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Cover: Rendering of *Olivella* shell beads recovered from Nephi Mounds in central Utah. Cover image generated from a photograph provided by the Museum of Peoples and Cultures at Brigham Young University.

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Message from the Editor

The philosopher and Roman poet, Lucretius, once said, "Nothing from nothing ever yet was." With this phrase he was suggesting that everything (objects, organisms, ideas, etc.) that exist in the present have a unique genealogical history. Humans are genetically linked to their ancestors, technological innovations develop from previous breakthroughs, and philosophical ideas are founded upon previous musings. This concept can easily be applied to the purpose and history of this journal in that the information contained in the articles are largely built upon previous research. At the same time this new research will one day provide foundational information and concepts for new inquiries in the future. As the new editor of Utah Archaeology, I am thrilled to help build this intellectual legacy of research. This issue includes articles that are a great representation of the breadth of archaeological history in and around our state, both those in the recent past as well as in prehistory.

I would be remiss if I did not thank our outgoing editors, David Yoder and Chris Watkins, who have tirelessly worked to publish the wonderful research that can be found in the last seven issues (2006–2012). Their attention to detail, the diversity and breadth of the articles, and the thematic volumes have contributed significantly to our knowledge of Utah history and prehistory. They were able to accomplish a huge task in reviving our journal, and we owe them a debt of gratitude for this colossal feat.

Of course these recent volumes of the journal would not exist without the contributors who have submitted such important work. I look forward to working with you on the next several issues and encourage you to submit. It is only by making this information available to the public that we fulfill our duty as avocational archaeologists, scholars, scientists, and as stewards of the past.

The Editor

Michael T. Searcy

An Archaic Infant Burial from 42RI176, Northeastern Utah

Ronald J. Rood
Cultural Resource Analysts, Inc.

Andrew T. Yentsch
Environmental Planning Group, Inc.

Jack Pfertsh, Matthew Landt, and Rand Greubel
Alpine Archaeological Consultants, Inc.

Derinna V. Kopp
Antiquities Section, Utah Division of State History

Human burials dating to the Archaic period are uncommon in the archaeological record from Utah. Additionally, infant burials dating to the Archaic are especially rare. A recent chance discovery, of an infant burial during an archaeological survey, has led to a significant discovery of a 5,000 year old burial associated with wooden artifacts and a sage grouse feather.

During a pedestrian archaeological survey for a natural gas pipeline across northern Utah, archaeologists from Alpine Archaeological Consultants, Inc. recorded a small rockshelter just northeast of Woodruff, Utah, in Rich County (Figure 1). This rockshelter exhibited evidence of extensive digging completed by non-professional archaeologists. Chipped stone littered the small shelter and the slope below (Figure 2). Upon examination of the interior of the shelter, several bone fragments were found partially exposed in a side-wall profile. The field archaeologists (recognized the bone as a portion of a cranium from a small child or infant. The exposed human bone was approximately 15 cm below the top of the undisturbed site matrix. In accordance with Utah law (Utah Code §9-8-309), the Rich County Sheriff's Department was notified, as was the Utah State Antiquities Section.

The site was visited by staff from the Antiquities Section and Alpine Archaeological Consultants the day after the human bone was discovered. In consultation with the landowner, a decision was made to carefully excavate the human remains; the landowner wanted to continue to look for artifacts in the rockshelter but did not want to further disturb the human remains. The crew from Alpine recorded the site and it was assigned Smithsonian number 42RI176.

Under Utah code, the Antiquities Section and the Utah Division of Indian Affairs are the two state agencies responsible for implementation of Utah's state NAGPRA code. Rood consulted with Forrest Cuch, then the director of the Utah Division of Indian Affairs, who informed the Native American Review Committee about the discovery and the plan to scientifically excavate the remains as per the wishes of the landowner. The excavation was completed by Antiquities Section personnel (Rood et al. 2009).

Methods and Excavation

The current landowner and others had been digging in this rockshelter for many years and there was a scatter of chipped stone within the shelter and downslope. We began by examining the downslope area and an adjacent packrat midden for human bone removed by the rats or that eroded downslope. Excavation began by establishing a 1 m by 1 m grid unit and then removing soil matrix located above the exposed human bone. Limited excavation revealed that

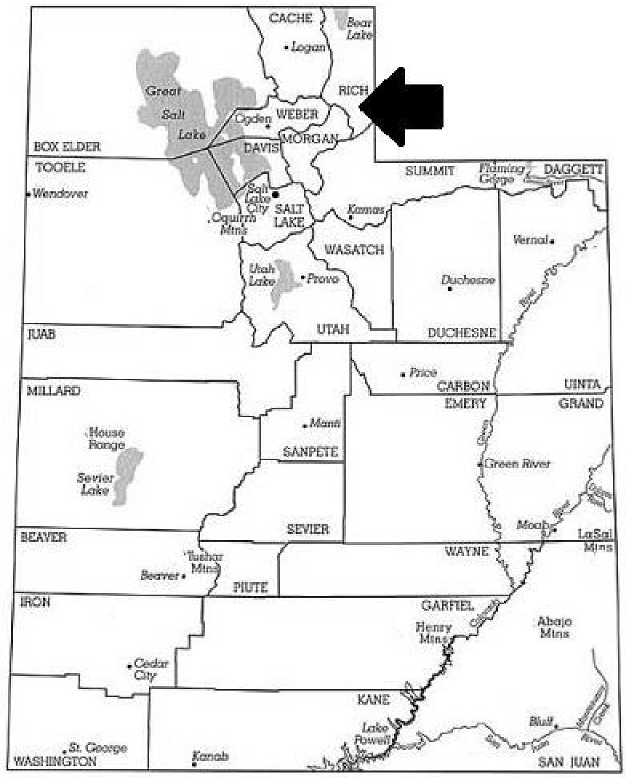

Figure 1. Map of Utah showing the general location of 42RI176.

the cranium, a few vertebrae, and several ribs were more or less *in situ*. Given the shallow horizontal depth of the rockshelter and the location of the exposed remains, we assumed that most of the post-cranial remains had eroded downslope. We screened samples of dirt from the disturbed context and did find several bones in the screen. Investigation of the adjacent packrat midden also resulted in the recovery of several bones. The excavation revealed that the infant was placed within a small pit. The fill within this burial pit was a slightly different color than the surrounding matrix, and it lacked rocks and bits of plant fiber that were ubiquitous in the rockshelter. We exposed the cranium and several ribs and vertebrae (Figure 3) and were able to trace the outline of the burial pit. The burial pit itself was basin-shaped, measured approximately 40 cm by 45 cm, and was approximately 35 cm deep.

While exposing the cranium, a feather was found in contact with the cranium (Figure 4). Below the feather, we encountered a patch of intact desiccated skin and hair on the right side of the cranium (Figure 5). Due to the fragile nature of the cranium and the presence of the dried tissue and hair, we removed the cranium within a block of dirt and placed it in a cardboard box, supported with tissue. Additional excavation of the cranium and separation of the tissue from the surrounding matrix took place in the archaeological laboratory at the Antiquities Section.

Once the human remains had been removed, we continued to excavate the remainder of the burial pit. Within the pit, two wooden artifacts were discovered. These two nearly identical artifacts, are complete and appeared to be in excellent condition (Figure 3). The focus of

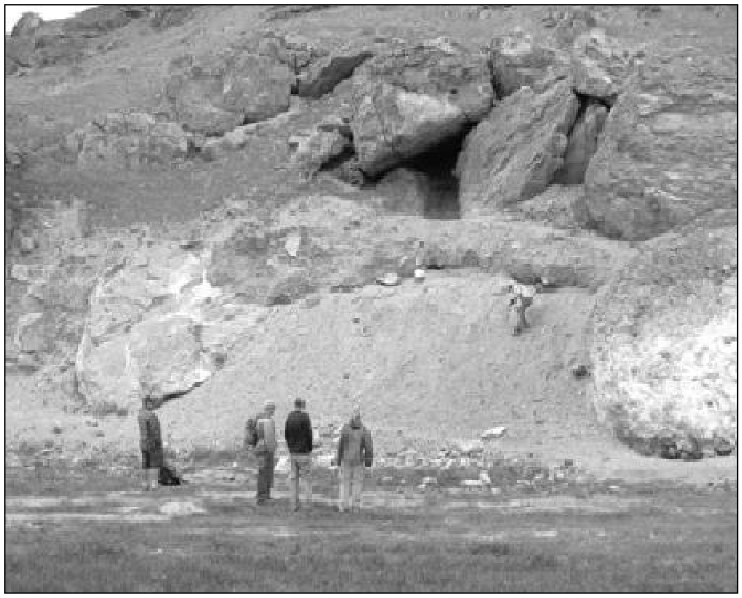

Figure 2. Small rockshelter (42RI176) where human remains were recovered.

our excavation was only to remove the human remains. We did not attempt to excavate any of the remaining intact matrix within the rockshelter.

Human Remains

Analysis of the human remains was completed by Derinna Kopp at the Utah State Antiquities Section. The remains represent the incomplete skeleton of an infant aged 2–3 months (Figure 6). Missing from the skeleton are the lower limb bones, the pelvis, and most of the vertebral column. The cranium, along with upper limbs, a few vertebra, and ribs and fingers were recovered. Even the tiny bones of the inner ear were present. Preservation was excellent, with hair and desiccated scalp still attached to the cranium. There was no evidence of trauma or pathology exhibited by the remains and sex could not be determined. There was no evidence suggesting the cause of death for the infant. Previous disturbance to the site prevents any firm conclusions about the orientation of the burial within the burial pit.

Associated Artifacts

Sage-Grouse Feather

The proximity of the feather to the skull suggests it was directly associated with the human remains. Although the feather was not dated, there was no evidence from our excavation suggesting that the feather was an intrusive item. That said, with the proximity of the packrat midden and the extensive disturbance that had taken place within the rockshelter, there could be some doubt about the context of the feather.

The feather was sent to Dr. Carla Dove, Program Manager of the Smithsonian Institution Department of Vertebrate Zoology, Division of Birds. Dr. Dove identified the feather as a wing feather from a greater sage-grouse (*Centrocercus urophasianus*). Rich County, Utah is within the historic range for the sage-grouse (Utah Division of Wildlife Resources 2009). Figure 7 is a photograph of the feather from 42RI176 taken by Dr. Dove after it had been cleaned.

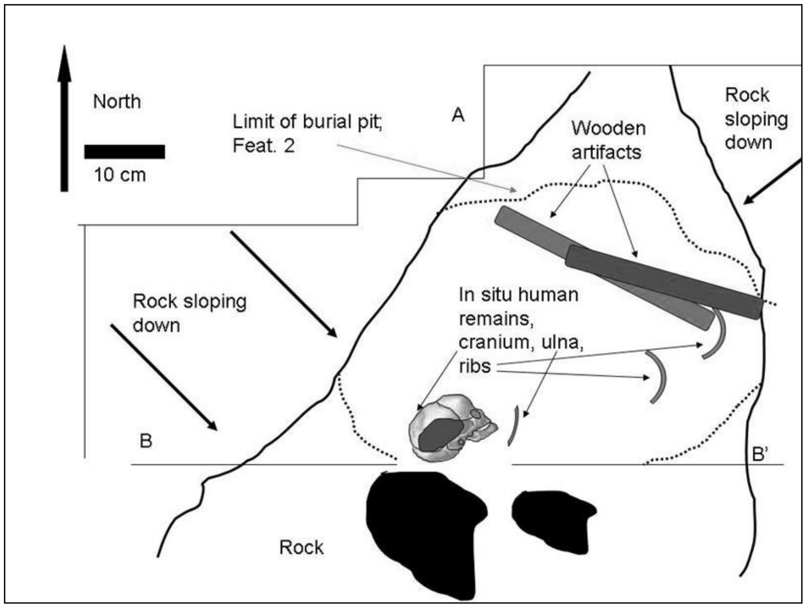

Figure 3. Plan map of the excavated area showing the outline of the burial pit, in-situ human remains, and the wooden artifacts.

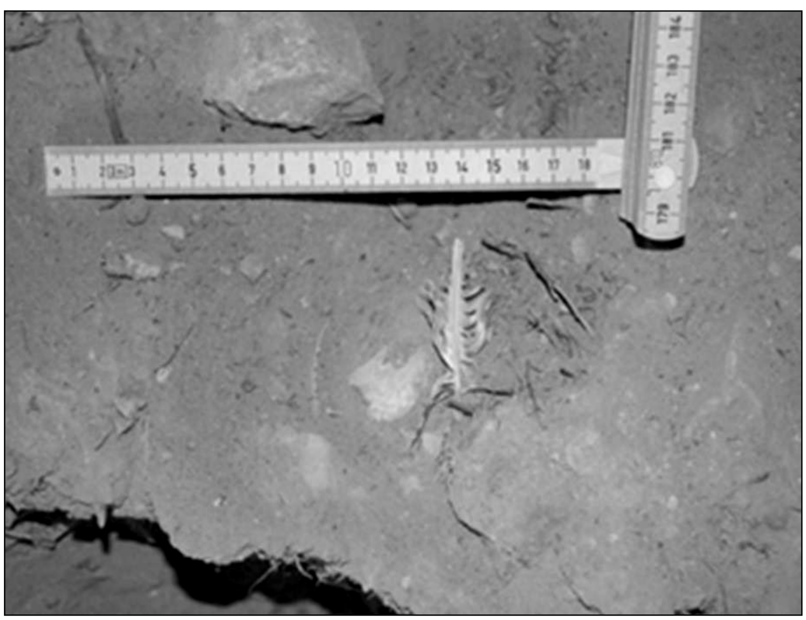

Figure 4. Sage-grouse feather in contact with the cranium.

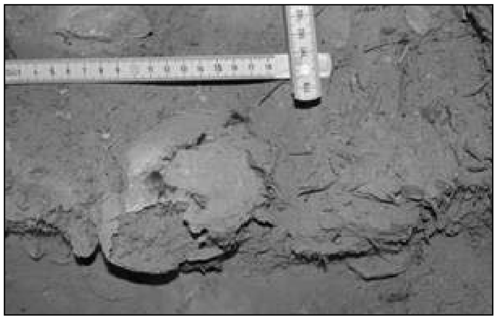

Figure 5. Human remains showing desiccated skin and hair.

Wooden Artifacts

Two wooden baton-like artifacts were located within the burial pit. One measures 28.6 cm in length and the other measures 30 cm in length. Their diameters range from 5–7 cm. Both were on the edge of the burial pit with one resting partially on top of the other (see Figure 3). Andrew Yentsch analyzed the wood and determined that the items are both made of Western chokecherry (*Prunus virginiana*). The function of these items is unknown. Both show deliberately cut and rounded ends and both show polish and hematite staining along the long-axis of the artifact (Figures 8 and 9). There is no evidence of battering on the ends that would imply a pounding or grinding function for these items. These items were shown to many individuals to try and get some idea of their function. Suggestions ranged from pestles to parts of a cradleboard. Tribal representatives from the Ute, Paiute, and Goshute tribes had no suggestions as to their function.

Radiocarbon AMS Dating

No diagnostic artifacts were found with the burial or within the rockshelter that might address the age of this burial. For that reason, a sample of the desiccated skin tissue was submitted for radiocarbon dating. In addition, a small sample of wood cored from one of the wooden artifacts was dated. These dates are presented in Table 1.

These samples are statistically different at the 95% confidence level (t=17.78049 Xi2 3.84, df=1). The presence of the older wooden artifacts within the burial pit and in association with the human remains may indicate these items were heirlooms placed in the pit with the child. An alternative interpretation could be the chokecherry wood was collected long after the plant had died and the artifacts were constructed from "old wood."

Discussion

Only a handful of Archaic period human burials have been reported from Utah and surrounding areas (e.g. Magennis et al. 2000; Rood 2013) and of these, the Archaic affiliation was uncertain for those reported from Deadman Cave (Smith 1952; Rood 2013). Documented Archaic burials from Utah include the Mosida burial (Janetski et al. 1992), human remains from Sudden Shelter (42SV6) (Jennings et al. 1980), a single pubis from Danger Cave (42TO13) (Jennings 1957:215), a human bone from Promontory Cave No. 2 (42BO2), and a possible Archaic burial from Stansbury Island (42TO2) (these remains were not dated [Steward 1937:103]). A burial from Rasmussen Cave within Nine-Mile Canyon, Utah, is likely Archaic in age (Gunnerson 1969), and Late Archaic human remains were found at the Thursday Site (42MD1053) (Shearin et al. 1996) and Elsinore (42SV2111) (Wilde and Tasa 1991).

Only one of these previously reported Archaic burials contain sub-adult remains. One burial from Sudden Shelter was that of a 3–4 year old child found flexed in a vertical position within a shallow pit. The pit was capped with a sandstone block (Jennings et al. 1980:103; Hylton and McCullough 1980).

Recently, additional Archaic period human remains have been recovered by the Antiquities Section and dates were obtained on several sets of remains from Deadman Cave (42SL1), which are curated at the Natural History Museum of

Table 1. Radiocarbon AMS Dates from Human Remains and Wooden Artifacts from 42RI176.

Sample Number	Material	Measured Age	Conventional Age	δ 13 C ‰	2 Sigma Calibration
Beta246763	Desiccated Skin (Human)	4700±40	4800±40	-18.7 o/oo	(cal BP 5333 to 5347) (cal BP 5355 to 5357) (cal BP 5370 to 5370) (cal BP 5465 to 5606)
Beta253060	Wood	5010±50	5070±50	-21.5 o/oo	(cal BP 5663 to 5674) (cal BP 5681 to 5687) (cal BP 5710 to 5919)

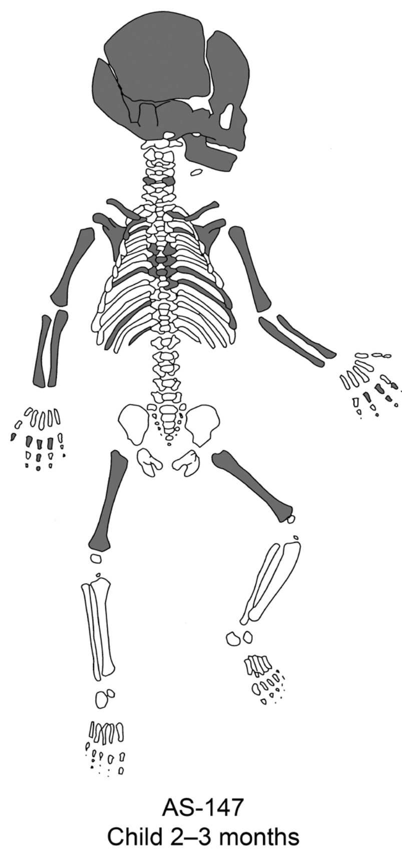

Figure 6. Human remains from 42RI176. Shaded areas represent skeletal elements recovered.

Figure 7. Sage-grouse feather from 42Ri176 being analyzed at the Smithsonian by Dr. Carla Dove.

Figure 8. Wooden artifacts from 42RI176.

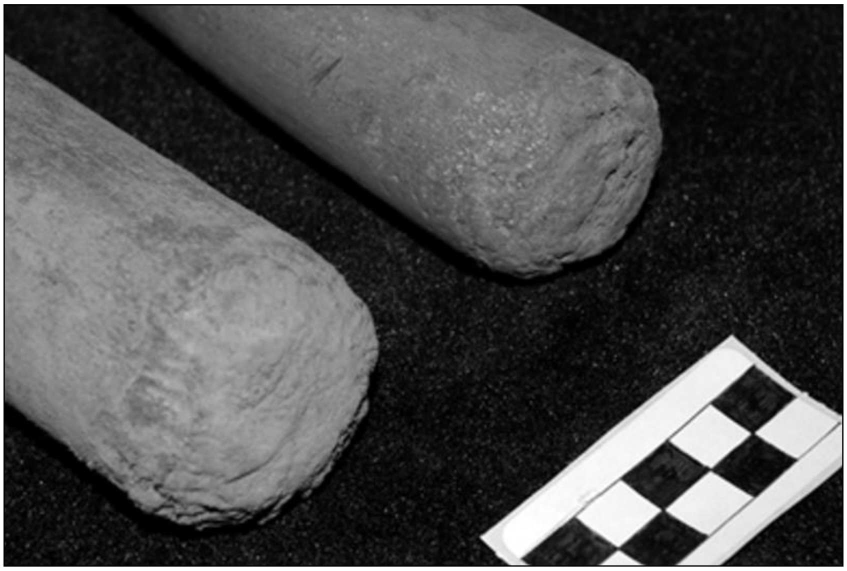

Figure 9. Wooden artifacts from 42RI176 showing the modified ends.

Utah. Most of the remains from Deadman Cave are Archaic (e.g. Rood 2013).

Of significance here is the discovery of two infants found during a construction project near Boulder, Utah. The remains from Site 42GA4616 were associated with a layer of dark, charcoal-stained sediments, and several artifacts including worked bone, a side-notched projectile point, and a metate (Latady 2000). The remains were highly fragmented due to postmortem damage, but did not exhibit any trauma or pathology. These human remains were dated to 6110±50 B.P. and 6210±50 B.P. (Beta 246762 and Beta 246763) (Rood 2013).

The burial from 42RI176 is a very well preserved Archaic burial of a small child only a few months of age. The child was buried in a pit in a small rockshelter, likely with a feather and two wooden batons of unknown function. The wooden artifacts are at least 200 years older than the burial itself and may represent significant heirlooms interred with the child. ■

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Protohistoric and Historic Metal Projectile Points in Utah

Andrew T. Yentsch
Environmental Planning Group, Inc.

Aboriginal weaponry constructed from historic metals are scarce in the archaeological record and in the archaeological literature for Utah despite their likely widespread use for a short but critical time in the relatively recent past. Before 2013, only two projects have formally reported their discovery in archaeological contexts in Utah. This paper describes twenty-one Protohistoric/Early Historic-era metal projectile points from eight sites.

The period between A.D. 1700 and 1850 was a time of drastic change for the indigenous inhabitants of what would become Utah, and the Great Basin and Colorado Plateau. This time period is generally referred to as the Protohistoric (Tuohy 1992; Arkush 1990), encompassing the time just prior to, and including the period of initial contact between native groups with the Spanish to the south, and later with American explorers and settlers. Contact with Euroamericans occurred at different times throughout the region, slowly expanding until, by the second half of the nineteenth century, a large number of permanent settlers, primarily Mormons, occupied the region and ultimately pushed the majority of the Native American inhabitants onto reservations. This was a time of rapid cultural transformation for Native Americans in the region that included technological transitions, changes in economic relations and social networks, and acculturation (Crabtree 1968; Tuohy 1992; Arkush 1990; Janetski 1991). Evidence of contact during this period is generally in the form of Euroamerican manufactured trade goods such as trade beads, axes, metal utensils, metal tinklers, and metal projectile points on otherwise aboriginal archaeological sites. Protohistoric sites are rare and difficult to detect, as aboriginal populations were generally small and highly mobile; and with few exceptions (see Janetski 1991:41), most groups had little in the way of material culture.

It is during the Protohistoric that the Numic groups occupying the region that would become Utah encountered Euroamerican trappers, traders, explorers, and pioneers. The historically known Paiute, Gosiute, Shoshone, Ute, and Navajo acquired elements of Euroamerican material culture through direct trade with, or raiding Euroamerican groups, or indirectly through other native groups of the region (Arkush 1990; Horn 1988). This was greatly facilitated for some groups (particularly the Northern and Southern Ute, and the Eastern Shoshone) following the introduction of the horse around A.D. 1700. Southern Ute groups acquired horses from the Spanish by A.D. 1680 (Conetah 1982; Forbes 1959), with the Northern Utes and Eastern Shoshone shortly thereafter (Callaway et al. 1986; Shimkin 1986:309). Especially in the eastern areas, horses increased Ute and Shoshone mobility, allowing them to focus on big game hunting and adopt Plains Cultural elements (Callaway et al. 1986; Jefferson et al. 1972; Fowler and Fowler 1971:8). Horses facilitated increased mobility and territorial expansion, changed subsistence pursuits, and increased trade opportunities. Some groups, particularly in the west, acquired the horse much later (e.g., the Goose Creek Shoshone in the 1840s [Madsen 1986:25]), or did not acquire the horse at all and maintained their pre-contact hunting and gathering lifestyle (Callaway et al. 1986; Stewart 1942). The Ute and Shoshone are both known to have hunted, traded, and to a lesser extent raided over a large area after the introduction of the horse, and their use of metal for utilitarian purposes and weaponry is well documented (Horn 1988). An increase in the presence of glass items (including trade beads), metal objects such as knives and scissors, and other items of Euroamerican origin in the archaeological sites in the region also occurred during this period (Arkush 1990).

Little is known about aboriginal weaponry constructed from historic metals in the region. As these artifacts are largely made of iron and usually found co-mingled in surface artifact scatters, the lack of information could perhaps relate to poor preservation. Some could be "hidden" in private collections of individuals (as suggested by the various collector's forums on the internet), or possibly that archaeologists in the field do not recognize these items as artifacts, or even confusing them for items of more recent manufacture.

Although scant in comparison to other material culture, archaeologists have identified considerable numbers of metal projectile points from sites in the western and southwestern United States. Review of available literature identified other sites containing these items in Arizona (Lyndon 2005; Formby 1986; Christenson 1987), Idaho (Willson 2008; Croney 2008; Plew 1989; Plew and Meyer 1987; Crabtree 1968), Nevada (Tuohy 1992), New Mexico (Boyer 2012 and references therein; Gibbs 2003), Texas (Brown and Taylor 1989; Chandler 1984, 1986, 1989, 1993; McReynolds 1982; Mitchell and Highly 1982; Smith 1984), and Wyoming (Vlcek 1992; Gardner et al. 1992; Frison 1978).

Unlike the surrounding states, references to metal projectile points in Utah are exceedingly rare. John Wesley Powell is known to have collected several iron-tipped arrows during his expeditions to Utah between 1867 and 1880 (Fowler and Matley 1979:151, 154), and M.S. Severance of the Wheeler Expedition reported the recovery of several iron arrowheads from a site in Beaver in 1872 (Metcalf 1974:13). Descriptions of individual items in the literature for Utah are available for three artifacts recovered from two sites (Dalley 1976; Janetski 2010). This paper describes twenty-one metal projectile points from eight sites. I am not proposing a specific typology or method for analysis, but merely presenting information on these unique artifacts to introduce them into the literature for the state. It is hoped that this will encourage others with knowledge of these items to add to this data and expand the knowledge base about this class of artifacts for the region.

Research for this paper involved tracking down metal projectile points in museums, private collections, and those mentioned in cultural resource management literature. Nineteen arrow-sized projectile points from seven sites were examined, measured, weighed, described and photographed for the present study. Summary descriptions of two metal projectile points described by Janetski (2010) were added as supplementary information, but were not analyzed. General locations of these finds are presented in Figure 1. While discussed separately, all data is presented in Table 1 (including data provided in Janetski [2010]), following the individual discussions. At least 18 additional artifacts from archaeological sites and collections (Church History Museum and Daughter's of Utah Pioneers Museum) are known to exist in Utah, but were not identified in time to be included in the present analysis, and are awaiting similar treatment.

Historic and Ethnographic Information on Metal Projectile Points in the Western United States

Lewis and Clark were the first to document use of metal projectile points on the Plains, and among the Lemhi Shoshone in Idaho in 1805 (Thwaites 1904:19). John Wesley Powell noted their use among the Shoshone, Ute, and Paiute of Utah during his explorations of the Colorado Plateau and eastern Great Basin (Powell 1961; Mason 1893:Plate LXXXIX). While there is

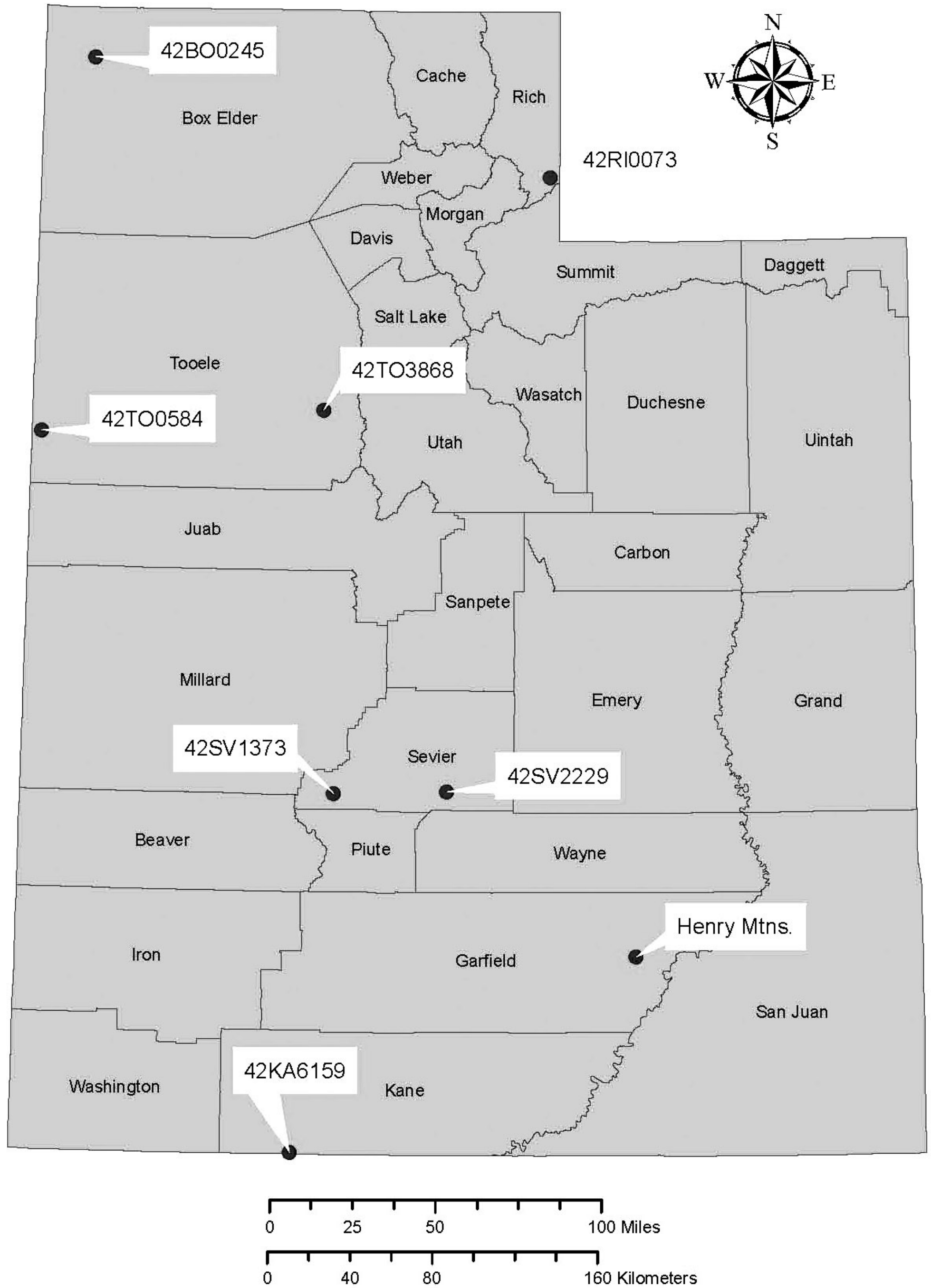

Figure 1. Map of Utah showing the locations of metal projectile points analyzed.

Table 1. Data for the specimens used in this study.

Site Number	FS	Total Length (mm)	Maximum Width (mm)	Maximum Thickness (mm)	Weight (g)	Stem Length (mm)	Neck Width (mm)	Shoulder Angle	Blade Width (mid.)
42BO245	6–27	58.7	14.3	0.8	2.3	12.2	4.4	130, 135	10.9
42KA6159	4	80.7	18.9	1.2	7.3	12.2	6.1	155, 140	16.1
*42RI73	1.1	8.2 cm	17.9	4.6	8.9	1.8 cm	17.9	NM	12.3
*42RI73	1.2	5.2 cm	17.0	2.2	6.0	1.4 cm	17.0	NM	10.2
*42RI73	1.3	8.3 cm	18.3	2.0	8.9	1.9 cm	18.3	NM	14.0
*42RI73	1.4	6.3 cm	21.3	5.7	13.1	NM	19.7	NM	19.6
*42RI73	1.5	7.7 cm	19.1	3.9	8.5	NM	NM	NM	13.9
*42RI73	1.6	6.1 cm	17.5	4.2	7.0	1.3 cm	7.7	NM	16.8
*42RI73	1.7	8.8 cm	18.9	5.1	9.4	2.1 cm	15.8	NM	15.1
*42RI73	1.8	6.3 cm	19.6	2.3	6.9	1.0 cm	19.6	NM	15.4
*42RI73	1.9	5.3 cm	20.1	2.9	5.0	1.6 cm	20.1	NM	5.8
*42RI73	1.10	8.1 cm	8.7	4.2	4.7	NM	8.7	NM	5.6
*42RI73	1.14	7.5 cm	19.2	2.6	9.6	2.3 cm	19.2	NM	12.7
*42RI73	1.15	7.3 cm	19.5	2.3	8.7	1.1 cm	19.5	NM	13.1
*42RI73	1.20	7.9 cm	16.4	9.0	7.8	2.6 cm	16.4	NM	8.0
42SV1373	–	62.6	19.1	3.7	7.3	18.8	9.9	100, 100	12.1
*42SV2229	–	39	18	N/A	NA	NA	NA	NA	NA
*42SV2229	–	46.7	20.1	1.2	NA	NA	5.7	NA	NA
42TO584	3	42.5	14.1	0.9	1.9	8.5	6.1	115, 120	8.2
42TO3868	T1	75.7	15.9	1.6	5.4	11.5	5.2	95, 105	10.1
Henry Mountains	–	42.3	11.0	1.4	2.9	10.8	6.4	95, 95	9.3

* not analyzed by the author; NM - not measured

sparse ethnographic documentation of the use of metals by the aboriginal inhabitants of the region, metal projectile points, knives, and spear and lance points appear in paintings and photos from the region during the nineteenth century (George Catlin [2002], Edward S. Curtis [1997], A. Frank Randall [2006], and others). As reported by Hansen (1975:26), citing Lewis and Clark and Tabeau, metal arrowheads were already common on the Plains in 1805. Metal projectile points have been occasionally reported from surrounding states, with references for these items more common in the literature in the east, on the Plains, and in the southwest, Texas in particular (Chandler 1984, 1986, 1989, 1993; McReynolds 1982; Mitchell and Highley 1982; Smith 1984). They are, however, virtually invisible in the literature for Utah.

Arrowheads are known to have been created from iron, brass, and copper acquired through trade with Euroamerican trappers, traders, and settlers (Hanson 1975; Frison 1978; Boyer 2012; Tuohy 1992:3). American and European cutlery firms produced metal points, with traders also manufacturing items for sale and trade. Commercially produced projectile points were widely distributed to Native American groups in the American West, and Hanson (1975) states that metal arrowheads enjoyed a wider usage and variety of manufacturing sources than any other trade object adapted from Euroamerican technology. Pierre Chouteau, Jr. and Company (American Fur Company, Western Territory), Hudson's Bay Company, trading post blacksmiths, and others are known to have produced these items locally for trade with Native American groups (Rood 2010; Gardner et al. 1992). Commercially produced projectile points often exhibit notched or serrated stems that provide a secure mount on the arrow shaft. They also tend to be symmetrical, proportionally consistent, and often possess an ovate blade. Companies would often mark or stamp logos and initials on these trade points (refer to Boyer 2012:28; Hansen 1975).

Native Americans would also sometimes manufacture projectile points from "salvaged", "scavenged", or "recycled" metals discarded by others (Tuohy 1992; Boyer 2012). Scavenging or recycling generally focused on iron or steel, although scraps of brass from gun parts were sometimes used. Iron hoops from wooden barrels were useful for making projectile points, as they were thin and required less effort to manufacture points than thicker and harder metals (Boyer 2012; Tuohy 1992:10). An early publication on the weaponry of the indigenous inhabitants of North America shows several arrows collected from Utah, Idaho, and Arizona tipped with "hoop iron" points (Mason 1893: Plate XLIV). Implements were formed by cutting with a cold-chisel, or pounding (with a hammerstone type implement and anvil stone) to initially shape and flatten the metal, then filed to finish and sharpen. In contrast to those points commercially produced for trade, outlines of Native-manufactured articles are often triangular in form, and are asymmetric and irregular.

It is rare to find aboriginal tools manufactured from Euroamerican items (metal projectile points specifically) on archaeological sites; either manufactured by Euroamericans for trade, or manufactured by Native Americans for their own use. Frison (1978:76) stated that metal projectile points and knives "were common surface finds a few decades ago but most have now rusted away." Poor preservation of the items on open-air surface archaeological sites likely affects their discovery, but is not the only factor limiting them from the archaeological record. A lack of awareness regarding Protohistoric metallic artifacts among archaeologists likely also affects their identification. Another possibility is that these items have been encountered as isolates and have therefore not entered into the statewide dataset, as federal and state agencies, and the Utah State Historic Preservation Office does not maintain these types of records. Prior to 2013, only three of these artifacts have been described in the literature from sites in Utah, providing little more than simple measurements (Dalley 1976:100; Janetski 2010:60, 90–91).

Metal Projectile Points in Utah

At the onset of this research project, only Dalley (1976) and Janetski (2010) formally reported on the presence of metal projectile points in archaeological contexts in Utah. Dalley's (1976) description provided limited information, but the artifact was available for reanalysis and is detailed under the section for Kimber Shelter (42BO245). Janetski's (2010) report is more thorough, and the artifacts were not re-analyzed for this project. They are, however, briefly described under the section for Moon Ridge (42SV2229).

Beyond the previously recorded sites with metal projectile points, it was difficult to ascertain other examples existing in archaeological collections statewide. The author first conducted a search of records on file at the Utah State Historic Preservation Office to determine whether or not metal projectile points have been identified at archaeological sites in the state. The author then contacted several archaeologists with a long history in Utah. These individuals included Kevin Jones (former State Archaeologist for Utah), Ron Rood (former Assistant State Archaeologist), Joel Janetski (Professor Emeritus, Department of Anthropology, Brigham Young University [BYU]), Marian Jacklin (USFS Archaeologist, Dixie National Forest), Bob Leonard (USFS Archaeologist, Fishlake National Forest), Byron Loosle (BLM Utah State Archaeologist), and other agency and professional archaeologists statewide. Several institutions were also contacted to ascertain whether or not metal projectile points (iron, steel, or brass) existed in their collections. Institutions contacted include the Natural History Museum of Utah at the University of Utah (NHMU), the Museum of Peoples and Cultures at BYU, the Hutchings Museum in Lehi, Fremont Indian State Park near Richfield, Utah, and the Daughters of Utah Pioneers Museum in Ogden.

42SV2229: Moon Ridge

Two metal projectile points were discovered during BYU's work in the Fish Lake area between 1993 and 1995 (Janetski 2010). The first was a complete iron projectile point recovered from the surface of Structure 1, Excavation Area 1 at Moon Ridge (42SV2229) in Sevier County. Janetski (2010:60) described the tool as a rather well-preserved metal projectile point with fine serrations visible on the stem. Janetski further suggests that the serrated stem and symmetrical ovate blade represent a projectile point obtained through trade rather than manufactured from salvaged material (Janetski 2010:60). Although the report provided no formal measurements, artifact measurements were extrapolated from the photographs presented. The tool measures approximately 39 mm in length, has a maximum blade width of 18 mm, and measures roughly 5 mm wide at the base of the stem. The lateral margins appear to have been sharpened, as both edges exhibit slight beveling (Janetski 2010:49). Other diagnostic artifacts recovered from the surface of the same area include an Elko series projectile point, a Cottonwood Triangular, and a Desert Side-notched projectile point.

The second metal projectile point described by Janetski (2010:90–91) is a complete iron artifact recovered from the uppermost 5 cm of fill of a 2-by-2.5 m semi-circular alignment of stones (Structure 2), in Excavation Area 3 at Moon Ridge. Janetski observed Fremont and Late Prehistoric/Protohistoric projectile points (Rosegate, Desert Side-notched, and Cottonwood Triangular), as well as brownware ceramics (Paiute-Shoshone Wares) on the surface of the site and in the same deposits. It is interesting to note that Structure 2 was the only feature at the site to contain additional historic items, including a tinkler cone, a metal offset awl, glass "seed" beads, and shotgun shell casings. The Protohistoric/Historic component of the site dates roughly between A.D. 1861 and 1931 (Janetski 2010:90).

The iron projectile point recovered from Structure 2 is heavily rusted, but exhibits a contracting stem with rounded shoulders. The tool measures 46.7 mm in length, has a maximum blade width of 20.1 mm, and measures 1.2 mm in thickness. The proximal end of the stem measures 5.7 mm wide (Janetski 2010:91).

42BO245: Kimber Shelter

Kimber Shelter (42BO245) is located near the north end of the Grouse Creek Range, Box Elder County. The site is a 62-foot-wide, 25-foot-deep east-facing shelter that was excavated by the University of Utah in 1970. No chronometric dates are available from Kimber Shelter. Although detailed elsewhere (Dalley 1976:91–106), the artifact assemblage showed evidence of a long occupational history, spanning the Archaic (characterized temporally by the presence of Humboldt and Pinto Series projectile points), Fremont (marked by Rose Spring and Eastgate projectile points, as well as Great Salt Lake Gray Fremont ceramics), and Protohistoric (based on the single iron projectile point). With the exception of the ceramic artifacts and worked bone, the assemblage suggests this location served as an intensive, but infrequently used hunting camp (Dalley 1976:99).

Excavations at Kimber Shelter resulted in the recovery of one iron projectile point (1970.5–24341; FS 6–27) in Stratum 3 of the shelter, which includes the surface to roughly 10 cm below. The artifact is curated at the NHMU. Dalley (1976:100) described the point as a complete but badly corroded long, slender projectile point. This specimen (Figure 2) measures 58.7 mm in length, is 14.3 mm wide, and is 0.8 mm thick in the hafting area. The tool exhibits a blunted, rounded tip with a straight-sided, elongated triangular blade. Shoulders are abrupt and angled, with an obtuse shoulder angle (130 to 135 degrees). The tool has a neck width of 4.4 mm, with a pronounced stem 12.2 mm long and 6.2 mm wide. The stem is excurvate in the center and constricting at both ends, meaning it is wider in the center than it is at the shoulders and the base (Dalley's "diamond-shaped" stem). Stem margins are irregular/asymmetrical, and while not truly serrated, the stem does exhibit two small indentations on one side that may have provided grip for the hafting material to hold the point in place in the shaft of the arrow. The stem is irregular in outline and terminates at a point.

Significant corrosion obscures any visual indication of smoothing or abrasion from use. The lateral margins, though corroded, appear to have been sharpened, as both edges exhibit slight beveling. In addition, there is what appears to be a groove at the haft area, and the surface of the artifact is less weathered in this one particular area than elsewhere on the tool (Figure 3). It may be that this is the result of the hafting material decaying not long before the artifact was recovered. The artifact possesses no stamp or other indication of manufacturer.

42KA6159

Site 42KA6159 is a Southern Paiute artifact scatter in Kane County dating from the late- 19th to mid-20th century. The site measures 250 by 159 m, and is located on a low ridgeline overlooking Jackson Flat to the north. Prehistoric material on the site consists of 400–500 pieces of lithic debitage, two biface fragments, an iron projectile point, a brown chert bifacial scraper, a quartzite mano fragment, and a quartzite hammerstone (Gourley 2006). No features were noted. No chronometric data is available from this site.

The projectile point from this site (Figure 4; FS4) measures 80.7 mm in length, is 18.9 mm wide, and is 1.2 mm thick in the hafting area. The tool exhibits a blunted, rounded tip with a straight-sided, elongated triangular blade. Shoulders are abrupt and angled, with an obtuse shoulder angle (140 to 155 degrees). The tool has a neck width of 6.1 mm, with a pronounced stem 12.2 mm long and 9.1 mm wide. The stem is excurvate in the center and constricting at both ends; exhibiting a diamond-shaped outline. Stem margins are irregular/asymmetrical, and

Figure 2. Metal projectile point from site 42BO245 (1970.5-24341; FS 6-27). Courtesy of the Natural History Museum of Utah.

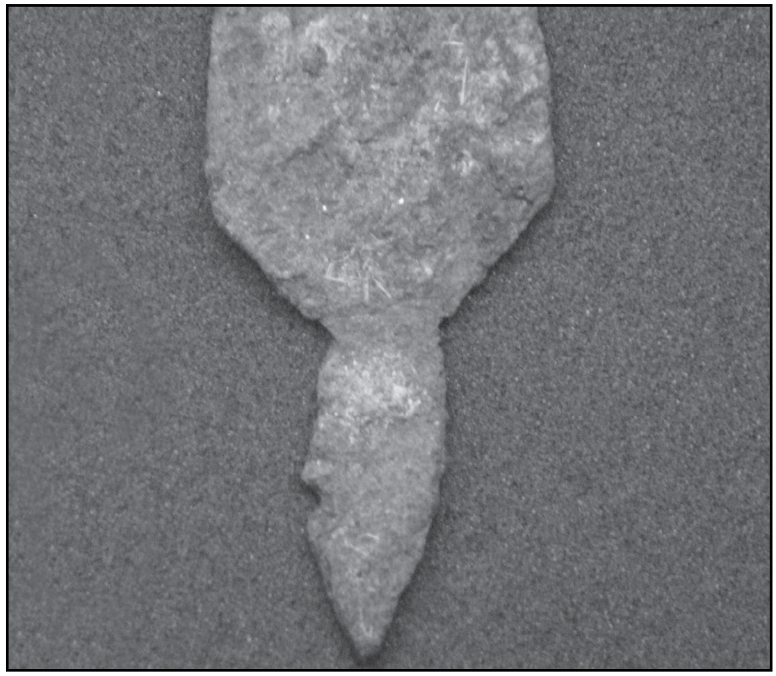

Figure 3. Close up of hafting area of projectile point from site 42BO245 (1970.5-24341; FS 6-27). Note discoloration and possible hafting groove at neck. Courtesy of the Natural History Museum of Utah.

while not truly serrated, the stem does exhibit small indentations that may have provided grip for the hafting material to hold the point in place in the shaft of the arrow. The stem is irregular in outline and terminates at a point.

Significant corrosion obscures any visual indication of smoothing or abrasion from use. The lateral margins, though corroded, appear to have been sharpened, as both edges exhibit slight beveling. The artifact possesses no stamp or other indication of manufacturer.

42RI73

Site 42RI73 comprises two sets of human remains and associated goods discovered by local ranchers and analyzed by the Antiquities Section of the Utah Division of State History in 1998. The site is located near Crane Creek in Rich County, approximately 5 miles west of Evanston, Wyoming. The remains and artifacts were discovered in a rock crevice approximately 15 m in length, 1 m to 1.5 m high, and 1 to 2 m deep (Rood 2010:7). Analysis indicated that two individuals were interred: a female aged 31–35 years, and a male aged 15–16 years, both likely Shoshone (Rood 2010:13). The human remains and all associated artifacts were reinterred with the human remains and were not available for analysis.

The associated artifact assemblage is a collection of everyday utensils, material goods and artifacts belonging to the two individuals. Recovered artifacts included metal projectile points, chain, buckles, a ceramic pipe, files, awls, a spoon, bells, buttons, lead balls, a stirrup, silver items, a bundle of straight pins, a large mammal bone, fire striker and flint, and what may have been a leather pouch. A total of 3,201 beads were found around the female skeleton, which was lying on top of a woven blanket consisting of cloth and part of a bison skin (Rood 2010).

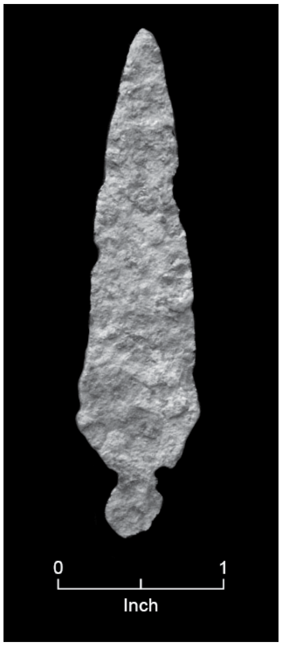

Figure 4. Projectile point from site 42KA6159 (FS4). Photograph by the author.

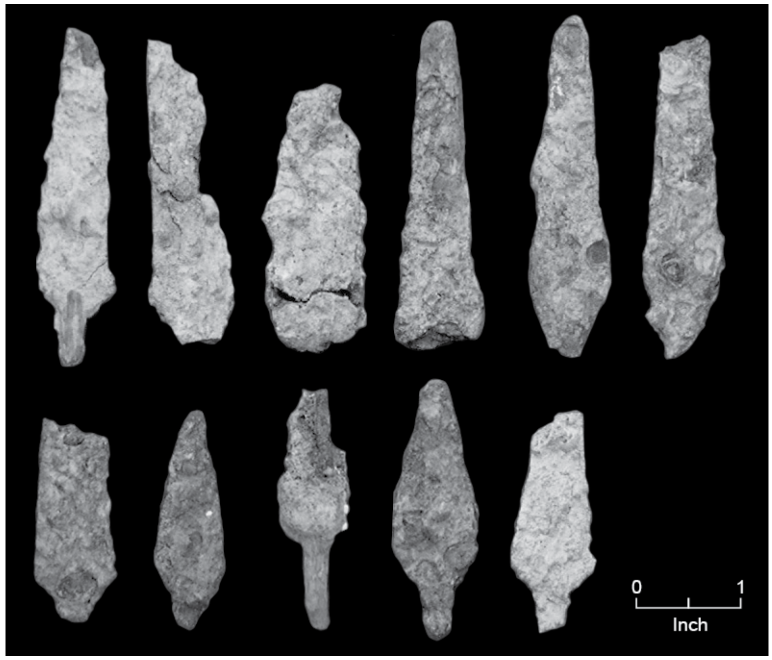

Figure 5. Metal projectile points from site 42RI73. Photo courtesy of Ron Rood.

Thirteen metal projectile points were recovered from this site (Figure 5). These projectile points range in length from 6.6 to 10.8 cm, with an average length of 8.5 cm, and range in weight from 4.7 grams (g) to 13.1 g. There are two different shapes represented in this collection. Several are long with a tapering base (FS's 1.3, 1.5, 1.7, 1.10, 1.14, and 1.15), and are similar to those from the Central Plains (the western portion of the Dakotas, southeastern Montana, eastern Wyoming, and western Nebraska) described by Hanson (1975) as diamond-shaped arrowheads. The remaining seven projectile points (FS's 1.1, 1.4, 1.8, 1.9, 1.10, 1.16, and 1.20) are stemmed. Rood (2010) completed detailed measurements of these artifacts and that report provides the information included in Table 1. None of these projectile points exhibited any commercial cutlery names or stamps during analysis. Based on their overall consistent size and shape, it is likely these items were produced commercially (Rood 2010:40).

Based on the analysis of diagnostic artifacts, the assemblage from 42RI73 suggests a date between A.D. 1840 and 1890 (Rood 2010:55–56). A small sample of bone from the female skeletal remains was submitted to Beta Analytic for AMS radiocarbon dating. The analysis results suggest the remains are a bit older than what is suggested by the artifact assemblage alone (2-Sigma calibrated ranges of A.D. 1540, A.D. 1630 to 1680, and A.D. 1740 to 1810), raising questions about the dates themselves or concerning the association of the items with the remains. That issue, however, is outside the scope of this paper.

42SV1373: Lott's Farm

Lott's Farm is an historic farmstead and Fremont habitation on the north bank of Clear Creek, in Sevier County. The site was discovered, tested, and excavated by the Antiquities Section of the Utah Division of State History as part of the I-70 construction project, and described elsewhere (Talbot et al. 1999).

Figure 6. Metal projectile point from site 42SV1373 (AS-81-1-424; F18). Courtesy of the Natural History Museum of Utah.

One metal projectile point (Figure 6; AS-81-1-424; F18),) was recovered from this site and is curated at the NHMU. The artifact is 62.6 mm in length, has a maximum width of 19.1 mm, and is 3.7 mm thick in the hafting area. It has a pointed tip, and the blade exhibits an elongated triangular form with straight edges. The shoulders are abrupt and angled, with a perpendicular to slightly obtuse shoulder angle (100 degrees). The tool has a neck width of 9.9 mm. It has a pronounced stem 17.6 mm long and 7.4 mm wide. The stem is straight-sided to slightly constricting. The stem margins are straight but undulate slightly, due to corrosion. No serrations or notches are present. The base of the stem is straight.

Corrosion of this artifact obscures any signs of smoothing or abrasion from use-wear. Artifact thickness suggests that it was created by a cold-chisel technique. This technique employs a tempered steel chisel to remove excess metal (to trim or shape) when the work cannot be done easily with other tools such as a hacksaw, file, or bench shears. The lateral margins, though corroded, appear file-sharpened, as both edges exhibit slight beveling. No stamp or indication of manufacturer was observed.

Although researchers identified artifacts representing Archaic through Late Prehistoric utilization of this locale, Paiute Brownware ceramics and a scraping tool made from historic amethyst glass suggest an additional Protohistoric occupation. It has been suggested by Talbot and others (1999:136) that the Protohistoric artifacts identified at this site represent use of the area between A.D. 1800 and 1877, when Joe Lott and his family settled the area.

42TO584

Site 42TO584 is a large, open lithic scatter in the Deep Creek Valley of western Utah. Bureau of Land Management archaeologists first identified this site in 1990 and described it as a prehistoric lithic scatter containing 100 to 500 pieces of lithic debitage, ground stone, and fire-cracked rock. One Elko Corner-notched projectile point, one Desert Side-notched projectile point, one iron projectile point, and two brownware ceramic sherds were collected from the site surface (Robb 1990). No chronometric data is available for this site. The artifacts are curated at the NHMU.

Robb (1990) noted one Protohistoric unspecified metal projectile point (Figure 7), completed an illustration and collected it, but no measurements or physical description of the artifact is provided on the site form. The iron point (UMNH.A.2008.41; FS 3) is 42.5 mm in length, is 14.1 mm wide, and is 0.9 mm thick in the hafting area. It has a blunted, rounded tip and the blade is an elongated triangular form with straight edges. The shoulders are abrupt and angled, with an obtuse shoulder angle (115 to 120 degrees). The tool has a neck width of 6.1 mm. It has a pronounced, constricting stem

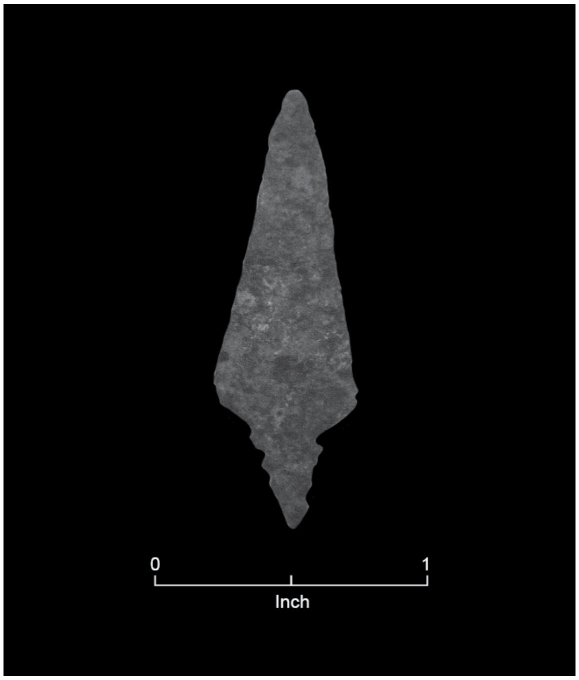

Figure 7. Metal projectile point from site 42TO584 (UMNH.A.2008.41; FS 3). Courtesy of the Natural History Museum of Utah.

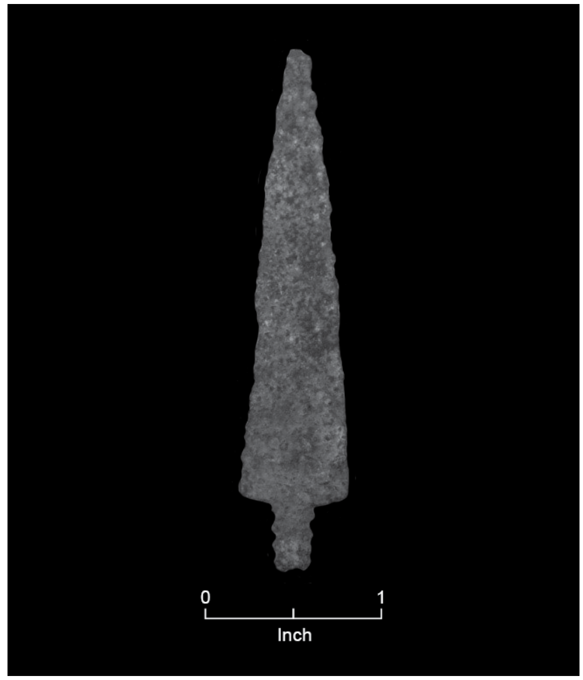

Figure 8. Metal projectile point from site 42TO3868 (T1). Photo by the author.

8.5 mm long and 6.1 mm wide that terminates at an asymmetric point. The stem margins are irregular/asymmetric and exhibit serrations angled toward the proximal end.

Corrosion of this artifact obscures any signs of smoothing or abrasion from use-wear. The lateral margins, though corroded, possess evidence of sharpening, as both edges exhibit slight beveling. No stamp or indication of manufacturer was observed.

42TO3868

Site 42TO3868 is located in a low flat area near the historic Ajax Underground Store and the Union Pacific Railroad line, in Juab County. The site is multi-component, consisting of a sparse scatter of 30 pieces of lithic debitage, one fire-cracked rock concentrations, three ground stone artifacts, two ceramic concentrations (Great Salt Lake Gray and Shoshone Brown Wares), three projectile points (Rosegate Series, Desert Side-notched, and a Cottonwood Triangular), five bifaces, and one drill fragment (Huffman 2009). Diagnostic artifacts consist of Fremont and Late Prehistoric/Protohistoric artifacts, and suggest site use sometime between 850 and 100 B.P.

The Protohistoric/Historic component of the site consists of a small, discrete artifact scatter located within the larger prehistoric site. Historic artifacts include one metal projectile point, one amber glass bottle neck, several fragments of an olive bottle, two hole-in-cap cans, several amethyst glass fragments, one bullet fragment corroded to a point where diagnostic attributes were not obtainable, and several pieces of miscellaneous metal. Diagnostic artifacts indicate that the historic component reflects use from the Protohistoric Period into the early 20th century, roughly 1800 to 1915 (Huffman 2009).

The projectile point from this site is iron (Figure 8; T1), is 75.7 mm in length, is 15.85 mm wide, and is 1.6 mm thick in the hafting area. It has a blunted, rounded tip and the blade is an elongated triangular form with straight-to slightly convex edges. Shoulders are abrupt and angled, with a perpendicular to slightly obtuse shoulder angle (95 to 105 degrees). The tool has a neck width of 5.0 mm. It has a pronounced, straight-margined stem 11.5 mm long and 5.2 mm wide. The stem exhibits regular-symmetric serrations angled toward the proximal end. The base is somewhat irregular, with what appears to be an intentional concavity.

Corrosion of this artifact obscures any signs of smoothing or abrasion from use-wear. The lateral margins, though corroded, appear to have been sharpened, as both edges exhibit slight beveling. No stamp or indication of manufacturer is visible.

Henry Mountains Projectile Point

This site from which this artifact was identified has yet to be recorded. It was discovered by a wildlife specialist with the Utah Division of Wildlife Resources in the Trail Canyon area, at the southeast edge of the Henry Mountains in Garfield County. Observed artifacts include tin cans, metal fragments, bottles and glass fragments, and lithic debitage. It is presently unknown what period the site dates to, but based on informant descriptions, artifacts were deposited sometime between the 1880s and 1915.

The iron projectile point from this site (Figure 9) measures 42.3 mm in length, is 11.0 mm wide, and is 1.4 mm thick in the hafting area. It has a blunted, slightly rounded tip and the blade is an elongated triangular form with straight edges. One lateral edge exhibits a steep edge angle the entire length of the blade (31.7 mm), suggesting filing of the blade. The shoulders are abrupt and angled, with an obtuse shoulder angle (95 degrees). The tool has a neck width of 6.4 mm. It has a pronounced, constricting stem 10.7 mm long and 4.8 mm wide that terminates at an asymmetric point. The stem margins are irregular/asymmetric and exhibit serrations angled toward the proximal end.

No evidence of smoothing or abrasion from use-wear is present. The lateral margins, though corroded, possess evidence of sharpening, as both edges exhibit beveling. No stamp or indication of manufacturer was observed.

Discussion

All of the projectile points examined in this study are stemmed varieties with no evidence of notching. Five specimens (42BO245, 42KA6159, 42TO584, 42TO3868, and the Henry Mountains artifact) exhibit serrations on the stem that would have provided better grip for the hafting material to hold the point in place in the shaft of the arrow. All artifacts examined contain evidence of file shaping or sharpening, consisting of beveled edges.

While there is some variability in form, the projectile points examined in this study are similar to other points from surrounding states (Tuohy 1992:2, 11 for Nevada; Frison 1978:73 for Wyoming; Croney 2008:17 for Idaho; Chandler 1993:30 for Texas). Although Tuohy has assigned affiliation for the points in his study (1992:11), I think there are too many similarities in point form across the region, and do not think it is possible to assign particular points to specific groups at the present time. The data set is too small and there is no geographic patterning evident.

Given the present data, I also think there is no way to determine whether or not these items were the product of Native manufacture, or of Euroamerican manufacture. Unlike Idaho, Wyoming, and New Mexico, no evidence has been found in Utah of either Euroamerican or Native American projectile point manufacturing locations (Crabtree 1968:38–42; Gardner et al. 1992; Boyer 2012). Method of manufacture (shear-cut versus cold chisel) was not discernible; nor were any marks suggestive of battering, a method used for thinning, shaping, and refining metal implements (Crabtree 1968:38). With the exception of the artifact from 42SV1373, however, all projectiles in this study are thin in profile, exhibit serrated stems, are symmetrical and are proportionally consistent: suggestive of commercial manufacture (refer to Boyer 2012:28; Hansen 1975; Janetski 2010:60). None of the specimens in this study contain manufacturer's marks or stamps.

With one exception, 42RI73, no chronometric data is available for dating these artifacts. All sites contain lithic debitage and other stone artifacts that are indistinguishable from earlier prehistoric sites. Three sites (42SV2229, 42TO584, 42TO3868) contain Late Prehistoric diagnostic lithic projectile points (Cottonwood Triangular and Desert Side-notched varieties), and three contain Late Prehistoric/Protohistoric ceramics (Paiute/Shoshone Brown wares). Three sites (42SV2229, 42TO3868, and the Henry Mountains site) contain Historic-era artifacts that allow for cross-dating. Collectively, the projectile points in this study show use of metal arrowheads in Utah between A.D. 1800 and 1915.

Although no metallurgic analyses were conducted in this study, it appears that all artifacts are ferrous with the majority being of various types of iron while one (42SV1373) is considerably thicker in profile and appears to be made of steel. Additional studies of this artifact class would benefit greatly from metallurgic studies in that patterns in the elemental signatures are somewhat standardized and can be correlated with specific time periods (Willson 2008:13), and may allow for more precise temporal parameters for those sites on which they are discovered.

A review of ethnographic material for the historic Shoshone, Ute, Paiute, and Gosiute of the region (Steward 1941, 1943; Stewart 1939, 1941, 1942; Lowie 1924; Kelly 1964; Smith 1974; Janetski 1991), however, found almost no mention whatsoever of metal arrowheads. Only Steward (1941:237) mentions three iron projectile points collected from a Snake River Shoshone by the Peabody Museum at Harvard, even though Sapir states that by the time of his studies of the Shivwits Southern Paiute (1910), arrowheads were almost exclusively made of iron

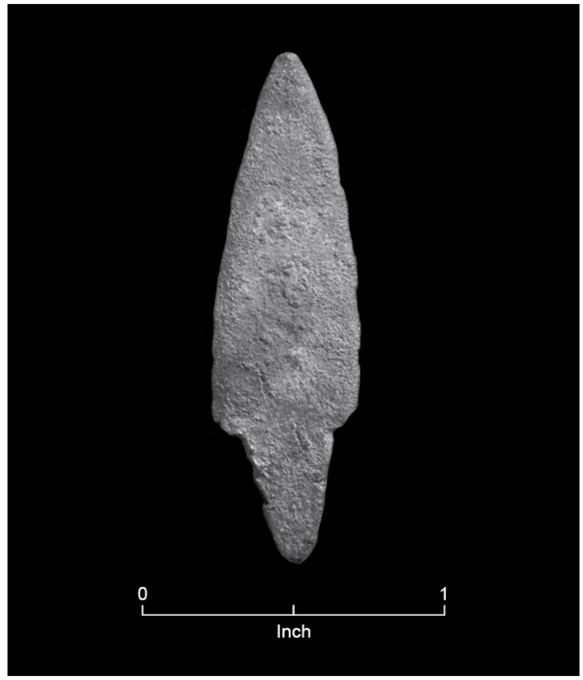

Figure 9. Projectile point from the Henry Mountains. Photo by the author.

(refer to Fowler and Matley 1979:65). During his explorations in Utah between 1867 and 1880, Powell reported seeing stone arrow points being manufactured by Shoshone, Pahvant and Uintah Ute, and Southern Paiute. He also collected metal-tipped arrows from the region during this time (Fowler and Matley 1979). As part of Simpson's expedition across the Great Basin in 1859, C.R. Collins (1860:470) described the Paiute word for "iron" as the same as the word for "knife", suggesting knowledge of metals and their inclusion in the native toolkit. Is the lack of information pertaining to metal projectile point reflective of ethnographic bias and the desire to document traditional technologies? Or is it reflective of the limited availability of metal to the primarily pedestrian Protohistoric/Early Historic (A.D. 1700 to approximately 1890) occupants of Utah? If this were the case, then we would expect to find more metal items on Ute and Shoshone sites in the eastern and northern portions of the state. This is not evident at the present time.

While not a focus of this paper, several avenues of inquiry could be addressed through additional research. Potential research avenues include the socio-economic role of projectile points and how this may have changed after the introduction of metals into the Native American toolkit (Boyer 2012; Woods 2009; Woodburn 1968); questions of technological transitions in point form and function (primarily relating to use in hunting or warfare), which may have necessitated changes in arrow technology (construction), and whether or not functional differences exist in arrowhead size, weight, and morphology (Pyszczyk 1999); whether or not group affiliation can be discerned through the analysis of metal projectile point styles, as has been done with certain lithic tools and ceramics; and conducting metallurgic analyses of the point collection to get a better idea of the temporal parameters for the sites on which they were found, that may assist in addressing questions outlined above.

Conclusion

The Protohistoric Period (A.D. 1700 to roughly 1850) and Early Historic (post A.D. 1850) was a time of extreme cultural transformation for Native Americans in the western United States. Initial contact with Euroamericans in the 19th century brought rapid changes in economic relations and social networks, technological transitions, and acculturation (Crabtree 1968; Tuohy 1992; Arkush 1990; Janetski 1991). Evidence of contact during this period is generally in the form of Euroamerican manufactured trade goods such as trade beads, metal utensils, metal tinklers, and metal projectile points on otherwise aboriginal archaeological sites. Without the rare discovery of metal arrow points or worked glass, Protohistoric sites (or components of sites) are nearly impossible to identify without chronometric (or tree-ring) data. Twenty-one metal projectile points from eight archaeological sites are described in this paper.

As mentioned in the introduction, the intent of this paper is not to propose a specific typology or method for analysis, but merely to present information on these rare artifacts and to introduce them into the literature for Utah. It is hoped that this will encourage others with knowledge of these items to add to this data and expand the knowledge base about this class of artifacts for the region. At least 18 additional artifacts from archaeological sites and collections (Church History Museum and Daughter's of Utah Pioneers Museum) are known to exist in Utah, and are awaiting similar treatment. As the data set for this artifact class grows, researchers will be better suited to address questions related to Native American interaction, exchange, and trade on both intra- and inter-group scales, projectile point form and function and the potential technological transitions in arrow construction, and Native American socio-economic transitions during the Protohistoric/Historic era. ■

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Using 3D Laser Scanning Technology to Document the Sand Cliff Signatures Site Historic Inscriptions, Iron County, Utah

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This article reports the results from the Sand Cliff Signatures Public Archaeology project conducted by USU Archeological Services. Here we employed terrestrial LiDAR scanning technology to document what remains of the historic inscriptions left by participants of the 1849–1850 southern expedition of Parley P. Pratt in Fremont Canyon, Iron County, Utah. By using LiDAR we were able to produce a high resolution digital surface model of the historic inscriptions. The model preserves the spatial context of the panels and allowed us to isolate historic names and dates related to the 1849 expedition from subsequent inscriptions. This project highlights the benefits of using LiDAR and photogrammetry in documenting historic sites and provides a summary of our results.

INTRODUCTION

Rock art researchers employ a variety of methods to document and depict pictographs and petroglyphs, ranging from the traditional hand-drawn sketches accompanied by written descriptions to three-dimensional digital models aided by high resolution photogrammetry and topographic laser scanning. Three-dimensional digital documentation, particularly laser scanning technology, offers clear advantages over more traditional approaches such as photo journals, rubbings, tracings, or castings. Comparatively quick and inexpensive, laser scanning methods generate high resolution, quantifiable, objective, and replicable data sets with negligible impacts to the physical integrity of rock art panels (Haynes and McCarthy 2006; Trinks et al. 2005).

Slowly, archaeologists and, notably, cultural resource managers are adopting these new technologies to document, monitor, and interpret rock art sites (Eklund and Fowles 2003; Haines and McCarthy 2006; Hurst et al. 2009; Simpson et al. 2004; Trinks et al. 2005). For example, Gonzalez-Anguilera et al. (2009) employed non-invasive three-dimensional survey methods to build integral and multi-scalar models of Paleolithic Caves in Northern Spain. The digital models incorporated natural (chambers, walls, and tunnels) and cultural features (rock art panels) that produced high resolution photo realistic virtual animations. This newly rendered three-dimensional perspective facilitated new research into artistic element placement, use of space, and other anthropological research issues (Gonzalez-Aguilera et al. 2009).

Not only can LiDAR (light detection and ranging) data generate new methods of interpretation and visualization; those data can be used to monitor impacts to rock art. Barnett et al. (2005) and Vogt and Edsall (2010) employed scanning LiDAR data converted for use in geographic information systems (GIS) software packages to locate types and extent of various weathering processes on rock art panels. In both cases, the researchers identified a host of weathering types including fissures, disintegration, salt leaching, lichen growth, and even paintball residue (Barnett et al. 2005; Vogt and Edsall 2010). These research projects indicated that spatially-referenced, high-

Figure 1. Overview of the Sand Cliff Signatures Site with terrestrial LiDAR equipment.

resolution LiDAR data taken over a period of time can be used to identify sub-millimeter scale levels of surface material loss or accumulation on surfaces.

In 2011, USU Archeological Services (USUAS) conducted the Sand Cliff Public Archaeology Project. Here we employed terrestrial LiDAR scanning technology to document what remains of the historic inscriptions left by participants of the 1849–1850 southern expedition of Parley P. Pratt in Fremont Canyon, Iron County, Utah (Figure 1). However many of the inscriptions left by Pratt's expedition are illegible due to erosion and more recent superimposed graffiti (Peart et al. 2012). Recording the panels with LiDAR produced digital, high-density topographic surfaces with point spacing of less than 1 mm. Overlain with projected and draped high-resolution digital images we created three-dimensional depictions of the inscription panels. High resolution documentation allowed us to isolate historic names and dates related to the 1849 expedition from subsequent inscriptions. This project highlights the benefits of using LiDAR and photogrammetry in documenting historic sites and provides a summary of our results.

SOUTHERN EXPEDITION OF PARLEY P. PRATT (1849–1850)

The following historical summary of the Southern Expedition of Parley P. Pratt (1849–1850) borrows from the more detailed historical accounts provided by Smart and Smart (1999a) and Fish (1992). Following colonization of the Salt Lake Valley by the Mormon Pioneer Company in 1847, it became apparent to Brigham Young that with several tens of thousands of converts on their way to the territory, he needed a comprehensive colonization program. Identifying new settlement locations, discovering economic resources, and spreading out the population to alleviate resource strain within the Salt Lake Valley became key operating principles of Young's strategy (Fish 1992).

At the November 1849 meeting of the Legislative Assembly of the Provisional Government of the State of Deseret, Young requested that Parley P. Pratt lead an expedition to explore the region to the south of Salt Lake City (Fish 1992). Following Young's command, the committee commissioned Pratt to lead the expedition. Pratt (1964:365) wrote in his autobiography:

> I now received a commission from the Governor and Legislative Assembly of the State of Deseret to raise fifty men, with the necessary teams and outfit, and go at their head on an exploring tour to the southward . . . This company was soon raised, armed and equipped and ready for a march into the dreary and almost unknown regions of southern Utah.

Events transpired rather quickly. By 22 November, Pratt had gathered most of the necessary supplies, equipment, and the majority of the company at the home of John Brown near Salt Lake City (Smart and Smart 1999b). Among the provisions and equipment, Pratt (1964:366) lists

> 12 wagons; 1 carriage; 24 yokes of cattle; 7 beeves; number of horses and mules, 38; average in flour, 150 lbs to each man; besides crackers, bread and meal. One brass field piece; firearms; ammunition in proportions.

As was customary for Mormon groups at the time they organized in a company of fifty men, with five groups of ten, each with their own captain (Pratt 1964). The assembled group voted Pratt as president of the company with William W. Phelps and David Fulmer as his counselors. The company also voted John Brown as Captain of the Fifty, William W. Phelps as Topographical Engineer and Ephraim Green as Chief Gunner (Pratt 1964). Table 1 contains the names of the men in the party when they departed the Salt Lake Valley.

On the morning of 24 November 1849, the party headed south from Brown's home (Brown 1941). Hampered by winter storms and deep snows, the company passed Fort Utah, present-day Provo, and camped at Hobble Creek. Over the next week the company travelled on established wagon roads into Juab Valley and then to the newly established settlement at Sanpitch by 3 December 1849. Before departing the settlement, on 5 December, the company added two wagons and five men: Madison D. Hamilton, Gordon G. Potter, Sylvester Hewlit, Edward Everet and John Lowry (Brown 1941).

For the next two weeks, the party endured sub-zero temperatures and nearly continuous winter storms as they traveled along the Sevier River to present-day Marysville. From here, the party continued south to Circleville Valley. Robert Campbell wrote, "The valley terminated in an impassable canyon, and abrupt chain of mountains sweeping before and on each hand, and the river rushing like a torrent between perpendicular rocks" (Fish 1992:72). The company remained in the valley while scouts searched for a pass over the mountains to the west connecting to the Little Salt Lake Valley. Arriving at camp after a day of scouting, Captain John Brown and Robert Campbell reported finding "a route very difficult, but not impassable, winding over a succession of canyons with steep ascents and descents, nearly perpendicular in places, with rocks and cobblestones all the way" (Fish 1992:80). The group decided to take this route over the mountains in the hope that they would find passage to the Little Salt Lake Valley. This route proved to be very arduous as historian Rick J. Fish (1992:81–82) explained:

> The company descended and ascended these steep rocky passes, while much of the way, shoveling snow as high as 4–6 foot in order to make the trail. Occasionally they dismounted their horses and stamped a double track where the animals and wagons would follow. In some places twenty men would use axes, spades and picks to open up narrow gaps in the trail.

On 20 December, Pratt and Brown rode into camp after finding a pass leading into the Little Salt Lake Valley. Although they named the pass, Brown's Pass, after its discoverer John Brown, the area is now known as Fremont Pass and Fremont Canyon after John C. Frémont who famously explored the area a few years later. While passing through Fremont Canyon on 21 December 1849, several members of the party inscribed their names on a rock face they named "Cornish Rock" now known as the Sand Cliff Signatures site (42IN418). John C. Armstrong (Armstrong 1848–1849, emphasis added) wrote in his journal:

> After passing through the canyon . . . the rocks at some sides very much like theramparts of some ancient Baronial castle such as was used in feudal times . . . there was a range of stupendous rocks, one was named Cornish rock on account of its resemblance to a cornice work done by stone mason and cut to put over doors. *I cut my name on the face of these rocks, and many more had I the time*.

John C. Armstrong's deeply incised name remains the most prominent at the site. Smart and Smart (1999a) identified inscriptions made by Henry Heath and possibly Homer Duncan, William Wadsworth, Christopher Williams, John Holladay, and John and William Matthews at the Sand Cliffs Signature Site. Local ranchers claim other historic signatures, including those made by John C. Frémont and his party, were formerly visible at the site (Peart et al. 2012).

Continuing west through Fremont Canyon, the party reached Red Creek, present-day Paragonah, on 23 December. Here they decided to split up. Pratt led a group on horseback to explore the Virgin River region, while the remaining balance of the company continued to explore the Parowan and Cedar Valleys. The party reassembled near Parowan and started back towards Salt Lake City on 10 January 1850. They made it as far north as present-day Fillmore where the combined effects of bitterly cold temperatures, deep snows, and limited feed for their animals made it impossible for the oxen and wagons to continue.

Again, they decided to split up. Pratt and about half of the men departed north on horseback while the others remained with the wagons. Pratt's mounted group made it to about 50 miles south of Fort Utah before exhaustion, lack of food, and inclement weather halted the party. Pratt and Chauncey West took the strongest horses and headed north to Fort Utah. The returning rescue party helped the mounted group return to Salt Lake by the end of January 1850. The wagon party remained snow-bound for the next seven weeks but eventually made it to Salt Lake City by the end of March (Smart and Smart 1999a).

In total, the group traversed about 536 miles, with an additional 190 miles travelled by the group that explored the Virgin River region on horseback (Smart and Smart 1999a; Figure 2). The official report produced by the party listed 26 places south of the Salt Lake Valley desirable for settlement (Pratt 1964; Smart and Smart 1999a). Within 15 years, Brigham Young sent settlers to all of these locations including Payson (Peteeneet Creek), Juab Valley (Yohab), Nephi, Salina, Richfield, areas near St. George, Parowan, Cedar City, Fillmore, Harmony, and Santa Clara (Smart and Smart 1999a, 1999b).

3D LASER SCANNING METHODS

LiDAR documentation for the project employed a Leica ScanStation2 terrestrial laser scanner (TLS or ground-based LiDAR) to capture high-density, topographic data points on the outcrop surfaces that contain the historic inscriptions. The Leica ScanStation2 equipment employs a high-speed, pulse laser (scan rate up to 50k points per second) integrated with a high-resolution digital camera. The equipment delivers survey-grade, locational point data with single positions accurate to 6 mm and distance measurements to 4 mm (one sigma accuracy at 50 m). We established five instrument setup locations (101–105) to minimize the effect of shadowing from different perspectives while

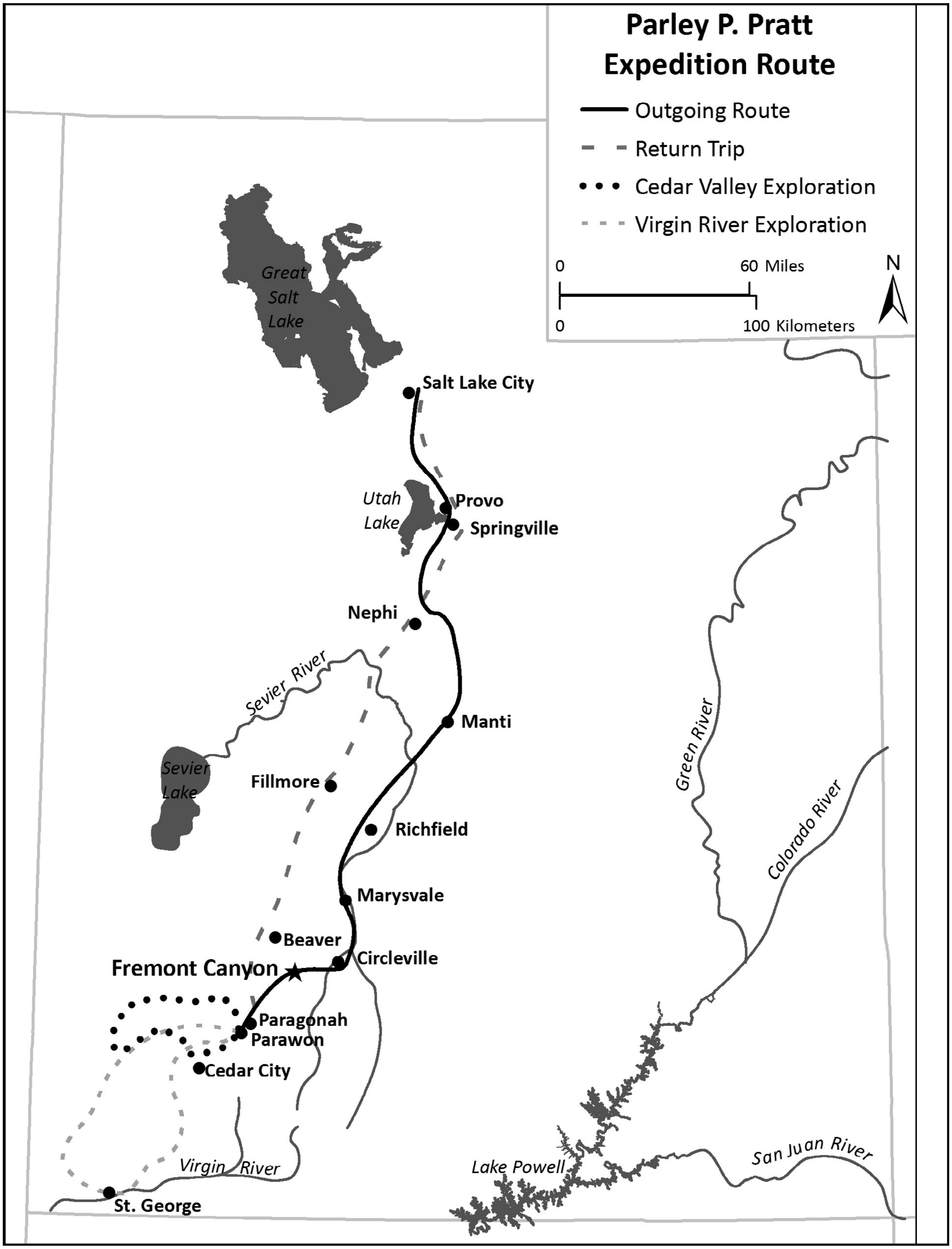

Figure 2. Overview map showing the route of the southern expedition of Parley P. Pratt (1849-1850). Adapted from Smart and Smart (1999:x).

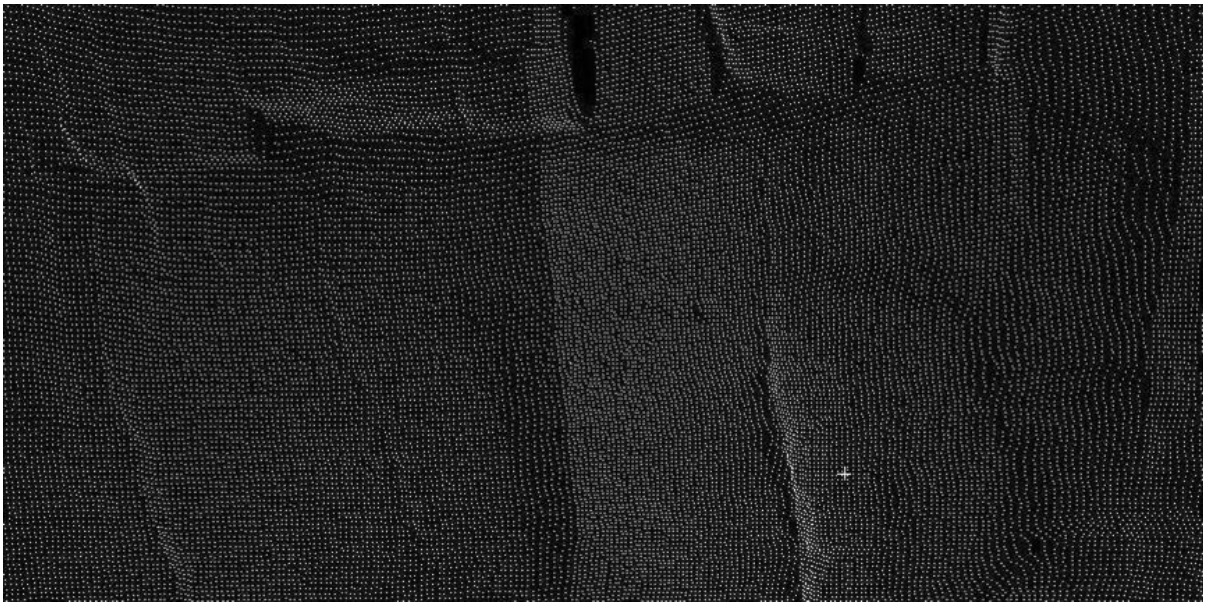

Figure 3. Raw LiDAR point cloud data generated from the main signature panel, reduced point sample for visual effect.

maintaining point spacing of 1 mm or less within the core area of inscriptions (one million points per square meter). Collected raw LiDAR data was downloaded and post-processed with Cyclone Scan and Leica TruView software suites. The LiDAR documentation of the panels generated well over 20 million X, Y, Z and intensity value individual data points (Figure 3). The documented area measures about 12 m long by 3 m tall with a core area about 4.5 m in length.

We also produced written descriptions and photographed the core area of inscriptions using a series of digital cameras equipped with a range of lenses and from multiple angles. With Cyclone Scan software, mosaicked high-resolution digital images were draped over the LiDAR point cloud data which produced three-dimensional virtual walk-through animations of the entire documented outcrop in QuickTime user navigable file formats (Figure 4). LiDAR and digital photographic documentation of the site produced a high-resolution record that preserves the spatial context of the rock surface with an inventory of discernible historic inscriptions.

PROJECT RESULTS AND DISCUSSION

By implementing LiDAR scanning and digital photography we were able to accomplish two primary project goals. Our first goal was to create a quantifiable and replicable digital model of the historic signature panels that inventories all inscriptions and preserves their spatial context. The second goal was to use this digital model to explore data manipulation (e.g., geospatial statistics, map algebra, spatial filtering) and visualization techniques to indentify inscriptions and possibly rock art not readily apparent to the unaided eye.

To accomplish our first goal, we mosaicked orthorectified digital photographs to produce a panoramic image of the entire rock surface (Figure 5). We digitized all visually recognizable inscriptions on the panoramic image using Adobe Illustrator and cross-checked the results with our field descriptions of the panels and existing site documentation (Figure 6). Of the 1849 party members, we were only able to visually identify John C. Armstrong's and the barely decipherable Henry Heath's inscriptions. The

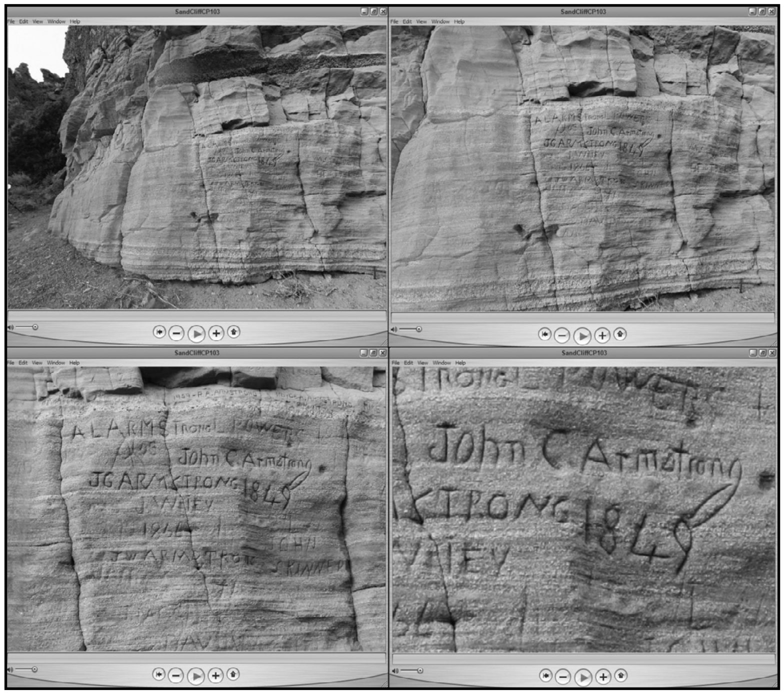

Figure 4. Selection of screen shots generated from QuickTime walk-through animation.

Figure 5. Panoramic image of the Sand Cliff Signatures main historic inscription panel, produced from mosaicked digital photographs.

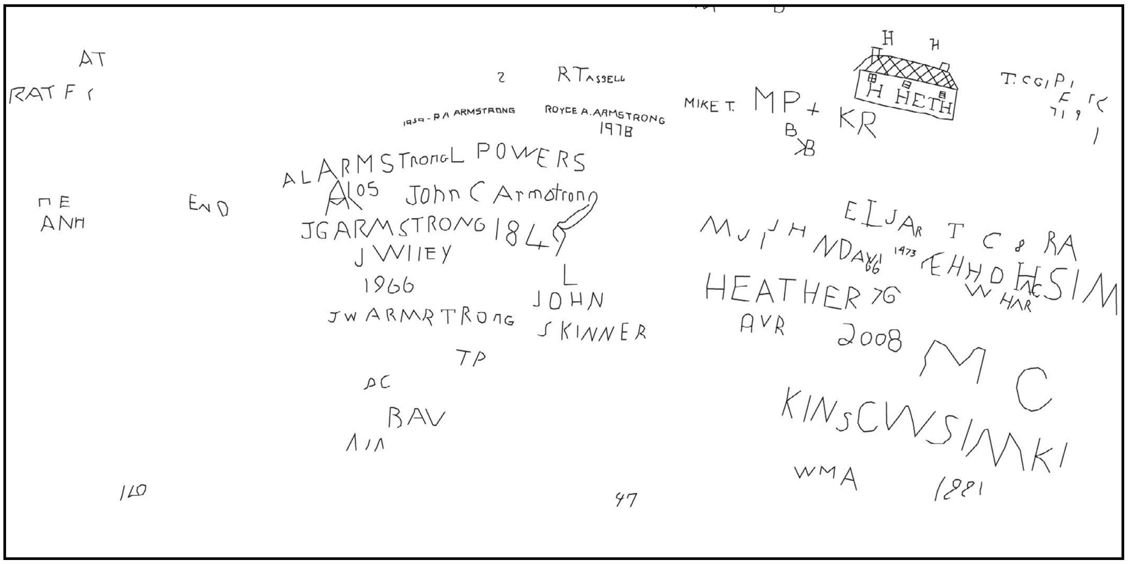

Figure 6. Overview sketch depicting visually identified inscriptions at the Sand Cliff Signatures Site.

other inscriptions tentatively identified by Smart and Smart (1999a) were not identified probably due to erosion and superimposed graffiti.

John C. Armstrong's name remains the most prominent inscription at the site and is encircled with several of his descendants' engravings (Figure 7). These include his son, John G. Armstrong, to the left; two of his sons, Arthur Leroy (L.A.) Armstrong and John W. Armstrong; and John G. Armstrong's wife, Mary Ann Jane Simkins's brothers, Hezekiah Simkins and Charles Simkins Jr. More recently, another descendent, Royce A. Armstrong appears to have visited Sand Cliff twice, once in 1959 and again in 1978, leaving his signature both times. Evidently, the Sand Cliff Signatures Site remains an important traditional landmark for the descendants of John C. Armstrong. The prominence of John C. Armstrong's inscription may indicate the signature is periodically maintained by his descendants.

To fulfill the second project goal, topographic point data were exported from selected areas of the panels as comma-delineated files compatible with ArcGIS software. We converted the raw point data using ArcGIS Versions 9.3.1 and 10.1 into ESRI shapefiles and with ArcGIS Spatial Analyst toolkit generated two-dimensional raster datasets. Raster data represents a matrix of identically-sized square cells where each cell stands for a spatial location and stores a value (e.g., elevation or intensity). Our field methods generated data with sub-millimeter point density allowing us to produce high resolution rasters with about 1 mm cell dimensions. Due to the irregular shape of the outcrop surface, inevitably some grid cells remained unsampled due to shadowing. We used the ArcGIS Spatial Analyst raster interpolation function, in this case Natural Neighbor, to estimate the values of these unsampled cells thereby filling in the gaps and producing continuous raster representations of selected areas of the rock surface containing the historic inscriptions.

We tested a host of different visualization strategies and geostatistical surface manipulation techniques (e.g., interpolation, map algebra, spatial filtering) primarily available within the ArcGIS Spatial Analyst suite of functions to investigate which methods generated the best results. We consulted previously–conducted, LiDAR-based studies of rock art inscriptions (Eklund and Fowles 2003; Haines and McCarthy 2006; Hurst et al. 2009; Simpson et al. 2004; Trinks et al. 2005) and tested a number of techniques including surface derivatives (e.g., slope and aspect),

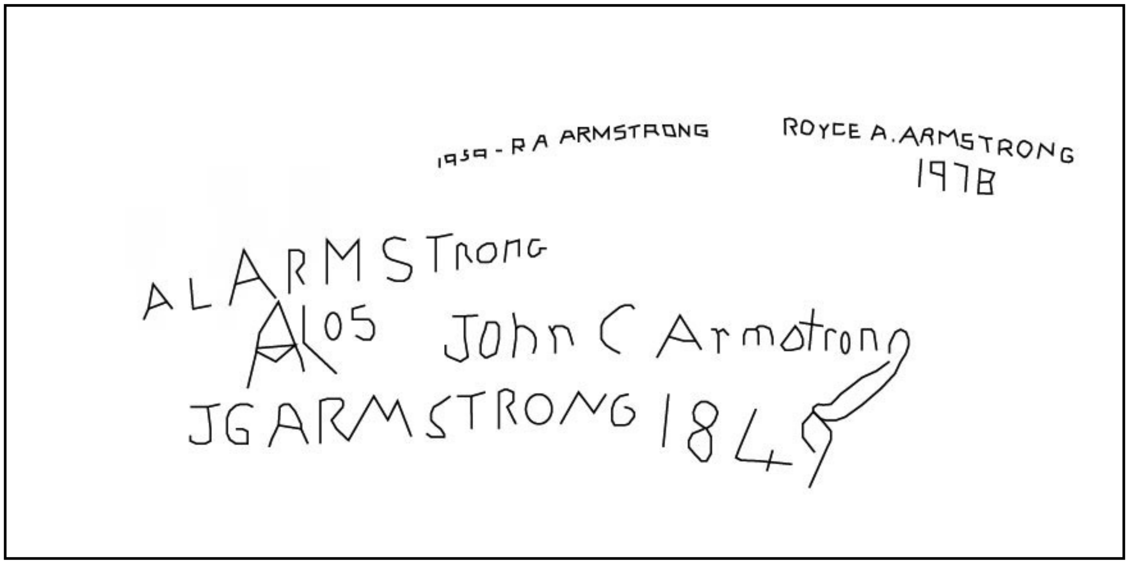

Figure 7. Close-up sketch of John C Armstrong's inscription surrounded by those of his descendants.

spatial filtering (e.g., high and low pass filtering, Krigging), triangulated irregular network (TIN) surfaces, and a series of map algebra techniques to highlight local topographic variability (e.g., logarithmic and exponential map algebra). Through trial and error, we discovered that two techniques, high-pass filtering (also called edge detection) and hillshade visualization generated the most useful results considering our dataset and research goals.

Hillshade uses an artificial light source to illuminate a raster and generates the appearance of a three-dimensional topographic surface due to the combined effects of light and shadow. By adjusting two parameters, light source altitude and azimuth angle, different topographic features (e.g., inscriptions) can be visually enhanced. For this project we employed the hillshade function within ArcGIS Spatial Analyst in an attempt to identify traces of faint historic inscriptions not readily apparent to the naked eye. Unfortunately, the irregular rock surface of the outcrop proved too coarse-grained for the discrimination between cultural and natural surface features based on any of the visualization techniques tried (e.g., hillshade, graduated/ramped raster symbology) or simple surface derivatives (e.g., slope, aspect). Even so, hillshade raster provides a simple visualization technique that produces the aesthetic illusion of three-dimensions and is shown to effectively highlight identified historic inscriptions (Figure 8).

In order to highlight the signatures, we determined that the surface topography of the rock needed to be eliminated. High-pass filters sharpen local raster surface topographic variability also called spatial autocorrelation (Conolly and Lake 2006). One of the ancillary benefits of using a high-pass filter is that it removes large scale trends and orients the panel squarely in two-dimensional space. Low-pass filters smooth out or blur surface variability using a process called spatial filtering where cell values are calculated as a function of a weighted average within a defined spatial extent (e.g., cell neighborhood). We found the ArcGIS software Spatial Analyst toolkit's preloaded "filter" tool simple to use, but unsuccessful in highlighting signatures within our specific dataset. Instead, we calculated the high-pass filter using map algebra by subtracting a low-pass filter from the original surface raster (Conolly and Lake 2006).

The specific spatial filtering technique used to generate the most effective filter depends on

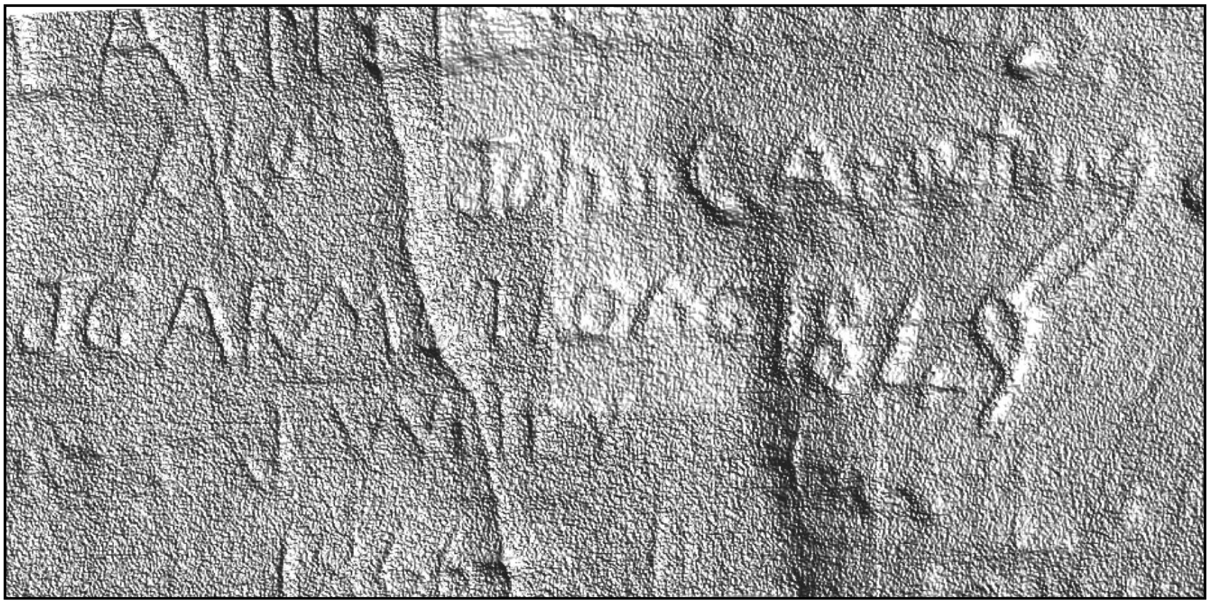

Figure 8. Example of a hillshade raster centered on John C. Armstrong's inscription.

the resolution and nature of the individual dataset (Conolly and Lake 2006). For our project, we found that the Natural Neighbor function set to populate a new raster with cell sizes ten times larger than the original raster (original cell size = .00015) generated the most applicable low-pass filter. To perform the map algebra both rasters (original and low-pass filter) must be at the same resolution. Therefore, we resampled the low-pass filter with Cubic Resampling to populate a higher–resolution, cell-size, low-pass filter. Using map algebra we generated the high-pass filter by subtracting the low-pass filter from the original raster. The resulting high-pass filter (Figure 9) produced a flat depiction of the rock face that accentuates areas of high topographic variability. These quantitatively derived areas represent possible historic inscriptions.

Concluding Comments

By implementing high resolution LiDAR and consistent digital photograph methods we were able to produce an accurate and replicable digital model that preserves the entire context of the Sand Cliff Signatures Site. In the future, these data can be used to track impacts to the surface of the panels (Barnett et al. 2005; Vogt and Edsall 2010). We were also able to explore quantitative surface manipulations and visualization techniques to select for locations on the rock surfaces with high topographic variability while also creating clear visual enhancements. This project highlights both the interpretive and cultural resource management value of three-dimensional high-resolution documentation of historic inscriptions. While archaeologists practice similar research methods to document prehistoric rock art, this study shows that these same methods can be effectively applied to sites containing historic inscriptions. ■

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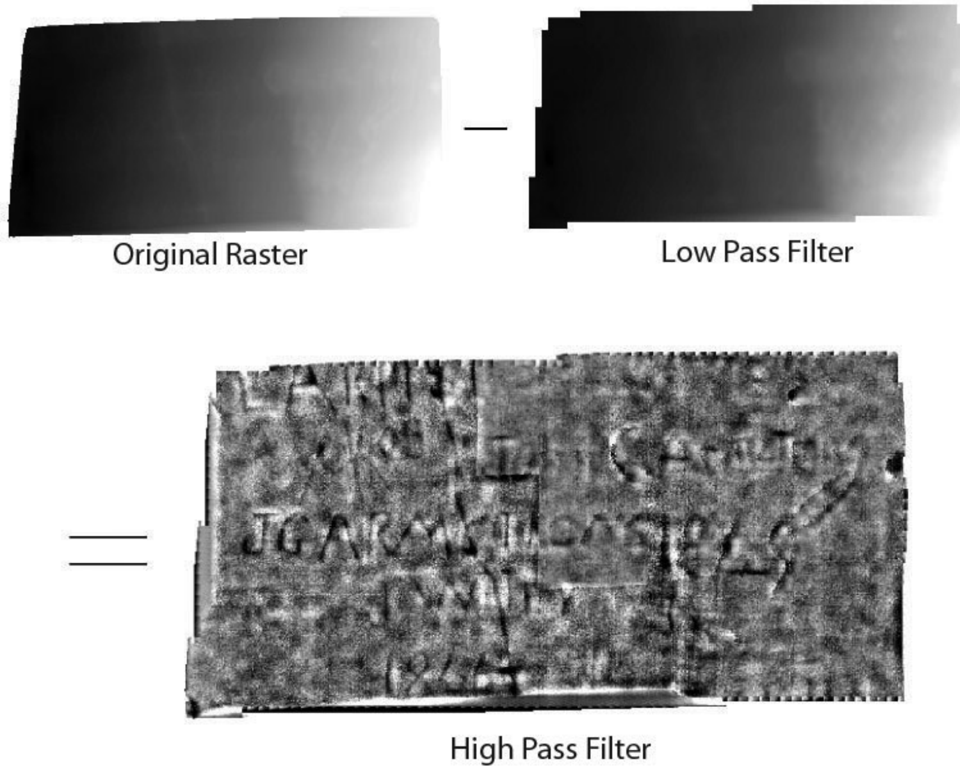

Figure 9. Series of rasters showing the original raster (1), followed by a generalized raster used to recreate the natural surface of the rock (2), reclassified version of raster 2 used in raster math calculation that resulted in the final product that shows signatures quite clearly (3).

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Shell Artifacts from Wolf Village: A Fremont Site in Utah County, Utah

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Brigham Young University's Department of Anthropology recently recovered the largest concentration of marine shell beads ever discovered at a Fremont site. Between 2009 and 2012, 173 beads were collected from Wolf Village in Goshen, Utah. We report the results of the analysis, including a description of the methods used to study marine and freshwater shell, and also discuss some problems associated with shell identification. We determined that contrary to the belief that most Fremont Olivella shell beads were made from Californian Gulf varieties, most beads were probably manufactured from Olivella shells endemic to the California coast. The results of our analysis seem to suggest that Wolf Village participated in trade, possibly as part of a larger network between the California Coast and the Great Basin. Nevertheless, the extent and nature of this exchange system remain inconclusive.

For the past few decades, archaeological research in the North American Southwest has been uncovering large amounts of artifacts belonging to a Native American pre-historic group called the Fremont. These people inhabited the eastern Great Basin and Colorado Plateau from at least A.D. 400 to A.D. 1300 (Janetski 2008). Towards the end of the Fremont period, these people adopted above-ground architecture and practiced more widespread agriculture, while supplementing their diet with hunting and gathering wild resources. The Fremont were also linked with a variety of other groups who traded exotic goods such as shell beads, ceramics, and turquoise.

This article aims to describe the results of the analysis of marine shell artifacts found at the Fremont site of Wolf Village (Figure 1) where Brigham Young University's Department of Anthropology recently uncovered one of the largest concentrations of shell beads discovered in the Fremont culture area. This report follows the archeological fieldwork completed at Wolf Village from 2009 to 2012, where a total of 173 *Olivella* beads have been recovered. From these, 77 (44.5 percent) were associated with an enormous pit structure located in the southern part of the site, measuring 16 m in length and 7.64 m in width with a total surface area of 75 m^2. Accordingly, this is the largest pit structure ever excavated in the Fremont world and one of the largest concentrations of marine shell beads.

The presence of non-local artifacts indicate trade, which according to Janetski (2002:349) is "the acquisition of non-local or exotic goods through transactions between people within the Fremont area and others." With the presence of such artifacts we look at the spatial patterns of non-local materials and goods to determine what type of interaction and exchange may have taken place. Wolf Village and its role in the trade of the Fremont landscape is still being studied, and this report might prove to be a helpful tool in the discussion of Fremont trade particularly of marine shell beads. Research conducted on marine shell beads and other exotics has been carried out at several Fremont sites such as the Parowan Valley Sites, Five Finger Ridge, and the Nephi Mounds. Joel Janetski (2002), Cady Jardine (2007), and Christopher Watkins (2011) have also explored exotic items and their relation to trade and exchange. Janetski (2002:359) offered the idea that "locales exhibiting higher frequencies of exotics hint at the possibility that these are places where people with items to trade might have congregated." However, though Wolf Village does have higher frequencies of excavated marine shell, it is too soon to discuss what part, if any, Wolf Village played in trading.

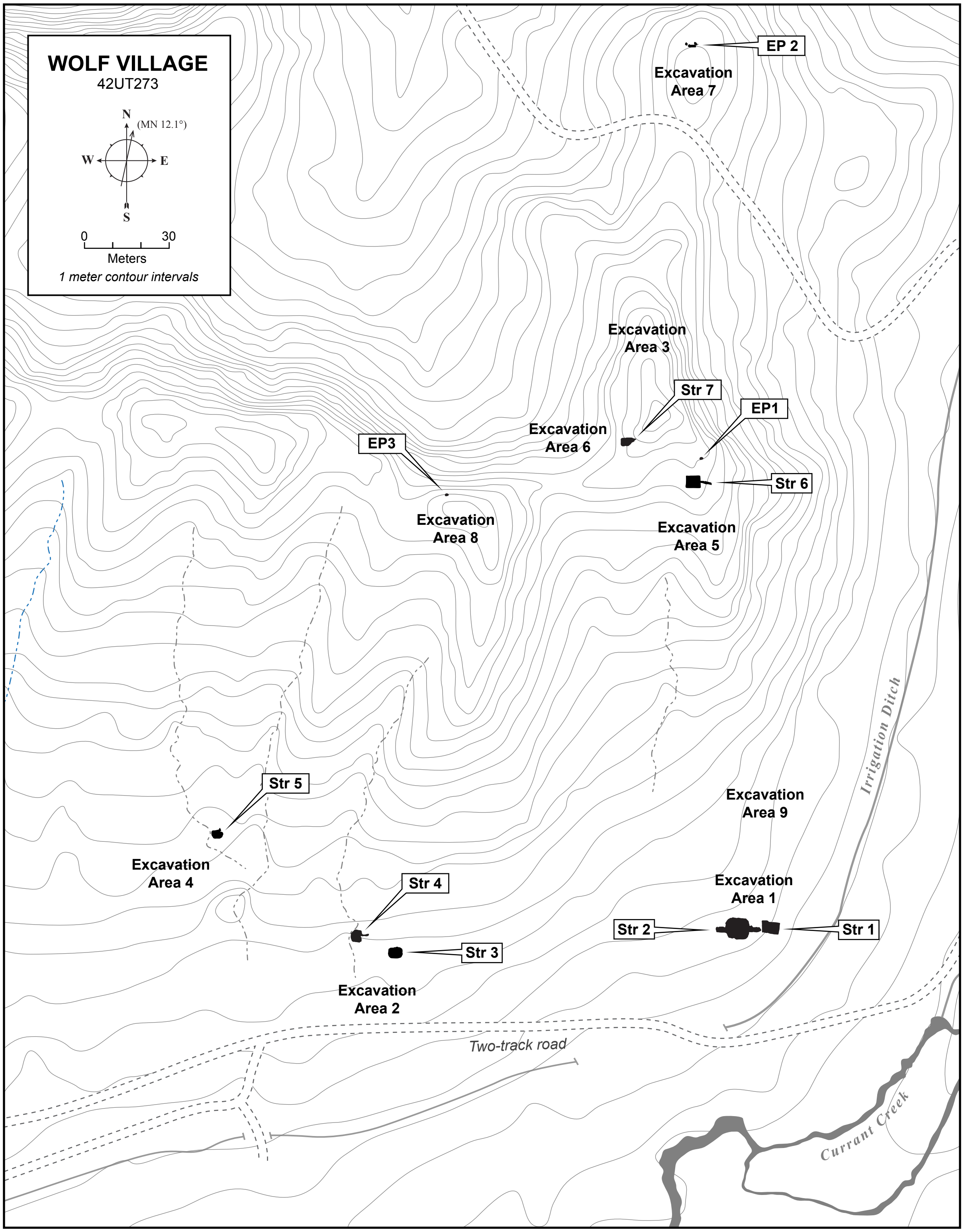

Figure 1. Topographic map showing Wolf Village Excavation Areas and Structures. Courtesy of Brigham Young Department of Anthropology.

Site Description and Cultural Group

Fremont is not only a name assigned to a prehistoric formative time period between A.D. 1 and 1300 (Jardine 2007:v), but also the designation of a cultural tradition practiced by people who inhabited the Great Basin and Colorado Plateau regions during this time period. Many scholars have proposed different dates for the origins of the Fremont, varying from A.D. 1 to A.D. 400 (Janetski 2002:344; Pitblado et al. 2013; Talbot 2000:278; Watkins 2009). Consensually however, in at least A.D. 1000 the Fremont dwelled in pithouses and adobe-walled structures, farming the land and growing corn, beans, and squash. They supplemented their diet by hunting and gathering wild animals and plants.

Even though Fremont sites always exclude one or more of the traits which have been considered Fremont (Madsen 1975), this group is distinguished from other neighboring groups by a set of characteristics including anthropomorphic rock art, ceramic decorations and patterns, clay figurines, distinctly styled moccasins, and the occasional presence of non-local materials such as turquoise, ceramics, and shell beads.

Wolf Village is located in Goshen Valley, on the property of the Wolf family, after whom the site is named. Students and faculty from the Anthropology Department at Brigham Young University excavated Wolf Village during the 2009–2012 excavation seasons. The Brigham Young University field schools were directed by Drs. Joel C. Janetski, James Allison, and Michael Searcy. The site is near the mouth of Goshen Canyon and lies across several ridges. This prehistoric village is a Fremont site which appears to have been occupied between A.D. 650 and 1150. This settlement is situated in an area with resources that include Currant Creek to the west, a perennial drainage of fresh water which flows through Goshen Valley. To date, there are nine confirmed structures at Wolf Village of which seven have radio carbon dates. Based on these dates, Wolf Village appears to have had two occupation periods, the first starting around the seventh and eighth centuries (650–750±40), and the second around the tenth and eleventh centuries (930–980±40). The site is located on a ridge and sloped area, where "vegetation (at the time of 2009 tests) consists of abundant greasewood and dense cheat grass on the lower flanks of the site" (Allison 2012:46).

Materials and Methods

The analysis of shell was conducted according to a criteria established by the Museum of Peoples and Cultures at Brigham Young University, and modified to accurately describe the specimen analyzed. The first category was the field specimen number (FS number), followed by feature numbers, grid/unit number, depth of find, if marine or fresh water shell, and when identifiable, family, genus, and species.

We collected more details for marine shell, namely if it was a complete bead or a fragment. Shells were only identified as beads if we could see either the shape/curvature of a bead and/or a perforation. Worked edges did not qualify and were therefore identified as fragments (fragment or complete), portion (what portion of the shell was collected), if painted or not (if no traces of color, "no", if "yes", the color was noted; all painted beads in the sample had red paint), and `type of bead (Bennyhoff and Hughes 1987), type of perforation (Gibson 1992). As for quantitative descriptions, we measured the diameter of the bead perforation, height, width, weight, and quantity. The quantity represents the number of pieces from each unit/level and not necessarily the number of individual shell beads.

Distinction between Freshwater and Marine Shells

Even though 471 pieces of shell and beads were found at Wolf Village between 2009 and 2012 not all of them were marine. Consequently, the most important distinction to establish became the original environment in which the shells developed (i.e. freshwater vs. marine shells). Freshwater shells were only collected during the 2012 field season while marine beads were collected all four field seasons. For this reason, the numbers and ratios presented here for freshwater shell might seem misleading if applied to the entire site regardless of provenience or if compared with marine shell.

In general, the composition of marine shell is much denser than freshwater shell. According to Keith (1964) the minerals, oxygen, and carbon available in the ocean have transformed the exoskeleton of marine mollusks into compacted bodies of matter. On the other hand, freshwater shells are very flaky and much less dense. Chemically, the isotopic composition of carbon and oxygen of modern mollusk shells from marine and continental environments varies greatly. Furthermore, "marine shells show a range of δC^{13} (relative to Chicago PDB standard) from +4.2 to -1.7 percent, whereas the fresh-water mollusk shells are relatively deficient in C^{13} carbon, in the range of -0.6 to -15.2 percent. There is a similar difference in O^{18} content" (Keith 1964:1757).

The biggest challenge posed in the identification of the original environment of shells pertained to the identification of mother of pearl species. Two groups were possible: *Haliotis* sp, a genus of marine shell existent along the Pacific coast of North America, and *Anodonta* sp. a genus of freshwater shells endemic to the western regions of North America, from Baja California to the Yukon Territory and Alaska. However, due to thickness, comparison with full pieces in online databases, and the probability of finding mother of pearl marine species in archaeological contexts in Utah, we concluded that all shells displaying mother of pearl nacre most likely came from freshwater environments.

Freshwater Shells

The analysis of freshwater shells was reduced to the description of family, genus, and species. Since only one potential freshwater bead was found, and due to its thickness the analysis is still inconclusive, no measurements were taken of all freshwater shells. Likewise, type of bead and paint were not applicable for freshwater shells. The context of deposition of these freshwater specimens is discussed below.

Species were defined according to the descriptions provided by Drews (1990) and Perez et al. (2004). These sources describe the major freshwater shell species found in archaeological sites in Utah, which are divided in two large classes: bivalvia (clam shells), Pelecypods, and gastropods (snail shells). The most common genera found at Wolf Village were *Anodonta* sp., *Helisoma* sp., as well as the species *Lymnaea stagnalis* and *Physa utahensis.* It is also important to mention the presence of some other genera which appeared with much less frequency. It was impossible to classify these individuals more specifically than their general group: *Sphaeriidae* sp. and *Valvatidae* sp.(possibily *Valvata Utahensis*) (Figure 2).

Marine Shell

Each identified marine shell was sorted as a bead or as a shell fragment. The criteria we adopted to separate shells from beads determined that in order to be a bead, the shell should display clear signs of human manufacture, including grinding or cutting visible in the shape/curvature of a bead and/or the presence of a perforation. Worked edges alone did not qualify a specimen as a bead and were sorted as worked fragments. All marine shell pieces were measured and weighed.

If determined to be a bead, the height was recorded by measuring the size of the piece oriented vertically with the spire up and aperture down following growth lines. Width was recorded by measuring the maximum size perpendicular to the height. The size of the perforation was recorded as the diameter for the circular hole drilled or punched through the surface of the bead (types C–M). In some cases however, the form of the bead is achieved by removing the spire and grinding the aperture (types A, B, O–Q). In these cases, the size of the hole was taken where the spire was removed. Species was also determined and is commonly diagnostic of the

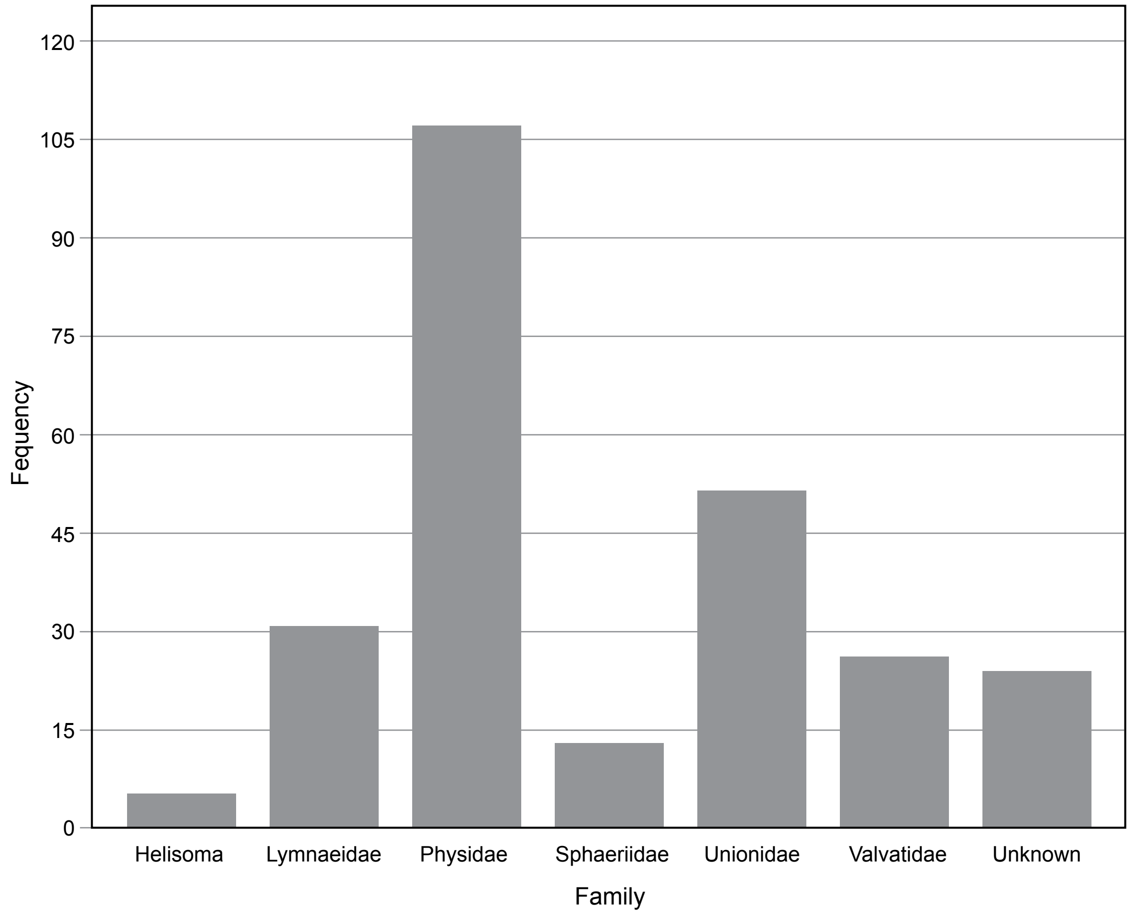

Figure 2. Frequency of freshwater shell families at Wolf Village.

original environment, whereas bead types can be diagnostic of particular time periods.

Species

The occurrence of marine shell at Fremont sites appears to be very common. About 97 percent of excavated Fremont sites had marine shell present. In Jardine's (2007:55–57) study of Fremont finery and exchange, 45 Fremont sites were compared and 44 out of the 45 sites were found to have the presence of marine shell. It is believed that "most of the marine shell found is *Olivella*. *O. biplicata* and *O. dama* are the most prevalent species of *Olivella* found in Fremont sites, with *O. baetica* found occasionally" (Jardine 2007:18). *O. baetica* is found in deeper waters along the Pacific Coast, which has, up to this point, been a justification for the scarcity of *O. baetica* at Fremont sites. *O. biplicata* is also found along the Pacific Coast, whereas *O. dama* is only found in the Gulf of Mexico.

We used three main sources to distinguish the species of *Olivella,* each of them offering valuable distinctions. Joan Silsbee (1958) created a guide to determine the basic sourcing of *Olivella* shells. John Bell, a professor at Brigham Young University and a specialist in marine shells, provided shell classification descriptions, and online comparative collections allowed us to differentiate *Olivella* species.

Silsbee (1958) provided information pertaining to the structural differences between species from the Gulf of California (*O. dama*)

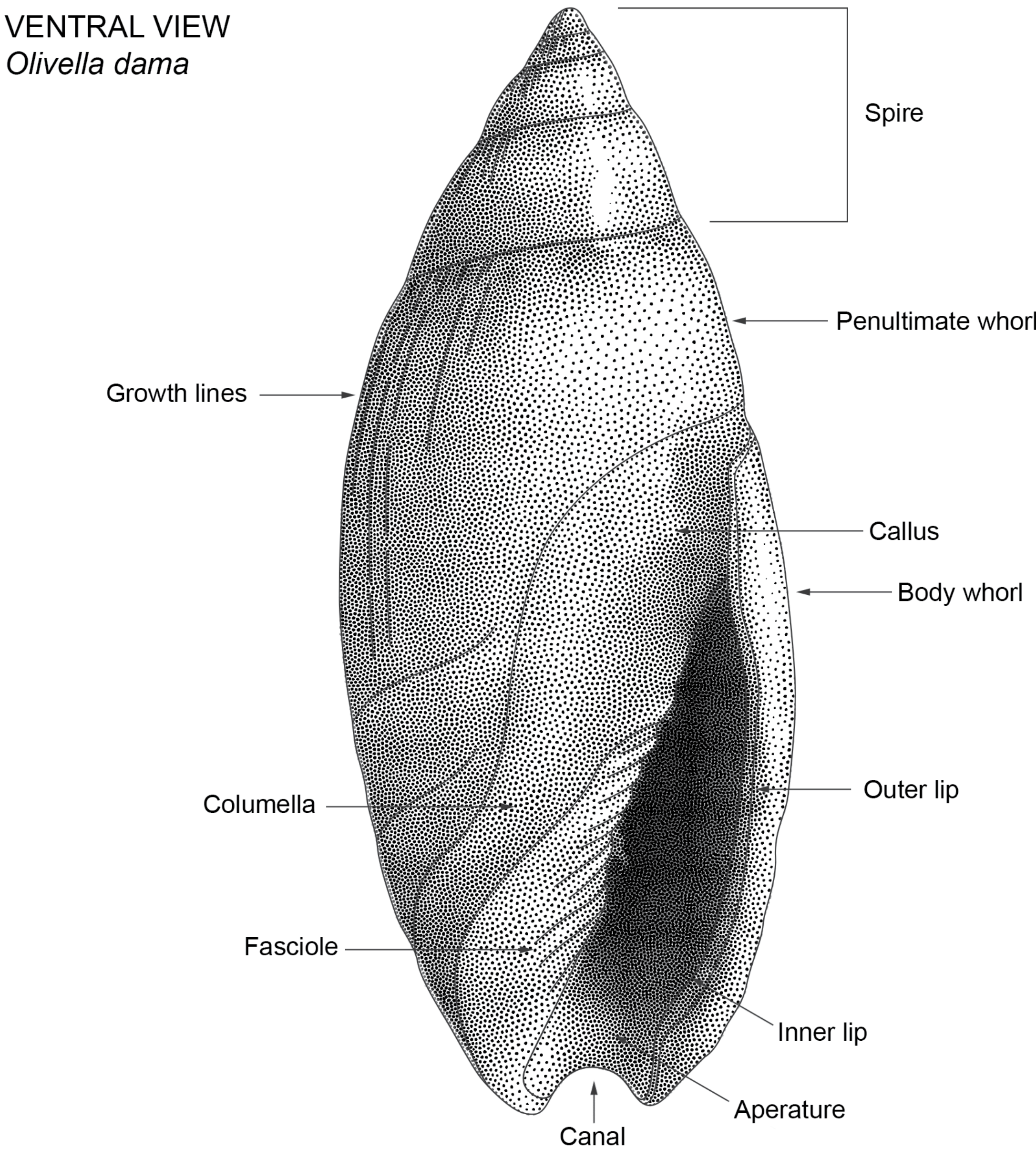

Figure 3. Olivella Shell Anatomy.

and those coming from the California coast, Baja California, and British Columbia (*O. biplicata* and *O. baetica*). The differences mostly lied within the callus of the shell (Figure 3). *Olivella* from the coast have a curved, short callus which "does not extend towards the apex of the shell beyond the aperture, i.e., the callus does not go above the open space" (Silsbee 1958:11). On the other hand, *Olivella dama* originating from the Gulf of California displays a long, straight "callus which extends toward the apex to the suture above the attachment of the outermost side of the aperture, i.e., the callus goes well beyond the top of the opening. [It also has a] flatter ridge with many lines almost as deep as the level of the rest of the callus" (Silsbee 1958:11).

Due to the complexity of species identification, we asked for help from John Bell. Bell provided a detailed description of *O. dama*, *O. biplicata,* and *O. baetica,* which were incorporated to complete a classification initially compiled from Silsbee (1958) and Jardine (2007).

O. biplicata, commonly known as purple olive shell, is usually found in marine environments less than 5 m deep and in very high densities (up to 500 in an area of one square meter). The body of the *O. biplicata* shell is ovate and quickly comes to a point towards the spire. The spire at the top of the shell is approximately ¼ to ⅕ of the length of the shell, which can reach 30 mm. *O. biplicata* shells can be a variety of colors including, white, brown, tan, purple, and grey. Like other *Olivella* shells there are growth lines, which look like striations, on the body of the shell that extend from the top of the last suture line of the spire to the fasciole, or the basal white band that surrounds the canal at the bottom of the shell (Silsbee 1958:11).

O. dama shells are found south of Point Conception, California. They are also called dwarf olive and measures between 10 and 22 mm on average. The *O. dama* shell has a narrow profile, more slender than the *O. biplicata* body. The slender spire tapers gradually and is approximately ⅓ of the total length of the shell. The color and patterning of the body of the *O. dama* shell is distinctly different than the *O. biplicata*. *O. dama* is normally green, yellowish green, or brown with a diamond-shaped pattern. The area between the bottom and middle suture lines is approximately twice the size of the middle and top suture lines.

Endemic to the pacific coastal regions between Alaska and California, *O. baetica* is another type of dwarf olive that is only sporadically found in archaeological contexts, primarily because it is typically found in the intertidal zone at the water's edge at a mean depth of 51 meters and is therefore rarer to find on the beach. *O. baetica* is highly polished, without any sculpture other than fine growth lines in a zigzag pattern. It is normally brown or grey, thinner and less robust than *O. dama* or *O. biplicata*. The widest part of the aperture (near its lower end) is normally less than half the diameter of the shell. More importantly, and this was the key characteristic which led Bell (personal communication, 2012) to assume that the beads excavated at Wolf Village were in great part made of *O. baetica*, is the darker coloration of the fasciole. This dark-brown coloration is not present in either *O. biplicata* or *O. dama*, and the polishing of the beads did not fully remove traces of this unique characteristic.

The Conchology Incorporations and Hardy's Internet Guide to Marine Gastropods website (2012) provided online comparative collections that allowed us to see the differences between *Olivella* shells through virtual profiles and pictures.

Type

Methods used for analysis of *Olivella* ornaments were based upon the definitions and typologies established by Bennyhoff and Hughes (1987). This publication was referenced for identification of ornament types and associated characteristics, namely type of perforation, species, and measurements (Table 1).

Problems with Species and Typology Identification

A few problems emerged during the analysis of marine shells and marine shell beads. First, most beads were highly polished, which frequently resulted in the complete erosion of the callus and the exterior coloration. Since these are the two main characteristics used to identify *Olivella* species, the classifications attributed may need revision. Second, the typology stipulated by Bennyhoff and Hughes (1987) was sometimes deficient as to more specific and distinguishing characteristics between beads. Namely, differences between bead types such as certain saucer bead and saddle beads were not easily detectable. In order to overcome these problems, we searched for secondary indicators, such as size

Table 1. Typology of shell beads from Wolf Village analyzed from 2009–2012 based on Bennyhoff and Hughes (1987).

Class/Type	N
A Spire-lopped	13
A1 Simple Spire-lopped	9
A2 Oblique Spire-looped	1
A5 Applique Spire-looped	1
B End-ground	59
B1 Side-ground	13
B2 End-ground	7
B3 Barrel	33
B5 Spire	1
B6 Double-Oblique	3
C Split	30
C1 Beveled	1
C2 Split Drilled	12
C3 Split Oval	8
C4 Split End-Perforated	3
C5 Scoop	1
C7 Split Amorphous	4
D Split Punched	30
D1 Shelved Punched	24
D2 Rectangular Punched	4
D3 Oval Punched	2
E Lipped	16
E1Thin Lipped	6
E2 Thick Lipped	6
E3 Large Lipped	2
F Saddle	7
F1 Oval Saddle	1
F2a Full Saddle	3
F2b Round Saddle	2
F3a Square Saddle	1
G Saucer	8
G1 Tiny Saucer	2
G2 Normal Saucer	5
G3 Ring	1
H Disk	2
H1a Ground Disk	1
H3 Chipped Disk	1
J Wall Disk	1
M Thin rectangle	3
M1a Normal Sequin	1
M4 Trapezoid Pendent	2
Q Columella	3
Q1 Tube	3
Triangle	1

(*O. Biplicata* beads are bigger and more dense, and different types are made from different species), or overall coloration of the bead.

Perforations

One last characteristic is the type of perforation. At Wolf Village, perforation is another trait that is exclusive to the manufacture of marine shell beads (except for one probable freshwater bead). Figure 4 contains the key we used to determine the type of perforation of shell beads and was adapted from Gibson (1992). Besides the pre-determined types of conical (C), biconical (B), and straight (S), we defined two more patterns in our data set: ground (G) and cut (Cu). Grinding is used to achieve a hole only in beads where the spiral and the aperture have been removed (mainly barrel beads). Withing our sample, we also found one, possibly two beads, where the perforation on the wall of the shell was rectangular in shape, instead of the most commonly found circular shape to which conical, biconical, and straight types apply. As such, we designated this rectangular type of perforation "cut."

Results

Freshwater Shells

A total of 471 shells, beads, and fragments were recovered from Wolf Village between 2009 and 2012. Nonetheless, freshwater shells were only recovered during 2012, where work was primarily done in Areas 1, 7, and 9 of the site (Figure 1). Of these 256 are freshwater shells, and one was a freshwater bead.

Most gastropod and bivalve shells were identifiable at least as far as their family. We identified *Helisoma* sp. (n=5), *Lymnaea Stagnalis* (n=31), *Sphaeriidae* sp. (n=13), *Valvata Utahensis* (n=26)**,** *Physa Utahensis* (n=107), *Anodonta* sp. (n=51), and *Valvatidae* sp. (n=26) (most likely to be *Valvata Utahensis*) (Figure 5). We were unable to determine the family, genus, or species of 13 fragments, even though it was clear they were freshwater species. As mentioned before, mother of pearl fragments

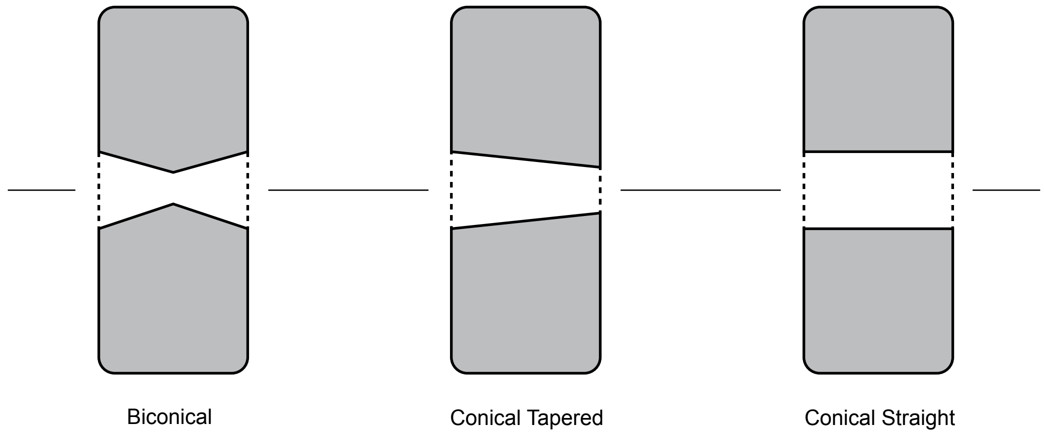

Figure 4. Type of perforation of shell beads (adapted from Gibson 1992).

posed some challenges, especially because they were very friable. All pieces of mother-of-pearl were assumed to be from freshwater clams for the reasons explained above (Figure 6). Partially because most of the 2012 excavations took place in Structure 2 the overwhelming majority of freshwater shells found at Wolf Village also came from this area. This area revealed 251 freshwater shells and one bead found in the midden layer of Structure 2 (Figure 7). The remaining five shell fragments came from an artifact concentration and two possible superimposed structures.

Freshwater mussels are confined to permanent water bodies, such as creeks, rivers, ponds, and lakes. However, at least in the case of gastropods, freshwater shells pose a significant problem for archaeologists given that they "may enter the archaeological deposit as a source of food and/or ornamentation, as a non-cultural biological occurrence, or through accidental introduction." (Silsbee 1958:71). Despite the uncertainty, there are some possible explanations for their intrusion, especially those related to human activity.

Freshwater mollusks might have been used as a dietary supplement, and some researchers have concluded that "while caloric yield may be low when compared to other food resources, the protein content of shellfish remains relatively high" (Drews 1990:65; cf. Erlandson 1988; Glassow and Wilcoxon 1988). Similarly, freshwater mollusks might have been transported to the site with the plants collected from the water resources destined for consumption (James Allison, personal communication 2012). On another note, these shells are also a good indicator of seasonality, since according to Glassow and Wilcoxon (1988) seasons can be determined for time of death. Therefore, "archaeologists frequently have used shell remains for purposes of site dating and environmental reconstruction, and as indices of seasonality patterns" (Drews 1990:63). But further inquiries into this topic have not addressed in this paper.

Marine Shells

A large quantity of marine shell beads and marine shell pieces were found at Wolf Village displaying a wide variety of different types (Figure 8). The largest amount was concentrated in Excavation Area 1, where Structures 1 and 2 were excavated. From the 214 marine shells found at the site (n = 173 beads, n = 28 fragments, n = 13 worked fragments), 159 (74 percent) come from Area 1 (Figure 9). More remarkable however, from these 159 marine shells, 114 (53 percent) were recovered from within Structure 2. This represents more than half of all the marine shell beads and fragments at Wolf Village. The

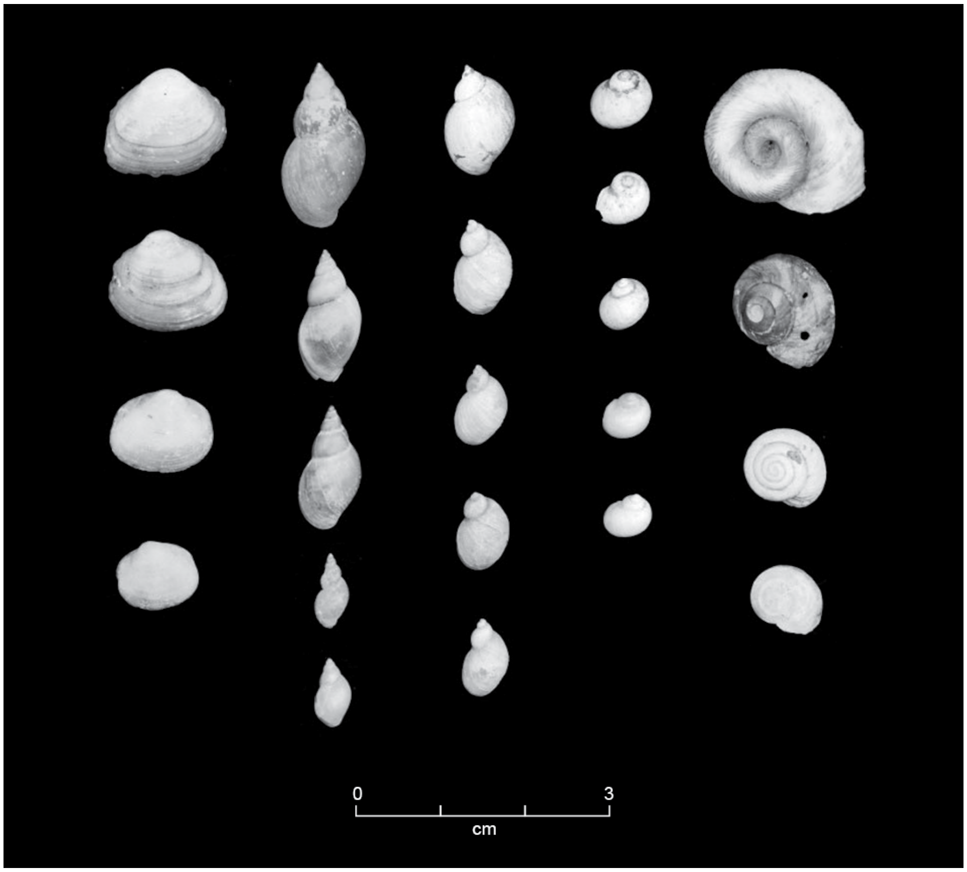

Figure 5. Freshwater clams and gastropods found at Wolf Village (from left to right). Column 1: *Spaeriidae* sp.; Column 2: *Lymnaea Stagnalis*; Column 3: *Physa Utahensis*; Column 4: *Valvatidae* sp.; Column 5: *Helisoma* sp. (top), and *Valvatidae* sp. (four specimens below).

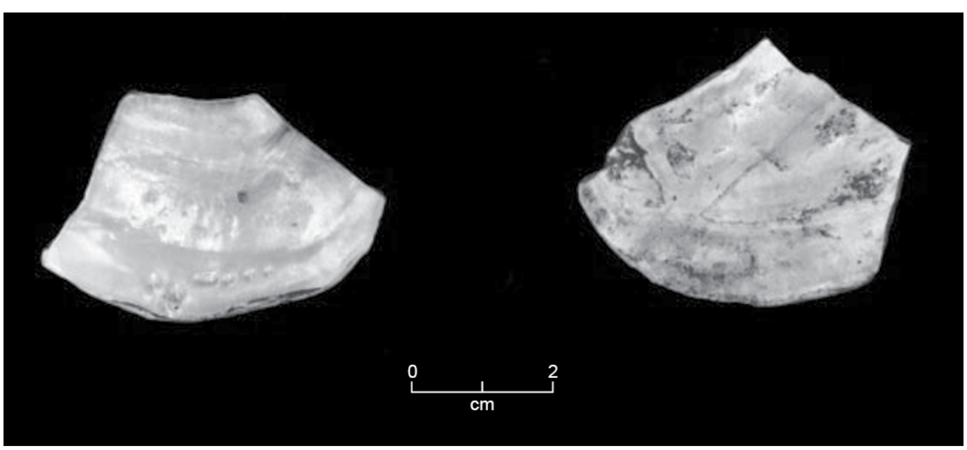

Figure 6. Example of two *Anodonta* sp. fragments found at Wolf Village.

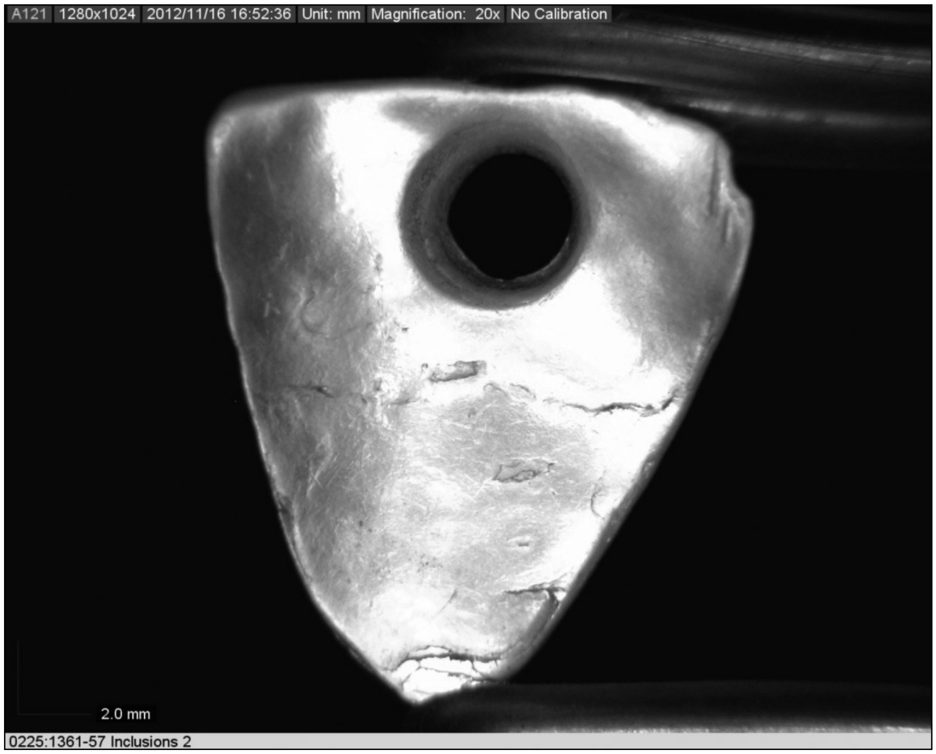

Figure 7. Mother-of-pearl freshwater shell bead (W1).

excavation methods used for all the structures at the site were constant throughout the project, and because all specimens have been analyzed and are therefore represented, we feel confident that there is little sampling bias in these numbers.

During excavation at Wolf Village, we found a distinct layer of midden above what appeared to be adobe material from the roof of the structure. This trash layer proved to be very rich in marine shells; 64 marine shell beads and worked fragments were recovered from this stratum (Figure 10). The remaining 50 beads and fragments were found in other layers and units of Structure 2. From these, 18 were directly below or mixed in the roof fall layer, and 17 were found in the western tunnel, most in a dark charcoal-rich fill. In the eastern tunnel, seven marine shells were recovered, again mostly beads.

In Excavation Area 1, there is also a surprising concentration of shelved punched beads (D1). Out of the 24 found at the site, 19 come from this area. Likewise, 17 of the 33 barrel beads (B3) also come from Excavation Area 1, as do 11 of the 13 side-ground beads (B1). However, it is important to note that most beads come from this area anyway, despite their type. Those categorized as scoop (C5), split amorphous (C7), large lipped (E3), tube (Q) and wall disk (J) are also only found in Excavation Area 1.

The importance of correctly identifying the type of bead is in great part connected with the potential for some beads to be diagnostic of distinctive time periods in California and Great basin regions. Milliken and Schwitalla (2012:9) have recently published an *Olivella* shell bead guide, mostly based on the 1987 publication by Bennyhoff and Hughes (1987), but with significant improvements in dating methods. Based on their studies, we concluded that there is a clear spike in the trade of beads at Wolf Village—and this number pertains only to beads that are diagnostic of one specific time period, since most beads are found in many time periods—during the transition from the Middle Period to the Late Period, which

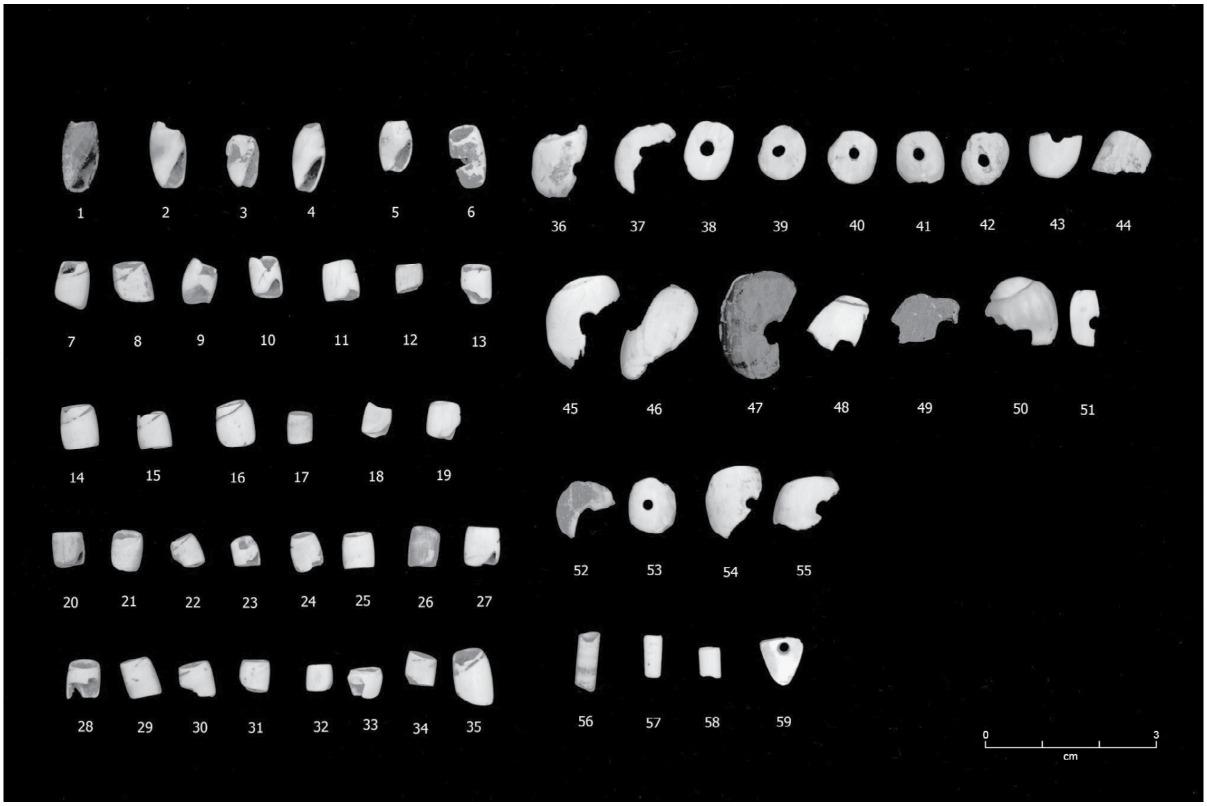

Figure 8. Shell beads displayed according to typology: A1 (1–6), B1 (7–13), B2 (14–19), B3 (20–33), B6 (34–35), C2 (36–37), C3 (38–43), C7 (44), D1 (45–50), D2 (51), E2 (52–53), E3 (54–55), Q1 (56–58), W1 freshwater bead (59).

happened between A.D. 1010 and 1210 (Figure 11). These periods are once again based on the chronologies established for the archaeology of California and the Great Basin, since there are still no chronologies and time periods sufficiently developed for the Fremont world.

The statistical analysis of species also revealed that most beads were being traded in not from the Gulf of California but from the California coast. As explained above, *O. biplicata* and *O. baetica* are species endemic to the coast, while *O. dama* is a species endemic to the Gulf. Unlike Fremont sites excavated thus far (Jardine 2007:21), we found a large amount of *O. baetica* in contrast to *O. dama*. Nevertheless, *O. biplicata* remains the prevalent species of *Olivella* for beads at Wolf Village (Figure 12). Again, this analysis was conducted on beads almost devoid of any identifiable characteristic; therefore we consider any implications concerning the provenience of the shells and the cultural implications of the different trade connections this could imply as tentative.

Finally, when compared to other Fremont sites in the Great Basin and Colorado Plateau (Table 2), Wolf Village has, beyond doubt, the highest ratio of shell beads per structure. At Caldwell Village, another Fremont site, 153 beads were found at one single structure, and another 11 distributed across the site (Jardine 2007:38). Nevertheless, even though this number surpasses the amount found at Structure 2 of Wolf Village (n = 114), the ratio of shell beads per structure in Caldwell Village is 10.25 (164 beads at sixteen structures). In the Great Basin, Baker Village is the site with the highest amount of beads per structure. Having eight structures and 112 beads (14 per structure). At Wolf Village, nine

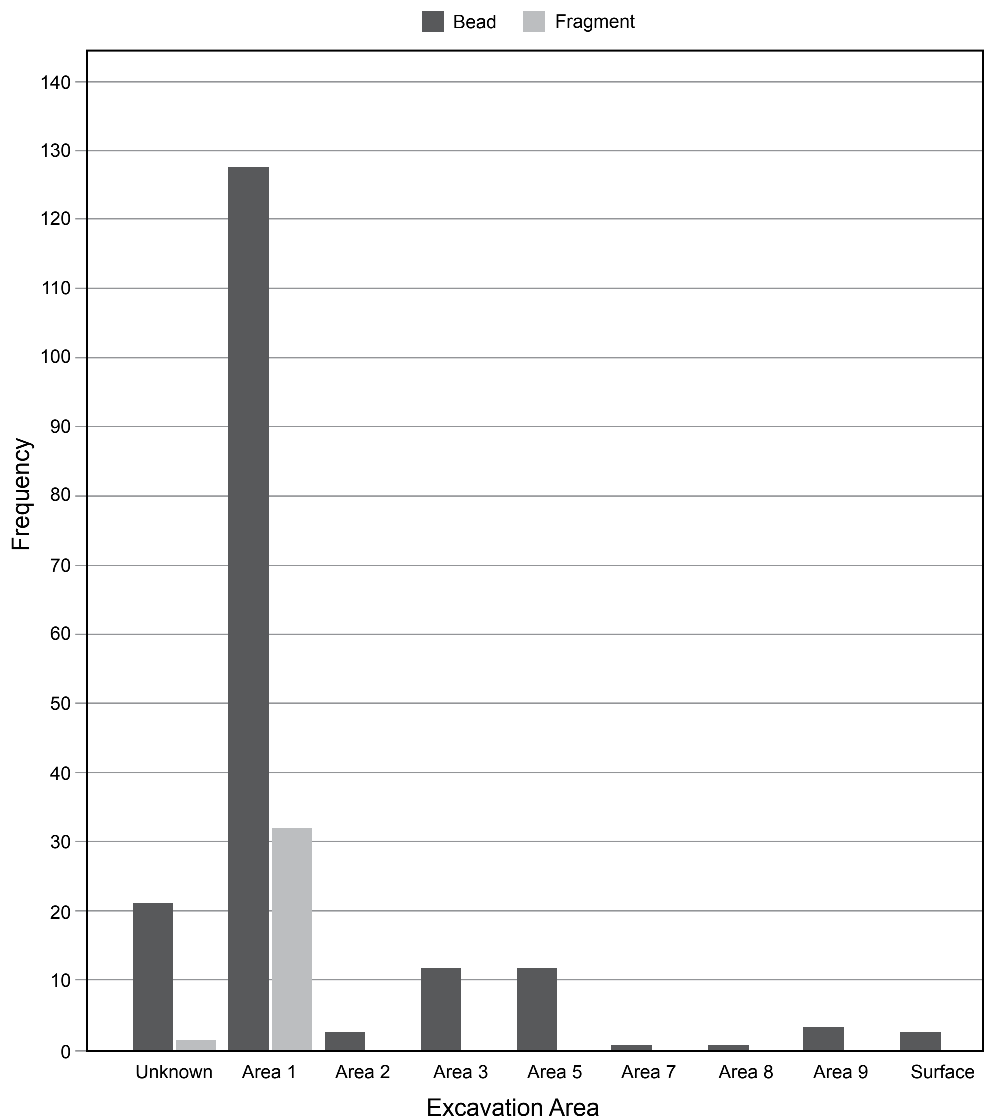

Figure 9. Distribution of marine shell beads and fragments across Wolf Village by Area of Excavation. Number 4 corresponds to the area where structure 2 is located.

structures have so far been confirmed, while 173 beads have been found (19.2 per structure).

Preliminary Conclusions and Discussions

The results of this analysis are not final or conclusive. However, it is evident that Wolf Village participated in trade. The evidence pertaining to marine shell beads suggests that the site was part of a larger network of marine shell trade. From these studies of shell we may also learn of interactions between peoples and settlements between the California coast, Great Basin, and other surrounding areas which might have also been involved in trade. Janetski et al. (2011:42) state that "Large quantity of shell ornaments reflects the importance of the site on the Fremont landscape, as well as its location."

More analysis still needs to be conducted on distribution patterns to understand marine shells (non-local artifacts) and their accumulation at certain sites. Janetski (2002:359) states that

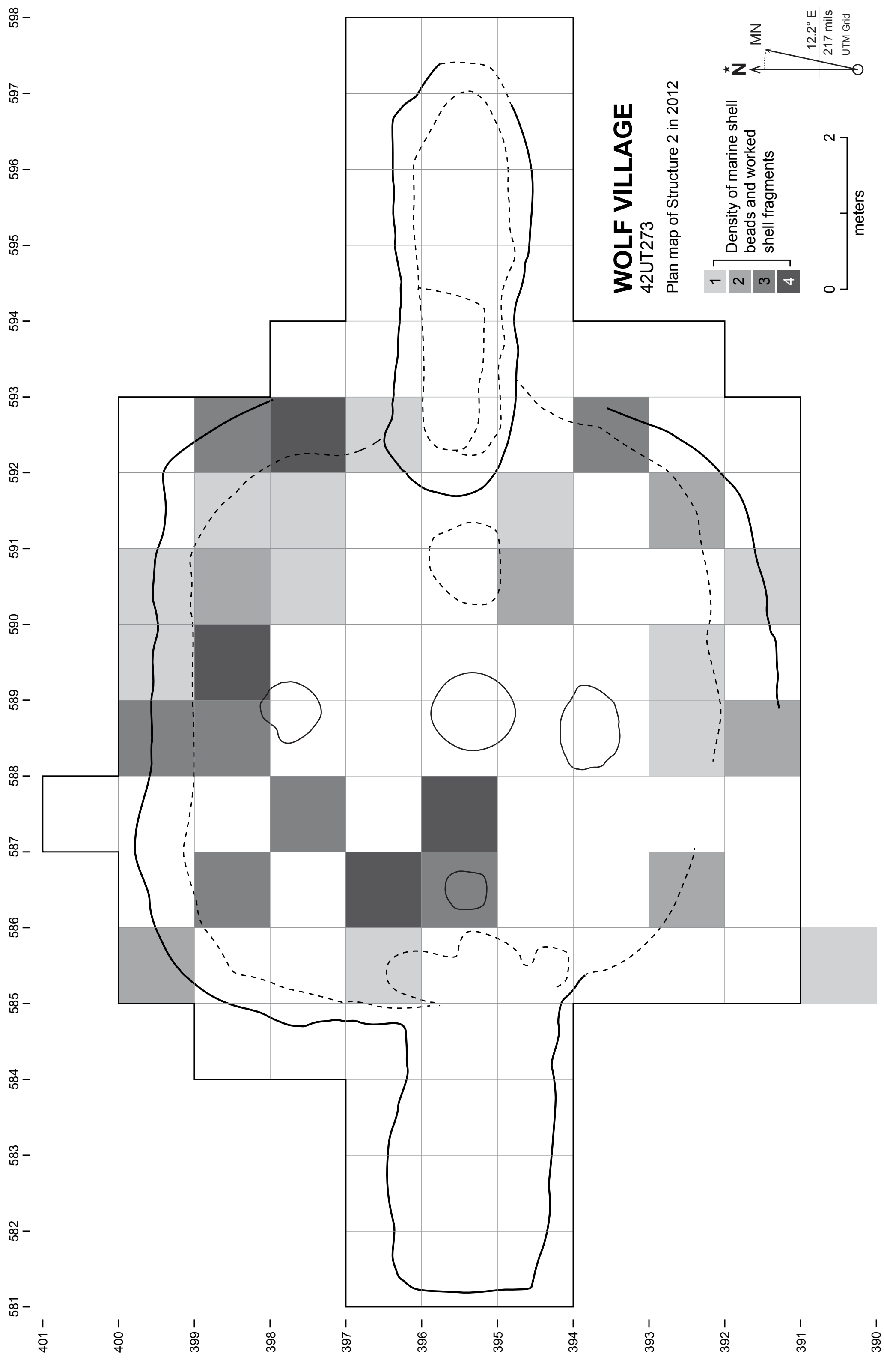

Figure 10. Spatial distribution of marine shell beads and worked fragments in the midden layer of Structure 2.

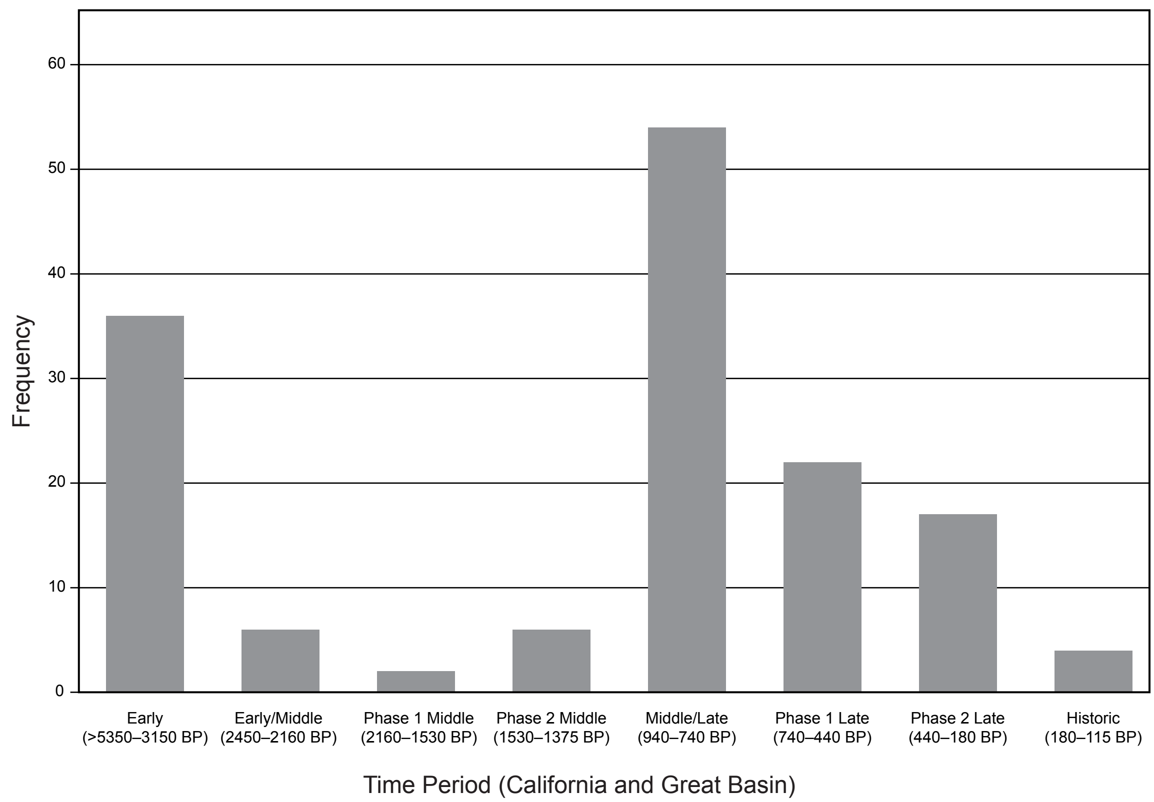

Figure 11. Frequency of diagnostic marine shell beads and their corresponding time period. Note the clear spike of activity during the transition from the Middle to the Late Period.

"locales exhibiting higher frequencies of exotics hint at the possibility that these are places where people with items to trade might have congregated." Colin Renfrew (1977:85) also mentions that "the central place is a locus for exchange activity, and more of any material passes through it than through a smaller settlement." So when looking at sites, archaeologists try to look at the spatial patterns of non-local materials and goods to determine what type of interaction and exchange may have taken place.

Structure 2 at Wolf Village is the largest Fremont structure to ever be excavated. This space was most likely either a center of commercial and social activity and/or a massive garbage pit, especially if considering all other types of unique artifacts found within its limits (pipes, ceramics, figurines, bone tools, gaming pieces, etc.). It is important to point out, however, that the second hypothesis seems more convincing, since most artifacts were recovered from the layers created after the pithouse collapsed, thus telling us very little about the original use of the structure.

It is also important to note that the differences in numbers of shell artifacts could result from different excavation methods. Large numbers could be a result of disproportionate amounts of excavation conducted (Janetski et al. 2011). During the Wolf Village excavations, layers of dirt were screened with ⅛ inch screen mesh, whereas at other sites ¼ inch screen meshes may have been used during the excavation process or no screening at all. The small size of the shells would make them prone to passing through screen sizes larger than ⅛ inch and thus be lost or unseen.

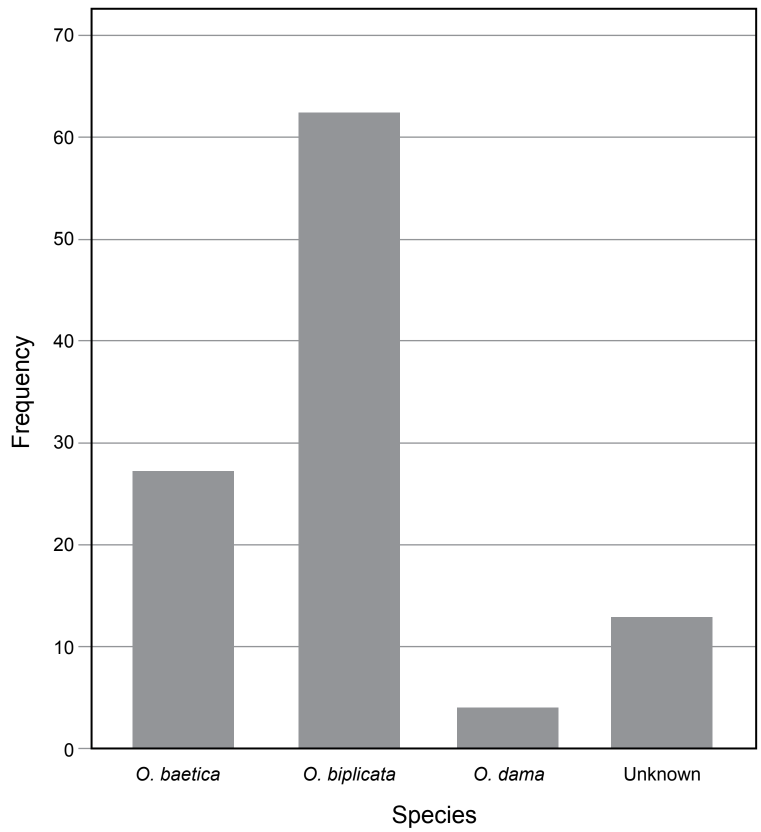

Figure 12. Frequency of Olivella shell species at Wolf Village.

Dating the beads might also point to a period of commercial activity at Wolf Village, even though we feel that the time represents periods of bead types used by Milliken and Schwitalla (2012:9) might be too broad in some cases and too constraining in others. Additionally, further research should be conducted. Looking at down-the-line trade and core-periphery models might help shed some light and understanding on what type of trade system the inhabitants of Wolf Village used. In addition, further comparisons of the number, provenience and design of shell beads recovered from the central structures of Fremont sites should be made. ■

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Table 2. Distribution of Olivella artifacts in the Fremont area adapted from Jardine (2007).

Site Name	*Olivella* Beads	No. of Residential Structures	Ratio *(Olivella/* excavated Res. Str.)
Colorado Plateau			
Steinaker Gap	9	1	9
Caldwell Village	164	16	10.25
Gilbert Site	1	2	0.5
Whiterocks Village	4	4	1
Huntington Canyon	11	4	2.75
Snake Rock	1	13	0.077
Poplar Knob	4	3	1.3333
Round Spring	44	13	3.384
Durfey Site	2	3	0.66667
Turner Look	10	8	1.25
Bull Creek	2	2	1
Roadcut	1	1	1
Rattlesnake Point	2	3	0.6666
Arrowhead Hill	2	2	1
Sky House	2	1	2
Eastern Great Basin			
Bear River No. 1	2	–	–
42WB144	4	–	–
42WB32	4	–	–
South Temple/ Block	6	3	2
Woodard Mound	28	1	28
Kay's Cabin	2	2	1
Benson Mound	13	–	–
Peay Mounnd	3	–	–
Hinckley Mounds	3	3	1
Seamon's Mound	3	–	–
Grantsville	1	8	0.125
Tooele	2	1	2
Nephi Mounds	46	10	4.6
Nawthis Village	43	4	10.75
Kanosh	4	12	0.3333
Pharo Village	–	3	–
Marysvale	3	5	0.6
Hunchback Shelter	1	–	–
Fallen Eagle	1	1	1
Baker Village	112	8	14

Table 2. Continued.

Site Name	*Olivella* Beads	No. of Residential Structures	Ratio *(Olivella/* excavated Res. Str.)
Garrison	2	1	2
Paragonah (UCLA)	37	39	0.9487
Summit (UCLA)	77	17	4.5294
Parowan (UCLA)	81	8	10.125
Paragonah (SI)	34	?	–
Summit/Evans Mound (SUU)	90	?	–
Wolf Village	173	9	19.222
Totals	1063		

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An Unusual Educator: Understanding the Life and Work of Albert B. Reagan, 1871–1936

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As an employee of the Bureau of Indian Affairs from 1898-1934, Albert B. Reagan spent his career among native communities in the upper Midwest, Northwest coast, and throughout the Southwest. Born in Iowa, his Bureau assignments took him to Arizona, New Mexico, Minnesota, Utah, and Washington. His ethnographic and archaeological publications focus on the communities in which he lived: Jemez Pueblo, Apache, Quileute, Ute, Goshute, and Chippewa. Though often conflicted trying to balance employment duties as an agent with his curiosity as an individual and scientist, his numerous publications record significant aspects of geological, archaeological, and ethnographic information around the areas where he was stationed. This paper focuses on the major employment and life events of Reagan to illuminate the context of his contributions to science and literature.

"If I'd see a flattened mound in the sagebrush or out of the car I'd rush with my sack and get some potsherd samples. My friend said I was obsessed with this pottery collecting, and should my chauffeur notice a raised spot in the brush he would even speed up the car to try to get by it before it would attract my notice"
- *Albert B. Reagan*

This brief statement in his own words sums up the energy with which Albert Reagan approached his research interests. In 1934, after decades working for the Bureau of Indian Affairs, Albert B. Reagan made his appearance as the first Special Professor of Archaeology on the Brigham Young University (BYU) campus (Brigham Young University [BYU] 1975:40). In partnership with geologist George Hansen, Reagan taught graduate level archaeology and anthropology classes (BYU 1935:141). Reagan was hired through the recommendations of several members of the BYU faculty. In addition to Hansen, Arthur Crawford, Professor of geology, encouraged BYU President Franklin Harris to hire Reagan, "if you can possibly secure the additional funds, I think you could spend them in no better way than in facilitating the establishment of a real museum of Indian archaeology around Dr. Reagan as curator" (Crawford 1934).

Even those outside geology and BYU had caught notice of Reagan's work. Julian Steward, prominent Utah archaeologist in the 1930s said of him, "I had the opportunity to get down to Ouray to visit Mr. Reagan. He is a rather strange man, egocentric in a way, but none the less intelligent" (Steward 1931).

One might wonder how Reagan, a non-Mormon, with a Ph.D. in geology, became BYU's first professor of archaeology (Figure 1). As this article will demonstrate, Reagan's last employment was not unusual for a man led by his own curiosity through decades of interesting life situations. A sort of modern renaissance man, Reagan was interested in all areas of science and art, even writing fiction. Reagan extensively wrote and researched in the fields of geology and archaeology and published over 500 papers during his lifetime. During his assignment as an agent for the Bureau of Indian Affairs, he took time to survey the land around him, collect artifacts, and report his findings. His correspondences are interspersed with sketches of pottery sherds, oral histories, and myths from the native communities he worked with, and letters to editors regarding the publications of his

Figure 1. Albert Reagan's Bureau of Indian Affairs personnel record photograph. Courtesy of the National Archives and Records Administration [NARA].

works. He was a member of several state academies of science including Kansas, Indiana, California, New York, Oklahoma, Nebraska, Iowa, Illinois, and Utah. He was also a member of the American Anthropological Association, the American Association for the Advancement of Science, and the Ethnological Society (Encyclopedia of Biography 1934:88).

This article does not attempt to report specific details of his research related to any of the areas or cultures where he worked. Rather, it outlines key events and locales important to his life's work, his last interests being focused in northern Utah. As Reagan's career was first and foremost as an agent and schoolteacher for the Bureau of Indian Affairs, his progressive interests in geology and archaeology, leading to an eventual Ph.D. in geology and a position as professor of archaeology, must be understood through the progression of his life. It would be impossible to have a thorough discussion of the contributions of Albert B. Reagan to any single discipline—geology, archaeology, creative writing, ethnology—without a clear picture of his time as an agent and schoolteacher for the Bureau of Indian Affairs. This article provides the picture that topical specialists can build on.

Childhood

Born January 22, 1871, Albert B. Reagan first appeared in the 1880 United States Census in the center of Iowa at Indian Creek. He was nine years old at the time and the oldest of then five children.[1] Reagan was listed as a scholar by the census taker—not "at school" or "student" as most censuses list, but "scholar"—which seems appropriate given his lifelong dedication to study (United States Census Bureau 1880: Indian Creek, Iowa, 377C). Later, his journals indicate that he taught three years of school in Iowa. Then, unsatisfied with his own education, he received a degree from the Central Normal School of Oklahoma in 1898 (Tanner 1939:5). Shortly thereafter, Reagan joined the Bureau of Indian Affairs at the age of 28; although what made him interested in the Bureau is unclear.[2] Perhaps stories he heard in his youth of the West "being won" influenced his career choice to work with native communities. He recalled later in life having read stories about Indians as a young boy (Reagan 1911:141).

Reagan Joins the Bureau

By the time Reagan joined the Bureau, its purpose had gone from "removal of eastern tribes to the West, to reservation confinement, to land allotment and assimilation" (Utter 2001:279). As an agent, Reagan was in charge of delivering government stipends, managing funds, and adjudicating disputes between Native Americans and whites, as well as disputes between Native Americans and other Native Americans (Utter 2001:279). Bureau agents were also often assigned responsibility to teach Native American children in Indian Schools, which were designed to assimilate young Native Americans into Euro-American culture. In addition to teaching English and writing skills, "Training for the boys consists chiefly in farming, gardening, dairying, carpentering, printing, shoe and harness making, and engineering; that for the girls is in sewing, baking, cooking, laundrying, music and general house work" (Ross 1909:2).

Reagan's First Posts—American Southwest

Reagan joined the Bureau in 1899 and was stationed first on the Jemez reservation in New Mexico from May 1899 to January 1901. While he is listed on the 1900 census as being a farmer, he took time to sketch symbols he noticed in the community. Some of his sketches are now housed in the National Anthropological Archives (see Reagan ca. 1900).

Between 1901 and 1902, he moved to Fort Apache, Coconino, Arizona (Reagan 1900s: box 1, folder 1; Nation Archives and Records Administration [NARA] ca. 1900a). It is unknown whether he taught school at this time, but it appears that he was there to teach the Native Americans how to farm. He appears to have written little on his time in Fort Apache. Intriguingly, a short newspaper story alludes to some difficulty where another agent assaulted Reagan ("Conflict of Authority," *Bisbee Daily Review*, 11 July 1902).

Even though he was busy with his Bureau responsibilities, Reagan took the time to continue his education. In 1903, he received a Bachelor of Arts degree from the University of Indiana, and in 1904, he was awarded a Masters of Arts. It is unknown if he completed this schooling through correspondence or if he returned to Indiana to get his degrees.

Reagan must have had enough leisure time between his studies and work to meet and marry a woman named Otilla Adelaide Reese (United States Census Bureau 1880: Jefferson, Fayette County, Ohio, 355C). Reagan was 33 and Otilla was 37 at the time of their marriage, June 15, 1902, in Bloomington, Indiana (Tanner 1939:6; "Two more Utahns Killed in Road Accidents," *Salt Lake Telegram*, 2 Dec 1947). By November 1904, they were both employed by the Bureau and stationed in Washington state (NARA ca. 1900b: folder 1, p. 46).

Northwest Coast Posts

During 1904–1905 Reagan was "placed in charge of the Lummi reservation in the state of Washington" (Reagan 1919b:429) and quite quickly was given responsibility with the Quileute which lasted from 1905–1909. Working with the Quileute appears to be Reagan's first station as a teacher at the Indian school. Mention is made of Otilla nursing the sick, and of her teaching the young girls how to sew (Reagan ca. 1900s: box 1, folder 1).

Reagan spent five years with the Quileute tribe at La Push, and it was certainly a tumultuous time for him. La Push is located on the very northwestern tip of Washington State. Reagan described it as "a picturesque little spot on the Pacific coast" (Reagan 1907).

In the original treaty under which the Quileute surrendered, the tribe was promised the right to continue their normal migrations to mouths of rivers in the winter and taking long hunting trips in the spring and summer. However, by 1904, the government gave land allotments to Natives that they were expected to reside in year round, and their children were required to attend school. This interrupted the tribe's subsistence patterns and caused many problems for the Quileute in Washington, including starvation (Reagan ca. 1900s: box 1, folder 2).

One struggle at the Quileute Reservation was chronic food shortages. Reagan explained that especially during the summer, the elderly had no way of obtaining food. Younger tribe members left for long hunting trips, and there was no longer a table for the elderly to eat at. In 1909, Reagan tried to help by disbursing extra rations. His supervisor wrote him a letter censuring him for giving out the extra flour. Reagan did not budge from his position but said:

> this time of year is the hardest time on the old Indians. The other Indians are away at work and there is no fishing done and no one's table

> for them to eat the offal from. Before we issued rations to them (3 years ago), several starved to death each year at this time. When I issued rations this quarter, I had nothing but flour. So I issued them enough. [Reagan 1909]

The agency had apparently neglected to have beans and rice in store, so Reagan issued extra flour instead of the normal amount. He continued, "The old people need the rations more this quarter than any other…if the extra flour cannot be issued that way, I will replace it at my own expense." (Reagan 1909).

Another challenge for Reagan arose from his interactions with members of the tribe who had joined the United Society of Believers in Christ's Second Appearing, the religious group commonly known as "Shakers." While extremely popular with the Native Americans, the Bureau had mixed feelings on the Shaker movement, and it appears Reagan did as well. One benefit of the Shaker movement, from the Bureau's perspective, was that it encouraged abstinence from alcohol and tobacco. However, "shaking" could sometimes become violent and be a potential health risk. That combined with the Bureau's apparent fear of Native American ritual and dance contributed to the Bureau's decision to limit and sometimes all together prohibit "shaking" (Bureau of Indian Affairs [BIA] 1905). Rules regarding "shaking" had already been issued by the Bureau for years, but it appears that Reagan was much more adamant about enforcing the rules than previous agents. He wrote to his supervisor, "The officers and I could at least enforce regulations if we were sure of support when we make such arrests" (Reagan 1905). The agency seems to have wanted him to enforce the rules only lightly—avoiding big trouble but still encouraging change. However, Reagan seems to have been a rather absolute man, and struggled with this lack of support.

Reagan appointed a Native American man named Luke Hobucket to be the police for the tribe. Though it was normal for an agent to assign tribe members jobs as judges and policemen, it caused problems within the tribe. Hobucket had the responsibility of reporting "unauthorized shaking" but by doing so he was ostracized from much of the tribe. For this reason, Reagan went with Hobucket when he suspected "illegal" activities. The arrangement meant that Reagan was often involved with affairs beyond the schoolroom. Despite being present during arrests, Reagan took great interest in the religion and is a key source for understanding their early beliefs and practices among the Quileute, publishing several articles on the subject (Ruby and Brown 1996:250). Demonstrating his usual curiosity, he is reported to have interrupted a Shaker meeting to take the pulses of the participants in an attempt to strengthen his argument that hypnosis was a major part of shaking (Anderson 2009:90). Paradoxically, he strived to uphold government regulations in arresting and jailing anyone who shook "out of hours," but he often attended sanctioned meetings.

The issue of Bureau control was certainly complicated. As School Teacher in Charge Reagan's main assignment was to teach the children. From his letters to the Bureau it is clear that he had struggles enforcing Bureau rules (Reagan 1906). Reagan appears to have been a very principled man. Even in his messy field notes, his voice is always consistent and systematic. According to Reagan, when he arrived on the reservation in 1905, hardly any English was spoken. Three years later, all of the children could speak well, and everyone except for the "old Indians" could speak some (Reagan 1900s:box 1 folder 2). Many had also learned to read and write. Yet even while he was teaching English in place of their native tongue Reagan took the time to record several language charts in his journals. Thus we see one of the great dichotomies of Reagan's life—spending a great deal of time recording oral traditions, language, and surveying the remains of Native American ancestors while also enforcing Western language, culture, and life ways.

Along with insisting that the tribe speak English he also "saw that the children were kept cleaner, and the houses cleaned up. . . he made them clean up, send their children to school, and respect the regulations governing the service" (Reagan 1908). Reagan continually worked to get adequate supplies and support from the Bureau, but he did manage to improve, in a western sense, the condition of the school and the town. He paved roads, fixed houses, encouraged town cleaning, and repainted and fixed up the schoolhouse (Reagan ca. 1900s:box 1 folder 2).

Reagan seems to have struggled more at the Quileute Reservation than at any other Reservation; the number of court cases skyrocketed as did the number of jailings and disciplinary actions. According to his superior, Reagan's problem was "aiming at 'transformation' instead of 'improvement'" (Minor 1906). Perhaps this can be expected of a still young agent navigating a balance between his required duties as agent and a personal approach to understand the cultural differences to maintain order. He did not find that balance by the time he was transferred out of the area in 1909 as Reagan himself made the transfer request.

In addition to his regular duties, during his time at La Push Reagan began pursuing a doctoral degree in geology with an emphasis on zoology and chemistry from Stanford University (Tanner 1939:6).

Post at Nett Lake, Minnesota

Reagan's request was granted and he was restationed in Nett Lake, Minnesota, on the 16th of October, 1909 (Reagan ca. 1900s:box 1, Folder 2). He received a promotion less than a year later to be the superintendent of the Nett Lake school. The tribe was scattered over a large area, and Reagan ran one of two Indian schools for the reservation. Reagan had 42 students in the Nett Lake School in 1912.

Reagan was also the Special Disbursement Agent, meaning that he was in charge of allotting rations to the Native Americans (Reagan ca. 1900s:box 2, folder 8). Reagan appears to have enjoyed the natural surroundings of his post on the Bois Fort Ojibwa Reservation in Minnesota, positioned on the shores of Nett Lake. During school vacations, he traveled through the area, going on hunting trips with members of the tribe. He also wrote several papers on the Medicine Lodge Ceremonies of the Chippewa at Nett Lake (Reagan ca. 1900s:box 5, folder 5). Reagan took a census of the Ojibwa in Bois Fort, Minnesota, in October of 1909. He took it upon himself to organize his census in a different way than previous censuses had been taken. According to him, the Bureau's normal census taking system was unorganized, and looking for names on the lists, "meant tired eyes and slow business at best" (Reagan ca. 1900s:box 5, folder 5).[3] In his own census, he recorded both the native and white name of each individual, sex, relation to the head of household, and age. He also tied the census with a previous census the bureau had taken, and indicated which individuals were missing, and for what reason (i.e. death, migration, etc.). It is likely that he took a trip across the reservation and recorded all of the names that he could find, numbering over 500. He wrote:

> The Bois Fort Indians are very much a scattered band. A part live on the reservation. The rest are scattered throughout all northeastern Minnesota and into Canada on the north and Wisconsin on the south . . . . This scattered condition makes the allotting work, the determining of heirs and all annuity business very difficult. To aid in facilitating the agency work, I have secured the post office address of each of the scattered members of the tribe. I have also arranged the Census and Annuity Rolls alphabetically by families and find that this aids materially in the agency work. [Reagan ca. 1900s:box 5, Folder 4]

A lengthy 486-page, apparently unpublished manuscript documents his efforts to understand this tribe. "While Indian Agent of the Bois Fort Indians from 1909 to 1914 I made those Indians a study and, believing that my observations will prove of benefit to the world, I have written this volume" (Reagan ca. 1900s: box 5, folders 6 &7). The manuscript includes copies of reports from previous Indian Agents dating back to 1850, a history about French involvement in the 1800s, as well as cultural stories and medicinal practices (Reagan ca. 1900s:box 5, folder 6, p. 125).

Reagan seems to have been extremely interested in and dedicated to his job, and he filled what could have been his free time with projects and excursions that he was not required to take. This probably contributed to the difficulty of finding a "private" life in his history—he did not differentiate between his work and his leisure. Right after one grueling excursion, which demonstrates Reagan's adventurous and determined spirit, he had a dispute with another Bureau employee. Charles N. Brooks describes an incident in which Mr. Burns, an unhappy Bureau employee, verbally assaulted Reagan who refused to pay him for Sundays that he had not worked. Reagan, who had been lost and starving in the woods for the past three days, had just stumbled back to the reservation and even before he could get a bite to eat Mr. Burns was accosting him to pay up. Despite being "in a starving condition, bloodshot eyes, and nerves so racked by the exposure that his hands and face trembled and he could hardly stand up", Reagan refused to pay him (United States Congress 1912:395).

Brief Posts in Utah and Colorado

Reagan's first assignment to Utah came in 1914 as a teacher for the Ibapah Ute Reservation (NARA ca. 1900a). His time at Ibapah was short, lasting only eighteen months. By 1916, he was stationed as the principal at the Indian School with the Southern Ute in Ignacio, Colorado (Reagan 1916). Within two years, Reagan was reassigned to northern Arizona.

Post at Kayenta, Arizona

On October 3rd, 1918, Albert and Otilla Reagan arrived at Tuba City, Arizona, to assume their new post at Marsh Pass, an area 80 miles northeast of Tuba City (Reagan 1919a:131). This new post was about 120 miles north of Reagan's first station at Coconino, Arizona.

It took Reagan and his party nine days to get from Tuba City to Marsh Pass, and when they arrived on October 12th, the situation looked grim. The 1918 Influenza Epidemic had become a global concern by this time, and it had recently broken out among the Native Americans. Reagan and his company had heard of the devastating effects of the disease while they were traveling, and two of his companions had already fallen ill with fever. The influenza epidemic of 1918 took the lives of over 600,000 Americans, and many more lives were lost worldwide (American Experience, "Influenza 1918" http://www.pbs.org/wgbh/americanexperience /films/Influenza/).

The Indian school at Marsh Pass had not yet been open, and Reagan and his wife were only in Kayenta (Marsh Pass) for 6 days before they received orders to return to Tuba City to care for the sick. An automobile drove the 160 miles to pick them up and bring them back to a rather desperate situation (Reagan 1919a). At the infirmary, Reagan was in charge of 59 sick young boys, 23 of whom were described by Reagan as "frothing at the mouth" and many were delirious with fever. Otilla cared for 79 girls who had fallen ill, as well as several of the agency workers. They were severely understaffed. The room was crowded and reeked of fever and bodily fluids. Otilla and Albert cared for the sick for a long week before the epidemic calmed down. Reagan's feet blistered from running up and down the dormitory stairs bringing supplies back and forth and checking on his wife in the girl's dormitory (Reagan, 1919a:132). Two young Navajo girls died during this time, and Reagan and his wife sneaked their bodies out and buried them in the night. If the other children had seen the dead, there would have been chaos. Navajos believe it is necessary to flee the area of death—and Reagan wished to avoid the possibility of 140 sick children running out of the infirmary in panic. In Reagan's words, "otherwise we likely would have had a worse stampede than when a wolf gets into a chicken house" (Reagan 1919a:132). The students did not know that anyone had died until the epidemic was over.

For a full month, Albert and Otilla traveled throughout the Tuba City area caring for sick Native Americans. On one occasion, Reagan was not in the room when a patient passed. On hearing the death wail, he

> rushed into this dormitory. Pandemonium had already taken possession of the sick there before [he] arrived. With wild eyes they were starting to leave the "place of the dead"; even a sick man who could scarcely hold his head up the evening before was out of bed, trembling from head to foot. [Reagan 1919a:132]

Not only did the patients flee the hospital, they refused to return to the dormitory where the man had passed. It took several days for Reagan to convince the sick to return to the infirmary.

After an intense month of caring for the sick, the flu began to pass and Reagan and his wife were able to resume their normal jobs at Kayenta. Reagan wrote about his experiences caring for those afflicted with the flu and in many cases recorded traditional methods of healing. "The final and last remedy was a massaging, contorting process. As the disease usually terminated in pneumonia, and consequently the lungs were tight, the medicine man jumped on the afflicted parts to loosen them up. The result can be imagined." (Reagan 1919a:136)

Reagan's difficulties did not stem from just Native-White relations. While stationed in the remote area of Marsh Pass, all of his white employees resigned on the same day due to an argument between Reagan and one of the employees. One employee who quit simply stated, "It is too lonesome here." Reagan and his wife had to hold down the fort alone for several weeks while the Bureau found replacements.

In 1925, during Reagan's time at Kayenta, he earned his doctorate from Leland Stanford University (Tanner 1939:6). His 653 page dissertation was entitled "Contributions to the Geology of the Navajo Country, Arizona, with Notes on the Archeology".[4] Reagan completed most of his graduate schooling through years of work and taking his vacations to spend time at Stanford and various museums in the Southwest and California (Crawford 1934).

Post at Ouray, Utah

Reagan returned briefly to the Northwest in 1928 at the Hoquiam Reservation, but by 1929, Otilla and Albert were stationed in Uintah, Utah, at the Ouray Indian Reservation. Reagan was a teacher at the school and Otilla was a housekeeper for the school (Regan ca. 1900s:box 1, folder 2) (vv 2). Both seemed to have enjoyed their station in Utah, and had very few problems with their last assignment (Reagan 1933).

In 1930, Reagan requested the Bureau allow him to survey ruins in Ashley Valley, Utah, during the summer (Reagan1930). He assured them that he would be back on the first of September to teach school again, and that it would not interfere with his work. Additionally, on at least two occasions, Reagan surveyed Nine Mile Canyon, an area about sixty miles west from the above-mentioned Ashley Valley, with a fellow archaeology enthusiast Leo Thorne (Figure 2). A professional photographer, Thorne was a native of Vernal, Utah, and had developed an interest in the history of his state at an early age (Miller 2003:7). The party traveled down into Nine Mile Canyon via Gate Canyon, and surveyed hundreds of rock art panels along the way—several cultural groups are represented in the art of the canyon. Their work is important as it created an early record of the rock art. Preserved in their records is information now lost as more and more of the rock art is lost to time and to vandalism. Even in Reagan's time vandalism was an issue. Reagan's contemporary Julian H. Steward remarked, "Depredations around Vernal are unusually serious and I do not see any way to stop them. Reagan has written to Nusbaum but you know how difficult it is to do anything. Our only hope is to beat the vandals to it" (Steward 1931). Many of the panels have been vandalized, and current researchers are using Leo Thorne's photographs to compare what the panels looked like 80 years ago to what they look like today (Miller 2003:8).

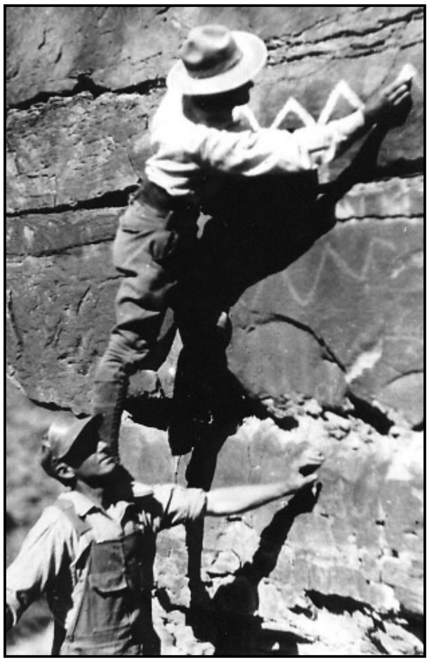

Figure 2. Albert Reagan standing on the shoulders of his photographer, Leo Thorne, during a survey in Nine Mile Canyon. Reagan chalked the petrogpyphs to improve contrast in photographs. Photograph by Layne Miller.

Reagan took nearly his entire summer vacations to survey these areas. Leo Thorne acted as photographer while Reagan wrote detailed notes. The Museum of Peoples and Cultures at Brigham Young University now houses these field notes in its archives, and many of Thorne's photographs are in the possession of his descendants as well as the Vernal Public Library (Miller 2003:8).

Reagan's Time at BYU

In 1934, the Bureau of Indian Affairs had a significant change of policy. Land allotment was abandoned and Native Americans were given back the right to self-govern. Whether this is why Reagan retired on June 30, 1934 or if it was for some other reason is not known (Reagan ca. 1900s:box 1, folder 4). He was 63 and his wife was 67 when they retired from their last post at the Ouray Indian School in Uintah, Utah in July of that year (Reagan ca. 1900s:box 7, folder 1). Soon thereafter, Reagan was hired as Special Professor of Archaeology, the first professor of anthropology, at Brigham Young University in Provo, Utah, about ninety miles away from the Ouray Reservation. One of his classmates from Stanford University, zoologist Vasco Tanner, was teaching at BYU at the time. This may have been the connection point for Reagan to come to BYU. Reagan was a denominational Christian, but not a member of the Church of Jesus Christ of Latter-day Saints, the university's sponsoring institution, so he was not religiously affiliated with BYU. He applied for the job on recommendation from Arthur L. Crawford, a fellow geologist and also a graduate of Stanford University. The two apparently talked at a Ute Bear Dance in Ouray when Reagan was considering retirement from the Indian Bureau. Others at BYU were also behind the action to hire Reagan.

> Dean Eyring of the College of Arts and Sciences, Dr. Hansen, Dr. Tanner and others who know you, and of you, are all enthusiastic about the possibility of having you affiliated with us in this work. President Harris is also very friendly and is anxious to do everything and anything that he can to bring it about. (Nelson 1934)

With these ties, Reagan came into academia at BYU with at least a few friends. He came highly recommended by Crawford, who thought Reagan would serve well as the curator for a new "Indian Museum" that was being talked about at BYU.

Reagan worked at BYU for only two years; his tenure cut short by his death in 1936. During his time there, he conducted several surveys in the Provo area, surveying ancient mounds and collecting pottery, some of which is now housed at the Museum of Peoples and Cultures at BYU. While at BYU, he took students on several trips, including one to northeastern Utah to witness an Ouray Bear Dance in April of 1935. He took several students to survey pictographs at Pelican Point on Utah Lake, and examined burial

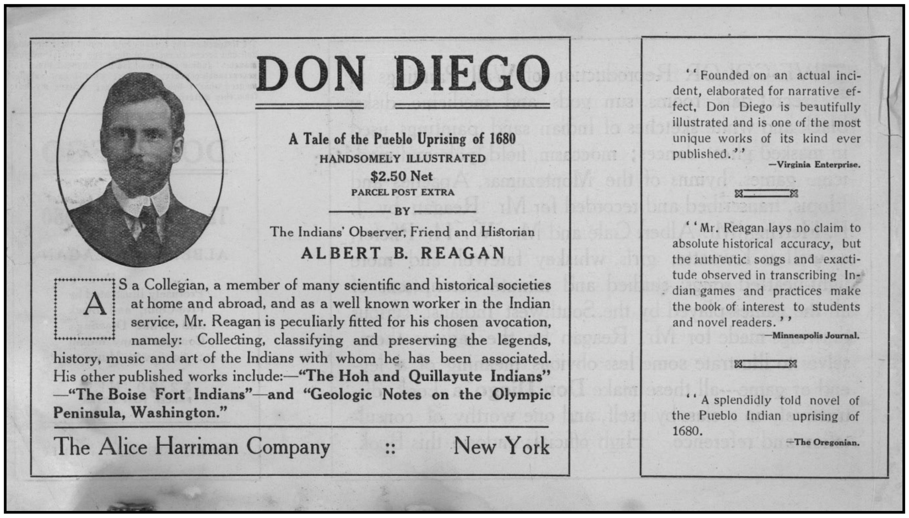

Figure 3. Selection from pamphlet advertising Reagan's published novel. Photograph courtesy of the Museum of Peoples and Cultures, Brigham Young University.

sites that had been discovered in Orem during the construction of a steel plant (Reagan ca. 1900s:box 1, folder 4).

Reagan seems to have been active all the way up to his death on the 30th of May, 1936.[5] His time in Arizona and Utah were the most prolific for his archaeological work. He continued doing surveys up until 1935. After a short illness, he passed away in Provo, Utah. His colleague and friend Vasco Tanner spoke at his funeral. Tanner said, "Dr. Albert B. Reagan's life was one devoted to service and a search for the meaning of life" (Tanner 1939:6). Tanner's obituary of Reagan echoes the feeling that Reagan's life was dedicated to his work and that he had an undying curiosity regarding the things of the past.

Publication and Research

Reagan wrote extensively. He produced 31 known journals, mostly filled with field notes and brief summaries of the day's work. His writing is rarely of a personal nature. He often typed his fiction on the backside of advertisements and old correspondence. He appears to have enjoyed fiction as his unpublished pieces often total several hundred pages each. His one published full-length novel, *Don Diego of the Pueblo*, is based loosely on the Pueblo revolt of 1680 (Figure 3). He also recorded a number of native oral histories during his various Bureau posts, several of which have been typed but never published; some are housed in the L. Tom Perry Special Collections in BYU's Harold B. Lee Library.

Reagan used many outlets to publish his research. In addition to scientific journals, he published his writing in several newspapers, including the *Vernal Express*, the *Deseret News*, and the *New Harmony Indiana Times*. The *Record-Republican* paper of Washington, Ohio stated that, "Again the readers of this publication have a real treat in store in the offering of two excellent articles concerning "Indians" as prepared by Albert B. Reagan, Ph.D. . . . whose interesting write ups in recent months have created quite a large following" (HBLL Special Collections Box 1 folder 2 letter dated 24 Aug 1932). Reagan was very proud of his writing, and sought to publish as often as possible.

In several cases, he is the only researcher of his time to have surveyed given areas, and now, nearly 100 years later, his notes are proving to be of significant interest to researchers, including efforts to determine the extent of damage to rock art in Nine Mile Canyon and a reexamination of sites documented in the Uintah basin.

Trained in geology and serving as a schoolteacher for most of his life, Reagan used spare moments to document the landscape around him. Geology was a key component of Reagan's observations and writing. He published about the geology of nearly every area where the Bureau posted him. The landscape of New Mexico was markedly different from his native state of Iowa, and he wasted no time in making observations of it. His first article "The Jemez Coal Fields" was published in the *Proceedings of the Indiana Academy of Science* in 1902, just three years after joining the Bureau.[6]

His documentation efforts soon extended beyond the physical landscape to include the people and cultures he came in contact with. He began to do ethnographic work during his first post with the Bureau at the Jemez, New Mexico Reservation in 1899.

Conclusion

As no indication has been found for his interest in archaeology, perhaps the transition from geology to ethnology to archaeology was natural and accelerated by his work with Native Americans. Surrounded by new cultures, and landscapes scattered with their past, he examined the landscape with a geologist's eyes looking at landforms, soils, and geologic change. Little wonder that he soon began publishing papers on the archaeology of the Southwest. By 1904, his first paper on archaeology, "The Cliff-Dwellers of Arizona," was published; just two years after his first geology paper (Tanner 1934). Although highly educated for the time, there is no evidence that he ever received any formal archaeological training. While his methods and some conclusions suffer somewhat due to his lack of formal archaeological training, the volume of Reagan's publications demands recognition of his important contributions to the field of archaeology, in addition to his geological and natural science contributions. When asked how he had time to accomplish all of this—to write, teach, and research, most of the time while being employed by the Bureau—he replied,

> My studying and writing is done while many people are playing cards, golf, or billiards, or are attending our numerous but often worthless picture shows. The use of my spare moments has secured me an education, recognition as an Indian writer, and considerable money besides. In short, it has paid me well. [Reagan ca. 1900s:box 3, folder 7] ■

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Notes

1. His father, William Reagan, was born in Pennsylvania and had served in the Civil War. William was severely wounded and taken prisoner on April 30, 1864 at the Battle of Jenkins Ferry. He managed to escape the Confederate troops and return to his unit in Arkansas, from which he was mustered out on June 6, 1865. Just five years after Albert's father ended his service with Company E of the 40th Iowa Infantry, he married Anna in February of 1870 in Jasper, Iowa. His mother, Anna, was born in Indiana, and kept house with the five children while her husband ran a farm. Albert was the oldest of nine children. In 1880, Albert's four younger siblings were Hermon age seven, George age six, Sarah age three, and Rhoda age two. Four more children were born between 1880 and 1890 – Clara in 1882, Elton in 1884, Maggie in 1886, and John in 1890. Between 1886 and 1890, the Reagan family moved to Wilson, Kansas. It appears that Albert did not make the trip, however—as it is likely that he had graduated from school and was on his own around the age of 19.
2. The bureau was not officially named the Bureau of Indian Affairs until 1947 but was referred to by various similar names before that time (see BIA 2013).
3. His wife, Otilla, worked as a teacher. Otilla and Albert never had any children, but they did sometimes share their house with extended family members. Reagan's younger sister Maggie, who was 15 years his junior, also worked at Nett Lake at this time as a stenographer for the Indian School. Albert would have left home when Maggie was just four years old, so this is likely the first time that the siblings really got to know each other. Albert's sister-in-law, Francis, also joined them in Minnesota as the finance clerk. The Reagans also had two boarders, both white men, living with them as well, one of which was a carpenter and the other a farmer, both working for the government. It is likely that these men were employed by the Bureau of Indian Affairs, as the only white men living on reservations typically were. The census for their town lists only twelve individuals total, as it was only recording white members of the township.
4. Stanford does not publish their students' thesis papers, so a copy has yet to be obtained by the authors.
5. Albert's wife, Otilla, remained in Provo after Albert's death until her own death. She continued to work towards publishing her husband's work during this time, even traveling to the yearly Kansas Academy of Science meetings well into her seventies. In 1939, Otilla donated $1,000 to the Academy to create the Albert B. Reagan Endowment Fund in memory of her husband, indicating that, "it was her wish that the income from the Reagan Endowment should go by preference to the young struggling scientist." It is hard to get a sense of who she was because we have not found any writing of her own, but she traveled with Albert all over the country, teaching alongside him at the Indian Schools, and doing laundry and cooking during times that they were running boarding schools. She is rarely mentioned, but in a few of Albert's publications, he notes that the sketches of pottery sherds and shells were done by his wife. At the age of eighty, she was hit by a taxi while crossing a street near her home. She died eleven days later. She and her husband were both buried in the Peoria, Iowa, cemetery in Albert's hometown.
6. It is important to note that finding published work before this date is difficult. It appears that he did not begin publishing his papers until he was well into his undergraduate in geology.

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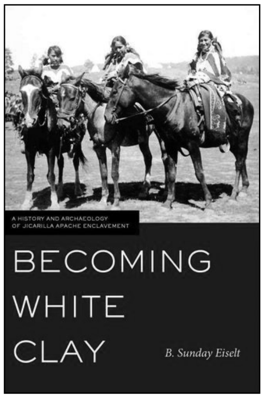
Book Review



Becoming White Clay: A History and Archaeology of Jicarilla Apache Enclavement. *B. Sunday Eiselt. 2012. The University of Utah Press, Salt Lake City, Utah. 320 pages, 23 b/w illustrations, 31 line drawings. $45.00 (cloth). $56.00 (ebook).*
ISBN-10: 1607811936
ISBN-13: 978-1607811930
ISBN: 978-1-60781-202-9 (ebook)

Review by Ren R. Thomas, Utah Statewide Archaeological Society, Utah County Chapter, Provo, Utah, 84601

Becoming White Clay is an excellent and compelling history of the Jicarilla Apache people from their Canadian Athapaskan genesis to their Southwest homeland of today. I am tempted to write of Eiselt's insightful understanding of the subject, but that would be cliché and understating; this work is indeed insight-filled. This scholarly work is a worthy read for the expert as well as the serious lay student of Southwest history and archaeology. Eiselt's steadfastness to detail can at times slow you down but demonstrates her grasp and command of the primary sources to which this will lead you. Then her clear and vibrant prose in synthesis and summary explanation brings you back invigorated for the next chapter of exploration.

This is a comprehensive history of the Southwest unlikely to be found anywhere else. Told from the perspective of the mountain and plains Athapaskan nomads that occupied the middle ground, the in-between places among the settled pueblos of the Southwest, filling the niche as traders, emissaries, protectors, and competitors in pre-contact times. It then follows their story through the tumultuous times of European conquest with its introduction of a whole new suite of trade goods including metal wares, cattle, horses, and the Spanish hierarchical caste system replete with firearms and the militarization of the region. The author adeptly handles the complexities of shifting populations with the inevitable alliances and contentions as further pressures were exerted from French and U.S. expansion across the continent.

But this is more than just another history; it is grounded solidly in the down to earth lives of the people of this saga and of the times. Part II of the book presents the ethnography and archaeology of the Jicarilla Apache, who in 1887 became the last Native American tribe in the U.S. to be settled on a reservation. Much of this is achieved with the original work of the author in the Rio del Oso of the Jemez Mountains of New Mexico.

This book should be of special interest to the readers and contributors of Utah Archaeology not only for its treatment of the Athapaskan presence in Utah, but for the theoretical possibilities it contributes for understanding the complexity of the Fremont archaeological record. Eiselt posits that it is the structural institutions of Athapaskan culture and society that has allowed this highly mobile people to prosper while undertaking "one of the most extraordinary human migrations since the peopling of the New World." Athapaskan society allowed for, or better yet encouraged, interaction, trade, and cooperation with outside groups. Adapting what they learned to maintain their own mobile society and world view in changing geographic and political environments among the more settled and sedentary populations of the American continent. The theoretical underpinnings of mutualism and enclavement presented here should be fully considered when exploring the seemingly dual nature of Fremont society as well as its interaction with the Southwest's Ancestral Puebloan cultures in its southern borderlands. ∎

B. Sunday Eiselt is an assistant professor of anthropology at Southern Methodist University. She is author or coauthor of books and articles on community-based and engaged approaches in archaeology, ceramic source geochemistry, and the Jicarilla Apache and Hispanic societies of New Mexico. (From the dust cover).