**THE PARADOXICAL COLLECTION IN THE CABINETS:
ESTABLISHING A SITE CHRONOLOGY OF SDSU-0897, 5MN191,
FROM PARADOX VALLEY, COLORADO**

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James J. Turner

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The Undersigned Faculty Committee Approves the

Thesis of James J. Turner:

The Paradoxical Collection in the Cabinets: Establishing a Site Chronology of

SDSU-0897, 5MN191, from Paradox Valley, Colorado

Seth Mallios, Chair
Department of Anthropology

Arion Mayes
Department of Anthropology

Sarah Elkind
Department of History

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Approval Date

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James J. Turner

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DEDICATION

To the orphaned collections of the world.

But Mouse, you are not alone,
In proving foresight may be vain:
The best laid schemes of mice and men
Go often askew,
And leave us nothing but grief and pain,
For promised joy!
--Robert Burns

ABSTRACT OF THE THESIS

The Paradoxical Collection in the Cabinets:
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Paradox Valley, Colorado

by
James J. Turner
Master of Arts in Anthropology
San Diego State University, 2018

Site 5MN191, also referred to as the Paradox 1 site, was excavated in a 1970's field school located in Montrose County, Colorado and run by San Diego State University, then California State University, San Diego. The head of the field school, Dr. Larry Leach, theorized that the site was associated with the Fremont cultural group, and a large portion of the artifacts were taken back to SDSU for further study. After a thesis was completed in 1972, the artifacts were stored in the Collections Management Program, where they resided until a flood in the late 1970s damaged a large portion of the Collections Management facility. The flood destroyed most, if not all, of the field notes and associated documents for the Paradox 1 site, washing away much of the provenience information. This study aimed to do two things: First, it sought to rehabilitate and describe the collection. Second, it attempted to create a cultural chronology of the site using a lithic analysis and a ceramic typology.

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CHAPTER 1

INTRODUCTION

Orphaned collections and assemblages pose several challenges in the archaeological community. As more and more archaeological sites are excavated, many archaeologists and cultural resource management (CRM) firms face difficulty finding ways to store the artifacts; often this leads to the artifacts being lost or forgotten. Here, an orphaned collection is defined as a set of artifacts that has been abandoned for various reasons by its principle investigator, or as a group of artifacts that has lost curatorial support (Voss & Kane, 2012). Voss and Kane point out that this abandonment, in conjunction with combination with the overly common time gap in recovery and analysis, creates a high likelihood that the artifacts will be separated from their field records and provenience information. This separation produces a series of unique problems: unprovenienced artifacts risk becoming separated from their assemblages and may end up as part of other, completely unrelated, assemblages. Aside from this, the unprovenienced artifacts also risk becoming devalued in terms of research and repatriation potential.

The artifacts from site 5MN191 are an example of an orphaned collection. Located in Paradox Valley, near the Utah/Colorado border, 5MN191 rests on what was referred locally as “Wray Hill,” a 100-foot tall, 2-acre hill (Kasper, 1972). In the summer of 1970, Dr. Larry Leach, Professor of Anthropology at California State University San Diego - now San Diego State University (SDSU) - lead a joint field school in the area with Colorado College. Then, in 1972, San Diego State University graduate student Janice Kasper wrote a thesis in which she analyzed the butchery patterns present in the faunal remains. Both Kasper and Leach postulated, based on independent analyses, that the cultural group most likely to have inhabited the site was the Fremont cultural group.

There is virtually no provenience information accompanying the artifacts. The field documents, which were in the possession of SDSU, were lost in a flood in the 1970s.

Information about the 1970s excavation can be found in five documents: 1) Janice Kasper's 1972 thesis; 2) Dr. Leach and Lippold's 1973 grant proposal; 3) the site's cultural resource form; 4/5) and two local newspaper clippings. This research seeks to do two things: First, the main goal was to rehabilitate and curate the collection; the second goal was to determine a chronology of the Paradox 1 site in Montrose County, Colorado, by utilizing the projectile points and ceramics.

This thesis utilized several lines of evidence to deduce the possible inhabitants of site 5MN191, as well as answer the following research questions:

1. Based on the surviving artifacts and documentation, is it possible that the Fremont inhabited this site? Does the evidence indicate if:
 - a. The ceramics Fremont in origin?
 - b. The lithics are Fremont in origin?
 - c. Is there any indication that the bone tools, including the awls, are Fremont in origin?
2. Is it possible to recreate the stratigraphy of the site by using projectile point and ceramic seriations?

CHAPTER 2

LITERATURE REVIEW

The information needed to contextualize this site is vast. As a result, the literature review is presented in four sections: 1) the environment and ecology of Colorado; 2) a cultural history of the area; 3) a discussion of the three artifact types addressed in this thesis; and 4) a brief history of the site.

THE ENVIRONMENT OF COLORADO

Colorado is unique in that there are five of what Mutel and Emerick (1984) call physiographic provinces, or geographic areas of specific geomorphological structural elements. These provinces each have unique characteristics that impact not only the makeup of the land itself, but also the climate and weather patterns of the region. Three provinces make up most of the state - the southern Rocky Mountains, the Great Plains, and the Colorado Plateau. The southern Rocky Mountains bisect the state in a north-south manner, forming the Continental divide. More than fifty mountain peaks over 4,000 meters high dominate the region, which also contains some of the oldest rock in the continent (Mutel & Emerick, 1984).

East of the Rockies lie the Great Plains, which cover approximately 40% of the state (Mutel & Emerick, 1984). The border of the Rockies and the Great Plains consists of an abrupt change in topography: as one goes westward, an increased number of mesas and hills appear. Behind these, a discontinuous series of ridges, formed by steeply tilted sedimentary rock formations created during mountain uplift, rise out of the hills to form the hogbacks. The Great Plains slope gently downward to the east to form the Palmer Divide, a wide and cool highland.

West of the Rockies stands the Colorado Plateau. A series of high plateaus surround the lower center of the province, forming a dish-shaped area of land that sits at an elevation

ranging from 1520 meters to more than 3650 meters (Cordell, 1984). These plateau surfaces have an extension of the environments seen in the lower mountains, which is a sharp contrast to the desert-like conditions at the bases of the plateaus. Deep canyons are formed by the Colorado River and its tributaries (Mutel & Emerick, 1984).

The climate is extremely varied, though there are a few generalizations that can be made: Colorado is sunny with warm summers and cool winters. These variations in climate can occur within short distances; for example, the annual mean temperatures of Pikes Peak and Las Animas, which are about 90 miles apart, is similar to the differences between southern Florida and Iceland (Doesken, Pielke, & Bliss, 2003). Due to the physiographic provinces, the weather in Colorado is marked by extreme variations that can occur right down to an hourly basis. These regions are also caused by the fact that there is no large body of water nearby, as well as the elevation and the position of the mountains and valleys.

As the elevation increases, several things occur: the temperature decreases by about 3 degrees Fahrenheit every 300 or so meters, the air becomes thinner, annual precipitation increases, the solar radiation becomes more intense, and average wind velocity increases (Mutel & Emerick, 1984). As air masses are forced to rise over the Rockies, the temperature decrease causes the water vapor to condense, causing rain or snow. This orographic precipitation, or precipitation that is produced when moist air is lifted to great elevations above mountains, usually comes from eastward moving Pacific air masses. These air masses lose most of their moisture when they pass over mountains in Washington, Oregon, California, Nevada and Utah, though more is lost as they pass over the Rockies. By the time these air masses reach the Front Range, there is virtually no moisture left (Mutel & Emerick, 1984). This explains why the western portion of the state receives more annual precipitation than the east.

This western precipitation typically occurs mostly in the winter months. Lower elevations receive little moisture, with June being the driest month (Doesken et al., 2003). Alpine tundra environments receive most of the moisture as snow, though most of the precipitation for plants in the area is provided by summer convective storms. The driest period in this region is the fall. This contrasts with the eastern plains, where most of the moisture occurs during the spring and summer months during thunderstorms. When warm, moist air masses from the Gulf of Mexico enter the region and impact arctic air masses

passing over the Rockies, heavy snowfall can occur on the eastern plains and foothills, much to the joy of schoolchildren wishing for a snow day (Mutel & Emerick, 1984).

The vegetation of the Colorado Plateau is rather diverse. Higher elevations are graced with several species of spruce and fir trees, with these species transition into mixed-conifer forests. Lower elevations are occupied by desert scrub - a mixed community of low-altitude shrubs and perennial grasses. There is an interesting adage spoken by ecologists in the area regarding the distinction between trees and shrubs: if you must walk around it, it is a shrub; if you must walk under it, it is a tree (Mutel & Emerick, 1984).

The winter precipitation determines the total productivity among perennials (Schwinning, Belnap, Bowling, & Ehleringer, 2008). This precipitation accumulates in the soil due to the low temperatures and low transpiration rates that occur during the colder portion of the year. In the warmer months, when plant growth is triggered by the increasing temperatures, plants tap into this water reserve, usually depleting the moisture near the soil surface by late June (Schwinning et al., 2008). The shallow-rooted plants typically go dormant once this moisture is used up; and any summer precipitation is typically used by grasses and late-summer annuals which maintain an active shallow-root system.

The Colorado Plateau landscape evolved under very little grazing pressure. Native ungulate populations were kept at low numbers due to the limited surface water and forage, save for higher elevations or during wet winters (Schwinning et al., 2008). Once the introduction of sheep and cattle occurred roughly 150-200 years ago, species of palatable grasses, such as winterfat and ricegrass, declined. Species of grasses indicative of overgrazing, such as snakeweed and cheatgrass, became more prominent in the areas once the edible grasses were consumed (Schwinning et al., 2008).

The fauna of the Colorado Plateau is a mix of both year-round and seasonal residents. Several varieties of shrews, including the masked and dusky variety, occupy the western portion of the state. Colorado is also home to several species of squirrel, rat, and mouse, as well as other small mammals, such as gophers and rabbits. Larger species of herbivorous mammals, such as mule deer and elk are typically found in the lower elevations of the Colorado Plateau region, while whitetail deer and pronghorn antelope are found throughout the state. Carnivores such as black bears, an assortment of weasels, coyotes, and wolves are

also endemic to the area, though in recent years, populations of these carnivores have decreased due to hunting and ranching (Mutel & Emerick, 1984).

Site 5MN191 is positioned in the Colorado Plateau. The site is located in Paradox Valley, which in turn is located in the Paradox Basin (King, Block, Yeck, Wood, & Derouin, 2014). The Paradox Basin is a 200-mile-long and 80 miles wide northwest-southeast basin extending from Eastern Utah into Western Colorado. Paradox Valley sits at an elevation of around 1520 meters, and is roughly 38 kilometers long and approximately 5 to 8 kilometers wide. The valley occupies a large portion of T.46N R.17W, T.47N R17 and 19W, and T.48N R.19W, and is about 89 kilometers southwest of the city of Grand Junction and about 16 kilometers east of the Utah-Colorado border (Chenoweth, 1987; King et al., 2014). The valley, as well as the basin, was named by Henry Gannett in 1875 for the peculiar flow of the Dolores River - the river crosses the valley midway across the long axis in a south to north direction, cutting deep canyons through the sandstone and shale that form the valley walls, (Chafin, 2003; Chenoweth, 1987). The first map that described the valley was published by A. C. Peale in 1878 (Chenoweth, 1987; Figure 1).

Paradox Valley was created as a result of the structural collapse of a crest of a salt-cored diapiric anticline (Kharaka, Ambats, Thorsden, & Davis, 1997). Anticlines are ridge-shaped folds of stratified rock where strata slope downward from the crest. In the case of the Paradox Valley anticline, the Dolores River eroded a channel across the salty anticlinal crest. This exposed salt quickly went into solution and was rapidly removed. It is estimated that the salt core of the anticline was roughly a kilometer higher than it is now due to these erosion processes (Chenoweth, 1987).

Due to this exposed salt anticline, before the initiation of deep injection wells, the Dolores river picked up approximately 185,000 metric tons of salt annually as it flowed across the valley (Kharaka et al., 1997; King et al., 2014). A series of diffuse brine springs discharge about 260,000 milligrams per liter of dissolved salts into the river. For comparison, seawater has about 35,000 milligrams per liter of dissolved salts (King et al., 2014).

Figure 1. Map of Southwest Colorado with parts of Utah, New Mexico, and Arizona. Source: (Peale, 1878).

CULTURAL HISTORY

Since the primarily goal of this research is to create a chronology of the Paradox 1 site, it would be beneficial to describe briefly the proposed cultural sequence of the area. Leach and Lippold (1973), as well as Kasper (1972), stated that the presumed cultural sequence of the area is Basketmaker III to Pueblo I-II to Fremont. This presumption is based mainly on Leach's analysis of the remaining architecture of the site, though there are several artifact types in the collection that have the ability to provide diagnostic evidence to support the cultural sequence put forth by Leach, Lippold, and Kasper. Therefore, a brief cultural sequence based on Leach and Lippold's presumed chronology follows, beginning with a look at the Pre-Basketmaker period, followed by the Basketmaker periods, then the Pueblo, and finally the Fremont.

Pre-Basketmaker Period (6500 – 1500 BCE)

According to Lipe (1993), the Pre-Basketmaker stage consists of two periods- the Paleo-Indian and the archaic. The Paleo-Indian period referred to the early Holocene cultures, which are characterized by large spear points, such as those in the Clovis or Folsom cluster, small bands, and big-game hunting. The archaic period referred to hunter-gathering cultures that depended on a considerable variety of flora and fauna, which were usually exploited during the seasonal migrations (Cordell, 1984; Lipe, 1993). These cultures employed varied technology; usually stone tools, such as manos and metates, and stemmed projectile points or dart points cast by the atlatl, and occupied smaller territories than earlier Paleo-Indians. The materials used to make these tools were typically made of local materials (Cordell, 1984). These groups subsisted on wild foods, were highly mobile with a low population density, and occupied rock shelters and open sites. There was no sign of pottery during this period (Lipe, 1993).

Basketmaker (1500 BCE – 750 CE)

The Basketmaker stage is divided into three periods, each exemplified by a set of distinct traits. The origin of the term "basketmaker" lies with discoveries of burials whose accompanying mortuary offerings were baskets. The remains in these burials usually had a large basket inverted over the head - which initially led to the label of "basket-people"

(Amsden, 1949, p. 41). The term “basket maker” may have been used as early as 1894 by B. T. B. Hyde, who financed several excavations by the American Museum of Natural History. Charles Amsden (1949), however, makes a very good point when he states that it is “essentially a meaningless term, for most of the world’s peoples are makers of baskets” (p. 44). Hughes (1977) argues against this, however, stating that they were called Basketmakers “because of the great variety of well-made, beautifully decorated baskets found among their remains.” The Basketmakers, according to Hughes, were not very different from the archaic and Paleo-Indian peoples that inhabited the area before them. All three of the basketmaker stages utilized metates and manos to grind plant seeds, and atlatls and darts assisted in the hunting of wild game (Amsden, 1949; Cordell, 1984). Maize and horticulture was theorized to have come to the Colorado Plateau around the time the first Basketmaker period started - around 1500 BCE - and beans were added to this mix around 500 CE (Amsden, 1949; Chisholm & Matson, 1994). Settlements were located in areas where these crops could be cultivated with relative ease, and the reliance on cultigens slowly transitioned the Basketmakers from relying primarily on hunting and gathering to relying more on agriculture.

In the Basketmaker I period, ranging from 1500 BCE to 50 CE, there was a long-term seasonal use of caves for camping, storage, and burial activities. The typical basketmaker cave, according to Amsden (1949), consisted of a shallow and well-lit recess at or near a base of sandstone cliffs. No pottery was found at these sites, though evidence of atlatl and dart use was common. The early basketmaker people relied on corn and squash, usually cultivated in floodplain or runoffs.

The Basketmaker II Period, from 50 - 500 CE, saw the use of shallow pithouses and storage pits/cists (Amsden, 1949; Cordell, 1984). Settlements were dispersed throughout small, low density villages, and upland dry-farming occurred in addition to floodplain farming. There was evidence of maize horticulture present at multiple Basketmaker II sites throughout the Colorado Plateau (Lipe, 1993; Matson, 2006). Once again, no pottery was found associated with this period.

The farming techniques of the Basketmaker II period were based off of floodwater and runoff technology, utilizing alluvial soils in canyons and valleys. While maize was initially not adapted to short growing seasons, the dry climate, and long summer days of the

area, led to a guided adaptation or evolution occurred with time. This led to the adoption of farming to drier mesa-tops and uplands. This shift in upland dry-farming was accompanied by an overall increase in regional population and the development or adoption of the pithouse as the principal residence for nuclear or small extended families (Chisholm & Matson, 1994; Matson, 2006).

Like the early Basketmakers, the Basketmaker II peoples relied on maize agriculture for a portion of their diet (Amsden, 1949; Chisholm & Matson, 1994). Approximately 60 to 80 percent of the diet of some basketmaker individuals consisted C4 plants, such as maize or grain, compared to 20 to 40 percent of the diet of Archaic individuals or 80 to 87 percent of the diet of the later Pueblo II/III individuals (Chisholm & Matson, 1994). Maize was the likely the most important source of calories, though squash was present throughout the period and was important not only for a source of calories, but also as a container (Amsden, 1949; Chisholm & Matson, 1994). Grass seeds and pinyon nuts were more important in the Basketmaker II period than the later periods, though there was an infusion of beans into the diet as the period progressed into the Basketmaker III period. Because of this lack of protein, the Basketmaker II people may have done more hunting for wild game than their later descendants (Amsden, 1949; Chisholm & Matson, 1994).

The third Basketmaker period was a continuation of the previous stages, though the introduction of plain gray pottery distinguishes this stage from the previous two (Amsden, 1949; Cordell, 1984). This pottery consisted of undecorated jars and bowls made from alluvial clays that, when fired, are categorized as graywares. These remained undecorated until after approximately 570 CE, when small frequencies of black on white pottery began to appear (Stone, 1999). Additionally, there was clear evidence that agriculture became more common during this time - beans were added into the agricultural complex, and corn dominates ethnobotanical assemblages. The bow and arrow replace the atlatl and dart in Basketmaker III (Lipe, 1993).

The pithouses associated with this stage typically tend to be deeper than those from the second stage, and often contain antechambers, or small rooms that lead to larger ones. Surface structures were larger and more common than in the previous stages. The community pattern shifts to include small hamlets and villages of closely-spaced houses in some areas while in other areas there were loose clusters of very widely dispersed houses.

The great kivas, which are large circular structures, make an appearance as possible locations for rituals, and represent an important architectural and social shift (Stone, 1999). Typical Basketmaker III sites consisted of 1-12 semi-subterranean pithouses with large antechambers and cists (Cordell, 1984).

Pueblo I-II (750 – 1150 CE)

The Pueblo I period (750 – 900 CE) in Colorado was characterized by above-ground structures in year-round villages accompanied by a rise in population (Cordell, 1984; Stone, 1999). The above ground structures were typically one to two rooms deep and one or two rooms wide, with the backmost room (typically the north most room) used primarily for storage (Stone, 1999). These surface dwellings were made in an adobe style, with sandstone slabs for bases.

This change in architecture, according to Stone, was most likely a response to changes in mobility, which in turn was a response to the adoption of agriculture (Stone, 1999). As this reliance increased, so did the storage requirements and the processing time. Because of this, interior work areas were needed - square surface structures are typically easier to subdivide into rooms. Plain and neck banded gray pottery were common, with low frequencies of black on white and decorated red ware occurring throughout Pueblo I sites (Lipe, 1993).

Sites in the second Pueblo period (900 – 1,150 CE) were smaller and more dispersed than those in the first period, though the occupants in nearby sites remained in contact through economic, kin, and ritual ties (Cordell, 1984; Stone, 1999). Most of these sites consisted of masonry and jacal structures that were laid out in continuous room blocks with an accompanying semi-subterranean kiva (Stone, 1999). The ceramics consisted of corrugated graywares and elaborate black on white pottery, as well as decorated red or orange types (Lipe, 1993).

It was during this stage that the world shifted into what is now referred to as the "Medieval Warm Period" (MWP), also sometimes referred to as the Little Climatic Optimum. The MWP lasted from approximately 900 – 1200 CE; temperatures were above average in some areas, such as the North Atlantic and below average in others, like the tropical Pacific (Lamb, 1977). The Colorado Plateau was not affected by prolonged

environmental deviations. However, there was what Dean (1994) called "considerable variability" in low and high frequency environmental factors, such as temperature and rainfall, and in the behavior of groups during the time period. The ancestral Puebloans saw growth in several areas during the first portion of the MWP: population, geographic range, organizational complexity, and intergroup interaction (Dean, 1994). The latter portion of the warm period, after about 1150 CE, saw a drastic shift in the Puebloan culture; the range began to shrink as populations abandoned fringe areas in favor of localities favoring agriculture (Dean, 1994).

Fremont Stage (300 – 1300 CE)

The scattered groups of foragers and farmers during the later periods have been classified as the Fremont, a group for which "basic definitions and chronologies have never been firmly established" (Richards, 2014, p. 1). The origins of the Fremont have been the source of much debate (Gunnerson, 1957; D. B. Madsen & Simms, 1998; Simms, 1986; Wormington, 1955). There are two main camps - those that believe that the Fremont developed out of groups of hunter-gatherers through the diffusion of ancestral Puebloan cultural traits, and those that believe that the Fremont represent movements of people related to groups living in the plains into the area (Berry, 1980; Cordell, 1984; Gunnerson, 1957). The culture was first named by Noel Morss, who excavated several sites along the Fremont River in Utah, which in turn was named for American explorer John C. Frémont (Richards, 2014).

Most Fremont archaeologists (at least those in the past two decades) acknowledge a three period chronology of the Fremont (Richards, 2014; Talbot, 2000; Wilde & Soper, 1999). The early period (roughly 1 – 500 CE), which is marked by the first evidence of corn in the Utah area and temporary dwellings (Richards, 2014; Talbot, 2000). The middle period (500 – 900 CE), where ceramics became more common, and the presence of Utah style metates, Fremont style moccasins, and one-rod-and-bundle-baskets became more prevalent. Finally, the late period (900 – 1350 CE) hosted a series of changes (Richards, 2014). Many characteristics that are associated with the Fremont culture are established during this time (Richards, 2014). Corrugated ceramics were present for a short time around 1050 CE, shell beads and turquoise artifacts became more abundant, and more projectile points were present

at sites (Holmer & Weder, 1980; Richards, 2014; Richens, 2000). It is important to discuss the “dramatic transition to the late period” in the context of the Southwest (Richards, 2014, p. 14). Leckson (2014) suggests that this transition is a reaction or consequence of the expansion of the Chacoan system, which had a political explosion in roughly 1000 CE. This system included the construction of large towns that showed evidence of planning, as well as water-control features, such as irrigation canals, and roads (Cordell, 1984).

The Fremont occupied the northern Colorado Plateau and eastern Great Basin (D. B. Madsen & Simms, 1998; Figure 2). In terms of modern political geography, the boundaries of the Fremont group or complex lie as far north as Pocatello, Idaho and south to the Utah-Arizona border. They lived as far west as what is Ely, Nevada, and as far east as Grand Junction, Colorado (Simms, 2008). Several authors have developed various classification schemes that each depict the Fremont as occupying different regions - curiously, each of these classification schemes, save the earliest, place the Fremont as living far from the Paradox 1 site (Gunnerson, 1957; Wormington, 1955).

The Fremont (mainly during the later period, but also during the middle period) lived in small villages that were typically situated on or near slight ridges or knolls. These villages were also usually located near streams or other water sources - this enabled the use of nearby low lying land for agricultural purposes (Gunnerson, 1957). These low-lying lands near water sources likely allowed for the growth of agricultural products, such as squash and corn, though in dry areas that show signs of Fremont occupation, the crops were most likely irrigated by canals. Metcalfe and Larrabee (1985) described evidence of such an irrigation canal in Gooseberry Valley in central Utah. According to the authors, the canal shows evidence of artificial construction - that is, the canal could not have been a product of natural fluvial processes (Metcalfe & Larrabee, 1985). There seems to be no consistent village plan - structures are placed at random, though the location is usually influenced by the conformation of land.

Figure 2. Fremont cultural area with selected sites. Source: (Richards, 2014).

The architecture in the Fremont areas tended to be variable (Cordell, 1984; Gunnerson, 1957). Structures were semi-subterranean, built on the surface of the ground, or in rock shelters. The semi-subterranean pit houses were usually upwards of a meter in depth and 3-10 meters in width. A round, adobe-rimmed fireplace, often paved with stone slabs, was usually located near the center of the pithouse, and postholes were typically found about halfway between the fireplace and the outer edge of the house, though not necessarily in a regular pattern. Plaster was not always applied to the subterranean walls, but it may have been used only when the dirt was not solid enough to stand without it. The walls above the ground level were made of crude stone and adobe masonry or of poles and adobe (Gunnerson, 1957).

Fremont surface structures typically were more rectangular than circular, and ranged anywhere between 2 to 8 meters across. Fireplaces, similar to those found in pithouses, were common, though they may not have been in every room. Postholes are either scattered at random, just inside the four corners of the structure, or were completely absent. The walls were often coursed masonry, possibly jacal or a similar construction. The outline of stones suggest that the footing of the walls was of stone and the upper portion was a less substantial material, like adobe. Entrances were usually, but not always, at ground level - some structures have been theorized to have been entered through the roof. Gunnerson describes “spectacular surface structures” made from well preserved masonry situated on tops of isolated points or on the rims of deep canyons. These tower- or fort-like structures usually had a single, circular room, but they can have more than one, though this is less common. These structures usually had an absence of cultural material in and around them, which makes it difficult to identify their cultural complex or use (Gunnerson, 1957).

Other structures usually assigned to the Fremont, though usually without much evidence, include storage cists. These beehive-shaped cists were circular in structure, where the height and diameters were nearly the same, and were usually about one to two meters in size. They most commonly were made by walling off natural niches or corners of rock shelters - unshaped rocks or slabs are laid in adobe mortar and often plastered. These rocks or slabs may have been roughly coursed, set vertically, or added in at random (Gunnerson, 1957).

Gunnerson (1957) noted that, in terms of bone, shell, and antler artifacts, awls, game pieces, and ornaments are common. Awls typically were the most common of the bone artifacts, ranging in length from 4 to 24 centimeters in length. Three main styles of construction were used at the Fremont sites: awls made from long bones with all or part of the articulation left to serve as a handle and the shaft split and the rough edges smoothed down, bone splinters with one end pointed and rough edges smoothed, and carefully smoothed and well-polished cylinders of bone. The game pieces were made from long bones and still showed the curvature of the bone; most pieces still had a little of the cancellous portion of the bone present. Additionally, some surfaces had deliberately made scratches with red paint. The ends of the game pieces were usually squared, though they could also be rounded. Finally, other bone and shell artifacts, such as ornaments, were common. These included small, tubular bone beads, perforated elk teeth, smooth bone pendants with perforations at one end, and beads made from shell and shell fragments, possibly belonging to the *Olivella* genus. Antler gouges were also an item found in Fremont sites (Adovasio, 1980; Gunnerson, 1957).

Ground stone artifacts typically found in Fremont sites included metates, manos, beads, and small spheres or balls (Adovasio, 1980; Gunnerson, 1957). The Utah-style metate, first reported in Western Utah, was made from a carefully shaped boulder and included a large trough at one end, and a smaller basin, depression or shelf at the other. Other varieties of metates found at these sites included deep basin metates, trough metates, and flat milling stones with slight depressions. Metates from the southern area of Fremont occupation were usually made with basalt, while those from the northern regions were made of Uintah quartzite. Metates made from sandstone slabs were found everywhere else (Gunnerson, 1957). Like the metates, Fremont manos also came in multiple forms, though unlike the metates, they were not restricted to any area. Rocker-shaped manos were common throughout the Uintah Mountains in Utah - these manos were distinguished by their shape: the grinding surface had two curved facets meeting at the keel, while the upper surface was concave. The width of these manos were equal to the thickness, and was about one third of the length. There was a diverse array of mano styles found at Fremont sites: loaf-shaped with a single convex or flat grinding surface, rectangular with one to two flat grinding surfaces, round or elliptical (country) biscuit shaped with flat to slightly convex grinding surfaces, and

manos that looked like cobblestones. The mano materials are equally diverse, with basalt, sandstone and quartzite being the most common materials.

Beads and pendants made from turquoise and other stones also occurred in Fremont assemblages. The ground stone pendants were usually one centimeter in length, one centimeter in width, and 0.3 centimeters in thickness. They were carefully smoothed and perforated near one edge. As mentioned previously, Richards (2014) notes that shell beads and turquoise artifacts were more abundant during the later period, mainly between 900-1000 CE. Small, spherical, well-polished stone balls were also found in Fremont assemblages. Four to eight centimeters in diameter, the exact function of these balls is currently unknown, though they were often found near patterns of small cups or holes pecked into nearly horizontal bedrock (Gunnerson, 1957). Another unexplained ground stone artifact found at these sites are small hematite, alabaster or sandstone disks that may be unperforated or contain a single hole in the center. The use of these disks, like the balls, are unknown (Gunnerson, 1957).

Ceramics increased in commonality during the later Fremont period (Richards, 2014). Corrugated ceramics were present, as mentioned above, during a short time beginning around 1,050 CE (Richens, 2000). Painted ceramics also occurred during this time, though there is some discrepancy about whether the first appeared around 700 or 900 CE and lasted until 1,200 or 1,300 CE (R. E. Madsen, 1977; Richens, 2000). Richards (2014) noted that, in general, Fremont ceramic vessels were constructed by coil and scrape methods and were fired in a reducing atmosphere. The majority of these vessels, existing in one of three forms (jars, bowls or pitchers), were polished on the surface and some exhibited surface manipulation, including incising and applique (Richards, 2014). When painted, Fremont ceramics are almost exclusively painted on the interior, though there have been ceramic specimens found that were painted on the exterior as well as the interior (Richards, 2014).

The final category of artifacts commonly recovered from Fremont sites was chipped stone. Artifacts ranging from projectile points, to blades, drills, and scrapers were often recovered. Chipped stone disks, similar to those of ground stone, also make an appearance, though are far less common.

Most of the projectile points attributed to the Fremont were less than three centimeters long, and were predominantly triangular with notching at the corners

(Gunnerson, 1957). The stem of the projectile points tended to be narrow, growing slightly wider at the distal end. The stems may also have had parallel sides. Few corner notched points may have had broad stems - these points tended to be less delicate than those with thinner stems. The corner notched bases were also slightly convex. The triangular side notched points, often delicate, typically had small side notches that were in the basal quarter of the point. The bases of these points were usually concave, and rarely contained basal notches. Unnotched points found at Fremont sites were usually straight with slightly convex bases, and were stated to be of inferior quality (Gunnerson, 1957). These points may have actually been meant for knives.

The chipped stone blades found at Fremont sites were similar to those at other sites: the sides of the blades were nearly parallel, save for the top third that comprised the point. The bases tended to be square or slightly convex. Few blades were triangular with slightly convex sides - of these, the average size ranged from seven to eleven centimeters in length and two to three and a half centimeters in width. Very rarely were complete triangular blades found. Side- and corner-notched blades also existed; ranging from six to eight centimeters in length, the blades were slightly triangular to slightly leaf-shaped with side notches very close to the base. These notches allowed for the blade to be mounted in short wooden or bone handles and used as knives. Finally, thick, percussion-flaked blades, ranging in size from four to eight centimeters long, two to five centimeters wide, and one to two and a half centimeters in thickness were occasionally recovered. These blades, chipped from both faces, seldom showed any signs of dulling (Gunnerson, 1957).

Drills and scrapers were not as common as the projectile points and blades. Drills were often cylindrical and had expanding bases, while scrapers were very crude uniface blades. Chipped stone disks “apparently are characteristics of Fremont sites,” according to Gunnerson (1957). These disks were three to six centimeters in diameter, and were usually less than one to two centimeters thick. The edges showed a deliberate dulling, and the exact use of these items is unknown, like their ground stone brethren.

Simms (1986) identified three adaptive strategies that the Fremont employed: local foraging, mobile during portions of the year, and horticulturists living in the same region as full-time hunter-gatherers. Local foraging allowed for the Fremont to supplement their own horticultural production. They would have remained sedentary at horticultural sites - evident

by pit and surface structures that show signs of substantial investment. Additionally, many smaller short-term camps would be associated with this horticultural home base. Simms stated that one can expect to find morphologically identical ceramics at both these short-term sites and the horticultural base. Examples of sites that show evidence for this adaptive strategy are scattered along the southern portion of the Eastern Great Basin.

During times of the year where there was a horticultural shortfall, or during successive years of poor horticultural production, small groups or portions of groups may have moved to new areas that were more suitable for horticulture and built new structures. Groups may have also fissioned for periods of time that could stretch from weeks to years. These groups likely became hunter-gatherers with mobile settlement patterns. Springing from these new hunter-gatherers were many small, short-term and special use sites used to collect resources for transport to a small horticultural base site. The western deserts show signs of this adaptive strategy.

In the third of Simms' proposed adaptive strategies, the Fremont become horticulturalists, similar to those in the previous two strategies, that live in the same region as full-time hunter-gatherers. Both groups occupied separate or partially overlapping niches to reduce the levels of conflict. This strategy produced the greatest regional diversity in terms of material culture, and a more practical approach to ceramic creation than at the hunter-gatherer sites (Simms, 1986). There are no clear-cut examples of this strategy, however Simms stated that the western deserts of Utah are likely places for this to occur (Simms, 1986).

ARTIFACTS

Projectile Points

Tools such as the atlatl and spear or bow and arrow were used by hunters, forming an intricate bond between the tool and the tool user. These projectile tools had one purpose: to pierce the hide of the prey animal (or human) and enter the body cavity deep enough to cause a hemorrhage that led to death (Browne, 1940). To accomplish this bloody task, the prehistoric craftsmen and women used what hard materials they had at their disposal: bone, antler, and stone all made comparably deadly weapons. Since this research will deal

primarily with points made from stone, most of the information in this section will deal primarily with projectile points made from stone.

Christenson (1986) defined four primary requirements for a projectile to be effective: accuracy, killing power, range, and durability. Note the lack of reference to the weight in these requirements: Christenson argued that the discussion of the weight of the projectile point itself misses the point. This overlooks the fact that these points are the part of a larger object - that the projectiles themselves can have a foreshaft, mainshaft, and a fletch shaft, complete with feathering. When the weight is discussed, it must be done in such a way that considers the general context of the design and construction of the whole projectile. Essentially, context is key.

Accuracy is primarily a function of the flight stability and trajectory of the projectile. The stability of the projectile in flight is based on two principles: the object's center of mass and its center of pressure. The center of mass is located at the point at which the object will be balanced - literally at the center of its mass - and is based upon the materials and method of construction. The center of pressure, however, relates to the distribution of the object's surface area, and is a function of the shape of the projectile and the presence and amount of fletching. The addition of feathers moves the center of pressure back beyond the midpoint (Christenson, 1986). A heavier projectile is less subject to interference from crosswinds than a lighter one.

The trajectory of the projectile plays a large role in its accuracy. The trajectory is affected by the weight and velocity of the projectile - a light, high velocity projectile is more accurate than a slower, heavier one. Therefore, the heavier, slower projectile must have a higher trajectory in order to travel the same distance as its lighter counterpart. The velocity at a given point is determined by the initial velocity and any deceleration due to air resistance. Once again, any fletching on the projectile will affect the object's flight. Deceleration is positively related to the number and size of the feathers used in the fletching. Additionally, the deceleration is also impacted by the cross-sectional area of the shaft or the projectile point - whichever is larger.

The killing power of the projectile was based on the interplay between two characteristics: size and penetration power. A large, broad point will make a larger wound than a smaller one, though it will not penetrate as deeply than the smaller point. Mass,

however, is more important than the velocity in determining the depth of penetration - a lighter point will not penetrate as deeply as a heavier point when moving at the same velocity. The sharpness of the point also plays a role in maximizing the depth of the wound (Browne, 1940; Christenson, 1986).

These aerodynamic characteristics of the projectile become more important as the range of the target increases. The maximum range - literally the farthest the projectile can travel - is a direct result of the physical characteristics of the projectile. Usually, in studies of projectiles, most researchers tend to discuss this range far more often than the effective range, or the range at which the projectile can consistently mortally wound a target animal.

Durability of the projectile was often a secondary concern to those who create it. The durability was affected by the shape of the point, as well as the size and weight of the shaft to which it is attached. The material that the point is made from is also important. Larger points made from brittle materials are more likely to break than smaller points made from harder materials (Browne, 1940; Christenson, 1986).

Projectiles were among the more durable artifacts left by ancient peoples. Since the points were often made of stone or bone, they had the unique ability to remain intact for hundreds to thousands of years. Like any artifact, projectile points have their own set of terminology, which will be the focus here. Starting with the most distal region of the projectile points, the base is just that; the bottom section of the projectile point. Bases were not always straight - they could have been concave or convex, or even bifurcated, depending on the construction method. The stem or neck connects the base to the rest of the point, commonly called the blade. A contracting stem was one that tapers inward from the shoulder of the point (discussed next) to the base, while an expanding stem was one that grows in width from the shoulder to the base. The shoulder is the protruding area just above the stem. Shoulders could be flared, straight, or rounded, and gave the projectile point its characteristic shape. Some projectile points were notched - that is, there was a distinct gap created just under the shoulders of the point that allowed for the point to be fastened to a shaft of wood or bone. These notchings usually occurred in one of three places: the sides, which led to parallel notches; the corners, where the blade met the base, causing the creation of a barbed point; or the base, which created a point with long barbs (Justice, 2002).

Ceramics

Ceramics are composed of three main materials: clay, non-plastic inclusions, and water (Sinopoli, 1991). Clay is a sticky, fine grain sediment that typically becomes plastic or moldable when wet. In general terms, clays are very fine-grained sediment with particle sizes of less than two thousandths of a millimeter that becomes sticky and plastic when mixed with water and can maintain its shape as it dries. Non-plastic or non-clay particles, including organic materials and rock fragments, affect the workability, shrinkage, and the clay's responses to being fired. Water is added to the dry clay in order to make the clay and its inclusions moldable. This water is lost when dried and fired.

Clays can be classified and defined in many different ways, including the size of the particles, the source or point of origin, and the chemical composition. Additionally, clays are composed of a small number of elements and compounds, mainly silicates, but other elements occur in smaller quantities. These trace elements allow for the identification of clay sources for archaeological ceramics. Other minerals in clay include kaolinites, a very common clay mineral used to make porcelain, and smectites and illites. Kaolinite-heavy clay forms a pair of layered crystalline sheets, while smectite- and illite-heavy clay form three layered clays. These clay minerals affect the overall shrinkage, strength, and color of the clay (Sinopoli, 1991).

Ceramic classification tends to have high variability, both in their creation and their specificity. Traditionally, ceramics are classified using a type-variety classification scheme. Ceramic "type" refers to the set of specific, diagnostic traits that allow for the sorting and classification of ceramics. Varieties are just that - varieties of the ceramic type (Gifford, 1960). Types are typically designated with a location-surface characteristic notation, while the variety is noted with a single term that refers to a specific defining characteristic of the variety (Sinopoli, 1991). A series is a set of technologically related ceramic types that are similar in decorative technique or surface manipulation or manufacture. Finally, the term ware is defined as a grouping of stylistically varied types that are similar technologically and in manufacture (Wheat, Gifford, & Wasley, 1958). That is, a ware is a group of pottery types that have a large majority of characteristics in common but differ in others (Watkins, 2009).

It should be noted, however, that the definition of type was not always as static as it is now. Spaulding (1953) argued that artifact types are inherent in the artifacts themselves, and

are waiting to be discovered by the archaeologist. Ford (1954), on the other hand, suggested that types are created by archaeologists, and that the types are designed for the construction of cultural history in time and space.

Bone Tools

Buc and Laponte (2007) defined bone awls as being sharpened points on bone fragments used in basketry weaving or hide perforation. These artifacts are typically the most common type of bone tools recovered from archaeological sites. There are three main categories of bone awls: awls made from mammal leg bones, awls made from mammal rib bones, and awls made from bird bones (Kidder, 1932). On top of this, there are two methods used in the construction of awls: scraping with flint implements and grinding with an abrasive stone (Campana, 1989).

The mammal leg bone awls are typically the most frequent of the three groups, and are broken down into five subgroups: a) awls with the proximal or distal head of the long bone left intact; b) awls with the head of bone unaltered except by splitting; c) awls with the distal end of the bone worked down; d) awls with the head of bone removed; and e) splinter awls. According to Kidder (1932), the first subgroup is usually constructed using the ulnae of small mammals, though often time the awls are made using metapodials. The second subgroup is produced by splitting a metapodial in half, and then grinding down the proximal portion. For the third subgroup, the distal end of the metapodial is worn down, either by use or design, and the proximal portion is shaped into a sharper point. The butt of the awl can become bifurcated if an unfused bone from an immature individual is used; this notch can broaden and deepen with use. The most abundant type of awl belongs to the fourth subgroup. Most of the awls in this subgroup have little to none of their original shape left due to the surfaces of the bone being worked smooth. There are, however, some indications as to the identity of the bone: there may be slight swelling at one end, cancellous bone surrounding the butt, or grooves down the shaft of the awl that are representative of the parent shaft. The final group of mammalian long bone awls are the splinter awls. These awls are made from fragments of long bones that were broken open for marrow or to make other tools. As such, it is nearly impossible to identify the bones used (Kidder, 1932).

Awls made from mammal rib bones can be further separated into three categories: worked, splintered, and awls made from the edge of rib. Worked rib awls are carefully made from the outer wall of the rib, with the cancellous portion of bone on the concave surface of the awl (Kidder, 1932). The butts of the awls are typically rounded, the sides straight or convex, and the points are sharp. Additionally, engravings may be present on the outside portion of the awls. Splinter awls are thought to be byproducts of “finer specimens” (Kidder, 1932). The sides and butts are irregularly shaped, though there is smoothing due to use. The cancellous bone is more protuberant and ragged. The final group of rib awls, those made from the edge of ribs, tend to be triangular in cross section. This shape is made from two converging faces of the rib and the cancellous interior that had been cut square across (Kidder, 1932).

The final group of awls - those made from bird bone - are usually made from leg or wing bones and are extremely brittle. There are two categories of bird bone awl- those made from the whole bone, and those made from splinters. The awls made from the whole bone are typically constructed with the joint intact, though the bones are snapped in two and the jagged end is worked down and pointed by grinding. Splinter awls made from bird bones are similar in construction and morphology to splinter awls made from mammal bones, though they appear to have been used only temporarily. This is probably due to the brittle nature of bird bones: it is likely that these awls would break during normal use and then be discarded. It is also common to find awls made from bird bones that were originally meant to be other artifacts, such as flutes. During creation, the creator would reshape the flute into an awl if they noticed any imperfections (Kidder, 1932).

There are two main methods of awl construction: scraping using a sharpened stone tool, and grinding using an abrasive surface (Campana, 1989). Awls created using a sharp stone tool or flake tend to have an irregular shape due to the edge of the tool causing convexities and concavities. The profile of the awl will have an undulating appearance, and its cross section could appear polygonal (Campana, 1989). These awls also have parallel striations along the tip; these striations are rarely uniform and often times overlap (Campana, 1989; Olsen 1984). Shallow, rapid strokes produce fine, nearly straight striations, while deep and slow strokes will appear as pronounced undulations.

There are two categories of grinding techniques: cross grinding and axial grinding (Campana, 1989). Cross grinding consists of rubbing the bone back and forth across an abrasive stone at an angle perpendicular to the axis of the bone (Campana, 1989). This technique is very effective for reducing and rounding the sharp edges of the fragment, for rough shaping, and for forming flattened facets. Cross grinding tends to leave distinct flat portions on the sides, though small or curved surfaces could also produce hollow or concave areas. Across these flat portions run clear, parallel striations, which are straight and evenly spaced. Axial (or parallel) grinding, on the other hand, involves rubbing the bone in a direction parallel to its length (Campana, 1989). This technique tends to be slower than cross grinding, though it leaves a smoother surface with even curves. It is also effective when making sharp tips and when shaping symmetrical objects such as points. The profile of awls made using axial grinding are straight cones, because it is difficult to produce concavities. Striations are smaller, and typically tend to overlap or create a crisscross pattern. These striations are difficult to distinguish from the natural grain of bones (Campana, 1989). Using experimental archaeological techniques, Campana (1989) found that there is little difference in the effectiveness of grinding in regards to the condition of the bone, though they note that it is important to keep the bone and grinding implement flushed with water to prevent clogging of the implement.

Several authors have mentioned that the tips and shafts of the awls are often times polished by use (Buc & Loponte, 2007; Olsen, 1984; Olsen & Wheeler, 1978). The tips are often rounded down and striations tend to disappear (Buc & Laponte, 2007). This is due to fine grit or powder creating microscopic striations in the implement as it is drawn over hide (Olsen, 1984). Very polished bones tend to be the result of the friction of the bone against the hide. In the case of the mammal bone awls in which the head has been worked down, this polish is most likely due to the oils present on the user's skin, along with any fine particles of grit (Olsen, 1984).

THE PARADOX 1 SITE

In the 1930s, the Woodburys surveyed the length of Paradox valley, and found that, aside from a single broken corrugated vessel, no archaeological sites lie east of the Dolores River. In this same survey, they excavated a site on a hill, exposing a square structure with at

least four rooms, two of which were completely exposed. The ceramics and projectile points they discovered prompted them to label the site as being part of the Pueblo I or Pueblo II time periods (Leach & Lippold, 1973; Woodbury & Woodbury, 1932). In the late 1960s, this site was reported to nearby landowner Mr. Al Look, who then reported it to a southwestern archaeologist, Dr. Hannah Marie Wormington. In 1970, Dr. Wormington reported the site to Dr. Larry Leach of California State University, San Diego (now San Diego State University), who lead an eight-week summer excavation of the site with Colorado College (Hansel, 1970).

The 1970 excavation was limited to a single site in the valley - the very same one that the Woodburys had tested three decades earlier. The goal of this excavation was twofold: Dr. Leach wanted to “introduce [sic] the students to basic field techniques in archaeology,” and to “clear and clean the ‘pot’ holes to ascertain the amount of damage that might have been done by” local collectors and amateur archaeologists who had obtained or excavated archaeological specimens from throughout the valley (Leach & Lippold, 1973, pp. 7-8; Figure 3). Due to time and budget constraints, as well as the small labor force averaging 10 students, Leach decided only to excavate the sites that the students had cleaned (Hansel, 1970). The excavation occurred from Monday, June 22nd, 1970 through Wednesday, August 5th, 1970. The owner of the land at the time, Hardy Redd, planned to build a fence to protect the site from vandals (Wright, 1970). It is unclear whether this occurred.

The site was excavated by feature system and utilized arbitrary levels, as “any grid on this site would have been counterproductive” due to the architectural features (Kasper, 1972; Leach & Lippold, 1973). Five test units were excavated: four were located in “potted” areas of the site, while the fifth was a stratigraphic test trench (Figure 4, Table 1). The unit numbers were assigned based on order of discovery. Once again, due to time and budget limitations, none of the units were completely excavated.

Figure 3. Student excavators from Paradox Field School. Back (L to R): Dick Noyes, Tom Seibert, Ed Joyce, Dave Kinder, Denny Fischer. Front (L to R): Audry Land, Scott Hoover, Russ Curry. Photo Credit Unknown.

Unit 1 was originally exposed by an amateur archaeologist in the form of a pothole that exposed a portion of a house structure. Arbitrary stratigraphic levels were used to remove the overburden until the first floor level was reached. Vertical stratigraphy was used from this point on, as the texture and color of the soil apparently indicated different layers. None of these layers were recorded on the artifact bags. Six centimeters below the Pueblo floor surface a pithouse surface was exposed, and the materials were “labeled and bagged separately” since vertical stratigraphy was also present here (Kasper, 1972, p. 29).

Figure 4. Map of Paradox 1 Site. Adapted by Michael Prouty from Kasper (1972).

Two structures were located in unit 1. Structure 1 was composed of two or more square rooms, with thick walls built of natural sandstone. This structure was built above ground, and was typical of Pueblo I-II dwellings. The second structure was a pithouse characteristic of the Basketmaker III period. It appeared that the structure had been constructed by excavating a circular area in the soil, then coating the resulting walls with a layer of adobe. Sandstone slabs had reinforced some portions of the walls. The structure appeared to have suffered from fire damage: burned roof materials were recovered from the floor of the structure, including beams indicating a cribbed log roof type of construction, as well as brush and grass remains that were most likely stuffed into spaces in the roof. Adobe was found to have been slathered over the roof (Kasper, 1972).

Unit 2 was the stratigraphic test trench, approximately 75 inches wide and 7 meters and 75 inches long. The trench proceeded in an uphill direction, from the base of the knoll to the top in an uphill direction and was dug vertically until bedrock was exposed. Once again, arbitrary stratigraphic levels were used (Kasper, 1972).

Unit 3, similar to unit 1, in that previous amateur activities had uncovered a small storage cist. Two small house structures were exposed by excavations, and both of these dwellings showed signs of being occupied at two separate times during the same cultural period. As with the other units, arbitrary levels were removed until the floor surface was reached. Two circular dwellings were located in unit 3. These dwellings were more recent in origin and "significantly different in architecture" than the dwelling found in unit 1. According to Kasper and Leach, these structures were indicative of the Fremont culture. Characteristics of the structures include: walls of sandstone and adobe mortar, adobe plastered floor surfaces, internal roof supports, adobe rimmed hearth and small storage and ash pits (Kasper, 1972).

According to Kasper (1972), unit 4 also began as a potholed area, though the materials from this unit proved to be "unproductive."

Unit 5 was located on a cactus-covered mound with several fragments of exposed adobe. Two 75-centimeter-wide exploratory trenches were dug into the mound - one in a north-south direction, the other in an east-west direction. The feature method of excavation occurred, and, as is tradition with this site, arbitrary levels were used. According to Kasper (1972), this test area produced the largest number of structures, artifactual materials, and faunal materials. Additionally, it contained two circular structures similar to those in unit 3, both showing signs of separate occupations. Once again, fire had destroyed one of the dwellings, as evident by burned wooden support beams recovered at the site (Kasper, 1972).

During the excavation of unit 5, a tunnel or passageway that once connected the two dwellings was discovered. The walls were lined with sandstone slabs, and the roof was constructed of small wooden beams covered with large sandstone slabs. These slabs were then covered by a layer of adobe. A human burial associated with the second occupation of the dwellings was found placed within the passageway adjacent to the structures. Additionally, a group of round storage cists were discovered associated with the dwellings.

Ceramic and lithic materials recovered from this unit were representative of the Fremont culture (Kasper, 1972).

After the excavations, the assemblage was divided among Colorado College and California State University, San Diego (CSUSD). An unknown fraction of the assemblage was housed at Colorado College, while the remainder of the artifacts, as well as the field journals, were loaned to CSUSD with the understanding that research would occur in a timely manner. Leach and Lippold (1973) suggested that the Basketmaker III group inhabited the site first, followed by the Pueblo I-II, then finally the Fremont (Figure 5). In 1972, Masters student Janice Kasper studied the faunal material from the site in order to “provide a faunal analysis for the temporal period in which the Fremont Culture Complex is believed to have flourished” and to “examine the feasibility of making inferences about the cultural patterns of a people by analyzing faunal material obtained from a preliminary investigation of an archaeological site” (p. 1).

Table 1. Brief Summary of Units from 5MN191 Derived from Kasper (1972)

Unit	Brief Summary
1	Above ground structure – associated with Pueblo I-II Below ground structure – associated with Basketmaker III <ul style="list-style-type: none"> • Shows evidence of burning
2	Stratigraphic Test Trench
3	Two circular structures – associated with Fremont <ul style="list-style-type: none"> • Show two occupations from same cultural period
4	Potholed area “Unproductive”
5	Two circular structures – associated with Fremont <ul style="list-style-type: none"> • Show two occupations from same cultural period • One structure damaged by fire • Tunnel connecting two structures <ul style="list-style-type: none"> ○ Contained human burial Excavated two trenches, one North/South, one East/West “Produced largest number of artifacts”

Figure 5. Possible cultural chronology of the site. Source: (Leach & Lippold, 1973).

It was unclear what exactly happened to the collection after the completion of Kasper's thesis research. In the late 1970s, a heavy rainstorm destroyed the field journals and documents, though several dozen photographs from the excavation process did survive (Gamble, 2002). At some unknown time following this, the artifacts located in Colorado were damaged in a fire. When the Collections Management Laboratory was relocated to its current location in the basement of Hardy Tower in 2007, the many boxes (and two colanders) of artifacts were scattered throughout the cabinets in the lab (Figure 6). In this move, several large metates seem to have been misplaced. It was not until the fall 2013 semester, when three boxes of faunal remains from the site were assigned to an unsuspecting intern for revitalization, that the artifacts were rediscovered. As the semester progressed, the intern discovered the remaining artifacts. Revitalization of the artifacts continued until completed in the summer of 2016, as described in the methodology section.

Figure 6. The artifact boxes from 5MN191.

CHAPTER 3

THEORETICAL FRAMEWORK

As Lewis Binford stated in 1980, a “good [archaeological] diagnosis is theory dependent” (p. 5). Therefore, two main theoretical frameworks will be utilized in this thesis: contextual archaeology and environmental archaeology. Three underlying themes link the two theories together: adaptation, behavior, and the human ecosystem.

CONTEXTUAL ARCHAEOLOGY

Contextual archaeology is less concerned with artifacts than with the actual sites (Butzer, 1980). There is a focus on the multidimensional expression of human decision-making in the environment, which in turn stimulates more holistic research by calling attention to systemic interactions between cultural, biological, and physical factors. The practical goal of contextual archaeology is to study archaeological sites as parts of the human environment.

There are five central themes in contextual archaeology (Butzer, 1980):

1. Space - Objects and phenomenon are very rarely homogenous in space. Phenomena such as topography, climates, biological communities, and human groups exhibit spatial patterning and are liable to spatial analysis.
2. Scale - Essentially, the configurations of living communities are created and changed by processes that operate at several different spatial and temporal scales that may also be periodic or aperiodic.
3. Complexity - As mentioned previously, environments and communities are not homogenous. This means that any analysis of the human environments and communities requires flexible, multiscale, spatial, and temporal approaches.
4. Interaction - The interaction between humans and the environment occur at different scales, in variable degrees of proximity, and at unequal or differing rates.
5. Stability - All communities of any environmental complex are affected by negative feedback due to internal or external processes. Because of this, readjustment occurs, whether short or long term, minor or major.

The underlying thread of the contextual approach to archaeology is that adaptation and adaptability are at the heart of the human ecosystem. Adaptation, as defined in contextual archaeology, are strategies for survival, while adaptability is the capacity of a cultural system to adjust (Butzer, 1980). Behavior is subservient to adaptation. Classically, adaptation is measured by relative fitness, one's genetic contribution to the next generation (Jochim, 1979). However, when behavior is discussed in relation to animals, it is often times phrased in terms of adaptive significance, or as a contribution to the organism's fitness. Therefore, adaptation is also assumed to be the underlying goal of an activity (Jochim, 1979). Adaptation is difficult to measure, Jochim points out, because behavior and the environment continuously changes. We cannot state with certainty that human beings have ever been adapted to their environment - both social and physical - except for frozen points in time (Jochim, 1979).

ENVIRONMENTAL ARCHAEOLOGY

This relationship between behavior and the environment falls under the area of study of environmental archaeology. Simply put, environmental archaeology is the study of the relationship between culture and the environment, with the ultimate goal of understanding the ecology of past populations (Butzer, 1980; Paddayya, 1982). Environmental or ecological archaeology grew out of Julian Steward's cultural ecology, where culture was seen as a reaction to or a buffer between the environment and man. According to Jochim (1979), the environmental archaeological studies can be broken down into several dimensions, usually examined in a systems framework, though this usually involves the assumption that any aspect of human behavior involves a direct interaction with the environment. The most common of these dimensions is that of behavior, which itself can be broken down and organized into further subsystems. For example, subsistence is the one of the systems where the relationship between humans and the environment is the most obvious. The interaction between humans and soils, water systems, plants and animals are extremely complex - these are not static factors to be utilized or exploited; they show unique patterns of behaviors, which alter the patterns of their use and their response to the use (Jochim, 1979).

Other systemic studies include those on technology, settlement, demography, and social organization. Human behavior also has a geographic dimension and is thematically

present in societal groupings and energy flow. This can be studied in persistent places. A persistent place, according to Schlanger (1992), was a place that was repeatedly used during a long-term occupation of a region. These places are “neither strictly sites ... nor simply features of a landscape;” they represent a conjunction of distinct human behaviors on a particular landscape (Schlanger, 1992, p. 110). A focus on behavior as problem solving allows for cross-cultural comparisons, but one must be aware that no decision is made in a vacuum - there are dozens, if not hundreds, of variables at work that influence decisions (Jochim, 1979).

CHAPTER 4

METHODOLOGY

The following sections will first discuss the curation methodology, followed by the methodology of three lines of inquiry (ceramics, projectile points, and bone tools).

CURATION METHODOLOGY

The artifacts from 5MN191 were curated in random groupings. That is, each bag of artifacts (most were in their original excavation bags) was grouped by artifact class, with each resulting group being counted and weighed, before being bagged in polyethylene bags. Once this initial revitalization was finished, the artifacts were entered into a Microsoft Access database (Figure 7) and new, finalized tags were created on acid-free paper that included such information as the artifact class, count, and weight. Artifacts were placed in multiple boxes based on object class and stored in the Collections Management Laboratory while research was being conducted. A box inventory was prepared for each box that contained an itemized list of the artifacts housed in each box. This inventory documents the unit, level, class, object, material, quantity and weight of each cataloged artifact.

Some artifact classes – mainly faunal remains and chipped stone – were cataloged in groups. For example, instead of cataloging individual fragments of faunal remains from a bag, and thus producing upwards of a hundred unique artifacts in some cases, these artifacts were lumped together under the same accession number for ease.

SAN DIEGO STATE UNIVERSITY

Collections Management

Catalog Card Form

Accession Number: SDSU-0897

Catalog Number: 2678

Other Catalog #: 5MNI-107

Unit:

Level (in cm):

Num LV: 1

Feature:

Other Provenience:

Class: Bone

Object: Bone

Material/Species: Faunal

Color:

Modified One:

Modified Two:

Fragment Type:

Culture:

Total Quantity: 1

Total Weight: 0.7

Box Number: 0897-015

Catalog Date: 12/1/2015

Excavation Date: 6/25/70

Excavated By: DH

Catalogued By: VL

Missing: No

Discard:

Comments: Room fill

Accession Number: SDSU-0897

Catalog Number: 2679

Other Catalog #: 5MNI-269

Unit:

Level (in cm):

Num LV: 1

Feature:

Other Provenience:

Class: Bone

Object: Bone

Material/Species: Faunal

Color:

Modified One:

Modified Two:

Fragment Type:

Culture:

Total Quantity: 1

Total Weight: 1.2

Box Number: 0897-015

Catalog Date: 12/1/2015

Excavation Date: 6/29/70

Excavated By: DH

Catalogued By: VL

Missing: No

Discard:

Comments: Fire affected, Room fill

Accession Number: SDSU-0897

Catalog Number: 2680

Other Catalog #: 5MNI-240

Unit:

Class: Bone

Object: Diaphyses Fragme

Material/Species: Faunal

Color:

Total Quantity: 1

Total Weight: 0.5

Box Number: 0897-015

Catalog Date: 12/1/2015

Excavation Date: 6/29/70

Excavated By: DH

Catalogued By: VL

Missing: No

Print Artifact Labels by Accession #

Print Artifact Labels by Catalog Card Range

Close Catalog Card Form

Figure 7. Screenshot of Microsoft Access Database used to inventory artifacts.

CERAMIC TYPOLOGY

Due to the existence of three distinct surface styles, the ceramics from 5MN191 were first categorized by surface styles. These styles included corrugated, painted, and plain (Figure 8). Painted sherds were then categorized based on the style of the design; either line drawing or geometric design (Figure 8, B and C). Following this separation scheme, the ceramics were then investigated under magnification using a digital microscope in order to study the core composition of each sherd. This information was recorded in an excel data sheet.

Figure 8. Ceramic surface styles. A) Corrugated, B) Geometric Surface Painting, C) Linear Surface Painting, D) Plain.

PROJECTILE POINT TYPOLOGY

The projectile points from 5MN191 were grouped based on cultural cluster specified by Justice (2002). Overall morphological variation of each point was compiled in a data

sheet that required the inputting of a point's length, width, thickness, and so on. Next, the point clusters were organized based on timespan to attempt to glean a rough chronology of the site. The artifact labels on the projectile points were used in conjunction with this resulting chronology to approximate the depth of the excavation, though as mentioned in the Results section, this failed due to the presence of repeated artifact labels.

BONE AWL ANALYSIS

Kidder (1932) suggested that there are three main categories of bone awls; 1) those made from mammal leg bones; 2) those from mammal rib bones; and 3) those made from bird bones. Because of this, the awls from 5MN191 were first classified into one of these three categories. Next, the awls were subdivided into subcategories based on the method of construction. Mammal leg bone awls were divided into five subcategories: a) awls with the head of the bone left intact; b) awls with the head of bone unaltered except by splitting; c) awls with the head of the bone worked down; d) awls with the head of bone removed; and e) splinter awls. The awls made from rib bones were separated into three categories: a) worked; b) splintered; and c) awls made from the edge of rib. Finally, the awls made from bird bone were split into two categories: a) those made from a whole bone; and b) those made from splinters. This classification scheme is presented in Table 2. Once this classification was completed, the awls were examined under magnification to attempt to ascertain the method of construction.

Table 2. Bone Awl Classification Scheme

Awls from Mammal Leg Bones	Awls from Mammal Rib Bones	Awls from Bird Bones
A. Awls with Head of Bone Intact <ul style="list-style-type: none"> Usually small mammal ulnae Also metapodial 	A. Worked Awl <ul style="list-style-type: none"> Made from outer wall of rib Cancellous portion on concave surface Butts rounded Sides straight or convex Points keen Engravings possible on outside 	A. Awls made from Whole Bone <ul style="list-style-type: none"> Usually made with joint intact Bones snapped in two and end grinded down
B. Awls with Head of Bone Unaltered Except for Splitting <ul style="list-style-type: none"> Split metapodial in half Grinded proximal portion 	B. Splintered Awl <ul style="list-style-type: none"> Sides and Butts irregularly shaped Smoothing due to use Cancellous bone more protuberant and ragged 	B. Awls made from Fragments <ul style="list-style-type: none"> Similar in morphology and construction to splinter mammal awls Temporary use due to ease of break Possibly meant to be other artifacts
C. Awls with Head of Bone Worked Down <ul style="list-style-type: none"> Distal end of metapodial worn down Use or Design Proximal portion shaped to point If unfused bones used, butt can become bifurcated Can widen and deepen with use 	C. Edge of Rib Awl <ul style="list-style-type: none"> Triangular in cross section Made from converging faces of rib and cancellous interior that has been cut square across 	
D. Awls with Head of Bone Removed <ul style="list-style-type: none"> Usually most abundant Little to no original shape left Slight swelling at one end possible 		
E. Splinter Awls <ul style="list-style-type: none"> Fragmented long bones that were broken open for marrow or other tools 		

CHAPTER 5

RESULTS

A total of 45,386 artifacts were cataloged while the collection was curated (Table 3, Figure 9). Table 3 and Figure 9 show the artifact count by class; the collection was made up mostly of chipped stone and faunal bone artifacts but also contained a substantial amount of ceramics, stone tools (mainly projectile points and utilized flakes), ground stone, and miscellaneous vegetal objects, such as burned corn cobs. Strangely enough, the site also contained three shell artifacts – all beads – belonging to the *Olivella* genus. Approximately 120 other beads were found in the assemblage, most of which (73 beads) were made from stone, while the remaining 48 beads were made from bone. While curating the collection, it was found that many bags had inaccurate labels; for example, one bag listed several artifact types that were not present. An example of a bag label is shown in Figure 10.

Table 3. Artifact Quantities

Artifact Class	Quantity
Chipped Stone	28,756
Faunal Bone	11,336
Ceramic	2,170
Tool	2,087
Vegetal Materials	510
Ground Stone	442
Soil Sample	53
Historic	29
Shell	3
Total	45,386

Figure 9. Pie chart of artifact classes.

Figure 10. Example of bag information. Note the inclusion of Fischer in the excavators and the corrected number of utilized flakes.

CERAMICS

Roughly 2,170 ceramic artifacts were inventoried. Of this number, 1,967 artifacts were sherds; the remaining 203 artifacts were gaming pieces (including discs and balls) and chunks of clay. Surface corrugation was the most common form of surface treatment, while painted was the least common (Figure 11). Dark and light grey ceramics tended to be the most common color, while brown and orange sherds appeared to be the least common. The majority of the ceramics (686 sherds) were found in Unit 5, which was also the more diverse

unit in terms of ceramic color and surface treatment (Figures 12, 13). More than half of the ceramic sherds were burned – unit 5 contained the most burned sherds, 383 sherds, while units 2 and 4 only produced 8 and 7 sherds respectively (Figure 14). Additionally, there were a few sherds in the assemblage that displayed notching along the rim – as mentioned previously in the background chapter, this notching is usually attributed to the Fremont (Figure 15).

Figure 11. Ceramic surface styles.

Figure 12. Surface styles present in each unit.

Figure 13. Ceramic colors present in each unit.

Figure 14. Burned ceramic sherds present in each unit.

Figure 15. Ceramic sherd showing rim incising.

PROJECTILE POINTS

A total of 462 projectile pointers were categorized into eleven clusters based on cultural grouping, as suggested by Justice (2002) (Table 4, Figure 16). Of these, 119 points were classified as unknown or unidentifiable – a point was classified as unknown if it did not match or have a similarity in the typology, while a point was classified as unidentifiable if it

was too heavily fragmented. Data, such as the weight and length of each point, were taken for each projectile point in order to create an average point for each cluster. Of the eleven clusters, five date to the Basketmaker III period, three are associated with the Pueblo I and II periods, and two are associated with the Fremont (Justice, 2002; Table 5). About half of the points were unprovenienced – due to the depressing state of the documentation and storage, a good amount of the artifacts lost their unit information. Ignoring the unprovenienced points, Unit 3 produced the highest number of categorized projectile points – of these, the majority were either of the Chaco or the Dolores clusters, both of which are associated with the Pueblo I and II groups (Justice, 2002). Unit 5 contained the second highest amount of points, with Chaco and Cienga also being the most prominent point type. Unit 2 contained a single point, which was categorized as a Chaco point.

ARTIFACT LABELS

The artifact labels on the projectile points and other artifacts came in two formats: one in which the binomial notation “5MNI-X” was used, and one in which the trinomial “5MN-P-X” was used. In both cases, “X” refers to the unique number found on the artifact. These binomial and trinomial labels follow the Smithsonian system, in which 5 represents Colorado (as it was the fifth state alphabetically when the numbering system was implemented) and MN represents Montrose County (Crow Canyon Archaeological Center, 2013). Overall, the site designation “5MN191” translates to the 191st archaeological site registered in Montrose County, Colorado. The letter “P” in any label that follows the “5MN-P-XX” notation is assumed to stand for Paradox Valley. There are around 110 labels in the “5MN-P-XX” notation and 280 in the “5MNI-XX” notation.

Table 4. Descriptions of the Projectile Point Clusters

Cluster	Description	Example from 5MN191
Chaco	Flat, oval shaped with deep corner or side notches.
Dolores	Wide and thin, barbed, straight stemmed.
Cienga	Concave or convex bladed, narrow neck with possible exaggerated serrations.
San Pedro	Corner notched point with straight to convex edge. Bases are typically convex.
Black Mesa	Oval or triangular points with deep, u-shaped notches and possible fine serration.
Durango	Narrow, side to corner notched with serration.

(tables continues)

Table 4. (continued)

Cluster	Description	Example from 5MN191
Gypsum	Triangular shaped point with a contracting stem.
Pueblo Alto	Small triangular point with convex blade and base.
Elko	Triangular side notched point.
Western Triangle Cluster	Small, lightweight triangular point.
Northern Side Notch	Lanceolate to triangular shape point with a concave base, though straight bases are possible.

Source: (Justice, 2002)

Figure 16. Projectile Points from 5MN191 grouped by cluster. Blue: Chaco cluster; Red-Orange: Dolores Cluster; Purple: Cienga Cluster; Orange: San Pedro cluster; Yellow: Black Mesa Cluster; Dark Purple: Durango Cluster; Grey: Pale Yellow; Aqua: Elko Cluster; Pink: Western Triangle Cluster; Gray: Pueblo Alto Cluster; Dark Grey: Northern Side Notch Cluster; White: Unknown; Brown: Unidentified.

Table 5. Projectile Points of 5MN191

Cluster	Time Span	Cultural Associations	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	No Unit	Total
North Side Notch	6,000 BCE – 3,000 BCE	Archaic	0	0	1	0	0	0	1
Elko	3,500 BCE – 1,400 BCE	Archaic	0	0	0	0	1	0	1
Gypsum	2,000 BCE – 800 BCE	Archaic	0	0	1	0	0	5	6
Durango	2,000 BCE – 450 BCE	Basketmaker III	0	0	0	0	2	4	6
San Pedro	1,500 BCE – 400 CE	Basketmaker III	1	0	3	0	1	14	19
Cienga	100 BCE – 900 CE	Basketmaker III	4	0	4	1	6	19	34
Black Mesa	1 CE – 800 CE	Basketmaker III	2	0	2	0	1	7	12
Dolores	600 CE – 1,000 CE	Basketmaker III, Pueblo I, Pueblo II	2	0	60	1	11	29	103
Chaco	750 CE – 950 CE	Pueblo I, Pueblo II, Fremont	4	1	75	1	21	55	157
West Triangle	1,000 CE – 1,400 CE	Many, though Fremont were the only group to inhabit the area	0	0	0	0	0	1	1
Pueblo Alto	1,020 CE – 1,200 CE	Pueblo II, Pueblo III	0	0	0	0	1	2	3
Unknown	N/A	N/A	5	0	34	0	7	39	85
Unidentified	N/A	N/A	0	0	6	0	0	28	34
Total			18	1	186	3	51	203	462

BONE TOOLS

Of the faunal remains, 142 bone fragments were made into awls (Table 6, Figure 17). The vast majority of the awls found appear to be created from long bone fragments, though there are awls present from the other categories of mammal long bone awls. The least common category of awls present was those that had the head of the bone unaltered, followed by those made from splitting the awl in half. The awls in both of these categories were made using deer metapodials. Microscopic analysis showed that the majority of the awls in this assemblage were produced using cross grinding methods, as there are perpendicular striations present on the tips of the awls. A little less than half of the awls showed high levels of polishing; they were polished to the extent that striations were not visible, indicating high amounts of use. Awls that show virtually no signs of use were also present – their extremely sharp points showed no signs of wear or polish. Additionally, several rectangular bone game pieces, as well as a bone pendant, were found in the collection (Figure 18, 19).

Table 6. Bone Awls Found at 5MN191

Awl Type		Quantity
Awls made from mammal leg bones	Head intact	1
	Split head	7
	Worked head	14
	Removed head	11
	Splinter Awl	79
Awls made from mammal rib bones	Worked	4
	Splintered	0
	Rib edge	0
Awls made from bird bones	Whole bone	0
	Fragment	0
Unidentified		26
Total		142

Figure 17. Bone Awls from 5MN191. Top: Awl made from Rib Bone; Middle: Awl. made from long bone fragment; Bottom: Awl made from metapodial.

Figure 18. Bone game pieces found in the collection. Note the artifact labels.

Figure 19. Bone pendant found in the assemblage. Note the artifact label.

CHAPTER 6

INTERPRETATION

Overall, the data presented in the previous chapter suggests that the Fremont culture did occupy 5MN191 at some time *after* the site was occupied by the Basketmaker and Pueblo peoples. It is important to note, however, that due to the lack of stratigraphy and provenience information, the artifacts were analyzed as if they came from the surface of the site. This section begins by restating the research questions that this thesis sought to answer, then answers each question in turn.

RESEARCH QUESTIONS

1. Based on the surviving artifacts and documentation, is it possible that the Fremont inhabited this site?
 - a. Are the ceramics Fremont in origin?
 - b. Are the projectile points Fremont in origin?
 - c. Is there any indication that the bone tools, including the bone awls, are Fremont in origin?
2. Is it possible to recreate the stratigraphy of the site by using projectile point and ceramic seriations?

ARE THE CERAMICS FREMONT IN ORIGIN?

Typical Fremont ceramics, according to Richards (2014) and Wormington (1955) included plain gray and blackware, with both rough and smooth finishes, as well as corrugated and painted ceramics. The most common forms of Fremont ceramic pottery were wide-mouthed jars with full body handles, large bowls, and pitchers (Richards, 2014; Wormington, 1955). Three main tempers appear to have been common in Fremont ceramics: calcite, grey siltstone, and black igneous rock tempers are commonly found in Fremont sites in Utah.

Since corrugated Fremont ceramics increased in commonality beginning around 1,050 CE, one can assume that the corrugated ceramics that were found in units 3 and 5 may be of Fremont origin (Richards, 2014). However, corrugated ceramics were also present during the Pueblo II period – because of the lack of provenience, it is difficult to say whether or not the sherds found in the units were actually Fremont or simply discarded Pueblo sherds (Lipe, 1993). It is safe to say, however, that the corrugated sherds found in unit 1 belong to the Pueblo II period, as the Fremont were not thought to have occupied that unit (Kasper, 1972; Leach & Lippold, 1973). The sherds that contain incising along the rim come exclusively from unit 5, which points to unit 5 housing the Fremont at some point, as these sherds are said to be of Fremont origin.

ARE THE PROJECTILE POINTS FREMONT IN ORIGIN?

The projectile point clusters present at the site show associations with the three groups hypothesized by Leach to inhabit the site – the Basketmaker II, Pueblo I-II, and the Fremont. The most common points in the assemblage – the Dolores and Chaco points – are associated with all three; that is the Dolores points are associated with the Basketmaker III and Pueblo I-II, while the Chaco are associated with the Pueblo I-II and the Fremont. There was a single point cluster that was solely associated with the Fremont in the area – the West Triangle cluster was found to have a single representative points in the assemblage.

Some of the projectile points from the site are Fremont in origin. Figure 20 displays the projectile points from units 1, 3, and 5, of which the latter two units were deemed Fremont in origin by both Kasper (1972) and Leach and Lippold (1973). These units contain projectile points that are associated with the Fremont (points from the Chaco cluster are found in both units 3 and 5), while the units also contained points that are typically associated with the Pueblo. Because each unit contained structures that show multiple occupations during the same cultural period, and because of the overlap in time that the Fremont and Pueblo existed (both existing from 750 CE to about 1,200 CE), both structures could have housed the two groups, albeit at different times, making the site a persistent place. This would account for the presence of points that are associated with the two groups. Additionally, because unit 1 has a structure indicative of the Basketmaker III people, and a structure associated with the Pueblo, it can also be assumed that any points from clusters

associated with the two that are found at the site could be evidence of either scatter or disposal because of the close proximity of the units. The projectile points found in unit 1 are all associated with the Basketmaker III, save for the five points from the Chaco cluster, which could have been deposited by the Pueblo inhabitants of the surface structure.

The structures at 5MN191 could be examples of Schlanger's (1992) persistent places because of the sheer amount of points. Schlanger (1992) noted that these sites may provide an exploitable resource for people in need of tools (i.e., projectile points). More projectile points are typically found in surface assemblages associated with multicomponent occupations than in single component occupations; additionally, more points are found in sites that were used after 900 CE than those occupied before (Schlanger, 1992).

IS THERE ANY INDICATION THAT THE BONE TOOLS, INCLUDING THE BONE AWLS, ARE FREMONT IN ORIGIN?

Several conclusions could be made from the awls. First, the inhabitants of the site relied more on bone tools than stone tools. Aside from an extremely small number of bone drills, the majority of pointed, conical tools are made from bone. As mentioned previously, the polish that is present on many awls is indicative of heavy use. Because a large number of the awls had heavy polished sections, it is safe to assume that these awls were used more often than any others. Second, the inhabitants of the site tended to use cross grinding more than other methods of awl preparation, which is inconsistent with the large number of worked chipped stone flakes found at the site. This inconsistency could be due to the fact that there was artifact loss in the assemblage's modern history.

Typically, according to Wormington (1955), the Fremont used all types of awls, though splinter awls and those made from deer metapodials were typically the most common. Because of the general commonality for ancient peoples to utilize faunal remains to fashion tools, as well as the lack of provenience, it is difficult to say whether the awls present at the Paradox site are explicitly Fremont in origin or were crafted by the preceding Pueblo or Basketmaker inhabitants. However, the presence of the small, rectangular polished pieces of bone, thought to be game pieces, also point to a Fremont origin (Wormington, 1955).

Figure 20. Projectile Points from Units 1, 3, and 5 with Cluster timespans overlaid.

IS IT POSSIBLE TO RECREATE THE STRATIGRAPHY OF THE SITE BY USING PROJECTILE POINT AND CERAMIC SERIATIONS?

Due to the severe lack of depth information recorded on the artifact bags, it is nearly impossible to reconstruct the stratigraphy of the site using the only primary sources left from the excavation. It was up to the artifacts themselves to provide this information. Most of the datable artifacts (i.e., the projectile points and ceramics) were labelled (see Results chapter for more information). Initially, these artifact labels were assumed to provide some provenience information. However, this turned out to not be the case, as discussed below. The artifacts were analyzed as if they all came from the surface of the site because of this failure in creating a site stratigraphy. A rough chronology of the site is possible to create using the projectile points and ceramic sherds.

Artifact Labels

The artifact labels written on each artifact did not appear to have any immediate level significance – for example, the more recent points (i.e., the Pueblo Alto, Chaco or Dolores) would theoretically have had lower numbers due to their proximity to the surface, though this was found not be the case. These points have a variety of numbers assigned to them, ranging from 1 to 101, while the other, older, points (such as the Durango, San Pedro, and Black Mesa), range in assigned values from 2 to 97. An attempt was made to correlate the units with the labels, though this was not successful, because some artifact labels came from multiple units (for example, artifacts with the label 5MN-P-14 were found in units 1, 3, and 5). It suffices to say that assuming that each unit produced artifacts with certain labels was wishful thinking – in reality, it appears that there was no real order to the artifact labels, at least none that were not lost to the ravages of a flood, fire, or time.

Ceramic Sherds

The ceramics assisted in constructing chronologies of the site as well. The Basketmaker III period (500 – 750 CE) ceramics consisted mainly of undecorated jars and bowls until about 570 CE, where small frequencies of painted ceramics appeared (Stone, 1999). The ceramics in the Pueblo I period (750 – 900 CE) was mainly grayware, though

small amounts of black on white and decorated redware did occur (Lipe, 1993). The Pueblo II period (900 – 1,150 CE) contained corrugated graywares and elaborately painted black on white and black on red ceramics (Lipe, 1993). Finally, the late Fremont period (900 CE – roughly 1,300 CE) contained painted ceramics and graywares, some of which showed incising around the rims (R. E. Madsen, 1977; Richens, 2000). Later, around roughly 1,050 CE, corrugated ceramics appeared in the Fremont record, though they only lasted for a short time (Richens, 2000). All this is presented in Figure 21, which shows this chronology along with the quantities for the sherds that could be classified by cultural association.

How does this affect the chronology of the site? Any Basketmaker III pottery would have to have been created after 570 CE, which shifts the timespan of the Basketmaker occupation to 570 – 750 CE. The corrugated and non-corrugated graywares that came out of unit 1 can be assumed to be Pueblo in origin, therefore it can be suggested that sometime after 750 CE the inhabitants were from the Pueblo I period, and after 900 CE the people from the Pueblo II period inhabited the site. Additionally, this information pushes the starting date for a possible Fremont occupation (if the corrugated sherds found in units 3 and 5 are indeed of Fremont origin) up to 1,050 CE. That is, the very latest that the Fremont could have started to occupy the site is around 1,050 CE. Based solely off of the ceramics, the proposed chronology of the site is as follows: Basketmaker III (570 CE – 750 CE); Pueblo I and II (750 CE – 1,050 CE); Fremont (1,050 CE – 1,300 CE).

Projectile Points

The projectile points assisted in creating the chronology of the site. Figure 22 displays the general chronology of the site utilizing projectile point timespans. The quantity of each cluster was first displayed in bar graph form, and the approximate year ranges are overlaid in a fashion similar to a battleship diagram. The most common point clusters (the Chaco, Dolores, and Cienga) are all relatively recent – that is, they are associated with groups that occupied sites from about 100 BCE to about 1,200 CE. If these clusters were focused on, based on the Basketmaker III, Pueblo I-II, Fremont chronology suggested by Leach and Lippold (1973), the approximate date of the site's occupation can be narrowed down to approximately 100 BCE to approximately 1,200 CE. Finally, if it was to be assumed that this initial chronology is correct, then one could argue for an occupational period of

approximately 600 CE to roughly 1,300 CE – the sheer amount of Dolores and Chaco points suggest that they were being manufactured at the site, whereas points such as the Pueblo Alto or the Black Mesa could be evidence of trade. All this, however, is based off of the fact that there is no provenience. That is, the projectile points and other artifacts were analyzed as if they came from the same layer; crucial information, such as artifact depth, would have enabled a more accurate chronology. Figure 23 shows the most common clusters found at the site with this proposed chronology of the area overlaid.

Projectile Points and Ceramics

Combining the chronologies created by both the ceramics and the projectile points provides a somewhat more accurate chronology of the site. The earliest date for the ceramics (based on cultural association) is roughly 500 CE. The projectile points provide the *terminus post quem*, however, due to the high number of projectile points from the Dolores and Chaco Clusters; this is because the Dolores cluster, which is associated with the Basketmaker III, existed after 600 CE. Starting at roughly 750 CE, the Pueblo moved into the site – this is evident through the Pueblo projectile points – and they most likely abandoned it sometime after 1,020 CE, when the Pueblo Alto projectile points (associated with the Pueblo II and III) appeared in the archaeological record. The Fremont probably moved into the site around 1,050 CE; the presence of the Western Triangle projectile points (which range from 1,000 CE to 1,400 CE) and Fremont corrugated ceramics (1,050 CE – 1,300 CE) suggest that the *terminus post quem* for the Fremont has to be around 1,050 CE. This date is also the *terminus ante quem* for the Pueblo I-II group. This chronology is presented in Figure 24.

Figure 21. Ceramic chronology with sherd quantities.

Figure 22. Timespan of 5MN191 Based on Projectile Points. The color of the bars refers to the cultural association: Green refers to Fremont, Orange refers to Pueblo I-II, Grey refers to Basketmaker III, Yellow refers to Pueblo II-III, Purple refers to Archaic, and Blue refers to Unknown. Color gradients refer to possible chronologies of the site, with light blue referring to an occupation that started approximately 3,500 BCE, purple referring to an occupation that started approximately 1,500 BCE, and the orange referring to an occupation that started approximately 600 CE.

Figure 23. The timespans of the most common clusters found at the site. Overlaid is the site chronology: Green, Basketmaker III (500-750 CE); Orange, Pueblo I (750-900 CE); Purple, Pueblo II (900-1,150 CE); Blue, Fremont (300-1,300 CE).

Figure 24. Proposed chronology of 5MN191 based on projectile points and ceramics.

Chronology by Seriation

A seriation can be a helpful tool in constructing chronologies of sites. Table 7 is a seriation based on space displaying the main artifact types of the collection. Unfortunately, it is not overly helpful in creating a unit chronology – the artifact types are too spread out to be of much use. This is not surprising, however, as the majority of the artifact types used in this seriation have lost their unit provenience.

Chronological seriations are displayed in Tables 8 and 9. Note that the shell beads – associated with the Fremont – act as a date range intersection in both seriations. Table 8 suggest an occupancy range of about 900 CE to 950 CE, while Table 9 suggests an

occupancy range of about 750 CE to 1,050 CE. The mean date suggested by the latter range is 900 CE – the starting point of the former. Additionally, the presence of the shell beads (associated with the Fremont from about 900 CE to 950 CE) connects what appears to be two different occupations – one from about 500 CE to roughly 900 CE, and one from 900 CE to roughly 1,300 CE (Table 8). The seriation of all the associable artifacts shown in Table 9, however, narrow these ranges down to about 750 CE to 950 CE and 1,000 CE to 1,150 CE. Both occupations were characterized by large numbers of projectile points and ceramics sherds.

These seriations show that it is difficult to be definitive when discussing the occupational sequence of the site. However, they can assist in addressing the theories regarding the origin of the Fremont group. Some archaeologists argue that the Fremont were descendant from some form of Pueblo predecessor; others dispute this notion and suggest that the Fremont were a distinct cultural group that is unrelated to the ancestral Pueblo. The data presented in these seriations show that there may be some form of connection between the Fremont and Pueblo that came before them at the Paradox 1 site.

Table 7. Spatial Seriation of Common Artifact Types

Unit	Dolores Points	Chaco Points	Plain Ceramic	Painted Ceramic	Corrugated Ceramic	Bone Awls
1			X	X	X	X
2						
3	X	X	X	X	X	X
4						
5	X	X	X	X	X	X
N/A	X	X	X	X	X	X

Note: Artifact Types used Consisted of More than 10% of the Unit Assemblage

Table 8. Temporal Seriation of Known Datable Artifacts

Date	Dolores Points	Chaco Points	Shell Beads	Pueblo II Ceramics	Fremont Painted Ceramics	Fremont Incised Ceramics
500						
550						
600	X					
650	X					
700	X					
750	X	X				
800	X	X				
850	X	X				
900	X	X	X	X	X	X
950	X		X	X	X	X
1000				X	X	X
1050				X	X	X
1100				X	X	X
1150					X	X
1200					X	X
1250					X	X
1300						
1350						
1400						

Note: Artifact Types Were Restricted to Known Associable Artifacts

CHAPTER 7

CONCLUSION

This thesis has demonstrated the realities of an orphaned collection. As Voss and Kane (2012) predicted, the lengthy gap in time between recovery and analysis, combined with an admittedly poor initial storage facility, lead to the separation of the artifacts from their field records and provenience information. This collection was a worst case scenario, however, as the records were lost when a flood hit the San Diego area shortly after their arrival. Nevertheless, this thesis sought to utilize the remaining artifacts to address the question of who occupied the structures at the Paradox 1 site.

Drs. Leach and Lippold's initial architectural assumption, as well as Kasper's faunal analysis, suggested that either the Fremont inhabited the site sometime after the Basketmaker and Pueblo peoples, or there was a sort of exchange system in place between the groups. The results of this thesis – mainly the projectile point typology and the ceramic sherds – supported this proposed chronology and suggests that the Fremont may have lived more east than previously thought. Furthermore, these artifacts were used to narrow down the occupations to create a somewhat more accurate set of dates for the occupations.

LIMITATIONS

There were many roadblocks in the analysis of the collection. The lack of any provenience information was catastrophic for this collection. The absence of extant field journals or dedicated site reports made it virtually impossible to know exactly how the students excavated, aside from a brief mention of “arbitrary” layers. Of course, a way around this would be to return to the site and assess the stratigraphy. This may prove slightly difficult, however, as the land where the site was located is currently under the ownership of Redd Ranches, whose beefy mission statement is “to supply [their] customers with cattle that are genetically superior and better acclimated to the harsh conditions of the west” (Redd

Ranches, n.d.). The lack of stratigraphic information forces one to view the artifacts as if they all came from the same layer, and this obviously causes many problems in analysis. Without that crucial depth information, it is difficult to create artifact chronologies. On top of that, it is difficult to say which artifacts came from which structures inside the individual units. Some artifacts were labelled with a feature number – i.e., Feature 1a or Feature 2b – but there was no indication as to which structure these features correlate to. Thousands of artifacts, including over 200 projectile points and 260 ceramic sherds, were without any form of provenience information. Not having any unit information for these artifacts essentially makes them impractical for the dating of the individual units.

FUTURE RESEARCH DIRECTIONS AND CONCLUDING REMARKS

This thesis presented a preliminary study of the most datable artifacts in the assemblage – the ceramics and the projectile points. Further research can shed light on the other artifact types in the collection. While invasive, genetic analyses can be performed on the faunal remains to further speciate them. Additionally, aging the faunal remains may provide important information on dietary preferences – whether the occupants allowed the animals to reach full maturity before they consumed them, or if they indiscriminately hunted and used any animals they could find. Petrographic analyses of the ceramic sherds would assist greatly in the classification of the sherds beyond the simple observational sorting scheme used in this thesis. Material analyses of the projectile points and stone beads from the site may also answer questions about the sourcing – that is, an analysis of the materials may show if the projectile points were made from locally available rock, or were brought to the area by temporary occupants or through trade networks. A possible treasure-trove of information may be found in those who excavated the site. If the students that participated in the field school could somehow be found, they could be interviewed to gain insight into the site. However, one must consider that the excavation took place close to fifty years ago and it may be difficult to find the students. Finally, once the questions of who occupied the site and for how long are answered, it is important that the assemblage be repatriated to the closest cultural descendants.

The irony of the phrase “future research” is not lost on the author. The collection was shuffled around the campus and stored away in trailers and cabinets for more than forty years, after all. If it was not for an unsuspecting intern with a fledgling interest in zooarchaeology, the collection may have fallen victim to the curse of the orphaned collections, never to see the fluorescent lights of an archaeological laboratory.

REFERENCES

- Adovasio, J. M. (1980). Fremont: An artefactual perspective. *Fremont Perspectives. Antiquities Section Selected Papers*, 7(16), 35-40.
- Amsden, C. A. (1949). *Prehistoric Southwesterners from Basketmaker to Pueblo*. Los Angeles, CA: Southwest Museum.
- Berry, M. S. (1980). Fremont origins: A critique. *Fremont Perspectives. Antiquities Section Selected Papers*, 7(16), 17-25.
- Binford, L. R. (1980). Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *American Antiquity*, 45(1), 4.
- Browne, J. (1940). Projectile points. *American Antiquity*, 5(3), 209-213.
- Buc, N., & Loponte, D. (2007). Bone tool types and microwear patterns: Some examples from the Pampa Region, South America. In R. B. Walker & C. G. St-Pierre (Eds.), *Bones as tools: Current methods and interpretations in worked bone studies* (pp. 143-157). Oxford, United Kingdom: BAR Publishing.
- Butzer, K. W. (1980). Context in archaeology: An alternative perspective. *Journal of Field Archaeology*, 7(4), 417-422.
- Campana, D. (1989). *Natufian and Protoneolithic bone tools: The manufacture and use of bone implements in the Zagros and the Levant*. Oxford, United Kingdom: BAR Publishing.
- Chafin, D. T. (2003). *Effect of the Paradox Valley Unit on the dissolved-solids load of the Dolores River near Bedrock, Colorado, 1988-2001*. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey.
- Chenoweth, W. L. (1987). Paradox Valley, Colorado; A collapsed salt anticline. *Rocky Mountain Section of the Geological Society of America*, 76, 339-342.
- Chisholm, B., & Matson, R. G. (1994). Carbon and nitrogen isotopic evidence on Basketmaker II diet at Cedar Mesa, Utah. *Kiva*, 60(2), 239-255.
- Christenson, A. L. (1986). Projectile point size and projectile aerodynamics: An exploratory study. *Plains Anthropologist*, 31(112), 109-128.
- Cordell, L. S. (1984). *Prehistory of the Southwest*. Orlando, FL: Academic Press.
- Crow Canyon Archaeological Center. (2013). *What does the site number mean?* Retrieved from <https://archive.li/K9fqj>
- Dean, J. S. (1994). The medieval warm period on the Southern Colorado plateau. *The Medieval Warm Period*, 26(2-3), 225-241.

- Doesken, N. J., Pielke, R. A., Sr., & Bliss, O. A. (2003). *Climate of Colorado* (Tech. No. 60). Fort Collins, CO: Climatography of the United States.
- Ford, J. A. (1954). The type concept revisited. *American Anthropologist*, 56, 42-43.
- Gamble, L. E. (2002). *SDSU-0369, CO-MN-1, PARCEOX, CO. NAGPRA narrative [DOC]*. Unpublished report, Department of Anthropology, San Diego State University, San Diego, CA.
- Gifford, J. C. (1960). The type-variety method of ceramic classification as an indicator of cultural phenomena. *American Antiquity*, 25(3), 341-347.
- Gunnerson, J. H. (1957). *An archaeological survey of the Fremont areas* (No. 28). Salt Lake City: University of Utah Press.
- Hansel, D. (1970, August 20). Ancient Fremont Indian culture now studied in work at Paradox Valley. *The Times-Independent*.
- Holmer R. N., & Weder, D. G. (1980). Common post-archaic projectile points of the Fremont area. *Fremont Perspectives. Antiquities Section Selected Papers*, 7(16), 55-68.
- Hughes, J. D. (1977). *American Indians in Colorado*. Boulder, CO: Pruett.
- Jochim, M. A. (1979). Breaking down the system: Recent ecological approaches in archaeology. *Advances in Archaeological Method and Theory*, 2, 77-117.
- Justice, N. (2002). *Stone age spear and arrow points of the Southwestern United States*. Bloomington: Indiana University Press.
- Kasper, J. (1972). *An analysis of mammalian fauna from the Paradox 1 site, Colorado* (Master's thesis). San Diego State University, San Diego, CA.
- Kharaka, Y. K., Ambats, G., Thordsen, J. J., & Davis, R. A. (1997). Deep well injection of brine from Paradox Valley, Colorado: Potential major precipitation problems remediated by nanofiltration. *Water Resources Research*, 33(5), 1013-1020.
- Kidder, A. (1932). Objects of bone. In *The artifacts of Pecos* (pp. 195-271). New Haven, CT: Yale University Press.
- King, V. M., Block, L. V., Yeck, W. L., Wood, C. K., & Derouin, S. A. (2014). Geological structure of the Paradox Valley Region, Colorado, and relationship to seismicity induced by deep well injection. *Journal of Geophysical Research: Solid Earth*, 119(6), 4955-4978.
- Lamb, H. H. (1977). *Climate: Present, past and future, vol. 2, Climate history and the future*. Methuen, London: Routledge.
- Leach, L. L., & Lippold, L. K. (1973). *Environment-subsistence relationships of the Fremont*. Research proposal submitted to National Science Foundation by California State University, San Diego, CA.
- Leckson, S. H. (2014). Thinking about the Fremont: The later prehistory of the Great Basin and the Southwest. In N. J. Parezo & J. C. Janetski (Eds.), *Archaeology in the Great*

- Basin and Southwest papers in honor of Don D. Fowler* (pp. 109-117). Salt Lake City: University of Utah Press.
- Lipe, W. D. (1993). The Basketmaker II period in the Four Corners area. In V. M. Atkins (Ed.), *Anasazi Basketmaker: Papers from the 1990 Wetherill-Grand Gulch Symposium* (No. 24, pp. 1-10). Salt Lake City, UT: Bureau of Land Management.
- Madsen, D. B., & Simms, S. R. (1998). The Fremont complex: A behavioral perspective. *Journal of World Prehistory*, 12(3), 255-336.
- Madsen, R. E. (1977). *Prehistoric ceramics of the Fremont (Museum of Northern Arizona Ceramics Series No. 6)*. Flagstaff, AZ: Museum of Northern Arizona.
- Matson, R. G. (2006). What is Basketmaker II? *Kiva*, 72(2), 149-165.
- Metcalfe, D., & Larrabee, L. V. (1985). Fremont irrigation: Evidence from Gooseberry Valley, Central Utah. *Journal of California and Great Basin Anthropology*, 7(2), 244-254.
- Mutel, C. F., & Emerick, J. C. (1984). *From grassland to glacier: The natural history of Colorado*. Boulder, CO: Johnson Books.
- Olsen, S. L. (1984). *Analytical approaches to the manufacture and use of bone artifacts in prehistory* (Doctoral dissertation). London, England: University of London.
- Olsen, S. L., & Wheeler, R. (1978). Bone and antler artifacts. In *Bones from Awatovi: Northeastern Arizona* (Vol. 70, pp. 40-74). Cambridge, MA: Harvard University.
- Paddayya, K. (1982). Ecological archaeology and the ecology of archaeology: The archaeologist's viewpoint. *Bulletin of the Deccan College Research Institute*, 41, 130-150.
- Peale, A. C. (1878). Geological report on the Grand River District. In F. V. Hayden (Ed.), *Report of progress of the exploration for the year 1876: U.S. Geological and Geographical Survey of the Territories tenth annual report* (p. 244). Washington, DC: Government Printing Office.
- Redd Ranches. (n.d.). *About us*. Retrieved from <http://www.reddranches.com/about-us/>
- Richards, K. K. (2014). *Fremont ceramic designs and their implications* (Master's thesis). Provo, UT: Brigham Young University.
- Richens, L. D. (2000). Ceramics. In J. C. Janetski (Ed.), *Clear Creek Canyon archaeological project: Results and synthesis. Museum of Peoples and Cultures Occasional Papers* (No. 7, Ch. 3). Provo, UT: Brigham Young University.
- Schlanger, S. H. (1992). Recognizing persistent places in Anasazi settlement systems. In J. Rossignol & L. Wandsnider (Eds.), *Space, time and archaeological landscapes* (pp. 91-112). New York, NY: Plenum Press.
- Schwinning, S., Belnap, J., Bowling, D. R., & Ehleringer, J. R. (2008). Sensitivity of the Colorado Plateau to change: Climate, ecosystems, and society. *Ecology and Society*, 13(2), 28.

- Simms, S. R. (1986). New evidence for Fremont adaptive diversity. *Journal of California and Great Basin Anthropology*, 8, 204-216.
- Simms, S. R. (2008). *Ancient peoples of the Great Basin and the Colorado Plateau*. Walnut Creek, CA: Left Coast Press.
- Sinopoli, C. M. (1991). *Approaches to archaeological ceramics*. New York, NY: Plenum Press.
- Spaulding, A. C. (1953). Statistical techniques for the discovery of artifact types. *American Antiquity*, 18, 305-313.
- Stone, T. (1999). *The prehistory of Colorado and adjacent areas*. Salt Lake City: University of Utah Press.
- Talbot, R. K. (2000). Fremont farmers: The search for context. In M. Hegmon (Ed.), *The archaeology of regional interaction: Religion, warfare, and exchange across the American Southwest and beyond* (pp. 275-294). Boulder: University Press of Colorado.
- Voss, B. L., & Kane, M. S. (2012). Re-establishing context for orphaned collections: A case study from the market street collections. *Journal for Museum and Archives Professionals*, 8(2), 87-112.
- Watkins, C. M. (2009). Type, series, and ware: Characterizing variability in Fremont ceramic temper. *Journal of California and Great Basin Anthropology*, 29(2), 145-162.
- Wheat, J. B., Gifford, J. C., & Wasley, W. W. (1958). Ceramic variety, type cluster, and ceramic system in Southwestern pottery analysis. *American Antiquity*, 24(1), 34-47.
- Wilde, J. D., & Soper, R. A. (1999). *Baker village: Report of excavations, 1900-1994* (Museum of Peoples and Cultures Technical Series No. 99-12). Provo, UT: Bingham Young University.
- Woodbury, G., & Woodbury, E. (1932). Archaeological survey of Paradox Valley and adjacent country in Western Montrose County, Colorado, 1931. *The Colorado Magazine*, 9(1), 1-21.
- Wormington, H. M. (1955). *A reappraisal of the Fremont culture with a summary of the archaeology of the Northern Periphery*. Denver, CO: Denver Museum of Natural History.
- Wright, A. (1970, July 20). Paradox dig better than expected. *The Grand Junction Sentinel*.