) and R. Cowan (1967:21-35) analyzed 30 of several hundred human coprolites found in a crevice near the entrance of Lovelock Cave. A sample "Entrance" (ENT) coprolite gave a radiocarbon date of A.D. 1805 ± 80 (UCLA-1071-E). Another group of coprolites was found at the bottom of an abandoned cache pit located near the east wall inside the cave. Twenty of these coprolites were analyzed. One of the "Interior" coprolites produced a radiocarbon date of A.D. 756 ± 60 (UCLA-1071-F, see Tubbs and Berger 1967:89-92). These radiocarbon dates indicated that the "Interior" coprolites were approximately 1000 years older than the "Entrance" coprolites. However, these two groups of coprolites were essentially homogeneous in composition (Table 9).

The preliminary analysis of Lovelock Cave coprolites performed by Roust and the more detailed analysis of Lovelock Cave coprolites carried out by Ambro and Cowan provided evidence of the extensive use of lacustrine subsistence resources obtained from Humboldt Lake, the former shoreline of which was located less than two miles from Lovelock Cave. The late date of some of the ENT coprolites (A.D. 1805) indicated that the "lacustrine adaptation" persisted in this area until just before the discovery of the lake by Peter Skene Ogden in 1829 (Cline 1963). A modified version of the lacustrine subsistence adaptation is documented in the ethnographic literature (Hopkins 1883; Scott 1966; Heizer n.d.).

The late date of the "Entrance" coprolites and the discovery, in midden trash removed from the cave in 1911 by guano miners and discarded on the hillside in front of the cave, of several types of projectile points used during the Late Period in western Nevada (Clewlow 1968:89-101; Clewlow and Napton 1970) demonstrated that Lovelock Cave had been occupied much more recently than many investigators had supposed (see Loud and Harrington 1929; Grosscup 1960). Thus, coprolite studies helped not only to clarify the prehistoric subsistence economy, but also provided information about the protohistoric and terminal stages of Lovelock Cave occupation. Nevertheless, the approximate date of the beginning of human occupation of the site remained unknown.

The radiocarbon dates of the "Interior" coprolites (A.D. 756) suggested that the lacustrine-oriented "Lovelock" subsistence pattern might have begun at a fairly early date--perhaps during the pre-Christian era. This possibility seemed to be supported by the results of analysis of 74 coprolites found in the "Thirty-Two Inch Midden" in Hidden Cave, near Fallon, Nevada. These coprolites were examined and reported upon by Roust (1967:49-88). Vegetal material said to have been associated with this midden gave a radiocarbon date of 1094 B.C. ± 200 (L-289BB; Broecker and Kulp 1957).[1]

The oldest date of cultural material from Lovelock Cave (1218 B.C.; C-735) was obtained from basketry collected by Harrington in 1924 (see Cressman 1956: 311-312). A very early date of 4054 B.C. (C-278) was produced by solid carbon analysis of a sample of unburned bat guano taken from just above the base of the cultural strata in the cave. It was obvious, of course, that if the date of 1218 B.C. represented actual occupation of the cave, the lacustrine subsistence adaptation might have been in existence at that time, and, implicitly, at an even earlier date. On the other hand, the subsistence basis might have been much different during the earlier phases of cave occupation.

(4) [1967-1970]: In order to investigate some of these unknown aspects of the cave's prehistory, we made a brief visit to the site in May, 1968. Fortunately, the cave contained a few small remnants of undisturbed midden in crevices or under large rocks, and we decided to excavate some of these pockets of material, gambling on the possibility that we would find enough coprolites and vegetal material to provide information about the subsistence adaptation of the earliest inhabitants of the site.

We began work in the cave in September, 1968 (see Heizer and Napton, this volume). Excavations were completed in the spring of 1969. Widely separated parts of the cave deposit were tested by us in order to obtain a sufficiently extensive horizontal sampling of coprolites (fig. 2). When conditions permitted, we attempted to obtain samples of coprolites and vegetal materials from stratified contexts by means of deep test units extending from the existing surface of the cave midden to its base (fig. 3). Unfortunately, because of the extensive damage caused by the guano miners in 1911 and by the generations of relic collectors who have burrowed in the cave for more than a half-century, we were able to obtain coprolites from only a few contexts which could provide satisfactory stratigraphic control. The temporal position of coprolites found in the midden was determined by radiocarbon dating of associated vegetal material, and in many cases by radiocarbon dates obtained directly from individual coprolites (see Heizer and Napton, this volume, Table 4).

Coprolite Analysis Procedures: Analysis of human coprolites found in archaeological sites has become a very useful supplemental source of information about the dietary practices of extinct human populations. The coprolite analysis procedure currently in use at Berkeley subsumes four separate procedures, the first of which (collection of samples in the field) is discussed, with reference to Lovelock Cave, in the following section. The general problem of sample size in coprolite analyses is given further consideration at the conclusion of this article.

When the investigator has acquired a number of coprolites, it is of course necessary to be able to distinguish between the coprolites produced by the human inhabitants of the site and those produced by other mammals. At this writing, the most reliable and certainly the most expedient method of distinguishing between human and non-human coprolites is not by form, color, or size, but by the contents or constituents of the individual fecal specimens. The occurrence, in a single sample of excrement, of burned seeds, fish bone, bird feathers, charcoal, bulrush seeds and human hair obviates any question as to the species of mammal responsible for producing the fecal specimen. Only man would gather, prepare, and consume the unique assortment of foods found in most of the Lovelock Cave coprolites. This apparently obvious situation can be complicated, however, by the visual similarity between the feces of man and bears, and by the fact that some of the coprolites could have been produced by scavengers. Coyotes, for example, are known to consume food scraps, human cadavers, and even human feces. Domesticated dogs kept by the Indians would also have consumed food residue and other debris descarded in the cave.

Several methods for distinguishing between human and non-human coprolites have been applied in our study of the Lovelock Cave coprolites (Stross 1970: 47-48). Samples of human and non-human coprolites were processed by either extraction and chromatography to determine the cellulose content. Cellulose materials are not completely digested by humans (see Consolazio, Johnson, and Pecora 1963). The cellulose content of Lovelock Cave coprolites CR-1 and CR-2 (human coprolites) is much higher than that of coprolite X-3, which, on the basis of color, form, and composition, was believed to have been produced by a carnivore, probably a coyote (see Table 1):

Table 1

Cellulose and Inorganic content of Human and Non-human coprolites from Lovelock Cave, Nevada (NV-Ch-18), expressed as percentages

Sample	Cellulose	Inorganic
CR-1	33.8	5.6
CR-2	23.8	4.5
X-3	11.3	33.6

The data presented in Table 1 suggest that variations in cellulose content can be used to distinguish between coprolites produced by various mammals; however, this assumption must be verified by processing additional samples.

Processing of samples: This general topic includes three sub-topics (A) Levels of analysis, (B) methods of dispersion and (C) methods of quantification. These are discussed in the following pages.

(A). Coprolite analysis: There are five major "levels of analysis" of coprolites from archaeological contexts.

Macroscopic: Large fragments of floral, faunal and inorganic materials recovered from the coprolite by sieving or manual segregation are identified (if possible to the species level) and are quantified by weight or volume. It is this fraction of the coprolite which provides the most useful date pertaining to food habits.

Microscopic: Small items (tiny seeds, pollen exines, fish bones, plant fibers, bird feathers, hairs, etc.), are examined on the microscope stage. Identification to the family or generic level is possible; however, quantification is extremely difficult. Usually, the "Ocular Proportional Tabulation and Identification Control method" is the only feasible means of quantifying this material if large numbers of specimens are to be processed.

Microchemical: The submicroscopic level of analysis. Various stains (eosin, "Lugol's," Pyronin and others) aid in distinguishing between meat and vegetal fractions of the detritus suspended in the trisodium phosphate solution. The results of examination or identification of coprolite components by stain techniques depend to a considerable extent upon the experience of the technician, and for this reason are not readily reproducible.

Chemical: Routine chemical analyses are often made of fresh human fecal material (Gradwohl 1956) but the method has received only minimal application in the field of coprolite analysis (see Heizer 1967a:1-20). Fry (personal communication, 1970) reports an unusually high sodium cloride content in some of the human coprolites from Danger Cave, Utah (see also Fry 1968). Lovelock Cave coprolites are now being processed for detection of fatty acids and lipids. An extensive study of the amino acids in the Lovelock human and non-human coprolites has been carried out at the University of California, Berkeley, by Edward Blake (personal communication, 1970), and cholic and lithocholic acids occurring in the Lovelock coprolites have been analyzed by Evans and Evans (personal communication, 1970).

Bacteriologic: Fry and Moore (1969:1620) and Moore, Fry and Englert (1969: 1324-1325) successfully demonstrated pinworm (Enterobius vermicularus) infection in ancient human coprolites from Danger Cave, Utah. Dr. F. L. Dunn, University of California Medical Center, San Francisco, examined 168 Lovelock Cave coprolites and found no evidence of endoparasites (see Dunn 1966:329-345; 1968:221-228; Dunn and Watkins, this volume; see also Radovsky, this volume). Dr. John M. Budinger, Consulting Pathologist for the Bronx Zoo and Director of Laboratories, Lawrence Hospital, Bronxville, New York, examined a large sample of Lovelock Cave coprolites, as well as the visceral contents of a mummified human body from the cave. No evidence of human parasites was found. Larval nematodes of the genus Rhabditis were found by Dr. Dunn in Lovelock Cave coprolites which he examined in 1966, indicating that helminths can be preserved in recognizable form in the Lovelock fecal pellets (see Heizer 1967a:1-20). For further information on parasitological studies of coprolites from archaeological sites see Grzywinski (1959/1960:195-199; 1962:548), Woodbury (1965), Samuels (1965:175-179), Pike and Riddle (1966:293-296), Pike (1967:184-188), and Hall (1969).

(B). Dispersion techniques: At least five different chemical solutions have been used in processing desiccated biological and botanical materials. Van Cleave and Ross (1947:318) used trisodium phosphate (Na_3PO_4) to reclaim dried tapeworms; Benninghoff (1947:325-326) dispersed peat in a 0.25 to 0.05 per cent aqueous trisodium phosphate. Barghoorn (1948:480-481) used sodium chlorite in similar paleobotanical investigations. Wilder (1904:1-17) discussed solutions used in restoring dessicated human tissue for histological examination. The first use of trisodium phosphate in rehydrating coprolites was by Callen and Cameron (1955:51; 1960:35-37; 39-40). Colyer and Osborne (1965:186-192) processed human coprolites from Wetherill Mesa, Colorado, in an 0.2 percent lye solution. Samuels (1965:175) processed Wetherill Mesa coprolites in an organic chelating solution consisting of 2.0 percent (w/v) sodium hydroxide with 0.5 percent (w/v) ethylenedinitrilotetraacetic acid disodium salt (EDTA, or Versene). Witenberg (1961:86) used Triton solution to rehydrate coprolites from archaeological sites in Palestine. The principal effect desired in rehydration of coprolites is to soften the desiccated fecal mass, reconstitute the vegetal and other organic matter, and disaggregate the individual components. Rehydration of the Lovelock Cave coprolites

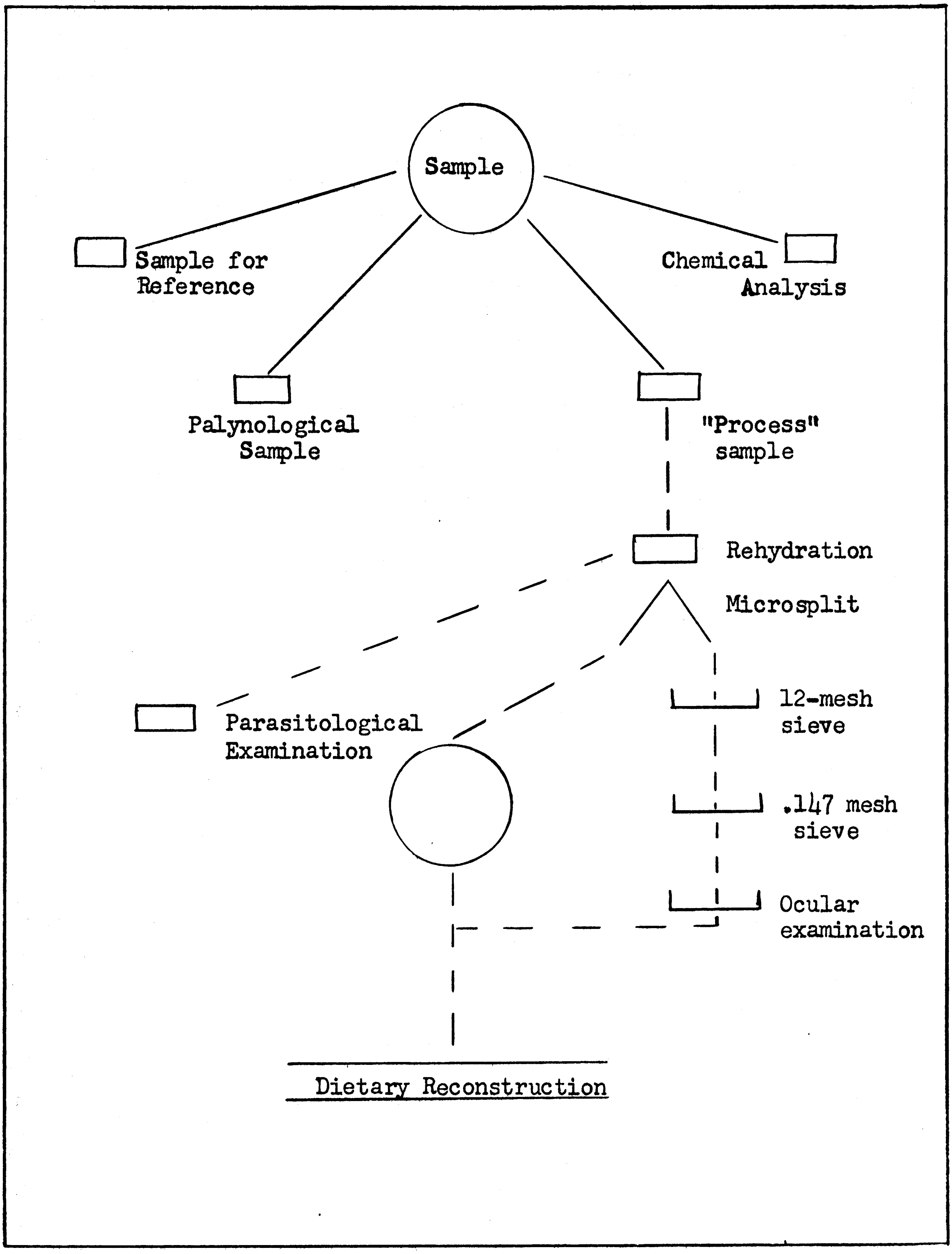

Figure 1. Diagram of coprolite analysis operations

was achieved by soaking each specimen for 48 to 72 hours in an 0.5 per cent solution of trisodium phosphate at room temperature. Disaggregation was expedited by occasional manual agitation of the container. The rehydrated coprolites were decanted into a series of progressively finer wire sieves (1.68 mm., Tyler Series No. 10; 500 my, Tyler Series No. 32; and 147 my, Tyler Series No. 100). Colyer and Osborne (cited supra), Fry (1968:27), Watson (1969:44) and others have used various combinations of graded sieves as an aid to segregation of coprolite components.

(C). At this writing there is no standard or uniform method of quantifying the components of coprolites. Ambro and Cowan attempted to quantify the components of the ENT and INT coprolites by weight; Roust (1967:49-88) used both weight and volume measurements. Watson (1969) and others have used systems of arbitrary indices or "values" such as "trace", "dominant", "scarce", "scanty", or "abundant". Gravimetric procedures were used in quantifying the manually segregated Lovelock Cave coprolites processed by us in 1968: food items having sufficient bulk to permit gravimetric quantification were weighed on an Ainsworth triple beam balance or on a Mettler Analytical balance (Model P120), and the data were recorded, of course, as weight in grams.

In 1968-9 we processed a total of 75 coprolites and midden samples using the basic trisodium phosphate method (see Callen and Cameron 1960:35-37; Callen 1963:186-194; Heizer 1967a:1-20; Heizer 1969b:563-568). We have retained for future analysis about one-half of each coprolite selected for processing. This was a departure from the earlier procedure used by Ambro and Cowan--the ENT and INT coprolites were processed in their entirety, except for microsamples averaging a gram or two in weight, which were reserved for future chemical and palynological analyses. We augmented this major change in procedure by adapting, from well-established techniques used in wildlife food habits studies, the "Ocular Proportional Tabulation and Identification Control" method. In the application of the"OPTIC" method, approximately three-fifths of each coprolite is processed in an aqueous solution of 0.5 percent trisodium phosphate. When dissaggregation is complete, the coprolite constituents are decanted into small sieves (147 my; Tyler No. 100) and are re-desiccated in a laboratory oven or under controlled constant temperature heat lamps. The entire processed sample is then scanned under 10X binocular dissecting microscopes by two or more experienced technicians, each of whom identify the major coprolite components and record the observed occurrences as an estimated volumetric percentage of the entire processed coprolite (see Martin and Korschgen 1963:320-329; Browning 1962: 91-107). The application of quantification procedures resembling the "OPTIC" method is discussed by Folk (1951:32-33), Terry and Chilingar (1955:229-234), Griffiths and Rosenfeld (1954:74-91), and Allen (1956:160-161).

The major advantage of the "OPTIC" method is of course the considerable saving of time when the method is employed to supplement the tedious manual segregation procedure. Coprolites processed by manual segregation are eventually reduced to an "irreducible minimum"--a residuum which often represents a significant fraction (by weight) of the processed coprolite. In the end one usually has no other recourse than to try to estimate the proportions of the various components of this residuum. In earlier phases of the Lovelock coprolite project, the composition of the residuum was estimated and the percentage was "adjusted" to represent a function of weight.

Experimental replicate estimates of the volumetric contents of sample coprolites tabulated by the "OPTIC" method were in close agreement. Using this method, the proportional composition of the various constituents is rapidly determined. Constituents are identified and quantified, and the occurrence of minor or adventitious constituents is suppressed. The method permits one to quickly access the contents of a large series of coprolites. The data obtained by application of the "OPTIC" system are expressed as volumetric percentages based on examination of the entire processed portion of each coprolite. However, these are at best only controlled approximations. When attempting to quantify feathers, for example. gravimetric data--even when carried to excesses of accuracy--has little meaning in terms of the actual <u>amount</u> of digestible food consumed.

We found that manual segregation of recognizable food items and visual estimates of proportions of the residuum was an effective procedure. The manually segregated coprolite components can be quantified by weight, volume, or frequency of occurrence, and thus can be adjusted to be comparable to the volumetric percentage estimates.

Identification and quantification may be achieved simultaneously; however, there are very few persons who are qualified to accomplish this rather specialized task. Human coprolites often contain extremely intricate combinations of fragmentary plant material, insects, fish, bird bone, feathers, skin, animal hair, and dozens of other kinds of organic and inorganic substances, all of which have been altered by maceration or by passage through the digestive tract, and have been stained by the fecal matrix and distorted by prolonged desiccation.

Early in 1968, enough was known of the general contents of the Lovelock coprolites (Roust 1967:49-88; Cowan 1967:21-35) that it was obvious that the prehistoric inhabitants of Lovelock Cave and adjacent cave sites in western Nevada subsisted on many types of "lacustrine" foods, such as cattail seeds and rootstalks, tui chub, mudhens and bulrush seed. A large number of these vegetal foods are eaten by contemporary waterfowl. Ducks (McAtee 1939) and geese (Dow 1943:3-18) thrive on the seeds of aquatic plants (Martin, Zim and Nelson 1951), a fact which assumes considerable significance in view of the importance of lacustrine food resources to the prehistoric human population of Lovelock Cave. It occurred to us that wildlife biologists would have occasion to examine vegetal materials similar to those found in the Lovelock coprolites. Accordingly, we made contact with Bruce Browning, Chief of the Food Habits Investigations Laboratory, California Department of Fish and Game, Sacramento, and arranged for examinations to be made of the total constituent suites (less chemical and pollen samples) of the fifty ENT and INT coprolites processed by Ambro and Cowan.

The coprolites were transferred to the Sacramento field laboratory in 1968, and analysis and identification of the coprolite constituents was made by means of the same techniques employed in wildlife food habits studies (see Errington 1932:75-86; Dusi 1949:295-298; Browning 1962:91-107; Martin and Korschgen 1963: 320-329). Identifications were made by scanning the constituents of each coprolite under wide field 9X ocular and 9.7X binocular microscopes. All major food items observed in the coprolites were identified and described by two independent analysts (B. Browning and W. Stienecker), each of whom estimated the volumetric percentage of the identifiable and unidentifiable coprolite constituents. Items estimated to occur in quantities of less than one percent by volume were recorded as *trace* amounts, following standard practice in the field. It was possible to identify a wide variety of materials by visual inspection of the entire constituent suite of each coprolite.

The results of the pilot examination of the entrance and interior coprolites, which apparently represented two separate intervals of cave occupation, were productive enough to encourage us to make further excavations in Lovelock Cave. Random samples of these coprolites were rehydrated, following the usual laboratory routine, and were segregated manually. This analytic procedure differed from previous analyses in the small but important detail that the contents of the coprolites were sorted in their entirety and the separated constituents were placed in one-dram shell vials. The superiority of this procedure over examination of coprolite components mounted on microscope slides lies in the fact that all components of each separate type were contained in individual vials and could be identified *en masse*. Identification of seeds, achenes, hairs, and other coprolite components was accelerated by this procedure. Fifteen coprolites from each excavation unit were processed, but the total sample of fifteen specimens transected the five stratigraphic units, so that the sample from each level consisted of only three individual specimens. Obviously, three coprolites from each level was not an adequate sample. It was necessary to expand the sample laterally, in order to provide a more adequate representation from each occupational horizon. Thus, in the case of the LX, WA, and WE coprolite sample series, the original sample of fifteen specimens (three specimens from each of five arbitrary levels) was augmented, insofar as possible, to comprise approximately fifteen specimens from each level (Table 3).

Rationale of the Coprolite Sample

The Lovelock Cave coprolites were obtained from several locations in the cave (see figs. 2,3), in order to minimize the possibility that our interpretation of the prehistoric diet of the Lovelock population might have been skewed by too limited or selective sampling. Lovelock Cave is of sufficient size (50 by 160 feet) and is structured in such a way that different areas of the cave floor could have been occupied at different times. In fact, the interior of the cave and the exterior cave, or outer rockshelter, can be demonstrated to have been occupied at different times. There were obvious differences in the composition of coprolites obtained from the various test or excavation units. These differences are considered to be temporal, rather than strictly positional phenomena. That is, in our opinion the observed dietary differences are not due to alternating occupation of the site by different groups, but are interpreted as being a function of gradual changes in the various types of foods available in the vicinity of the cave at different times in the past. The sources of the various coprolite groups or samples from Lovelock Cave are indicated in Figure 2. Coprolites were obtained from the following units or "lots" (Table 2).

Table 2

Source Locations and Totals of all Lovelock Cave Coprolites Processed in 1967-1970

Area	Code reference	Number
West Alcove	(WA)	135
West Crevice	(WC)	20
West End	(WE)	49
Lot AN	(AN)	15
Lot LX	(LX)	52
East End	(EE)	10
Entrance	(ENT)	20
Interior	(INT)	30
Nonhuman	(CS)	10
Roust group	(RG)	51
Medical Study (Dunn)	(PD)	168
Medical Study (Budinger)	(PB)	15
Other analyses	(RX)	25
TOTAL		600

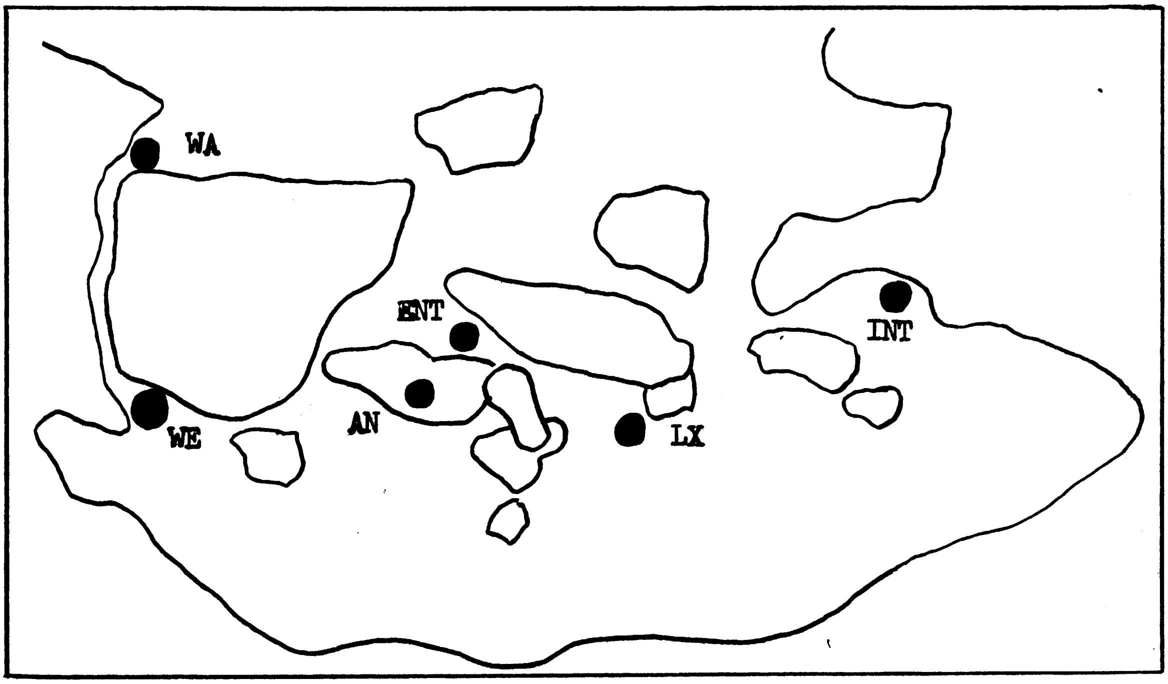

Figure 2. Horizontal provenience of coprolite samples collected and analyzed, 1967-1969.

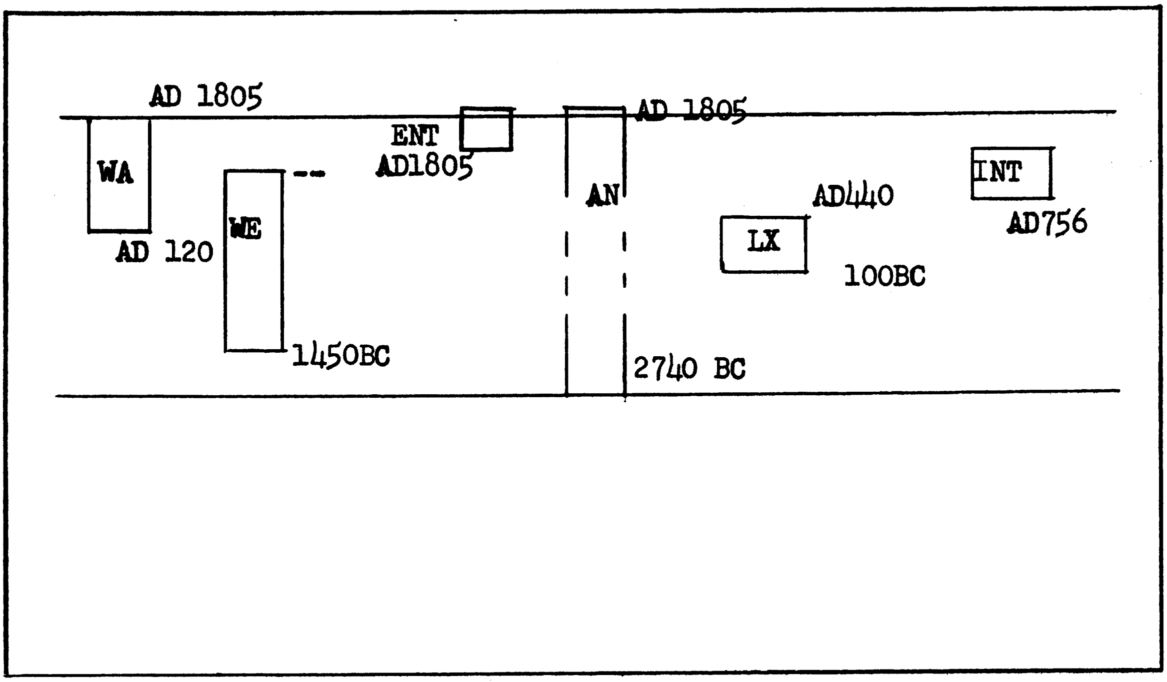

Figure 3. Lovelock Cave, Nevada. Schematic vertical relationship of coprolite samples collected 1968-69.

The "West Crevice" coprolites came from a sliding mass debris which had accumulated in a deep and narrow crevice between rock A and the west wall of the cave (see Heizer and Napton, this volume, figs. 10 and 23). The "East End" coprolites were found in spoil dirt in the deep east end of the cave. These specimens, which are entirely without stratigraphic or associational context, closely resemble the contents of the "Interior" coprolites, a well-controlled sample obtained in 1965 from a cache pit located near the east inside wall of the cave. The "West Crevice" and "East End" coprolites will not be reported upon in detail at this time.

Lovelock Cave Coprolite Samples

West Alcove: The best set of coprolites, from the point of view of stratigraphic control, came from the "West Alcove" (WA). Here, in a previously undisturbed ante-chamber of the cave, we found a narrow crevice which was almost completely filled with occupational debris. More than 1000 coprolites were retrieved from this crevice. The entire available collection of West Alcove coprolites was examined by visual inspection in our laboratory and the major visible components were identified. On the basis of this preliminary examination, the coprolites were grouped by stratigraphic level and by approximate composition, and the process sample was selected at random from the total population. This was done in order to obtain a representative sample of the population collected from the WA area during the 1969 excavations. The same procedure was used in selecting all of the Lovelock Cave coprolites processed in 1968-1969. The 20 "ENT" and 30 "INT" coprolites processed in 1967 were selected by Ambro and Cowan from total populations of more than 200 coprolites each, which were recovered from the "Entrance" and "Interior" locations (fig. 2). Each group was considered to be a discrete sample representing a "point" occurrence. That is, these two samples do not span long periods of time, but instead represent relatively brief intervals of occupation, occurring *circa* A.D. 1805 and A.D. 756.

The West Alcove coprolites range in age from about A.D. 1800 (surface) to A.D. 300 (at 11 feet deep) and A.D. 120 (12 feet deep). The coprolites in the crevice were so abundant that it was possible to analyze a sample of 15 coprolites from each of eight stratigraphic levels. The 15 specimens were selected at random from an average total population, per level, of about 60 coprolites. We believe that the occurrence of large numbers of coprolites in this crevice is due to the fact that the occupants of the west alcove and outer rockshelter used the deep crevice as a latrine. The aggregate volumetric percentages of these specimens are expressed graphically in Table 6.

The principal difference within the West Alcove coprolite series is the presence in the upper level specimens of the seeds of *Typha*, *Najas*, and *Panicum*, and the relative scarcity of *Elymus* (wild rye), which occurs in the lower level

West Alcove coprolites. It is possible that use of Elymus in the past reflects exploitation of meadowland resources near Humboldt Lake, and the increased use of Typha, Najas, and Panicum in recent times could indicate intensification of lacustrine specialization. This is perhaps the most obvious interpretation that one might make of the shift from Elymus to primarily mesic and hydrophytic flora. There are, however, several other factors which could account for this phenomenon. The transition could be due to seasonal differences, although Elymus and the hydrophytes flower and seed at approximately the same time. The transition could be due to far more subtle factors, such as deliberate cultural choice, or perhaps to selection by personal preference. On a larger scale, the transition could be due to ecological alterations in the vicinity of Humboldt Lake. It is known, however, that stands of Elymus existed near the lake in 1840. The extensive Elymus crop was used as livestock forage by the Bidwell-Bartleson party in 1840 (Bidwell 1928). By 1849 the wildrye crop had been denuded by the emigrants. In 1864, the Blake brothers were able to obtain a good sample of wildrye grass from the sloughs near the present site of the town of Lovelock (USDA/NHRBSFP 1965). In view of the documented presence of Elymus in the lower reaches of the Humboldt River in the eighteenth century, we conclude that the transition from the use of Elymus to extensive exploitation of seeds of water-loving flora is probably due to "cultural factors"--perhaps to the gradual intensification of exploitation of lacustrine resources. This trend is also indicated by the fish bone found in the coprolites. Fish bone (mostly Gila [Siphateles] bicolor) is present in small amounts in the older WA coprolites. The cui-ui and Tahoe sucker (Catostomus tahoensis) occur in the upper level midden trash. An increase in fish bones is indicated by the contents of the INT and ENT coprolites, the LX coprolites, and the upper AN coprolites (see Follett, this volume). Bulrush seed (Scirpus sp.) occurs in almost all of the WA coprolites.

The older WA coprolites, dated by radiocarbon analysis of sample specimens, were deposited as early as the first century A.D., extending the demonstrated range of the lacustrine adaptation at Lovelock Cave back through time from A.D. 756 to the beginning of the Christian era.

West End coprolites (WE): The WE coprolites came from disturbed midden debris in the deep west end of the cave near the "Lot 15" area, excavated in 1924 by M. R. Harrington and L. L. Loud. An unknown amount of cultural material had been removed from the upper part of the midden deposit in the west end of the cave as part of Harrington's Lot 16. Thus, the sample begins well below the original surface of the midden. The test unit (S40/W85) was carried to the base of the midden deposit.

The age of the upper level WE coprolites (found 48 to 54 inches below the existing surface) is indicated by a date obtained from cultural material found in Level II of Lot 15 (A.D. 268; C-728,-729,-730). Basketry fragments from a lower level (Level IV of Harrington's Lot 15) provided the date of 1218 B.C. (C-735). Human remains collected by us in 1969 (see Morbeck, this volume) from the bottom of the West End deposit yielded a date of 1450 B.C. ± 80 (UCLA-1459-C). The human bones lay about six inches above the base of the west end deposit. The coprolites found superior to the bones are of course younger. Unfortunately, the available fund allocations did not permit radiocarbon determinations to be made of the deep WE coprolites. We would judge that the WE coprolites range in age from about A.D. 268 to *circa* 1200 B.C.

The WE coprolites are very similar in composition to the deep WA coprolites. *Elymus* is present; fish bone is present but is scarce compared to the copious amounts contained in the most recent Lovelock Cave coprolites. Seeds of *Scirpus* cf. *acutus* are unusually abundant in some of the WE coprolites. Bird feathers, bones and skin are present in very small amounts. There is an indication, which is not brought out by the volumetric tabulations, of extensive use of small mammals, especially of ground squirrels. This is revealed by the presence of numerous hairs of ground squirrels in some of the deep WE coprolites (O. Brunetti, personal communication, 1969). We do not have at hand sufficiently large samples of the osseous component of the Lovelock Cave midden to provide verification of the occurrence of ground squirrels during the time period represented by the older WA coprolites. The contents of 49 WE coprolites, grouped by levels, are detailed in Table 6.

AN coprolites: The AN coprolite sample constitutes a stratified series. The entire group came from midden debris found under a very large rock (Heizer and Napton, this volume, fig. 9, rock B), which was located near the entrance of the cave. The sloping mass of debris under the rock is situated in such a way that the uppermost, or surface coprolites, were derived from the "entrance" (ENT) coprolite crevice. Thus, many of the most recent AN fecal pellets probably date *circa* A.D. 1805.

The older AN coprolites comprise two samples; a group of five (AN 7-10) from about 72 inches below the surface of the entrance deposit which were probably deposited *circa* 1000 B.C., and a group of five from about 84 inches below the surface. The oldest sample of coprolites (AN 11-15), consisting of five specimens from a layer of bat guano and midden trash, probably dates *circa* 1500-2000 B.C.--about the same period as the deepest WE coprolites (66"-72").

The AN coprolites number only five coprolites per level. Because of this deficiency, the possibility of sampling error is increased by a factor of ten. The upper level coprolites, however, are approximately the same age as the ENT coprolites. We obtained a larger sample of "recent" AN coprolites (about 75), all of which were inspected visually or by partial dry-dissection prior to selection of sample AN 1-5. The recent AN coprolites appear to be more homogeneous than the earlier specimens, but this impression might be due to the inadequate sample representing the older AN occupational levels.

As we observed in reference to the WA and WE coprolites, *Elymus* is common in the older AN coprolites. Fish bones are scarce or absent in the older specimens (AN 10-15), but increase in the recent AN 1-5 specimens (see Follett, this volume). Coprolites of intermediate age are poorly represented in the AN unit due to the intrusion in the test unit of two large cache pits which originated from a recent occupation level in the upper midden deposit. These cache pits must have been constructed prior to A.D. 400, the approximate date of the fall of rocks B, C, and D.

Vegetal material found in association with coprolites AN 10-15, produced a radiocarbon date of 2740 B.C. ± 100 (I-3962). This matted vegetation, containing human hair, quids, fragments of twine or netting, and other cultural debris, is considered to represent the oldest presently known occupation of Lovelock Cave. Fish bones are relatively common in this level. There are several fragments of coprolites which are composed of nearly pure Typha pollen, which must have been gathered in the spring of the year. Fragments of aquatic tubers are not present in coprolites frim this time-level in the cave. Bulrush seeds are ubiquitous, just as they are in almost all of the coprolites from the cave. However, these seeds tend to be not so abundant in the early coprolites--Elymus perhaps served as the approximate dietary equivalent.

LX coprolites: The upper levels of the LX test area were removed in 1924 by Loud and Harrington. Excavations between rocks C and D by us in 1968 led to recovery of 52 coprolites. These specimens cover a time range from circa A.D. 700 (the approximate equivalent of the INT coprolites) to about A.D. 50. Coprolites LX 1-3 came from the surface debris and are of unknown age. We assume that the LX specimens are temporally coeval to the INT coprolite sample. LX 4-6, found 24 to 36 inches below the existing surface of the test unit (Grid location NS0/W30) probably were deposited in the midden circa A.D. 500-600. Coprolites LX 7-9, found 36 to 48 inches deep, may have an approximate date of A.D. 400-500. Coprolites LX 10-12, recovered from 48 to 60 inches below the surface of the test unit, have been approximately dated by stratigraphy. Coprolite LX 10 gave a date of A.D. 480 ± 90 (I-3963) and coprolite LX-16, from a depth of approximately 56 inches, produced a date of A.D. 350 ± 50 (UCLA-1418). Coprolites LX 13-15, recovered from 58 to 72 inches below the existing surface of the test unit, probably were deposited during the pre-Christian era. Vegetal material from the uppermost part of this level yielded a radiocarbon date of A.D. 50 ± 60 (UCLA-1417). The underlying coprolites are older. However, an empty cache pit found at this depth in the north profile of the LX test unit attests to disturbance of this area in prehistoric times. (The area had not, however, been disturbed during the guano mining or early excavations of the cave.) It is probable that the entire LX test unit is of much more recent date than one would suspect on the basis of depth measurements alone. The Older Guano layer, encountered in the nearby test unit NS0/W35, was not present in the north profile of the LX unit. There had been little or no disturbance, either ancient or recent, in the north profile of NS0/W35, and the radiocarbon dates of vegetal matter from this unit, taken from equivalent depths, are much older. Therefore, we conclude that the deepest LX area coprolites are not as old as the deepest AN or WE coprolites.

The LX coprolites, like the WE series, gave evidence of a gradual transition from use of Elymus in the past to recent use of Scirpus. Fish bones increased through time, and aquatic wildfowl became more popular in relatively recent times.

Aquatic tuber fragments are well-represented in the upper level LX coprolites, and several intact, charred aquatic tuber fragments were found in the midden debris. It is likely that the recent LX coprolites are equivalent in age to the INT coprolite series. Due to the fact that the upper levels of the LX area were removed in 1924 by Harrington, none of the LX coprolites are as recent as the ENT, upper WA, or upper AN specimens.

The constituents suites of the sample ENT, INT, AN, LX, WE, and WA coprolites are given in Tables 6-9. Coprolites from Humboldt Cave (NV-Ch-35) and Pyramid Lake, Nevada caves, are tabulated in Table 10.

Table 3

Location Data on 282 Lovelock Cave Coprolites Processed in 1968-1969 for Identification of Food Remains[(a)]

Depth (in.)	Identification Number	Sample Total
	WA (WEST ALCOVE)	
0-12	1-5,104-113	15
12-24	6-10,114-123	15
24-36	11-15,86-103[(b)]	23
48-60	31-45	15
72-96	46-55,131-135	15
108-120	56-65,126-130	15
120-122	22-24,66-75,124-125	15
122-144	25-30,76-85	16
		(129)
	WE (WEST END)	
48-54	8-12,32-41	15
60-66	14,20,24,27,30,13,15, 17,18,19,21,22,23,25, 26,28,31	17
66-72	1,3,6,7,29,2,4,5,42-49	16
		(47)

WC (WEST CREVICE)		
Depth (in.)	Identification Number	Sample Total
unknown	1-20	20[(c)]
		(20)
	AN	
0-6	1-5	5
48-56	6	1
72	7-10	4
84	11-15	5
		(15)
	LX	
0-12	1-3,17-28	15
24-36	4-6	3
36-48	7-9,29-40	15
48-60	10-12,41-52	15
58-72	13-15	3
		(51)
	EE	
unknown	1-10	(10)
	CS	
unknown	1-10	(10)

Notes to Table 3

(a) See Table 2 for total of coprolites processed in all types of studies.

(b) Twenty-three coprolites were processed; 8 were examined for parasites, 15 for food remains.

(c) The depth of the West Crevice coprolites is unknown. (See text.)

Table 4

Coprolites from Western Nevada Caves (other than Lovelock)
Processed in 1968-1969

Humboldt Cave, Nevada[a] (NV-Ch-35)		
Depth (in.)	Identification Number	Sample Total
12-18	35-A	1
48-54	35-B	1
60-66	35-C,D	2
48-88	35-E,F,G	3
90	35-H,I,J	3
		(10)
Pyramid Lake, Nevada[b]		
26-WA-525[c]		
Burial-2	525-A,B	2
26-WA-385		
6-9	K10-A	1
12-15	K11-B,J10-C	2
36-39	K11-D	1
		(4)
26-WA-275[d]		
surface	M7-40	1
--	M7/L9-3	1
Level 5	M7/L5-13	1
--	M7/L4-20	1
Level 1	J7/K7-111	1
		(5)
		(19)

Notes for Table 4

(a) Partial sample of coprolites collected in 1937 by R.F. Heizer and A. Krieger (1956). In the intervening 30 years the coprolites from Humboldt Cave (NV-Ch-35) have been lost in the Lowie Museum of Anthropology. (See Roust [1967:49-88].)

(b) Coprolites from caves near Pyramid Lake, Nevada, collected by Don Tuohy in 1966-1967. The excavation data are given as noted on the data sheet of each coprolite. At this writing, only one of these sites (26-WA-525) has been reported upon (see Tuohy 1967:4-5).

(c) Coprolite from the pelvic cavity of a desiccated human body (see Rodovsky, this volume).

(d) Stratigraphic data made available to us by D. Tuohy for these specimens are incomplete.

Conclusions

Analysis of the food remains found in 300 human coprolites from Lovelock Cave reveals that about 90 per cent of the foods known to have been consumed by the occupants of the cave were obtained from the lacustrine resources of Humboldt Sink. Seeds of aquatic or mesophytic flora, such as bulrush, cattail, waterweeds, and wetlands grasses (*Panicum*, *Elymus*) formed the bulk of the diet of the Lovelock population. Wildfowl, especially ducks and mudhens, were important dietary elements. Fish (*Gila bicolor*) were another very important food item.

It is obvious that the "lacustrine biome" was far more productive of foods useful to man than was the vaunted Pinyon-Juniper zone of the upland or "range" part of the Great Basin (see Steward 1938; 1955). The lack of seeds of the pinyon pine in coprolites and midden samples from several Great Basin Caves suggests that native reliance on pinyon seeds as "*the* primary food" (as some observers have put it), may not be true in some parts of the Great Basin during the proto-Historic period.

One can be sure that there were deficiencies in the Lovelock diet--for example, a probable lack of the vitamins usually obtained by consumption of fresh fruit, and a possible calcium deficiency. In spite of this, the lacustrine resources made possible a relatively stable existence in the vicinity of the Great Basin Lakes.

Communal food preparation is suggested by the homogeneity of the Lovelock coprolite components. Many of the bulrush seeds eaten by the occupants of the cave had not been modified by milling prior to ingestion. This might indicate that these seeds were eaten while the Indians were in residence at the cave (few milling implements having been found in the cave midden), perhaps during times when the lakeshore sites were flooded. It is a matter of interest to find that very few of the seeds found in the Lovelock coprolites exhibit evidence of having been milled by means of a mano and metate. Therefore, one cannot assume, by the absence of these types of milling implements in the artifact assemblages of Great Basin archaeological sites, that seeds were *not* part of the subsistence regime. It is probable that the ordinary method of seed preparation involved reducing them to flour and cooking by stone-boiling in baskets. At Lovelock Cave water for cooking may have been in short supply and required a hike to the lake edge. An alternative method of seed preparation utilized by people who were temporarily visiting in the cave seems to have been to parch the seeds and swallow them whole. In this light, the cave occupants can be seen as travelling light -- "camping out" as it were.

One of the parameters which we hoped to investigate by coprolite analysis was the probable season or seasons during which the cave was occupied. Unfortunately, most (if not all) of the food items found in the coprolites could have been stored for an indefinite time after collection. The majority of the foods represented in the coprolites were most plentiful for harvest during the autumn months, and for this reason it is possible to suggest that Lovelock Cave was occupied in late fall, during the winter months, and in early spring. Foods collected in the fall might have provided a small surplus to aid in survival through the winter months. Wildfowl would have been one of the winter mainstays, and seeds, especially Scirpus, which were collected during the autumn months, helped to provide a reasonably well-balanced dietary during the lean winter months.

The overriding use of lacustrine resources at Lovelock Cave demonstrated by the contents of the human coprolites found in Lovelock Cave is interpreted as a manifestation of a well-developed subsistence pattern or adaptation, for which the name "Lacustrine Subsistence Pattern" has been proposed (Napton 1969: 28-97).

The Lacustrine Subsistence pattern in the western Great Basin may be seen as a long continued and increasingly intensive exploitation of lake, riverine, and wetlands resources. The earliest manifestation of this pattern probably occurred in the vicinity of the post-Lahontan lakes that covered most of Nevada and parts of Oregon and California (Russell 1885; Morrison 1964). As Rozaire (1963) has suggested, the lacustrine pattern might have persisted over a very long period of time. The first native occupants of the Great Basin would have been drawn to the lake and marsh areas by the presence of game and other types of foods. The initial phase of the lacustrine susbistence adaptation probably began with occasional use of wetlands resources. Later, increased use was made of wildfowl, seeds, and fish, as techniques for obtaining these foods gradually became more sophisticated.

The prehistoric subsistence regime which we have outlined here probably obtained elsewhere on the margins of other Great Basin lakes such as Carson Sink, Walker Lake, and Pyramid Lake, though we assume that in these locations there could have been local specializations not present at Humboldt Lake. Outside the Great Basin, as indicated earlier by Jennings and Norbeck (1955:1-11), several areas in southern Oregon and Northern California display an ethnographic manifestation of this regime (Barrett 1910), and the same is true in recent times for the Tulare Lake area (Beals and Hester 1958:211-217), as well as the Clear Lake area in central California (Barrett 1952).

Summary: The human coprolites found in the Lovelock Cave WA, WE, AN, LX, ENT and INT areas (300 processed specimens) represent a well-developed phase of the lacustrine subsistence pattern in western Nevada; see Barrett (1910:230-292), Jennings and Norbeck (1955:1-11); Heizer and Krieger (1956); Beals and Hester (1958:211-217); Rozaire (1963:72-77); Davis (1966:147-165); Napton (1969:28-97). We do not, however, witness in the archaeology or coprology of Lovelock Cave the beginning or initial development of the lacustrine subsistence adaptation in the Great Basin. Instead, the occupation of Lovelock Cave was made possible by the cumulative result of centuries of human adaptation to, and modification of, the circumstances of Great Basin environment. Humboldt Lake is known to have been subject to extremes of flooding and occasional desiccation, and the human population living in the vicinity of the lake made use of lacustrine flora and fauna when these resources were available. In the event of failure of the lacustrine resources, the Indians turned to foods derived from other ecological or economic "niches" in the Humboldt Valley and adjacent areas.

The initial occupation of Lovelock Cave, circa 2000 B.C., might have resulted from rejuvenation of the lake following prolonged water resource failure prior to 3000 B.C. The earliest evidence afforded by the Lovelock Cave coprolites suggests that the first occupants of Lovelock Cave subsisted on foods obtained from lacustrine sources. The roots of this economic orientation will probably prove to lie, when they are finally run to earth, in the post-Lahontan-Bonneville lacustrine or riverine adaptation, such as that hinted at by surface finds of artifacts on the Black Rock Desert, northwestern Nevada (Clewlow 1968b:1-94; Tuohy 1968:6-9).

The single most important fact demonstrated by the Lovelock Coprolite Research and Analysis Project, during 1967-1970 is the intensive, overriding utilization of lacustrine resources, extending (if the coprolite and midden evidence found in Lovelock Cave is any criteria), from as early as 1500 B.C. to as late as A.D. 1805--a scant 24 years prior to the arrival of white men in western Nevada. The longevity and stability of the "Lovelock" dietary can be interpreted as evidence of a very lengthy (if discontinuous) occupation of this site and the surrounding area by a group (or groups) whose culture was very similar to that of the Northern Paiute of the Historic Period--so much so, in fact, that arguments for cultural or linguistic discontinuities in this part of Nevada, based on the presence or absence of certain traits in the Northern Paiute and Lovelock material cultures, would seem to be fallacious, in view of the archaeological and coprological evidence provided by the study of Lovelock Cave and adjacent archaeological sites.

Sample Size in Coprolite Analyses

Impressive numbers of human coprolites have been analyzed from sites in the Great Basin, Mexico, Kentucky and Peru, and a great amount of detailed information on dietary items has been secured. On the basis of these analyses, certain generalizations on changes of diet over time have been proposed, but the present authors are doubtful whether some of these generalizations are correct. Many of these generalizations are based on analysis of very small numbers of coprolites obtained from sites which have been occupied for very long periods of time. The data given in Table 5 illustrate this point. By dividing the number of coprolites into the time span of occupation, the average coprolites/year ratio ranges from as low as 1/9 to as high as 1/365. While such a calculation is admittedly arbitrary, in default of more precise information as to dating, this means that we have a record of one meal eaten by one person on the average of once each nine years to once each three hundred and sixty five years. While it is generally true that there is a readily discernible pattern in the diet of the occupants of each of the archaeological sites from which coprolites have been collected and examined, it is nevertheless true that there is a good deal of variation in the contents of individual coprolites. It is even possible that in some cases a very small number of coprolites from a single layer could have been left there by a single person or a single family during a brief sojourn. We are not arguing that this is the case, yet the limited number of samples from one layer which was laid down over a fairly considerable period of time (e.g. two coprolites from the Ajalpan phase, Tehuacan Valley, dating 1500 to 900 B.C.; six coprolites from Danger Cave I, Utah, laid down between 9500 and 7000 B.C.) are scarcely sufficient to be taken as anything but a minute sampling of ancient diet.

We are not disputing the fact that precise information can be obtained by analysis of human coprolites; however, when the number of samples is small, broad generalizations about diet or trends of change through time may be in error. We are unable to suggest a universally applicable number which would, in our opinion, constitute an adequate sample of coprolites on which to base tenable general conclusions about ancient diet. We cannot do this because we do not know anything in detail about how the dry cave or shelter sites in Mexico or the Great Basin were used in prehistoric times. Merely because a cave is large and contains a considerable amount of occupation refuse does not mean that it was used by large numbers of people. Lovelock Cave was apparently not permantly lived in on a daily basis, but rather was occupied on a temporary or seasonal basis. Twenty occupants would presumably leave only one-fifth as many coprolites as evidence of a sojourn there as one hundred people would, and because we do not know how many people used the cave we have no way of judging whether the 6000 coprolites which we have collected were left there by only a few or many occupants. It is because of these and other imponderables that it is difficult to make unequivocal statements about the diet of a social group over long periods of time.

Table 5

No. analyzed	Period and age	No./year
TEHUACAN VALLEY, MEXICO (1)		
14	Venta Salada (700-1500 AD)	1/57
59	Palo Blanco (200 BC-700 AD)	1/15
18	Santa Maria (900-200 BC)	1/39
2	Ajalpan (1500-900 BC)	1/300
0	Purron (2300-1500 BC)	--
5	Abejas (3500-2300 BC)	1/240
12	Coxcatlan (5000-3500 BC)	1/125
6	El Riego (pre-5000 BC)	?
116	Time span---+7000 years	1/60 av.
DANGER CAVE, UTAH (2)		
3	DC V (surface) age?	--
9	DC V (2950 BC-20 AD)	1/330
8	DC IV - - - - - - -	--
8	DC III (7100-6560 BC)	1/68
9	DC II (7800-7000 BC)	1/90
6	DC I (9500-7000 BC)	1/416
43	Time span---10,000 years	1/230 av.
TAMAULIPAS, MEXICO (3)		
ca. 250	6000 BC - 1500 AD	1/30
HUACA PRIETA, PERU (4)		
15	HP-3 (3000 BC-800 BC)	1/147
6	HP-5 (800 BC-500 BC)	1/50
SALTS CAVE, KENTUCKY (5)		
3	Lower SC (1190-770 BC)	1/210
11	Middle SC (400-710 BC)	1/29
87	Upper SC (890-290 BC)	1/7
101	Time span---900 years	1/9 av.
HOGUP CAVE, UTAH (6)		
2	Kelton Phase (1350-1850 AD)	1/250
5	Hogup Phase (400-1350 AD)	1/180
1	Elko Phase (1500 BC-400 AD)	1/1900
19	Wendover Complex (8000-1500 BC)	1/340
27	Time span---9850 years	1/365

Table 5 (continued)

No. analyzed	Period and age	No./year
LOVELOCK CAVE, NEVADA (NV-Ch-18)(7)		
300	2000 BC-1800 AD	1/12
BAUMHOFF'S SHELTER, NEVADA (NV-Pe-8)		
12	1 AD-1800 AD (est)	1/150
HIDDEN CAVE, NEVADA (NV-Ch-16)		
85	1000 BC-1800 AD	1/33
HUMBOLDT CAVE, NEVADA (NV-Ch-35)		
10	1 AD-1850 AD	1/185

Notes for Table 5

1. Data from Callen (1967:261-289). (See also Callen 1968:641-656.)

2. Danger Cave coprolite data from Fry (1968). Archaeological stratigraphic data from Jennings (1957). Unpublished radiocarbon determinations obtained since 1960 provided by Jennings (personal communications to Heizer and Napton, 1968-9).

3. Data from Callen (1963).

4. Coprolite data from Callen and Cameron (1955:51; 1960:35-37, 39-40). Numerical data from Callen (personal communication to Heizer, 1969).

5. Data from Watson (1969).

6. Coprolite data from Fry (1968).

7. Data from Nevada caves given in this article, Tables 3, 4.

Explanation of Tables 6-10

Table 6: Coprolite constituents from Lovelock Cave, Nevada, WA and WE areas, expressed graphically as percentages. The full width of each column is equivalent to one hundred per cent. The WA coprolites analyzed are given as aggregate percentages by depth in inches. The contents of small samples of the WA midden (0-12M, 12-24M, 24-26M) are given for comparison. Coprolites from the WE area are given in groups by depth, from 48 to 72 inches. Note the prevalence of _Typha_ in the upper level coprolites and the occurrence of _Elymus_ in the lower level coprolites from the West Alcove.

Table 7: Coprolites from the AN unit, Lovelock Cave, Nevada. The coprolite constituents are listed by percentage and are arranged in stratigraphic sequence. AN1-5, depth surface to 6 inches; AN-6, 48-56 inches; AN7-10, 72 inches; AN11-15, 84 inches below the existing surface of the test unit. The prevalence of _Typha_ in the upper levels and _Elymus_ in the lower levels is evident in this sample of coprolites.

Table 8: Coprolites from unit LX, Lovelock Cave, Nevada, NV-Ch-18. LX1,2,3, 17 and 18 depth, 0-12 inches deep; LX4,5,6, 24-36 inches; LX7,8,9, 29, and 30, 36-48 inches; LX10,11,12,41 and 42, 48-60 inches; and LX13,14, and 15 were found 84 inches below the existing surface of the test unit.

Table 9: Sample WA midden constituents and sample ENT and INT coprolite constituents, expressed by frequency of occurrence. Sample constituents are arranged in random sequence in order to emphasize the difference between the constituents of Lovelock Cave, Humboldt Cave, and Pyramid Lake coprolites. Coprolites ENT (E) 10,11,33,38 and INT (I) 5,6,24, and 32 are selected by random numbers. _Typha_ is dominant in the ENT coprolites (dated A.D. 1805), and in samples taken from the upper 18 inches of the West Alcove midden.

Table 10: Coprolites from Humboldt Cave, Nevada. (See Table 4 for stratigraphic data.) Compare the data in the first half of Table 9 to data in the second half of the table, pertaining to coprolites from Pyramid Lake, Nevada.

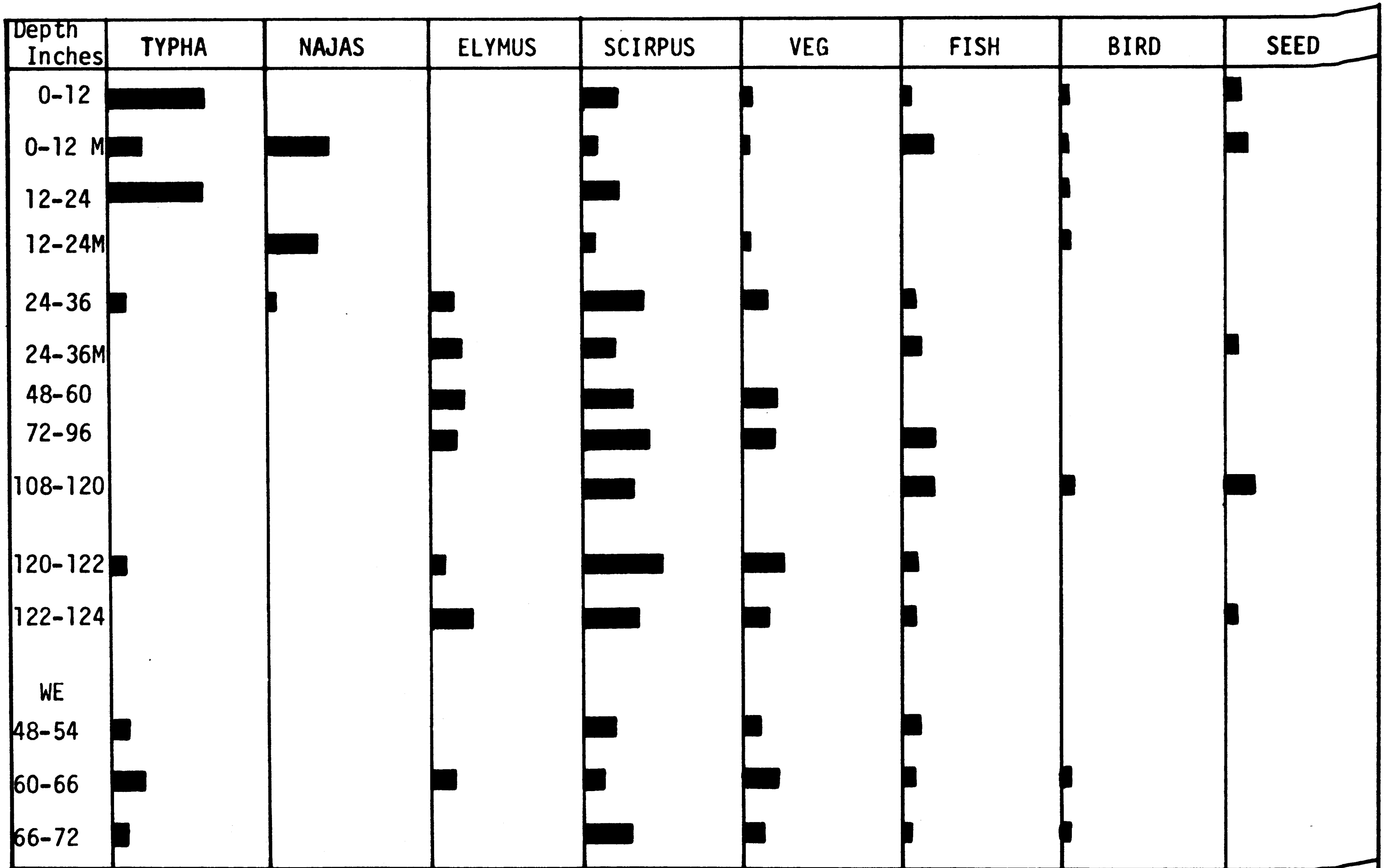

Table 6: Lovelock Cave, Nevada (NV-Ch-18), WA and WE areas, coprolite constituents by percentage. Depth in inches given in right-hand column.

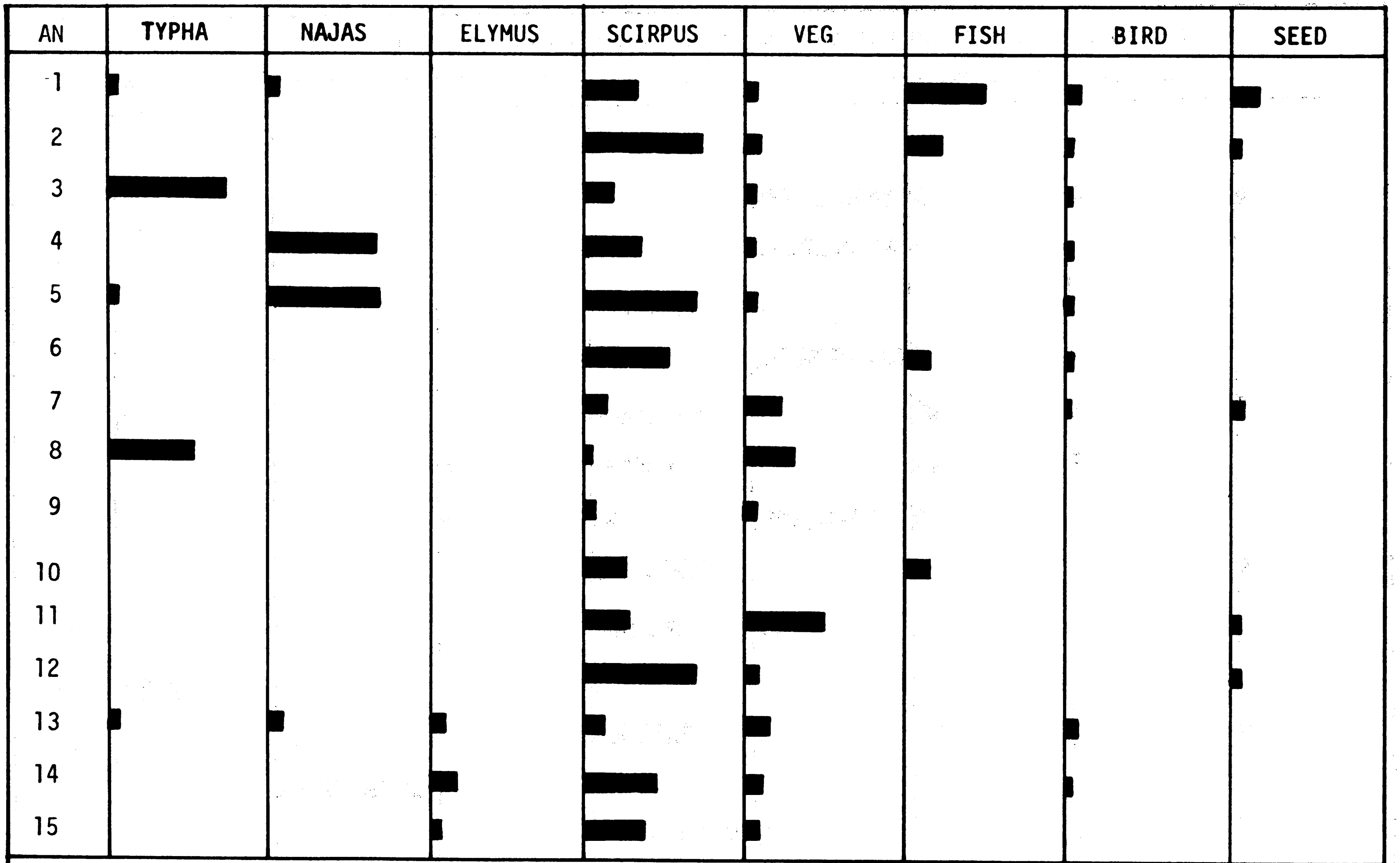

Table 7 Lovelock Cave, Nevada (NV-Ch-18), AN unit, coprolite constituents by percentage. Specimens AN 1-15 are in stratigraphic sequence.

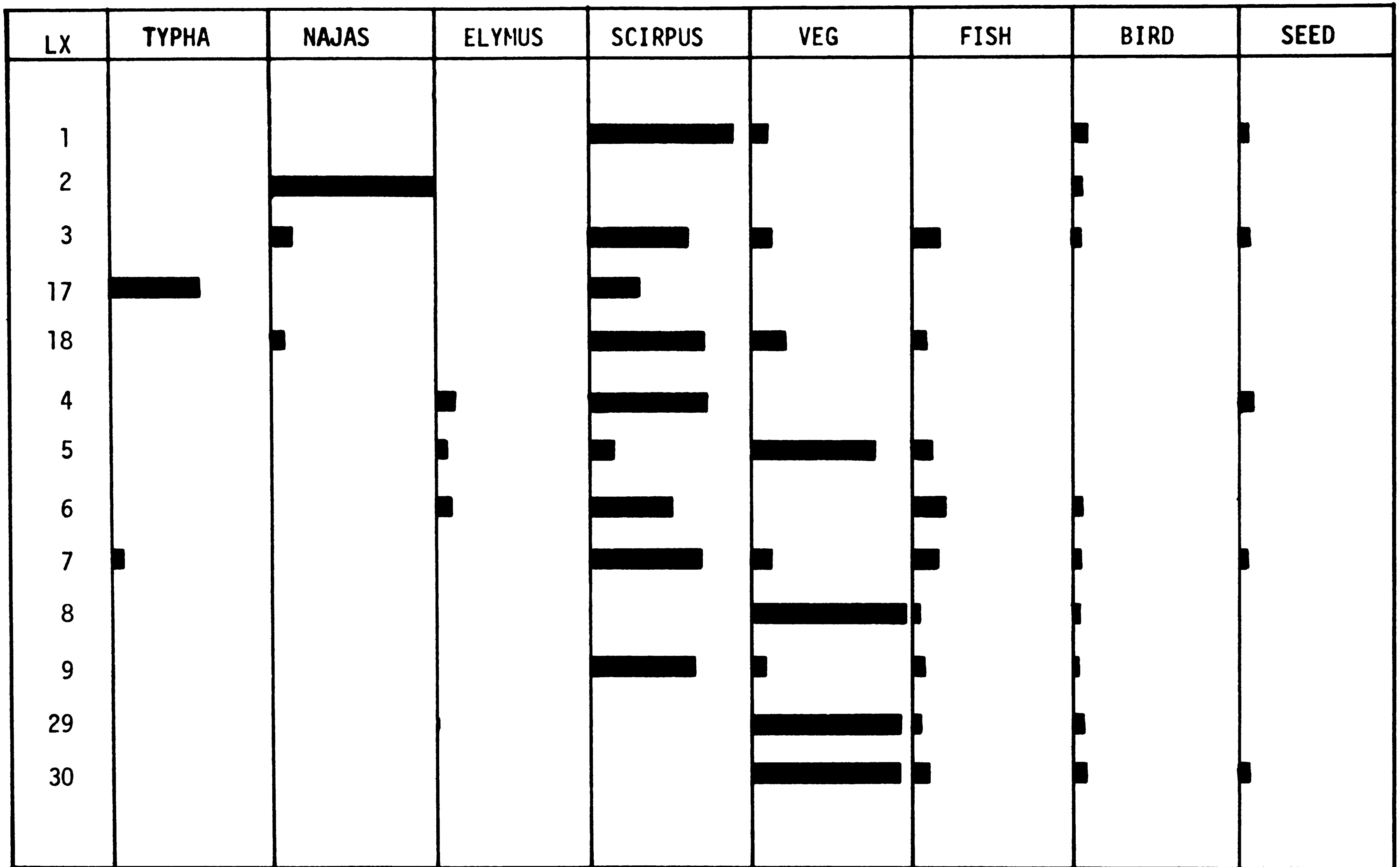

Table 8 Lovelock Cave, Nevada (NV-Ch-18), LX unit, coprolite constituents by percentage, arranged by depth. (See Explanation of Tables 6.14-6.18.)

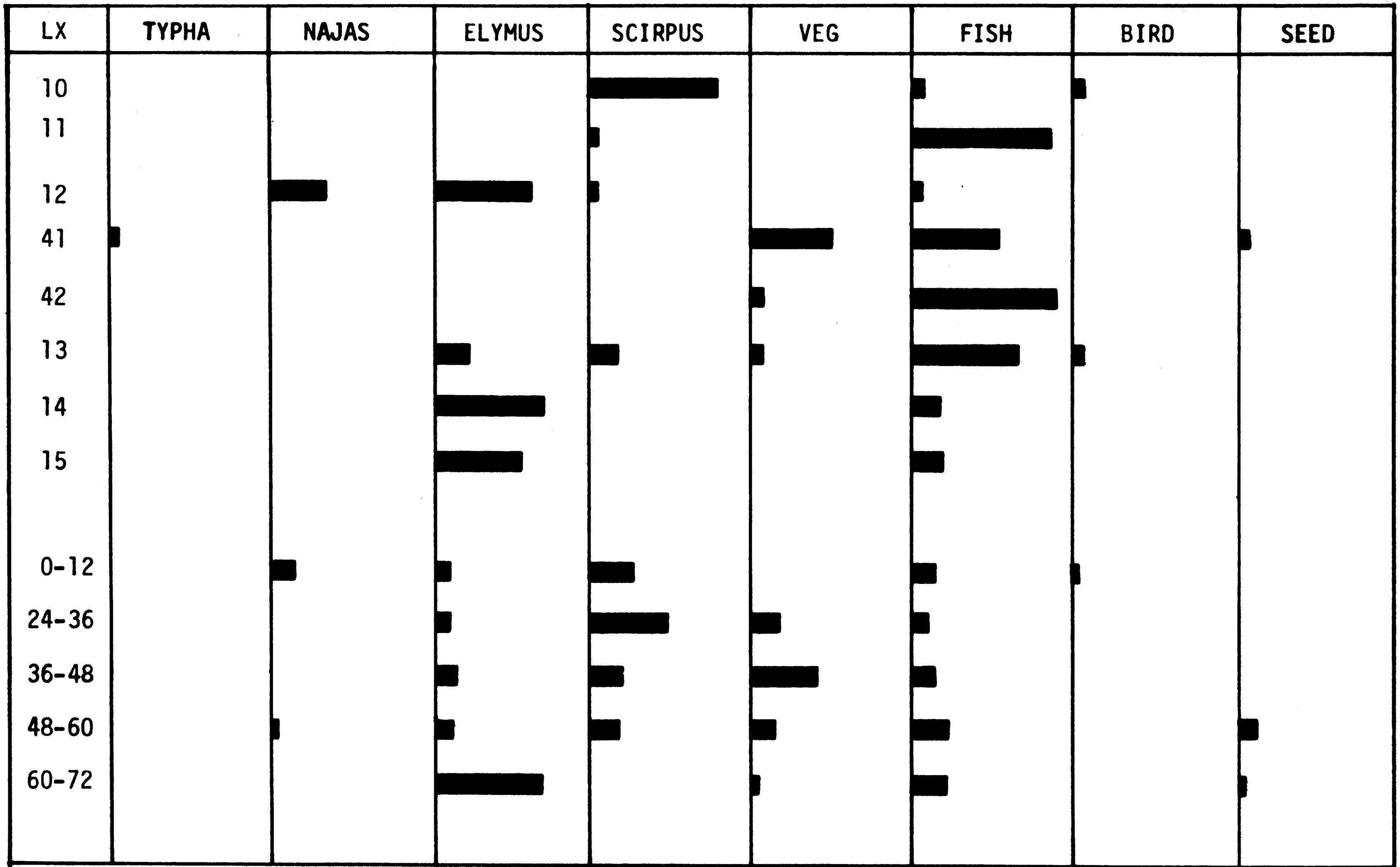

Table 8 (Con't): Lovelock Cave, Nevada (NV-Ch-18), LX unit, coprolite constituents. "Group"totals by depth in inches.

	Typha	Feathers	Rodent Hair	Bone	Fish bone	Charcoal	Fish Scales	Elymus	Atriplex	Human hair	Scirpus R.	Distichlis	Insect	Spheroids	Vegetal	Oryzopsis	Cricket	Mentzelia	Deer hair	Lizard	Ruppia	Potamogeton	Panicum	Suaeda
6 WA	X			X							X													
7 WA	X			X					X		X													
8 WA	X		X	X					X		X				X		X						X	
11 WA	X		X			X					X												X	
15 WA	X		X	X		X			X		X				X								X	
E10	X	X			X	X					X	X		X	X									X
E11	X	X		X	X							X		X	X									X
E33	X	X		X	X						X			X	X									
E38	X	X		X							X	X												
I5		X			X		X				X				X									X
I6	X	X			X		X	X	X		X													
I24	X	X			X				X		X				X									
I32	X			X					X		X	X						X						

Table 9 Lovelock Cave, Nevada(NV-Ch-18), ENT and INT constituents and WA midden samples. Five ENT (E) and five INT (I) specimens selected by random numbers.

NV-Ch 35	Typha	Feathers	Rodent Hair	Bone	Fish bone	Charcoal	Fish Scales	Elymus	Atriplex	Human hair	Scirpus R.	Distichlis	Insect	Spheroids	Vegetal	Oryzopsis	Cricket	Mentzelia	Deer hair	Lizard	Ruppia	Potamogeton	Panicum	Suaeda
A	■	■	■	■	■	■	■																	
B					■			■	■	■														
C																								
D	■	■			■						■	■	■	■										
E		■			■						■	■			■									
F											■				■									
G	■	■	■	■	■		■		■		■				■									
H		■						■			■				■									
I	■			■	■	■	■			■				■	■									
J			■			■					■				■									
(ALL)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									

Table 10 Humboldt Cave, Nevada (NV-Ch-35), coprolite constituents by occurrence. Sample constituents are selected and grouped at random.

[site]	Typha	Feathers	Rodent Hair	Bone	Fish bone	Charcoal	Fish Scales	Elymus	Atriplex	Human hair	Scirpus R.	Distichlis	Insect	Spheroids	Vegetal	Oryzopsis	Cricket	Mentzelia	Deer hair	Lizard	Ruppia	Potamogeton	Panicum	Suaeda
[275]																								
3				■											■	■	■							
13		■			■	■	■							■	■		■	■						
20				■	■										■			■						
40							■		■	■				■	■	■	■	■						
45				■	■	■	■							■	■	■	■	■	■					
111			■												■		■			■	■			
[385]																								
A	■				■	■		■	■		■			■	■									
B	■	■		■			■		■		■				■						■			
C	■	■	■	■	■			■	■		■				■	■		■	■		■			
D				■							■				■	■					■	■		
[525]																								
A		■	■			■			■						■	■								

Table 10 (Con't): Coprolites from cave sites at Pyramid Lake, Nevada. Sample constituents are selected and grouped at random.

Notes

1. Vegetal materials from the "Thirty-Two Inch" midden in Hidden Cave (NV-Ch-16) were collected in 1955 by P.C. Orr. According to Orr, these materials date the human occupation of this segment of the cave deposit. The radiocarbon age of the vegetal materials is 1094 B.C. ± 200 (L-289-BB, Broecker and Kulp 1957:1324-1334). Radiocarbon determinations of the age of human coprolites from this midden would be of great interest, in view of the fact that the contents of many of the Hidden Cave coprolites analyzed by Roust (1967:49-88) are remarkably similar to coprolites from Lovelock Cave.

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Abbreviations Used

AA	American Anthropologist
AAnt	American Antiquity
CFG	California Fish and Game
DRI-TRS S-H,	Desert Research Institute Technical Research Series S-H,
SSH-P	Social Sciences and Humanities Publications
JG	Journal of Geology
JSP	Journal of Sedimentary Petrology
JWM	Journal of Wildlife Management
KAS	Kroeber Anthropological Society
-SP	Special Publication
NAS-R	Nevada Archaeological Survey Reporter
NGM	National Geographic Magazine
NSM	Nevada State Museum
-AP	Anthropological Papers
SAA	Society for American Archaeology
-M	Memoir
UC	University of California
-ARF-C	Contributions of the University of California Archaeological Research Facility
-ASR	Archaeological Survey Reports
-PAAE	Publications in American Archaeology and Ethnology
USGS	U. S. Geological Survey
-M	Monograph
-PP	Professional Paper
UU	University of Utah
-AP	Anthropological Papers

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III.

CORRESPONDENCE CONCERNING THE LOVELOCK CAVE INVESTIGATIONS BY THE UNIVERSITY OF CALIFORNIA IN 1912 AND 1924, AND PREPARATION OF L. L. LOUD'S FINAL REPORT

Edited by R.F. Heizer and L.K. Napton

The correspondence presented here is on file in the Lowie Museum of Anthropology and has to do with the excavations in 1912 at Lovelock Cave by Llewellyn L. Loud, the further investigation of the cave jointly by Loud and M. R. Harrington in 1924, and A. L. Kroeber's long continued efforts to get Loud to finish his report on the 1912 work.

Kroeber in 1912 was in charge of both the Department and Museum of Anthropology. The Department home was on the Berkeley campus and the Museum was at the Affiliated Colleges, Second and Parnassus Avenues, San Francisco. Kroeber had learned about Lovelock Cave and some of the remarkably preserved cultural materials which were found by James Hart and David Pugh during guano removal operations in 1911, and decided to carry out work there in order to secure a collection for the University before relic hunters destroyed the site. There were no archaeologists on the teaching staff of the Department or in the Museum who were available to be sent on short notice to Nevada. While there is no specific record, it appears that Kroeber asked Loud, then a guard in the Museum, if he would care to go to Lovelock and make a collection of cave materials. So far as is known Loud had no experience at all in archaeology and we do not know whether Kroeber tried to instruct him how to excavate or make records. Loud was unaware of the utility of recording the depth at which artifacts were found, but he did keep a rough record of location of objects within the cave to the extent that areas of irregular size and bounded by the cave wall or fallen rocks were designated as "lots" and all material recovered from each lot was kept separate and so catalogued. Loud dug 41 lots whose total surface area covers roughtly one-eighth of the cave floor.

The joint report on the excavations of Lovelock Cave in 1912 and 1924 written by Loud and Harrington and published in 1929 tells us practically nothing about how the cave came to the attention of Kroeber. The correspondence printed here tells us how The University learned about Lovelock Cave.

Loud was experienced in outdoor living, but his lonely tour of duty for four months (April 1-August 1, 1912) when he lived and worked alone in Lovelock Cave under what must have been conditions with few comforts surely stands as one of the most unusual archaeological field trips in the history of the University of California.

Once having made his collection (amounting to about 10,000 specimens), Loud was then expected to write a report on it for publication. Kroeber apparently found Loud willing to analyze the material and write the report, but this went very slowly, partly because Loud was engaged as a full time guard in the daytime at the Museum and in addition was building himself a house in Richmond. The Lovelock Cave report was written for the most part as an after-hours project.

It is probable that when Kroeber agreed to release Loud in 1924 to go a second time to Lovelock Cave, the latter agreed to complete his report on the 1912 excavations which would be published with Harrington's report on the 1924 work. A hint of this is seen in Lowie's letter to Loud of February 6, 1924, some five months before Loud joined Harrington at Lovelock. Two years later, in 1926, Loud has not yet finished the 1912 report and Kroeber, realizing that Loud should have some time wholly free for this, arranges to relieve him of guard duties for the period February 7 to April 7, 1926. By mid-February 1927 Loud's report was done and being edited. By September 1927 Harrington's sections were in hand. In October 1928 the galley proof of Lovelock Cave was ready, and the report was issued by the University Press on February 15, 1929, as Volume 25, No. 1, pp. viii + 183, 1929, University of California Publications in American Archaeology and Ethnology. Kroeber, and probably Loud as well, must have been glad that the project, begun 17 years before, was now finished. Loud's record of allowing only 17 years to go by before his cave report was published is actually a pretty good one. Humboldt Cave was dug in 1936, but not published until 1956, and the report on Hidden Cave, excavated in 1951, has been finished since 1957 and is still in manuscript. There are a half-dozen other Great Basin cave excavations known to us which have been carried out in the past 15 years for which we have no report available, either in manuscript or published. And there are at least a half-dozen other unreported cave excavations done between 1924 and 1950 for which notes and collections exist. If these dozen or so reports could be written and/or published, we would probably see our information on Great Basin cave cultures quadrupled. We note this situation to point out that good opportunities still remain to enlarge our knowledge of the prehistory of the Great Basin. A site which has been excavated, however carefully, and for which excavation records and collections exist, but for which no published report has been made available, is not really much different so far as the study of human prehistory goes, as one which has been looted by relic hunters.

The earliest record we have located in which the cave and its contents are reported is a memorandum by C. Hart Merriam which refers to letters written to him by Isaac P. Richardson of Sacramento dated December 5, 1911 and February 5, 1912. The note reads:

> Isaac P. Richardson, employed by the Standard Oil Co. at Sacramento, Calif., writes me on December 5, 1911 and February 5, 1912 that at a depth of 15 or 16 ft. in a guano cave near Humboldt Sink, a number of Indian things were found. Among these were bodies or skeletons of Indians, parts of baskets and matting, buckskin moccasins, duck decoys. Three of the latter, which he sent me, proved

to be Canada Goose (Branta canadensis), Gray Goose (Anser albifrons gambeli), and Ring-neck Duck (Aythya collaris). These consisted of the skin of the head, neck, and fore part of the body with the skull inside. They were stuffed with tules and doubtless when used were attached to floats.

The collection was sold to Dr. A. L. Kroeber, Affiliated Colleges, San Francisco.

C. Hart Merriam advised Richardson to get in touch with Kroeber. John C. Merriam of the University's Department of Paleontology also learned early in 1912 about the cave from J. H. Hart. A letter from F. C. Ware of April 5, 1929 is reproduced below, and in it he states that he reported the cave to the Smithsonian Institute in November, 1911. Ware probably had seen the Lovelock Cave report, just issued. J. Claude Jones of the University of Nevada was asked by J. C. Merriam on January 1, 1912 to help determine ownership of the cave, and mentions that artifacts from the site were offered for sale to the University of California by Mr. Harold Fletcher.

Loud was sent to Lovelock to work in the cave, with the approval of James Hart on April 1, 1912. Although Loud's plan of the cave which shows the areas ("lots") worked by him indicates that he dug around the entire interior perimeter, Kroeber in the Editor's Preface to the 1929 report states that "one of the joint claimants [D.Pugh] of the cave prohibited work in his end of the cave [and thus] made stratigraphic work not feasible." As an aside, we believe that Loud was not instructed by Kroeber to do "stratigraphic work". In 1912 the practice of stratigraphic work was not being followed in the United States. This procedure came first in 1916 with N. C. Nelson's work at Tano, and Harrington in 1924 was well aware of the utility of the principle. Keoeber may have written the remark quoted above in the effort to excuse the fairly obvious lack of stratigraphic information in Loud's sections of the Lovelock Cave report since Harrington made so much of his stratigraphic investigation in Lot 15 at the west end of the cave.

Kroeber and Loud between April 2, 1912 and July 21, 1912 wrote frequently to each other. There is a record of the dates of these letters (nine from Kroeber to Loud, 23 from Loud to Kroeber) in the Lowie Museum Accession No.443 file, but of these all but one letter from Loud and three from Kroeber are missing and cannot be located. We believe that they were extracted sometime before 1929 either by Loud or Kroeber to be used to provide information about the collection during the time Loud was writing his report or while it was being edited by Kroeber.

We present below those communications which have been preserved and which we believe are of some interest in connection with the Lovelock Cave project for the years 1912-1928.

Fitting, Nevada, Sept. 28th, 1911

University of California
Berkeley, Calif.

Gentlemen:

Am engaged in cleaning out an old cave near Lovelock, this state, that is full of guano and the other day sunk a shaft about sixteen feet to get an idea of the depth of guano and was surprised to find quiet (sic) a lot of old indian relics in a very good state of preservation.

The cave is known as Indian Cave and there are a great many legands connected with it. The old Indians here say that those that lived in this cave were red headed and bad fighters. None of the present Indians can be got near the cave.

If this is of any interest to you and can be of any service to you in connection with saveing things, please advise me,

Respectfully,

J. H. Hart

Jan. 11, 1912.

Professor John C. Merrian,
University of California,
Berkeley, Cal.

Dear Professor Merrian:

I thank you for your letter of January 9th with enclosure under date of Nov. 23 from Furlong.

I am wondering whether you can give me any information about the Guano Cave near Lovelocks. I have recently had a small collection of cultural material from this cave sent me on approbation for sale. I have also talked with Miss Wier, Professor of History at the University of Nevada who has visited the cave in person and has been promised specimens. All the material I have seen is clearly pre-historic. By this I mean it shows no trace of influence of civilization. At that however it need not be more then 75 or 150 years old. It might of course be a great deal older. Some of the textiles and feathers are preserved in a remarkable manner. The cave is being grossly exploited by private parties in the vicinity who have extravagant ideas of the fabulous sums that they will realize from the specimens and at the same time treat them with the most complete negligence, going so far as to destroy or throw away some of the best pieces which they think may not have commercial value. I am very anxious to know whether the cave is not on government or railroad land. In the former case further vandalism could be absolutely checked and exploration confirmed to scientific institutions. If the land belongs to the Southern Pacific a similar arrangement could probably be provided. I hardly imagine from the condition of the specimens and from what Miss Wier has told me of the statements made to her by Mr. Claude Jones of the University of Nevada that the deposits can be of any great geological antiquity. They are however of tremendous importance ethnologically because purely aboriginal. Their importance in this regard would not be diminished even though they prove to be only a hundred years old instead of a thousand years old. Perhaps you have had exact description of the location of the cave and could indicate to me its township, range and section so that I might ascertain in whom title to the land rests. The manner in which the deposits have been abused is appalling and I shall greatly appreciate any information at all that you could furnish me.

Sincerely yours,

A. L. Kroeber

Berkeley, California, Feb. 1, 1912.

Professor Claude Jones,
Department of Geology
University of Nevada
Reno, Nevada

My dear Professor Jones:

Your letter of January 22nd was received, and I thank you very much for the information which you have given. I have just written to Mr. Hart about the cave, and have told him that we should be glad to make a careful investigation if we can obtain from him the right to collect without interfering in any way with any other interests. I shall let you know further about the matter and shall also inform you as to any results which we may get relating to the probable age of this deposit.

With kindest regards, I am

Very sincerely yours,

John C. Merriam

Berkeley, California, Feb. 1, 1912.

Mr. J. M. Hart,
Lovelock, Nevada

My dear Mr. Hart:

Through the Secretary of the University of California I received from you some months ago a letter in which you kindly suggested to the University that certain excavations were being carried on in a cave near Lovelock, and that some interesting human remains were being obtained. At that time you suggested that you would be very glad to see these remains saved, and very kindly offered your services in this connection. A letter written to you at that time seems to have gone astray, presumably because I wrote to Fitting, Nevada, instead of Lovelock.

I have learned that since the date of your letter excavations have been carried on, and a considerable number of relics have been obtained, and that these have been scattered widely through the country. The University of California is very anxious indeed to make a careful study of these relics, and if we would not be interfering with the rights of any other persons we would be glad to carry on some excavation work in this cave. I write to enquire whether we might not obtain from you the rights to excavate without the possibility of conflict with any other interests, and without, of course, interfering in any way with your work in the cave.

With kindest regards, I am

Very sincerely yours,

John C. Merriam

Berkeley, California, Feb. 21, 1912.

Dr. A. L. Kroeber
Department of Anthropology
Affiliated Colleges
San Francisco, Cal.

My dear Dr. Kroeber,

Dr. C. Hart Merriam writes me that he has had offered to him for sale by I.P. Richardson the heads of three geese or ducks stuffed with tule obtained from the cave near Lovelocks. C. Hart Merriam is returning these to Richardson with the suggestion that, you who have already purchased some of the other material, will be glad to have some of these also. You may perhaps have heard from C. Hart Merriam with reference to the matter, but I was not certain whether he had written to you also.

Very sincerely yours,

John C. Merriam

Fitting, Nevada, March 11th, 1912

Mr. John C. Merriam,
Berkeley, Cal.

My Dear Mr. Merriam: -

In answer to your inquirie of the 6th, ult. will say that shipped five cars of guano from the cave you mention and while there was quite a lot of Indian relics and one or two partialy mummified remains found in the guano there yet remains in one end of the cave considerable material composed of reeds, loose rocks etc. that at one time I sunk a prospect shaft [into] to the depth of about 20 ft. and which seems to be well mixed with human remains, parts of baskets etc. etc. It is here at this lower end that the old Indians claim that there is another entrance to a much larger cave.

If you care to do any excavating will aid you all that can and if you wish to make an examination and will let me know when you will be in Lovelock will meet you there with machine and drive you out to the cave which is about 18 miles from town. Will also furnish any tools and camp equipment other than tents that might be needed including powder, drills etc. altho the latter would not be needed as far as can see.

Mail addressed to me at Lovelock or Fitting will reach me but only get mail Tuesdays and Saturdays by stage.

Respectfully,

J. H. Hart

March 18, 1912

Professor J. C. Merriam
University of California
Berkeley, Cal.

Dear Merriam,

I return you herewith Mr. Hart's letter of which I retain a copy. I wrote him immediately on receipt of this and hope that if all goes well to have Mr. Loud on his way within a week.

Sincerely yours,

A. L. Kroeber

Sunset Guano Cave, Nevada, Th Apr. 25,1912

Prof. A. L. Kroeber:

My Dear Sir:

On another sheet I send a list of the stuff I have obtained, that shows the range of objects found and proportions belonging to the various classes.

As for provisions on hand, I have plenty of water for 2 weeks, considerable in my barrel, and I am using dipped up rain water for cooking mostly and using the barrel for drinking. The dipped up water is perfectly fresh but muddy and it refuses to settle, but is all right for cooking. I have enough beans oats and dried fruit for 2 weeks. Other food provisions getting low. Kerocene rather low but I think I will start some of my cooking outdoor with sage brush. I think I can manage 2 weeks without ordering provisions, so there is no need of you making a decision about prolonging my stay here untill you get another letter from me.

Now as for my opinion as to whether I should stay or not, I think my arte-facts speak for themselves. When you can do a trifling amount of scratching on the surface and get 2 or 3000 artefacts and when the whole cave seems to be full of them to an unknown depth, it seems to me a little digging ought to be done. I should say 3 months for one may is the least that should be thought of. You may answer back, "no money", but then when a gold mine is realy discovered, there is usually enough money discovered to develope it. If you do not discover the money, American Museum, or Smithsonian Institute will. It seems to me such a collection as might be obtained ought not to go East. Some time ago I thought I saw a "revolving exibit" in sight, I am now thinking of the Worlds Fair in S.F. The Univ. of Cal. Museum besides the fine collection of Modern Cal. Indians, has been the pioneer in 2 fields: Peru and S.F. Bay Shellmounds. It is not every day that a brand new field can be found. So far as I know the Plateau Region is a brand new field. The Plateau Folks have been considered inferior, here is a chance to realy get some material on which to base our judgement. There must be plenty of men in S.F. and vacinity glad to give several hundred dollars in order to save a collection worth several thousand dollars. However there is no hurry for you to decide on keeping me here longer untill I send another letter. I will hold out as long as possible on the provisions I have, then if I can give a good enough report to warrent another load of provisions I can send back the stuff I have collected. In bulk the shipment of stuff on hand now would not be larger than the Castro Mound shipment and in weight would be far less, as I have very few bones, and only 3 stones of any size. I have 3 cement sacks full of cave material, one of pure guano, one of lime dust and dirt, one of reeds and straw. Express charges for 100 pounds value \$100 Lovelock to S.F. is \$4.75. Insurance for each additional \$100 valuation is 15 cts as I understood it.

Now as for money, you gave me \$70 for expences. I have paid out \$32.40 in general expences. \$16.55 for food, although ultimately I pay for part of the food myself. I have $15.80 cash on hand. That means that I have embezzled to the extent of $5.25. I paid in my March salery on my piece of land over in Berkeley, then in buying clothing for Nevada I ran short, and embezzled $5.25. Evidently $15.80 cash on hand is not enough to get a team to take stuff to Lovelock and pay R.R. far to S.F. If I buy another months stock of provisions, no hurry about paying. Mr. Hart asked the grocer to give me credit and told me if I ordered stuff to be sent out to me not to pay untill I saw what I got. For that matter I might send the bill to you, and you send check to grocer direct. As for my own wages for the month, that will be settled up at the end of the job, but I would like a partial payment of $35 so as to make another payment on my land. Then I don't want to be April fooled out of $1.33 for Monday April 1st. My Nevada job begins with Tu Apr. 2, and Monday belongs to my Guard job although a holiday because I am intitled to one day in seven. It makes no difference how it is settled now or later so long as I get it.

L. L. Loud

Lovelock, Nevada Sunday, Apr. 28

The chore boy has not been around this week. He may come today, so I leave this letter on my water barrel. My provisions will last untill I can send another letter I get answer. I go exploring to N.E. today, to try and find another cave or two.

L. L. Loud

May 1, 1912

Mr. L. L. Loud,
Lovelock, Nevada

Dear Mr. Loud:

I have your letter of Thursday April 25 with the memorandum of April 28. You are certainly getting good stuff although I gather that practically everything is in fragments. As nearly as I can make out you have not got a single complete basket or sandal. You also do not mention any nets whatever. Please confirm my impression on this point.

I would ask you to send a rough sketch showing the approximate location of the 12 lots which you describe in your tabulation. Also those parts of the cave which seem to contain material and which you think should be worked. In this connection you might also state whether you have any belief as to the depth of the deposits in these spots.

I am not clear whether your total as given in the tabulation includes or excludes the stuff found on the dump heap.

I wish very much you would sack or box up the stuff you have got to date and ship it to us. The specimens of guano and dirt and the heavier pieces, such as the mortars or anything else, that is inconvenient or expensive to ship, you might hold back for the present. You should include however all textiles, rope, sandals, wood implements etc. I can then judge more accurately and more quickly the results to date than if you were to sit down for three days and write descriptions. You might have the shipment taken out to the express office by the same party that brings you your provisions and groceries, thus saving charges for hauling.

I am sending you herewith in the copy of this letter which goes to Big Five, a check for $25.00. This should keep you going a little while longer. If insufficient buy your groceries on credit and have the bill sent to me. In this case, however, it will be necessary for you to check up each item and mark the bill as correct.

You do not state when you need the $35.00 for yourself. If you will advise me how much of your pay you will need before July and when you want it, I will be better able to plan out some way of keeping you going. Every dollar that you are willing to have us defer paying until after the new fiscal year begins, July 1, will mean that you can continue so much longer. As to the $1.33 for the 1 of April I will not forget this, but straighten the matter out when you come here. The check for the whole of April is in Juan's name to save complications.

I think you had also better fix up a statement of all expenses incurred by you to date, append to same the vouchers you have and transmit this to me. The Comptroller's office wants statements every month or so and it is clear that your work is going to stretch out so long that I will have to render some sort of partial statement of account before you come back. I had rather not include all your bills for provisions and then have you refund your share later because that would tangle the bookkeeping. Perhaps you can figure out our and your respective pro ratas for provisions to date and then turn in as expense vouchers sufficient bills to about cover our share and consider the rest as paid by yourself. If your provisions are all listed on one bill you can deduct on this the part paid by yourself and then turn in the original bill as reduced in this way as a voucher for the amount of our share. I am sorry to have to trouble you with things of this kind at the present time when your mind is on other things, but if I do not render some statement to the Comptroller's office they will be getting after me.

I was very glad to get your letter and hope you will continue to keep me posted frequently. I think the shipping of your light stuff is of great importance, not only because it will be of advantage in enabling me to size up the situation, but because I will have the goods to show in case there is any question of raising the money to keep you on longer. If at the same time you send a sketch showing the location of each lot, I will have all the data I need.

I need hardly mention that it is just as important for you to receive mail regularly and with fair frequency as to report here. With best regards, I am,

Sincerely yours,

A. L. Kroeber

May 20, 1912

Mr. L. L. Loud
c/o G. Stephens
Big Five, Lovelock, Nev.

Dear Mr. Loud:

I enclose herewith check for $25.00 to your order. Together with the last I hope that this will keep you going until July 1, if not, please advise me in time. I enclose also a blank bill covering this advance which kindly receipt and return.

We have begun to unpack the first of your stuff which came safely to hand on Saturday. It runs very much as I expected, as regards fragmentary conditions, but is so rich in its significance that I am delighted with it. It is really a pot-making stuff in the story which it will tell. It is a little disappointing for show purposes, but when properly displayed and explained will make a pretty tolerable exhibit. It looks as if all the cream had been skimmed off the cave before you came.

I am glad you have arranged things so amicably and hope you will continue to get on well with Mr. Pugh. I am writing him a letter such as you suggest. I think you had better by all means stick to the work as long as you can. Once you quit it would be very doubtful if we could ever get a concession to go back. I can now handle the financial side until July 1 and after that it will be plain sailing.

There is another reason why I should like you to stay until July. You and Hall and Poyser are all to have two weeks vacation this summer, but not until after July 1. If you come back before I will not be able to keep Juan and he is likely to drift away to a distance then when we come to look for a substitute to take your places during your vacations there may be nobody available.

From what you write in your last letter I imagine when your present concession expires there will be no difficulty, with a little tact, in getting Mr. Pugh to renew same or at least to give you some sort of privilege. The main thing at present is to keep the work up without a break or hitch even if results for the time being are slim. We have enough already in hand to warrant the expenses of your trip even if you were to dig without finding a specimen for a month or two to come.

If things come to a dead stop I would advise you sending a night telegram with a full statement of the case to Mr. Farnham Griffiths, the president's secretary, asking him to address Mr. Pugh, or if the president is away to do so himself. This may bring the desired action. I do however, object most emphatically to paying any money for the concession. If we once begin this there is no telling where it will end. I further object to it as a matter of principle as we are not doing the work for gain and are not depriving the owners of the claim of anything that has money value. Of course you do not want to bring the President in unless every other means had failed.

I suggest this of course as a possibility because I am going south the last of this week and shall probably remain away until just before the summer school opens on June 24. You had better continue to write me here as I shall be on the move in the south and can not keep you posted of my changes of address. If you have any communication which needs urgent attention mark the envelope "immediate" and it will be attended to here as best as possible. Otherwise mail will be forwarded direct to me.

As to the book by Sarah Winnimucca I would not take any of her statements too seriously. What little of an Indian character she put into her book seems to have been edited out of it. It is one of the most disappointing books I know of. Miss Wier showed me the section containing the legend. I should guess offhand that the Indians found the burials in the cave and devised the legends to explain them.

I send this letter to Big Five, though you advise in yours of the 13 not to send any more mail there, but I judge from your subsequent letters since you are back at the cave you are working under the old arrangements for mail. Unless you wish it I will hereafter send mail only to Big Five and discontinue sending duplicates in care of E. Sommers.

Sincerely yours,

A. L. Kroeber

June 27, 1912

Mr. L. L. Loud
c/o Operator at Toy
Lovelock, Nev.

Dear Mr. Loud:

We have not got your shipment of 25 cans etc. of stones and other pieces, and the Southern Pacific advises us that it has not arrived. I am therefore unable to form an opinion as to the value of the work you are doing. Unless you can explain the long delay you had better make inquiries at your end and secure the bill of lading, or shipping receipt, which you should have got in the first place, and forward same to us.

Another item that must be taken into consideration in speaking of "value" is the cost of freighting and hauling and on this I am also completely in the dark.

I think you had better get back at once to work in the cave. I am perfectly confident that the mortars, arrowpoints, etc. that you have been finding out on the surface will be good things to have and worth the money. There are, however, a thousand good bargains to be picked up in collecting and the mere fact that a thing is worth more than you pay for it is not reason for buying it when you have not the money. I believe that in any case you have got a pretty fair representation of that sort of thing and we should not sink any more of our slender resources for getting specimens that are frequently duplicated. Anyway the stone stuff will keep and whenever we have time and funds it will be an easy thing to spend a day or week or even a month in gathering it up. The cave stuff is rather unique and I regret every minute that you might give to finding more of it and do not. For this reason I am still waiting anxiously to hear whether you have been able to get anything definite from Pugh or if not, what his attitude is, and also what are your prospects for making any more special finds in the cave. One mummy or complete skeleton which may perhaps never be duplicated, or handful of unique objects of wood are likely to be worth five tons of mortars and pestles and may cost less. I can not advise you in detail how to spend each hour or even each day, but must trust to your judgment, just as I must leave it to you whether it is more expedient to boil your coffee on a gasoline lamp or on a fire of sagebrush, but the above is my general policy which I must ask you to adhere to as closely as conditions allow.

You need not take this as a reflection on your activity of the last few weeks as we have been pretty well out of touch and I have been willing to have you use your judgment, but the first and next and the last thing for you is to get out of the cave whatever you can. Unless you are prevented from continuing work inside the cave until July 31 you may figure on remaining there as long as that. I herewith send you a check and bill for $20.00 to keep you going a little longer. As soon as I get time to settle down and straighten out accounts and can get the money in hand I will send you all the balance necessary.

When you find out what has become of your shipment of June 8 I think you had better advise us here by telegram.

With best wishes, I am,

Sincerely yours,

A. L. Kroeber

Berkeley, September 24, 1912

Dr. A. L. Kroeber
Affiliated Colleges
San Francisco

My dear Dr. Kroeber:

The Finance Committee September 24 authorized you to sell to the Nevada Historical Society, at $150, portions of the collection of specimens made by the University of California in a cave near Lovelock, Nevada. Would you kindly arrange the details with Comptroller Merritt.

Very sincerely yours,

W. A. Henderson
Office of the Secretary of the Regents
University of California

MUSEUM OF THE AMERICAN INDIAN HEYE FOUNDATION
Broadway at 155th Street, NEW YORK

May 7, 1923

Dr. A. L. Kroeber
University of California
Berkeley, California

My dear Dr. Kroeber:-

I saw Kidder a few days ago and we were discussing cave material in general. He informed me that some time ago he had a talk with you regarding finds in caves around Tule Lake in Nevada, and he also informed me that you had sent a man there, but that you had told Kidder you were not going to pursue this line of investigation any further. I am writing to ask you in regard to this location, and if you do not contemplate continuing your work there, would you have any objection to our investigating it? I should certainly appreciate any information you could give me regarding this matter, and also the best time of year to go into that region to work.

With best wishes, and trusting I may have the pleasure of seeing you when I get out to the Coast this summer, I am

Sincerely yours,

Geo. G. Heye

May 21, 1923

Mr. L. L. Loud
Museum of Anthropology
Second and Parnassus Avenues
San Francisco

Dear Loud:

I enclose copy of a letter just received from Heye. I think we should not play dog-in-the-manger, and that it is up to us to encourage him to work in the Lovelocks cave. I think he is perfectly willing to respect your priority rights of authorship. On the other hand, 10 years have gone by without anything appearing, and we cannot ask Heye nor any scientific body to postpone further excavation because you are delaying publication. I think this is distinctly the time for you to wind up your report immediately and thereby put me in the position of cooperating with Heye as I want to and ought to, and at the same time preserve to yourself and the University of California the prestige of the fruits of your work.

Heye is a driving business man, and once he has the material in hand you can depend upon his putting through a publication in very short time if he is interested.

Please let me have your reaction now, and we will talk farther on the matter next time I am in San Francisco, which will probably be during the week.

Sincerely yours,

A. L. Kroeber

June 6, 1923

Mr. L. L. Loud
Museum of Anthropology
Second and Parnassus Avenues
San Francisco

Dear Loud:

Heye writes me as follows:

"Many thanks for your kind letter regarding the Nevada caves. It would be impossible for us to take up this matter until late next fall or early in the spring, and that is one reason why I have asked you whether it is possible to work in that district in the winter time. If we do take up this matter I would be delighted to have Loud join our party. He certainly would be of great use to us. Please let me know some more details when you get the data from San Francisco."

I presume that winter would be pretty uncomfortable for work in that altitude unless the caves remain tolerably warm and are big enough to camp in. Please let me have your reaction so that I may write to Heye.

Sincerely yours,

A. L. Kroeber

June 7, 1923

Dr. A. L. Kroeber
Anthropology Building
University of California
Berkeley, California

Dear Dr. Kroeber:

In answer to Heye's letter of inquiry regarding best time to work in Nevada, I will say that I worked in the cave from April 1st to August 1st. At first I pitched my tent outside of cave and although I had a "tin" stove was uncomfortable, but more particularly because of wind. In a week or two I moved into the cave and was more comfortable. The cave is 160 X 40 feet and 20 feet high. So it is plenty big enough to camp in. April perhaps averages all right as a working month though quite a few days are disagreeable. There was a 2 or 3 inch snowfall in the month, it melted in 3 or 4 days.

As for work in the fall, probably October would be very good, but after November 1st disagreeable weather would be encountered. I would not care to try work later than November 1st.

Yours sincerely,

Llewellyn L. Loud

February 6, 1924

Mr. L. L. Loud
Museum of Anthropology
Second and Parnassus Avenues
San Francisco, California

Dear Mr. Loud:

I wish to discuss the matter of making available for other students the result of your studies upon Nevada archaeology. Will you please therefore call upon me next Wednesday, February 13, at one o'clock, in my office, Room 7 Anthropology Building, Berkeley. Please bring your finished manuscript with you.

I have arranged with Mr. Gifford that you be relieved of guard duty for the necessary period on that day.

Sincerely yours,

R. H. Lowie
Chairman Department of Anthropology

R. H. Lowie

This week, Feb. 14 to Feb. 17 [1924], is only 4 days have completed no MS. Made a general sort-over of notes, got 15 trays of wooden objects up from basement into my room, and begun comparisons.

L. L. Loud

R. H. Lowie

Feb. 26, 1924. Reporting for last week will say I have not made much of a showing, only 3 pages of M.S., but at any rate I have been endeavoring to accomplish what I could. I hope to make a better showing next week.

Yours Truly,

Llewellyn L. Loud

Museum, Affiliated Colleges, San Francisco

April 9, 1924

Dr. R. H. Lowie

Dear Sir:-

Been some time since I reported on Nevada. First my time was occupied on the Stege Shellmound paper. Then I took a cold and for two weeks have had bum eyes. For nearly two weeks have had to have eyes bandaged every night to keep them from itching and to keep them away from my fingers. For two weeks have made just as little use of eyes as possible. Now my eyes are coming back towards normal condition so you may expect to hear more favorable reports.

Yours,

Llewellyn L. Loud

Museum, Affiliated Colleges, San Francisco

April 23, 1924

Dr. R. H. Lowie

Dear Sir:-

I don't seem to get the time to do much real work at my Nevada paper. There have been students and visitors every day until this week to keep me from doing anything by day. Nights I am largely occupied by house building or resting up. Two or three nights a week I cross the bay and work half a night by lantern light grading, making sidewalk to garrage, and digging sewer. The nights that I stay home I make up for loss sleep. Mondays generally I arise at 5 A.M. and get back to bed at midnight then I am about dead for two days. Last week I also spent a day at Burlingame shellmounds. However with all the distractions I am keeping the Nevada paper ever ever before me and last week wrote two pages of manuscript. I am hoping that I can soon get time to make a real showing.

Yours,

Llewellyn L. Loud

Lovelock, Nevada, July 3, 1924, 7 A.M.

A. L. Kroeber

Harrington has arrived and bought a new Ford. He will come into town twice a week from the cave 20 miles away. Send all 1st class mail to Loveloc, Nevada. We go out to the cave this morning for first time.

L. L. Loud

Peter Decker Ranch, 20 miles from Lovelock, Nevada

July 19, 1924

My dear Mr. Gifford:

Mr. Harrington continues his work in Nevada through the month of July and August going to Pyramid and Winnemucca Lakes after leaving Lovelock cave. There is a cave on Winnemucca Lake that we know about. It is easy to get about because of the Ford that we have. However Harrington has to wind up his work 1st of September because he is a reserve army officer and has to be at an eastern emcampment on September 12th. He is going to visit San Francisco, Los Angeles etc., first few days in September.

Harrington wants a companion for all the time he spends in Nevada and has the O.K. of George Heye by telegraph. Heye is leaving for a trip to Brazil and leaves it to me to obtain leave of absence from University of California for month of August. I would very much like to stay here through August. Harrington tells me that I do not have to pay anything for food so the $125 a month that Heye pays me is clear gain, which will come in very handy on my house, as the loan I obtained is just a little shy of what I need to complete the house.

We are obtaining a lot of new types of artifacts at the cave and learning a lot and having an awfully good time.

Yours Truly,

Llewellyn L. Loud
Lovelock, Nevada

WESTERN UNION TELEGRAM

1924 AUG 22 AM 11 48

LOVELOCK NEV.

E W GIFFORD

MUSEUM ANTHROPOLOGY 2 AVE & PARNASSUS SAN FRANCISCO CALIF
STRIKING GOOD STUFF LOTS OF DEPOSITS LEFT HARRINGTON GOT LEAVE OF ABSENCE FOR MOBILIZATION DAY AND WANTS ME TO CONTINUE HALF MONTH OF SEPTEMBER CAN I GET LEAVE OF ABSENCE EXTENDED HALF MONTH

L L LOUD

August 23, 1924

Mr. L. L. Loud
Lovelock, Nevada

Dear Loud:

Your telegram requesting a further leave of absence for two weeks has been received.

I have already arranged with the President's office for the dismissal of the substitute and your return to your regular duties on September 1. I feel that we cannot grant you a further leave.

Looking forward to seeing you in September, I remain

Sincerely yours,

A. L. Kroeber
Chairman

Thursday evening, Mar. 4, 1926

Dear Dr. Kroeber:

Have finished rope (10 pages) and knots (9 pages). There are 142 pieces of braid, quite technical stuff of 3, 4, 5, 6, 7, 16, and 18 strands but the technical examination is finished and I hope to complete the manuscript description of it tomorrow.

Yours,

L. L. Loud

Tuesday evening, March 16, 1926

My Dear Dr. Kroeber:

Mr. Gifford tells me you are anxious for a statement of progress and especially you want to know when my job will be finished.

I have been given a very hard task. I think this is an opportune time to state a few facts. Just to start out with, I wish I knew just how many specimens Harlan Smith collected in Washington and British Collumbia. I read his publications carefully years ago. He got <u>very</u> few. He did well in publishing what he did with the amount of material he had. Papers are often published on collections of only a few hundred specimens or less. My own collection of 700 specimens at Humboldt Bay ranks as a good collection. The collection from Lovelock Cave are the most remarkable collections ever taken out in America. My collection numbers about 9000 pieces of almost every class of object that imagination can conceive of. The task of writing up such a collection is a man's sized job. Any man that can adequately describe such a collection has got something to his credit. And my task though it has been wearisome is very largely completed. I am in no frame of mind to give up now.

I appreciate the six weeks time that you have given me to work on the collection. I am making progress. As the time you allowed has been drawing to a close I have been wondering what to do to get through the job. I decided yesterday that I would hire the substitute guard to stay on and I would pay him myself for at least two weeks more.

Gifford urged me to get a letter off to you before mailing time so I must close now, although I really have more to say later.

Yours Sincerely,

Llewellyn L. Loud

March 18, 1926

Mr. L. L. Loud
Museum of Anthropology
Second and Parnassus Avenues
San Francisco, California

Dear Loud:

There is no reason why you should pay the substitute's salary out of your pocket as long as we can fix it. There will be no administrative difficulty about our continuing him until the seventh of April which, as I remember, will make two clear months, and I will so arrange it. I should however like from you before very long a summary and quantitative statement of three things:

1) Pages of manuscript written and in hand on February 7.
2) Number of pages written between February 7 and date or conservatively estimated to be written by April 7.
3) Estimated number of pages; if any, that may remain to be produced after April 7 in order to complete the manuscript.

The points you make and the difficulties you enumerate are all perfectly valid and no one recognizes them better than I. Consider me as agreeing wholly with you as to the factors that have entered into the situation, and therefore please give me, succinctly, the three items asked for, which I shall need if I am to help you in planning the best continuance of your work.

I am glad that things seem to be going well with the job.

Sincerely yours,

A. L. Kroeber

March 30, 1926

Mr. L. L. Loud
Museum of Anthropology
Second and Parnassus Avenues
San Francisco, California

Dear Loud:

I do not want to harass you but to help you. You are certainly at liberty to work in any way you see fit. On the other hand I want you to appreciate my situation. I cannot go along piecemeal and keep asking every few weeks for an extension of appropriation on the ground that your work is again and again and again taking longer than expected. If I do that they will say either you don't know your business or I don't know it and will cut off the grant.

All I want is this. You have been on this job now close on to two months. If in that time you have completed about two thirds of what remained to be done when you began on February 7, the presumption is that another month will wind up the remaining third. In that case I think I can get you the money. If on the other hand you have in these two months completed only one third of what remained, it would take about four months more to finish up and I might or might not get the funds for this period. In any event I will not ask for funds for one more month if the real prospect is that three or four will be needed.

The whole thing is for you to tell me in plain English in terms of either weeks or months or proportion of work completed how the situation stands. Your answer should be truthful to yourself and should be based on your knowledge of the situation as a whole. I do not want you to count specimens, still less grams or weight and even number of manuscript pages will not help me nearly so much as a simple answer if I know that this answer represents a general attempt to estimate the actual facts as closely as they can be estimated at present.

I think you can compile this information to the best of your ability in half an hour if you will bring your mind to bear on that point, and you can write me the facts in five minutes. If you have tried to compile anything else or have got fussed up over the situation it is because you have not understood what I was after. There is no friction and you need not feel that there is any pressure on you. But I think you should understand that I cannot deal with administrators in any piecemeal or blind fashion and feed them part of the facts every two weeks or so. They will not stand for this sort of thing for quite obvious reasons and if you want me to do anything for you with them it is up to you to help me out as much as you can.

Sincerely yours,

A. L. Kroeber

San Francisco, Tues. 4:00 A.M., March 30, 1926

My Dear Dr. Kroeber:

I have been so fussed up that I could not sleep much more than about 4 hours so I am getting up to start another dreary day. I am aware it is getting time for me to make some kind of report to you. A week ago Monday I could have made a report as follows:

> Completed the study of 1115 pieces of wicker basketry. Weight 14,055.2 grams (31.6 pounds). 7 pages of manuscript. Drew 9 text figures of designs ready for engraver when cut and pasted on a cardboard. I found that the designs of old dirty faded basketry is brought out more clearly by washing, so I washed 80 or more pieces that showed designs.

A week before I had reported finishing the study of 1419 pieces of matting of round and triangular tule, juncus rush, cattail, spike rush, grass, and cane. Weight 17,802.9 grams (39.25 pounds). 7 pages of manuscript. 4 pages of explanation of plates being so full of description that they should count as pages of manuscript. I did not report, as I might have, that I made 8 dummy text figure drawings to illustrate methods of making borders and selvage.

After I made my report of progress on the matting Mr. Gifford brought word to me that you was not satisfied with that method of reporting progress. That you wanted a birds eye view of progress on the entire Nevada collection, total number of pages completed, number of pages yet to be written, how long it would take, etc. I told Gifford immediately that I could not make any such report, but he insisted that I must. Consequently I wrote to you about the magnitude of the task of adequately describing such a complicated collection as 9000 pieces. I received your answer a week ago Monday evening but I seem to have lost it as I can't find it this morning.

Now as for the birds-eye report that you desire I can only say that during the process of the construction of such a paper, I don't keep things in such orderly shape that a comprehensive report can be quickly made. I had my coiled and twined basketry spread out for study but your desire for the report had the effect to make me break off from this study to somewhat prematurely begin the editing of manuscript already made, and of re-arranging it and the table of contents. Although my paper may be anything but orderly during the process of construction, comparable to a building construction with both good and refuse materials scattered about the job, you have every reason to believe that the paper will be orderly when completed.

For one thing I have never known, and hardly expect to know until the job is complete exactly how many artifacts I got in Nevada. Many things were catalogued that are not artifacts or only slightly worked. From rough calculations I have been saying that there are somewhere around 9000 artifacts. In shuffling a class of objects from one position in the table of contents to another more logical position the statistics of number of pieces and weight become confused. These statistics in some cases fail to "balance accounts" as we say in bookkeeping.

Working under pressure the past week has made it difficult to straighten out discrepancies and I have sometimes become much fussed up, so fussed up in fact as to somewhat interfere with efficiency. All last week I kept hoping to soon have everything in such orderly shape that I could report to you, so I kept delaying the report. Yesterday from 2:15 to 5:00 p.m. I quit, laid off, and went to the beach. Sunday March 14th I laid off about 3:15 and went to the beach. Sunday Feb. 21 I laid off for the day at 10:00 A.M. Occassionaly evenings I go shopping or for a walk, also several times went to library for needed information. Otherwise since Feb. first I have been sticking close to my job trying to push it through. When I am trying to do my best it seems to me that I should not be harrassed by any pressure that may interfere with efficiency. It would be far easier for me to pay the substitute guard myself.

However I am coming down the line and approaching the end. I may not be good for much work today after my short sleep but will stick it out and try. Expect to have the comprehensive report for you in a day or two and if things should go well to have description of specimens completed in a week or two.

Yours Truly,

Llewellyn L. Loud

February 14, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

I would like to have you come in some time soon to talk over your paper on the Lovelocks Cave and Nevada work with me. It is in the process of editing now and there are some points which need clearing up. I am usually free on Tuesdays and Thursdays, if you would like to take a chance on catching me then, or if you prefer telephoning first to make sure they will tell you at the office when I am in.

I hope everything is going well with you.

Sincerely yours,

A. L. Kroeber

March 29, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

Will you be good enough to write to Raymond Harrington at the Heye Foundation, Broadway at 155th Street, New York City, and tell him what parts of his collection you think he should describe to supplement your paper? He has asked me to advise him what classes of objects you have covered, but I am afraid that a mere list of names of classes might not be sufficiently descriptive to inform him, and we have no carbon copy of your text to turn over to him.

I have written him that you and I talked about this point and that as I remembered you thought the duck decoys were the most important class remaining for him to deal with. Also that there were two or three classes of small objects like marbles which you thought he might handle. These latter however I was not sure of and you can better tell him directly.

My suggestion is that you do not load too much on him, as I adhere to the original plan of the paper being your and his an appendix.

Sincerely yours,

A. L. Kroeber

April 20, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

I wish you would come in sometime during the next week or two. You had better telephone beforehand. I am mostly in the office, but out part of the time, and there is no use your making a trip for nothing.

Sincerely yours,

A. L. Kroeber, Curator

April 26, 1927

Dear Dr. Kroeber:

Received your letter asking me to come see you in a week or two. Don't see how I can come this week. I am trying to get this job finished up so I can get some income from it, also so that I can be ready for a job. Will come as I can. I sent field notes of 1924 Cave excavation to Harrington by air mail. I did have some plans of the Cave or rather certain parts of the cave showing locations of lots and Pits 1924 excavation. The plans were on typewriter size of yellow 1/4 inch mesh coordinate paper. I can't find them in S.F. If you found a blueprint plan of the whole cave 1912 excavation the 1924 plans might be rolled up inside. I found the printers copy (on tracing paper) of maps and plans. Brought them to Richmond to consult for data for Harrington. Will bring them to Berkeley when I come.

L. L. Loud

April 28, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

I wish you would try to get in touch with me because I ought to talk over with you both plans for the future and your cave paper. If you are working during the day, ring up and we will try and make an appointment for an evening. You will find me in the telephone book at 1325 Arch Street, Ashberry 2580.

I wish you would turn over to me the basic map of the cave. Gifford thought it might be in your room and was waiting to see you at the Museum to have you deliver it to him. We ought to have it in hand to make the paper intelligible. It will do you no good in Richmond, and Harrington ought to write his appendix with reference to your paper as we have it assembled, not on the basis of correspondence once with you and once with us.

We found the blue print copy, but there was nothing with it.

Sincerely yours,

A. L. Kroeber

June 2, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

Please come in again one of these days. You had better telephone in before to find out if I am in. I am at the office every day, but sometimes leave during the middle or end of the afternoon to do other things. Monday, for instance, will be taken up.

Sincerely yours,

A. L. Kroeber

June 9, 1927

Mr. L. L. Loud
2035 Ohio Street
Richmond, California

Dear Loud:

You had better come in to see me at the first opportunity. I am sorry you have not been in this week. I shall probably be in the city tomorrow afternoon, and Saturday afternoon is an uncertain quantity, so I hope you can make it early next week.

Sincerely yours,

A. L. Kroeber

Richmond, Calif., Wed., June 22, 4:15 P.M., 1927

My dear Dr. Kroeber:

I am not at all feeling bad about not coming back to the S.F. Museum July 1st for another year. I guess it is pretty well known by myself and all hands concerned that I am pretty filled up on the museum work and its glory and re- muniations. I feel that I have been treated a little rough but there is some recompensation in the relief that I am free. A sence of duty and uncompleted tasks was drawing on me to bring me back yet I have had some hesitation about coming back.

I have the prospect of a job. The job will not be ready for a week or 10 days or perhaps a couple of weeks. My working for you for a few days or a week is of course subject to the condition that I am not already engaged. In order to get your task out of the way perhaps I can begin a few days sooner than I proposed if your editorial work is completed. I will know better next week just where I stand and let you know of developments.

Yours,

L. L. Loud

June 25, 1927

Mr. L. L. Loud
2035 Ohio Avenue
Richmond, California

Dear Loud:

I am glad to hear that prospects have developed so quickly.

As to going over the manuscript, the time is at your own disposal. You can begin before or after July first, or on that date. Let me have a day's notice so that I can have things assembled for you.

Sincerely yours,

A. L. Kroeber

Oakland, Th. Aug. 11, 1927

Dear Folks:

Got that explanation of plate, Ocala Cave, but I got no time now to do anything but make lots of money working for one of largest California corporations.

Work at 7 A.M. (8 A.M. Sundays) to 6, 7, 9, 11 P.M. (4:30 P.M. Sundays). My No. is 2575, classification "Carpenter" though I don't get regular carpenters pay and do other kinds of work besides carpentering, including painting, janitoring, blacksmithing, machine shop work, etc. etc. remodeling a factory. I did not make as much money in month of July as I would if I had come back to old job at Museum but then I lost half a month working for University. Now that I have got started I am rapidly paying off debts. Every week I split my debt to some person in half, or pay up somebody in full.

I am addressing "GH [Gwendoline Harris] or AW [A. Warburton]" because I want to let all of you know how I am, although some of the letter concerns Gifford, that is my inability to do anything on the Nevada paper at present, at least, until work possibly slacks up to shorter hours.

Yours,

L. L. Loud

September 26, 1927

Mr. L. L. Loud
558 16th Street
Oakland, California

Dear Loud:

Harrington was in Saturday afternoon and Sunday morning and looked over his part of your joint paper. There is probably nothing more to be done on the paper, except to re-copy some patches that have been cut up in the editing. Harrington would have liked to see you, but I could not find your address during the limited time he was here. He was behind schedule for reconnaissance work which he is doing in northern California and northeastern Nevada before the season gets too late. He sends you his best regards.

Drop me a line some day to let me know what you are doing, and how you are getting on. In any event keep me posted as to your address, in case this changes.

Sincerely yours,

A. L. Kroeber

November 25, 1927

Mr. L. L. Loud
558 16th Street
Oakland, California

Dear Loud:

I am wondering whether my last letter failed to reach you or whether you did not answer it. I should be glad to know where you are and what you are doing. Harrington is also inquiring for your address. I would suggest your writing him directly at Nixon, Nevada. He will be there for some months he thinks.

Sincerely yours,

A. L. Kroeber

October 16, 1928

Mr. L. L. Loud
558 16th Street
Oakland, California

Dear Mr. Loud:

We have in hand now galley proof of the Lovelock Cave paper. Will you call for it, personally, or do you wish us to send it to you? If the latter, please send me specific instructions where to mail it to you. From our talk the other day I gather that you will carefully check plates with their plate references in the text. Can you set an approximate date when you will return these proofs, corrected?

With kind regards,

Sincerely yours,

G. Harris, Assistant in Anthropology

Wed., Oct. 17, 1928

A. L. Kroeber

Regarding galley proof, will say I am working and cannot call personally for it. I can read it Sundays and evenings. Don't know how long it would take to read it but I could report progress at the end of a full week after receiving it. Send it to usual address: 558-16 St. Oakland. I hope to receive it before next Sunday.

Yours,

L. L. Loud

Wed., Oct. 31, 1928

G.H. [G. Harris]

One week ago today received Nevada galley proof and all but proof of one plate. Plate 2 the map of the cave is lacking but I don't know as I need it. I have gone over one quarter of the galleys.

Yours,

L. L. Loud

558-16 St. Oakland, Calif.

November 6, 1928

Mr. L. L. Loud
558 Sixteenth Street
Oakland, California

Dear Loud:

Miss Harris tells me you imply you will take a month to read proof. I do not know just how you are circumstanced for time, but hope you will make every effort to crowd this job through. I would suggest that you give particular attention to such matters as cross references, specimen numbers, checking of illustrations and text, etc., on which you know more than anyone else. When it comes to supplying punctuation and matters of English, the printer first reads proof to copy, then the editor in the Press, then Miss Harris, then I will look the whole works over, so nothing much of this sort is likely to get by us. The typography and style are probably more correct for the duplicate proof in your possession that you would be led to infer, because this is just as it came from the printer, whereas our copy has been read both by the Press and by us.

I should not like you to be so slow that I feel I can wait no longer and have to turn our copy of the proof in without having received your corrections. Harrington has returned his proof.

Sincerely yours,

A. L. Kroeber

32 Broadmoor Ave., Colorado Springs

April 5, 1929

Re: Bat-Cave and Relics - Humboldt Mts. near Lovelock, Nev.

This cave reported by me to the Smithsonian Nov. 1911 after seeing a number of relics in possession of a salesman introduced to me in Fallon as Coal Oil Johnny, The Arrow-head Kid, only name given me. The salesman has a superb collection of arrow-heads, and may have relics of importance to you.

In my letter I gave Winnemucca as nearest town so Smithsonian may have been thrown off the track. They wrote the Reclamation Service at Fallon, and a Geol. Survey party to get any data available at that time.

The Geol. Survey party at Timber Lake found, shore Carson Sink near Timber Lake a number of skeletons, an imbedded arrow-head, metates, etc. H.S. Gale party chief there.

F. C. Ware

IV.

Fish Remains from Human Coprolites and Midden Deposits Obtained During 1968 and 1969 at Lovelock Cave, Churchill County, Nevada

W. I. Follett

INTRODUCTION

This is a report on fish remains obtained from human coprolites and midden deposits collected during 1968 and 1969 at Lovelock Cave, Churchill County, Nevada. These were collected since the publication of an analysis of fish remains from the human coprolites and midden deposits collected during June 1965 in other parts of the cave (see Follett 1967:93-116).

Lovelock Cave (site NV-Ch-18), situated in a limestone outcrop of the West Humboldt Range (see Heizer and Napton 1969, figs. 3, 4) at about 4,240 feet (1,292 m.) above sea level, is some two miles east of the bed of Humboldt Lake (the terminus of the Humboldt River) and 15 miles south-southwest of the town of Lovelock.

The present collections of coprolites comprise two series of 15 each: the "AN" series, collected during September 1968 and May 1969 in Lovelock Cave, at grid locations S10/W50 and S10/W55 (see Heizer and Napton, fig. 9, this volume), and the "LX" coprolite series collected during 1968-1969 by members of a University of California archaeological field party (see Heizer and Napton, fig. 9, this volume), at grid location NS0/W30. Identification numbers are those assigned by the Lovelock Coprolite Analysis Project, Department of Anthropology, University of California, Berkeley. (The collections are deposited in the Lowie Museum of Anthropology on the Berkeley campus.)

Each coprolite of these two series was divided approximately into halves: one half was retained intact for possible future pollen analyses, radiocarbon determinations, or for other studies; the other half was rehydrated (see Heizer and Napton 1969:566), and the fish remains and other constituents were segregated for study and analysis.

Radiocarbon dates obtained by the University of California at Los Angeles and by Isotopes, Inc., Westwood, New Jersey, are approximately A.D. 1800 to 2740 B.C. for the "AN" series of coprolites and approximately A.D. 700 to A.D. 50 for the "LX" series.

The "AN" coprolites were found in three separate stratigraphic horizons, the characteristics of which are described in the article by Heizer and Napton (this volume). Coprolites AN 1-5 came from the surficial debris in the AN test unit. According to Napton (personal communication, March 1970), all of these specimens are approximately equivalent in age and composition to the "Entrance" coprolite series analyzed by Ambro (1967:37-47) and Cowan (1967:21-35). Fish bones found in these coprolites were studied by Follett (1967:93-116). A sample entrance coprolite gave a radiocarbon age of A.D. 1805±80 (UCLA-1071-E; Tubbs and Berger 1967:89-98). Coprolite AN-6, found in a level 48 to 56 inches below the surface, is of unknown age. Coprolites AN 7-10, from a depth of 72 inches, probably were deposited in the midden <u>circa</u> 1000 B.C. (Napton personal communication, March 1970; see Heizer and Napton, this volume). Radiocarbon analysis of a sample of vegetal material (AN-16), consisting of fragments of Scirpus sp. and Typha sp., from the same depth, produced a date of 2740 B.C. ±110 (I-3962; Buckley, personal communication to Napton, January 1969). Coprolites AN 11-15 came from a layer of guano and midden trash, at a depth of 84 inches. Napton (personal communication 1970) suggests that these coprolites might have been deposited prior to 1500-2000 B.C.

The "LX" coprolites range in age from about A.D. 700 to A.D. 50. Coprolites LX 1-3, which were found in the disturbed surface debris, may be approximately equivalent to the "Interior" coprolites analyzed in 1967 (see Cowan, Ambro, Follett, and Tubbs and Berger, cited supra). Coprolites found at a depth of 24 to 36 inches in the LX test unit may date from about A.D. 600, while coprolites LX 7-9, from 36 to 48 inches deep, may have been deposited in the midden circa A.D. 500. Coprolites LX 10-12, found 48 to 60 inches below the surface, are bracketed by two radiocarbon determinations: coprolite LX-10 has a date of A.D. 480±90 (I-3963; Buckley, personal communication to Napton, March 1969); and coprolite LX-16 has a date of A.D. 350±50 (UCLA-1418; Berger, personal communication to Napton, 1968). Coprolites numbered LX 13-15, found at a depth of 58 to 72 inches below the surface of the test unit, may date from about the first century A.D. Vegetal material (LX-56), consisting of saltgrass (Distichlis cf. spicata) and cattail (Typha cf. angustifolia) found in association with the coprolites, yielded a date of A.D. 50±60 (UCLA-1417; Berger, personal communication to Napton, 1968). This sample of vegetal material was found at a depth of 56 inches below the surface. According to Napton, who provided the information discussed in the preceding paragraphs, an empty cache pit was found at this depth in the north profile of the LX test unit, and its presence suggests that some mixing of the deposits probably occurred in prehistoric times, even though there had been no disturbance of this small segment of the original cave deposit during the modern era (see Heizer and Napton, this volume).

Baumhoff and Heizer (1965:702) noted that "the earliest radiocarbon date for human occupation of Lovelock Cave is 1218 B.C." Vegetal material from the "AN" unit taken at a depth of 78 inches has yielded a date of 2740 B.C. ±110 years (I-3962; discussed supra). This represents the oldest date yet obtained at Lovelock Cave from probably cultural material. Cultural dates older than 1218 B.C. are provided by radiocarbon dates of human remains, which date 1420 B.C. ±100 (I-4758) and 1450 B.C. ± (UCLA-1459-C; Berger, personal communication to Napton, 1969).

FISH REMAINS

More than 5,800 remains, representing at least 98 fish, were recovered from 14 coprolites (eight coprolites of the AN series; six of the LX series).

Forty-seven remains, representing at least seven fish, were obtained directly from midden refuse in an auxiliary part of the Lovelock rockshelter.

These remains were from two stations, one of which is the "WA" (West Alcove), grid location S15/W100, depth 10 to 11 feet, sample 46:1029. The approximate age of this stratigraphic level is indicated by radiocarbon dates of sample coprolites. Coprolite WA-20-A produced a date of A.D. 300±60 (UCLA-1459-B; Berger, personal communication to Napton, 1968), and coprolite WA-21 gave a date of A.D. 120±60 (UCLA-1459-A; Berger, personal communication, 1970).

The other locus from which fish-bone samples were obtained is WA grid location S10/W95, surface to 12 inches deep, sample 46:1044. The approximate age of the deposit containing these bones is probably not much later than A.D. 1805, and not earlier than A.D. 1430, according to Napton (person communication, 1970). These dates are based on the radiocarbon date of the entrance coprolites and on a radiocarbon determination of a layer of seeds (Scirpus cf. robustus) found at a depth of seven inches in the West Alcove test unit, grid location S10/W95. The radiocarbon age of this seed sample (82:1577) is A.D. 1430±95 (I-4672; Buckley, personal communication to Napton, 1970).

I wish to express my appreciation to Mrs. Lillian J. Dempster, of the California Academy of Sciences, for assistance with the manuscript; to Mr. Maurice C. Giles, of the California Academy of Sciences, for enlargements of the photographs; to Dr. Robert F. Heizer, of the University of California, for permission to report on these fish remains; to Dr. Robert R. Miller, of the University of Michigan, for literature references; and to Mr. Lewis K. Napton, of the University of California, for archaeological data.

FISHES REPRESENTED

Fishes of two families, three genera, and three species are represented in the present collections of coprolite and midden materials: tui chub, Tahoe sucker, and cui-ui. The size attained by these species, and archaeological sites at which their remains have been collected, were noted by Follett (1967: 95).

The fish remains from the coprolites are those of the tui chub (see p. with the exception of a quadrate of the Tahoe sucker (pl. 3; see p.). A few remains of the cui-ui (see p.) were found in the midden material, but none in the coprolite material.

Many of the numerous skeletal elements recovered from the coprolites are identifiable to species with reasonable certainty, but since the lower pharyngeals are the most distinctive, they have been selected as the basis for identification and measurement of the coprolite material. However, since no pharyngeal of a Tahoe sucker was found, a quadrate of that species was used (pl. 3); for comparison, a quadrate of a tui chub is illustrated (pl. 4).

In this paper, "length" of fish indicates total length (straight-line measurement from tip to snout to end of longest caudal ray). Weight of fish is computed from length of fish, as determined from length of pharyngeal (or quadrate). The weights are necessarily estimates, since fish (of the same species) of identical length may differ considerably in weight.

Minnows -- Cyprinidae

Tui chub, Gila (Siphateles) bicolor (Girard)

This chub (see Follett, 1967, pl. 5), known to the Northern Paiute as "tui-pagwI" (Loud and Harrington 1929:156), is a palatable food fish although it is bony (Kimsey 1954:406).

Coprolite Material: 144 pharyngeals (32 complete, 112 incomplete; pls. 1, 2), ranging from 3.1 to 9.1 mm. in length (measured as by Uyeno 1961:332, fig. 1A), representing at least 97 fish about 45 to 130 mm. in length and perhaps 0.7 to 20.8 g. in weight (total weight of fish, perhaps 471 g.). One hundred twenty-five pharyngeals were taken from seven coprolites of the AN series and 19 from six coprolites of the LX series (table 1).

Characteristic remains of this species (basioccipital, cleithrum, pharyngeals, preopercle, ribs, vertebrae) from Lovelock Cave coprolites were illustrated by Heizer and Napton (1969, fig. 6, middle row, middle group).

Midden Material: Three pharyngeals (two complete, one incomplete), 16, 18, and 24 mm. in length, representing three fish about 22, 25, and 32 cm. in length and perhaps 140, 190, and 350 g. in weight; WA Sample 46:1029. Four vertebrae (incomplete, two of the Weberian series articulated); WA Sample 46: 1044.

Suckers -- Catostomidae

Tahoe sucker, Catostomus tahoensis Gill and Jordan

This sucker (see Snyder 1917, fig. 1, as Catostomus arenarius) was known to the Northern Paiute as "awago" (Loud and Harrington 1929:156).[1]

Coprolite Material: One quadrate (incomplete, pl. 3), 8.4 mm. in length, representing a fish about 21 cm. in length and perhaps 120 g. in weight, from coprolite AN-11.

Midden Material: None.

Cui-ui, Chasmistes cujus Cope

This sucker (see Snyder 1917, fig. 2) was known to the Northern Paiute as "kuyui."[2] It formerly constituted the principal food-supply of the Northern Paiute of the Pyramid Lake region (Powers 1877:449), the most widely known band among all the Northern Paiute (Stewart 1939:138); they were known as the Kuyui-dika (Kroeber 1925:584).[3]

Coprolite Material: None.

Midden Material: Two cleithra[4] (one incomplete, representing a fish about 55 cm. in length and perhaps 1.8 kg. in weight; one fragment, articulated with scapula, coracoid, and mesocoracoid); one pelvic fin (incomplete, identification to species doubtful); WA Sample 46:1029. Thirty vertebrae (seven precaudal, incomplete; 23 caudal, one complete, 22 incomplete), representing fish to about 61 cm. in length and perhaps 2.5 kg. in weight; three hypural fans (incomplete); one pelvic fin (incomplete; identification to species doubtful); WA Sample 46:1044.

DISCUSSION

All three species recognized in the present collections, tui chub, Tahoe sucker, and cui-ui, were represented in the fish remains obtained from coprolites and midden deposits collected at Lovelock Cave during 1965. The Lahontan speckled dace, *Rhinichthys osculus robustus* Rutter, of which five pharyngeals were found in the 1965 collections (Follett 1967:96), was not recognized in the present material.

Remains of the Lahontan cutthroat trout, *Salmo clarkii henshawi* Gill and Jordan, were not found in the present collections, nor in those of 1965, nor in the yet earlier collections recorded by Loud and Harrington (1929) from Lovelock Cave. The absence of this trout from the two earlier collections was discussed by Follett (1967:101), who concluded that possible explanations of this absence would be conjectural. The same conclusion applies as well to the absence of this fine trout from the present collections.

Fewer fish remains were recovered from the present collections (both of coprolites and of midden materials) than from the 1965 collections. In the present collections, about 97 tui chubs and one Tahoe sucker are represented in 14 half-coprolites, and about three tui chubs and three cui-ui in midden materials; in the 1965 collections, about 298 tui chubs, five Lahontan speckled dace, and three Tahoe suckers are represented in 29 whole coprolites, and about 22 tui chubs, seven Tahoe suckers, and eight cui-ui in midden materials. The fishes represented in the present collections are intermediate in size between the largest and the smallest represented in the 1965 collections.

More than six times as many pharyngeals were recovered from the AN series of the present collections as from the LX series (125 from the AN series, 19 from the LX series). Similarly, in the 1965 collections 458 pharyngeals were recovered from the entrance lot (situated near the AN unit and of comparable age to AN coprolites 1-5) and only 24 from the interior lot, which was located in the vicinity of the LX unit. (The interior coprolites are of about the same age as the latest of the LX coprolites.)

Possibly this difference in number of pharyngeals reflects a seasonal difference in the occupation of the sites (see Napton 1969:28-97). The AN location, and the entrance location, may have been occupied at a season, perhaps late summer or early fall, when small tui chubs were readily obtainable in the receding pools of the Humboldt Sink. In contrast, the LX location, and the interior location, may have been occupied during a season, perhaps winter, when tui chubs were difficult to obtain, or when the Lovelock Cave people resorted to scanty supplies of fish that they had dried and stored in the interior of the cave.

Remarkable numbers of pharyngeals of the tui chub were recovered from two coprolites of the 1965 collections: 123 from one, 101 from another (Follett 1967:95, table 2, pl. 1). The 45 pharyngeals recovered from half-coprolite AN-2 of the present collections (table 1) may represent an abundance approaching that of the 101 pharyngeals from a whole coprolite of the 1965 collections.

The presence of a considerable number of pharyngeals (32 of 144) bearing a complete series of teeth (which are readily dislodged from the arch) is convincing evidence that at least the heads of these fish had been swallowed whole. The 1965 coprolite material supported the same conclusion (Follett 1967:100).

The fishes represented in the present collections, like those of the 1965 collections (see Follett 1967:99-101), were probably taken in Humboldt Lake or in the lower Humboldt River (tui chubs, especially the smaller ones, and Tahoe sucker) and in Pyramid Lake, Winnemucca Lake, or the lower Truckee River (tui chubs, especially the larger ones, and cui-ui).

The conclusion expressed by Follett (1967:100), rejecting the possibility that the cui-ui represented at Lovelock Cave could have been taken at a time when a high stage of Lake Lahontan had extended the range of the species to the vicinity of Lovelock Cave, is further supported by Morrison (1965, table 1 and fig. 4-D), who indicated that the last stage of Lake Lahontan occurred more than 10,000 years before the present. As noted on page , *supra*, this was long before the earliest known human occupation of Lovelock Cave.

Table 1

Weight of Remains and Size of Pharyngeals and of Fish Represented in Coprolite Material of Tui Chub, *Gila* (*Siphateles*) *bicolor*

				Fish represented by pharyngeals			
Coprolite	Total remains	Pharyngeals				Weight (g.)	
No.	Weight (g.)	Number	Length (mm.)	Number	Length (mm.)	Range	Total
AN Series (A.D. 1800 to 2740 B.C.)							
AN-1	0.90	23	3.1-6.0	15	45-86	0.7-6.3	33.1
AN-2	0.54	45	3.2-7.3	29	46-105	0.8-11.6	86.2
AN-6	0.01	1	4.2	1	61	1.8	1.8
AN-7	0.14	9	4.2-6.3	7	61-91	1.8-7.6	32.0
AN-8	0.52	4	4.1-8.7	4	59-124	1.7-18.4	36.9
AN-9	0.58	11	5.4-7.7	9	78-110	4.3-13.1	69.0
AN-10	1.64	32	4.7-9.1	18	68-130	2.7-20.8	124.6
Total	4.33	125		83			383.6
LX Series (A.D. 700 to A.D. 50)							
LX-3	0.23	1	4.7	1	68	2.7	2.7
LX-6	0.02	1	5.3	1	77	4.2	4.2
LX-7	0.66	5	5.1-8.1	3	74-116	3.7-15.2	34.1
LX-9	0.02	4	4.5-6.5	4	65-94	2.3-8.4	19.7
LX-11	0.21	4	3.6-4.3	2	52-62	1.2-1.9	3.1
LX-14	0.12	4	5.5-7.6	3	80-109	4.8-12.8	23.9
Total	1.26	19		14			87.7

Table 2

Fish Remains in Midden Materials (WA = West Alcove)

Species	No. of fish represented	Skeletal element	No. of elements
WA Sample 46:1029 (depth 10-11 feet, approximate age A.D. 300)			
Tui chub (Gila bicolor)	3	Pharyngeal	3
Cui-ui (Chasmistes cujus)	1	Cleithrum	2
		Pelvic fin	1
WA Sample 46:1044 (depth 0-12 inches, approximate age A.D. 1805 to A.D. 1430)			
Tui chub (Gila bicolor)	1	Vertebra	4
Cui-ui (Chasmistes cujus)	3	Pelvic fin	1
		Hypural fan	3
		Vertebra	30

End Notes

1. This name was spelled "awagu" by Stewart (1941:425).

2. Anthropologists usually spell this name "kuyui" (see Kroeber 1925: 584); ichthyologists now follow Snyder (1917:50) in spelling the name "cui-ui" (see American Fisheries Society 1960:17). Cope (1883:149), who published the original description of this species, spelled the name "couia".

3. The name of the "cui-ui eaters" was spelled "kuyui-tekade" by Loud and Harrington (1929:153) and "kuyui-dökädö" by Stewart (1941:363).

4. A cleithrum of the cui-ui was illustrated by Follett (1967,pl. 2).

Explanation of Plates

Plate 1 Right lower pharyngeal, dorsal (occlusal) aspect, length 5.5 mm., of tui chub (Gila bicolor); representing a fish about 80 mm. in length and perhaps 4.8 g. in weight; from coprolite AN-2.

Plate 2 Ventromesial aspect of right lower pharyngeal shown in Plate 1.

Plate 3 Right quadrate, lateral aspect, length 8.4 mm., of Tahoe sucker (Catostomus tahoensis); representing a fish about 21 cm. in length and perhaps 120 g. in weight; from coprolite AN-11.

Plate 4 Right quadrate, lateral aspect, length 4.0 mm., of tui chub (Gila bicolor); representing a fish about 85 mm. in length and perhaps 6 g. in weight; from coprolite AN-10.

Plate 1

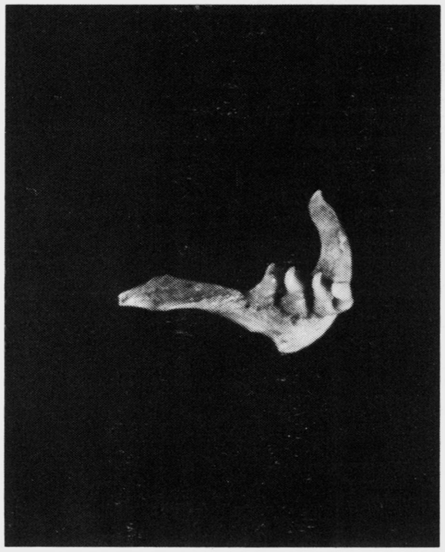

Plate 2

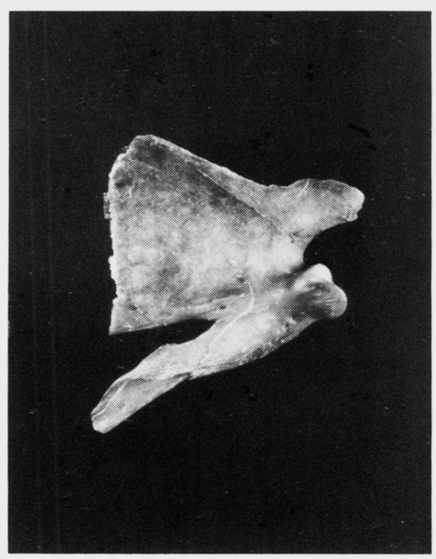

Plate 3

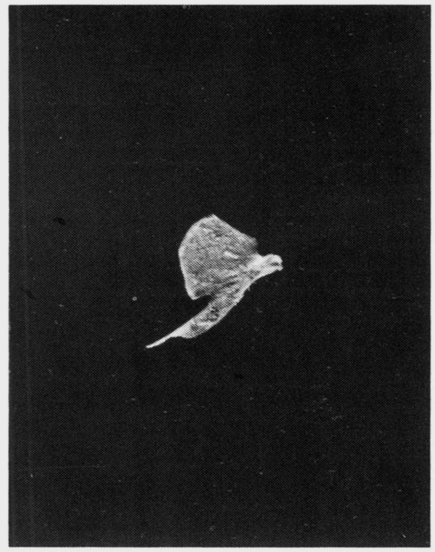

Plate 4

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V.

PARASITOLOGICAL EXAMINATIONS OF PREHISTORIC HUMAN COPROLITES FROM LOVELOCK CAVE, NEVADA

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This paper summarizes the findings in two series of parasitological and other biomedical investigations of prehistoric (i.e., pre-contact) human coprolites collected by Professor R. F. Heizer and his colleagues from several localities in Lovelock Cave, a Great Basin dry cave site in Churchill County, Nevada. Our studies were initiated in 1965-1966 when we examined a group of 52 specimens. Some of the findings of these preliminary studies have been noted briefly elsewhere (Dunn 1968; Heizer 1967; Heizer and Napton 1969). Studies of 116 additional specimens were undertaken during 1969 in an effort to provide further substantiation for some of the earlier observations. For this report we have combined the data for the two series of studies; thus we describe findings for samples from 168 Lovelock Cave coprolites. We shall also report briefly on the examination of a single sample of dry fecal material taken from the pelvic cavity of a mummified human, excavated from a cave site near Pyramid Lake, Nevada.

SPECIMENS AND METHODS

The localities in Lovelock Cave from which the coprolites of this report were collected are listed in Table 1, together with the numbers of samples from each locality, the numbers of samples that were parasitologically "positive", and the types of samples.

In the 1965-1966 study we examined coprolites from two localities in Lovelock Cave: those from the "entrance" or "crevice lot" (from a rock crevice "latrine" in the ancient entrance to the cave) and those from the "interior" or "cache lot" (from a concentration of specimens in the interior of the cave) (Heizer 1967:1-2, 12). A coprolite from the interior lot has been dated at A.D. 756±60 (UCLA-1071-F) while a specimen from the entrance lot has been dated at A.D. 1805±80 (UCLA-1071-E). In further discussion of these dates Tubbs and Berger (1967:89-92) indicate that the age of the interior lot coprolite was actually about 680, 800, or 880 A.D. (depending upon interpretation of the relationship between radiocarbon and calendar years at the time in question) and that of the entrance lot coprolite was either about 250 or 300 years old for similar reasons.

The specimens for the 1969 studies came from three localities in the western end of the cave: the West Alcove (near the shelter line), the West End (in the interior), and the West Crevice (running between the West Alcove and the West End). Five localities within the cave are thus represented in the series of samples examined for parasites (see Napton and Heizer, this volume).

Forty-three samples were received in the dry state; these were reconstituted in 0.5 percent aqueous solution of trisodium phosphate in the laboratory in San Francisco. The remainder of the samples were previously reconstituted fine screenings, received from the laboratory in Berkeley in small vials. The dry samples from the entrance lot (examined in 1965-1966) were fairly large fragments of whole coprolites. These large samples were required so that uncontaminated material could be removed from the core of each fragment under sterile conditions for a bacteriological investigation. Small quantities of each vial sample or reconstituted dry sample were examined microscopically as direct smears under 22 x 22 mm. coverslips. In the 1965-1966 studies at least two direct smears were prepared from each specimen and examined completely and systematically under several magnifications. In the 1969 study one smear per specimen was searched. Many smears were, of course, examined for those specimens with positive findings on initial screening.

RESULTS

Bacteriological Studies

Core samples were removed with sterile techniques from each of the 16 dry specimens from the entrance lot. These were studied by Drs. Vera L. Sutter and Valerie Hurst of the Department of Microbiology, School of Medicine, University of California Mecical Center, San Francisco. In their report of 28 October 1965 on this investigation they state that the specimens were tested for the presence of coliform bacteria, _Salmonella_, _Shigella_, and coagulase positive _Staphylococcus_ _aureus_ "with negative results for all of these bacteria. Our methods were as follows: _1._ Specimens were emulsified in a small amount of water. _2._ 0.1 ml of the heavy suspension was inoculated to EMB, SS, and Tellurite Glycine Agars. _3._ All cultures were incubated at 37° C. for 72 hours before being discarded as negative."

Crystals of the Charcot-Leyden Type

Specimen SF-13 from the entrance lot--a semi-formed fecal mass--was found to contain rare crystals resembling those known as Charcot-Leyden crystals which are often noted in diarrheal or dysenteric fecal specimens in association with the intestinal protozoan _Entamoeba_ _histolytica_, the agent of amoebiasis. Crystals of this type were detected only in this single specimen. Protozoan cysts, if present in SF-13 or other samples, were not recognized as such.

Mites

Fourteen sarcoptiform mites were recovered from the fine coprolite screenings in vial B-29 of the 1965-1966 entrance lot series. These well-preserved specimens are described in a separate report by Radovsky (1970). No other Lovelock Cave coprolites have yielded mites.

Rhabditoid Nematodes

Specimens of rhabditoid nematodes, mainly larvae but also several mature forms, were encountered in six coprolites from four of the five cave localities (table 1). Some of these specimens are illustrated (figs. 1-3). At least two species seem to be represented but specific and generic identifications have not been made and may not be feasible unless additional mature specimens can be recovered. If these worms are plant parasites they must have been ingested with plant foods; if, on the other hand, they are free-living worms they must have penetrated the fecal material before desiccation occurred, i.e., very soon after excretion of the feces.

Helminth Eggs

One of the most interesting observations in the initial study (1965-1966) was the apparent absence of the common parasitic helminth eggs of man, especially those of the hookworms (_Necator americanus_ and _Ancylostoma duodenale_), the whipworm (_Trichuris trichiura_), and the large roundworm (_Ascaris lumbricoides_). Nor were the eggs and/or larvae of other less common parasitic helminths of man detected. Our additional studies in 1969 were carried out in an attempt to confirm or disprove this observation of apparent freedom from intestinal helminth infection, and the recent examinations have indeed failed to reveal eggs or larvae of the common parasitic helminths. However we have encountered eggs of two species of presumed helminths that remain to be identified. The first of these is a single egg, apparently that of a fasciolid trematode (a _Fasciola_ or _Fasciolopsis_-type egg), found in a smear of material from a West Crevice coprolite (WC-20). This thin-walled and rather distorted egg, whose identification even at the familial level must remain tentative, measured 60 microns in greatest breadth and 100 microns in length. Unfortunately, satisfactory photographs of this egg were not obtained. The thick-walled eggs of a second helminth species are beautifully preserved; details of embryonic structure are visible within the egg (fig. 4). It has not as yet been possible to identify these eggs. The average dimensions are 60 microns in length and 40 in breadth. Two of these eggs were seen in smears from a West End coprolite (WE-22) and three were found in specimen WE-28, also from the West End.

Examination of Fecal Material from a Pyramid Lake Mummy

Fecal material collected from the pelvic cavity of a mummified human, Burial #2, excavated at Pyramid Lake site 26-WA-525 in Nevada was also made available to us for parasitological study. A dry sample of the intestinal contents was reconstituted in San Francisco and many direct smears were searched for parasites. None was found, but a single fragment of a rhabditoid nematode and one very well-preserved hypopal stage sarcoptiform mite were recovered. The mite, which has proven to be of exceptional interest, is described in the separate contribution by Radovsky (1970).

DISCUSSION

The lack of success of Drs. Sutter and Hurst in their 1965 effort to cultivate pathogenic bacteria from Lovelock Cave coprolites was experienced also by Tubbs and Berger (1967) who have described a similar bacteriological attempt using two coprolites from the same cave site. Many smears prepared from freshly reconstituted dry samples contained yeast cells but we were not able to cultivate these either.

No protozoan cysts were recognized as such although small objects in some of the smears were cyst-like and provoked speculation about their possible protozoan nature. Protozoa appear to have been recognized in coprolites in the Americas only once, i.e., cysts of *Entamoeba* sp. from a mummified Inca child from a tomb in the Andes (Pike 1967).

The presence of well-preserved rhabditoid nematodes in several coprolites of considerable antiquity--notably those from the West End locality which may be more than 2000 years old (R. F. Heizer and L. K. Napton, personal communication)--indicates that parasitic worms and eggs, if present in the feces at the time of excretion, should also have been well-preserved. The rhabditoids may have been ingested with plant materials or may have penetrated the feces from the soil prior to desiccation, but in any case they are ancient, dating from the time when the feces was formed or was still freshly passed and moist. Samuels (1965:176) has observed similar nematodes in Weatherill Mesa coprolites and has reached the same conclusion about their antiquity.

Since we should have been able to detect parasitic helminth eggs or worms if present in the coprolites, and since we have now examined an adequate number of specimens (168), we may conclude with some assurance that the inhabitants of Lovelock Cave at the times represented by these coprolites were free from infection with the common parasitic helminths of the human intestinal tract. We cannot be quite so certain that the inhabitants of the cave were actually free of pinworm (*Enterobius vermicularis*) infection because pinworm eggs are commonly shed by the female worm outside the intestinal tract on the peri-anal skin. Pinworm infection without pinworm eggs in the stool is a normal occurrence; thus these infections are often overlooked upon routine stool examination for eggs. That *Enterobius* infection could have occurred in Lovelock Cave inhabitants is at least suggested by the discovery of such eggs in a prehistoric coprolite from Wetherill Mesa, Colorado (Samuels 1965).

The presumed fasciolid egg from a West Crevice coprolite may represent human parasitism but it could also represent pseudo-parasitism resulting from ingestion of a parasitized host animal. The second, unidentified egg (from a West End coprolite and therefore perhaps several thousand years old) is probably a pseudo-parasite. The egg is not identifiable with one of the familiar parasitic helminths of man; in all likelihood it was ingested with infected animal viscera.

With the addition of these eggs, apparently shed by two kinds of helminths, the literature for the Western Hemisphere provides evidence for pre-contact human parasitism or pseudo-parasitism by six kinds of helminths. The four others are: 1) Enterobius vermicularis, the pinworm of man, recognized in a 1000 year old coprolite from Wetherill Mesa, Mesa Verde National Park, Colorado (Samuels 1965). 2) A thorny-headed worm, Moniliformis sp. (probably Moniliformis clarki), that may have been parasitic or pseudo-parasitic in man at Danger Cave, Utah 2-4000 years ago (Moore et.al. 1969). 3) The whipworm, Trichuris trichiura, represented by eggs found in a mummified eight or nine year old Inca child from a tomb in the Andes. The age of the body is said to be about 450 years (Pike 1967). 4) "objects that might have been the eggs of a species of tapeworm belonging to the genus Diphyllobothrium" (Callen and Cameron 1960:40) found in a Peruvian coprolite from Huaca Prieta dated between 3000 and 5000 years old. The record for Diphyllobothrium has been noted in several reviews as though it were fully confirmed, but Cameron himself was hesitant about the identification. However he concludes that "there is a strong presumption that these objects actually are the eggs of a species of Diphyllobothrium."

We have noted elsewhere that the apparent absence of common intestinal parasites in those who used Lovelock Cave is not surprising (Dunn 1968:222). The ecosystem that the occupants of Lovelock Cave exploited was, and remains today, relatively "simple" (in contrast to a tropical rain forest ecosystem, for example) and we have shown that one should expect to find very few species of parasitic organisms in man in such an ecosystem. This is the case for the Australian Aborigine and the African Bushman and it seems also to have been the case for those who occupied Lovelock Cave.

But perhaps the apparent absence of Ascaris and hookworm at the cave also reflects total freedom from infection by these parasitic helminths for pre-Columbian man in the Western Hemisphere? Perhaps even whipworm was absent from man in the Americas prior to 1492, for the status of the Trichuris infection in an Inca child is uncertain. The body of the child dates to about the time of first European contact in western South America; the child could have acquired the infection, indirectly, from one of the newcomers. At this stage we can only speculate. Many additional parasitological surveys of coprolites are needed to help us unravel the story of prehistoric human parasitism in the New World.

ACKNOWLEDGEMENTS

We should like to express our appreciation to Dr. Vera L. Sutter and Dr. Valerie Hurst of the Department of Microbiology, School of Medicine, University of California Medical Center, San Francisco for their contribution of a bacteriological study to this series of investigations. We should also like to thank Mr. Frank L. Lambrecht for his participation in the examination of the dry samples from the entrance lot. Finally we record our deep appreciation to Prof. Robert F. Heizer and Mr. Lewis K. Napton for providing us with the samples and thus giving us the opportunity to conduct these studies.

Table 1

Lovelock Cave Coprolites: Localities of Samples Examined Parasitologically

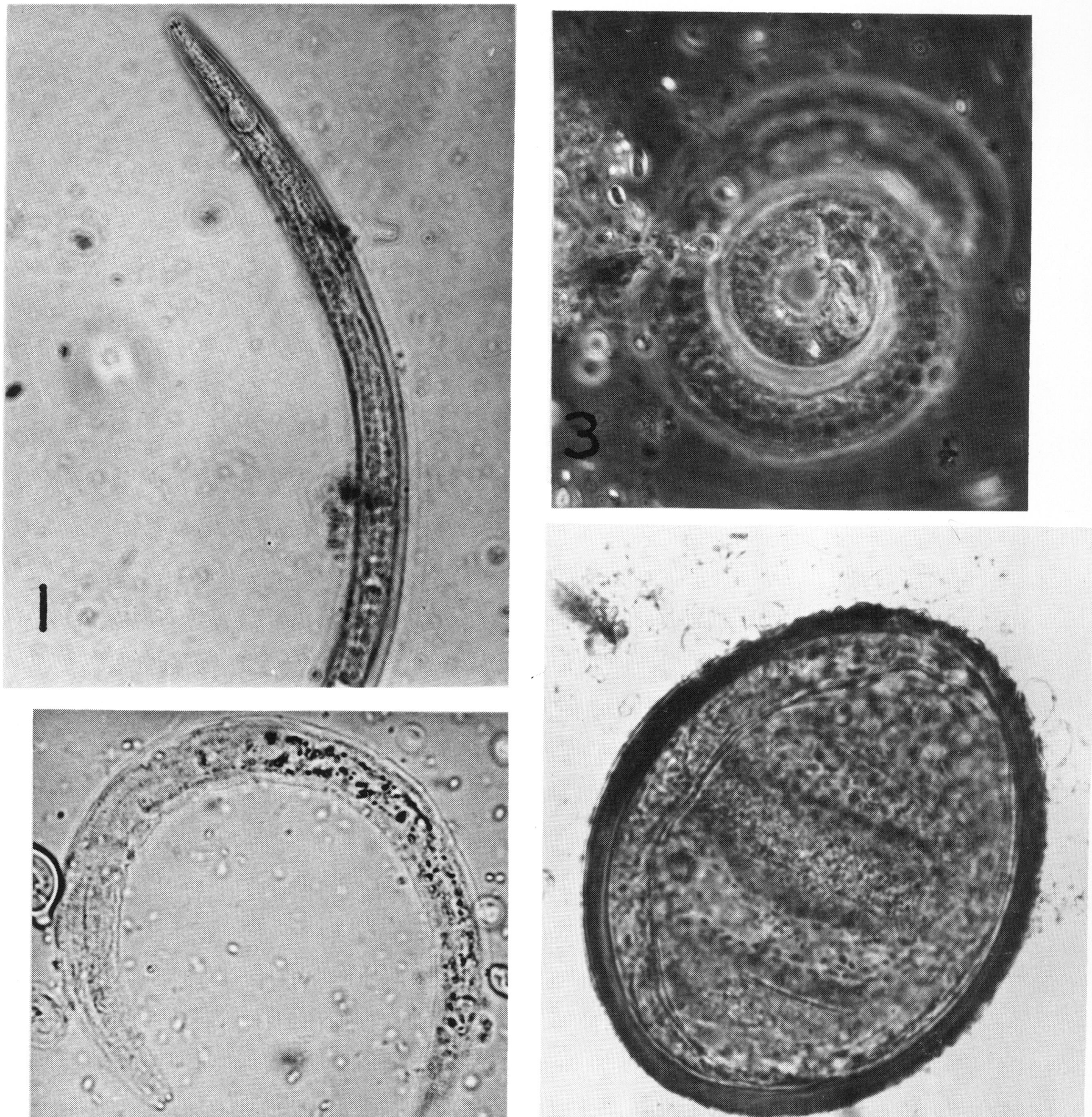
Locality	No. of Samples	No. with "Positive" Findings	No. Negative	Type of Sample	Year of Study
ENTRANCE LOT (CREVICE)	17	2 (B-29 -- mites) (B-18 -- nematodes)	15	vial*	1965-1966
ENTRANCE LOT (CREVICE)	16	2 (SF-13 -- crystals) (SF-15 -- nematodes)	14	dry**	1965-1966
INTERIOR LOT (CACHE)	19	-	19	vial	1965-1966
WEST CREVICE (WC)	20	3 (WC-8 -- nematodes) (WC-14 -- nematodes) (WC-20 -- helminth egg)	17	vial	1969
WEST END (WE)	27	2 (WE-22 -- nematodes; helminth eggs) (WE-28 -- nematodes; helminth eggs)	25	vial	1969
WEST ALCOVE (WA)	69	-	69	vial (46 samples) & dry (29 samples) representing 69 different coprolites	1969
totals:	168	9	159		

*vial = vial of fine screenings in 0.5% trisodium phosphate, prepared in Berkeley

**dry = dry sample broken from coprolite, reconstituted in 0.5% trisodium phosphate in San Francisco

Explanation of Plates

Plate 1	Anterior portion of a rhabditoid nematode larva from coprolite WC-8, West Crevice, Lovelock Cave, Nevada.
Plate 2	Rhabditoid nematode larva from coprolite WE-22, West End, Lovelock Cave. About 170 microns in length.
Plate 3	Coiled adult male rhabditoid nematode from coprolite WC-14, West Crevice, Lovelock Cave.
Plate 4	Egg, presumably that of a helminth, from coprolite WE-28, West End, Lovelock Cave. Length 60 microns; breadth 40 microns.



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VI.

MITES ASSOCIATED WITH COPROLITES AND MUMMIFIED HUMAN REMAINS IN NEVADA

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The original material was provided by R. F. Heizer and L. K. Napton. Specimens were recovered at the Hooper Foundation and referred to me for identification and study by F. L. Dunn and R. Watkins (Dunn and Watkins 1970). Mites were obtained from a coprolite (B-29) taken from a crevice (the "entrance lot") of Lovelock Cave and reconstituted and screened in the Department of Anthropology, University of California, Berkeley (Heizer 1967; Heizer and Napton 1969). A single mite was found in fecal material dissected from the apparently intact pelvis of a mummy found (as Burial #2) at Pyramid Lake site 26-WA-525 in Nevada. Material from the mummy was reconstituted in 0.5% trisodium phosphate solution at the Hooper Foundation. Mites were mounted in Hoyer's medium (Baker and Wharton 1952) and the slides heated for several minutes at 70°C to expand the specimens. Preservation is excellent, and the final preparations are comparable to those made with fresh specimens. Radiocarbon dating information is not yet available for either of the fecal samples from which mites were recovered. However, the nature and situation of the material is indicative of prehistoric (i.e., pre-contact) placement (Heizer and Napton, personal communication, 1969).

The mites all are in the suborder Sarcoptiformes and represent three non-parasitic families: Anoetidae, Acaridae, Lardoglyphidae. Mites in these families can be anticipated in the reported situations, because of their generally saprophagous habits and frequent phoretic association with dung- and carcass-invading insects. The phoretic form called the hypopus is in the second nymphal or deutonymphal stage. The hypopus does not feed and lacks mouthparts, but it is relatively resistant to environmental stress and, in the species associated with insects, has a sucker plate functioning as an attachment organ.

Three species are represented among the 14 mites recovered from the coprolite. Twelve specimens are hypopi of a _Myianoetus_ species (Anoetidae) (fig. 1). The material is close to _M. dionychus_ Oudemans, 1910 (=_M. diadematus_ Willmann, 1937 = ?_M. digitiferus_ Tragardh, 1904; Scheucher, 1957). _M. dionychus_ has been reported from numerous caves in Europe where hypopi were associated with a variety of cavernicolous insects. Scheucher (1957) notes (translated) "I found the deutonymphs on cave flies in the Sophienhohle at Rabenstein (Frankisch Alps). I could easily rear the adults from this location on feces. In the cave they probably live on bat droppings or on slime and algae."

Another anoetid hypopus (fig. 2) was found in the coprolite, resembling Anoetostoma oudemansi Womersley, 1941 (see Hughes and Jackson 1958). A. oudemansi has been reported only in Australia where hypopi were found on the housefly, Musca domestica.

The last specimen from the coprolite (fig. 3) is a tritonymph of the family Acaridae. This mite could have been brought to the fresh droppings as a hypopus on an insect and moulted to the following stage before its death.

The mites taken from a coprolite sample probably were carried to fresh human feces by coprophilic insects. That is the usual source of such mites in excrement and both the recovered stages (13 hypopi and one tritonymph) and the presumed fecal habitat of the preponderant species are in keeping with this hypothesis. However, anoetid and acarid mites are sometimes ingested with food and passed in the feces, perhaps frequently in most human cultures. It is also possible that a coprolite could be externally contaminated by mites after drying, as through contact with infested bat droppings which overlaid other materials in Lovelock Cave, but the stage composition makes this appear unlikely.

A single hypopus of the monogeneric family Lardoglyphidae was found in the material taken from within the pelvis of a mummy. The hypopus represents an undescribed species of Lardoglyphus. The two described species in the genus are L. zacheri Oudemans, 1927, and L. konoi (Sasa and Asanuma, 1951). L. zacheri was originally described from specimens found on hides in South America. L. konoi is a species of economic importance infesting dried sea-foods in Japan and India. Both species were recorded from butcher's offal in England by Hughes (1956, 1961). The same author, who reared the two species on dried heart muscle, found that hypopi readily attached to larvae of a hide beetle, Dermestes maculatus, and noted that L. zacheri has been collected on larvae of Dermestes lardarius and D. frischii. Dermestes species feed on animal remains in a relatively dry state; some of the larger species found in the arid southwestern United States, e.g., D. maculatus (=D. vulpinus) are commonly used to deflesh dried animals in making skeletal preparations.

Feeding habits of previously known Lardoglyphus species and of dermestids on which the hypopi are phoretic indicate that the Lardoglyphus hypopus from the mummy might have entered the body after it was in an advanced state of dessication but prior to complete mummification. Presence of the mite suggests that the pelvic region of the mummified individual did not remain intact after death, although it is possible that the mite was ingested or entered through the anus. This has obvious implications in the interpretation of the source of other organisms recoverable from the sample, such as helminths.

The new Lardoglyphus is of considerable interest in itself, as the third known species in its family and the first clearly autochthonous record from

North America. The hypopus which will be described elsewhere, is close to L. zacheri in most features but has dorsal setation like that in L. konoi and several features differing from both of the other species. The association of this mite with datable human remains is of acarological significance. It has been suggested that L. zacheri and L. konoi were recently introduced to Europe through commerce (Hughes 1956), a question that would be resolved by evidence of the kind reported here.

At least one new species and possibly others are represented by the mites recorded in this study. It might be rewarding to use fresh fecal material and animal carcasses in an attempt to collect mites at the same sites. In addition to supplying additional material for systematic study, the resulting comparative data on the acarine fauna after an extended interval could be of value to the anthropologist and the climatologist as well as the acarologist.

Figure Captions

Figures 1-3 Mites from coprolite (B-29) in Lovelock Cave.

Figure 1 Myianoetus sp. near M. dionychus, hypopus, ventral view (0.210 mm).

Figure 2 anoetid sp. near Anoetostoma, hypopus, ventral view (0.180 mm).

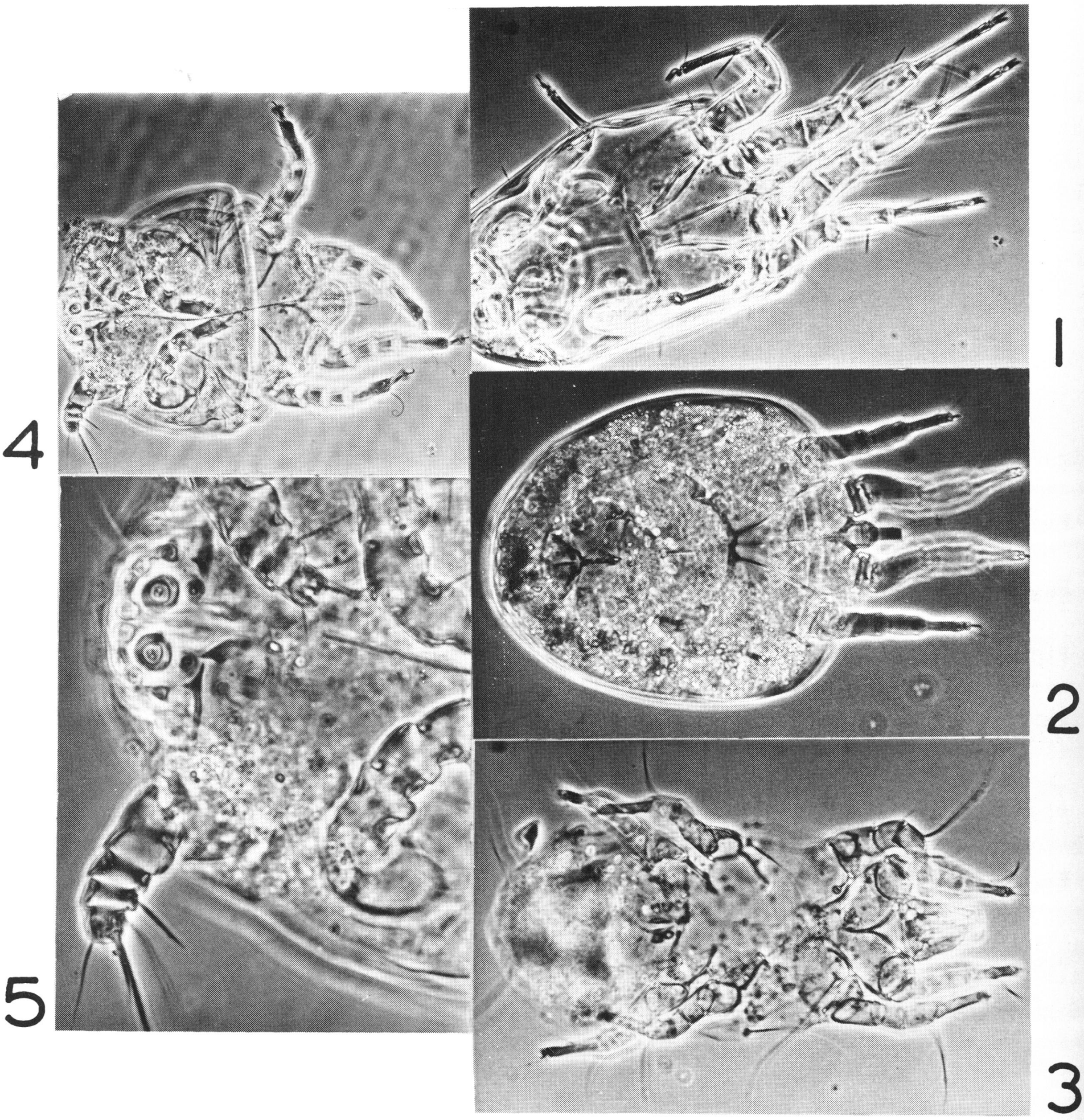
Figure 3 acarid sp., tritonymph (0.218 mm).

Figures 4-5 Lardoglyphus, n. sp. hypopus, from fecal material in pelvis of mummy, burial #2, Pyramid Lake Site (0.260 mm).

Figure 4 Ventral view.

Figure 5 Sucker plate.

(All figures photographed under phase contrast. Measurements are for length of body, without appendages or mouthparts, of each mite photographed.)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VII.

DESCRIPTION OF SKELETAL MATERIAL FOUND IN LOVELOCK CAVE (NV-Ch-18) IN 1969

Mary Ellen Morbeck

The skeletal material from Lovelock Cave, NV-Ch-18, S40/W85, Feature 5, consists of a single mandible, a few complete long bones, and assorted scapulae, clavicles, ribs, vertebrae and other smaller bones.[1] There are no crania or innominates that could be used in determination of age and sex; consequently only limited analysis is possible.[2]

Age variation within the assemblage is indicated by several features. Size, epiphyseal union and dental eruption patterns suggest adult, juvenile and child stages of ossification and development present in this sample of the Lovelock population. More specific identification is impossible due to the unknown variability that probably existed within the population. Computation of stature derived from long bone measurements has not been attempted. As the remains are presumably American Indian, it is difficult to apply formulas for calculating individual height from statistical samples of other racial populations. Furthermore, population variability during the time period represented by this assemblage may not accurately reflect such contemporary ranges of variation. Sexual differences also may effect stature determination. Females are generally shorter and less robust than males. Thus, lacking a representative sample, the few complete bones are not suitable for accurate sex identification (see Brothwell 1965; Krogman 1962).

Skull and Mandible

No complete or even partial cranial material is available for study. A discolored, fragmentary parietal found with the post cranial material is not useful for description. The single mandible is that of a child, approximately five years old. The small, sturdy bone is almost complete, lacking only the left coronoid process, which was broken, post-mortum, at sometime in the past. The deciduous incisors and molars are visible. The medial and lateral milk incisors on each side of the jaw have fused. Each root of these combined teeth is wide, flat and slightly curved. Deep alveoli indicating a large, single rooted deciduous canine tooth, lie lateral to each set of fused incisors. Both left and right milk first and second molars have erupted. Permanent lower first and second molar sockets and developing tooth buds are visible. Unfortunately, the range of variation within the dental morphology is not known, and the single available specimen has deciduous dentition.

Scapulae, Clavicles and Sternum

Three adult scapulae are present, one nearly complete left scapula, and two incomplete right specimens. The single left scapula is relatively large with a prominent spine and areas for attachment of the trapezius and deltoid muscles. Although the coracoid process and inferior angle are broken, the acromial process and axillary border are prominent, exhibiting bony muscular ridges. The transverse scapular ligament has ossified, and the vertebral border suggests some "chipping" of the bone. A corresponding right fragment, perhaps from the same individual, shares features such as size and pronounced muscular attachment regions. The coracoid process is almost complete but the vertebral border has been lost. The third specimen is less robust, displaying less prominent muscle relationships. Both the coracoid process and acromion are broken.

Of the five clavicles, three are from the right side of the body and the remaining two from the left side. Therefore, at least three adult individuals are present in the sample. All appear normal except a gracile left clavicle displaying a very much reduced acromial and, perhaps the result of some pathology in life--for example, a withered arm and restricted shoulder joint.

Three sternal fragments yield little information. The largest indicates clavicular and rib facets but the others are incomplete. Some cartilaginous material adheres to the body of the sternum.

Vertebrae, Sacrum and Ribs

Cervical, thoracic, lumbar and sacral vertebrae are represented in the 20 available specimens. The eight cervicals include two atlases, two axis (one set articulating) and four other vertebrae. All the spinous processes are bifid except in one specimen which approaches this condition, otherwise they are normal. Only one anomaly is evident: an inferior articular facet is assymetrically enlarged in one of the vertebra.

The nine vertebrae exhibit rib facets and long, nearly vertical spines. Several appear to be in articulation. Organic material in the form of bits of cartilage, hair and feathers, adheres to most of the bones.

All three fragmentary lumbar vertebrae seem to be affected by osteoporosis characterized by abnormally porous bone. The sacrum is complete with some organic material attached to its surface. Its size and shape suggest it is a male sacrum.

Little information can be derived from the ribs although two dozen specimens are present. Only one first rib is included in the assemblage. Six right and seven left ribs are identifiable; the remaining are unknown.

Long Bones, Calcaneum and Metacarpals

The right forearm is represented by an articulating radius and ulna. The complete adult long bones are relatively robust, illustrating epiphysealdiaphyseal fusion and prominent areas of muscle attachment. A right fibula is also complete and relatively robust.

At least one non-adult is present represented by a small femur lacking the distal articulation surface and the epiphyseal union of the femoral head and trochanters. Other juvenile specimens may include a humeral shaft and two additional fragments. Several broken unidentifiable long bones are also present in the assemblage.

The single foot bone, the calcaneum, appears to be a left, adult specimen. It is weathered but is apparently normal. Two adult metacarpals are also evident in the deposit.

Other Material[3]

A large femur was sacrificed for radiocarbon determination. The date obtained from the femur is 1450 $\pm$ 80 B.C. (UCLA-1459-C, Berger, personal communication, 1970).

Non-human Material

At least five fragments can be classified as non-human remains. Other very small pieces may also prove to be non-human in origin.

Summary

The osseous assemblage from Lovelock Cave, grid location N40/W85, Feature 5, includes the bones of at least three adults and one child, age approximately five years. Another adult may be represented by a single burned fragment of a parietal. Some of the specimens were in partial articulation *in situ*; however, the assemblage would appear to be a multiple secondary reburial of bones that might have been disinterred from the deposit soon after initial interment. One specimen, a calcaneum, is weathered, which would seem to indicate that it had lain outside the cave for a period of time.

Table 1

Lovelock Cave (NV-Ch-18) S40/W85, Feature 5, Osseous Assemblage

		#	R	L	Comments
1.	Skull frag.	1			black, burned?
2.	Mandible	1			5 yrs., milk I fused
3.	Scapulae	3	2	1	two may be same individual
4.	Clavicles	5	3	2	1 acromial end degenerate, two may be same individual, all fragmentary
5.	Sternum	3			
6.	Vertebrae	20			many with organic material,
	Cervical	8			1 pathology
	Thoracic	9			vertebral arch pathology
	Lumbar	3			osteoporosis, all frag.
7.	Sacrum	1			male
8.	Ribs	24	6	7	11 unknown, 1 1st rib
9.	Long bones	4			
	Humerus	fragments?			
	Radius	1	1		articulates with ulna
	Ulna	1	1		
	Femur	1			juvenile
	Fibula	1	1		
	Other juveniles	3			
	Fragments	5			
10.	Calcaneum	1		1	
11.	Metacarpals	2			
12.	Non-human Fragments	5			

Total Bones - 97 Total Individuals - 4 (?)

Notes

1. Unfortunately, lacking skulls and complete individuals, it would be difficult to make comparisons with other human skeletal assemblages from the Great Basin and California (see Gifford 1926; Loud and Harrington 1929; Kennedy 1957; Reed 1967).

2. I wish to thank Professors R. F. Heizer and S. L. Washburn, and L. K. Napton, for giving me the opportunity to examine the skeletal material found in Lovelock Cave in 1968-69 and the material collected by Loud in 1912.

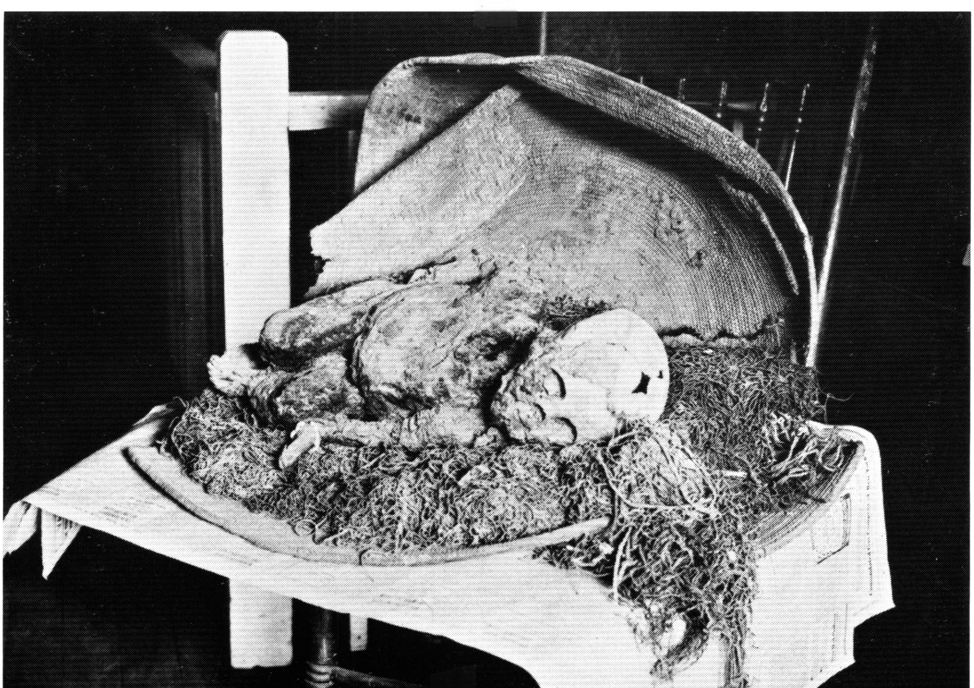
3. Five ribs, one right humerus, and one non-human bone fragment were sent to Dr. J. H. Stopps, Haskell Laboratory, E. I. dePont de Nemours and Co., for trace element analysis.

Explanation of Plates

Plate 1. Lovelock Cave (NV-Ch-18), west end, grid location S40/W85, Feature 5; cache of human bones found at elevation 4205.0, 20.7 feet below the elevation of UCB datum A. Trowel points north. Edge of massive rock A is at left of photograph.

Plate 2. Lovelock Cave (NV-Ch-18), mummy of infant said to have been found in Lovelock Cave *circa* 1911. Note that the fontanel is open. A string of *Olivella* shell beads is in place around the left wrist. The mummy was photographed by John T. Reid, probably in 1916, since the newspapers under the mummy carry that dateline. The mummy is now in the collections of the Nevada State Historical Society Museum, Reno. (Photograph courtesy of the Nevada State Historical Society.)


NV-CH-18
S45/W80
F-5 5/12/69



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VIII.

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R.F. Heizer and L.K. Napton

Lovelock Cave, Nevada (NV-Ch-18) has been under investigation for more than fifty years. The most recent work in the cave has been to collect human coprolites and examine remaining undisturbed portions of the cave fill in order to reconstruct the history of the cave occupation and the depositional chronology. Analysis of the coprolites has been made possible by several grants from public and private institutions and from private individuals. The first phase of the current Lovelock coprolite analysis project, carried out by R. Ambro and R. Cowan in 1966-67, was made possible by a special grant awarded by Dean S. Elberg, Graduate Division.

In 1968 further work was made possible by means of financial support for Napton in the form of a Wenner-Gren Predoctoral Fellowship in Anthropology. Napton completed examination of the coprolites processed earlier by Ambro and Cowan and prepared a detailed report of this phase of the project (Napton 1969: 28-97). Receipt of additional funds in 1968 from the E. I. DuPont de Nemours Co. made it possible for us to continue not only coprolite analysis, but to revisit Lovelock Cave to undertake the first extensive work at the site since 1924 (see Heizer and Napton 1970a).

The most recent phase of the Lovelock coprolite analysis project has been devoted to detailed study of 300 coprolites and other materials from Lovelock Cave (Napton and Heizer 1970). The studies carried out prior to 1968 were described in the series Reports of the University of California Archaeological Research Facility (No. 70). Research carried out during 1967-1968 was reported upon by Napton (1969) and the most recent series of papers appears in the series Contributions of the University of California Archaeological Research Facility No. 7. There are now more separate articles and reports (published since 1967) discussing various aspects of the prehistory of the Lovelock Cave than there are for any other archaeological site in the American West, with the exception of Tule Springs, Nevada (Wormington and Ellis 1969).[1] Therefore, we have thought it worthwhile to present this compilation of the various articles pertaining to Lovelock Cave.

Some of the interim results of the project have been reported at scientific meetings. These include papers read by R. F. Heizer at the Annual Meeting of the American Association of Physical Anthropologists, Berkeley, May, 1966; R. D. Ambro and R. Cowan at the Joint Meeting of the Great Basin Anthropological Conference and Society for American Archaeology, Reno, Nevada, May, 1967; and L. K. Napton at the Annual Meeting of the Great Basin Anthropological Conference, Pocatello, Idaho, August, 1968; the 34th Annual Meeting of the Society

for American Archaeology, Milwaukee, Wisconsin, May 1969; and the 35th Annual Meeting of the Society for American Archaeology, Mexico City, D.F., May 1970.

We wish to acknowledge our appreciation to the following persons and organizations for financial support in connection with the project:

Dean S. E. Elberg, Graduate Division, University of California, Berkeley (funds to inaugurate coprolite research in 1965-1966).

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Dr. J. G. Stopps, Assistant Director of the Haskell Laboratory, E. I. duPont de Nemours and Co., Wilmington, Del. (funds to excavate Lovelock Cave in 1968 and 1969).

Notes

1. Additional references to archaeological investigations at Lovelock Cave published prior to 1957 are given by Grosscup (1957).

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Abbreviations Used

AA	American Anthropologist
AAnt	American Antiquity
CFG	California Fish and Game
SAA	Society for American Archaeology
-M	Memoir
UC	University of California
-AR	Anthropological Records
-ASR	Archaeological Survey Report
-PAAE	Publications in American Archaeology and Ethnology
-CARF	Contributions of the Archaeological Research Facility

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