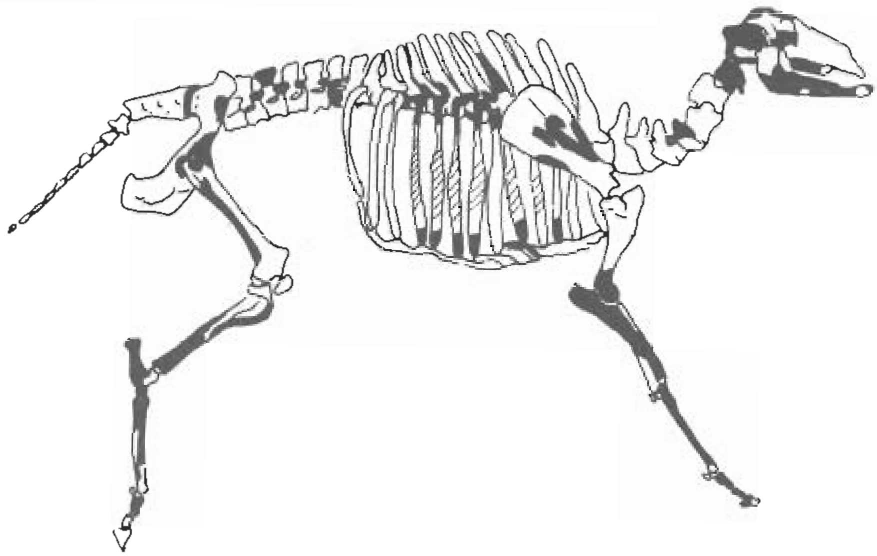
BUREAU OF LAND MANAGEMENT
UTAH



BLACK ROCK CAVE REVISITED

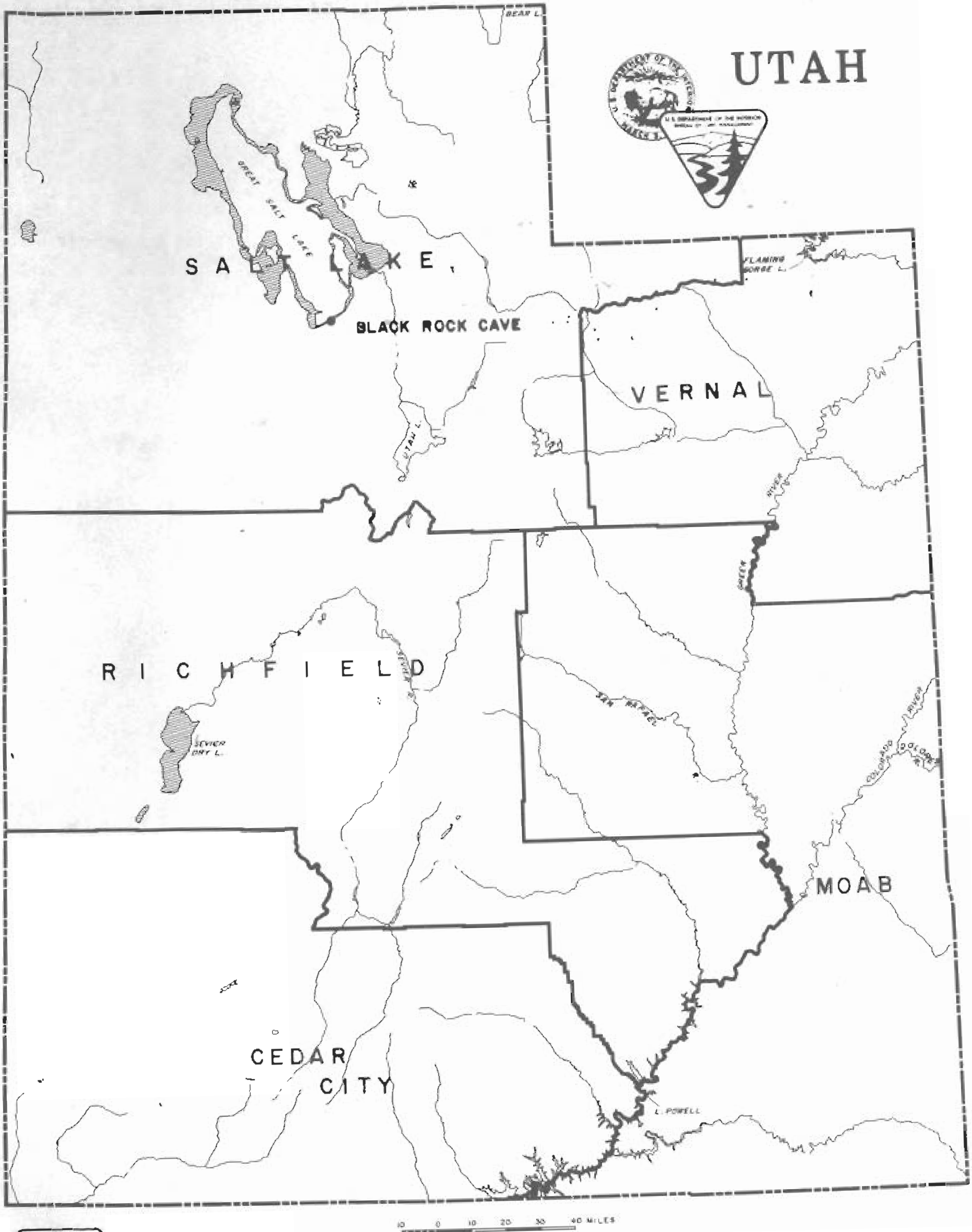
by

David B. Madsen

Chapters by

Patricia W. Dean, Richard E. Fike, Craig W. Fuller,
Richard N. Holmer, Joel C. Janetski, Kenneth E. Juell,
La Mar W. Lindsay, and Tim Pratt

CULTURAL RESOURCE SERIES
No. 14


UTAH
BEAR L.
GREAT SALT LAKE
SALT LAKE
BLACK ROCK CAVE
FLAMING GORGE L.
VERNAL
UTAH L.
GREEN RIVER
RICHFIELD
SEVIER R.
SEVIER DRY L.
SAN RAFAEL
COLORADO RIVER
DOLORES R.
MOAB
CEDAR CITY
L. POWELL
10 0 10 20 30 40 MILES

BLACK ROCK CAVE REVISITED

by

David B. Madsen

with Chapters by

Patricia W. Dean, Richard E. Fike, Craig W. Fuller,
Richard N. Holmer, Joel C. Janetski, Kenneth E. Juell,
La Mar W. Lindsay, and Tim Pratt

Antiquities Section
Utah State Historical Society
and
Department of Anthropology,
University of Utah

September 1, 1983

INTRODUCTION

The reexcavation of Black Rock Cave is yet another project in a continuing series of cooperative efforts between the Bureau of Land Management, Utah and the Antiquities Section of the Utah State Historical Society. In this program, conducted over the last ten years, the efforts of the two agencies have been combined to accomplish survey and excavation projects that were beyond the capabilities of either group. During that period, students and staff from the University of Utah's Department of Anthropology have often made contributions, but at the Black Rock Cave project the Department's Archaeological Center was fully involved for the first time. This cooperative effort produced much more than would otherwise have been achieved; the BLM had some limited funding for analysis, but none for personnel and equipment; the Antiquities Section had supervisory personnel and equipment, but no funds for analysis and insufficient staff for excavation and analysis; the Archaeological Center had limited funding and equipment, but did have interested student and staff volunteers who contributed time to both analysis and excavation. Without the cooperation of any of these three groups the Black Rock Cave excavations could not have been accomplished.

The publication of the Black Rock Cave Revisited, coming more than 50 years after Julian Steward first excavated the site, exemplifies the old cliche that the more things change, the more they stay the same. Despite the advent of new analysis techniques such as ^{14}C dating and pollen analysis, much of the focus of archaeological excavations remains the collection of artifacts in a stratified context that will allow the determination of change through time. Given that this focus was similar during both excavations of Black Rock Cave, it is perhaps not surprising the results obtained by Steward and by the 1982 excavations essentially reinforce each other. However, it is also true that many of the analysis techniques developed over the last 50 years allow a fuller assessment of the life-ways of prehistoric hunter/gatherers. The use of these techniques at Black Rock Cave results in a slightly different story than that obtained by Steward and makes the publication of this more comprehensive narrative a worthwhile contribution to BLM's Cultural Resource Monograph Series.

Richard E. Fike
David B. Madsen

ACKNOWLEDGEMENTS

The 1982 excavations at Black Rock Cave could not have been undertaken without the voluntary efforts of a variety of individuals. First and foremost are the authors of the various sections of this report, all of whom labored in the field, as well as in the laboratory and over the typewriter, without any renumeration. Their altruistic interest in the prehistory of the eastern Great Basin was the only basis for their involvement; furthering that interest was their only reward. They include Richard Fike, Craig Fuller, Richard Holmer, Joel Janetski, Ken Juell, La Mar Lindsay, Tim Pratt, and Patricia Dean.

There were a large number of people involved in both the laboratory and field portions of the project who also served as volunteers, but who will not have even the satisfaction of seeing themselves referenced. They include a number of professionals: Alan Schroedl, Betsy Tipps, Jim Madsen, Jim Kirkman, Liz Manion, Lorraine Dobra, Martha Hayden, and Julie Brunsman; as well as interested amateurs: John Mercer, Renae Hendry, Kevin Agaard, David Weidner, Fred Weidner, and David Jennings.

Voluntary individual efforts can only carry a project so far; analysis costs and general laboratory support are necessary ingredients. The institutions which directly or indirectly sponsored the 1982 Black Rock Cave excavations include the Bureau of Land Management, Standard Oil of Ohio, University of Utah-Department of Anthropology, and the Utah State Historical Society. The cooperative efforts of these institutions and the many individuals who contributed their time and efforts made possible a project which no one group could handle on their own.

ABSTRACT

Excavations at Black Rock Cave, on the northern end of the Oquirrh Mountains eastern Tooele County, Utah, were undertaken in the fall of 1982 as a result of a change from federal to private land ownership. The cave was first excavated in 1931 by Julian Steward. Data retrieved from the two excavations are comparable and can be interpreted with the aid of techniques like ^{14}C and pollen analysis, developed in the 50 year interval between the two excavations. Results suggest the cave was first briefly occupied about 7-6000 years ago. Limited or no occupation occurred during a subsequent 3000 year period. From about 3200 B.P. until after about 1000 B.P. the cave was occupied by late Archaic and Fremont groups. There is limited evidence of protohistoric Numic-speaking groups. Throughout the occupation span, subsistence seems to have been rather broadly based in terms of both flora and fauna and was focused on items immediately available in the vicinity of the cave. Black Rock Cave was apparently part of a "set" of sites occupied briefly but simultaneously. Environmental conditions seem to have remained relatively stable throughout most of the occupational period.

Table of Contents

FIGURES

TABLES

INTRODUCTION

The re-examination of Black Rock Cave (Figures 1 and 2) and the assessment of other prehistoric sites along the northern margin of the Oquirrh Mountains is the result of both federal cultural resource management requirements and the potential these sites have for helping answer many of the most obvious and pressing archeological research questions in the eastern Great Basin. The initial examination of the site was prompted by a proposed land exchange between the Bureau of Land Management and Kennecott Copper. As a result of this transfer of the site from public to private ownership, as well as its status as a National Historic Register quality site, federal law mandated salvage of any artifactual materials and information remaining in the site.

Black Rock Cave was initially excavated by Julian Steward in 1931 and served as one of the sites on which he based his interpretation of the "Ancient Caves of the Great Salt Lake Region" (Steward 1937). Steward excavated the cave in natural stratigraphic levels and it was apparent from the stratigraphy he described and the artifacts he recovered that any undisturbed materials remaining in the cave could prove invaluable in helping solve many of the archeological problems that have evolved in the last 50 years.

In 1980, personnel from the Antiquities Section, Utah Division of State History conducted a reconnaissance of the cave and determined that despite Steward's having excavated nearly half the deposits and despite more than 50 years of concerted relic hunting and vandalism, some intact deposits remained. Unfortunately full-scale, state-of-the-art excavations could not be conducted. Cultural stratigraphy must ultimately be based on artifacts-in-sequence, and the limited undisturbed deposits did not appear to contain enough diagnostic artifacts to be useful in defining such a sequence. However, a number of goals were obtainable even with the limited amount of intact fill. First and foremost, an absolute chronology could be established for the cave deposits by obtaining radiocarbon samples. While in and of themselves such dates could only be of limited utility, there was the possibility that the dates could be related stratigraphically to the artifact sequence obtained by Steward. A dated artifact sequence from Black Rock Cave could be of considerable importance in addressing such problems as (1) a possible hiatus between Archaic and Fremont groups (Steward 1937; Madsen and Berry 1975; Aikens 1976; Madsen 1978) or (2) the relationship and timing of the transition from Fremont to Shoshonian occupations (Madsen 1975; O'Connell, Jones and Simms 1982). Second, and perhaps even more importantly, subsistance information concerning the nature and timing of resource procurement stratagies could be obtained from pollen, flotation and bone samples taken from the deposits. Steward obtained virtually no subsistance information and such data are generally unavailable for all but a few sites in the eastern Great Basin. Since the subsistance/settlement strategies of mobile hunters and gathers can only be determined through the examination of a variety of sites it is critical that these data be obtained from sites like Black Rock Cave.

In sum, the research potential of Black Rock Cave, as well as federal management requirements, mandated salvage of the cave's intact deposits.

Figure 1 - View of Black Rock Cave looking south from the lake edge.

Figure 2 - View of the front portion of Black Rock Cave.

Unfortunately, available funding for the project was sufficient for only a portion of the necessary excavation and analysis and alternative sources of support had to be found. The problem was ultimately resolved by creating a cooperative project involving limited funding from the Bureau of Land Management and Kennecott Copper, equipment and supervisory personnel from the Antiquities Section, Utah Division of State History, staff personnel and students from the Anthropology Department, University of Utah and a number of interested volunteers. The varied skills and interests of this composite group contributed substantially to making the project a more comprehensive analysis of prehistoric adaptation on the northern Oquirrh Mountains.

SETTING

Black Rock Cave is on the extreme northern end of the Oquirrh Mountains directly overlooking the Great Salt Lake. Black Rock Cave, also known as Clinton's Cave, derives its name from the beach which it overlooks and ultimately from a small island/penninsula which protrudes into the lake some 2.2 km northeast of the site. The solution/wave cut cave is at an elevation of about 1396 m (4580') between the Provo and Stansbury terraces of Lake Bonneville and some 175 m (575') above the current elevation of the lake. Map references are SE 1/4, NW 1/4, NE 1/4, Sec. 25, T1S, R4W; UTM zone 12, 450610 N, 394960 E.

GEOLOGY

Black Rock Cave consists of a 105 m (315') long solution and/or wave cut cavern between two vertical limestone bedding units of the Oquirrh Formation, a depositional unit of Pennsylvanian age (Wheeler 1875; Anonymous 1954). The strike of the beds in this area is roughly 41.5^{o} east of true north and, hence, the direction the cave faces is northeast towards the south end of Antelope Island and the Farmington Bay area of the Great Salt Lake. The Oquirrh Formation consists of alternating beds of limestones and shales. In the area of the cave, the softer shales between the two limestone bedding units have been removed and were replaced by a breccia or conglomerate containing fragments of the limestone units. The present opening and the first third of the cave is about 3.4 m wide; it tapers irregularly to a width of about 1 m at the end of the cave. The roof of the cave is quite irregular, varying from less than 1 m to more than 12 m throughout the length of the cave. One interpretation of the formation of the cave is:

> "It thus appears that the first stage in the speleogenesis of Clinton's Cave was the removal by a Bonneville or pre-Bonneville lake of the shale and portions of adjacent beds. Similar unroofed examples are visible nearby today. At a later time, the conglomerate of the roof was subaqueously deposited in this narrow gulch. Finally, the waters of receding Lake Bonneville, at the cave level, resumed the excavations, and produced the cave as we now know it. except for its subsequent fill (Anonymous 1954:2)."

An alternative explanation provided by James Madsen (1982 personal communication) is only slightly different. The softer shales may not have been removed by a pre-Bonneville lake, but rather were broken by faulting and normal areal weathering processes. The breccia roof of the cave was deposited on top of this broken and partially weathered shale and was cemented by the available carbonates derived from the surrounding limestone. With the rise of Lake Bonneville, the underlying shale dissolved and became more compacted, leaving an opening that became the cave. Such an hypothesis explains the uneven nature of the cave roof and may be more plausible.

Whatever its origin, the cave was covered by lake waters from about 19-20,000 years ago to sometime between 13-15,000 years ago (Currey 1980; Currey and James 1982) and the history of the cave and its formation are intimately tied to fluctuations of Lake Bonneville. Subaqueous and/or beach gravels form the basal deposit in the first half of the cave. The upward slope of the floor in the middle of the cave prevented the deposition of gravels in the rear. The upper 10-20 cm of these lake gravels are poorly cemented with calcium carbonates and are stained a blackish-brown by organic debris. The date on overlying cultural materials suggests the cave remained essentially vacant for some 7-8000 years after recession of the lake and the cementing of the lake gravels probably results from the seepage of water through the overlying breccia.

CLIMATE

The northern Oquirrh Mountains fall in a climatic regime which cross-cuts the central Great Basin and extends into the central Wasatch Mountains (Kay 1982). However, general weather patterns found in this regime are modified somewhat around the Great Salt Lake by what has been called the lake effect (Eubank and Brough 1980) which often intensifies rain and snowfall. The two weather stations at the Salt Lake airport and at Tooele essentially bracket the Black Rock Cave area and have record durations long enough to provide some evidence of common patterns. According to Eubank and Brough (1979:235-236), the area around the Salt Lake station, some 13 miles east northeast of the cave, has:

> ....a semi-arid continental climate with four well-defined seasons. Summers are characterized by hot dry weather, but high temperatures are usually not oppressive, since relative humidity is generally low and the nights are usually cool. July is the hottest month, with average high temperatures in the 90s. The average daily temperature range is about 30^{o} in the summer and 18^{o} during the winter. Temperatures above 102^{o} in the summer or colder than 10^{o} below zero in the winter are likely to occur one season out of four. Winters are cold, but usually not severe. Mountains to the north and east act as a barrier to frequent invasions of cold continental air. The average annual snowfall (is) under 60 at the airport....The average maximum depth of snow during the winter varies from nine to about 13 inches. The average duration of continuous snow cover is 29 days. Precipitation, generally light during the summer and early fall, reaches a maximum in spring, when Pacific storms are moving through the area more frequently than at any other season. Winds are usually light....The growing season is quite long, averaging about 161 days from May 3rd to October 11th. The last freezing temerature in the spring usually occurs in April.

At Tooele, about 14 miles south southwest of Black Rock Cave precipitation averages 16 inches per year and:

> Wettest months are March and April, while July and September are the driest months. Temperature averages are similar to other valleys in northern Utah. Cold winter weather is rarely severe. Snowfall is moderately heavy, averaging about 75 inches for the year. Summers are warm and dry, but hot spells are of short duration and are offset by low humidity and cool nights. Daytime temperatures will equal or exceed 90^{o} on about half of

the days during July and August, and extremes of 100° or higher occur only about once in every four seasons. Annual extremes in an average year are -1° and 98°. The average growing season of 179 is somewhat longer than in most places in Utah. Freezing temperatures have been recorded up to the middle of June and as early as the first of September (Eubank and Brough 1979:255).

FLORA

Due to disturbance caused by copper milling operations on the northern end of the Oquirrhs, the present vegetation in the vicinity of Black Rock Cave has been modified somewhat from pristine conditions. A somewhat better understanding of the types of vegetation which surrounded the cave during periods of prehistoric occupation can be gained from descriptions left by early travelers and naturalists. Unfortunately these historical records often tend to be somewhat generalized and locational information is usually inaccurate. However, occasionally these historical records produce true descriptive gems, as is fortunately the case with Black Rock Cave.

Early travelers, following the Hastings cut-off around the south end of the Great Salt Lake, describe a series of springs and bogs around the north end of the Oquirrhs and west into Tooele Valley. A brackish spring slightly northeast of Magna (about 4-5 miles east of the cave) was described Heinrich Lienhard in 1846 as:

> "a swampy section, where bulrushes and a little rank marsh grass grew.......the water was salty and unpalatable, so the stock refused it. Two miles farther on we arrived at the foot of the mountain (the northern Oquirrhs), where a large, crystalline springs, somewhat warm and a little brackish, welled out of the ground. (This is probably in the vacinity of Garfield about 2.5 miles east of the site.) We passed along the occasionally marshy shore at the south end of the Salt Lake and camped finally at a large spring at the foot of the mountains, the water of which was slightly brackish. An expanse of swampy meadowlands here separated us from the lake." (Korns 1951:136-137).

One (or a series) of these springs, possibly less saline than the majority, was apparently in the vicinity of Black Rock cave since the area was selected by H. Kimball as the location of the first ranch in the area. A description of the vegetation around the ranch was provided by Ludlow in 1870:

> "On this ascending series of plains (Ludlow is here in the vicinity of Saltair moving towards Black Rock), no trees or large shrubs are anywhere visible. The vegetations of the moister portions chiefly consists of various sedges, rushes, and grasses: comprising an 'Equisetum' or scouring rush; a species of 'Juncus'; the blue-eyed, feather, hedgehog, and squirrel-tail grasses.....; with a variety of 'Scirpus' or club-rush, and of the 'Chara' or feather-bed plant, in the pools and marshes. On the higher levels, our

old comrade the sage appears again and a plant somewhat resembling it in fetid pungency, the hemlock geranium......The yarrow.....(also) exists here (Ludlow 1870:377)."

Probably the most fortunate early visitor to the Black Rock area was one of the foremost North American naturalists of the 19th century and the founder of the Sierra Club, John Muir. Muir visited the area twice in May and July of 1877 and provides eloquent descriptions of the local flora. During the May visit he limited himself to a swim at the beach, but describes "buttercups and wilds peas....blooming close down to the waves (Bade 1970:122)." In July, Muir hiked from the lake edge to the upper peaks of the Oquirrhs and described the vegetation along the way. From his description, it appears that his route took him along a ridge just west of the cave. While Muir focused primarily on descriptions of various lilies in bloom at the time his general description of the undisturbed vegetation is probably the best available for the northern Oquirrhs:

> Looking southward from the south end of Salt Lake, the two northmost peaks are seen swelling calmly into the cool sky without any marked character, excepting only their snow crowns, and a few small weedy-looking patch of spruce and fir, the simplicity of their slopes preventing their real loftiness from being appreciated. Gray, sagey plains circle around their bases, and up to a height of a thousand feet or more their sides are tinged with purple, which I afterwards found is produced by a close growth of dwarf oak just coming into leaf. Higher you may detect faint tintings of green on a gray ground, from young grasses and sedges; then come the dark pine woods filling glacial hollows, and over all the smooth crown of snow....From the more southerly of the two peaks a long ridge comes down, bent like a bow, one end in the hot plains, the other in the snow of the summit.....I determined to make it my way. I had not gone more than a mile from Lake Point ere I found the way profusely decked with flowers, mostly compositae and purple leguminous....This floweriness is maintained with delightful variety all the way up through rocks and bushes to the snow-violets, lilies, gilias, oenotheras, wallflowers, ivesias, saxifrages, smilax, and miles of blooming bushes, chiefly azalea, honeysuckle, brier rose, buckthorn, and eriogonum, all meeting and blending in devine accord. Two liliaceous plants in particular, _Erythronium grandiflorum_ and _Fritillaria pudica_, are marvelously beautiful and abundant. (They) grow in all kinds of places-down in leafy glens, in the lee of windbeaten ledges, and beneath the brushy tangles of azalea, and oak, and prickly roses.......I noticed the tracks of deer in many places among the lily gardens, and at the height of about seven thousand feet I came upon the fresh trail of a flock of wild sheep.....The evergreen woods consist, as far as I observed, of two species, a spruce and a fir, standing close together, erect and arrowy in a thrifty, compact growth....A considerable portion of the south side of

the mountain is planted with a species of aspen, called 'quaking asp' by the wood-choppers (Bade 1970:127-132).

Muir fails to mention two important woody species that, from current distributions and from pollen and plant macrofossil data from the cave, probably occurred fairly close to the Black Rock Cave. These include juniper (Juniperus osteosperma) and hackberry (Celtis reticulata). The present primary distribution of pinyon (Pinus monophyla) is on the south end of the Oquirrhs and if John Muir's description is at all accurate, it may be that this pattern is one of long standing.

FAUNA

The northern Oquirrh Mountains fall in the Great Basin Faunal Area of Utah as defined by Durrant (1952). It is distinct from other faunal areas in the the state principally by having a large number of species and subspecies of rodents which are unique to the area. This feature appears to be the result of the mountain "island-like" geography of the area which isolates individual mountain ranges, and hence the boreal mammals which inhabit them (Brown 1971; Grayson 1982). The Oquirrhs are one of 17 isolated ranges studied by Brown and Grayson and the number of boreal mammal species which inhabit them (5) suggests they are about average in terms of the length of time they have been isolated from other ranges.

Otherwise, the area of the northern Oquirrhs has all the animals common to Utah. Large game such as deer and elk occur on the mountains. As Muir noted mountain sheep occurred as late as 1877 and bison were known historically from the area (Durrant 1952). Smaller game animals such as various hares, rabbits, pikas, and larger squirrels are common. Carnivorous include bears, mountain lions, bobcats, coyotes, and foxes. Spring bogs along the base of the mountains provided habitates for a variety of marsh species such as muskrats. These same marsh areas also were the sources of over 100 species of aquatic birds such as ducks and geese.

PALEOENVIRONMENTS

An excellent summary of Late Quaternary paleoenvironments has recently been produced by Currey and James (1982). Using both biological and geological evidence (Figure 3), they have defined an environmental sequence that is probably relatively accurate on the order of 1000 year intervals. It is not probable that resolution to a finer scale can be produced in the forseeable future (Kay 1982). This is unfortunate since it is precisely the finer scale information on specific climatic and environmental features such as location and amount of water, type and availability of plants, and the numbers and distribution of animals, that are necessary for archeological interpretation. Despite that limitation there are broad correlations between climatic events and cultural change which can be identified.

Between about 20,000 to about 14,000 years ago variably full glacio/pluvial conditions were characterized by depression of treelines more than 500 m, a rise in closed basin lakes to their highest level, and the maximum extent of montain glaciation. These conditions began to change rapidly about 13,000 years ago (but see Eugster et all n.d. who

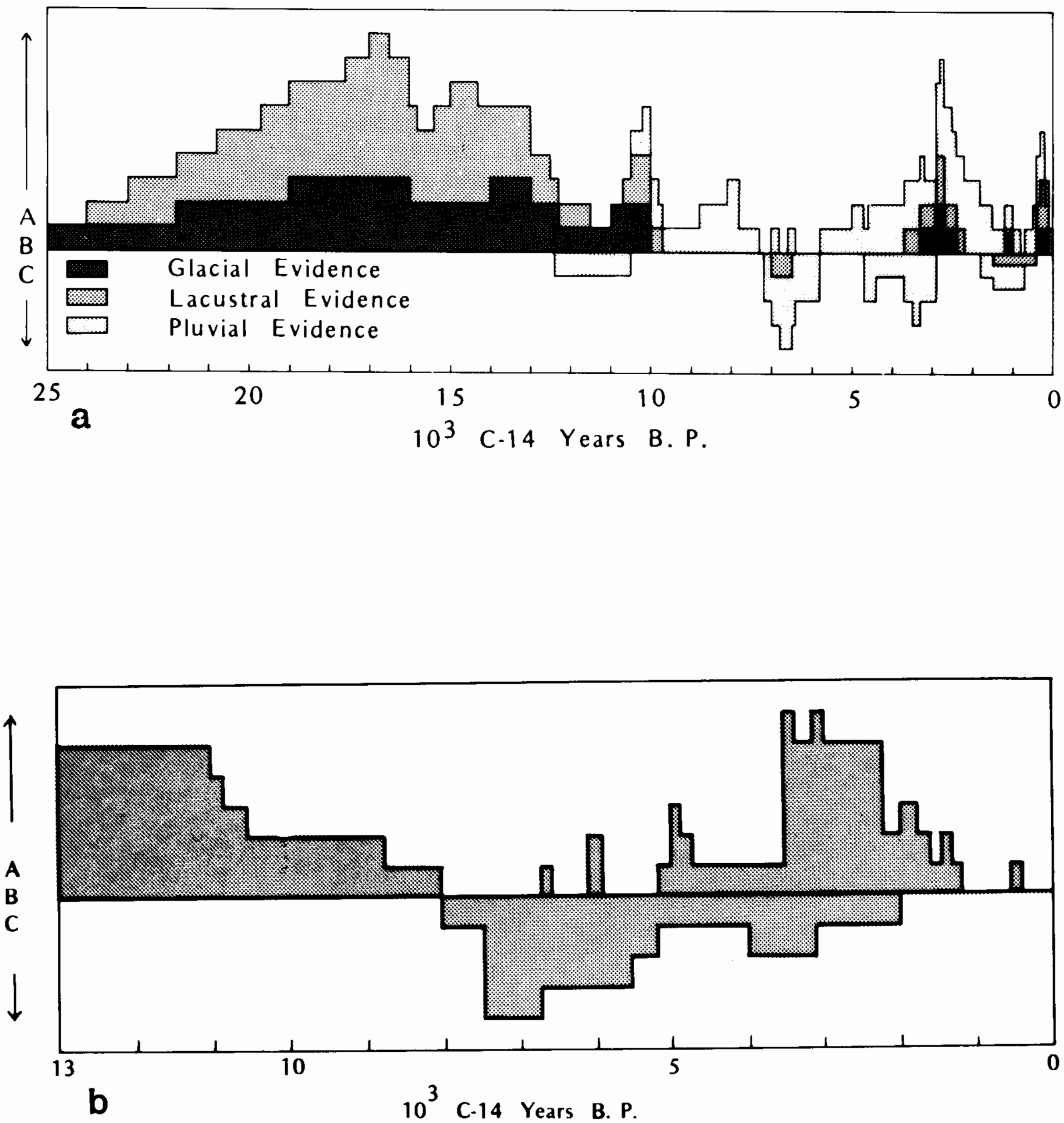


Figure 3 - Summary diagrams of late Quaternary paleoenvironmental changes based on physical (a) and biological (b) evidence (from Currey and James 1982).

suggest this rapid decline occurred about 15-14,000 years ago in the Bonneville Basin.). By 12-11,000 years ago, the period when prehistoric groups are first recorded in the area, pluvial Lake Bonneville had receded to below 1314 m and did not subsequently rise above this level.

The continuing reduction in levels of Lake Bonneville were slowed by a still-stand about 10,500 and possibly again about 8000 years ago. Vegetation, primarily salt tolerant species, on the valley floors changed rapidly with the elimination of water cover (Madsen and Kay 1982), but in higher elevations they changed more slowly and suggest that conditions remained cooler than the Holocene average until about 8000 years ago (Madsen and Currey 1979). During the early mid-Holocene, about 7500-5000 years ago, conditions reached their warmest and dryest. The Great Salt Lake became almost completely dessicated and vegetation zones on some mountain ranges shifted upwards as much as 150 m. Marsh areas around the Great Salt Lake may have been reduced in size but did not disappear (Currey 1980).

Neoglacial episodes dated to about 5500-4500, 3500-2000, and 1500-600 years ago are recorded in the area. The middle stade appears to have had the greatest impact on lake levels. Some of the lower elevation marshes, including those directly north of the Oquirrh Mountain sites, may have been flooded-out during this interval. Types and locations of vegetation probably did not change, but productivity of various species, and the animals which depended on them, may have changed significantly. This is particularly true of pikas, rabbits, and hares which seem to be significantly reduced during the mid-Holocene and afterwards (Grayson 1982). The only major vegetation change was that pinyon pine became a significant component of lower northeastern Basin coniferous forests during the early portion of these Neoglacial episodes (Madsen 1984). There appears to be some correlation between major episodes of Holocene climatic change and cultural change, but the nature of this correlation remains unclear at present.

AN INFORMAL SURVEY OF THE NORTHERN OQUIRRH MOUNTAINS

by
Tim Pratt

In conjunction with the 1982 excavation of Black Rock Cave, an informal field survey was conducted of areas adjacent to the cave in the northern Oquirrh Mountains. The purpose of this survey was to locate and record other caves and open sites in the area which might contain information useful for comparisons with data collected at Black Rock Cave and to reestablish the locations of previously recorded sites in the vicinity.

The northern Oquirrh survey area, most of which lies to the east of Black Rock Cave, coveres about 24 sq. km (9 sq. miles) of mountain slope in Utah's Salt Lake and Tooele Counties (Figure 4). The general topography of the area consists of northward trending ridges and ephemeral drainages interspersed with numerous rocky outcrops. A number of spring localities occur at the base of these outcrops where they meet the flat lying lacustrial deposits of Lake Bonneville.

Two of the remanent terraces of Lake Bonneville, the Stansbury and the Provo, are particularly evident within the bounds of the survey area and run generally east and west at an elevation of 4420-4520 ft and 4790-4925 ft respectively. The higher Bonneville terrace, which is also quite evident in portions of the survey area, was not extensively examined as a part of this survey.

The remnant terraces of Lake Bonneville proved to be associated with a high proportion of the cave sites recorded in the course of field examinations when those terraces bisected an area containing rock outcrops. This is probably due, in part, to the accelerated rate of erosion on those sections of rock exposed to wave action over long periods of time.

As a result of the initial literature search of the site files at the Utah Division of State History and the subsequent investigations in the field, seven prehistoric sites were identified as occurring within the bounds of the Black Rock survey area. In addition to Black Rock Cave, six other caves and one petroglyph site are recorded. They are as follows:

42SL1 (Deadman Cave)
SW 1/4 of the SW 1/4 of the SW 1/4 of Sec. 14, T1S, R3W. Deadman Cave is located about 7.4 km (4.6 miles) east by northeast of Black Rock Cave I and occurs at the lowest elevation (4280 ft) of all the sites in the study area. The cave was excavated in 1941 and contains both Archaic and Fremont components (Smith 1952).

42SL72 (Cave)
NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 20, T1S, R3W. 42SL72 is located about 2.5 km (1.6 miles) east by northeast of Black Rock Cave and immediately above the Provo terrace of Lake Bonneville at an elevation of 4900 ft above sea level. The cave measures 13 m deep by 8 m wide near the back and has a

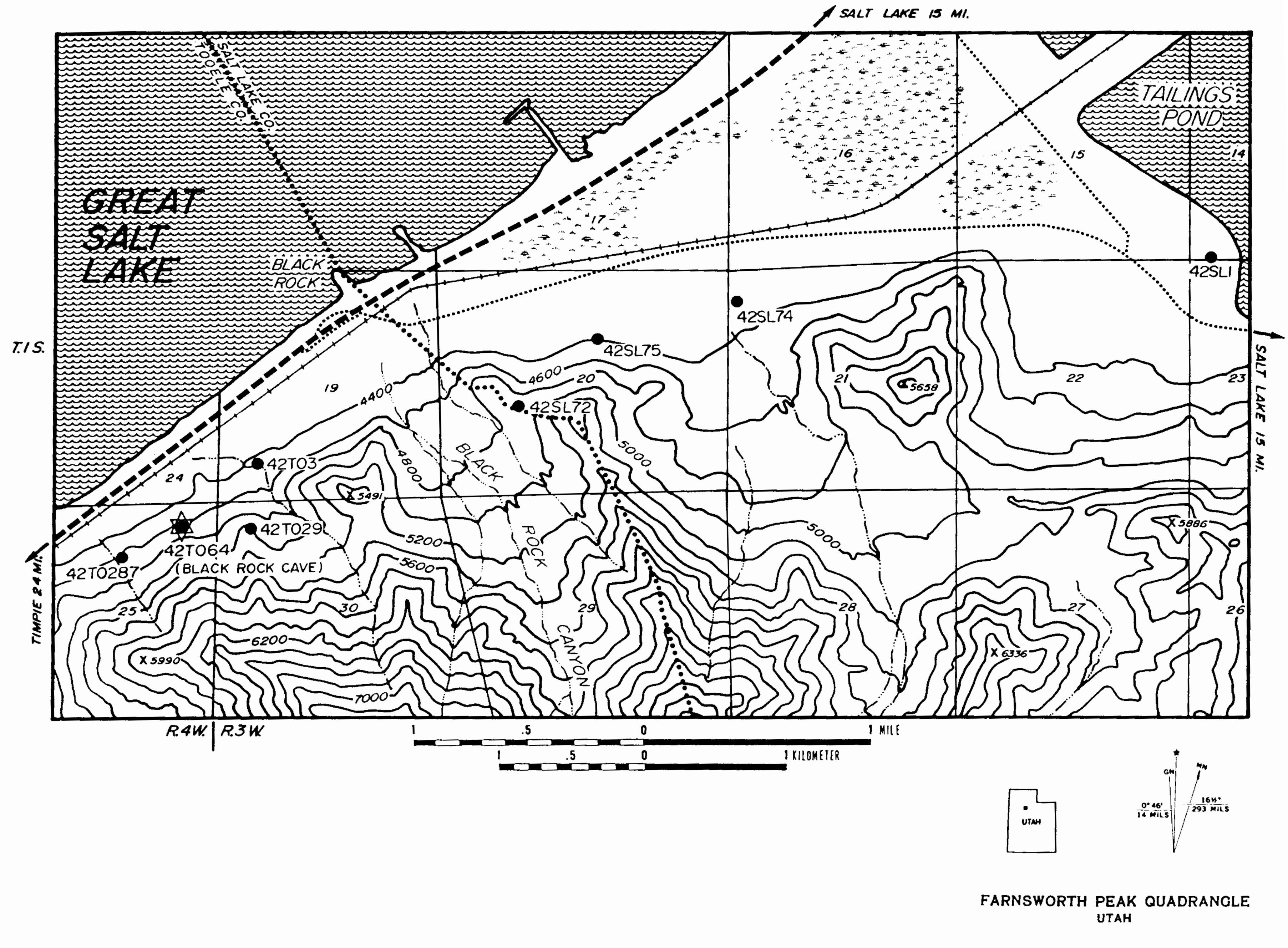


Figure 4 - Overview of northern Oquirrh Mountains.

relatively high roof dome (Figure 5). Cultural artifacts observed inside of the cave include: a mano fragment: 50+ white, orange-red, and tan chert thinning flakes; and many large mammal bone fragments including a human rib. Due to the lack of diagnostic artifacts at this cave site, cultural affiliation remains unknown.

42SL74 (Petroglyph)

SW 1/4 of the NW 1/4 of the NW 1/4 of Sec. 21, T1S, R3W. 42SL74 is a petroglyph site located at an elevation of 4300 ft above sea level and about 4 km (2.5 miles) east by northeast of Black Rock Cave I. The curvilinear petroglyphs are found on two large detached rocks laying on the lacustrial flats between the foot of the Oquirrh Mountains and the Great Salt Lake.

42SL75 (Cave)

NW 1/4 of the SW 1/4 of the NE 1/4 of Sec. 20, T1S, R3W. 42SL75 is a small cave located about 3.1 km (1.9 miles) east by northeast of Black Rock Cave I. The cave is situated in a small rock outcrop slightly below the Stansbury terrace at an elevation of 4420 ft. above sea level. The floor of the cave slopes sharply upward from a point near the entrance which leaves the habitable area of the interior at only 30 sq. m (Figure 6). This site has been heavily vandalized and no cultural artifacts with the exception of a screen sieve were noted. However, the vandal's backdirt piles contained a large amount of ash and small animal bones.

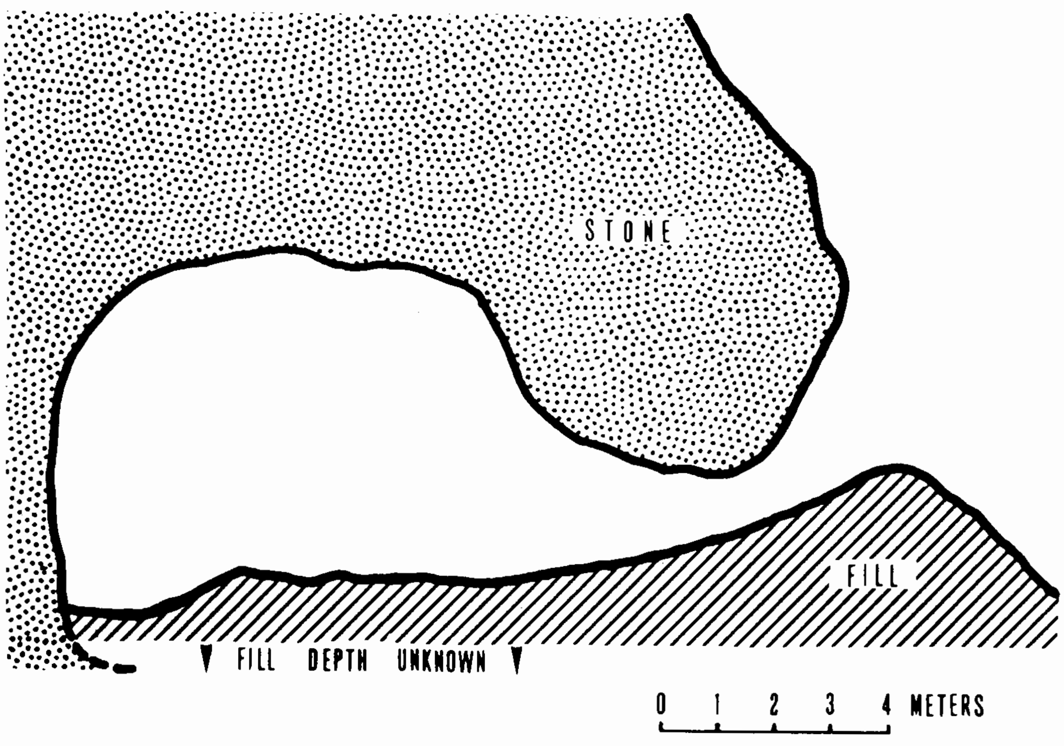


Figure 5 - Cross-section of cave 42SL72 showing depth and roof dome.

42To3 (Black Rock Cave III)

NE 1/4 of the SW 1/4 of the SW 1/4 of Sec. 19, T1S, R3W. Black Rock Cave III is located just 600 m (.4 miles) northeast of Black Rock Cave and is situated just below the Stansbury terrace at 4490 ft above sea level. The cave, measuring 6 m wide at the entrance by 7 m deep, was excavated in 1939 and contains both Archaic and Fremont components (Enger 1942).

42SL29 (Black Rock Cave II)

NE 1/4 of the NW 1/4 of the NW 1/4 of Sec. 30, T1S, R3W. Black Rock Cave II is a relatively large open cave which is situated just above the Provo terrace at an elevation of 4920 ft above sea level. This cave is located about 500 m (.3 miles) east of Black Rock Cave and faces north by northeast. It measures 19.5 m deep by 17.5 m wide in the rear and has a relatively high roof measuring 8 m above the floor (Figure 7). No cultural artifacts were observed in the cave, but numerous vandal trenches were noted.

42To287 (Cave)

NW 1/4 of the NE 1/4 of the NE 1/4 of Sec. 25, T1S, R4W. 42To287 is located about 500 m (.3 miles) west by southwest of Black Rock Cave and is situated at an elevation of 4600 ft above sea level. The cave faces the southwest and measures 14 m deep by 6 m wide. The cave slopes down from the entrance and appears to contain substantial amounts of undisturbed dry fill. Two human ribs were observed on the surface and several geometric charcoal designs have been drawn on the rear walls. No diagnostic artifacts were observed in the cave and cultural affiliation remains unknown.

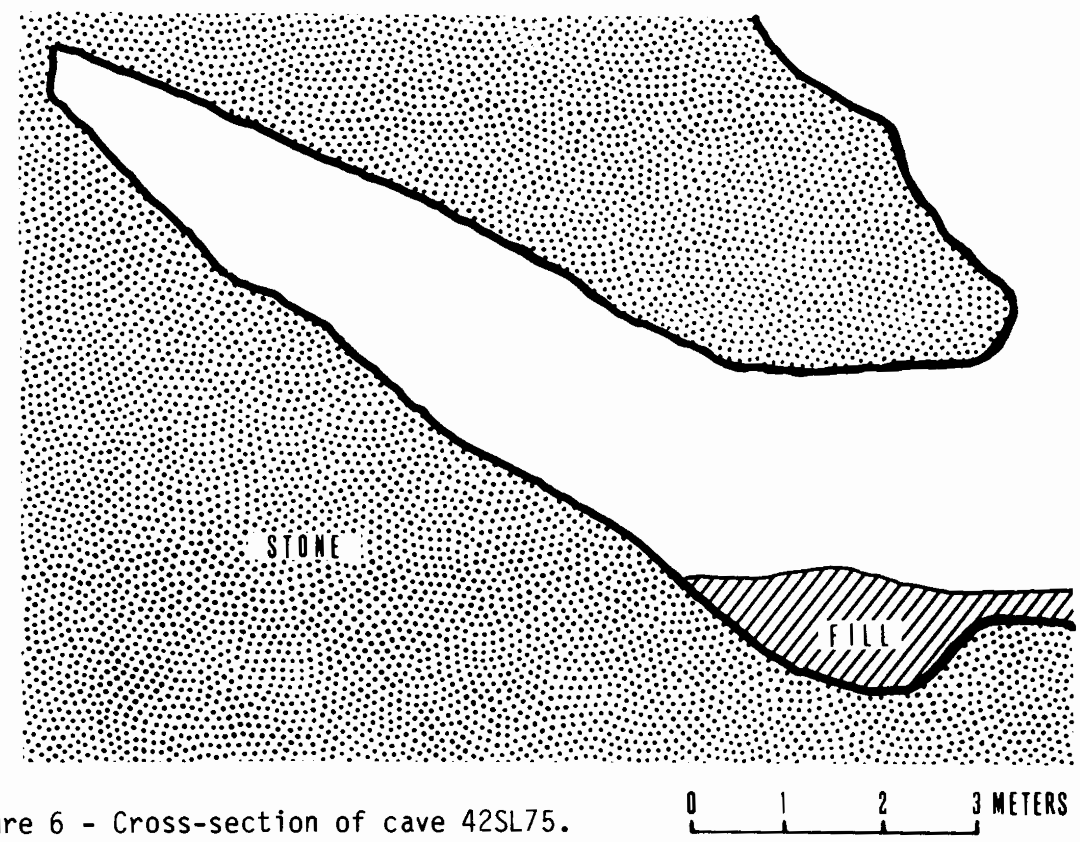


Figure 6 - Cross-section of cave 42SL75.

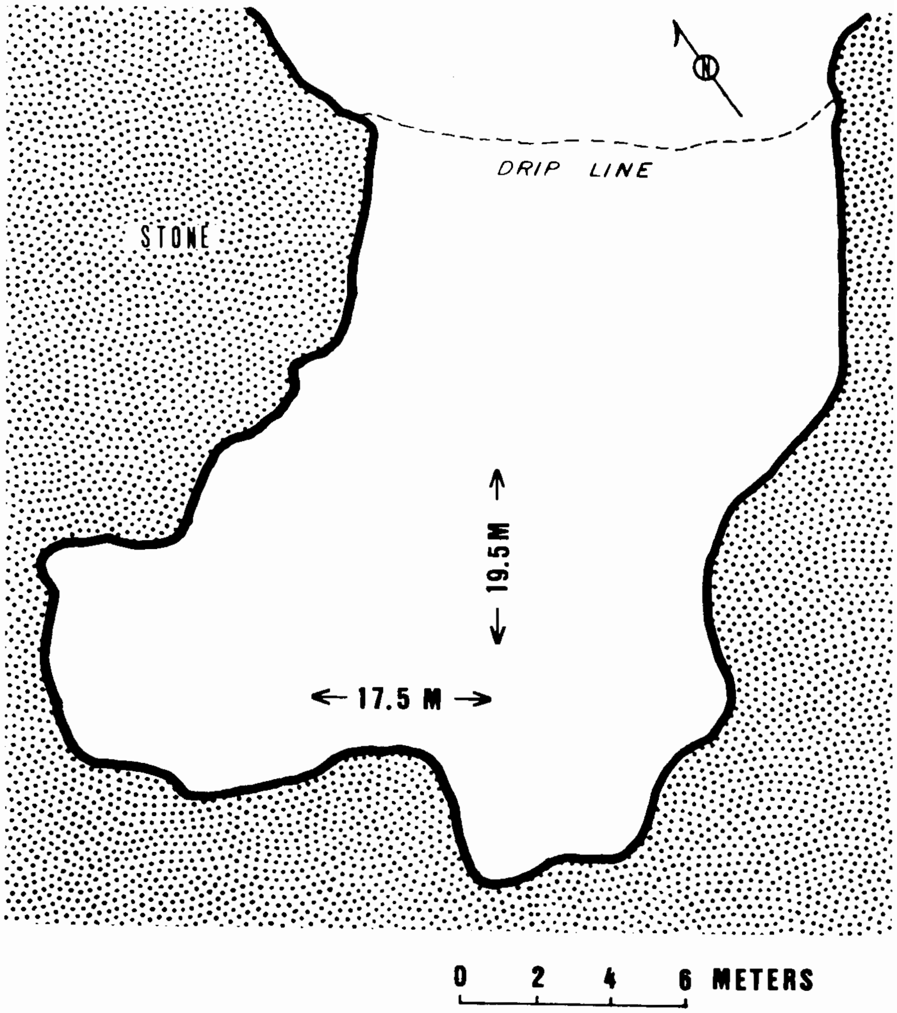


Figure 7 - Plan view of Black Rock II.

RESEARCH DESIGN

PREVIOUS RESEARCH

Archeological research in the vicinity of Black Rock Cave began with poorly reported amateur investigations in the late 1860's-early 1870's (Judd 1926). Scientific excavations (Figure 8) were not initiated in the area until the early 1930's when Julian Steward and Elmer R. Smith, both of the University of Utah, began excavations at Black Rock and Deadman's caves on the north end of the Oquirrh Mountains. Steward continued with work at caves on the Promontory Pennisula while Smith excavated Black Rock II (Steward 1937; Smith 1942). Steward also investigated open sites in the Tooele valley area just west of the northern Oquirrhs (Steward 1933). Smith and Robert Heizer subsequently conducted brief excavations at caves on the western margin of the Great Salt Lake Desert (reported in Rudy 1953). In 1942 Walter Enger reported the excavation of Black Rock Cave III, but this was the last signficant work in the area for a decade. In the late '40s and early '50s Jesse Jennings and his co-workers begin a series of excavations and surveys in the Wendover area of western Utah, with the most important of these being the excavation of Danger Cave (Jennings 1957; Price 1952; Rudy 1953). Other than briefly reported cave/rockshelter sites on Stansbury Island (Jameson 1958), no further work was done in the area until the late '60s when Aikens (1970) began work at Hogup Cave on the northwestern margin of the lake, Marwitt, Fry and Adovasio (1971) excavated Sandwich Shelter on Stansbury Island, and Fry (1970) resampled Danger Cave to obtain additional radiocarbon samples.

This sequence of projects generally reflects the changing research paradigms common to most Great Basin archeology (Fowler and Jennings 1982; O'Connell, Jones and Simms 1982). A cultural historical approach, characterized by the simple, but necessary, attempt to place artifacts in time and space, was used in the early work. The earliest definition of time/space relationships was that of Steward who suggested that an early people using "swallowtail points and slate blades" were replaced after an interval of unknown duration by a people using broad corner-notched points and small side-notched points used for arrows (1937:106). This sequence was either accepted or ignored by all subsequent researchers until Jennings (1957) suggested that the area had been continuously occupied, albeit by peoples using changing artifact inventories, throughout a 11-12,000 year time span. Despite some criticism by western Basin specialists (e.g. Baumhoff and Heizer 1965) this culture historical sequence was widely accepted until Madsen and Berry (1975) suggested that Steward's original interpretation may have been closer to the actual historic sequence. Since then there has been an unresolved debate concerning possible cultural continuity and a number of possible occupational breaks that may have occurred (Aikens 1970; Madsen 1975; Aikens 1976; Madsen 1978; Adovasio 1979; Marwitt 1979; Madsen 1979; Holmer 1978; Thomas 1981; Madsen 1981; Lyneis 1982; Madsen 1982a). At present the following cultural history sequence, modified from Madsen (1980) and combined with the areas of controversy can be identified:

> Brief Paleo-Indian occupation (ca. 12,000 to 9,000 B.P.); evidence of type of subsistence limited, but probably combination of hunting Pleistocene megafauna and collecting lake periphery resources.

Possible hiatus?

Early Archaic (ca. 8500 to 5500 B.P.); basically sedentary on lake periphery with subsistence focused on marsh and lake-edge resources.

Mid-Archaic (5500 to 3500 B.P.); migratory hunting and gathering based on both upland and lake-edge resources; population reduction.

Late Archaic (3500-2500 B.P.); upland hunting and gathering subsistence and occupation; evidence of lake margin habitation or use limited; population markedly reduced or regional abandonment.

Possible population reduction?

Fremont/Sevier (1500 to 500 B.P.); both sedentary village life with use of domesticates and migratory hunting and gathering.

Possible population replacement?

Proto-Shoshoni (550 B.P. to Present); migratory hunting and gathering; degree of sedentarism variable dependent on local resources.

Clearly, more than just culture history is defined in this sequence. This subsistence/settlement information is the result of a descriptive ecological approach that has dominated Great Basin archeology for the last 10-15 years (O'Connell, Jones and Simms 1982). The basic research questions involved in this approach include (1) discovery of those environmental parameters critical to the selection of site location; (2) the range of plants and animals used by prehistoric groups, as well as the timing of their procurement and the degree of reliance on any one species; (3) discovery of any climatic/environmental change which may have affected subsistance strategies; and ultimately (4), the degree of change that has occurred in subsistence/settlement stratagies (if any) and how such changes may be related to environmental, technological and social changes.

A third approach, involving the discovery of how and why people use the plants and animals that they do and why they live where they do is beginning to be used. This approach utilizes many principals of evolutionary ecology (O'Connell, Jones, and Simms 1982), but is difficult to use in prehistoric contexts. As a result archeologists must turn to biology and studies of modern hunter/gather to determine these principals (Aikens 1982; Madsen 1982a). Sites like Black Rock Cave, either individually or in mass, simply cannot provide answers to these types of questions and any research design involving the excavation of such sites must necessarily be directed towards answering the many remaining cultural historical and descriptive ecological questions.

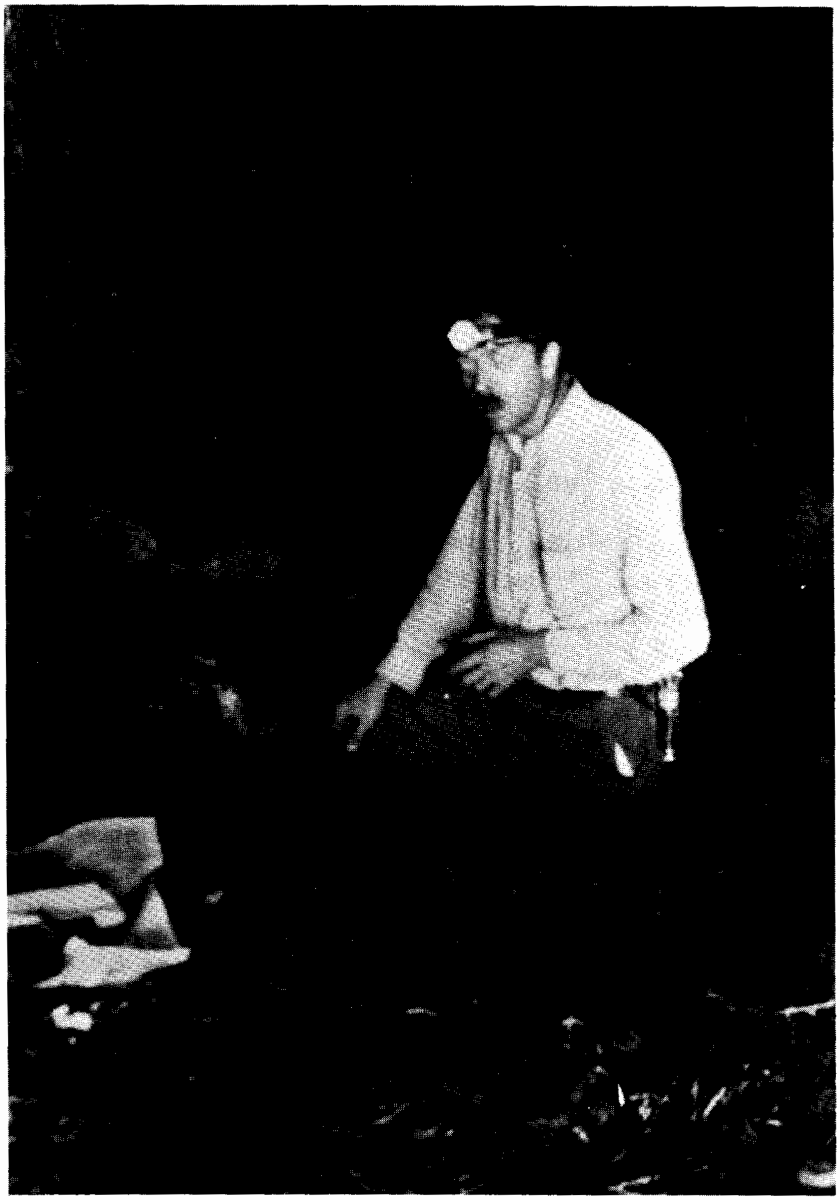


Figure 8 - Charles Kelly standing in the middle of his "test pit" prior to reporting of the site to Julian Steward in 1931 (Utah State Historical Society Photo Library).

RESEARCH QUESTIONS

The research design at Black Rock Cave focuses primarily on cultural historical and cultural ecological problems. A major cultural historical question involves the dating of the cave deposits and the artifact sequence defined by Steward and supplemented by our excavations. Despite more than 50 years of research in the Great Basin, some debate persists over the placement of many artifact types, particularly projectile points, in time and space (Thomas 1982; O'Connell, Jones and Simms 1982; Holmer 1984). A second historical problem revolves around when the initial use of lake-side cave sites began and how long such use lasted. A third and fourth question is whether artifact complexes associated with Fremont and Paiute/Shoshoni groups appear gradually in a transitional fashion, appear abruptly but immediately after earlier complexes, or appear abruptly after an occupational break of some length.

Ecological questions revolve around determining, as closely as possible, the subsistence base used by different groups while they occupied the cave and whether or not this subsistence based changed through time. A related question was to determine the seasonality of occupation by examining both the age and types of various plants and animals represented in the deposits. A third problem to be investigated was the relationship between changing environmental conditions and changes in the use and possibly the availability of various floral and faunal types. Lastly we hoped to examine any non-local floral types to determine other environmental zones which may have been exploited and what season of the year this exploitation occurred.

These various questions were investigated by an extensive sampling strategy that focused on two limited areas of undistured deposits in the cave. In these two areas the limited stratigraphy was defined and sampled for pollen and macrofossil flotation procedures. Once the various strata were defined they were systematically removed and screened to recover artifacts and larger faunal materials. This excavation process revealed fire hearths and other cultural features which were sampled for radiocarbon dating and again for pollen and flotation analysis. Together these samples provide a stratigraphically and chronologically controlled sequence of artifacts, animal remains, and plant parts that provide data which can help answer some of the research questions posed at the beginning of the project.

EXCAVATION PROCEDURES

The Black Rock Cave excavations were initiated on October 19, 1982 by mapping the extensively disturbed surface of the cave floor. This surface map was coordinated with a similar map drawn by Steward during his 1931 excavation and the areas excavated during that project were plotted on the ground. We are confident that datum points running parallel to the cave walls were located to within 5 cm and that datum points perpendicular to the walls were located to within 20 cm. of Steward's original horizontal controls. Based on investigations of the deposits conducted with this mapping, two areas of undisturbed fill (see Figure 9 for location) were formally identified and were related to Steward's excavation units. The primary excavation area, Area I, was located at the mouth of the cave and had been protected from vandalism by a mantle of backdirt from Steward's original excavation. The secondary excavation area, Area B, was located some 25 m from the cave mouth between Steward's Trench A and Trench B.

Disturbed fill from relic hunters holes and from excavated backdirt were removed from around these areas. Disturbance extended down into underlying sterile lacustrial gravel. As a result the two areas were separated by 6 m horizontally and could not be related stratigraphically. Once the undisturbed areas were defined, stratigraphic profiles of both areas were drawn and an attempt was made to relate the readily defined strata to Steward's descriptions and drawings. Unfortunately, only the lower strata can be correlated with any confidence. Steward's descriptions are essentially repetitive (for instance there are six or more units variously described as yellowish/grey) and his stratigraphic units were defined in terms of depth below the surface. Since the entire surface of the cave has been disturbed in the intervening 50 years (including the surface of the intact deposits), it proved impossible to identify any particular "yellowish grey streaked" stratigraphic unit. Site stratigraphy was therefore re-defined for our excavation and units are defined by distance above the underlying sterile gravels rather than distance below the surface.

Once the stratigraphy and horizontal controls were defined, individual strata were removed and processed in square units of one meter. Large soil samples of each stratigraphic unit were obtained and the remaining fill was passed through screens with 6.3 mm diameter openings. Extremely small artifacts and bones may have been missed in this process, but the absence of water in the area precluded the use of water screening techniques and the wet nature of the deposits prevented the use of finer grade screens. This latter feature of the fill may have even enhanced collection of small items since the muddy and rocky material was screened only with great difficulty and forced us to carefully pick through the fill prior to discarding it.

Profiles of the entire stratigraphic sequence were made at every one meter interval to ensure vertical controls were maintained. Any materials of questionable provienence were discarded. When cultural features such as fire hearths were encountered, they were mapped and sampled for ^{14}C and pollen and the entire fill collected for flotation analysis. Samples for comparative purposes were also collected from the cave

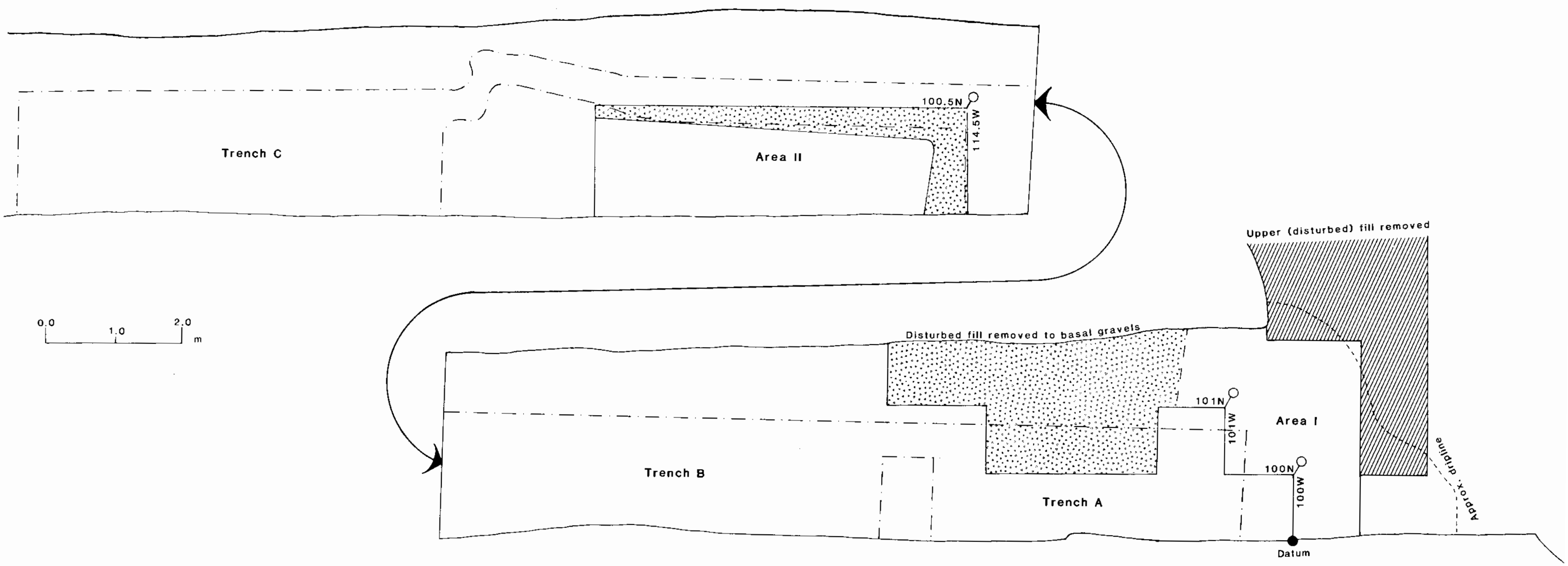


Figure 9 - Plan map of the front portion of Black Rock Cave showing areas excavated by Steward (dashed line) and during this project (solid line).

fill, the culturally sterile underlying gravels and from the surface outside the cave.

Historical features within the cave were also recorded and any historical artifacts in the uppermost disturbed deposits were collected for analysis. Historic graphitti in the rear of the cave was documented and photographed. This historical material related to both Steward's original excavation and to recreational use of the cave.

Upon completion of the excavation, extant profiles were collapsed to prevent injury. Some remaining undisturbed fill at the front of the cave was left intact for future research. Hopefully, there will be something left to examine on the centennial of Steward's original work.

STRATIGRAPHIC SEQUENCE AND DESCRIPTION

Seven stratigraphic units were defined in the primary excavation area at the mouth of the cave. Five stratigraphic units were defined in Area II, but only the basal two could be related to those in Area I with any degree of confidence. As a result, two separate stratigraphic sequences have been defined (Figure 10). However, none of the radiocarbon dates and very few of the recovered artifacts (in fact none of the diagnostics) were derived from Area B and hence the need to directly relate these units is less critical. These stratigraphic units were thickest at the mouth of the cave and thin out and slope downward toward the cave interior. The maximum depth of cultural deposits in Area I is 1.5 m, while it is only 45 cm in Area II.

AREA I (Figures 11 and 12)

UNIT A

Culturally sterile lacustrial gravels which exceed 50 cm in depth in most areas investigated and presumably overlie bedrock. Unit A forms the basal stratigraphic unit and consists of grayish subangular gravels ranging from 1 to 10 mm in diameter. Unit A contains very little organic debris. It does not extend into the rear chamber of the cave.

UNIT B_1

Calcium-carbonate cemented subangular gravels overlying Unit A in Area I. A similar unit, Unit B_2, overlies Unit A in excavation Area II and is probably equivalent. This descriptive unit cannot be clearly distinguished from the underlying unit and it essentially forms its upper surface. It is stained a dark brown by organic materials, but it is culturally sterile. Both the organic staining and the calcium carbonate cementing appear to be the result of a long period of non-deposition following the laying down of the beach gravels. The unit varies in thickness from about 10-30 cm (it cannot be clearly defined).

UNIT C

A grayish/brown layer of angular cobbles and gravels and loam in Area I containing charcoal, artifacts and other cultural features. The unit overlies Unit B_1 and underlies Unit D. It ranges in thickness from 5 to 25 cm and averages about 12 cm. The unit contains two fire hearths, numbers 1 and 2, and a radiocarbon sample from the former dates to 6100 B.P. It appears that Unit C represents the earliest occupation of the site.

UNIT D

A light grayish/brown loamy layer in Area I containing numerous angular cobbles overlying Unit C and underlying Unit E. It contains very little charcoal and few artifacts and may be of natural origin. It is thickest on the northwest wall of the cave at the mouth and varies from 15 to 25 cm across the mouth of the cave. Numerous rodent burrows make the layer somewhat discontinuous. A fire hearth, number 3, occurred in the upper 5 cm of the unit, but may have originated from the overlying layer. A radiocarbon sample from the hearth dates to 3240 B.P.

UNIT E

A dark brown loamy layer containing relatively few angular rocks. The unit is continuous throughout Area I and has a relatively uniform

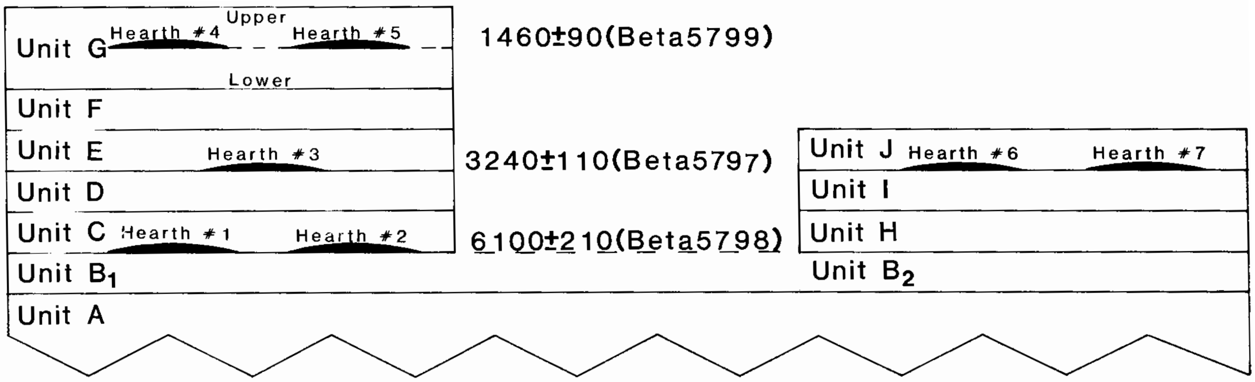


Figure 10 - Composite stratigraphic profile with cultural features and radiocarbon dates.

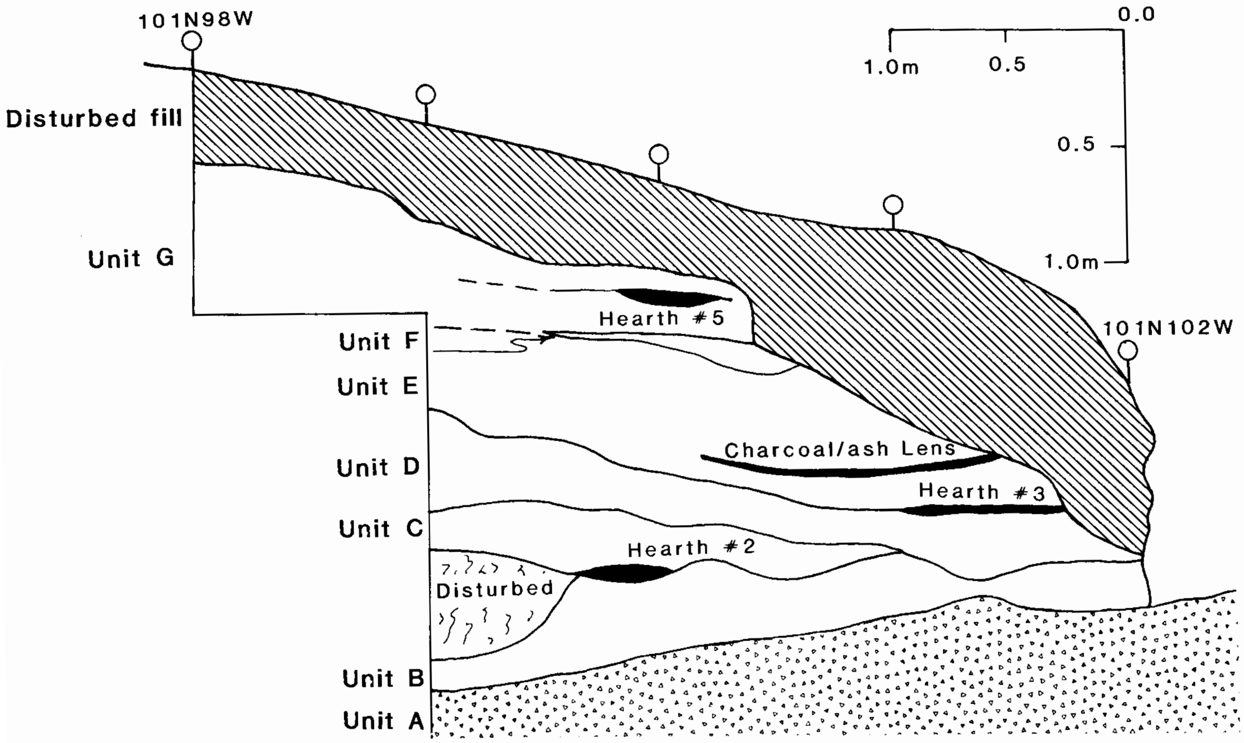


Figure 11 - Stratigraphic profile of deposits from center edge of excavation Area I at mouth of cave (101N98W) inward to disturbed area (101N102W).

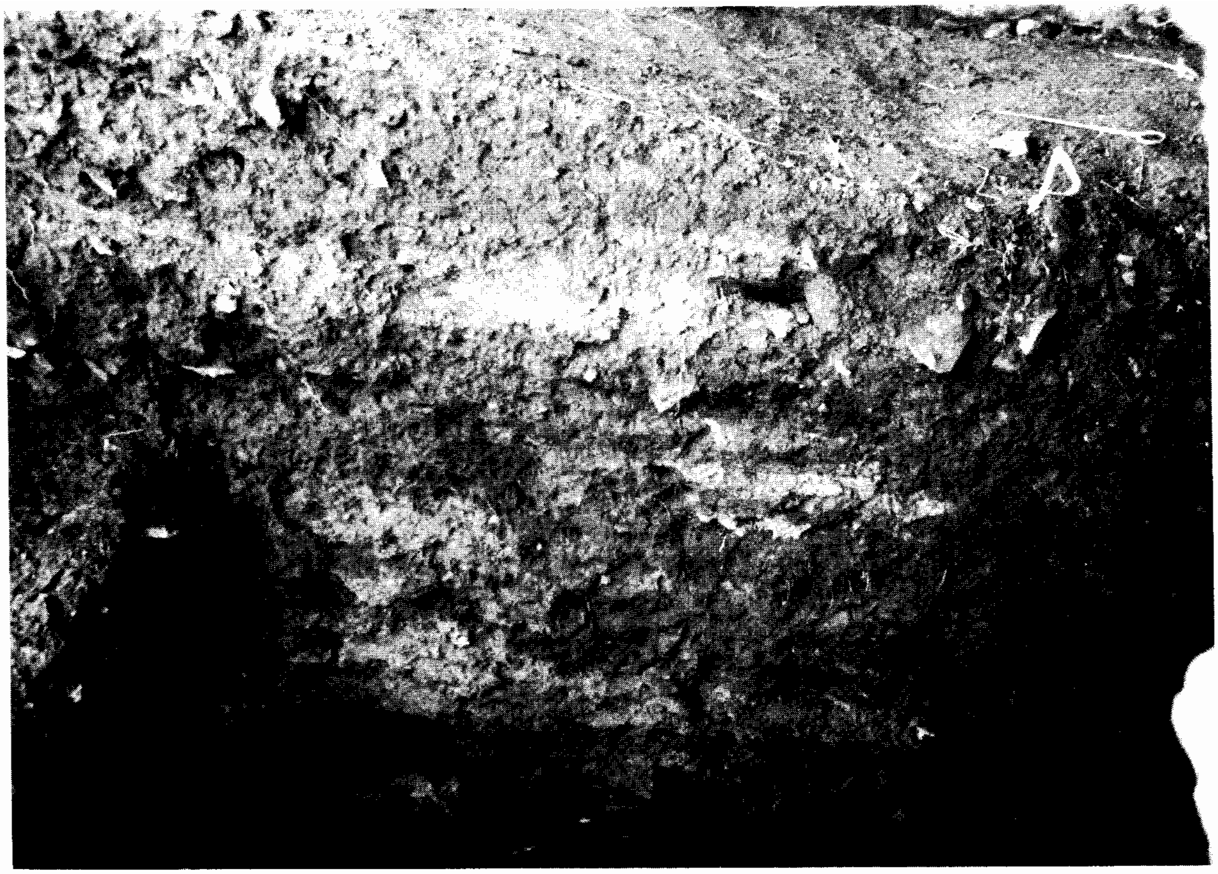


Figure 12 - View of stratigraphic profile depicted in Figure 11.

thickness of 17-22 cm. Charcoal staining is quite heavy and the artifact content of the unit is relatively high. Fire hearth #3, mentioned above, probably derives from this unit.

UNIT F

A relatively thin layer of light gray soil in Area I containing large amounts of angular rock. It is distinguished from the overlying Unit G and the underlying Unit E by its lack of charcoal. It also contains very few artifacts and may be naturally deposited. The unit varies from 10-27 cm thick, but for the most part is only 10-15 cm in width.

UNIT G

The uppermost undisturbed layer in Area I is a dark brown charcoal flecked unit containing large amounts of cultural materials. The layer can be divided in most areas into upper and lower units separated by two fire hearths, numbers 4 and 5, which feather out across the fill and meld into each other. This division cannot be made in all areas however and separation is arbitrary in spots. Hearth number 5 is dated to 1460 B.P. The upper and lower portions of Unit 6 may represent separate depositional units or, alternatively, the hearth may represent only a localized division. Unfortunately, the limited excavation area prevents a conclusion. The unit varies from 20-35 cm thick and is thickest towards the mouth of the cave.

AREA II (Figures 13 and 14)

UNIT A

Same as in Area I.

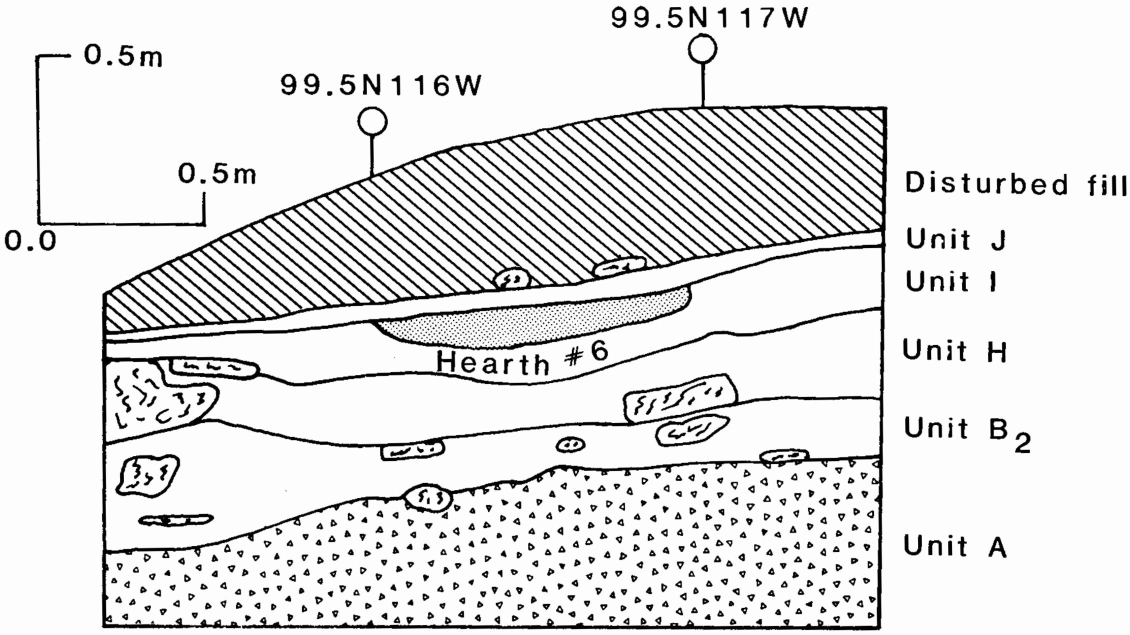


Figure 13 - Stratigraphic profile of Area II deposits.

Figure 14 - View of depositional units in excavation Area II.

UNIT B_2

Same as Unit B_1, but contains some large angular rockfall in this excavation area.

UNIT H

Dark brown gravelly loam varying from 8 to 12 cm in thickness. The unit is charcoal stained and contains minor amounts of lithic detritus. It contains several large pieces of shale which apparently were derived from roof fall.

UNIT I

A brownish/orange layer of mixed loam and sandy gravels containing comparatively little charcoal or ash and very little cultural material. Two fire hearths, numbers 6 and 7, occur on the upper surface of the unit. However, this upper surface is very compacted and is littered with historic materials and the two hearths may well represent historic depositions. The unit varies from 4 to 12 cm thick.

UNIT J

A thin grayish fine grained layer containing numerous small ash lenses. It averages 5 cm thick and contains historic artifacts including glass manufactured prior to 1900.

CULTURAL FEATURES

Other than the depositional units themselves, the only definable cultural features were seven fire hearths:

HEARTH #1

A circular concentration of charcoal center at point 101N100.6W. The 3 cm thick hearth contains little ash, but is underlain by burned, reddened soil. The hearth occurs at the base of Unit C in excavation Area I and overlies the naturally deposited Unit B_1. Charcoal from the hearth dates to 6100 B.P.

HEARTH #2

A lens of charcoal 30 cm long centered at 101N99.85W. The charcoal is overlain by a thin band of ash and underlain by reddened, burned soil. Maximum thickness is 5 cm. Other dimensions could not be obtained due to collapse of the profile face.

HEARTH #3

A shallow ash-filled basin on the interface between Units D and E in excavation Area I. The 7 cm thick (maximum) ash lens is 40 cm in diameter and is centered at 101N101W. The basin contains very little charcoal and most of the organic materials were completely burned. The hearth dates to 3240 B.P. No fire reddened earth could be detected below the hearth.

HEARTH #4

A layer of charcoal containing some ash in the middle of Unit G which serves, along with hearth #5 to divide the upper and lower portions of the unit. The thin (2.5 cm thick) lense is underlain by reddish-brown presumably burned soil. The lens is centered at 100.9N100.9W, but other dimensions could not be obtained due to wall collapse.

Figure 15 - View of Hearth #6.

HEARTH #5

A 70 cm diameter concentration of ash and charcoal in Unit G. The thin (3 cm maximum thickness) lens is centered at 100N99.5W. It contained numerous burned bone fragments and white chert flakes. Charcoal from the hearth dates to 1460 B.P.

HEARTH #6

An ash lens at the top of Unit I in excavation Area II is centered at 99.5N117W (Figure 15). The irregularly shaped lens is a maximum of 90 cm in diameter and 11 cm thick. It is underlain by charcoal stained soil, but no large fragments are evident.

HEARTH #7

An ash lens virtually identical to Hearth #6 is centered at 99.45N115W. The hearth has a maximum diameter of 72 cm and a maximum depth of 10 cm. It also is underlain by charcoal stained soil.

COMPARISON WITH STEWARD'S DATA

Any attempt to compare the stratigraphy described by Steward to that recorded during this excavation is fraught with difficulty. The primary problem is the disturbance of the upper levels during the last 50 years. This disturbance includes the accumulation of materials above the prehistoric deposition in some areas as well as removal of fill in others. Since Steward based his descriptions on distance below surface, it is virtually impossible to accurately determine vertical locations. As noted above, it is also difficult to relate Steward's descriptions to the extant stratigraphy because they are repeatative in nature and are of little or no utility in the absence of vertical dimensions. As a result it is possible to relate only the lowest portions of the cave deposits.

Below 49" in the outermost, and deepest portion of Steward's trench "A", he identified "rounded, bedded gravels...the top 4" to 6" of (which are) mixed with dust and decayed fibrous material, as if they had been trampled, and foreign material introduced by the first occupants of the cave.(1937:109)." Below that, to a depth of 66" he found more bedded lake gravels. Quite clearly, these can be related to Units A and B as defined here.

Above this point, Steward's descriptions based on depth are of little use. However, his profile drawings, particularly that from trench "A" parallel to the cave axis, are of some utility. Above the lake gravels and the organic debris on and in their surface, Steward shows a layer of angular rock and charcoal stained soil containing "charcoal and ash seams." Above this layer, and running the length of the profile is a "yellow/yellowish band." It is probable that these two layers are the equivalents of Units C and D, respectively.

Assuming that Units A-D can be related to the stratigraphy defined by Steward, and assuming that the datums used both by Steward and in this excavation are located fairly closely together, it is possible to attempt a combination of profiles drawn during both operations, essentially extending Steward's profile to outside the mouth of the cave (Figure 16). From this extended profile and from the stratigraphic descriptions, it is possible to draw several conclusions: (1) The underlying lake gravels grade, in a rather uniform fashion, upwards from the exterior of the cave to the interior edge of the excavation area; (2) Contrary to Steward's interpretation, there has been a build-up of deposits just outside the cave mouth (a common pattern in many occupied caves of the Basin) resulting in depositional units which slope down towards the interior of the cave; (3) The combination of these two factors created much thicker deposits in the cave mouth and suggest that the upper 20-50 cm of the deposits in this area have been disturbed and/or removed since Steward's excavation. This may account for the lack of the Fremont and Paiute/Shoshoni artifacts in any reliable context and it is probable that the upper Units E-G are equivalent to those 18" to 2' below the surface in Steward's stratigraphic profile. A Great Salt Lake gray potsherd from 4-8 inches below the surface in Steward's Trench A, has been dated to 1250±150 B.P., and it is probable that most of these upper deposits are of Fremont origin.

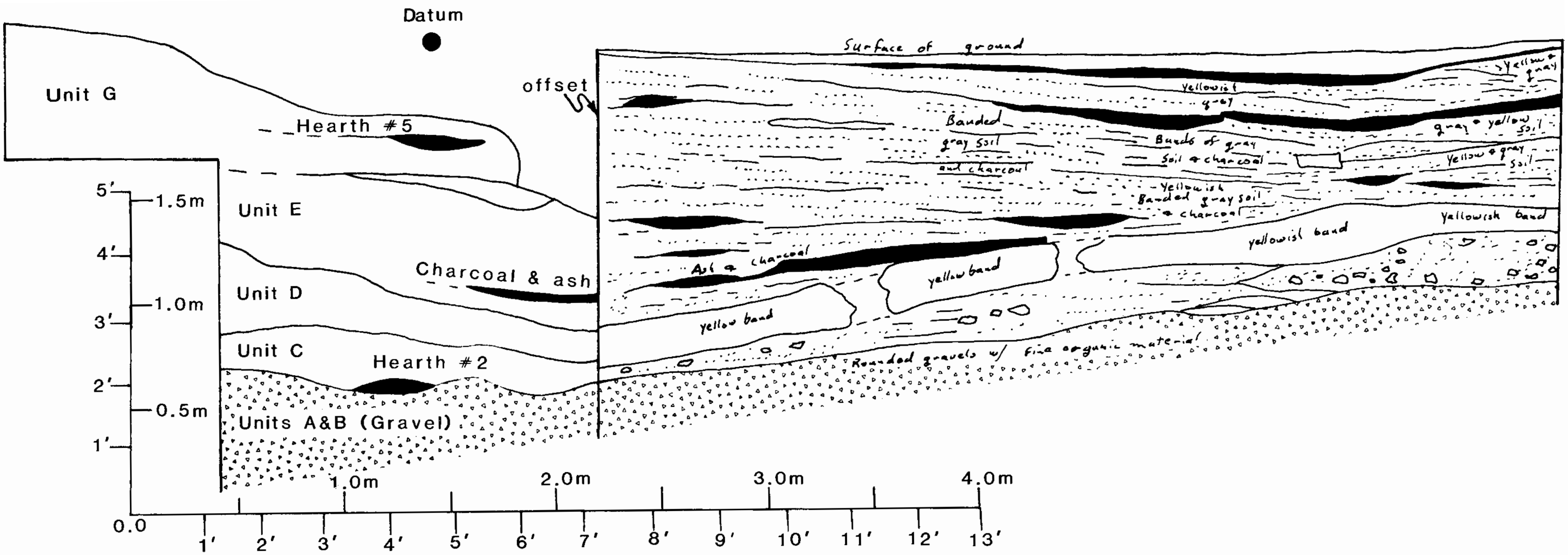


Figure 16 - Combined profile from the 1931 and 1982 excavations through the middle of the deposits parallel to the cave walls. Profiles are matched at datum and top of organically stained gravels, but are horizontally offset approximately 30 cm. 1931 profile is redrawn from Steward (1937:108, Figure 45).

CHRONOLOGY

Dating at Black Rock Cave is controlled by three radiocarbon samples from stratigraphic units and by chronologically well controlled diagnostic artifacts. The earliest date is from charcoal obtained from Hearth #1 between Units B_1 and C in excavation Area I. The date, which may represent the earliest occupation of the cave, is 6100±210 B.P. (Beta5798). Charcoal from Hearth #3 between Units D and E in excavation Area I dates to 3240±110 B.P. (Beta5797). The two dates bracket depositional units which can be correlated with Steward's lowest cultural units and which contain diagnostic artifacts of a comparable age. One of these may be a Humboldt Concave-base which has been attributed to either a Paleo-Indian (Bryan 1980) or early Archaic (Holmer 1978) contexts. A "Pinto Shouldered point" which dates to 7600-6200 years ago and a "Gypsum point" which dates to 3000-4500 years ago (Holmer 1978, 1984) correspond well with the radiocarbon dates.

The final radiocarbon date is derived from Hearth #5 in the middle of Unit G, Area I. The date of 1460±90 B.P. (Beta5799) is usually considered to be in the temporal range of the Fremont (Aikens 1970; Marwitt 1970), but at Black Rock Cave the date is not associated with diagnostic Fremont artifacts such as basketry, projectile points, or pottery. The only diagnostic artifacts from Unit G and those immediately below are Elko Corner-notched points which date from 7000 years ago to ethnohistoric times. However, a carbon sample from a diagnostic Fremont Great Salt Lake gray sherd has been radiocarbon dated to 1250±150 B.P. (A3391) (see Ceramics). Since the two dates overlap extensively, it is probable the hearth sample does represent a Fremont deposition.

There are a number of diagnostic artifacts recovered either from the upper portions of Steward's excavation or from unknown/disturbed provienences in these excavations which cannot be related to the stratigraphic sequence. These include Fremont diagnostics such as Great Salt Lake gray pottery and Bear River Side-notched projectile points which date to between 1000 to 700 years ago (Marwitt 1970; R. Madsen 1977; Holmer and Weder 1980; Holmer 1984). A Desert Side-notched projectile point recovered by Steward probably dates to after 800 years ago (Holmer and Weder 1980; Holmer 1984). These points are occasionally found in Fremont depositions, but nearly always in association with Paiute/ Shoshoni pottery and their presence is usually attributed to the existence of these later groups in the area (ibid).

In sum, radiocarbon dates and diagnostic artifacts suggest occupation from 6100 years ago or slightly before to sometime after 650 years ago. Historic depositions occurred during the last 100 years. The relative continuity of occupation during this period cannot be determined, although the probable natural deposition of stratigraphic Unit D does suggest a break of some kind between 6100 and 3200 B.P. The 1460 B.P. date from Hearth #5, like the 1250 B.P. date on the Great Salt Lake gray sherd, probably is related to Fremont depositions at the site. However, the upper portion of Unit G, to which the hearth is related, was identified and excavated in only one one meter square and no Fremont diagnostics were recovered. The date does provide an upper limiting date for underlying depositional units which contain neither pottery nor "arrowhead"-type projectile points.

ARTIFACTS

Artifacts from this excavation, Steward's excavation, and from surrounding sites have been examined and/or reexamined. These artifacts include pottery, worked and unworked bone, ground stone, and a variety of chipped stone tools and lithic detritus. Wherever possible the artifacts from this and Steward's excavation, as well as from other sites on the north end of the Oquirrh Mountains, are discussed in the same contexts.

CHIPPED STONE
by
Richard N. Holmer

A total of 756 chipped stone artifacts were recovered during the 1982 excavation of Black Rock Cave. For the purposes of this discussion, these artifacts have been divided into three general classes: projectile points, other tools, and debitage. Three basic material types are represented in the collection. The most common being chert (58%), followed by quartzite (40%), with obsidian being present only in small quantities (2%).

Projectile points, although only constituting about 1% of the recovered artifacts, are the primary focus of this chapter. This emphasis results from a need to summarize the culture history of the southern shore of the Great Salt Lake in light of recent breakthroughs in projectile point chronology. Since many projectile point styles are indicative of their period of manufacture, they play an important role in reinterpreting sites excavated before radiocarbon dating techniques became available. The points recovered during our excavation of Black Rock Cave have provided the stimulus to reexamine the points recovered by Julian Steward from the cave in 1931 and the points recovered by Elmer Smith during the early 1940's from three other cave sites in the immediated vicinity (Black Rock II, Black Rock III, and Deadman Cave). As a total collection, the projectile points tell us a great deal about man's history in the study area. This basic history is augmented by the analysis of the other tools and debitage which help clarify the range of activities that have taken place at the sites.

PROJECTILE POINTS

Nine complete and fragmentary projectile points were recovered by our excavation efforts (Figure 17). These, combined with the 14 points recovered by Steward during his excavations (Figure 18), include a range of point styles common to cave sites around the Bonneville Basin. Correlating the natural stratigraphy as observed in 1982 with Steward's excavation units is possible, but only approximately. Table 1 presents the correlation along with the provenience of the projectile points recovered during both excavations. Table 2 includes the point styles recovered from the three nearby sites excavated by Smith during the 1940's. The points have been reclassified following Holmer (1978) and Holmer and Weder (1980). Whenever possible, the actual points were examined. However, many of the specimens from the early excavations could not be located in the collections curated at the Utah Museum of

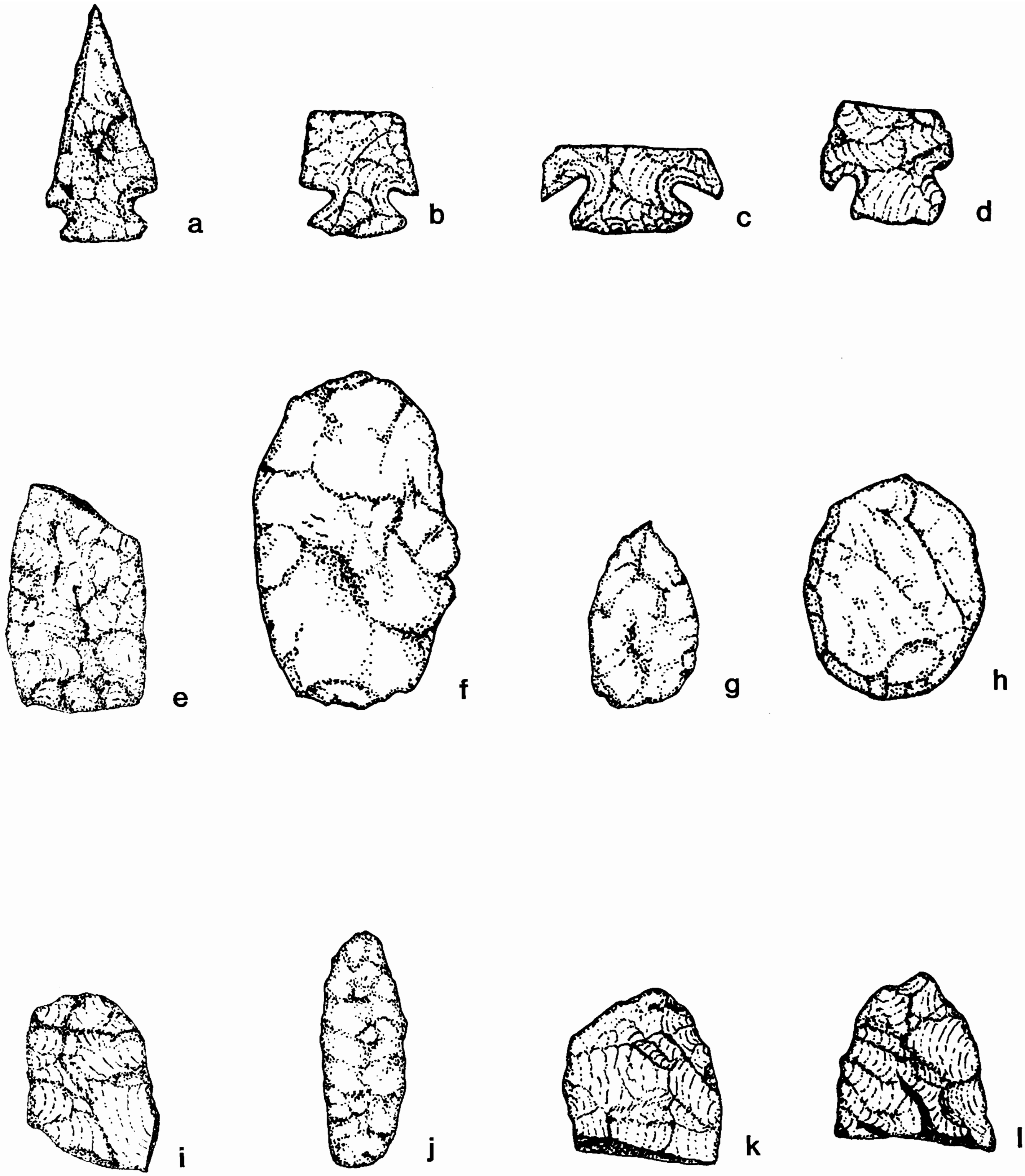


Figure 17 - Selected projectile points and bifaces from the 1982 excavations: Elko Corner-notched (a-d), bifaces (e-g, i-l), uniface (h) (actual size).

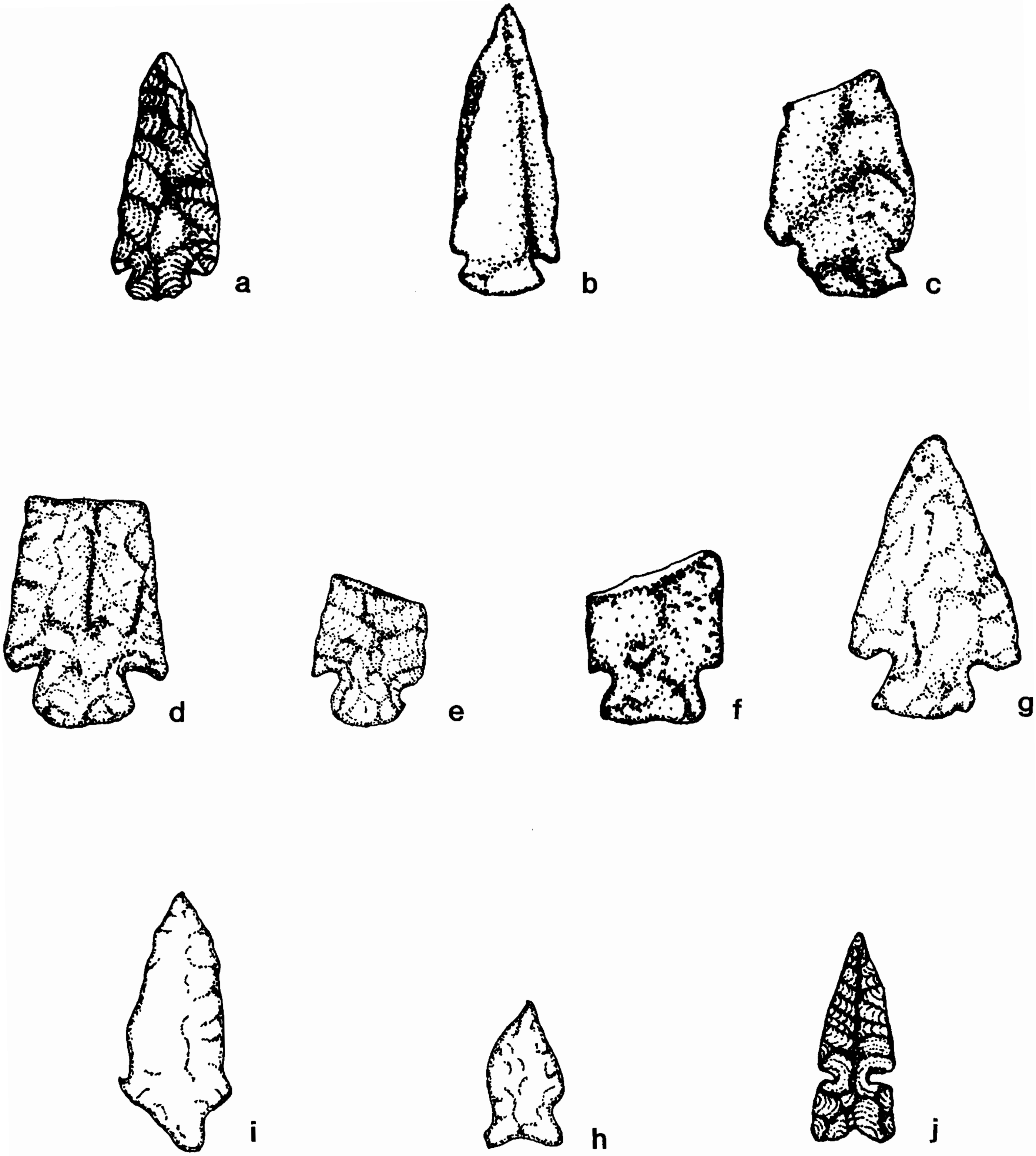


Figure 18 - Selected projectile points from the 1931 excavations: Elko Corner-notched points (a-g), Pinto Shouldered (h), Gypsum (i), Desert Side-notched (j) (actual size).

Table 1. Projectile Point Provenience Table.

1982 EXCAVATIONS				Steward's EXCAVATIONS						Date Range Based on Projectile Point Types (See Text for Explanation)	Radiocarbon Dates
STRATIFICATION UNIT	ELKO CORNER-NOTCHED	BEAR RIVER SIDE-NOTCHED	FRAGMENTS	STRATIFICATION UNIT	ELKO CORNER-NOTCHED	ELKO EARED	PINTO SHOULDERED	GYPSUM	DESERT SIDE-NOTCHED	B.P.	B.P.
SURFACE				SURFACE					1	800 - 200	
G upper		1	1	1-8"						1000 - 700	
G upper	1			8-10"	1						1460 + 90
G lower	4		1	10-14"	3					1800 - 1100	
G lower				14-19"	2						
F				19-24"	1	1					
F				24-29"							
E	1			29-32"				1		4600 - 1500	
E				32-36"	2					5000 - 3200	3240 + 110
D				36-40"							
D				40-45"							
C				45-49"							
C				49-54"	1		1			7200 - 6200 7600 - 6200	6100 + 210

Natural History. Therefore, Table 2 is a composite of published illustrations as well as actual points. Many of the points recovered from Deadman Cave are illustrated in Smith (1952) and those recovered from Black Rock Cave III are found in Enger (1942). Since the excavation of Black Rock Cave II was never published, illustrations of several points recovered there by Smith in 1941 are presented in Figure 19.

All projectile points recovered from Black Rock Cave are described below, organized by type and excavation level. Those points recovered by Steward are so designated and their provenience is given in his excavation levels (inches below surface) and our strata as correlated in Table 1.

Elko Series

Elko Corner-notched points are the predominant style recovered from Black Rock Cave. Sixteen of the 21 identifiable points are of this style. Unit G produced 11 Elko Corner-notched points; six were recovered by Steward and five by us. Of the five points recovered during 1982, four originated from the bottom portion of the unit (Figure 17, a-d). One point is manufactured from brown chert (Figure 17, a) and the other three are of brown or gray quartzite. The fifth point is a basal fragment (not illustrated) of orangish chert; provenience in the upper or lower portion of Unit G could not be determined.

Of the six Elko Corner-notched points recovered by Steward in Unit G, five appear to have originated in the lower portion (Figure 18, a-e), and one in the upper portion (not illustrated). Of the five in the lower portion, four are of gray or purplish quartzite (Figure 18, a-d) and one of pinkish chert (Figure 18, e).

Unit F did not yield any Elko Corner-notched points during our excavations although it appears as though Steward recovered one from that stratum (Figure 18, f). It is manufactured from purplish gray quartzite. Steward also recovered what appears to be an Elko Eared point from the same stratum. The point is missing from the museum collections so it cannot be examined. However, the drawing in Steward (1937; Fig. 47, i) resembles the eared variety more than any other type.

Unit E yielded one fragmentary Elko Corner-notched point (not illustrated) made of gray chert during our excavations. Steward recovered two complete Elko points from Unit E, both made of gray quartzite (Figure 18, g). Units C and D did not produce any projectile points during our excavations, although Steward recovered one Elko Corner-notched from the lower part of Unit C. It is made of brownish-gray chert (not illustrated).

Pinto Series

A single Pinto Shouldered projectile point was recovered from Black Rock Cave, Unit C, by Steward. The point is missing from the museum collections and could not be examined. Because of the importance of Pinto points as temporal markers, the point has been redrawn (Figure 18, h) from the rather crude illustration in the Steward publication. The point was made of obsidian and was described as being "very crudely made" (Steward 1937:115), which is a general characteristic of Pinto points.

Table 2. Projectile Points Recovered From Black Rock I, II, III and Deadman Caves.

PROJECTILE POINT STYLES	SITES			
	BLACK ROCK I	BLACK ROCK II	BLACK ROCK III	DEADMAN CAVE
Desert Side-notched	1	1	1	1
Bear River Side-notched	1	2		1
Rosegate Corner-notched			2	
Gypsum	1			10
Sudden Side-notched				4
Northern Side-notched				7
Humboldt Concave-base			1	14
Pinto Series	1			2
Elko Series	17	5	3	17

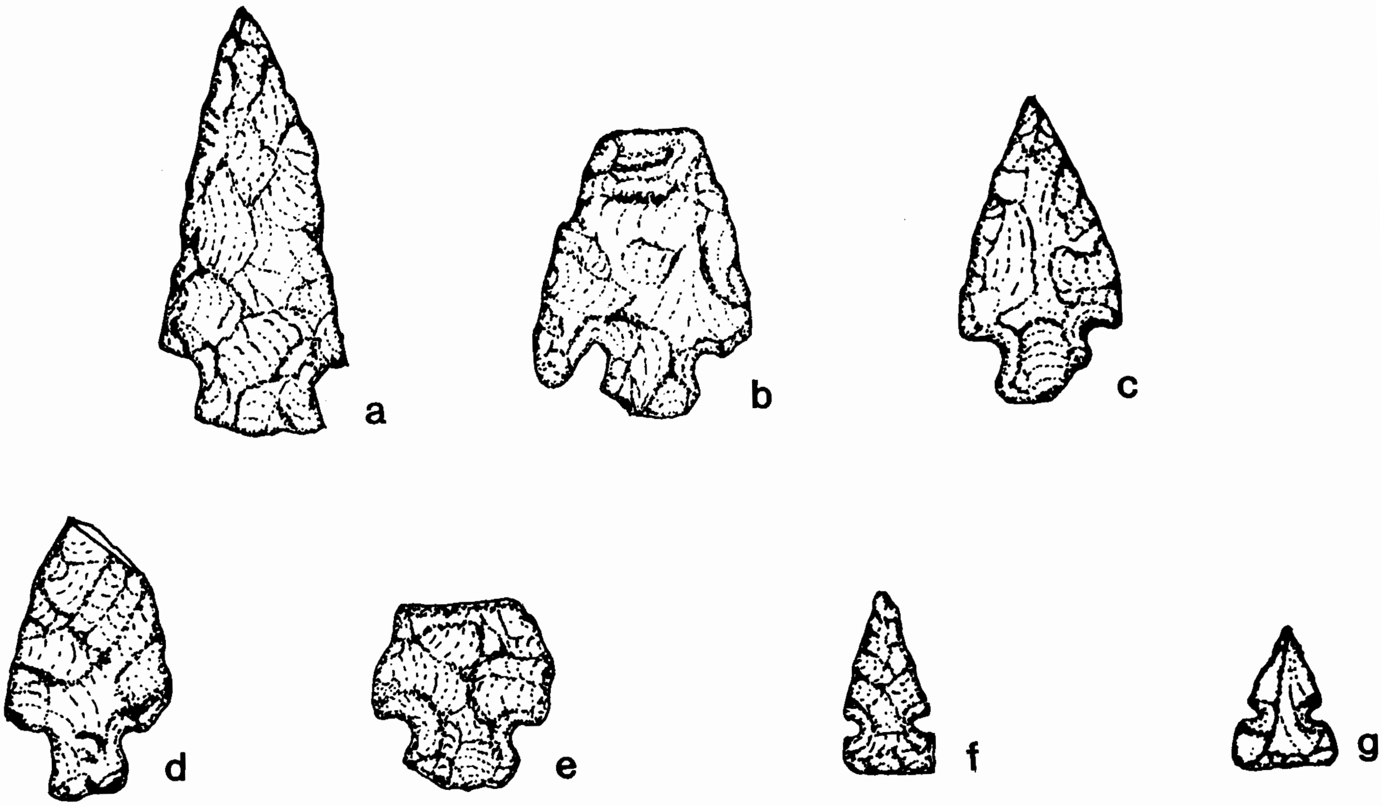


Figure 19 - Selected projectile points recovered by Elmer Smith from Black Rock II: Elko Corner-notched (a-e); Bear River Side-notched (f-g) (actual size).

Gypsum Series

A single Gypsum point was recovered by Steward from Unit E. Again, this point is missing from the collections, but a drawing is provided based on Steward's sketch (Figure 18, i). Like the Pinto point, the Gypsum was manufactured from obsidian.

Bear River Side-notched

One Bear River Side-notched point was recovered from near the modern surface during our excavations. The point, beautifully made of obsidian, disappeared at the site during visits by media personnel and is, therefore, not illustrated in this report. The only record of the point is a photograph published in a local newspaper.

Desert Side-notched

A single Desert Side-notched point (Figure 18, j) was recovered from the modern surface of the cave by Steward. It is "skillfully chipped from a curved flake of obsidian (Steward 1937:114)".

Unidentifiable Fragments

Two projectile point fragments were recovered during our excavations. One is a gray chert mid-section from the upper portion of Unit G and the other is an obsidian tip from the lower portion of the same unit. Steward mentions six fragments originating throughout the deposits.

Temporal and Cultural Implications

All of the classifiable projectile points recovered from Black Rock Cave contribute to our understanding of when the cave was occupied and what archeological cultures are represented. This information adds a considerable amount of temporal detail to the dating information provided by the radiocarbon assays. The following discussion will not be limited to Black Rock Cave, but will include the four sites: Black Rock I, II, III and Deadman Caves.

The earliest occupation of the four sites, as indicated by the projectile points, may be represented by a biface recovered by Steward (1937:Fig. 46, h) from Unit C of Black Rock Cave. The biface has been identified by Bryan (1980:84) as a Black Rock Concave-base projectile point. Bryan believes that the style is an antecedent of the Clovis point and that it probably dates to approximately 13,000 B.P. No points of this type have been recovered in a dated context in the eastern Great Basin, but it seems unlikely that they actually date that early (the Black Rock Concave-base points listed for Hogup Cave were misidentified). The point is missing from the museum collections and the type designation cannot be confirmed. Such an early occupation of the cave is possible because the lake level has been below the cave level since before that time.

Other evidence for an early occupation of the area comes from the lowest stratum of Black Rock III. There, a large stemmed point (Enger 1942: Fig. 2a) was recovered that is reminiscent of Scottsbluff or Alberta points. The specimen could not be located in the museum collections and it is not known if any of the diagnostic attributes of those styles are present (e.g., basal edge grinding). If it is, in fact, a Scottsbluff or Alberta point, then a Plano (9500-8500 B.P.) occupation of the area is implied.

An early Archaic occupation is indicated in two of the sites by Pinto Shouldered points which are common in the eastern Great Basin from 7600-6200 B.P. One of these was recovered from the lower part of Unit C of Black Rock Cave by Steward and its presence confirms the radiocarbon date of 6100±210 B.P. from a hearth also in the lower portion of the unit. No Pinto points were recovered from Black Rock II or III, although two came from Deadman Cave, indicating that it, too, was occupied during the early Archaic period (the provenience for most points from Black Rock III and Deadman Caves is not known).

The presence of Humboldt Concave-base points in both Black Rock III and Deadman Caves is indicative of an early and/or middle Archaic occupation of the area. Humboldt points date from approximately 8500 to 4500 B.P. in the eastern Great Basin. Another early/middle Archaic point from that occurs in Deadman Cave is the Northern Side-notched point. It is common in the eastern Great Basin from 7200 to 4400 B.P. Also present in Deadman Cave are a few Sudden Side-notched points which indicate occupation of the site between 6300 to 4400 B.P. All of the point styles discussed above document sporadic occupation of the four cave sites earlier than 4400 B.P. The earliest occupations may well have been between 13,000 and 8500 B.P.

Use of the area during the later part of the Archaic (4500-1500 B.P.)

is also well documented by the presence of Gypsum points in both Black Rock and Deadman Caves. Steward recovered a single Gypsum point from Unit E of Black Rock Cave. That unit has now been radiocarbon dated to 3240±110 B.P., which agrees with the 4600 to 1500 B.P. temporal span for Gypsum points. There are ten Gypsum points illustrated in the Deadman Cave report (Smith 1952), documenting use of that site during the late Archaic.

Elko series points are the most common style recovered from the four sites and they are the predominant style in all of the known Archaic sites in the eastern Great Basin. They are the least temporally diagnostic of all the point styles dating from early Archaic through Formative. However, they do not occur continuously through that 7000 year period. There are three flourits of the style: from 7200-6200 B.P., 5000 to 3400 B.P., and 1800 to 1100 B.P. (Holmer 1978:65). Those flourits agree with the occurrence of Elko points at Black Rock Cave, especially the late occurrence between 1800 and 1100 B.P. which suggests a date range for Unit G. That date range may also include Unit F if the stratigraphic correlations between the two excavations are reasonably accurate.

Occupation of the area between 1500 and 1000 B.P. is indicated by two Rosegate Corner-notched points recovered from Black Rock III. This style suggests the use of that site by early Fremont hunters. Later Fremont hunters use of Black Rock I and II and Deadman Caves between 1000 and 700 B.P. is documented by the presence of four Bear River Side-notched points.

Use of Black Rock Cave I by protohistoric Numic-speaking groups between 800 and 200 B.P. is indicated by a Desert Side-notched point. The point was recovered by Steward from the surface of the cave fill.

OTHER TOOLS

Ten bifaces and two unifaces were recovered during our excavations of Black Rock Cave. The comparable tool types recovered by Steward have not been reexamined and will not be discussed here.

Over half the non-projectile point tools originated in Unit G; most from the lower portion (Table 3). Those from the upper portion (Figure 17, e) are made of light gray quartizite; those from the lower portion are made of gray or brown quartzite (Figure 17, f-h). One uniface fragment (not illustrated) is not provenienced in Unit G.

Unit F contained two bifaces of gray chert (Figure 17, i). Unit E also contained two bifaces (Figure 17, j-k), both gray quartzite. One unprovenienced biface fragment (Figure 17, l) is made of a dark red chert.

A cursory examination of the tools revealed some visible edge wear although it is not extensive on any specimen. The most that can be said about the tools at this time is that the two unifaces were probably used as scrapers; this conclusion is a result of the very steep edge angle rather than the wear patterns.

DEBITAGE

The debitage recovered from Black Rock Cave has been segregated into three basic material types: chert, quartzite and obsidian. Chert is the predominant material constituting 58% of the total debitage collection recovered during our excavations (neither debitage recovered by Steward from Black Rock Cave nor the debitage recovered by Smith from the other three caves has been re-examined).

Quartzite makes up 40% of the collection and obsidian 2% (Table 4). Out of the total of 735 flakes there does not appear to be a single primary reduction flake present. This confirms our field observations that there are no suitable lithic sources available in the immediate vicinity of the site.

Since all of the debitage consists of secondary or tertiary flakes, it is apparent that only the last stages of tool manufacture and tool maintenance occurred there. Therefore, the quantity of debitage during any given time period provides a general index of tool manufacturing/maintenance activity and probably also reflects the intensity of the human use of the site. The debitage density figures in Table 4 demonstrate a dramatic increase in tool manufacture activity over time. The increase is not a smooth curve but makes a couple of steps: the first step includes units B, C, and D, the second includes units E and F, and the third is Unit G. A parallel pattern occurs in the numbers of projectile points and other tools. All indicate that the cave received little use before 3200 B.P., although the cave had received some use as early as 6200 B.P. Between 3200 and 1800 B.P. the use of the site increased somewhat and between 1800 and 200 B.P. it increased dramatically. With the increase in use of the site there is a reduction in the percentage of chert present in the collection. In levels B, C, and D it makes up 80% of the debitage, in E and F it makes up 70% and in G 57%. An even more dramatic decrease in obsidian occurs: 10% in B, C, and D; 8% in E and F; and 1% in G. Obsidian and chert are generally believed to be superior to quartzite from tool manufacture. Therefore, the increasing use of less suitable material as the site receives more use is the pattern. This probably reflects the greater availability of quartzites in the general vicinity.

SUMMARY

The analyses of chipped stone artifacts have provided clues about both the ages and types of activities conducted by man at Black Rock Cave and its surrounding environs. We know that the cave has been used for at least the past 6200 years. For approximately the first half of that period (6200-3200 B.P.) the site was used, but only rarely. From 3200 to 1800 B.P., it was visited more often. Between 1800 and 200 B.P. the site received considerable use.

But what was the site used for? As is often the case, we can tell more about what activities were not performed there than what were. The site was definitely not associated with acquisition of material for stone tool manufacture (based on the complete absence of primary decortication flakes). The site probably did not house individuals while they were processing animal resources (because very few bifaces and unifaces were recovered and no utilized flakes). However, hunting activities conducted on the north slopes of the Oquirrh Mountains may account for some, if not most, of the occupation (because of the presence of projectile points and the types of flakes associated with the final stages of point manufacture).

Table 3. Chipped stone tool provenience table.

Stratification Unit		Tools	
		Biface	Uniface
G	Upper	2	1
	Lower	3	1
F		2	
E		2	
D			
C			
N.P.		1	

Table 4. Debitage provenience table.

Stratification Unit	OBSIDIAN	CHERT	QUARTZITE	TOTAL	DENSITY (FLAKES/m^3)
G	6	361	265	632	372
F	4	25	13	42	84
E	3	29	14	46	66
D	1	3	2	6	8
C	0	2	0	2	5
B	0	2	0	2	10
N.P.	1	2	2	5	
Total	15	424	296	735	

The site appears to have been a stop-over associated with the acquisition of animals; the types that occupy the steep sage slopes of the Great Basin desert ranges. Even though the use of the site increased over the years, it never achieved the intensity of use of more favorably situated sites such as Deadman Cave. The other two Black Rock Caves, both located in steep sage environs, were also apparently used for temporary shelter/camp purposes while pursuing resources on the north slopes of the Oquirrhs.

It is apparent from the projectile point inventory and debitage density that the types of resources available on the mountain slopes were a part of the subsistence base throughout the last 6200 years. Desert Archaic, Fremont, and Numic groups all visited the Black Rock Caves as a part of their subsistence activities.

GROUND STONE FROM BLACK ROCK CAVE
by
Joel Janetski

The 1982 excavations at Black Rock Cave recovered four items of ground stone, all of which were unprovenienced. These include one complete mano, one complete and one fragmented metate, and one enigmatic object. The milling stones all appear to be manufactured from well-solidified sandstone.

The single mano is a flat, oval-shaped, well-used tool with both sides highly worn. It measures 11.5 cm long by 9.5 cm wide and 2 cm thick at one edge and bevels to less than 1 cm at the other. The circumference exhibits considerable pecking. The complete metate is essentially unshaped except for the single use surface which is both pecked and ground. It measures about 35 cm in length, 23 cm in width and 5 cm in thickness. Some pecking is evident around the edges of the stone. The metate fragment appears to have been shaped to a limited extent and exhibits some evidence of use on two surfaces, although one surface is considerably more pecked and smoothed than the other. This artifact measures 23.5 cm by 20 cm by 7 cm thick.

The enigmatic sandstone object is fragmented but is generally cylindrical in shape with a flattened-oval cross section. It tapers a bit toward one end and measures 5 cm in length and 2.5 x 2 cm in diameter at the larger end and 2 x 1.7 cm in diameter at the smaller end. The surface, where it is not pock marked, is well-smoothed, almost polished.

Steward (1937) found no artifacts of ground stone at Black Rock Cave during his 1931 excavation. Enger (1942:18-19), however, reports several manos, one metate and three possible pestles from nearby Black Rock III Cave. Smith (1941:34-37), by comparison, recovered rather large numbers of milling stones, 29 metates and 98 manos, from Deadman Cave located on the edge of a marshy area several km to the east of the Black Rock caves and considerably lower in elevation. These contrasts in artifact array suggest that plant food processing, as evidenced by the occurrence of grinding stones, was a more common activity at the lower elevations.

FAUNAL ANALYSIS OF BLACK ROCK CAVE

by

Kenneth E. Juell

INTRODUCTION

A total of 2184 bone specimens, including four pieces of worked bone, were recovered from stratigraphic contexts and backdirt piles at Black Rock Cave. Bone specimens were analyzed in an attempt to determine (1) the faunal subsistence resources used by aboriginal groups during cave occupations, (2) the relative economic importance of the taxa represented in these occupations, (3) the nature of faunal-subsistence change through time, and (4) the seasonality of cave occupations. The research questions could only be answered to various degrees of success due largely to small-sample sizes in identified strata. As a result, site discussions are necessarily limited to general ones.

METHODS

Mammal bones were identified using the University of Utah Archeological Center's comparative osteological collections. Bone specimens from taxa not represented in the comparative collection were identified using comparative osteological guides (Olsen 1973; Gilbert 1973; Schmid 1972; Bass 1971). The following specimen attributes were recorded during analysis: representative taxon, anatomical element, portion of element, side of body, age (degree of epiphyseal closure), presence of butchering marks (location and pattern), and presence of burning. One fish bone was identified by Gerald Smith, University of Michigan, and James H. Madsen, Jr., Utah State Paleontologist. Bird and reptile/amphibian bones were not identified taxonomically due to lack of comparative materials, but will be identified and analyzed at a later date. The recorded information will be placed on file at the Antiquities Section, Utah State Historical Society.

Bone specimens were identified to genus or species when possible. Specimens that could not be identified to genus or species, due to their fragmentary condition, were identified to broader taxonomic categories. Non-diagnostic mammal bones smaller in size than jackrabbit were classified as "small mammal". Mammal bones ranging in size from jackrabbit to coyote were classified as "medium mammal". Lastly, mammal bone larger in size than coyote were classified as "large mammal".

Minimum number of individual (MNI) counts were determined for each taxon by totalling the most common skeletal element or portion of element in each stratigraphic unit, with regard to side of body and/or bone growth development (based on epiphyseal closure). For example, two adult left tibias and one juvenile tibia (epiphysis open or absent from diaphysis), either right or left, from the same taxon were considered to represent three individuals of that taxon.

MNI counts were not determined for the broader taxonomic categories nor for nonprovenienced bones, except for specific cases mentioned below, since specimens in these categories could have been remains of the same individuals identified in genus and species categories. One individual each was counted for bison (Bison bison) and porcupine (Erethizon dorsatum) in the non-provenienced category as these taxa were not otherwise represented in stratigraphic units (see Table 5). Also, two large-mammal individuals in Unit C and one large-mammal individual in Unit H

Table 5. Provenience of Faunal Specimens with number of Identified Specimens and Minimum Number of Individuals (in parentheses).

SPECIES	UNIT B_1	UNIT B_2	UNIT C	UNIT D	UNIT E	UNIT F	UNIT G UNDIVIDED	UNIT G LOWER PORTION	UNIT G UPPER PORTION	NO PROVENIENCE	UNIT H	UNIT I	UNIT J	TOTALS
Bison bison										1(1)*				1(1)
Ovis canadensis	2(1)	1		3(1)	6(1)		3	7(1)	8(1)	16		7(1)	2(1)	54(7)
Odocoileus hemionus					6(2)	4(1)	1	5(1)	5(1)	12				33(5)
Antilocapra americana					1(1)?	2(1)?	1(1)?							4(3)?
Lg. Mammal	15		55(2)	19	113	63	71	172	184	108	9(1)	22	13	844(3)
Canis				1(1)	4(1)			1(1)		2		1(1)	2(1)	11(5)
c.f. *Canis*	1(1)		3(1)	1(1?)				1(1?)	2(1)					8 (3 or 5)
Marmota flaviventris									3(1)	1				4(1)
Erethizon dorsatum										1(1)				1(1)
Ondatra zibethicus			1(1)						1(1)					2(2)
Lepus	4(1)		5(1)	4(1)	12(1)	2(1)	3(1)	7(2)	33(2)	42	2(1)	7(1)	5(1)	126(13)
Med. Mammal	24		27	7	39	17	36	48	83	3		2	2	288
Sylvilagus	15(2)		12(2)	5(1)	23(3)	7(2)	11(1)	8(1)	15(2)	4	2(1)	8(1)		110 (16)
Sciurus			1(1)			1(1)			3(2)					5(4)
Citellus variegatus	9(2)		9(2)	1(1)	1(1)	2(1)	2	2(1)		1				27(8)
Citellus	2(1)		2(1)	1(1)	1(1)	2(1?)		1(1)		3				12(5 or 6)

Table 5 (continued). Provenience of Faunal Specimens with number of Identified Specimens and Minimum Number of Individuals (in parentheses).

SPECIES	UNIT B_1	UNIT B_2	UNIT C	UNIT D	UNIT E	UNIT F	UNIT G UNDIVIDED	UNIT G LOWER PORTION	UNIT G UPPER PORTION	NO PROVENIENCE	UNIT H	UNIT I	UNIT J	TOTALS
Cynomys						1(1)*		2(1)	1(1)					4(3)
Thomomys	10(2)		15(3)	4(1)	6(2)	2(1)	2(1)	1(1)	4(2)			2(2)	1(1)	47(16)
Neotoma	8(2)		5(2)	1(1)			1		1(1)	1	1(1)			18(7)
Dipodomys ordii	2(1)						1(1)							3(2)
Microtus	15(2)		5(2)	1(1)	1(1)	1(1)	2	1(1)	2(1)	2				30(9)
Peromyscus crinitus	1(1)													1(1)
c.f. *Peromyscus maniculatus*	1(1)													1(1)
sm. mammal	35		24	11	26	13	14	36	18	3	7	7	4	198
unident	7		9	3	16	19	13	14	16	2		2	1	102
bird	16		25	18	33	16	27	22	26	26	3	23	2	237
reptile/amphibian			1						4			1		6
Salmo clarki				1(1)										1(1)
human							1(1)			4				5(1)
Total # bones	167	1	199	81	288	152	189	328	409	232	24	82	32	2184
Total MNI	17		18	10or11	13or14	9or11	5 or6	11or12	16	2	4	6	4	115 to 121

were counted in MNI totals because they represented ungulate taxa that would not otherwise be counted. Finally, a MNI count was determined for taxa in Unit G (undivided) only when there were bone elements present in this unit that would raise the total represented in Unit G (lower portion) and Unit G (upper portion). At the beginning of excavation, Unit G was defined as one stratigraphic unit, but as excavation continued, it was noticed that this layer had an upper and lower portion divided by fire pits. From that point on, Unit G was divided into the two portions. Therefore, in this report MNI totals were determined for Unit G (lower portion) and Unit G (upper portion) and bone specimens from the undivided Unit G were only considered in MNI determinations when they increased the totals for taxa represented in Unit G (lower) and Unit G (upper).

WORKED BONE

Four pieces of worked bone and teeth were recovered during the 1982 excavation. They are described along with a reanalysis of 13 worked specimens (those remaining in the museum collection) recovered by Steward. The worked pieces recovered by Steward are identified in this report by specimen numbers that appear in his original text (Steward 1937: 115-117). The provenience data are given for the newly recovered pieces, but see Steward's text for general provenience information for pieces recovered during the 1931 excavation. Where sufficient evidence for functional use exists, specific functions are mentioned.

Bone awls and awl tips comprise the majority of the collection (13 of 17), including eight bone awls and two awl tips made from fragments of large-mammal long-bones, two awls made from fragments of large-mammal scapulae, and one made from a large-mammal rib fragment.

Three of the long-bone awls have portions of the articular surface present. One (11037+11038) was produced by longitudinally splitting the proximal end of an antelope (Antilocapra americana) right metatarsal. The lateral articular surface remained intact along with the lateral shaft of the bone (3/5's total length of bone). The distal end was shaped to form a gradually tapered tip by longitudinal, transverse, and diagonal grinding. Total length is 14.8 cm. The second awl (11062-3) was made from a longitudinally split portion of a mule deer (Odocoileus hemionus) left metatarsal. The piece consists of the lateral dorsal portion of the proximal articular surface with the lateral dorsal shaft forming the body of the awl. Transverse and diagonal grinding on the distal end shaped the gradually tapered tip, which was broken off during or after use. Total length is 16.1 cm. The third awl (10981) was made from a longitudinally split portion of a unidentified large- or medium-mammal long-bone. The shaft end was shaped to a gradually tapered tip by longitudinal, transverse, and diagonal grinding. Total length is 11.5 cm.

Two awls were made from distal fragments of the thoracic rim of large-mammal scapulae (mountain sheep or mule deer size). Unfortunately, this area of the scapula is not taxonomically diagnostic. One (11062-1) was made from a right scapula fragment which has a crenulated edge opposite the thoracic rim possibly produced by carnivore gnawing. The proximal end has a small thin spike (1.3 cm long) with a gradually tapered tip. Grinding striations were completely removed by polishing. Total length is 9.9 cm. The second awl (10993) was made from a left scapula fragment. The proximal end has a gradually tapered tip formed by transverse grinding, with striations largely obliterated by polishing. Total length is 10.3 cm.

Five awls were produced from spirally fractured large-mammal long-bone shaft fragments. One (10994) was made from a lateral volar midshaft fragment of a left radius. The distal end was shaped by grinding to form an abruptly tapered tip. Total length is 12.2 cm. The second awl (10998) was made from a medial dorsal mid-shaft fragment of a mule deer (Odocoileus hemionus) metatarsal, with one end having a gradually tapered tip produced by transverse grinding. This highly polished awl is 9.1 cm in length. The third awl (10968), produced from a shaft fragment, was worked on both ends. One end has a gradually tapered tip shaped by transverse and diagonal grinding. The other end was ground-off flat and polished. Total length is 7.0 cm. The fourth awl (11006) was made from a nondiagnostic shaft fragment. One end has an abruptly tapered tip that was rounded off by longitudial and diagonal grinding. Total length is 10.6 cm. The fifth awl (10940) was also made from a nondiagnostic shaft fragment. One end has an abruptly tapered tip shaped by longitudinal and diagonal grinding. Total length is 10.8 cm.

The last awl in the collection was made from a longitudinally broken mid-shaft fragment of a large-mammal rib. One end has a gradually tapered tip formed by transverse grinding. This awl was recovered in non-provenience looter's backdirt during the 1982 excavation. Total length is 7.4 cm.

Two isolated awl tips were from awls made from large-mammal long-bones. One (11048) has an abruptly tapered tip shaped by diagonal grinding, and is 7.2 cm in length. The other awl tip (11067) has a gradually tapered tip shaped by longitudinal grinding, and is 5.8 cm in length.

The final bone tool is a rectangular-shaped (10 cm x 3.8 cm) large-mammal scapula fragment from an area on the the blade near the spine of scapula. The working edge is crenulated and highly polished. Under low-power magnification (10x binocular), use-wear striations appear running parallel and perpendicular to the edge. The striations may indicate that the tool was used as a saw-like cutting blade as well as a "toothed" scraper when turned 90 degrees. The highly polished edge suggests the tool was used on soft material, possibly to remove meat and viscera from hides. This tool was recovered from nonprovenience backdirt piles during the 1982 excavation.

Three pieces of worked teeth are present in the collection. One (11051) is a rodent incisor (pocket gopher size) 1.7 cm in length with two incised grooves cut across the tooth, each 0.15 cm from the ends on the convex (labial) surface (see Steward 1937; Figure 48, b:116). The second piece is a rodent incisor tube 1.0 cm in length, with both ends ground flat and highly polished. One end of the piece is slightly carbonized. The tube may have been used as a bead. It was recovered from Unit G (lower portion) in 1982. The third tooth is a mountain sheep (Ovis canadensis) right mandibular first incisor with a groove incised around the circumference of the tooth root 0.3 cm from the root apex. Total length of tooth is 3.5 cm. The tooth was also recovered from Unit G (lower portion) deposits.

UNWORKED BONE

A total of 2184 bone specimens was recovered at Black Rock Cave. The specimens represent a minimum of 115 to 121 individuals. Of the 1833 recovered mammal specimens, only 503 could be identified to genus or species (27.4%). These bones represented 113 to 119 individuals (see Table 5). The remaining bone specimens could only be identified to broader taxonomic categories. Two hundred, thirty-seven bird-bone specimens and six reptile/amphibian bone specimens were recovered, but not analyzed for this report. One fish bone specimen and five human bones, representing at least one individual, were recovered from a stratigraphic unit and nonprovenienced backdirt piles. Finally, 102 bone specimens were taxonomically unidentifiable. These bones were too fragmentary to even include them in the broader taxonomic categories, but were probably mammalian.

Large-mammal specimens constitute 51.1% of the total mammal-identified bone and 18.3% of the total genus/species identified bone. Of the total genus/species-identified specimens, mountain sheep (Ovis canadensis) represent 10.7% of the total, and mule deer (Odocoileus hemionus) represent 6.6%. Four bone specimens, tentatively identified as pronghorn antelope (c.f. Antilocapra americana) due to their fragmentary condition, represent 0.8% of the total. One of the bone awls mentioned above, made from an antelope long-bone, may lend support to these bones being antelope as well. Finally, a single specimen of bison (Bison bison) represents 0.2% of the total. Based on bone totals and MNI determinations, mule deer and mountain sheep appear to be the important large-game resources exploited by the aboriginal inhabitants of Black Rock Cave. However, mule deer occurred in the stratigraphic record at Black Rock Cave only sometime after about 3200 B.P.

Medium-sized mammals represent 24.0% of the total mammal-identified bone and 30.2% of the total genus/species-identified specimens. This group is dominated by jackrabbit (Lepus spp.) which comprises 25.0% of the total genus/species-identified bone. Dog (Canis spp.), either domesticated dog or coyote, represents 2.2% of the total. In addition, eight specimens tentatively identified as dog (c.f. Canis spp.) but too fragmentary to be sure of confidence, represent another 1.6% of the total. The dog specimens could not be identified to species because all are post-cranial elements and post-cranial differences between domesticated Indian dog, coyote and wolf have yet to be worked out (Lawrence 1983). Domesticated dogs are known in western North America during the time period represented by the Black Rock Cave deposits (Lawrence 1968). Finally, muskrat (Ondatra zibethicus), marmot (Marmota flaviventris) and porcupine (Erethizan dorsatum) together represent 1.4% of the total genus/species identified bone.

Small mammals represent 24.9% of the total mammal-identified bone and 51.4% of the total genus/species-identified bone. Cottontail rabbit (Sylvilagus spp.) bones comprise the majority of small-mammal bones, representing 21.9% of the total genus/species-identified specimens. Pocket gopher, representing 9.3% of the total, was also apparently an important small-game resource for inhabitants of the cave. Both cottontail rabbits and pocket gophers are represented by a minimum of 16 individuals at the site. Mountain vole (Microtus spp.), 6.0% of the total; rock squirrel (Citellus variegatus), 5.4% of the total; woodrat

(*Neotoma* spp.), 3.6% of the total; and ground squirrel (*Citellus* spp.), 2.4% of the total; represent the remaining widely utilized small-mammal taxa. Mountain voles and woodrats are natural inhabitants of caves, but both taxa have burned bones present within the cave deposits and neither taxa was recovered in a depositional pattern distinct from other small mammals. The question concerning natural versus cultural deposition remains unanswerable until more is known about depositional processes (Binford and Bertram 1977). Because of their abundance in the deposits, it is appropriate to consider them as subsistence items. Finally, gray squirrel (*Sciurus* spp.), prairie dog (*Cynomys* spp.), Ord kangaroo rat (*Dipodomys ordii*), canyon mouse (*Peromyscus crinitus*), and deer mouse(?) (*c.f. Peromyscus maniculatus*), together comprise 2.8% of the total genus/species-identified bone. These taxa may occur in such low numbers for a variety reasons: (1)they may be only rare contributors to the prehistoric diet, (2)they may possibly be underrepresented due to recovery techniques, and/or (3)they may be natural inhabitants of the cave.

Steward collected bones from several large-mammal taxa including mountain sheep, mule deer, antelope, bison, and grizzly bear (*Ursus* sp.) (1937:118-119). Also collected were bones from jackrabbits and marmots, both of which were mentioned as "fairly common". The 1982 collection differs from Steward's in being substantially larger and taxonomically more diverse, although no grizzly bear bones were recovered and marmot bones were not very common (only four, with MNI of one).

Burning and/or butchery-marks are present on few bone specimens in the 1982 collection. One hundred and sixty-four bone specimens have burning present to some degree. Carbonization dominates in number although a few bone specimens are completely calcined. Burned specimens are present for the following taxa: mountain sheep, mule deer, dog, jackrabbit, cottontail, rock squirrel, pocket gopher, mountain vole, and large, medium, and small mammal. The majority of burned specimens include large-, medium-, and small-mammal long-bone fragments, and large-mammal rib fragments. A few jackrabbit and cottontail limb-bones were burned as well. The percentages of burned bone specimens by stratum ranged from 5% in Unit B to 18% in Unit E. Only 22 bone specimens show evidence of butchering marks. Eighteen large-mammal long-bone fragments have cut marks running across the specimen, probably indicating muscle tendon detachment from the bone. The remaining four bones include a mule-deer femur fragment with diagonal cuts near the proximal end, a large-mammal tibia fragment with cuts on the planter surface, and two large-mammal rib fragments with short cuts on the external surface. The low number of bone specimens with cut marks present is probably due to the lack of bones likely to show cuts from disarticulation.

A total of 237 bird-bone specimens, representing 10.9% of the total collection, were recovered during 1982 excavations. Analysis of this material has not been completed beyond counting the number of specimens. Steward reported thirteen bird taxa from material saved during 1936 excavation (1937:119). The collection includes 12 specimens from four taxa of waterfowl, 9 specimens from six taxa of predatory birds, and seven specimens from the three taxa of ground/tree dwelling birds. As with the mammals, several different habitats were exploited. In a study of bird bone from similar sites around the Great Salt Lake, Parmalee (1980) reports about 90% are aquatic or semi-aquatic species.

Unfortunately, the sample size is too small and provenience data too general to warrant paleoenvironmental inference for those from Black Rock Cave.

One fish bone, a vertebra 0.9 cm in diameter, was recoverd in 1982 from Unit D sediments. Unit D was deposited after 6200 BP but before 3200 BP at a time when Great Salt Lake shoreline-levels were much too low to allow fresh-water fish habitat (see Currey and James 1982 for paleoclimatic overview). The occurrence of a fish vertebra in Unit D suggests that earlier Lake Bonneville sediments were redeposited either by rodent burrowing or by human activity inside the cave, or that the fish vertebra was brought to the cave from a distant source. The vertebra was identified by Gerald Smith, University of Michigan, and James H. Madsen, Jr., Utah State Paleotologist, as cutthroat trout (Salmo clarki).

Five human bones were recovered at Black Rock Cave during the 1982 excavations. Specimens included isolated fragments of a right temporal, a thoracic vertebra, a distal end of a right radius, a distal phalanx, and a crown portion of a molar tooth. The isolated tooth was recovered from Unit G (undivided), while the other four specimens were found in nonprovenienced backdirt piles.

ASSESSMENT OF ATTRITIONAL DAMAGE

The fragmentary nature of the collection is perhaps best demonstrated by the number of bone specimens in the general categories "large mammal," "medium mammal" and "small mammal." Attritional damage is most advanced in large mammals where 844 of 936 (90.0%) bone specimens are identified only as "large mammal", due to their fragmentary condition. Bone specimens in this category include (in descending order of abundance) long-bone fragments, rib fragments, taxonomically unidentifiable fragments distinguished as large mammal by size and density, and nondiagnostic fragments of vertebrae, articular ends of long-bones, and cranial bones. Long-bone fragments are generally a product of marrow extraction by humans and carnivores, and all fragments listed can result from disarticulation damage, subsistence activities, and subsequent trampling by cave occupants (Brain 1981).

The number of fragments resulting from attritional damage appears to decrease with general size of the animal, as demonstrated by "medium mammal" and "small mammal" categories. In medium-sized mammals, 288 of 440 (65.4%) specimens are identified only as "medium mammal," while in small mammals, 198 of 456 (43.3%) are identified only as "small mammal." This is probably directly related to observations that larger bones break into more pieces and that fragments with dimensions smaller than screen mesh (here 1/4 inch) will not be recovered. It may also be related to the observation that small carnivores (dogs) selectively gnaw larger bones available in a population (Binford 1981). These factors would tend to increase the percentage of species-unidentifiable fragments in large mammals while decreasing the percentage of species-unidentifiable fragments in small mammals.

Another property of bone specimens to consider is their differential ability to withstand destructive treatment. In an analysis of various elements of ethnographically deposited goat skeletons, Brain (1981) demonstrated that the survival rate of bone specimens is directly related to the relative durability/compactness of each element. He also concluded that durability is related to the epiphyseal fusion time of articular ends and to structural properties of bone, and has provided a diagram of relative survivability potentials for bone portions in the bovid skeleton (Figure 20) (Brain 1981:139).

In an attempt to assess the degree of attritional damage on the large-mammal bone population present at Black Rock Cave, the skeletal distribution of recovered mountain sheep and mule deer specimens (Figure 21) was compared to Brain's diagram of bone survivabilty-potentials for bovids (goats). These three taxa are generally comparable because they are closely related in terms of evolution, and bone element properties of durability are roughly eauivalent. Bone specimens from the two Black Rock Cave closely resembles that of the high survivability-potential bone-portion distribution for bovids, suggesting the Black Rock Cave large-mammal bone population has suffered extensive attritional alteration. Bone fragments with low survival ratings probably exist at Black Rock Cave due to differences in depositional environment. The ground surface where Brain (1981) conducted his study of goat skeletons, was hard and compacted, while cave sediments are generally soft and less compacted. Vertebral fragments, scapular fragments, long-bone fragments (not shown in Figure 21), and rib fragments (shown as cross hatching in Figure 21) were probably small and flat enough to be easily trampled into the cave sediments and removed form the attritional environment.

Several attritional processes may be involved in creating the altered large-mammal bone population: (1) weathering, (2) long-bone breakage for marrow extraction, (3) breakage caused by trampling by cave occupants, and (4) carnivore action that reduced specimens in size or completely

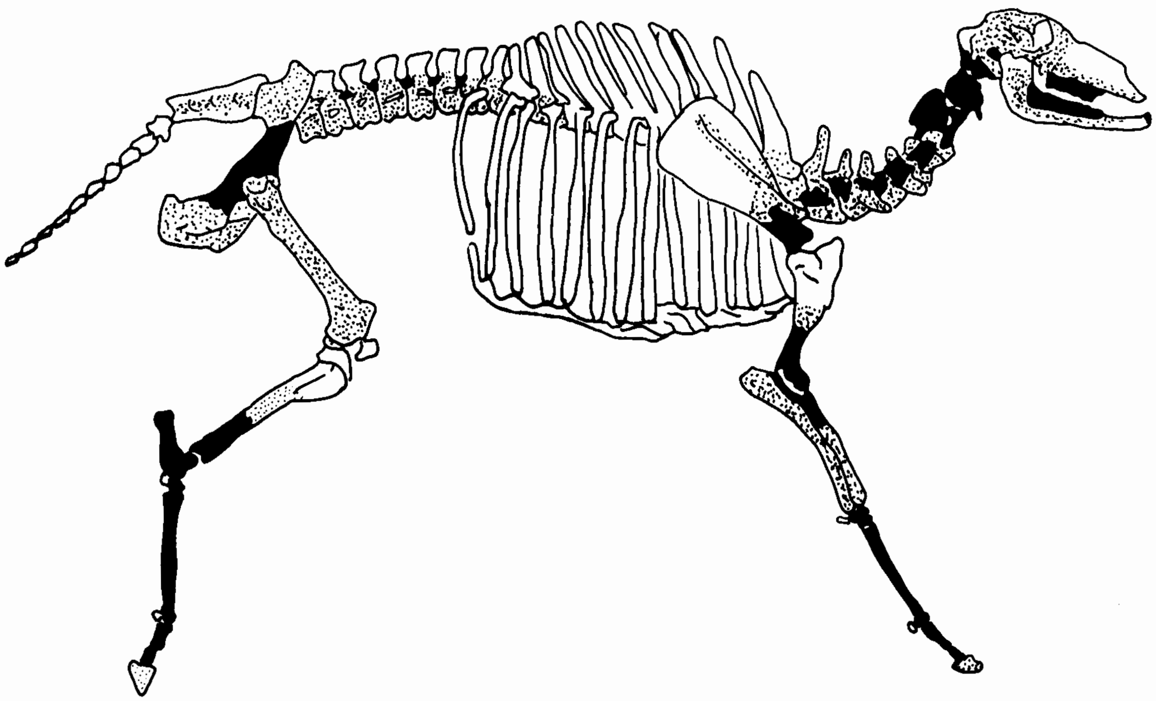


Figure 20 - Potential survivability of bovid skeletal parts: shaded=high potential survivability; stippled=intermediate potential survivability; unshaded=low potential survivability (from Brain 1981).

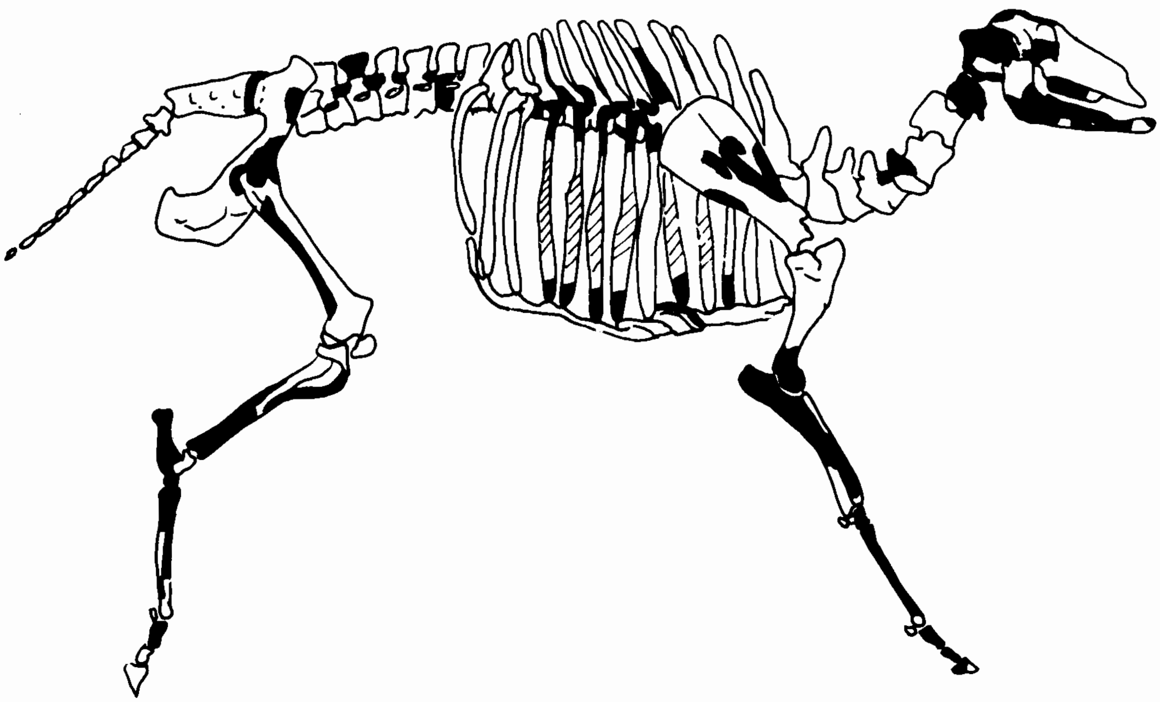


Figure 21 - Occurrence of mountain sheep(Ovis canadensis) and mule deer(Odocoileus hemionus) skeletal parts from Black Rock Cave deposits.

---

removed them the bone population. Evidence of weathering is present on a few specimens, but never to the extent that bones were close to complete disintegration. Therefore, it is probably safe to assume that weathering has not played an important role in alteration of the bone collecton. Characteristics of the other three processes are represented in the vast majority of large-mammal specimens or the lack of such specimens (see Figure 21), and all can be considered important contributors to the alteration of the bone collection. Few bone specimens have puncture marks or shallow, wide grooves indicative of carnivore gnawing, although collections can be significantly altered by carnivores without leaving much physical evidence (Binford 1981, Brain 1981). Carnivore bones (Canis or c.f. Canis) are present in every stratigraphic unit at Black Rock Cave except Unit's E, F, and H, suggesting: (1) domesticated dogs were sometimes present, (2) small carnivores were occasional resource items, and/or (3) small carnivores occasionally inhabited the cave. In any of these events, the carnivores would occasionally have access to bone refuse deposited in the cave. The majority of large- and medium-mammal bones are radially fractured long-bone fragments that generally indicate marrow extraction by humans or carnivores. Finally, trampling played an important role in attritional alteration of the collection, as evidenced by the number of small low-survival-potential bone specimens present in the collection.

SEASONALITY OF OCCUPATIONS

Bone specimens providing reliable seasonality estimates for Black Rock Cave occupations are poorly represented in the collection, due primarily to small sample size , but also due to limited development of techniques in archeology and wildlife biology that are necessary to determine accurate ages of skeletal individuals. For accurate seasonality determinations, the faunal analyst must incorporate life-history data of taxa represented at a particular site with age-determination techniques such as dental-eruption sequences and epiphyseal-fusion sequences. Lengths of birthing season during the year are vital information for seasonality estimates because an individual's determined age must be must be added to month/season of birth to derive the desired month/season of death. Once lengths of birthing seasons are known, dental-eruption sequences and long-bone epiphyseal-fusion sequences can be applied to determine seasonality estimates.

Taxa with short birthing seasons, such as ungulates and carnivores, can provide most temporal restricted seasonality estimates, while taxa with long birthing seasons, such as most rodents, can provide only very temporal broad estimates of seasonality. For example, 95 percent of mule deer fawns in Utah are born within a period of plus or minus 22 days of June 15th each year (Robinette et al 1957:135). With minimum error in age determination, various mule deer skeletal elements can provide seasonality estimates for site occupations within two or three months. On the other hand, muskrats can give birth to offspring in all months except November, December, and January (Errington 1978). Immature long-bones could be deposited in the archeological record in every month of the year, and the determined seasonality interval for muskrats would be a minimum of nine months or more (cf. Madsen 1982:23).

Seasonality estimates could not be determined for Black Rock Cave occupations for the following reasons: (1)an insufficient number of ungulate long-bone articular ends were recovered from cave strata, (2)no large-mammal mandibles with an adequate number of teeth for age-determination by dental-eruption sequence were recovered, and(3) epiphyseal-fusion sequences for medium-mammal and small-mammal taxa with short birthing seasons have yet to be determined.

CONCLUSIONS

A total of 2184 bone specimens, including four worked artifacts, were recovered from deposits excavated in 1982. The specimens represent a minimum of 115 to 121 individuals (see table 5). The main fauna analyzed were mammals, represented by 1833 specimens and 113 to 119 minimum individuals. Two measures of taxonomic abundance were applied in the analysis of mammal remains, the number of identified specimens per taxon (NISP) and minimum number of individuals per taxon (MNI). Individual specimens of a given taxon cannot be shown to be independent of one another, making application of statistical methods inappropriate. NISP-counts cannot directly be assumed to be appropriate measures of taxonomic abundance, and at best can only provide nominal-level (presence/absence) or ordinal-level (rank order) data (Grayson 1979:202). MNI-counts are more appropriate measures of taxonomic abundance because interdependence is not a problem, since every "minimum individual" counted must be independent of every other. It should be kept in mind that a MNI-count is the minimum number of individuals needed to account for all specimens in some aggregation unit. The actual abundance of a taxon may vary from the minimum number to some unknown higher figure (not higher than NISP). Therefore, MNI-counts do not provide exact values of taxonomic abundance, and the actual distances between minimum numbers are unknown. As a result, MNI-values cannot provide valid measures that are more than ordinal in scale (Grayson 1979:221).

At Black Rock Cave, most taxa are represented by very few individuals (MNI less than 10), while only a few are represented by many individuals (MNI greater than 12). The taxa that are similar in abundance will probably not have their ordinal abundance accurately reflected by MNI counts. Conversely, taxa whose abundances are well separated will probably have their ordinal abundances accurately reflected by MNI values (Grayson 1979:222). Determination of taxonomic abundances, and in turn, economic importances of taxa, is complicated at Black Rock Cave by small-sample size. A few bones added to or subtracted from bone totals for most taxa could significantly change the total MNI-count for those taxa. Cottontail rabbit and pocket gopher, each represented by 16 individuals, and jackrabbit, represented by 13 minimum individuals, are the taxonomically most abundant and the economically more important taxa at Black Rock Cave. Mountain sheep and mule deer, represented by seven and five minimum individuals respectively, are also economically important game resources, as these large mammals provide more meat per individual than small mammals. Also, ground squirrels as a group (rock squirrels and ground squirrels) can be considered important game resources, together represented by 13 or 14 minimum individuals. The taxonomic abundance and economic importance is less well known for the remaining taxa, as they are represented by few minimum individuals. The taxonomic abundances of large-game resources are probably underrepresented, as large-mammal bone portions have largely been reduced in size or removed from the population of originally deposited bones by factors of attrition, namely carnivore action, bone-marrow extraction, and trampling (see Figure 21 and section on assessment of attrition). Also, taxonomic abundances of small mammals may be underrepresented due to factors inherent in recovery methods.

The faunal subsistence strategy at Black Rock Cave focused on procurement of small-mammal taxa such as cottontail rabbits, pocket gophers, jackrabbits, and two or more species of ground squirrels, along with occasional mountain sheep and mule deer. All recovered taxa at Black Rock Cave could be obtained in close proximity of the site, most inhabiting the rocky slopes of the Oquirrh Mountains (see Durrant 1952 for present distributions). Several life-zones were utilized by the inhabitants, the most taxonomically diverse of which is the Upper Sonoran (Table 6). All taxa present could be obtained by a single hunter or by small groups of hunters, or by various techniques of trapping (Table 7). The presence of burned bones and bone specimens with cut marks, as well as a large number of large- and medium-mammal long-bone fragments, suggests that animals were brought to the cave for processing and subsistence- related activities. The distribution of small-mammal and medium-mammal bone elements indicates taxa of this size range were brought to the cave complete. Also, the distribution of large-mammal bone portions suggests that large mammals were at least occasionally brought to the cave before any disarticulation took place (Figure 21). Finally, the number, kind, and provenience of bone tools may suggest that meat and hide processing activities were conducted at Black Rock Cave. Unfortunately, small- sample size of the collection prohibits discussion of paleoenvirons, subsistence change through time, and seasonality of cave occupations.

Table 6. Occurrence of Black Rock Cave Taxa by Life Zone (#).

	LOWER SONORAN	UPPER SONORAN	TRANSITION	CANADIAN	HUDSONIAN	ARCTIC - ALPINE
Bison _Bison bison_	*					
Mountain Sheep _Ovis canadensis_		*	*	*	*	*
Mule Deer _Odocoileus hemionus_	(*)	*	*	*	*	
Prong-Horned Antelope _Antilocapra americana_	*					
Coyote _Canis latrans_	*	*				
Marmot _Marmota flaviventris_	(*)	*	*	*	(*)	
Porcupine _Erethizon dorsatum_		*	*	*	*	
Muskrat _Ondatra zibethicus_	*					
Jackrabbit _Lepus_ spp.	*	*	*	*		
Cottontail _Sylvilagus_ spp.	*	*	*	*		
Gray Squirrel _Sciurus_ spp.		*	*	*		
Rock Squirrel _Citellus variegatus_		*	*	*		
Ground Squirrel _Citellus_ spp.	*	*	*	*	*	
Prairie Dog _Cynomys_ spp.	*	*	*	*		
Pocket Gopher _Thomomys_ spp.	*	*	*	*	*	
Wood Rat _Neotoma_ spp.	*	*	*	*	*	
Ord Kangaroo Rat _Dipodomys ordii_	*					
Mountain Vole _Microtus_ spp.	*	*	*	*	*	*
Canyon Mouse _Peromyscus crinitus_	*	*				
Deer Mouse _Peromyscus maniculatus_	*	*	*	*	*	
20	14	16	14	14	8	2

* = present
(*) = rarely present
    = not present
\# = (Compiled from Durrant 1952, Burt and Grossenheider 1976, and Whitaker 1980)

Table 7 Ethnographic Faunal Procurement Methods In the Northeastern Great Basin.

	Hunting		Communal drive	Snare	Digging stick/ rodent skewer	Smoked out/ flooded out of burrow	Trap/ deadfall
	individual	small group					
mule deer	X	X					
mountain sheep	X	X					
antelope	X		X				
jackrabbit	X		X				
cottontail	X		X	X			
marmot	X				X	X	X
pocket gopher				X	X	X	
ground squirrel					X	X	X
prairie dog							
	(from Steward 1938: 14-32)						

INVERTEBRATE REMAINS FROM BLACK ROCK CAVE

by

Joel C. Janetski

Substantial numbers of terrestrial snails (Oreohelix sp.) were recovered from all cultural levels (Table 8) at Black Rock I during the 1982 excavations. The snails apparently occur naturally in the cave and their presence holds no cultural significance; however, their relative abundance in the levels may reflect climatic conditions during various temporal periods. Their numbers are represented in Table 8.

Table 8. Occurrence of Oreohelix sp. by Level in Black Rock Cave

Unit		Number
G	upper	7
G	lower	12
F		4
E		10
D		6
C		5
B_1		1

A single example of Physa ampullacea was recovered from Unit C. Steward (1937:117) recovered four Oreohelix sp. and one Physa ampullacea during his earlier excavations.

Although not recovered in the 1982 work at Black Rock Cave, Steward (1937:117) reports five specimens of "unworked clam" or mussel shell from the upper levels at Black Rock Cave. These were identified as Margaritana margaritifera Linn. Subsequent examination of these fragments by Dennis Shiozawa, Department of Zoology, Brigham Young University, supports Steward's findings. Identification of this species is based on the presence of well-developed cardinal teeth on the hinge portion of the bivalve. Neither Smith (1941) or Enger (1942) mention the presence of mussel shells at Deadman or Black Rock III caves, although a cursory examination of the Deadman materials revealed a number of M. margaritifera shell fragments. Steward (1937:29) also found mussel shells in the Promontory caves on the north shore of the Great Salt Lake.

According to Chamberlain and Jones (1929) M. margaritifera were present in the streams around Salt Lake City in the early 20th century. The closest source of these freshwater mussels from the caves at the northern end of the Oquirrh Mountains would probably have been the Jordan River about 20 km to the east. It is possible that mussels occurred in the marshy areas at the north end of the Oquirrhs, as both Anadonta sp. and M. margaritifera are reported from ponded waters such as Utah Lake (Chamberlain and Jones 1929). The rather thick shells of these specimens suggests, however, that they were from a riverine environment (Parmalee 1967). According to Parmalee (1967), mussels were best gathered in the summer when waters are lower and beds are exposed.

BLACK ROCK CAVE CERAMICS
by
Patricia W. Dean

In all, 42 pottery sherds have been recovered from Black Rock Cave (42To64). Only 28 sherds, however, were available for reanalysis. Of these 28 sherds, five were recovered during the 1982 reexcavation; the remaining sherds were recovered during Steward's 1931 excavation.

Steward included all of the Black Rock Cave pottery in one category: cave ware. He viewed this ware as typical of all cave sites around the Great Salt Lake, particularly from the Promontory Point sites. The ware is characterized by sandy, dark brown to black paste with coarse white quartz or gravel temper; occasionally some mica is used. Steward notes that one, and possibly two, sherds resemble puebloan pottery but considers that they may be variants from the standard cave ware (Steward 1937:111-112).

Reanalyses of the Black Rock Cave pottery was performed by macroscopic, stereoscopic and in two samples, by thin-section examination. The reanalyses affirms the presence of two distinct types of pottery as implied by Steward. One type falls within the normal range of Snake Valley Gray pottery and is affiliated with the Fremont culture. The other pottery type has characteristics which fall between Great Salt Lake Gray pottery (Fremont) and that described by Steward (1941, 1943) as characteristic of the northern Shoshoni.

ANALYSIS

Snake Valley Gray Pottery:

Seven sherds of Snake Valley Gray pottery were reanalyzed. Five of the seven sherds were recovered during the 1982 reexcavation. None of the seven sherds articulate with one another, though they are probably from a single vessel.

Macroscopic Examination: four of the seven Snake Valley Gray sherds have very dark gray to black (2.5Y 3/3 to 2/2) surfaces. Three sherds have gray (10YR 5/1) surfaces. All interiors of sherds are slightly lighter than the exteriors. Walls are 5 mm thick.

Interior and exterior surfaces are well-smoothed and lightly polished, though one sherd has a coil ridge evident on the interior surface. Muscovite and biotite are present on all surfaces.

Stereoscopic Examination (examination of all sherds was performed using a Wilde steroscope (20-50x): all sherds have identical subangular opaque to clear rock fragments. This temper material is generally .7 mm in maximum dimension. This is just outside the range of normal for Snake Valley Gray (R. Madsen 1977).

Thin-section Examination: one of the seven Snake Valley Gray sherds was chosen for thin-section analysis. The clay is not as fine-grained as in the Great Salt Lake Gray sherds, and organic matter is nearly absent in this sample.

R. Madsen (1977) identifies the temper material in Snake Valley pottery as quartz. Mineralogical identifiction of this sherd, however, indicates that 60% of the temper material is andesite. A minor amount of quartz is present but is so well-rounded that it probably comes from the same source as the clay.

Northern Shoshoni/Great Salt Lake Gray Pottery:
Twenty-three sherds of gray pottery were available for reanalysis. Many sherds articulate with one another and probably represent fragments from a single vessel.

Macroscopic Examination: all 23 sherds in this type are characterized by sandy black (7.5YR 2/2) paste which has evidence of uneven reduction firing. The walls range in thickness from 3 to 7 mm and contain particles of muscovite on the surface.

The exterior surface has been lightly polished and short (ca. 5 cm in length), polishing striations are apparent. The interior surface is slightly polished but has long, unbroken striations which do not overlap one another. Both the exterior and interior have undulating surfaces. This is generally associated with the forming technique of paddle and anvil. Steward suggests this as the method of construction for all of the cave wares (1936:6). The presence of undulating surfaces on Great Salt Lake Gray sherds was noted at the Levee and the Knoll sites (Fry and Dalley 1979) but they were, nevertheless, constructed by coiling as first suggested by Rudy in 1953.

Several sherds from this collection clearly show evidence of lightly smoothed coils on the interior surfaces. The distance between the coils range from 6 to 8 mm. Shepard (1957) notes that paddle and anvil is often employed with coil construction. It serves to bond the coils together and also to thin the walls (replacing the need for gourd or ceramic scrapers). Steward (1941, 1943) notes the use of coiling and pats of clay during the building of pots by the Northern Shoshoni in Idaho and the Shoshoni in Nevada. Finishing by stick scraping is common.

Stereoscopic Examination: Three distinct rock fragments comprised the tempering material: (1) (large 5-7 mm in maximum dimension), crystal- line white to gold rock fragments with subangular to rounded edges; (2) small (ca. 1 mm in maximum dimension), opaque crystals; and (3) muscovite (white mica) fragments.

Thin-section Examination: Two of the 23 Great Salt Lake Gray sherds were selected for thin-section analysis (Appendix I). One sherd had black paste and the other, gray.

The black-colored paste is the result, not of iron reduced clay, but of carbon material surrounding the clay particle. Even the gray paste contained some carbon material. Both sherds have very fine-grained clay and the particle size and color of both sherds indicate they may be from the same source.

The temper material in the first sherd is composed of three rock types: large (1-1.5 mm) granite rock fragments, hornblende, feldspar which has been partially or wholly altered to white mica, and quartz. The quartz appears to have been derived from the granite. Most of the mineral crystals in this sherd are unrounded and have jagged edges, indicating limited transport from the source area.

Temper material in the second sherd is composed of two rock types: large (up to 2 mm) volcanic rock fragments (probably andesite or diorite), and sedimentary rock fragments. The sedimentary fragments are well-rounded and indicate a mature sedimentary source.

Neither the granite nor the volcanic rock fragments occur near the site. The northern tip of the Oquirrh Mountains is geologically distinct from the rest of the mountain chain (Roberts and Tooker 1961), and is characterized by limestones, sandstones, shales and quartzite rocks. The closest source of granite and volcanic rocks (which can occur together), is on the east side of the Oquirrh Mountains near the present area of the Bingham Mines. The eastern slope of the Stansbury Mountains also contains small deposits of granite and volcanic rocks (Hintze 1980).

Distribution of Pottery:
All five sherds recovered from the 1982 reexcavation are identified as Snake Valley Gray. These sherds were recovered from the backfill and, thus, are unprovenienced. Over half of the sherds recovered by Steward came from near or just under the post-Caucasian refuse (Steward 1937). This distribution suggests a co-occurrence of both pottery types.

DISCUSSION OF BLACK ROCK CAVE CERAMICS

Two distinct pottery types were found in Black Rock Cave. They appear to be contemporaneous. One type of pottery falls within the range of normal for both Great Salt Lake Gray and Numic (Shoshoni) pottery. The interesting attribute of this pottery is the presence of carbon-covered clay.

In clays derived from both the surface and swamps and lakes, vegetal matter is common. However, if the carbonaceous matter is not fully removed before firing, gases will be trapped and the interior of the sherd will become black and vesicular. Since vesicularity is not present in the sherds examined here and since the carbon-covered paste is evenly distributed throughout the sherds, it appears the carbonaceous material was intentionally added. Shepard (1957) notes that there are a number of ethnological examples where potters increase the plasticity of their clay by adding such carbonaceous material as blood or vegetal juices (specifically, the juice of roasted prickly-pear cactus). The addition of these fluids serves to disperse the clay particles allowing each particle to be coated with the organic material. Grimm (1962) notes that organic material added to fine-grained clays not only increases the plasticity of the clay, but also increases the dry strength of the pottery. Thus, by the simple addition of some carbon material, the number of clay sources suitable for pottery manufacture is greatly increased.

In an experimental process, Austin Long (1983 personal communication) of the University of Arizona has attempted to radiocarbon date the small amount of organic material in these sherds through the use of a linear accelerator/mass spectrometer. A date of 1250±150 (A3391) from a Great Salt Lake gray sherd recovered by Steward, is comfortably within the range of Fremont occupation within the Great Salt Lake area and it appears the Fremont employed vegetal additives in their pottery manufacture. Steward also notes the use of several vegetal materials in the construction of both Nevada Shoshoni (1941) and Northern Shoshoni (1943) pottery. In the case of the Northern Shoshoni, both pitch and mallow (Malva and Sidalcea) were used in the construction of pottery. Rabbitbrush and mallow were used on the exterior surfaces by the Nevada Shoshoni and "boiled plant" was mixed with the clay by the Little Lake Shoshoni (Steward 1941:339). The use of vegetal additives has not been noted in other Great Basin ceramics and it appears that there is a degree of technological continuity between Fremont and Shoshoni potters.

Snake Valley Gray pottery is associated with the Fremont culture (R. Madsen 1977). A number of sites in southwestern Utah and southeastern Nevada have contained a co-occurrence of both Fremont and Numic (identified in the literature as Shoshoni) pottery. Sites such as O'Malley Shelter, Conaway Shelter, and the Scott Site (Fowler, Madsen, and Hattori 1973), Pine Park Shelter (Rudy 1954), Civa II (Busby and Seck 1977), and Silvovits Shelter and Avacado Shelter (Busby 1979), all contain Fremont and Numic pottery (as well as Western Anasazi pottery, in some instances). The Fremont pottery in all of these sites is Snake Valley (gray and black-on-gray). Thus, the presence of Snake Valley Gray in Black Rock Cave may be the result of exchange between the groups rather than the presence of Fremont people.

CERAMIC ANALYSIS OF THE GREAT SALT LAKE REGION

In an attempt to further distinguish whether the pottery found at Black Rock Cave was Numic or Fremont, a survey of nearby cave sites was made. An attempt to relate these sites to a larger region was then made by reanalyzing the ceramic material from Hogup and Danger Caves and other related sites.

Deadman Cave:

Pottery from the nearby Deadman Cave (42SL1) was compared with that from Black Rock Cave. Smith (1952) reportedly recovered 58 sherds from this site, but only 27 were available for reanalysis. Smith notes that 52 of the sherds from Deadman Cave are Great Salt Lake Gray sherds and three of the 52 sherds were decorated (one 'coffee bean' applique; two 'fingernail' impressed). Six of the 58 sherds were similar to the other 52 sherds except for the presence of a high percentage of medium coarse quartz crystals. The pottery from Deadman Cave appears to be entirely Fremont; that is, it appears to be classic Great Salt Lake Gray rather than the probable Shoshoni material from Black Rock Cave and Black Rock Cave III.

Macroscopic Examination: the 27 sherds available for reanalysis range in surface color from light brownish gray (10YR 6/2) to dark gray (10 YR 4/1). Most of the sherds are smoothed and lightly polished on the exterior and well-smoothed on the interior surfaces. None of the sherds available for reanalysis show evidence of undulating surfaces, as recorded by Smith (1952:9). They all have micas evident on both the interior and exterior surfaces.

Microscopic Examination: 26 of the 27 sherds reexamined fall within the range of normal for Great Salt Lake Gray pottery. Most of the sherds have a range of tempering material present within the paste and includes chert, sand and quartz and well as biotites and muscovites. One sherd contained medium subangular quartz crystals within a light paste and probably represents a Snake Valley Gray sherd.

Thin-Section Anaslysis: two of the 27 sherds from Deadman Cave were selected from thin-section analysis. Both of the sherds were Great Salt Lake Gray pottery as sacrificing the only Snake Valley Gray sherd was not considered to be appropriate.

One sherd contained masses of plagioclase which were distinctively aligned. The fragments contained minor amounts of augite, hypersthene and olivine minerals. The rock fragments are unaltered. Small amounts of fine-grained, well-rounded chert fragments, generally reddish-brown in color, were also found.

In general, the minerals in the rock fragments are unweathered, indicating little transport from the source. Sanidine accounts for 65% of the mineral fragments in this sherd. The second sherd thin-section contained rock fragments that were fairly well-rounded cherts and average .1 mm in maximum dimension. Sanidine accounts for 75% of the mineral fragments and is partly altered. A number of other 'opaques' are fairly well altered and result in biotite and magnetite. The thin-section contains unaltered minerals, suggesting that the clay and/or tempering material is much more highly weathered than in any other sample.

Black Rock Cave II:
Eight sherds are recorded in the Utah Museum of Natural History collections records as having been recovered by Smith. None of the sherds were available for reanalysis.

Black Rock Cave III:
Enger (1942) recovered 166 sherds from this site. The three groups recorded by Enger in his excellent analysis are supported by this reanalysis. One hundred twenty two of the sherds are characterized by subangular crystalline temper material which ranges in color from yellow-brown to gray. The paste is gray in color and clumps in uneven clots; it is not well-sorted. There is evidence of coiling on the exterior with the coils being approximately 8 to 10 mm in width. There is a minimal amount of smoothing of both surfaces.

This pottery type is remarkably similar to that of the Numic/Fremont pottery recovered in Black Rock Cave. It, too, has an undulating surface, and has thick walls which range from 6 to 8 mm. Some carbon material surrounds the temper (probably chert) particles, making it resemble black basalt. The core is uneven, being redder-gray towards the exterior. Steward notes the burning of material on the inside of the pot after drying by the Northern Shoshoni (1943:375). The pottery is not actually fired, but is hardened.

Twenty four sherds are similar to the above pottery but contain a different temper material. It, too, is a crystalline material, but appears to be an opaque mineral with biotite or magnetite present in the matrix. The walls are slightly thinner (4 mm thick) and the surfaces are lightly polished. Twenty other sherds contain quartz, with biotite present. All 44 of these sherds appear to be characteristic of Great

Salt Lake Gray pottery. The other 122 sherds are probably Shoshoni pottery.

Regional Analysis:

Pottery from Hogup Cave (Aikens 1970) and Danger Cave (Jennings 1957) were also examined in an attempt to further resolve the problem of distinguishing Great Salt Lake Gray and Numic (Shoshoni) pottery. Both sites have Great Salt Lake Gray and Numic pottery co-occuring. Though the Danger Cave sherds were recovered from the surface, the presence of both Numic and Fremont pottery together led Jennings to propose a coexistence of the two groups (1957:181).

Aikens (1970:32) also noticed the coexistence of both pottery types (he separated the two types by the presence of a coarse crushed rock temper and undulating surfaces on the Shoshoni pottery). On reanalysis, this pottery contains evidence of pitch in the clay. Aikens, too, suggested that the makers of both kinds of pottery utilized the cave concurrently (1970:32). Reports of excavated sites in the northwestern portion of Utah, such as at Swallow Shelter (Dalley 1976) and in the northeastern portion of Nevada, such as Thomas Shelter (Dalley 1976), support the coexistence of Fremont and Shoshoni pottery. Recent examination of pottery from southcentral and southeastern Idaho (10EL694 and Big Creek Cave) indicates a remarkable uniformity in materials used and technique of construction of Shoshoni material.

CONCLUSION

Variation in any cultural material record such as ceramics, is much like the old joke: the good news is that differences can be used to distinguish one "cultural" group from another; the bad news is that there is a concurrent question of whether these distinct "groups" equate with discrete ethnic units and, if so, can these ethnic differences be measured. Archeologists have attempted to address both issues on various analytic and theoretic levels, but generally reduce them to two questions: does the variation in the material culture reflect human behavior in adapting to diverse environments, or, does the variation also reflect degrees of interaction within and/or between groups?

There is conflicting evidence regarding the role of the environment in determining variability in the material record. Access to natural resources has been seen as critical for the utilization and development of such resources by prehistoric groups (Phillips 1974; Renfrew 1975; Sherratt 1982), while other studies show that the degree of access does not affect modern aboriginal groups (Arnold 1978; White and Modjeska 1978). Studies of modern groups by ethnoarcheologists indicate that the distance from the source of supply is not simply a geographical factor, but is affected, if not determined, primarily by social relationships (Hodder 1982; White and Modjeska 1978).

The degree of interaction between such groups, particularly those of distinct ethnic identity, is commonly viewed by archeologists as being the result of varying degrees of social interaction. Archeologists most commonly measure the relationship between (a) geographical distances between sites and (b) stylistic similarities (such as painted designs) among groups of artifacts. In some ceramic analyses (Fry and Cox 1974: S. Plog 1976) there is no relationship between the two variables, while in other studies, a definite correlation is suggested (Kay 1975; Washburn 1978).

Black Rock Cave and the other sites examined in this report have only plain gray ceramics, and, while painted designs on such pottery obviously cannot be measured, it is possible to measure the degree of technological attributes among and between the sites. Peoples at all the sites had similar geographical access to the raw material for the production of the ceramics and the degree of similarity in the resources used among the sites (including Hogup and Danger Caves) is remarkable.

Microscopic and mineralogic analyses from the sherds studied in this report show a high level of both intersite and intrasite technological similarity (in techniques of manufacture, firing and resources). In contrast, indications of high degrees of interaction between sites have been attributed to a high level of intersite stylistic similarity and a low level of intrasite homogeneity. Increasing physical interactions such as popu- lation pressure (Whallon 1968), social organization (Hill 1970), or refugias (Berry 1982) have been suggested as contributing to the evolving of homogeneous intersite styles.

The high level of technical similarity between the Fremont and Numic pottery studied in this report does not seem to be explained by any of the above studies. Rather, other scenerios are more likely: (1) the sites were occupied by a single Fremont or Numic group who, in the course of a number of years, moved from cave to cave; (2) the sites were occupied by contemporaneous groups of either Fremont or Numic populations; or, (3) there was an increase in contact between the Fremont and Numic populations so that the technology and style of pottery manufacture merged to reflect such an information exchange.

The slight shifts between Numic and Fremont pottery are not technological ones; they are slight variations of the same technology. In general it is: (1) rim and base shapes; (2) 'well-madeness' which is identified on the bases of wall thickness or the presence/absence of surface undulations, and, sometimes; (3) temper differences (sand/quartz temper for Fremont; "crushed rock" or chert temper for Numic). This shift would be explained by at least two means: that the Numic population derived much of their ceramic technology from the Fremont; or, that the changes are evidence of a gradual evolution of pottery technology by the Fremont themselves in response to some shift in their need for pottery (change in subsistence, for example).

These scenerios are ad hoc stories which fit the data and are not explanations. A more profitable method of exploration, at least with plain gray pottery, might be to evaluate only the technology of the pottery manufacture and test the degree of relatedness between and among the pottery identified as Fremont and Numic. In ranking the technology of manufacture, it might be possible to find a common currency in which to discuss the level of technology.

POLLEN ANALYSIS OF BLACK ROCK CAVE SITE DEPOSITS AND CULTURAL FEATURES

by
La Mar W. Lindsay

ABSTRACT

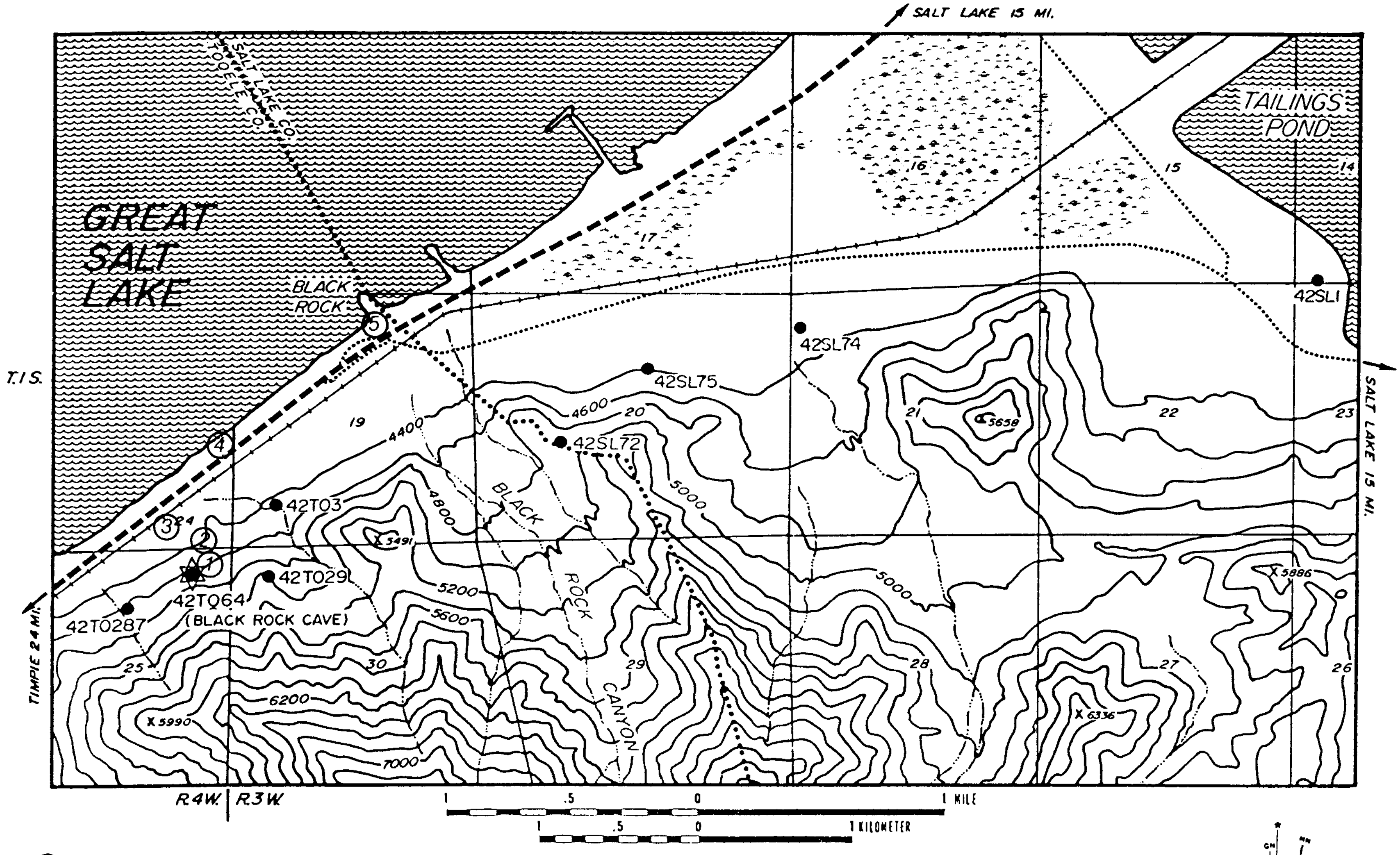
The pollen sampling of deposits from Black Rock Cave provides paleoenvironmental and limited paleoeconomic information from about 6100 to 1500 B.P., during middle and late Archaic and early Fremont times. Prehistoric vegetation was similar to that of today except that grasses predominated over Cheno-Ams to about the middle of the 4500 year record. The slopes in the vicinity of the cave in the northern part of the Oquirrh Mountains were essentially treeless just as they are today. The subsistence of Archaic and early Fremont peoples consisted of a "mixed bag" of resources including marsh plants. The early Fremont at the cave were also apparently practicing at least some horticulture.

INTRODUCTION

Sixteen soil samples were collected from Black Rock Cave deposits, cultural features, and the modern surface. The samples were collected over the course of the 1982 mid-fall excavations. Five samples were collected from the modern surface on a transect from the cave to the shore of the Great Salt Lake (Figure 22). The remaining samples are from site deposits including two from hearths. The prehistoric samples cover a period of about 6100 to 1400 B.P. and provide sampling of middle and late Archaic and early Fremont deposits. The modern samples provide a framework for comparison.

Minimal goals of the pollen study include the identification of various pollen types which occur in the prehistoric and record and how these may have changed over time. The various pollen types in the prehistoric record reflect both the general pollen rain and local plant species, many of which were introduced by man into the cave. Consequently, changing pollen percentages over time may be the product of both a changing environment or variations in the subsistence focus of prehistoric man.

Indications of paleoclimatic/environmental change should be apparent in the cave pollen record. The ca. 5000 B.P. transition from the Postglacial (Currey and James 1982) to the Neoglacial (Denton and Karlen 1973) should be detectable. More particularly, the ca. 3000 B.P. early-middle Neoglacial interstadial/middle Neoglacial stadial (Denton and Karlen 1973) transition should be most evident (Currey and James 1982; Madsen and Currey 1979). It was hoped that the cave pollen record would provide information on the nature of and change in the distribution of pinyon (*Pinus monophylla*) and the potential importance the species may have had for the various aboriginal inhabitants of the cave (Currey and James 1982:38-39; Madsen 1984). Unfortunately, the limited sampling over such an extensive temporal range of cave occupation does not provide a demonstration of consistent and gradual change. Thus, we are left with a few samples which show high pollen counts of one species or another which *may* support extant northeastern Great Basin reconstructions.



⑤ Pollen Samples

Figure 22 - Black Rock Cave and the modern pollen sampling loci on the north end of the Oquirrh Mountains.

FARNSWORTH PEAK QUADRANGLE
UTAH

The prehistoric pollen samples clearly show that most species present today were also present over much of the prehistoric record. The variability of the modern samples more-or-less reflects the expected distributions of various plant types along the surface transect. Modern plant distributions may have been modified somewhat by the nearby smelter. Modern vegetation is characteristically that of a cold desert/steppe. Sagebrush (*Artemisia* spp.) dominates the higher elevations at and above the cave. Composits become the principal component approaching the base of the mountain. Arboreal species, with the exception of scrub oak (*Quercus gambelii*), are limited to draws at higher elevations.

Early historic records suggest that several springs were present in the vicinity of the cave and that they supported marsh species such as sedges, rushes, and grasses. These include *Equisetum* sp., *Juncus* sp., and *Scirpus* sp. Other local species identified in early historic records include lilies, such as *Erythronium gradiflorum* and *Fritillaria pudica*, and various other plants such as *Rhamnus* sp., *Eriogonum* sp., and composits, legumes, violets, gilias, oenotheras, and saxifrages. Elsewhere on the Oquirrhs, principally on the central and southern end, *Juniperus osteosperma* and *Pinus monophylla* are at the lower elevations. Spruce and fir and, in places, dense stands of *Populus tremuloides*, occupy the higher climes. A number of these species are expected to occur at least in trace amounts in the prehistoric pollen record.

METHODS

The sixteen soil samples collected for pollen analysis are from cave deposits, hearths, and the modern surface. The eleven prehistoric samples were obtained from the excavation Areas I and II over the course of the mid-to-late fall project. The modern surface samples (1-5) were obtained during mid-winter, several months after excavations were completed.

Samples obtained from excavation Area I, in the mouth of the cave, are from stratigraphic units B_1 through G (upper and lower) (Figure 23). A sample was not obtained from the basal Unit A, the sterile lacustrial gravel deposit. Samples obtained from excavation Area II, 15-20 m inside the cave, are from units H and I. In addition, samples were obtained from Hearths #6 and #7, both associated with Unit I. Units A, B_2, and J were not sampled. See the chapters on Stratigraphy and Chronology for descriptions and dating of these units.

The five modern samples were collected from a transect running from immediately outside the cave to the waters edge of the Great Salt Lake. Sample #1 was obtained immediately outside the cave well beyond the spoil dirt of the excavation. The elevation is 1396 m (4580 ft). Local vegetation is dominated by sagebrush. Sample #2 was obtained about 120 m (400 ft) below the cave at 1360 m (4460 ft) elevation. Vegetation is dominated by both sagebrush and composits. Sample #3 was obtained about 275 m (900 ft) below the cave at 1305 m (4280 ft) elevation. Vegetation is dominated by Cheno-Ams. Saltbush is also present. Sample #4 was obtained from a marshy area below the cave, about 50 m (165 ft) from the lake edge. Saltgrass, cattail, and rushes are dominant. Sample #5 was obtained from the sands at the lake edge immediately west of Black Rock.

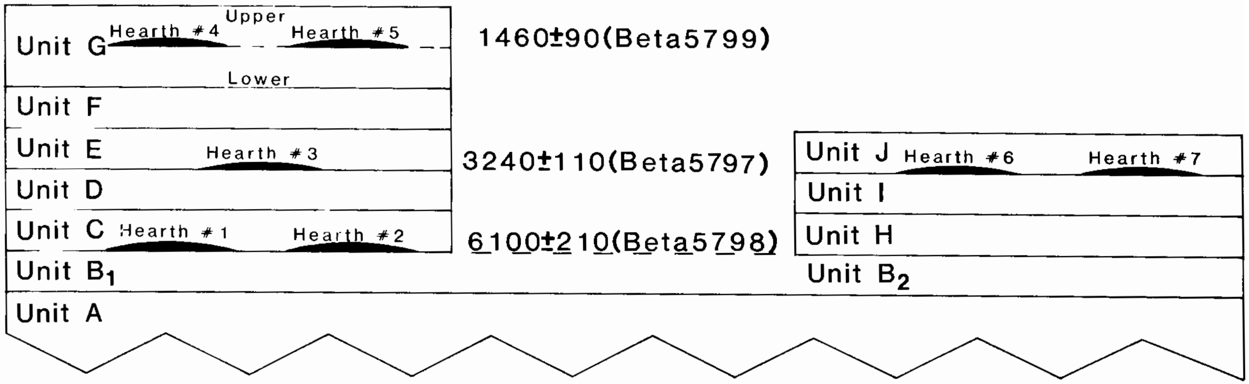


Figure 23 - Diagram of Black Rock Cave stratigraphy and dating; excavation Area I on the left and excavation Area II on the right.

Tamarix and saltgrass are dominant.

The samples were extracted following procedures in general use for alluvial and eolian samples from the Great Basin (Mehringer 1967). Extracted material was stained with basic fuschin, mounted in glycerol, and counted under 600X magnification. Identifications were made using modern reference material made available by the University of Utah Herbarium.

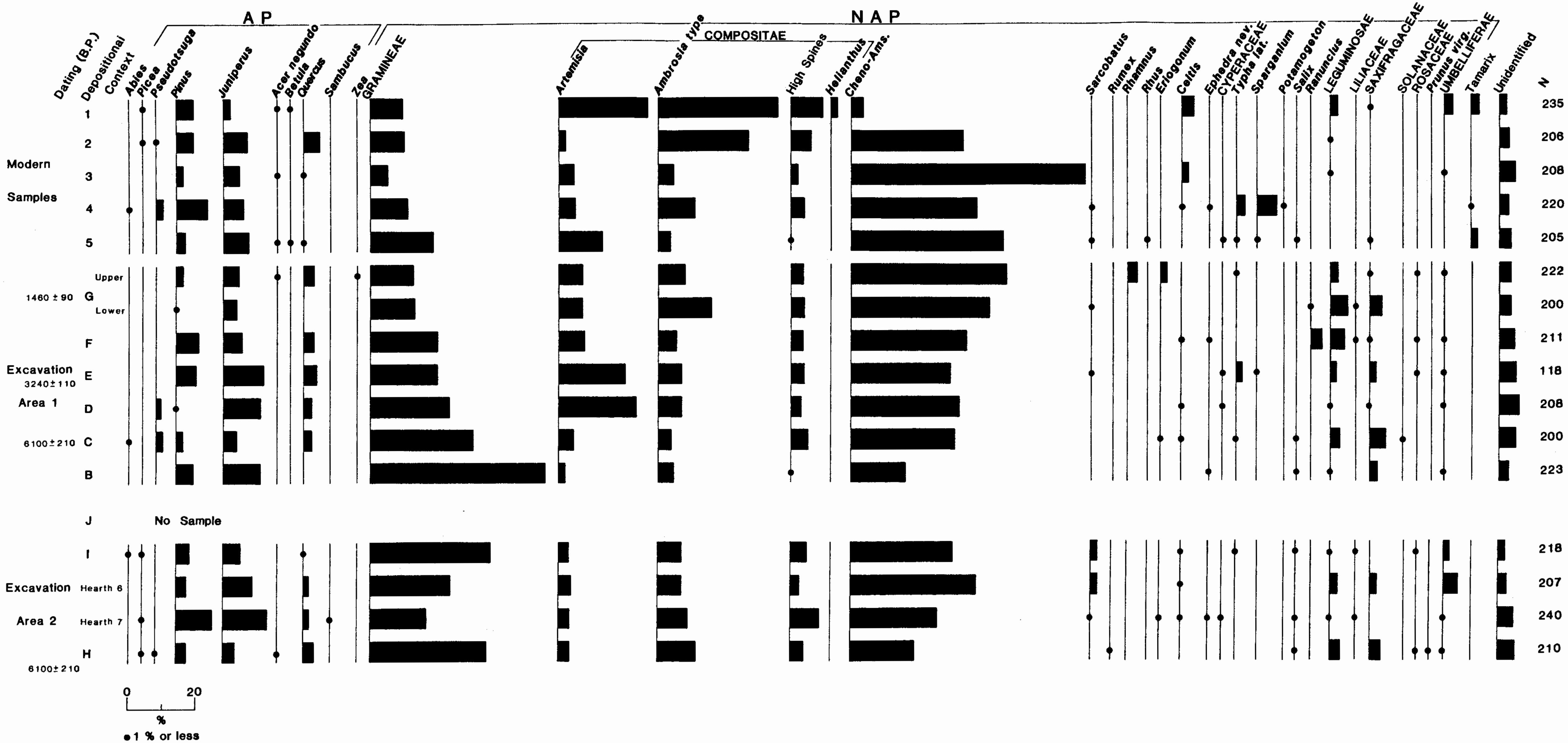
Pollen abundance and preservation were variable. Pollen counts of 200 grains or more were obtained from all but the sample from Unit E. Many of the extracted samples contained abundant silicates and spores while several were high in charred plant matter. This, added to the problems of poor preservation, made several of the samples difficult to count. Pollen abundance and preservation in the modern samples were quite good in contrast to the prehistoric samples.

RESULTS

Sufficient pollen counts were obtained from 15 of the 16 samples. Sample H provided a count of only 118 grains and is somewhat short of statistical reliability. The modern surface samples generally contained far greater amounts of pollen suggesting some distortion of the prehistoric record because of differential pollen preservation (Havinga 1967).

Arboreal pollen occurs in only minor amounts in both the modern surface samples and in the prehistoric record (Figure 24). Juniperus is slightly higher in several of the prehistoric samples (Hearth 7, and Units B, D, and E). Grasses, composits, and Cheno-Ams are the better represented taxa in both records.

FIGURE 24 POLLEN DIAGRAM OF RELATIVE PERCENTAGES



In general, the modern samples tend to show the expected pollen variation with changes in elevation. The Artemisia count from the sample (1) nearest the cave is by far the highest of the modern samples. Other composits are also highest in the vicinity of the cave. Cheno-Am counts are highest (Sample 3) where these plants dominate other vegetation. Pollen from marsh plants, including Typha, Sparganium, Potomogeton, Salix, and Tamarix are highest in the marsh sample (4). The exception is the Tamarix represented in the sample (1) from outside the cave. Tamarix counts from Sample 1 are nearly identical to that of the lake shore sample (5). This may be a function of the wind currents (updraft) at the north end of the Oquirrhs. Grasses show, overall, a slightly decreasing trend with lower elevations. Pinus counts seem a little low in the modern samples but not significantly so when compared with the values obtained from a core from the south end of the Great Salt Lake (Madsen and Kay 1982). The fairly high representation of Quercus in modern Sample 2, but not in the others, is not understood.

Arboreal pollen in the prehistoric samples is about as expected. Abies, Picea, and Pseudotsuga occur in trace amounts. Pinus and Juniperus are well represented, but are erratic through the sequence. In excavation Area I, Pinus counts are lowest between ca. 6100 and 3200 B.P., but little more so than the variation in the modern samples. This leaves little doubt that Pinus occupied the slopes in the vicinity of the cave at anytime represented in the sampling. The highest (10.5%) Pinus count from all samples is from the undated, Hearth 7 in Area II. The striking discrepancy (6.5%) between the hearth count and its depositional context (Unit I) suggests that either Pinus was used as firewood or that quite possibly nuts (pinyon?) were roasted in the hearth. The hearth sample also provides a high (13%) Juniperus count, similar to Units B, D, and E in Area I. The high Juniperus counts in Units D and E correspond to the highest (23.5% and 20%) Artemisia counts in the sample and may reflect the onset of the ca. 3,000 B.P. mid-Neoglacial stadial (Denton and Karlen 1973). Other arboreal pollen types are very limited in the prehistoric record including Acer negundo, Betula, Quercus, and a single identification of Sambucus. Quercus percentages vary from one to four percent and more-or-less correspond to the modern samples. In sum, prehistoric arboreal pollen types and amounts are not significantly different than those of today. This suggests that during prehistoric times the north end of the Oquirrhs was essentially treeless except for a few junipers and scrub oak. Other species such as Abies, Picea, Pseudotsuga, and Pinus were far removed from the site. The erratic Pinus counts provide no information on the spread, distribution, dating, and use of pinyon in the Great Basin. The five percent Pinus from Unit B_1 (Area I) which predates 6100 B.P. may not be pinyon and is more likely Pinus contorta (lodgepole) which is found as low as 1524 m (5000 ft). However, the Pinus counts obtained from Units E and F and from Hearth 7 (Area II) are probably from pinyon which, while not in the vicinity of the cave, had reached its northermost regional distribution prior to 3000 B.P. (Madsen 1984).

Nonarboreal pollen types and percentages are about as expected except for the intriguingly gradual, although inverse, changes in the proportions of grasses and Cheno-Ams. In Area I, grasses are extremely high (52%) in Unit B_1 with a marked change (30.5%) in Unit C (by ca. 6100 B.P.). This marked decrease probably reflects, in part, the warm-dry conditions of 7500 - 5000 B.P. (Currey and James 1982). Thereafter, the decrease in grass pollen is much less and quite gradual, probably indicating the ca. 5000 B.P. Neoglacial (Denton and Karlen 1973) conditions. Cheno-Am counts are roughly inversely proportional to grasses. The marked increase is from Unit B_1 to C where Cheno-Am percentages about double and thereafter counts change only gradually. Grass counts from Units H and I favorably compare with the Unit C sample in Area I and are consistent with the suggested dating of Area II. Similarly, Area II (Units H and I) Cheno-Am counts are more nearly like those from Units C, D, and E in Area I. The most recent sample (Units F and G) are similar to the modern samples suggesting that by ca. 1500 B.P. local vegetation at the cave was very similar to that of today.

Other nonarboreal pollen types are less informative than the grass Cheno-Am comparison and are either very "spotty" or quite erratic. The composits, including *Artemisia*, are fairly well represented. *Ambrosia* type composit percentages faintly suggest a gradual, increasing trend which favorably compares with the Cheno-Ams. The high spine composits remain fairly constant over time. Most of the remaining pollen types are representative of modern plant taxa at or in the vicinity of the cave. The occurrence of various marsh species, *Typha*, *Sparganium*, and *Salix* in the prehistoric samples indicates that marshes were present below the cave. *Tamarix* an introduced species, was not identified in the prehistoric record.

ECONOMIC CONSIDERATIONS

The occupation of Black Rock Cave spans a sizeable portion of the 8500 - 2000 B.P. Archaic period and at least part of the Fremont period. Pollen samples B_1 through F (Area I) reflect the middle and late Archaic while Unit G is probably associated with an early Fremont occupation. In Area II, Unit H postdates ca. 6100 B.P. and the pollen data suggests that Unit I may have been deposited shortly thereafter, corresponding to Unit E in Area I. The pollen data suggest the two units (H and I) are probably middle and late Archaic respectively.

The opportunity exists to evaluate from the pollen record various economic plants as defined in the eastern Great Basin ethnographic record and how such plant use may have varied during middle and late Archaic and subsequent early Fremont times. The transition from Archaic period hunters and gatherers to early Fremont peoples who adopted horticulture is still poorly understood (Marwitt 1970). The limited pollen sampling at Black Rock Cave spans this transition.

Economic flora consists of plants used for implements and shelter as well as those used in connection with dietary and medicinal purposes. Only the high *Pinus* count from the Hearth 7 (Area II) sample and possibly the high *Juniperus* percentages obtained from the hearth and from Units B_1, D, and E (Area I) *may* be interpreted as suggesting economic use of arboreal species. The high (10.5%) *Pinus* pollen from Hearth 7 may suggest that pinenuts were roasted in the hearth, but the dating of the hearth is unclear. Historic debris was identified at the level of origin of the hearth. The same is true of the high (13%) *Juniperus* from the hearth sample. The high (11% and 12%) *Juniperus* in the two depositional samples (Units E and E respectively) probably reflect the presence of a few juniper trees in the vicinity of the site because of the location of Excavation Area I at the cave mouth. The use of pine nuts (Bye 1972; Chamberlain 1911; Steward 1938) and to an extent juniper berries (Chamberlain 1911) are well documented in the Great Basin ethnographic record. The *Quercus* pollen counts are by no means significant but the presence of scrub oak throughout the prehistoric record may be important. Acorns were a part of the diet of ethographic groups (Chamberlain 1911; Bye 1972).

The considerable proportions of grass and Cheno-Am pollen provide some indication of the continuous availability of these plant taxa. The Shoshonean ethnographic record suggests a number of grass and Cheno-Am species (Chamberlain 1911) were probably used over the entire course of the prehistoric record. Grass seeds were collected, processed, and eaten by the Gosiute (Chamberlain 1911). Various *Amaranth* and *Chenopodium* seeds were gathered and eaten by the Gosiute (Chamberlain 1911) and additionally, *Atriplex* was utilized by the Southern Paiute (Bye 1972). The gradual, apparently decreasing availability of grasses and conversely, increasing Cheno-Ams, may have been reflected in changes in the diet over time. There is no evidence for increasing grasses accompanying the introduction of cultigens as was seen at Hogup Cave (Aikens 1970) and at Clydes Cavern (Winter 1973). The single corn pollen grain in Unit G (upper), immediately postdating ca. 1500 B.P., suggests that at least some horticulture was practiced by the early Fremont.

Composit pollen is well represented in the prehistoric record. *Artemisia* counts are high (23.5% and 20%) in Units D and E respectively (Area I). *Ambrosia*-type low spines are high (16%) in Unit G (lower) and indeed may suggest economic use by late Archaic/early Fremont peoples. A number of the composits were used both in the diet and for medication. The Gosiute (Chamberlain 1911) collected various composits. For example, *Artemisia* and *Helianthus* seeds were eaten. A medicinal tea was made from *Ambrosia*. *Balsamorrhiza* seeds and leaves were eaten. *Senicio* provided a chewing gum.

The identification of pollen from marsh plants in the cave deposits, 175 m (575 ft) above the probable marsh location argues for the economic use of such plants, particularly *Typha*. The latter is best represented in the Unit E (Area I) sample, immediately postdating ca. 3200 B.P. Only trace amounts from other marsh plants including sedges, *Sparganium*, and *Salix*, occur in the prehistoric record. *Typha* was extensively used by the Fremont at Backhoe Village (Madsen and Lindsay 1977). *Typha* seeds were eaten and *Salix* was used in the manufacture of baskets and fish weirs by the Gosiute (Chamberlain 1911).

Trace amounts of pollen from other plants occur sporadically in the prehistoric record and a few of these are known to have been used during ethnographic times. *Rumex* was used medicinally and berries from *Sambucus* and *Prunus virginiana* were eaten by the Gosuite (Chamberlain 1911). Other pollen types provide little information because of the limitations of pollen identification to genus and species levels.

SUMMARY AND DISCUSSION

The pollen sampling of deposits from Black Rock Cave, at the south end of the Great Salt Lake provides paleoenvironmental information from about 6100 to 1500 B.P. during middle and late Archaic and early Fremont times. The pollen data suggest:

1) Prehistoric vegetation over the approximately 4500 year period was quite similar to that of today. Most extant modern plant species were present during prehistoric times and only their proportions varied. This is best seen in the inverse relationship between grass and Cheno-Ams. Grasses predominated in the vicinity of the cave during the early part of the sampling, gradually diminishing to modern distributions by about 1500 B.P. The Cheno-Ams gradually increased from essentially low 6100 B.P. levels to modern distributions over the course of the same period.

Northern Oquirrh Mountain slopes were essentially treeless, over the 4500 year record as they are today, except, perhaps, for a few juniper. Curiously, there is little pollen evidence to suggest that historic vegetation has been significantly altered by the smelter as has been much publicized. Today, sagebrush and grasses predominant about the cave and Cheno-Ams and composits dominate the lower elevations toward the base of the mountain. The pollen evidence does suggest that during the early part of the 4500 year record grasses were more abundant and occupied the lower part of the slopes. There is good evidence (both historic and palynological) to suggest that springs and relatively extensive marshes were present below the cave near the shores of the Great Salt Lake. The pollen data generally supports extant northeastern Great Basin paleoenvironmental records (Currey and James 1982). The high sagebrush pollen counts of samples data about 3000 B.P. seems to reflect the occurrence of the Middle Neoglacial stadial (Denton and Karlen 1973).

2) The very limited pollen sampling precludes estimates of subsistence change either during the middle and late Archaic Period or the subsequent early Fremont. The changing proportions in the availability of grasses and Cheno-Ams may be reflected in the diet, but it is more likely that both plant taxa were taken <u>at all times</u> over the 4500 year record because both were available <u>at all times</u>. With the advent of the ca. 1500 B.P. Fremont, at least <u>some degree</u> of horticulture was practiced. It is likely that the subsistence strategies of both time periods were centered on a "mixed bag" of resources, not because they were necessarily scant, but because of variations in seasonal availability. The occurrence of the pollen of marsh plants, particularly <u>Typha</u>, at the cave is particularly significant because of the multiple <u>uses of</u> the plant for diet, basketry, and matting.

HISTORIC ARTIFACTS FROM BLACK ROCK CAVE

by

Richard E. Fike

Historic artifacts from Black Rock Cave, were collected from surface or near-surface manifestations and account for only a small percentage of the total material recovered. This small percentage is surprising considering the publicity and relatively high visitor use given the cave in recent historic times (ca. 1870 to the present).

After study, 82 individually catalogued specimens were found to represent parts of approximately 38 different items (see Tables 9 and 10). Note the frequency of occurrence variability in each table.

Table 9. Number of Historic Artifacts Collected.

Material		Number	Percentage
Glass		50	61.0
Wood		21	25.6
Metal		9	11.0
Carbon		1	1.2
Paper		1	1.2
	Total	82	100.0

Table 10. Number of Whole Historic Objects Represented.

Material		Number	Percentage
Glass		26	68.5
Wood		1	2.6
Metal		9	23.7
Carbon		1	2.6
Paper		1	2.6
	Total	38	100.0

The 82 items represent 50 pieces of glass from about 26 different vessels; 21 fragments of wood from one object; nine metal artifacts which include one bottle cap, one wire wrap, two wire nails, one beverage can and four cartridge casings; one carbon battery core and one newspaper fragment. The paucity of perishable material is not surprising given the humid nature of the cave.

Classification of the artifacts, by provenience, was for the most part unsuccessful. For example, 64 percent of all artifacts collected are of unknown provenience, and 18 percent were derived from prehistoric strata and were obviously out of context. The remaining 18 percent, comprised of 24 glass sherds from four vessels, two cartridge cases and the wire wrap, have the only integrity, being associated with Unit J, an intact historic surface component. Because most of the material was located out of cultural context and because nothing was found out of the ordinary or unexpected and because Euro-American use of the cave is publically and archivally understood, I selected a slightly different study approach. Rather than providing a detailed description and dimensional analysis of everything, I chose to concentrate on functional and chronological relationships, and give only limited descriptions of a few select artifacts, regardless of their age.

GLASS

Fifty pieces of glass were collected, representing about 26 different bottles. No whole vessels were found. Of this total, 42 (84%) are body or shoulder fragments, 5 (10%) are base sherds and 3 (6%) are neck or lip finished sherds (see Table 11). Table 12 provides a functional analysis.

Table 11. Attribute Analysis of Glass Bottles.

Physical Attributes	Color							Total	%
	Clear	Blue Aqua		Green		Amber			
		Light	Dark	Light	Dark	Light	Dark		
Body	5			14	1	1	21	42	84%
Neck					1			1	2%
Neck Finish	1		1					2	4%
Base	1				1		3	5	10%
Total	7		1	14	3	1	24	50	100%

Table 12. Functional Analysis of Glass Bottles.

Functional Class	Beverage						Household	Unknown	Total
Sub-Functional Class	Soda	Beer	Wine/ Champagne	Whiskey	Unknown Alcohol	Other Bev.			
Totals	3	11	1	1	1	3	2	4	26

The datable diagnostics consisted of eight sherds: four embossed or painted label fragments, two lip-finished sherds, one turn-mold neck sherd and one unembossed base sherd, unfortunately provenience is unknown.

EMBOSSED SHERDS (2)

The first embossed sherd is a body sherd from vessel of H. Denhalter and Son, Salt Lake City, Utah Territory (specimen: AS82.4.61.1). It is a light green soda water bottle fragment of unknown provenience (Figure 25). Technologically, the vessel employs the "Patent Spring Stopper" patented in 1879 by the W.H. Hutchinson Company, Chicago (Lief 1965) and discontinued in 1912 (Riley 1958).

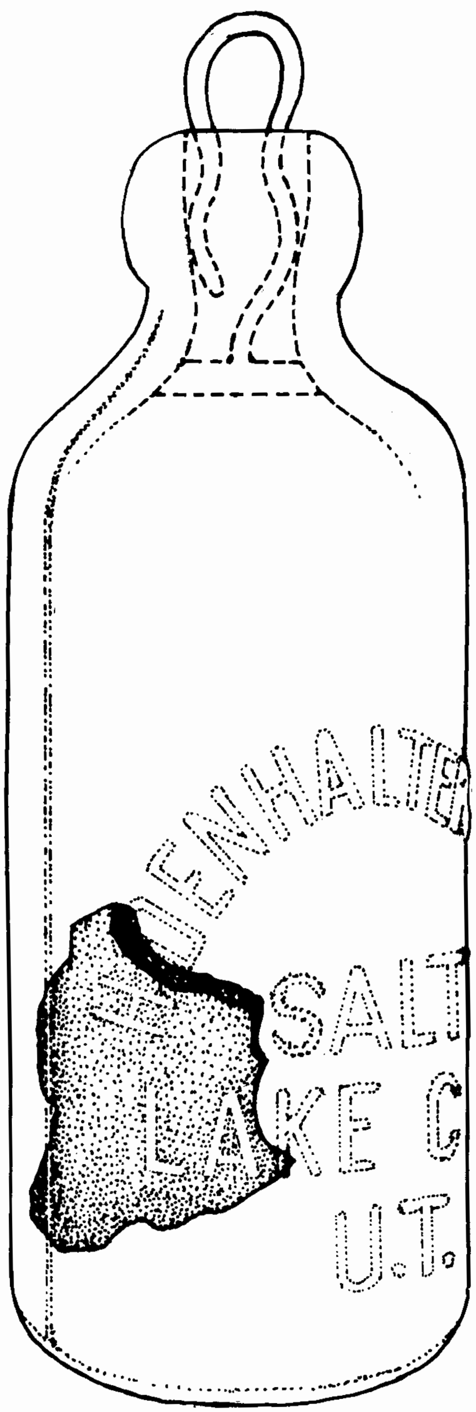


Figure 25 - Soda water bottle with "Patent Spring Stopper."

Henry C. Denhalter 1832-1914, German born, migrated to San Francisco in 1849. Denhalter's brief association in St. Louis, New York, Stockton, CA, and Corrine, UT, were followed in 1870 by a move to Salt Lake City. Records vary as to when he established his soda water business but by 1874 he was in partnership with P. Brader. This association was short-lived and there is no record that any bottles were embossed. Various mergers followed, but the first embossed bottles, using just the Denhalter name, occurred in 1880. The bottle pictured in Figure 25 was manufactured by Alexander and David Chambers or William McCully, both of Pittsburg, between ca. 1889 and 1894. After a brief absence, 1894 to 1896, Denhalter entered in partnership with James Metcalf. By 1898 their association had terminated. Denhalter incorporated in 1907 and died in 1914 (Ken E. Fee, personal communication, 1982). Business locations and other embossed variants are not important to this study.

The second embossed sherd is a base fragment embossed "S B & G CO." (specimen: AS82.4.1.2). It is an amber, cylindrical, quart beer bottle fragment of unknown provenience and is not illustrated. The bottle was manufactured by the Streator Bottle and Glass Company, Streator, Illinois, between 1881 and 1905 (Toulouse 1973).

PAINTED LABEL SHERDS (2, same vessel)

Two body sherds come from a cylindrical vessel produced by the Nehi Beverage Company, Salt Lake City, Utah (specimens: AS82.4.1.3; AS82.4.3.3). They are clear, painted label, soda water bottle fragments of unknown provenience (Figure 26).

The Nehi Bottling Company (soda water bottlers), Salt Lake City franchise, was acquired by J.L. Firmage and operated most likely from the early 1940s to about 1972 (Ernest D. Mariani, E.S. Mariani Company, Salt Lake City, personal communication, 1983). The local franchise was assumed by the Royal Crown parent company and is currently owned by the Mid Continent Bottlers Company. The Nehi flavor is still on the market nationally and is a product of the Royal Crown parent company (Dick Jutkins, E.S. Mariani Company, Salt Lake City, personal communication, 1983). The variant shown in Figure 26, with white lettering over a red background, postdates other common variants, such as the one employing red lettering over a yellow background, and probably dates from about 1955 to 1972.

LIP-FINISHED SHERDS (2)

One of two lip or neck-finished sherds is from a clear, alcoholic beverage bottle of unknown provenience (specimen: AS82.4.2.2). This sherd originates from a vessel possessing a brandy or wine lip finish, a finish almost exclusively reserved for alcholic beverage bottles, and was produced semiautomatically. Occasionally this finish is found on bottles containing tonics, bitters, cordials, etc. This vessel, produced prior to application of fully automated machines (introduced in 1903), was probably a flask, dating to the period between ca. 1890 and ca. 1910. Interestingly enough even as late as 1917 total automation still accounted for only 50 percent of all glass containers manufactured (Fike n.d.)

The second sherd is the lip of a neck-finished, blue-aqua, cylindrical canning jar of unknown provenience (specimen:

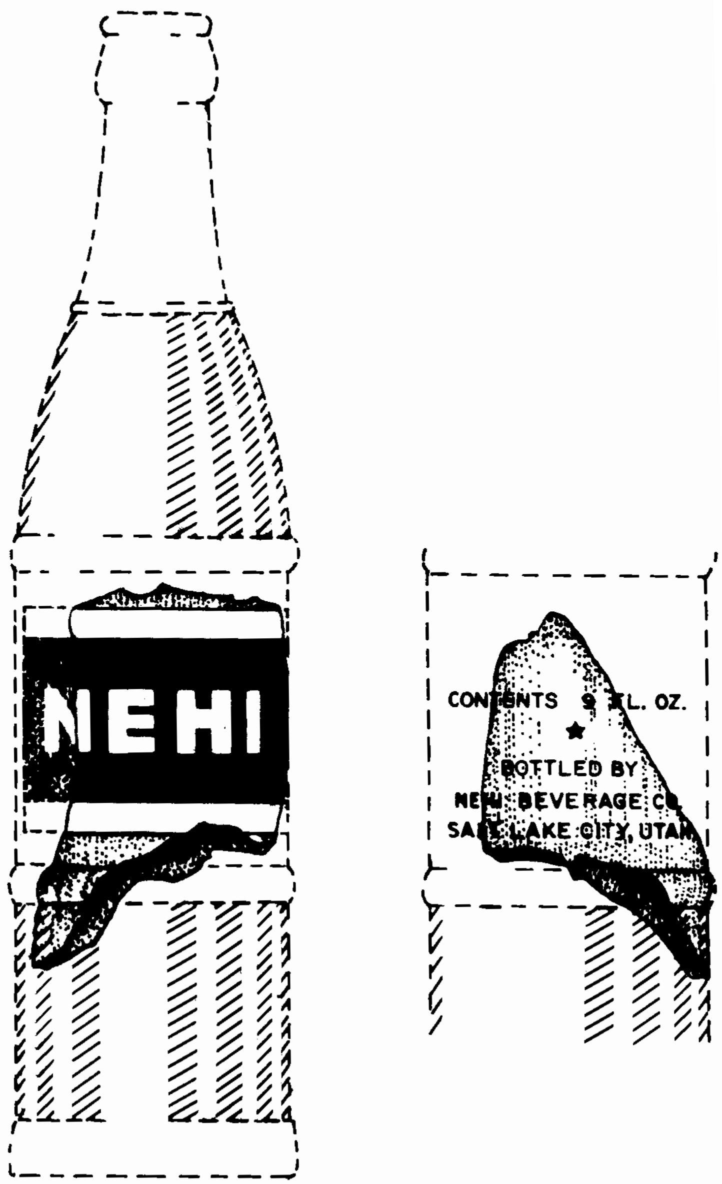


Figure 26 - "Nehi" soda water bottle fragment.

AS82.4.2.3). The vessel from which this sherd originates is a common, quart-size, threaded "fruit jar" used predominantly in canning. The bottle was manufactured with twentieth century equipment and is a rich blue-aqua variant dating to between ca. 1925 and ca. 1940. The vessel was probably embossed, and was very likely produced by Ball Brothers Company, Muncie, Indiana.

TURN-MOLD SHERDS (2)

A single turn-mold neck sherd from a dark green beverage bottle fragment is of unknown provenience (specimen: AS82.4.1.5). The cylindrical vessel from which this sherd originates was mold-brown and, while still plastic, was rotated in this mold to obliterate the seams. The vessels were never embossed. Toulouse (1969) states this technique was often used in production of wine bottles from the 1870s until possibly the 1920s. Often the rotation scars are visible as they are in this example. The artifact dates to between ca. 1880 and ca. 1890.

An unembossed body/base sherd (specimen: AS82.4.1.4) from a dark green, cylindrical, turn-mold, champagne bottle fragment is of unknown provenience (Figure 27). Champagne bottles have changed little in appearance in the past 100 years. The shape is traditional and the vessel represented here dates to between ca. 1880 and ca. 1915. The "kick-up illustrated in Figure 27 is always present in champagne bottles and often in other wine bottles. The purpose is utilitarian, designed specifically for catchment of sediments.

UNIDENTIFIED SHERDS

The sherds representing the four vessels with provenience were not discussed. The functions and dates of two are unknown and the only usable information from the other two vessels is that they are beer bottles manufactured before 1925. Of the 26 different vessels, represented in the collection, only about three (12%) were produced by the automatic bottle machine.

WOOD

The wood appears shrub-like and probably originated from one plant; its value seems unimportant. No unusual features were observed and no analysis was attempted.

METAL

Seven of nine metal artifacts lack provenience; a brief discussion follows:

RIMFIRE CARTRIDGES (3)

(1) .32 Long (specimen: AS82.4.36.26)
Provenience: Unit J
Base Markings: Impressed U
Information: The .32 Long Cartridge was introduced in 1861 originally for revolvers but was extensively used in rifles. This particular specimen is a product of the Union Metallic Cartridge Company, Bridgeport, Connecticut (1867-1910), which merged in 1910 to become the Remington Arms Company (Berge 1980; Gillio, et al 1980).
Dates: ca. 1890 to ca. 1940 (Listed with this particular marking in the 1897 Sears Roebuck Catalog.)

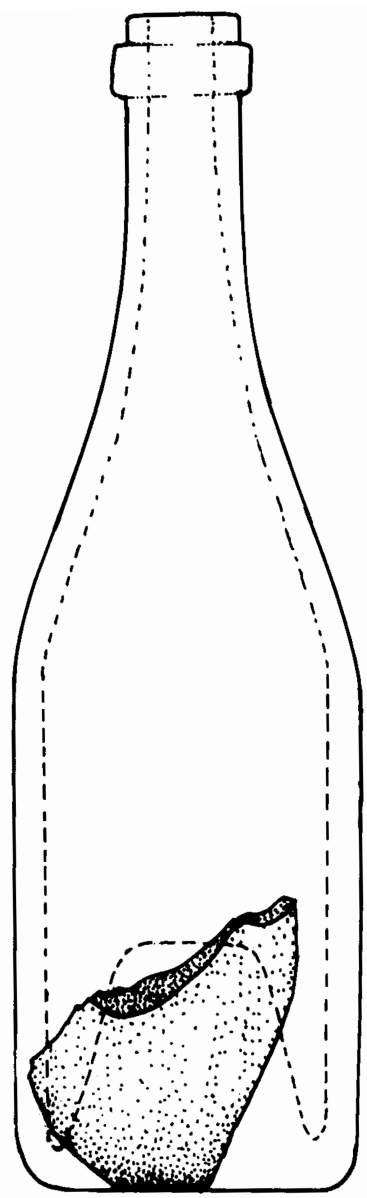


Figure 27 - Champagne bottle fragment.

(2) .22 Short, Blank (specimen: AS82.4.36.27)
Provenience: Unit J
Base Markings: None
Information: None
Dates: Unknown

(3) .22 Short (specimen: AS82.4.3.7)
Provenience: Unknown
Base Markings: Impressed Diamond
Information: Product of the Winchester Repeating Arms Company
Dates: After 1890

CENTER-FIRE CARTRIDGES (1)

(1) 30-40 KRAG (specimen: AS82.4.1.1)
Provenience: Unknown
Base Markings: Impressed SUPER-X 30-40 KRAG
Information: The 30-40 KRAG rifle was introduced in 1892, with first commercial sales (Winchester) in 1893. Commercial production ceased prior to World War II (Speer 1980). The KRAG was extensively used by the military, not only in the Spanish American War, but in other military exercises early into the present century. SUPER-X cartridges were introduced in 1898 (Berge 1980).
Dates: 1898-1940

OTHER METAL (5)

(1) Can-Hi C soda (specimen: AS82.4.2.6)
Provenience: Unknown
Condition: rusted, flattened
Information: 12 oz., Vitamin C Enriched Florida Punch soda
Dates: Early 1970s

(2) Bottle cap (specimen: AS82.4.2.7)
Provenience: Unknown
Condition: rusted
Information: The Crown closure was introduced after its patent in 1892.
Dates: ca. 1960s, 70s (based on rust deterioration)

(3) Copper wire wrap (specimen: AS82.4.36.38)
Provenience: Unit J
Condition: good
Information: None
Dates: Unknown

(4-5) Wire Nails
Machines, designed for making wire nails, were invented in France, ca. 1855 (Berge 1980); the first production in the United States being ca. 1875. "By 1888, only one nail in five was a wire nail, but by 1895, three-fourths of sales were of the new style (Gillio, et al. 1980)."

A. 16 p Box (specimen: AS82.4.3.5)
Provenience: Unknown
Condition: rusted
Dates: After 1900

B. 12 p Common (specimen: AS82.4.3.6)
Provenience: Unknown
Condition: badly rusted
Dates: After 1900

CARBON BATTERY CORE (1)

Specimen: AS82.4.4.1
Provenience: Unknown
Information: Flashlight battery, carbon core
Dates: After 1910

PAPER (1)

Specimen: AS82.4.30.1
Provenience: Unit H, out of context in prehistoric strata
Information: Newspaper fragments include advertisements for savings with rates of interest at 9 1/2% to 9 3/4%.
Dates: ca. 1975 to ca. 1978

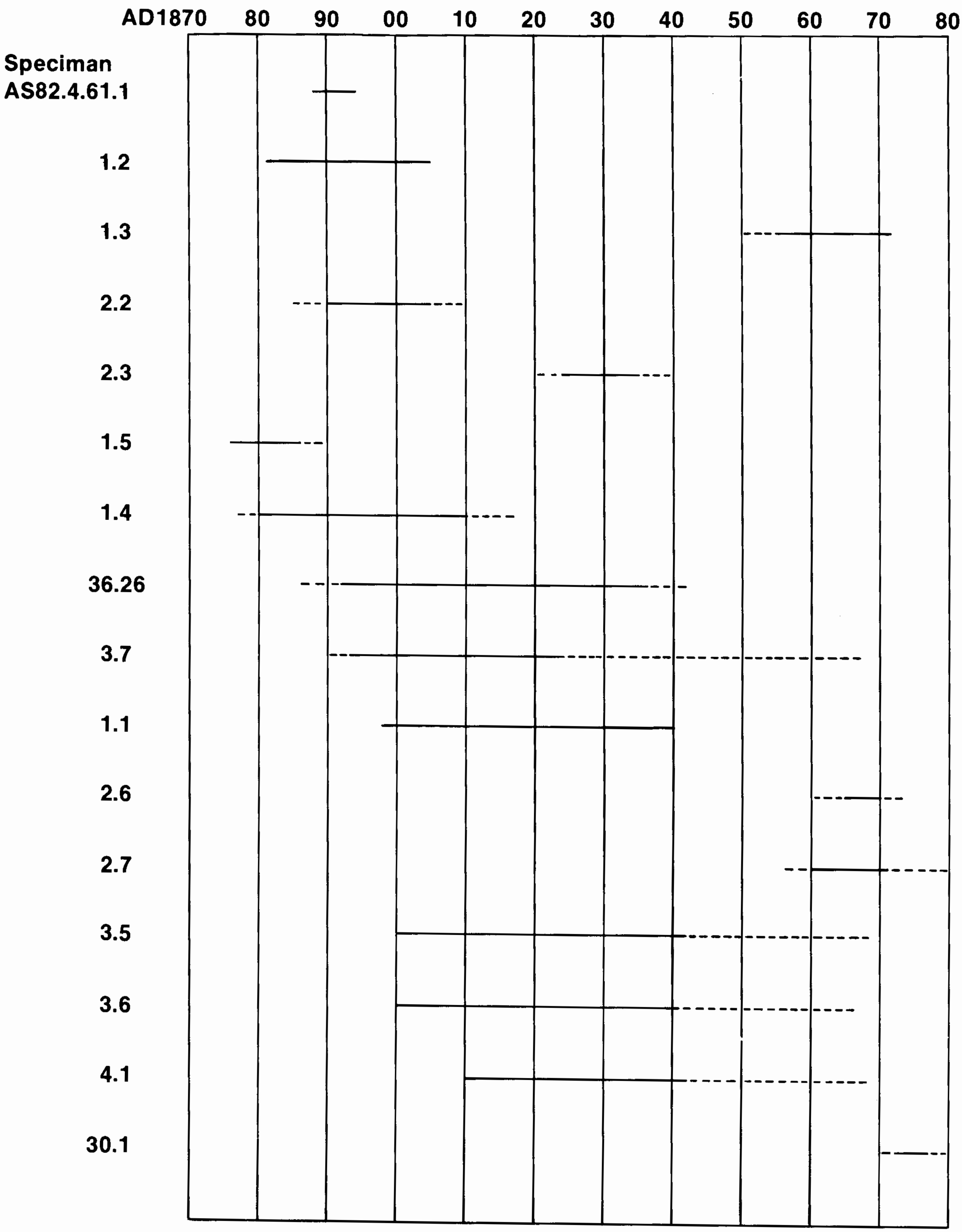
INTERPRETATION AND CONCLUSIONS

Historic use of Black Rock Cave is based upon artifact chronologies not on stratigraphic seriation. Table 13 was devised using the datable artifacts discussed above.

Besides the diagnostics discussed, most of the remaining bottle glass pre-dates the Automatic Bottle Machine and, by attribute analysis, post-dates ca. 1890, suggesting the most popular use of the cave occurred between ca. 1890 and 1920. This period also coincides with an era of popularity for the lakeside area and many of the dates scribed in the walls (see the Historic Overview).

Black Rock Cave was a popular recreational site for many years. Picnicking and/or drinking and target practicing were apparently favorite pastimes. The artifacts are consistent with this interpretation, with 22 of 38 items (58%) relating to beverage consumption and 4 (11%) relating to shooting. In recent decades the Kennecott Corporation has restricted access and use of the area.

Table 13. Major Period of Historic Use Based on Historic Artifacts.



BLACK ROCK CAVE: AN HISTORICAL OVERVIEW

by
Craig Fuller

The history of Black Rock Cave is closely linked to historical developments of the Great Salt Lake and the Intermountain West. Since early in the 17th century the Lake and Great Basin have drawn a great deal of attention by explorers, scientists and geographers because of the Basin's and Lake's unique characteristics. Moreover, the Basin and Lake have been, until this century, formidable barriers against easy transcontinental migration of people and goods.

The first known information about the Lake comes from the Spanish. The intrepid Spanish explorer Juan de Onate while exploring along the Colorado River and Grand Canyon between 1604 and 1606 came into contact with Indians who informed Onate that their homeland was far to the north near the shores of a large body of salt water. Three quarters of a century later another European explorer Baron LaHontan made a similar contact with Indians from the Great Basin. While on an expedition to the upper reaches of the Mississippi River, the Baron happened onto a large village of Gnacsitare Indians. At the village were four Mozeemleks that appeared to the Baron to be Spaniards. Upon further discussion with the Mozeemleks, LaHontan learned of the Indians' homeland situated near a large body of salt water.

Returning to Europe following his expedition to the upper Mississippi, LaHontan in 1703 published a map including the area of the Great Basin. LaHontan's map until 1776 was the basis for other maps of the west that were produced by other European explorers and cartographers.

In July of 1776 a small expedition of Spaniards headed by two Franciscan priests, Fathers Dominguez and Escalante, set forth from Santa Fe to find a suitable land route to the Spanish settlements of Upper California. Diverted north from Santa Fe into Colorado and Utah because of hostile Indians and difficult terrain, the expedition reached the shores of Utah Lake in late September 1776. There they learned of a large body of salt water located a few miles to the north. Deciding, however, not to venture further north, they turned south, hoping to reach their original objective. But, because of inclement weather and traveling without Indian guide, the expedition voted to return to Santa Fe where they filed a report of their discoveries with their superiors. In the small company was retired army officer Don Bernardo Miera y Pacheco who produced a map of Utah and western Colorado that accompanied the official report of the expedition. Like earlier maps, the Great Salt Lake and associated rivers were the focal points of Miera's map. It was, however, another fifty years before first-hand knowledge about the Lake and Basin was obtained.

By late summer or early fall of 1824 white men were again making their appearance in the Great Basin. This time an American, Jim Bridger, set eyes on the Lake. According to many historians, Bridger is credited with being the first white man to visit the Lake.

Bridger and those fur trappers from the William Henry Ashley company who accompanied Bridger to the shores of the Salt Lake confirmed what Indians had earlier told Onate, LaHontan and members of the Domingues-Escalante expeditions. However, it was not until the 1840s that the myths about the Lake were fully dispelled--that the Lake was indeed a Lake and not somehow connected with the ocean.

John C. Fremont, while leading an expedition to California in 1843 broke scientific ground by taking careful notes of his observations of the Lake and Basin. Six years later in 1849 Howard Stansbury, a member of the United States Army Corps of Topographical Engineers, was ordered to the Great Basin to explore and map the Great Salt Lake and adjoining territory.

Along with Fremont's observations, Stansbury's report stimulated further exploration and research of the Lake and Basin. Men such as Clarence King, F. V. Hayden, George Wheeler, Grove Karl Gilbert, and local men of knowledge such as John R. Park, crisscrossed the Great Basin and shores of the Lake many times carefully observing, noting and recording their findings (Miller 1973).

Black Rock and the south shore of the Lake have been part of transcontinental land travel, first in the late 1840s with emigrants heading to California using Hastings' Cutoff, later by the all weather Lincoln highway system, transcontinental rail lines and most recently the construction of the interstate highway network.

Hastings Cutoff of the California Trail beginning at Fort Bridger by way of the Salt Lake Valley, south shore of the Great Salt Lake, and on across the salt desert, was established by Lansford Hastings in 1846. Hastings was born and reared in Ohio but eventually found himself in northern California. An ardent promoter of California, Hastings traveled east in 1846 to encourage easterners to settle in California. Following portions of the Fremont Trail that was blazed by John C. Fremont in 1843, Hastings and his traveling companions discovered what they believed to be a shorter and better route to California from Fort Bridger.

Meeting up with several emigrant companies on the California Trail at Fort Bridger, Hastings persuaded several companies to take his newly discovered shortcut, thereby knocking off days of travel and shortening the distance to California.

The first company to try Hastings Cutoff was the small Bryant-Russell Company composed entirely of horses and mules. James Hudspeth, who had accompanied Hastings east across the cutoff, volunteered to accompany the company as far as the Great Salt Lake. The company made relatively good time through the Wasatch Mountains and within a few days was crossing the Jordan River near 27th South State. Turning more directly west, the company headed for the Oquirrhs and the Great Salt Lake. Bryant wrote of the area:

> Our route for several hours described nearly a semicircle, then there was a break in the range of mountains, and we entered upon another plain [Tooele Valley]. About three o'clock, p.m., we passed several

> remarkable rocks rising in tower-like shapes from the plain, to the height of sixty or eighty feet. Beyond these we crossed two small streams bitter with saline and alkaline impregnation. . . At seven o'clock p.m., we reached a spring branch descending from a mountain ravine, and fringed with small willows, the water of which is comparatively fresh and cool (Morgan 1951a:78).

The prominent tower-like rock formation described by Bryant is known today as Adobe or "Dobe" Rock, frequently identified incorrectly in early diaries, letters and maps as Black Rock. Black Rock, however, is located several miles north of Adobe Rock. The company made camp in Tooele Valley most likely at north Willow Creek near a number of springs sometimes referred to as Twenty or Hastings Springs, near present-day Grantsville.

Within the week of the Bryant-Russell Company departure, the Hastings Company composed of 40 wagons of the Harlan Young Company and later supplemented by an additional 26 wagons near Grantsville, headed west on Hastings Cutoff. Traveling in this company was the Swiss emigrant Heinrich Lienhard, who provides a vivid description of the Northern Oquirrhs:

> On August 8 we left the Wasatch Mountains to our left or to our rear and set out in a southwesterly direction toward another reddish-brown mountain [Oquirrhs], which in the exceedingly bright and clear morning air appeared to be hardly 6 miles away, though before this day was over we could testify that it was fully twice the distance. Ten miles on across a plain brought us to a swamp section, where bulrushes and a little rank marsh grass grew, through which the road yet took us. The water was salty and unpalatable, so that the stock refused to drink it. Two miles farther on, we arrived at the foot of the mountain, where a large crystalline spring, somewhat warm and a little brackish, welled out of the ground. We halted here a short time, so that our stock might gain a little rest. Where the spring broke out of the ground, it formed a beautiful basin, in which not even taking off our clothes, several of us bathed. In the vicinity of this spring stood an immense, isolated, rounded rock under which was a cave, and those going into it found a human skeleton. During the forenoon's travel we had again caught up with the advance division of our company, and the reunited train continued their journey together. We passed along the occasionally marshy shore at the south end of the Salt Lake and camped finally at a large spring at the foot of the mountains, the water of which was slightly brackish (Morgan 1951b:136-138).

Lienhard points out several important geographical features that are important to this study. The spring located near the foot of the mountain and being "crystalline . . . [and] somewhat warm and a little brackish" is located just north and east of the old highway U.S. 50 near the abandoned townsite of Garfield. The cave in which a human skeleton was discovered by members of the Lienhard party is known today as Deadman's Cave, marked by a Daughters of the Utah Pioneers road sign.

Traveling in the second section of the enlarged Hastings Company was T. H. Jefferson (Morgan 1951c). Little is known about the man other than he had published in New York in 1849 a detailed map of much of Hastings Cutoff. Jefferson carefully notes at least three springs located near Black Rock Cave (Figure 28). These sources of potable water were later used by Heber C. Kimball and others as developments occurred around the south shore of the Lake.

The Hastings company proceeded on around the north end of the Oquirrhs reaching the springs near Grantsville where they camped for several days. The company spent the time refitting wagons, recruiting their livestock and otherwise preparing themselves for the long and very difficult journey across the salt desert. While at the springs members of the company buried John Hargrave who had earlier contracted pneumonia. (Morgan 1973:169, 1951d:207).

Hot on the trail of the enlarged Hastings Company was a third company of emigrants. The Donner-Reed Party, traveling without a guide, found the going tough through the rugged Wasatch Mountains. Eventually making their way down Emigration Canyon, the company headed southwest to the Oquirrhs and around the south end of the Lake to the springs at Grantsville. Like the Hastings Party, it too, spent several days at the springs preparing for the long hard push across the salt desert. While camped at the springs, one of their company also died and was buried along

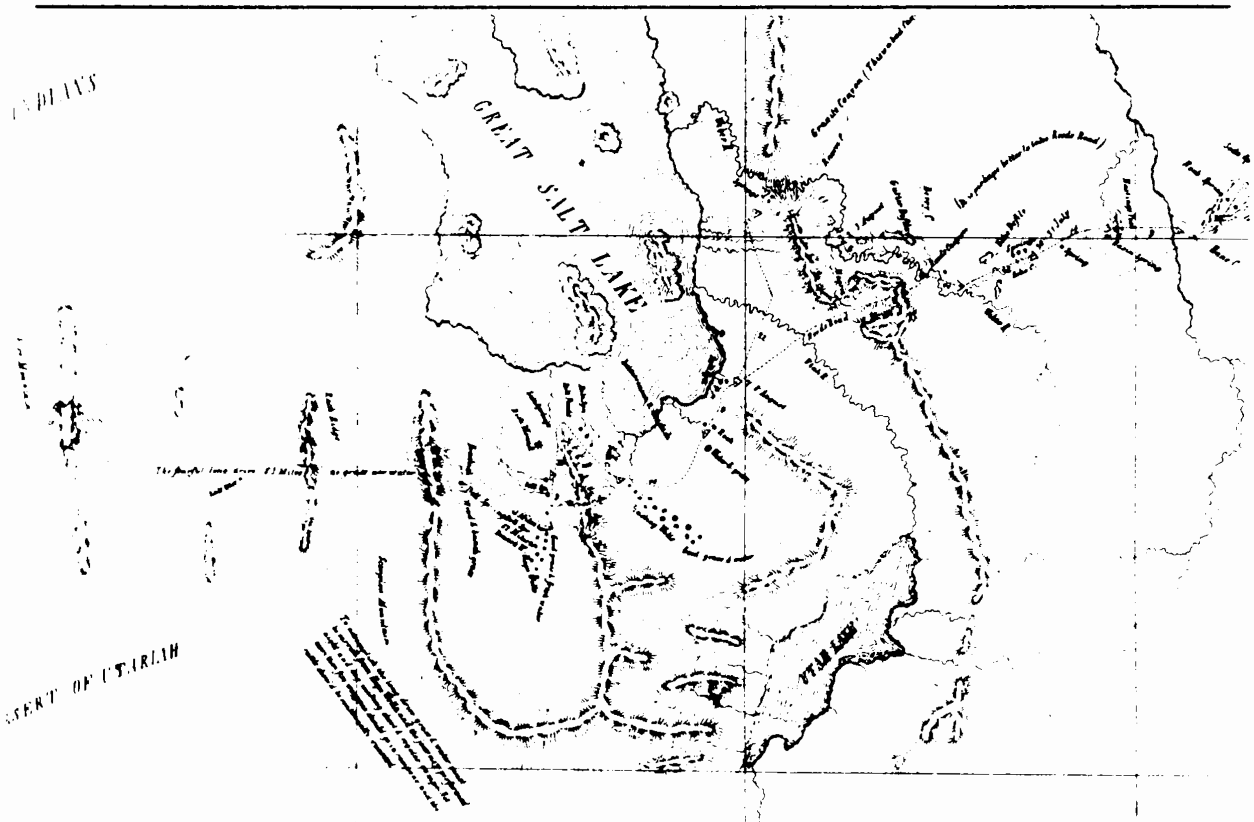


Figure 28 -Jefferson map of the northern Oquirrh Mountain area; note springs plotted on the north end of the Oquirrh Mountains (from Morgan 1951c).

side John Hargrave. Young Luke Halloran had for some time suffered from consumption, finally succumbing to the malady while at the springs (Morgan 1973:173).

Undoubtedly members of the Donner-Reed Party and later others who camped at or near the springs found time to explore the nearby Oquirrhs and shoreline of the Great Salt Lake. Some may have found their way into Black Rock Cave and perhaps left faint signs of their presence by carving their initials or names on the walls of the cave.

Hastings Cutoff continued to be used by emigrants until 1850 when the better suited Salt Lake Cutoff, north of the Lake, ended the need or use for the more difficult Hastings Cutoff.

Within days following the first Mormon emigrant company's arrival to the valley in 1847, members of the company were out exploring nearby areas. One such expedition was reported to have been made by Brigham Young to the northern end of Tooele Valley. There they found excellent grass and an adequate supply of drinkable water, well suited for the raising of livestock. On their return to the Salt Lake Valley the small exploring party stopped at Black Rock to experience for the first time the wonders of the Great Salt Lake (Morgan 1951:136-137).

It was not long after that northern Tooele Valley was settled by Mormon settlers. Grantsville was the first permanent settlement of any size, being established in October 1850 by the families of James McBride and Harrison Severe. Both had heard of favorable reports and with the establishment of a mill by E. T. Benson the prospects for locating in the valley were bright (Gardiner 1959:8). Other communities soon followed in northern Tooele Valley, including Erda (1852) also known as Rose Springs Fort and Batesville; Lake Point (1854) known as E. T.; Mills (1849); and Tooele (1849-1850).

Ranching and farming were the primary early economic activities in Tooele Valley. The first real industrial development of the Lake was the processing of lake water into salt. It is reported that in 1849 Charley White and his wife produced salt at the rate of 300 pounds per day (Anonymous 1961:138-139)).

It is recreational activities, however, that most people identify today with the Lake and Black Rock developments. The first known organized activities at the Lake was the Salt Lake Valley's celebration of the Fourth of July in 1851 (Morgan 1973:348-349). Nearly the entire valley spent the better part of two days bathing, dancing, hiking, and listening to speeches. Following the 1851 celebration Black Rock was used only sporadically by large groups until the early 1860s. Undoubtedly teamsters, herdsmen and travelers alike frequented Black Rock Beach during the intervening years. It is very likely later that as the mines and mills developed around the northern end and west face of the Oquirrhs miners and workers from the mills along with their families frequented Black Rock Beach as well.

In the 1860s and 1870s the Lake was the focus of special trips and articles written by a number of notables including the Frenchman Jules Remy, Sir Richard Burton from England and the American Horace Greeley.

One of these, Fitz Hugh Ludlow, has left us with a vivid description of his experience at Black Rock and with the Lake. Ludlow pens:

> A fifteen minute ride, and Black Rock rose grim and ugly, like the foundation of some ruined tower. . . We had expected a grim and desolate landscape; a sullen waste of brine, stagnating along low ready shores, black as Acheron, gloomy as the sepulchre of Sodom. Never had Nature a greater surprise for us. The view was one of the most charming which could be imagined (Ludlow 1870:385).

Many early visitors to the Lake expressed enchantment with the beauty of the Lake and wrote of their remarkable experiences of trying to sink in the Lake no matter how hard or what method one tried.

In 1860 Heber C. Kimball, first counselor to Brigham Young, built a story and a half cobblestone house with basement located immediately east of Black Rock. In addition to the house, often called the Charely White House, Kimball constructed a barn and outbuildings, bunkhouse and rock fence. The house and associated buildings served for a time as the center for Kimball's ranching operation on the south shore and on several of the Lake's islands as well. In later years the ranch house was frequently called the Black Rock Ranch by visitors to the ranch (Ludlow, 1870:385). An early photograph reveals that Kimball's ranch house is located just east of Black Rock (Figure 29). Apparently no longer used as a ranch house, the photograph does show how the house and nearby land was changed into a center for bathing activities with a number of bath houses and a bowery located nearby.

Figure 29 - View of Kimball ranch house east of Black Rock (Utah State Historical Society Photo Library).

While visiting the Kimball (Black Rock) Ranch, Fitz Ludlow took the opportunity to hike in the nearby Oquirrhs. Hearing of several caves in the immediate vicinity from one of Kimball's ranch hands named Smith, Ludlow explored for himself several of the unnamed caves. The first cave visited was nothing more than a shallow recess in the limestone, wrote Ludlow. The second cave, named by Ludlow for the ranch hand Smith, was explored only slightly, since Ludlow did not have candles with which to explore the larger cave more extensively. Ludlow writes of Smith's cave:

> The locality is a very likely one for such 'lusus nature' or would be, were there more running water in the neighborhood to produce the phenomena of erosion. The rock in which Smith found his cave is a limestone, similar to that capping the conglomerate and metamorphic slates everywhere on the lofty benches about the lake basin; a favorite stratum for Nature's operations in the line of subterranean architecture, and, in the abundance of sulphur associated with it under various forms, showing a probability of sufficient gypsum, for the extensive manufacture of stalactites (Ludlow 1870:386).

Ludlow does not mention in his description of the cave finding any artifacts nor discovering any initials carved on the cave walls. It is unlikely, being without artificial light, that he was able to reach the location in the cave where the initials and names are located.

Within a couple of decades following the construction of Kimball's ranch, Black Rock and the Great Salt Lake were connected to Salt Lake City by rail. In 1873 the Salt Lake, Sevier Valley, and Pioche Company was incorporated and work started in constructing a rail line to southwestern Utah via the south shore of the Great Salt Lake. By 1883 the railroad had reached Stockton but ran into financial difficulties. After a series of reorganizations, refinancing and name changes, the line pushed on through Utah, reaching Los Angeles by the turn of the century. A second line was also constructed early in the 20th century around the south shore of the Lake by the Western Pacific Railroad Company.

The railroad shortened considerably the time required to visit the Lake from Salt Lake City. In the spring of 1880 David John Taylor and Alonzo Hyde leased the Kimball property with the intent of turning the ranch into a recreational area (Figure 30). That same year the Utah and Nevada Railroad published a travel pamphlet exclaiming the opportunities available at Black Rock Beach. The pamphlet suggested other recreational activities other than swimming. It suggested that

> travelers may [want to] visit the "Giants' Cave," an opening extending several hundred feet into the mountain side, with a ceiling ranging in height from ten to seventy-five feet. Remains of some of the ancient tribes of Indians were, until quite recently, to be found scattered around on the floor of the cave. . . . . Persons desiring to fully explore the cave should provide themselves with torches or lanterns, as the light of the day penetrates but a short distance from the entrance (Anonymous 1886).

It appears from the description of the cave and its close proximity to Black Rock Beach that what the railroad company calls "Giants' Cave" might very well be Black Rock Cave or "Smith's" Cave. What is clear is

Figure 30 - View of recreational area at Black Rock (Utah State Historical Society Photo Library).

that people visiting Black Rock Beach were encouraged to explore and hike in the mountains. It is safe to assume that some people may well have left their names or initials on the cave's walls while hiking and exploring.

Other beaches were soon developed following the apparent financial success of Hyde and Taylor. Garfield Beach, Clinton's Landing and Beach, Sunset Beach, Crystal Beach, and famous Saltair Resort reached their zenith of activity and financial success near the turn of the century. At least one beach, Clinton's Beach, boasted of a hotel to meet the need of overnight visitors to the Lake. Several beaches had piers and pavillions as well.

Local newspapers including the Deseret News frequently promoted the recreational opportunities of the Lake. One such article in 1876 publicized:

> There are the extensive water and mountain views, the refreshing moist and cool breezes from the Lake, the steamer and now boat rides upon the waters, the bracing baths in the same, and the general calmness and quietude of the locality, all of which combine to render it an attractive and beautiful place to while away a few hours, days, or weeks, as the case may be, in the pursuit of recreative pleasures and renewed health (Morgan 1973:355).

The boastfulness of the Lake and Oquirrhs by local newspapers seems quite out of context, especially in today's view of the Lake and mountains. However, local enthusiasm for the Lake and mountains was supported by many outsiders. John Muir, one of the leading naturalists of the time, while on a visit to the Lake in 1877 wrote of the mountains:

> But in every walk with Nature one receives far more than he seeks. I had not gone more than a mile from Lake Point ere I found the way profusely decked with flowers, mostly compositae and purple leguminosae, a hundred corollars or more to the square yard, with a corresponding abundance of winged blossoms above the, moths and butterflies, the leguminosae of the insect kingdom (Bade 1970:126).

Muir's ecstacy of the Lake and of the moment does not end here. Because of the apparent copiousness of lillies growing on the Oquirrhs, Muir suggests that the mountains should more appropriately be called the "Lily Range."

In addition to the bountiful splendor of flora, Muir comments briefly on his sighting of signs of abundant animal life found on the Oquirrhs:

> I noticed the tracks of deer in many places among the lily gardens, and at the height of about seven thousand feet I came upon fresh trail of a flock of wild sheep, showing that these fine mountaineers still flourish here above the range of Mormon rifles (Bade 1970:126).

Muir was not unabashed about the beauty of the Lake either. In another article he writes of his own exhilarating encounter of the old Lake as he, for the first time, enjoyed the bouyance provided by a high content of salts in the Lake:

> Without any definite determination I found myself undressed as if some one else had taken me in hand and while one of the largest waves was ringing out its message and spending itself on the beach, I ran out with open arms in the next, and received a hearty salute. Then I was fairly launched and at home, tossed into right lusty relationship with the brave old lake (Anonymous 1886:23).

Muir's positive experiences with the Lake at the end of the 19th century were not unique. Other visitors had similar experiences, generally reflecting a positive impression of the Lake's beauty and above all unusual experiences in trying to swim in the lake.

Positive encounters with the Lake and mountains diminished as the 20th century wore on. All of the resorts faced similar cyclical problems resulting in the eventual demise of the Lake as an important recreational area until most recently. All of the beaches and resorts were plagued by the same things: fluctuations of the Lake played a part in forcing enterprising businessmen to turn elsewhere; lack of large quantities of potable water was an increasing problem, particularly with the increased visitors to the beaches spurred on by improved roads and special railroad fares. Fires were always a source of difficulty, resulting in some beach developers throwing in the towel. Another common ailment that plagued beach developers was the increased use of the lake by various Wasatch Front communities as a community sewage septic tank. The combination of all these factors, along with the development of recreational activities and places elsewhere, caused energetic businessmen to abandon the Lake as a recreational resource.

The Oquirrhs have also undergone changes since the days of Muir and Ludlow. Logging, mining and milling have each taken a toll on the once noticeable beauty of the mountains. Now, one is not drawn to the mountains because of their beauty or because of the greenery and accompanying wildlife, but the mountains are noticed because of the lack of vegetation. The construction of mills, rail lines and superhighways has contributed to the disruption of the delicate beauty and balance of the mountains and shore of the Lake. The independent nature of the Lake in its own vacillation has also played havoc with the shoreline and beaches.

With these dramatic changes through time, Black Rock Cave has not gone untouched or unnoticed. Historian Charles Kelly, while researching the Donner-Reed Trail early in 1930, called to the attention of Julian Steward, University of Utah anthropologist, the possibilities of doing an archeological dig at the cave. Steward's findings are published in Ancient Caves of the Great Salt Lake Region. It is strange that neither Steward nor Kelly, in their writings about the cave, mentions finding the names or initials found on the cave's walls.

In recent years there has developed once again an interest in developing the south shore and islands of the Lake as major recreational areas for an expanding population, as well as a possible tourist attraction. Saltair III is rising out of the ashes of old Saltair like the Phoenix of ancient Egyptian mythology. Other plans are being promoted by the Tooele Chamber of Commerce and the Salt Lake City Chamber of Commerce to develop the south shore into a multipurpose recreational-tourist area with beaches, an overlook and aerial tramway to the top of the Oquirrhs. An integral part of this proposed plan is Black Rock Cave. The cave, according to the proposed plan, is to be part of an interpretive display concerning prehistoric Indians living around the shores of the Lake.

People from LaHontan to the present have been fascinated with the intriguing aspects of the Lake, with its unusual beauty, charm, geographical features, and unique bathing opportunities. Any future developments of the Lake's south shore and northern Oquirrhs will undoubtedly include Black Rock Cave.

SUMMARY

Attempts have been made to identify the names and initials carved on the walls of Black Rock Cave (Table 14). A review of the 1860, 1870 and 1880 manuscript census failed to clearly identify the initials or names found on the walls. A similar search of the Daughters of Utah Pioneers history of Tooele County (Anonymous 1961), which contains a list of early pioneers to Tooele County, also fails to conclusively identify who the individuals were who may have left their marks on the cave's walls.

Table 14. Names and Initials Found on Cave Walls.

J.B	74	
J.M.B.		
C.H.E.		
C.P.M.		
E. Manning or Manning		
C.S.		
Mrs. Manning		
Saw telle		
E. Stevenson	1877	
E. T. Wolle		
G. M. Cannon	1880	
Cahoone		
Ch pord		
Milne		
Dusty		
Pitiiencey		
E. M. Fugsl or Fugel		
W. H. Wardlee		
W. W. Williams	74	77
Lowe		
C. Horne		
P. J.		
M? Cray or McCray		
S. Wotson	1871	
Bricy Casts	187	
L.W.R.		
H.W. Taylor		
C.S. Taylor		
S.P. Pack		
W.B.R.		
M. Horne		
Rich		
J.L.C.		
G.W. Badger	1869	
E. Haward or Howard	1878	
A.B.		
A.K.		
L.A.J.		
W.D.J.		
Lizzie Stevenson		
J.W.H.		
C.K.		
J.H.		
L.B.H.		
H. Cook	1860	
A. Reid	1880	
T.A.Spencer		
A.S.C. Edger		
Jenson 8 1894		

It is safe to conclude, however, that names found on the walls such as Taylor, Rich, Williams and Milne represent some of the well known and not so well known Mormons who were early settlers to the Salt Lake and Tooele valleys. It can also be argued that emigrants using Hastings Cutoff on their way to California had opportunities to hike the nearby Oquirrhs from the various refitting locations between Magna and Grantsville. No doubt some of these people left their names and initials for future generations to observe.

Northern Tooele Valley was an important grazing area for church and cooperative livestock herds. Grass was bountiful and water in various qualities was available for the herds (Stansbury 1852:118). Herders likewise had ample opportunities to visit and explore the cave.

Thus the names and initials found on the cave walls reflect a cross section of the western experience: men and women who traveled west hoping to gain their fortunes in California or Nevada, town builders and settlers of the Great Basin, young men employed as ranch hands and miners, men working in the nearby mills, and people looking for a few hours escape from the workaday world. All can be found in the names and initials carved on the cave's walls.

Thousands of residents from along the Wasatch Front and tourists to the area have had numerous opportunities as they have visited Black Rock Beach and other nearby beaches to hike and explore the Oquirrhs and to visit the cave. The railroad, in the 1880s, through its advertised reduced rates, encouraged recreational trips to Black Rock Beach. Moreover, the railroad, through its informational brochures about the Lake and Black Rock Beach, promoted the idea of "Persons desiring to fully explore 'Grants' [i.e., Black Rock] cave should provide themselves with torches or lanterns. . ." It is highly probable that many visitors to Black Rock Beach did take the suggestion of The Utah and Nevada Railroad to visit the cave. It is believed that the peak period of visitors to Black Rock Beach and other beaches located nearby was probably between 1880 an 1920.

It is evident that since the turn of the century and especially since the construction of an all-weather highway, hundreds of people have visited the cave.

Two other findings are noteworthy and deserve mention. First was the availability of potable water near the cave. Jefferson's 1846 map, for example, clearly identifies at least three separate springs or water sources within several hundred meters of the cave. During the survey of the Lake by Howard Stansbury, a survey station was established at Black Rock (Stansbury 1852:118 & 170). The decision by Stansbury and members of his expedition to construct a temporary survey station without the availability of water nearby was unlikely when there were other equally favorable locations.

The construction of a ranch house by Heber C. Kimball and its subsequent use as a "hotel" for visitors to the lake suggests the availability and reliability of suitable drinking water located nearby. The extensive developments by Clinton and Taylor and Hyde also suggest that there was a reliable water source in the immediate area. Equally important was the lack of any references in the historical records researched to the lack of water with the exception of pier or pavillion fires which required a great deal of water in a hurry.

Visitors to the south shore and cave at the end of the century remarked in their writings of the relative abundance of flora and fauna located on the west face of the Oquirrhs. This also suggests a constant supply of both ground and surface water.

The second relates to the apparent abundance of trees. Muir suggests that there existed an extensive stand of trees near the cave. It is rather difficult to pinpoint exactly where Muir hiked, but it can be assumed that he did not range far from his overnight accommodations at the Kimball Ranch house. During the late 1860s the Oquirrhs were a major source of timber for railroad ties. Contracts were held by several Mormons to supply cut ties to the Central Pacific Railroad Company at Promontory. Rail ties were transported by way of the Great Salt Lake to Promontory. Earlier in 1849 the State of Deseret granted to Ezra T. Benson, Anson Call, Josiah Call and Judson Tolman the right to cut and saw timber in the Oquirrhs (Anonymous 1961:44). Later with the discovery of valuable mineral mines, large quantities of timber was used for shoring and other mining activities. The Oquirrhs undoubtedly supplied much of the early timber demands for the mines.

In a February 1983 conversation with Mr. Orrin Miller, a long time resident of Tooele Valley, he recalls seeing, as a young boy, large areas in the Oquirrhs littered with fallen trees and tree stumps. All historical evidence points to the strong possibility that there were stands of trees found in the Oquirrhs which was suited for the construction of pioneer houses and barns, railroad ties and for shoring in the mines located nearby.

The establishment of smelters at the north end of the Oquirrhs coupled with earlier heavy demands for timber have resulted in the denuding of trees from the Oquirrhs. The loss of ground cover has also altered surface and subsurface water patterns that existed near the cave. Additionally, if the springs identified by Jefferson in 1846 were located between the shoreline and the Oquirrhs the likelihood of them being destroyed by the construction of two railroad lines and several generations of all purpose highways has occurred. Changes in the environment brought on by industrialization and settlement near the cave have modified earlier wildlife habitat and patterns as well.

SUMMARY OF THE BLACK ROCK CAVE EXCAVATIONS

Black Rock Cave is a wave/solution formed cavern cut into the Oquirrh Formation of the northern Oquirrh Mountains between the Provo and Stansbury Terraces of Lake Bonneville. Lake waters receded from the cave sometime between 12-15,000 years ago, but there is no evidence of human occupation until 6-7000 B.P. Vegetation zonation on the northern Oquirrhs was probably similar to that of the present throughout the occupational history, although the pollen data do suggest some slight changes in productivity of particular species and the historical information indicates some change in the distribution of the larger trees. "Swampy meadowlands" surrounded freshwater springs at the foot of the mountains and stretched out across the salt flat to the lake edge. Sage/grass and mountain brush zones were found in the immediate vicinity of the cave, while a coniferous zone occurred at the higher elevations of the Oquirrhs. Pinyon probably did not occur locally. Different sets of small game and birds were available in each of these zones and larger game including mountain sheep, antelope, deer, and possibly elk were also locally available.

Black Rock Cave was first excavated by Julian Steward in 1931. Steward excavated the cave in natural stratigraphic units, but unfortunately, he recorded the location of artifacts and cultural features in terms of depth below surface. As a result, it is difficult to relate artifacts recovered in 1931 to those recovered in 1982, although it is possible to tie much of Steward's stratigraphic descriptions to the stratigraphy we defined. The 1982 excavations concentrated at the mouth of the cave in undisturbed deposits underlying Steward's backdirt and the accumulation of 50 years of vandalism. The upper portion of the cultural deposits in this area were contaminated and only a limited quantity of material post-dating 2000 years ago and none post-dating 1000 B.P. was recovered.

Eight stratigrahpic units were defined at the mouth of the cave. Excavation in the middle of the cave defined a smaller series containing few artifacts. The lowest two stratigraphic units consist of lake gravels. The upper gravel unit contained numerous small animal bones, but these appear to have been either deposited by carnivores during the 7-8000 years the cave was uninhabited by human groups or ground in during the initial cave occupation. The remaining 6 units were deposited between about 6500 years ago and about 1000 B.P. Dating is controlled by three radiocarbon dates and by chronologically sensitive artifacts. The only cultural features defined in these units were seven fire hearths.

The earliest occupation of Black Rock Cave probably took place about 6-7000 years ago. The basal radiocarbon date is 6100 B.P., but the Pinto point found by Steward and attributable to this occupation (Unit C) is generally dated somewhat earlier. The single pollen sample from this occupation is somewhat different from the other samples in the sequence and may suggest an increased use of grass by cave occupants during the period or slightly different surrounding vegetation. Except for the absence of deer, bone from this period is not significantly different from subsequent occupations, however, and represents species, primarily small game animals, that occur within easy access of the cave.

The next occupation of Black Rock (Unit C) is associated with a radiocarbon date of 3240 B.P. Its deposition post-dates that of a unit which may be of natural origin and which separated two units definitely of cultural origin. Given this rather lengthy 3000+ year time-span and the presence of the natural deposition, it appears probable that the cave remained unoccupied for a substantial period of time. Elko corner-notched projectile points are the dominant diagnostic artifact from this occupational unit. The Gypsum point recovered by Steward is probably derived from this occupational unit and fits well with the dating. The pollen sample from the unit is similar to those from the overlying units and provides little evidence of either vegetational changes or changes in cultural use during the last few thousand years of occupation. The faunal remains from the unit continue to be dominated by bones of small to medium animals and birds, but deer appear for the first time in the record.

Unit F and the lower portion of Unit G represent an occupation that is similar to the underlying deposition and, indeed, may be a continuation of that pattern. Like the underlying unit, these units are dominated by Elko Corner-notched points to the virtual exclusion of other styes. Pollen samples and faunal remains are also very similar. The units are bracketed by radiocarbon dates of 3250 and 1460 B.P., but are not directly dated. There is no stratigraphic evidence, such as a spall layer or sterile eolian fill, of a significant occupational break between these units and the overlying units.

The uppermost undisturbed prehistoric occupational unit defined during the 1982 excavations was only identified in a limited area and very few diagnostic artifacts and faunal materials were recovered. This depositional unit is underlain by a radiocarbon sample dating to 1460 B.P. and probably represents occupation by Fremont groups. The pollen sample and the components of the faunal collection from the unit differ very little from the underlying units. However, a single grain of corn pollen was identified and the proportional amount of large mammal bone increases dramatically. The higher number of bones suggest an increased focus on hunting and/or a more intensive occupation of the cave, while the corn pollen suggests the cave served as part of a larger subsistence system which included domesticates grown at other locations. The Fremont pottery as well as the Bear River side-notched and Rosegate points found by Steward and in unprovenienced context in 1982 are probably derived from this occupation.

No post-Fremont prehistoric depositions were defined during the 1982 excavations. Steward, however, recovered a Desert side-notch projectile point which may be derived from such an occupation and, as noted by Dean, the pottery may represent something other than the Great Salt Lake Fremont as presently defined. Little can be said about dating, subsistence, or external relationships.

Historical materials on the upper surface of the deposits as well as the graffiti on the walls appears to be derived principally from a period of about 1880 to 1920. This fits well with historic data which suggests that the hey-day of recreational use on the south shore of the Great Salt Lake, and particularly at Black Rock Beach, occurred during this same period.

In sum, Black Rock Cave was apparently a seasonally occupied camp site serving as the locus for foraging activities directed toward the procurement of a broad spectrum of locally available plants and animals. This broad spectrum subsistence base was made possible by the compression of a large number of ecological communities, ranging from lake-margin salt tolerant communities and freshwater spring communities to sub-alpine coniferous communities, into a horizontally compact area. Sites like Black Rock Cave, located vertically towards the center of the area, provided relatively easy access to all of these communities. The rather limited occupation of the cave, both in terms of initial occupation and continuity of occupation, suggest that it occurred only when socially or environmentally induced stress made it the equal of normally more favorable locations.

BLACK ROCK CAVE IN THE CONTEXT OF THE NORTHEASTERN GREAT BASIN

Black Rock Cave fits into the pattern of eastern Great Basin Archaic changes recently defined by Aikens and Madsen (n.d.). Of the three periods they defined, the middle or Wendover Period (8500-6000 B.P.) is characterized by a relatively gradual increase in site numbers. This gradual increase suggests an internal population growth, but no complimentary changes in subsistence stratagies or settlement patterns can be discerned. The initial occupation of Black Rock Cave between 6-7000 years ago appears to be a part of this gradual increase.

Following the Wendover Period, Aikens and Madsen (n.d.) note a marked decrease in the numbers of occupied sites. While they can provide no suitable explanation, the correlation of this change with a midpost-Pluvial period of increased aridity is hard to ignore. Again, Black Rock Cave fits this pattern, since there appears to be a period of noncultural deposition following the initial occupation. About 5000 years ago, with the beginning of the Black Rock Period, there is a dramatic increase in the numbers of newly occupied sites (Figure 31). While lower elevation lake-edge sites like Black Rock Cave continued to be used, there appears to be a shift in emphasis to more upland locations. This, inturn, suggests a slightly different focus in the subsistence strategy of Archaic hunter/gatherers; a change Simms (n.d.) attributes to the appearance of pinyon in the region.

The problem of transition between Archaic and Fremont in the eastern Great Basin is not addressed by Aikens and Madsen (n.d.) other than to suggest that such a transition did indeed occur and that Southwestern features such as domesticated crops and pottery appeared well before the shift to the occupation of open village sites with pit-house architecture. The hypothesis of Madsen and Berry (1975) that a complete occupational hiatus between the Archaic and Fremont occurred in the eastern Basin appears to be discredited, but there does seem to be a marked reduction in the numbers of sites occupied. Again, what this reduction means and its causes remains unknown. At Black Rock Cave there is no evidence of an occupational break, but, on the other hand, it would also be difficult to make a case for the presence of a transitional phase at the site based on data from either the 1931 or the 1982 excavations.

Black Rock Cave is only one of a number of sites on the north end of the Oquirrh Mountains that may have been occupied as a "set." Black Rock Cave II, Black Rock Cave III, and cave 42To287 are all located within less than an arrow's flight of Black Rock Cave and were probably occupied at roughly the same time. While chronology in the caves is poorly controlled radiometrically, similarities in artifact complexes suggest they were occupied during the same periods. It makes little sense to suppose they were inhabited sequentially as part of a foraging pattern or a larger seasonal round since they are within only a couple of hundred meters of each other at roughly the same elevation. For much same reason, the suggestion that they were occupied sequentially on a yearly or multi-yearly basis would also be hard to understand. If the best choice is vacant, why take second best?

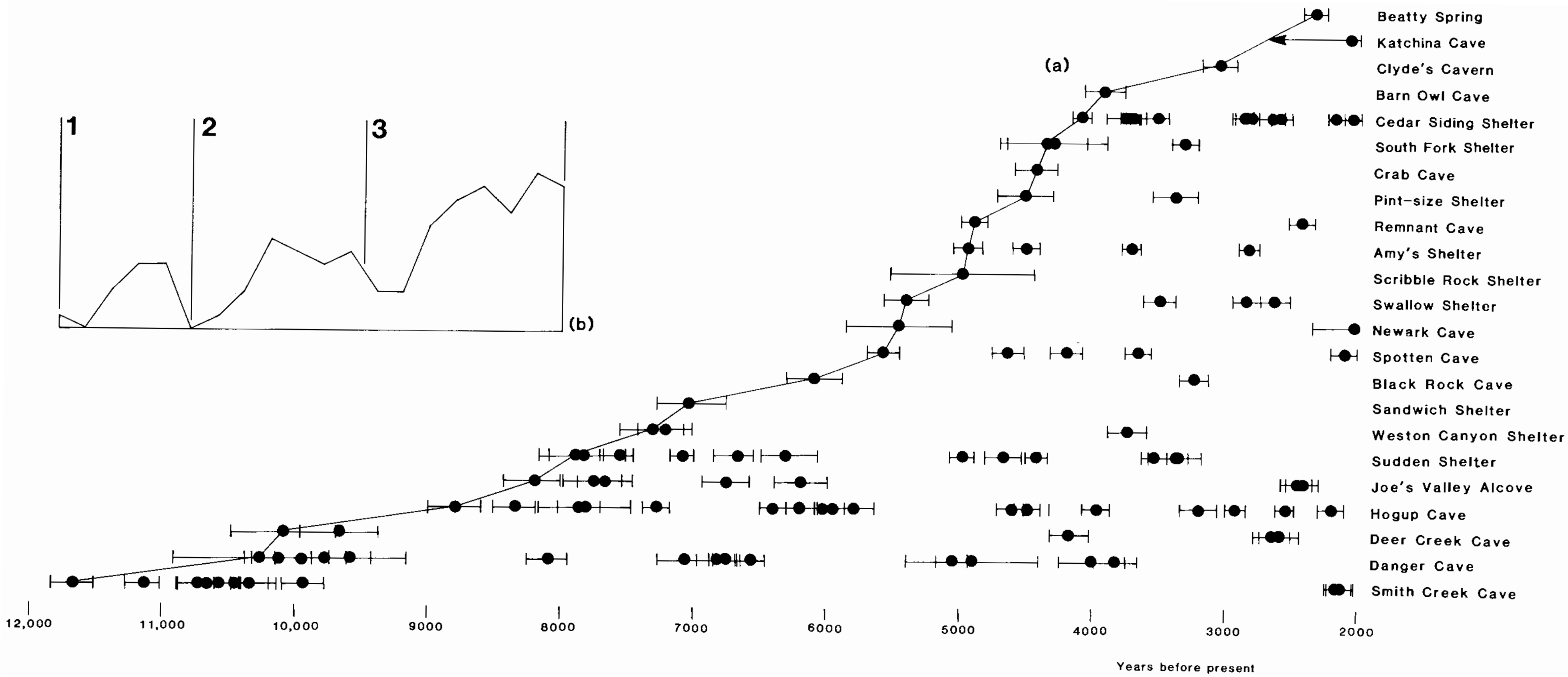


Figure 31 - Radiocarbon dated sites in the eastern Great Basin (from Aikens and Madsen n.d.). (1) Bonneville Period; (2) Wendover Period; (3) Black Rock Period.

It seems most parsimonious, then, to assume that these sites were inhabited at the same time by different groups of people. This is not meant to necessarily imply an intensive, long-term occupation; the sites may have been visited as briefly as a day or two. Nor does it mean that there were the same number of groups (or individuals in those groups) each visit; numbers of people undoubtedly did vary seasonally or yearly with the purpose and timing of the visit. However, it does imply that a fairly large number people were in the area simulataneously. If true, this assumption of simultaneous occupation raises several interesting questions. (1) What was the composition of the groups occupying each cave? (2) What were the relationships of the people both within and between each cave group? (3) How did the juxtaposition of this relatively large population effect foraging patterns in such a limited area? These and other similar questions are difficult to answer with the data at hand, but even unanswered they lead to other questions concerning common assumptions of Great Basin social systems.

A basic tenet of Steward's (1938) model of Great Basin sociopolitical groups is that large bands of interrelated family groups only occur when and/or where a large crop of a particularly abundant and highly ranked item (such as pinyon nuts or fish) can be found and that one of the primary underlying characteristics of such bands is the ability to fission into smaller family components. Clearly this pattern is not evident at the Black Rock Cave sites where the available subsistence data suggests a rather broadly based foraging subsistence system with no one item ranked significantly higher in the diet than any other; while, at the same time, it appears probable that several family groups coexisted within a relatively small area.

This pattern, the occurrence of "sets" of cave sites probably occupied simultaneously, is not an isolated one restricted to the northern Oquirrh Mountains, but is one that appears to be common in the northeastern Great Basin. Such "sets" occur on the Promontory Penninsula, on Stansbury Island, near Fish Springs, at the north end of the Lakeside Mountains, and around Danger Cave. Other "sets" may well occur but the nature of the survey data is inadequate to determine their presence or absence. However many sets there actually are, they appear common enough to represent an intentional pattern; one that deserves to be investigated. Such an investigation cannot be limited to the excavation of single sites, as has been the focus of nearly all previous research in the region, since obviously the entire set must be investigated to determine internal relationships within the set. Further, the set as a whole must be studied within a larger context of other seasonally occupied or special use sites.

It is important to stress here that individually occupied sites remain the dominant type of site in the eastern Basin and that existence of "sets" of sites does not negate the Steward model applied archeologically by Jennings (1957). Lower elevation sites like Hogup Cave and higher elevations sites like Sparrow Hawk have been defined on an individual basis and appear to have been critical elements in the seasonal rounds of prehistoric groups. It remains important to determine how such sites are related both to each other and to those sites which appear to have been occupied in concert.

It is also entirely possible that other explanations can be derived for the occurrence of site sets. It may be, for instance, that many of the sites within a particular set are caches for the storage of food and implements and only one or two sites actually represent habitations. This seems doubtful in light of the multiple excavations carried out in the Black Rock area, at Fish Springs, and in the Danger Cave area, but the occurrence of "cache" sites like Hidden Cave (Thomas 1982) in similar settings in the western Great Basin suggest that this possibility be investigated.

In a similar vein, another problem evident at Black Rock Cave can only be resolved with a broadly based investigation of a number of sites in different settings. The presence of Fremont artifacts in a context suggesting foraging and collecting of wild plants and animals, as well as the presence of corn macrofossils and pollen in those same contexts, leads directly to the question of how the growing of domesticated crops was integrated into a hunting/gathering subsistence strategy (or versa visa). Both Fremont horticultural sites and hunting/gathering sites have been investigated, but at no time have the two types of sites been investigated in conjunction. There are suggestions (Madsen 1982b) that in some places a substantial portion of the year (up to a third) was spent by Great Salt Lake Fremont groups in the collecting of wild resources. If true, how did such a significant investment of time and energy effect the production of crops and why was it necessary and/or desirable? Here again, the answers can be provided only by the investigation of a regional research program that can seek out related horticultural and collecting sites and investigate the nature of that relationship.

REFERENCES

Adovasio, James M.
1979 Comment. American Antiquity, Vol. 44, pp. 723-731. Washington.

Aikens, C. Melvin
1970 Hogup Cave. University of Utah Anthropological Papers, No. 87. Salt Lake City.

1976 Cultural Hiatus in the eastern Great Basin? American Antiquity, Vol. 41, pp. 543-550. Washington.

Aikens, C. Melvin and David B. Madsen
n.d. Eastern Great Basin Archaic. In, W. L. d'Azevedo (ed.), Handbook of North American Indians, Volume 11 : Great Basin. Smithsonian Institution. Washington, D.C.

Anonymous
n.d. "Journal History of the Church of Jesue Christ of Latter-day Saints." Church of Jesus Christ of Latter-day Saints Archives.

1860 Bureau of the Census, Manuscript Census. United States Government, Department of Commerce. (also 1870 & 1880).

1886 "Descriptive and Historical Sketch of the Great Salt Lake" The Utah & Nevada Railway. Salt Lake City.

1954 Speleogenesis of Clinton's Cave, Utah. Technical Note #18, Salt Lake Grotto, National Speleological Society. Salt Lake City.

1961 The History of Tooele County. Daughters of Utah Pioneers. Salt Lake City.

Arnold, Dean E.
1978 Ceramic variability, environment and culture history among the Pokom in the valley of Guatemala. In, I. Hodder (ed.), The Spatial Organization of Culture. pp. 39-59. University of Pittsburgh Press. Pittsburgh.

Bade, William F. (ed.)
1970 Steep Trails by John Muir. Berg Publishers. Dinwoody, Georgia.

Bass, William M.
1971 Human Osteology: A Laboratory and Field Manual of the Human Skeleton. University of Missouri Press. Columbia.

Baumhoff, Martin A. and Robert Heizer
1965 Postglacial climate and archaeology in the Desert West. In, H.E. Wright and David G. Frey (eds.), The Quaternary of the United States, pp. 697-707. Princeton University Press. Princeton.

Berge, Dale L.
1980 Simpson Springs Station - Historical Archaeology in Western Utah Cultural Resource Series Monograph No. 6. Bureau of Land Management. Salt Lake City.

Berry, Michael S.
1982 Time, Space and Transition in Anasazi Prehistory. University of Utah Press. Salt Lake City.

Binford, Lewis R.
1981 Bones: Ancient Men and Modern Myths. Academic Press. New York.

Binford, Lewis R. and Jack B. Bertram
1977 Bone frequencies and attritional processes. In, L.R. Binford (ed.), Background Studies for Theory Building. pp. 77-153. Academic Press. New York.

Brain, C.K.
1981 The Hunters or the Hunted? Academic Press. New York.

Brown, J.H.
1971 Mammals on mountaintops: nonequilibrium insular biogeography. American Naturalist, Vol. 105, pp. 467-478.

Bryan, Alan L.
1980 The stemmed point tradition: an early technological tradition in western North America. In, L. Harten, C. Warren, and D. Tuohy (eds.), Anthropology Papers in Memory of Early H. Swanson, Jr. Idaho State University Press. Pocatello.

Burt, William H. and Richard P. Grossenherder
1976 A Field Guide to the Mammals. Houghton Mifflin Company. Boston.

Busby, Colin I.
1979 The Prehistory and Human Ecology of Garden and Coal Valleys: a contribution to the prehistory of southeastern Nevada. Contributions of the University of California Archaeological Research Facility, No. 39. Berkeley.

Busby, Colin I. and Susan M. Seck
1977 Archaeological Investigations at Civa Shelter II, Lincoln County, Nevada: report of field activities, 1976. Nevada Archaeological Survey Reporter, Vol. 10, No. 5, pp. 1-5.

Bye, Robert A., Jr.
1972 Ethnobotany of the Southern Paiute Indians in the 1870's: With a note on the early ethnobotanical contributions of Dr. Edward Palmer. In, D.D. Fowler (ed.), Great Basin Cultural Ecology: A Symposium. Desert Research Institute Publications in the Social Sciences, No. 8. Reno.

Chamberlain, Ralph V.
1911 The Ethno-Botany of the Gosiute Indians of Utah. Philadelphia Academy of Natural Sciences Proceedings, Vol. LXIII. Philadelphia.

Chamberlin, Ralph V and David T. Jones
1929 A descriptive catalog of the Mollusca of Utah. University of Utah Bulletin, Biological Series, Vol. 1 no. 1. Salt Lake City.

Currey, Donald R.
1980 Coastal geomorphology of Great Salt Lake and Vicinity. In, J. Wallace Gwynn (ed.), The Great Salt Lake: a Scientific, Historical, and Economic Overview. Utah Geological and Mineral Survey Bulletin, No. 116, pp. 69-82. Salt Lake City.

Currey, Donald R. and Steven R. James
1982 Paleoenvironments of the Northeastern Great Basin and Northeastern Basin Rim Region: a review of geological and biological evidence. In, D.B. Madsen and J. F. O'Connell (eds), Man and Environment in the Great Basin, pp. 27-52. Society for American Archaeology. Washington.

Dalley, Gardiner F.
1976 Swallow Shelter and Associated Sites. University of Utah Anthropological Papers, No. 93. Salt Lake City.

Denton, George H. and Wibjorn Karlen
1973 Holocene climatic variations - their pattern and possible cause. Quaternary Research, Vol. 3, pp. 155-205. Washington.

Durrant, Stephen D.
1952 Mammals of Utah. University of Kansas Museum of Natural History Publications, Vol. 6, pp. 1-549. Lawrence, Kansas.

Enger, Walter D.
1942 Archeology of Black Rock Cave III, Utah. Archeology and Ethnology Papers, Museum of Anthropology. University of Utah Anthropological Papers, No. 7. Salt Lake City.

Errington, Paul L.
1978 Muskrats and Marsh Management. University of Nebraska Press. Lincoln.

Eubank, Mark E. and R. Clayton Brough
1979 Utah Weather. Horizon Publishers. Bountiful, Utah.

1980 The Great Salt Lake and Its Influence on the Weather. In, J. W. Gwynn (ed.), Great Salt Lake: a Scientific, Historical, and Economic Overview. Utah Geological and Mineral Survey Bulletin, No. 116. Salt Lake City.

Fike, Richard E.
n.d. A Dictionary and Guide to the Identification and Dating of Embossed Medicinal Containers. In preparation.

Fowler, Donald D. and Jesse D. Jennings
1982 Great Basin Archaeology: A Historical Overview. In, D.B. Madsen and J.F. O'Connell (eds.), Man and Environment in the Great Basin, pp. 105-120. Society for American Archaeology. Washington.

Fowler, Don D., David B. Madsen and E.M. Hattori
1973 Prehistory of Southeastern Nevada. Desert Research Institute Publications in the Social Sciences, No. 6. Reno.

Fry, Gary F.
1970 Prehistoric Human Ecology in Utah: Based on the Analysis of Coprolites. Ph.D. dissertation, Department of Anthropology, University of Utah. Salt Lake City.

Fry, Gary F. and Gardiner F. Dalley
1979 The Levee Site and the Knoll Site. University of Utah Anthropological Papers, No. 100. Salt Lake City.

Fry, R.E., and S.C. Cox
1974 The structure of ceramic exchange at Tikal, Guatemala. World Archaeology. Vol. 6, pp. 209-225. South Hampton, G.B.

Gardiner, Alma A.
1959 The Founding and Development of Grantsville, Utah, 1850-1950. Masters Thesis, Department of History, Brigham Young University. Provo.

Gilbert, B. Miles
1973 Mammalian Osteo-Archeology: North America. University of Missouri Press. Columbia.

Gillio, David; Levine, Francis; Scott, Douglas
1980 Some Common Artifacts Found at Historic Sites Cultural Resources Report No. 31: USDA Forest Service, Southwestern Region. Albuquerque.

Grayson, Donald K.
1979 On the Quantification of Vertebrate Archaeofaunas. In Advances in Archaeological Method and Theory. Vol. 2. pp. 199-235. Academic Press. New York.

1982 Toward a History of Great Basin Mammals During the Past 15,000 years. In, D.B. Madsen and J.F. O'Connell (eds.), Man and Environment in the Great Basin, pp. 82-101. Society for American Archaeology. Washington.

Grimm, Ralph E.
1962 Applied Clay Mineralogy. McGraw-Hill Book Company, Inc.

Havinga, A.J.
1967 Palynology and Pollen Preservation. Review of Palaeobotany and Palynology, Vol. 2. pp. 81-98. Amsterdam.

Hill, J.N.
1970 Broken K Pueblo: prehistoric social organization in the American Southwest. Anthropological Papers of the University of Arizona, No. 18. University of Arizona Press. Tucson.

Hintze, Lehi F.
1977 Geologic History of Utah. BYU Geology Studies, Vol. 20, pt. 3. Provo, Utah.

1980 Geologic Map of Utah. Utah Geological and Mineral Survey. Salt Lake City, Utah.

Hodder, Ian
1982 Symbols in action: ethnoarchaeological studies of material culture. Cambridge University Press. Cambridge.

Holmer, Richard N.
1978 A Mathamatical Typology for Archaic Projectile Points of the Eastern Great Basin. Ph.D. dissertation. Department of Anthropology, University of Utah. Salt Lake City.

1984 Projectile Points of the Intermountain Region. In, C. Stout and D.D. Fowler (eds.), Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings. University of Utah Press. Salt Lake City.

Holmer, Richard N. and Dennis G. Weder
1980 Common Post-Archaic Projectile Points of the Fremont Area. In, D.B. Madsen (ed.), "Fremont Perspectives." Antiquities Section Selected Papers, No. 16. Salt Lake City.

Jameson, Sydney
1958 Archeological Notes on Stansbury Island, Utah. University of Utah Anthropological Papers, No. 34. University of Utah Press. Salt Lake City.

Jennings, Jesse D.
1957 Danger Cave. University of Utah Anthropological Papers, No. 27. University of Utah Press. Salt Lake City.

Judd, Neil M.
1926 Archeological Observations North of the Rio Colorado. Bureau of American Ethnology Bulletin, No. 82. Washington.

Kay, M.
1975 Social distance among central Missouri Hopewell settlements: a first approximation. American Antiquity, Vol. 40, pp. 64-71. Washington.

Kay, Paul A.
1982 A perspective on Great Basin Paleoclimates. In, D.B. Madsen and J.F. O'Connell (eds.), Man and Environment in the Great Basin, pp. 76-81. Society for American Archaeology. Washington.

Kelly, Charles
n.d. Manuscript on File. "Charles Kelly Papers," Box 6, Folder 4, "Black Rock Cave," MS B 114. Utah State Historical Society.

Keer, Paul F.
1977 Optical Mineralogy. McGraw-Hill, Inc. New York.

Korns, J. Roderick (ed.)
1951 The Journal of Heinrich Lienhard. Utah State Historical Quarterly, Vol. 19, pp. 125-148. Salt Lake City.

Lawrence, Barbara
1968 Antiquity of Large Dogs in North America. Tebiwa, Vol. 11, No. 2, pp. 43-49. Pocatello.

1983 Guest lecture "Species distinction in the genus Canis", Center for Materials Research in Archaeology and Ethnology, Summer Institute course "Biological Materials from Archaeological Sites: Fauna." Massachusetts Institute of Technology, Cambridge.

Lief, Alfred
1965 A Close-up of Closures. Glass Manufacturer Institute, Inc. New York.

Ludlow, Fitz H.
1870 The Heart of the Continent. Hurd and Houghton. New York.

Lyneis, Margaret M.
1982 Prehistory in the Southern Great Basin. In, D.B. Madsen and J.F.O'Connell (eds.), Man and Environment in the Great Basin, pp. 172-185. Society for American Archaeology. Washington.

Madsen, David B.
1970 Great Lake Fremont Ceramics. In, Gary F. Fry and Gardiner F. Dalley, The Levee Site and the Knoll Site, University of Utah Anthropological Papers, No. 100. Salt Lake City, Utah.

1975 Dating Paiute-Shoshoni expansion in the Great Basin. American Antiquity, Vol. 40, pp. 82-86. Washington.

1978 Recent data bearing on the question of a hiatus in the eastern Great Basin. American Antiquity, Vol. 43, pp. 508-509. Washington.

1979 The Fremont and the Sevier: Defining Prehistoric Agriculturalists North of the Anasazi. American Antiquity, vol. 44, pp. 711-722. Washington.

1980 The Human Prehistory of the Great Salt Lake Region. In, J.W. Gwynn (ed.), "Great Salt Lake: a Scientific, Historical, and Economic Overview. Utah Geological and Mineral Survey Bulletin, No. 116, pp. 17-31. Salt Lake City.

1981 The emperor's new clothes. American Antiquity, Vol. 46, pp. 637-640. Washington.

1982a Get it where the Gettin's Good: a variable model of Great Basin subsistance and settlement based on data from the eastern Great Basin. In, D.B. Madsen and J.F. O'Connell (eds.), Man and Environment in the Great Basin, pp. 207-226. Society for American Archaeology. Washington.

1982b Prehistoric Occupation Patterns, Subsistence Adaptations, and Chronology in the Fish Springs Area, Utah. In, "Archaeological Investigations in Utah at Fish Springs, Clay Basin, Northern San Rafael Swell, and Southern Henry Mountains." Cultural Resource Series, No. 12, pp. 1-59. Utah State Office, Bureau of Land Management. Salt Lake City.

1984 Great Basin Nuts: a short treatise on the distribution, productivity and prehistoric use of pinyon. In, D.D. Fowler and Carol Stout (eds.), Essays in Honor of Jesse D. Jennings. University of Utah Press. Salt Lake City.

Madsen, David B. and Micheal S. Berry
1975 A reassessment of northeastern Great Basin prehistory. American Antiquity, Vol. 40, pp. 391-405. Washington.

Madsen, David B. and Donald R. Currey
1979 Dating Glacial Retreat and Late Quaternary Vegetation Changes, Wasatch Mountains, North Central Utah, U.S.A. Quaternary Research, Vol. 12, pp. 254-270. New York.

Madsen, David B. and La Mar W. Lindsay
1977 Backhoe Village. Antiquities Section Selected Papers, Vol. IV, No. 12. Salt Lake City.

Madsen, David B. and Paul A. Kay
1982 Late Quaternary Pollen Analysis in the Bonneville Basin. Paper delivered at the biennial meeting American Quaternary Association. Seattle.

Madsen, Rex F.
1977 Prehistoric Ceramics of the Fremont. Museum of Northern Arizona Ceramic Series, No. 6. Flagstaff, Arizona.

Marwitt, John P.
1970 Median Village and Fremont Culture Regional Variation. University of Utah Anthropological Papers, No. 95. Salt Lake City.

1979 Comment. American Antiquity, Vol. 44, pp. 732-735. Washington.

Marwitt, John P., Gary F. Fry, and James M. Adovasio
1971 Sandwich Shelter. In, C. Melvin Aikens (ed.), Great Basin Anthropological Conference 1970, Selected Papers. University of Oregon Anthropological Papers, No. 1. Eugene.

Mehringer, Peter J., Jr.
1967 Pollen Analysis of Tule Springs Area, Nevada. In, H.M. Wormington and D. Ellis (eds.), Pleistocene Studies in Southern Nevada. Nevada State Museum Anthropological Papers, No. 13. Carson City.

Miller, David E.
1947 The Great Salt Lake: Its History and Economic Development. Ph. D. Dissertation. Department of History. University of California. Berkeley.

Morgan, Dale L.
1973 The Great Salt Lake. University of New Mexico Press. Albuquerque.

Morgan, Dale L. (ed.)
1951 "T. H. Jefferson Map." Utah Historical Quarterly, Vol. 19, pp. 177-185. Salt Lake City..

1951 "The Journal of Edwin Bryant." Utah Historical Quarterly, Vol. 19, pp. 43-107. Salt Lake City.

1951 "The Journal of Heinrich Lienhard." Utah Historical Quarterly, Vol. 19, pp. 108-176. Salt Lake City.

1951 "The Journal of James Frazier Reed." Utah Historical Quarterly, Vol. 19, pp. 186-223. Salt Lake City.

O'Connell, James F., Kevin T. Jones, and Stevens R. Simms
1982 Some thoughts on prehistoric archaeology in the Great Basin. In, D.B. Madsen and J.F. O'Connell (eds.), Man and Environment in the Great Basin, pp. 227-240. Society for American Archaeology. Washington.

Olsen, Stanley O.
1973 Mammal Remains from Archaeological Sites - Part I: Southeastern and Southwestern United States. Peabody Museum. Cambridge.

Parmalee, Paul W.
1967 The Fresh Water Mussels of Illinois. Illinois State Museum Series, No. 18. Illinois

Parmalee, Paul W.
1980 Utilization of Birds by the Archaic and Fremont Cultural Groups of Utah. Natural History Museum Los Angeles County Contributions of Science, No. 330, pp. 227-250. Los Angeles.

Phillips, D.A.
1972 Social implications of settlement distribution on Black Mesa. In, G.J. Gummerman, D. Westfall, and C.S. Weed (eds.), Archaeological Investigations on Black Mesa, the 1969-1970 Seasons. Prescott College Studies in Anthropology, No. 4. pp. 199-210. Prescott College Press. Prescott, AZ.

Plog, Stephen
1980 Stylistic variation in prehistoric ceramics: design analysis in the American Southwest. Cambridge University Press. Cambridge.

Price, Sara S.
1952 A Comparison of Gosiute Material Culture and the Archeology of Western Utah. M.A. thesis, Department of Anlthropology, University of Utah.

Renfrew, Colin
1975 Trade as action at a distance. In, J.A. Sabloff and C.C. Lamberg-Karlovsky (eds.), Ancient Civilization and Trade. pp. 3-59. University of New Mexico Press. Albuquerque.

Riley, John J.
1958 A History of the American Soft Drink Industry: American Bottlers of Carbonated Beverages. Washington, D.C.

Roberts, Ralph J. and E. W. Tooker
1961 Structural Geology of the North End of the Oquirrh Mountains, Utah. Guidebook to the Geology of Utah, No. 16. Utah Geological Society. Salt Lake City.

Robinette, Leslie W., Dale A. Jones, Glenn Rogers, and Jay S. Gashwiler
1957 Notes on Tooth Development and Wear for Rocky Mountain Mule Deer. The Journal of Wildlife Management, Vol. 21, No. 2, pp. 134-153.

Rudy, Jack
1953 Archeological Survey of Western Utah. University of Utah Anthropological Papers, No. 12. University of Utah Press. Salt Lake City.

1954 Pine Park Shelter, Washington County, Utah. University of Utah Anthropological Papers, No. 18. Salt Lake City.

Schmid, Elisabeth
1972 Atlas of Animal Bones. Elsevier Publishing Company. New York.

Shepard, Anna O.
1957 Ceramics for the Archaeologist. Carnegie Institution of Washington, Publication 609. Reprinted by Braun-Brumfield, Inc., Ann Arbor. 1980.

Sherratt, Andrew
1982 Mobile resources: settlement and exchange in early agricultural Europe. In, C. Renfrew and S. Shennan (eds.), Ranking, Resource and Exchange: aspects of the archaeology of early European society. pp. 13-26. Cambridge University Press. Cambridge.

Simms, Steven R.
n.d. The Inception of Pinyon Use in Three Great Basin Cases. Ms. on file, Department of Anthropology, University of Utah. Salt Lake City.

Smith, Elmer R.
1942 Early Man in the Great Salt Lake Area. Mineralogical Society of Utah, Vol. 3, No. 2, pp. 27-32. Salt Lake City.

1952 The Archaeology of Deadman Cave, Utah: A Revision. University of Utah Anthropological Papers, No. 10. Salt Lake City.

Speer Omark Industries
1980 Speer Reloading Manual Number Ten for Rifle and Pistol: Speer Omark Industries. Lewiston, Idaho

Spencer, R.J., M.J. Baedecker, C.J. Bowser, H.P. Eugster, R. Forester, M.B. Goldhaber, B.F. Jones, K. Kelts, J. Mckenzie, D.B. Madsen, S.L. Rettig, and M. Rubin
n.d. Great Salt Lake, Utah: The Last 30,000 Years. Quaternary Research (in press).

Stansbury, Howard
1852 Exploration and Survey of the Valley of the Great Salt Lake of Utah. Lippencott, Grambo & Co. Philadelphia.

Steward, Julian H.
1933 Early Inhabitants of Western Utah, Part I - Mounds and House Types. University of Utah Bulletin, Vol 23, No. 7. Salt Lake City.

1936 Pueblo Material Culture in Western Utah. University of New Mexico Bulletin, Anthropological Series, Vol. 1, No. 3. University of New Mexico Press, Albuquerque.

1937 Ancient Caves of the Great Salt Lake Region. Smithsonian Institution Bureau of American Ethnology Bulletin, No. 116. Government Printing Office. Washington.

1938 Basin-Plateau aboriginal sociopolitical groups Bureau of American Ethnology Bulletin, 120. Washington, D.C.

1941 Culture Element Distributions: XIII, Nevada Shoshoni. University of California Anthropological Records, Vol. 4, No. 2. Berkeley.

1943 Culture Element Distributions:XXIII, Northern and Gosiute Shoshoni. University of California Anthropological Records, Vol. 8, No. 3. Berkeley.

Thomas, David Hurst
1981 God's Truth in Great Basin Archaeology? American Antiquity, Vol. 46, pp. 644-647. Washington.

Toulouse, Julian H.
1969 A Primer on Mold Seams Part 1. Western Collector, Vol. 7, No. 11. San Francisco.

1973 Bottle Makers and Their Marks: Thomas Nelson, Inc. New York.

Washburn, D.K.
1978 A symmetry classification of Pueblo ceramic designs. In, P. Grebinger (ed.), Discovering Past Behaviour. pp. 101-121. Academic Press. New York.

Whallon, R.
1968 Investigations of late prehistoric social organization in New York State. In, S.R. Binford and L.R. Binford (eds.), New Perspectives in Archaeology. pp. 223-244. Aldine. Chicago.

Wheeler, M.
1875 Explorations and Surveys West of the 100th Meridian. Government Printing Office. Washington.

Whitaker, John O., Jr.
1980 The Audobon Society Field Guide to North American Mammals. Alfred A. Knopf, Inc. New York.

White, J. Peter and Nicholas Modjeska
1978 Where do all the stone tools go? Some examples and problems in their social and spatial distribution in the Papua New Guinea Highlands. In, I. Hodder (ed.), The Spatial Organization of Culture. pp. 25-38. University of Pittsburgh Press. Pittsburg.

Winter, Joseph C.
1973 The Distribution and Development of Fremont Maize Agriculture: Some Preliminary Interpretations. American Antiquity, Vol. 38, No. 4. Washington.

APPENDIX I

CERAMIC THIN SECTIONS
by
David Tomten

Archeological Sources: Black Rock Cave I (42T064) and Deadman Cave (42SL1)

Sample 1: 42To64; FS 10932 (whole sherd used)

Matrix	52%
Rock & Mineral Fragments	48%

The matrix of this slide is composed of very fine-grained interlocking sheet silicates (clays) that have a very dark reddish-brown color and are nearly opaque in thin section. The sample itself is black. The darkness of this sample may be due, in part, to abundant organic matter disseminated throughout the matrix.

This sample is unique from the others in that it contains abundant very large coarse-grained rock fragments. These rock fragments are from felsic intrusives and contain hornblende, feldspars partly to wholly altered to sericite (a very fine grained white mica), and quartz. The rock fragments are generally unrounded, exhibit jagged edges and range up to 4.1 mm across. The average size of these rock fragments is 1 to 1.5 mm in length. Other, much less abundant rock fragments are also included in this sample. These appear to be well-rounded clay clasts. They are very fine-grained, fillile, homogeneous in appearance, and are a medium red brown color. Their average size is .3 mm, and range in size up to 2.0 mm x .9 mm. Chert is nearly absent in the sample with only 1 small grain observed.

Of the 48% of the rock composed of rock and mineral fragments, approximately 60% of them by volume are rock fragments (mineral aggregates). The other 40% are individual, discrete mineral fragments (part of an individual crystal), and most of these are clearly from the same source as the rock fragment. The mineral constituents of all these fragments are as follows:

		average size	range	comments
Microcline	43%	.3 mm	1.5 mm	note polysynthetic twinnins
Amphibole (Hornblende)	21%	.4 mm	-2.3 mm	
Plagioclase	15%	.3 mm	-1.0 mm	mostly altered to sericite
Opaques	2%		-.02 mm	may be low due to darkness of matrix
Quartz	11%			
Other	2%			
Biotite				
Muscovite				
Apatite				
Rutile				
Hematite				
Zircon Chert				
Clay Clasts	6%			

The discrete mineral fragments of this slide are unrounded and the edges of some are quite jagged. Euhedral crystal margins are rare. Two feldspars are present in this smaple, microcline and plagioclase. The plagioclase usually wholly or sometimes partly weathered to sericite. This is as predicted by Bowen's Reaction Series. The "An" content of the plag is indeterminate without more sophisticated analysis, due to the weathering, but based on the associated mineral assemblage or An content between 25 and 40 is likely. The quartz is clear, unstrained and probably also from the same granitic source.

Sample 2: 42To64; FS AS. 82. 4. 3. 10 (whole sample used)

The matrix is composed of very fine-grained medium red-brown clays.

Sample 2 contains rock and mineral fragments which are more abundant than any other sample. This difference may seem small as a percentage, but is easily discernable to the eye. As in Sample 1, there are two types of rock fragments. The most important rock fragments volumetrically are volcanic rock fragments composed of small (0.1 to 0.3 mm), interlocking plagioclase laths with lesser amounts of biotite and occasional hornblende. These rock fragments are rounded, unaltered, have an average length of 0.3 mm and range up to 2 mm in length. The other type of rock fragments are sedimentary rock fragments. These are well-rounded, fine-grained, fissile, clay clasts. They are dark brown in color, are up to 1.2 mm across and have an average length of 0.45 mm. A minor amount of chert is also present.

The individual crystal fragments are quite variable in size, and are larger than the minerals in the rock fragments. Quartz is the most abundat mineral fragment. It is, without exception, strained, showing wavy extinction and a small exial angle. The quartz is well-rounded and some grains exhibit secondary overgrowths. This indicates that the quartz has a mature sedimentary source. The plagioclase that is present is unrounded, zoned, and shows very little alteration. There has been relatively little transport from a volcanic source. The source of these fragments may be the same as the volcanic rock fragments. The plasioclase fragments are not abundant enough to measure the "An" content using statistical methods (Michael-Levi Method). A summary of the mineral fragments follow:

Matrix		42%
Rock Fragments:		36%
Volcanic rock fragments	26%	
Sedimentary rock fragments	8%	
Chert	2%	
Mineral Fragments:		22%
Quartz	12%	
Plagioclase	7%	
Hornblende	1%	
Other	2%	
Biotite		
Opaques		
Zircon		
Muscovite		

		avg. size	range
Sandine	72%	.3 mm	1.5 mm
Plagioclase	6%	.3 mm	1.0 mm
Biotite	7%	.2 x 0.5 mm	

Opaques	6%		-0.15 mm
Hornblende	8%	.2 mm	.4 mm
Other	1%		
Muscovite			
Hematite			

Sample 3: 42To64 FS#AS. 82. 4.3. 11 (half sherd used)

Matrix	52%
Fragments	48%

Matrix of this sample is a medium reddish-brown color. It is not as fine-grained as the other samples. It looks "grungier". Organic matter is nearly absent in this sample.

This sample is different from the others in that the rock fragments are very minor in abundance relative to the mineral fragments. The rock fragments comprise only about 5% of the total number of fragments in this sample. As in the other samples, there are two types of rock fragments. The more abundant type is very fine-grained, light red-brown in color and are probably clasts of clay. These are larger than the other type and range up to 1.0 mm across. The other type of rock fragment is fine-grained, is a lighter color than the matrix and is composed of very small interlocking plagioclase laths and small anhedral angite. Again, there are very minor in abundance relative to the mineral fragments.

The mineral fragments like the plagioclase-bearing rock fragments are unaltered and unrounded. The mineral fragments are broken and jagged and some even show euhedral crystal margins indicating limited transport from the source area. The dominate feldspar in this sample is plagioclase, with an "An" content of 50%, which was determined using the Michael-Levi Method. They exhibit normal zoning. A minor amount of quartz was also found. It is well-rounded and in one instance, was found included in a clay clast. It is, therefore probably from the same source as the clay. A summary of the mineral fragments follows:

		average size	range	comments
Plagioclase An50	59%	.3 mm	2.0 mm	max. extraction ___ = 28^{o}; zoned
Quartz	4%	.3 mm	-.5 mm	
Clinopyroxene/Augite	6%	.3 mm	-.85mm	C ___ Z = 53^{o}, very lt. pale green color
Amphibole/Hornblende	23%	.2 mm	-.6 mm	brown pleochroic
Opaques - probably Magnetite	6%	.2 mm	-.5 mm	note large size
Others	2%			
Biotite				
Muscovite				

Sample 4: 42SL1 FS#18636-4 (half sherd used)

Clay Matrix	58%
Rock Fragments	7%
Mineral Fragments	35%

The matrix of this sample has a medium gray-brown color. The most striking characteristic of this sample and one that distinguishes it from the rest of the samples, is the abundant opaque material throughout the matrix and rock fragments that give this thin section a mottled appearance in plane polarized light (ppl). Much of the opaque material is organic matter. The rock fragments and mineral fragments are both well rounded and fairly well altered. The only "fresh" mineral is the quartz and it is partly altered. Biotite and hornblende present as mineral fragments are highly altered. The result of this alternation is in part opaques (magnetite).

The rock fragments in this sample are composed of brown, well-rounded clay clasts that are darker than the matrix. Other more fissile clay clasts are also present. These are lighter in color. This slide is generally more fine grained than the others, with the clay clasts being an average of .1 mm across and ranging up to .4 mm across. A small number of volcanic rock fragments are also present. These are basaltic in composition and are fine-grained. A small number of volcanic rock fragments are also present. These are basaltic in composition and are fine-grained. A small amount of chert is also present.

The mineral fragments are also generally smaller than in the other samples, but are still very abundant in the groundmass. The mineral fragments are almost all clear, unaltered quartz. A minor amount of slightly altered, cloudy plagioclase is also present. Mafio phase in this sample account for less than 1% of the total number of phases.

Quartz is the dominant mineral fragment in this sample. It is strained and invariably gives a slightly biaxial interference figure. Some quartz particles are well-rounded and show secondary overgrowths. This suggests that the source of the quartz was a very mature sedimentary rock, probably a sandstone. Other fragments have been broken.

Sample 5: 42SL1 FS#18646-5 (half sherd used)

Matrix is very fine-grained and has a medium brown color.

This sample contains the lowest percent matrix of any of the samples and is quite unique from the other samples. Three distinct types of rock fragments are present in this sample. In order of relative abundance these types are:

1 - Volcanic Rock Fragments: the most abundant type of rock fragment are composed of masses of aligned, minute plagioclase laths. This alignment is quite distinctive. Some of these fragments include augite, hypersthene and rarely, olivine. These fragments are unaltered, and slightly rounded. Although most of these fragments are fine-grained, two medium-grained fragments were also present. These fragments are basaltic in composition.

2 - Sedimentary Rock Fragments: these are fine-grained, well-rounded clay and mud clasts. These are generally a light, reddish-brown color under ppl but some are dark red-brown.

3 - Chert: this sample contains much more chert than any other sample.

Individual mineral fragments in this sample are at most, slightly rounded. An occasional crystal face is even present amoung the jagged edges. These mineral fragments are generally unweathered to slightly weathered and are of moderate size (average = .0.2 mm). The composition of the sample is as follows:

Clay Matrix		41%
Rock Fragments:		41%
Volcanic Rock Fragments	19%	
Sedimentary Rock Fragments	14%	
Chert	8%	
Mineral Fragments:		18%
Feldspar	8%	
Quartz	4%	
Augite	4%	
Hypersthene	1%	
Other:	1%	
Biotite		
Hornblende		
Plagioclase		
Olivine		

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983—681-268/484 REGION NO. 8