UTAH ARCHAEOLOGY 2003

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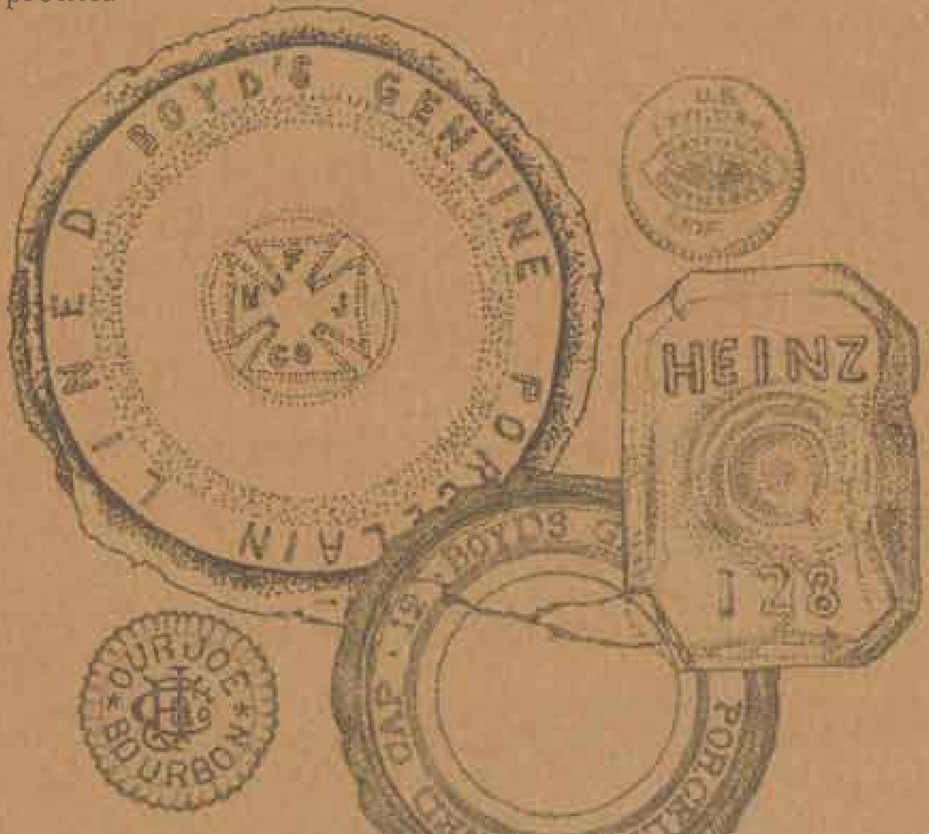

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BOOK REVIEWS

Front cover and volume endpiece illustrations: A sample of fruit jar closures, whiskey caps, and bottle bases from artifacts found at Simpson Springs, Utah.

Message from the Editor

We continue the Photo Essay section inaugurated in 2001 and take it to the next level with the first ever color photographs to appear in *Utah Archaeology.* Color photography brings flair to artistic subjects and this is evident in the photographs of the Patterson Bundle. They were taken by Jim Blazik for this issue's Photo Essay by Merry Lycett Harrison. Color photography can also be effective for technical presentations, such as the striking color digital photomicrographs of ceramic temper samples in the lead article by Bryan Hockett and Maury Morgenstein. The publication of the color photography in this issue is funded by Maury Morgenstein of the Archaeological Research Facility, University of California, Berkeley, and by the Archaeology Laboratory at Utah State University, Logan.

This issue continues the Avocationist's Corner that began in 2000 and shows that "the Corner" is not limited to amateurs. Ron Rood is Utah's Assistant State Archaeologist and his contribution shows that professionals can, and should, contribute to the Avocationist's Corner of the journal.

Many of you can help *Utah Archaeology.* Our journal exemplifies Public Archaeology and partnership. If you do field archaeology, please present some aspect of your research findings in a condensed, synthetic report. If you support the idea of public archaeology, prepare an essay for the Avocationist's Corner. These should be written for the educated, but lay reader, and on a topic of broad interest, but with some relevance to the archaeology of our region. If you have photographs that can tell a story, write some captions to pair with the photos and submit a Photo Essay. If you are an advanced undergraduate or graduate student, consider *Utah Archaeology* for those technical papers of regional interest, and use our collaborative editorial ethic to learn the ropes of publishing.

Utah Archaeology needs all professionals to contribute regardless of whether you work in higher education, are in government service, or run the engine of modern archaeology in the private sector. You have chosen archaeology as your life pursuit, and the ethics of our special profession demand your service in return for the privilege. We also need contributions from amateurs, because your feet are on the ground and your hearts are in the archaeology. Consider making a contribution to *Utah Archaeology* a USAS Chapter project.

It has been a challenging pleasure to serve *Utah Archaeology.*

Steven Simms, Editor

CERAMIC PRODUCTION, FREMONT FORAGERS, AND THE LATE ARCHAIC PREHISTORY OF THE NORTH-CENTRAL GREAT BASIN

Bryan Hockett, Bureau of Land Management, Elko Field Office, 3900 East Idaho Street, Elko, NV 89801

Maury Morgenstein, Archaeological Research Facility, University of California, 1048 Monterey Ave., Berkeley, CA 94707

Recent excavations at the Scorpion Ridge site, combined with chemical and petrographic analyses of the ceramic sherds recovered from that site and others in the area, suggest that Fremont plain wares were locally manufactured in the Upper Humboldt drainage by at least 1200 B.P. Thus, local ceramic production in portions of the central Great Basin occurred at least seven centuries earlier than the initial manufacture of Intermountain Brownware. Nevertheless, all of the Fremont and Intermountain Brownware ceramic samples analyzed here from the Upper Humboldt drainage basin were tempered with a schistose biotite granodiorite that contrasts with the monzonite temper found in plain wares from Ruby Valley, located on the east side of the Ruby Mountains. Fremont wares from the west Bonneville Basin region were tempered with materials unlike those of the Upper Humboldt River basin, and at least one of these vessels was probably manufactured in central or southern Utah. The projectile points from Scorpion Ridge include Nawthis Side-notched, and this may be the oldest and northernmost occurrence of this type found to date. The relationship of the inhabitants of the Scorpion Ridge site to farmers inhabiting the Fremont core region is uncertain, but it once stretched into the central Great Basin.

The Fremont were a mix of horticulturalists and foragers who occupied much of the eastern Great Basin from about 1500 to 500 years ago (Madsen 1980, 1989; Marwitt 1986). The Fremont also occupied areas to the east, north and south of the hydrographic Great Basin, including portions of southwestern Wyoming, northwestern Colorado, southeastern Idaho and southern Utah (Madsen and Simms 1998: Figure 1; Smith 1992). The Fremont occupation of regions west of the eastern Great Basin (west of the Bonneville Basin and the highlands that drain that basin) is not well defined or understood.

In a recent synthesis, Madsen and Simms (1998) suggest that the Fremont archaeological culture represents a variety of peoples who engaged in a diverse suite of subsistence practices, including full-time foraging, full-time horticulture, and a mix of foraging/horticulture that was very fluid in nature (see also Simms 1986, 1999). Within the Fremont culture, a diverse suite of ideologies concerning social norms and political organizations may have been practiced (Barker 1994; Hockett 1998; Janetski 2002; Talbot et al. 2000). Despite this diversity, these groups were somehow linked through the manufacture and trade of distinctive material items such as ceramics, projectile points, and textiles (Marwitt 1970; Morss 1931). Madsen and Simms (1998) defined this linkage as a "Fremont Behavioral Complex", in many respects similar to the "Hopewellian Interaction Sphere" defined earlier for sites in the midwestern and eastern

United States. Consider, for example, the following quotation from Ritzenthaler (1985:48), suggesting a similar conclusion is being drawn for the Fremont phenomenon:

> People still had their local ways of doing things, but Hopewell was a broad-scale phenomenon which overlaid these regional traditions. While Hopewell was not a separate culture, it is not necessarily clear what it represented. The closest term that archaeologists have come to accept is 'interaction sphere'.

One of the central issues to investigate in Fremont studies is the relationship between settled farmers at the center and foragers at the margins. Were the foragers along the Fremont periphery once farmers who left the center in search of new lands to cultivate? Were they folks who simply adopted some material items through contact with farmers? How far west did the Fremont Behavioral Complex extend? Madsen (1989) noted that Fremont ceramics have been found as far west as Grass Valley in central Nevada. However, research into these questions has been hampered by a number of assumptions about Late Archaic (post-1500 B.P.) prehistory west of the Bonneville Basin that may be in error. For example, it is well known that Eastgate and Rose Spring projectile points are common throughout the Intermountain West in sites that are clearly Fremont in character and in those that clearly are not (e.g., Holmer 1986). How are we to interpret a prehistoric campsite near the margins of the Bonneville Basin that contains Eastgate points but no ceramics? Should we assume that the site was left behind by a group who had no involvement in the Fremont Behavioral Complex? In addition, plain ware ceramics located west of the Bonneville Basin are often assumed to be Intermountain Brownware vessels that postdate ca. 700 B.P. Is this always the case? If Fremont ceramics are identified west of the Bonneville Basin, should we assume that they were manufactured elsewhere and traded into the western periphery?

Recent data collected from the Scorpion Ridge site in the central Great Basin (Figure 1) cast new light on these problems and assumptions. Among the artifacts recovered from Scorpion Ridge are 15 Eastgate points, one Fremont-style Nawthis Side-notched point, and approximately 150 gray to gray-brown plain ware ceramic sherds surrounding two hearths dating to approximately 1200 B.P. Plain wares are defined here as any non-painted vessel that may display various shades of color, including brown, tan, gray, and red. Results of chemical and petrographic thin sections of the ceramics from the Scorpion Ridge site and other plain and painted ware sherds from the region reported here for the first time suggest that the Scorpion Ridge vessels were manufactured from local clays and tempers procured from the Upper Humboldt drainage basin. These sherds extend the known age of locally manufactured plain wares by seven centuries, challenging previous assumptions about the age of ceramic production and the distribution of Fremont foraging cultures west of the Bonneville Basin.

LATE ARCHAIC CERAMICS AND PROJECTILE POINTS IN THE NORTH-CENTRAL GREAT BASIN: PREVIOUS RESEARCH

The north-central Great Basin is defined here as an arbitrary subregion of the cultural Great Basin as discussed in Grayson (1993). The northeastern one-quarter of Nevada encompasses most of this subregion (Figure 1), and this 16,000 square-kilometer area serves as the focus of this paper. The introduction of the bow-and-arrow about 1300 years ago marks the beginning of the Late Archaic in the north-central Great Basin (see Table 1).

The time period between 1300 and 600 B.P. represents the Maggie Creek Phase of the Upper Humboldt local chronological sequence (Elston and Katzer 1990), and it is characterized by the presence of Eastgate and Rose Spring projectile points (Holmer 1986). Fremont ceramics have occasionally been recovered in Maggie Creek Phase assemblages (e.g.,

Figure 1. Location of sites mentioned in text. The ceramic sherds listed by "CRNV" numbers were all found at open-air sites located along the Humboldt River between the headwaters of the Humboldt (the location of the Wells Dump site) to the east and the city of Elko to the west.

Table 1. Radiocarbon results and associated features, projectile points, and ceramics from single-component open-air sites and stratified occupations in caves and rockshelters excavated in northeastern Nevada through 2002. All reported dates are either unadjusted radiocarbon years B.P. or conventional radiocarbon B.P. dates adjusted for $^{13}C/^{12}C$ fractionation.

Site	^{14}C Age (B.P.)	Associated Artifacts	Reference
26EK4688, Locus 6	80 +/- 40	hearth; DSN point	Birnie (2001)
26EK6487	150 +/- 50	hearth; DSN point; ceramic sherd	Birnie (2000)
Dry Susie Creek	210 +/- 70	hearths; Cottonwood points; "Shoshone knife"	Reust et al. (1994)
26EK4688, Locus 8[a]	210 +/- 50	hearth; DSN and Cottonwood points	Birnie (2001)
James Creek Shelter	240 +/- 50	hearths; DSN points	Budy and Katzer (1990); Drews (1990)
Max's Retreat	250 +/- 50	hearths; DSN and Cottonwood points; brownware ceramics	Hall (1985)
CRNV-11-9371	280 +/- 50	hearth; DSN point; brownware ceramics	Vierra and Langheim (2002)
James Creek Shelter	280 +/- 50	hearths; DSN points	Budy and Katzer (1990); Drews (1990)
26EK3106	300 +/- 70	hearth; DSN points	Ataman and Drews (1992)
James Creek Shelter	300 +/- 50	hearths; DSN points	Budy and Katzer (1990); Drews (1990)
CRNV-11-8979	320 +/- 40	living/house floor; DSN point on floor	Hockett et al. (1999)
26EK5270	330 +/- 60	hearth; DSN and Cottonwood points	Tipps (1996)
Max's Retreat	340 +/- 50	hearths; DSN and Cottonwood points; brownware ceramics	Hall (1985)
CRNV-11-12103	470 +/- 50	hearth; DSN and Cottonwood points	Hockett (2003)
Round Mountain Camp	480 +/- 60	hearth; DSN points; brownware ceramics	Bright (1998)
26EU1505	490 +/- 110	hearth; DSN points	Tipps and Stratford (1996)
Carorra's Camp	590 +/- 50	hearth; DSN and Cottonwood points	Tipps (1988)
Wells Dump	750 +/- 70	hearth, Eastgate point; brownware ceramics; bison remains	Murphy (1988)
James Creek Shelter	750 +/- 50	hearths; Rose Spring and Eastgate points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	850 +/- 50	hearths; Rose Spring and Eastgate points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	930 +/- 60	hearths; Rose Spring and Eastgate points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	970 +/- 70	hearths; Rose Spring and Eastgate points; Fremont-style grayware?	Budy and Katzer (1990); Drews (1990)
Oranjeboom Cave	1100 +/- 40	hearths; Eastgate points; Fremont-style ceramics	Buck et al. (2003)
Swallow Shelter[a]	1120 +/- 110	hearths; mainly Rose Spring and Eastgate points; a few Elko points	Dalley (1976)
James Creek Shelter[a]	1190 +/- 60	hearths; mainly Rose Spring and Eastgate points; a few Elko points; Fremont-style grayware?	Budy and Katzer (1990); Drews (1990)
Scorpion Ridge	1200 +/- 40	hearths; Eastgate points; two Elko points; Nawthis Side-notched point; brown/gray ware ceramics	this report
Oranjeboom Cave	1220 +/- 60	hearths; Eastgate points; Fremont-style ceramics	Buck et al. (2003)
James Creek Shelter	1240 +/- 50	hearths; mainly Rose Spring and Eastgate points; a few Elko points	Budy and Katzer (1990); Drews (1990)
Scorpion Ridge	1290 +/- 40	hearths; Eastgate points; two Elko points; Nawthis Side-notched point; brown/gray ware ceramics	this report
Pie Creek Shelter[a]	1580 +/- 70	hearth; mainly Late Archaic and Elko points	McGuire et al. (2003)

Site	^{14}C Age (B.P.)	Associated Artifacts	Reference
CRNV-11-12177	1710 +/- 60	hearth; Elko point	Hockett (2002)
Ander Wright	1850 +/- 60	hearth; mainly Gatecliff points; several Elko points	Zeanah and Elston (1997)
Ander Wright	1890 +/- 60	hearth; mainly Gatecliff points; several Elko points	Zeanah and Elston (1997)
Ander Wright	1900 +/- 60	hearth; mainly Gatecliff points; several Elko points	Zeanah and Elston (1997)
James Creek Shelter	1940 +/- 60	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	2350 +/- 100	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
Pie Creek Shelter[d]	2510 +/- 60	hearth; mainly Elko points	McGuire et al. (2003)
James Creek Shelter	2630 +/- 100	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
Swallow Shelter[b]	2630 +/- 110	hearths; mainly Elko points	Dalley (1976)
Dry Susie Creek	2640 +/- 70	house floors; hearths; Elko points; "Shoshone knife"	Reust et al. (1994)
Pie Creek Shelter	2740 +/- 40	hearth; mainly Elko points	McGuire et al. (2003)
James Creek Shelter	2750 +/- 70	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	2780 +/- 120	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
Swallow Shelter	2850 +/- 100	hearths; mainly Elko and Gatecliff points	Dalley (1976)
Dry Susie Creek	2890 +/- 60	house floors; hearths; Elko points; "Shoshone knife"	Reust et al. (1994)
Dry Susie Creek	3030 +/- 70	house floors; hearths; Elko points; "Shoshone knife"	Reust et al. (1994)
Pie Creek Shelter	3060 +/- 40	hearth; mainly Elko points	McGuire et al. (2003)
James Creek Shelter	3160 +/- 100	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
James Creek Shelter	3280 +/- 70	hearths; Elko points	Budy and Katzer (1990); Drews (1990)
South Fork Shelter[e]	3320 +/- 200	"midden" deposit; mainly Elko points	Heizer et al. (1968)
Pie Creek Shelter[d]	3350 +/- 90	hearths; mainly Gatecliff points	McGuire et al. (2003)
Swallow Shelter	3500 +/- 100	hearths; mainly Gatecliff, Humboldt, and Elko points	Dalley (1976)
Pie Creek Shelter	3740 +/- 40	hearths; mainly Gatecliff points	McGuire et al. (2003)
James Creek Shelter[c]	3890 +/- 100	mainly Gatecliff points	Budy and Katzer (1990); Drews (1990)
Pie Creek Shelter[d]	3930 +/- 40	Humboldt points	McGuire et al. (2003)
Pie Creek Shelter	3960 +/- 70	hearths; mainly Gatecliff points	McGuire et al. (2003)
Pie Creek Shelter[d]	4300 +/- 70	hearths; large side-notched points; untyped stemmed and leaf-shaped varieties	McGuire (2003)
Pie Creek Shelter	4640 +/- 40	Humboldt points	McGuire (2003)
Pie Creek Shelter	4840 +/- 80	hearths; large side-notched points; untyped stemmed and leaf-shaped varieties	McGuire (2003)
Bonneville Estates Rockshelter[f]	6040 +/- 80	Northern Side-notched points; Pinto-like points; untyped side-notched points with convex-bases and "keyhole" basal notches	Schroedl and Coulam (1989); Graf et al. (2002)
Bonneville Estates Rockshelter	6100 +/- 50	Northern Side-notched points; Pinto-like points; untyped side-notched points with convex-bases and "keyhole" basal notches	Graf et al. (2002)
Bonneville Estates Rockshelter	6100 +/- 80	hearths; large side-notched points	Graf et al. (2002)
Bonneville Estates Rockshelter	6280 +/- 40	hearths; large side-notched points	Graf et al. (2002)

Site	^{14}C Age (B.P.)	Associated Artifacts	Reference
Bonneville Estates Rockshelter	7190 +/- 50	hearths; large side-notched points	Graf et al. (2002)
Bonneville Estates Rockshelter	7280 +/- 50	hearths; large side-notched points	Graf et al. (2002)
Bonneville Estates Rockshelter	7420 +/- 50	hearth; just below strata yielding large side-notched points	Graf et al. (2002)
Bonneville Estates Rockshelter	9520 +/- 60	hearth; stratigraphically associated with strata yielding stemmed points	Graf et al. (2002)
Bonneville Estates Rockshelter	10,040 +/- 70	hearth; Great Basin stemmed points	Graf et al. (2002)
Bonneville Estates Rockshelter	10,080 +/- 50	hearth; Great Basin Stemmed points	Graf et al. (2002)
Deer Creek Cave[g]	10,085 +/- 400	hearth	Shutler and Shutler (1963)
Bonneville Estates Rockshelter	10,130 +/- 60	hearth; Great Basin Stemmed points	Graf et al. (2002)

[a] A total of eight DSN points, five Cottonwood points, and one Rose Spring point was recovered from Locus 8. Given the relatively large sample of projectile points recovered, and the fact that 13 of the 14 points were either DSN or Cottonwood, the locus is listed as a good candidate for dating DSN and Cottonwood points. The date of manufacture of the Rose Spring point may or may not date to this time.

[b] Swallow Shelter is located along the Nevada-Utah border in extreme northwest Utah (see Figure 1). At Swallow Shelter, 27 of the 30 Rose Spring and Eastgate points (90%) post-date stratum 9, which was dated to ca. 1120 B.P. A total of 75 of the 77 Elko points recovered (97%) date between ca. 3500 and 1000 B.P. A total of 66 of the 77 Elko points (86%) date between ca. 3500 and 1120 B.P. A total of 25 of the 27 Gatecliff points (93%) and 5 of the 7 Humboldt points (71%) date between ca. 3500 and 2800 B.P.

[c] At James Creek Shelter, 22 of the 23 Elko points (96%) post-date ca. 3300 B.P. Three of the 23 Elko points (13%) were found in strata dating to ca. 1200 B.P., similar in age to those found at the Scorpion Ridge site. One Elko (4.3%) was found in the stratum dating to ca. 3900 B.P. The Gatecliff points all came from the stratum dating to ca. 3900 B.P.

[d] At Pie Creek Shelter, 12 of the 14 Rose Spring and Eastgate points (86%) were recovered from sediments post-dating ca. 1600 B.P., as were all of the DSN and Cottonwood points. These data suggest that arrow points generally post-date ca. 1600 B.P., and this date may closely approximate the earliest dates for Rose Spring and Eastgate points in the region. In addition, as suggested by the projectile points from Scorpion Ridge, as well as other Fremont assemblages in the eastern Great Basin (see discussions, this report), the Pie Creek data suggest that Elko points continued to be manufactured after the arrival of the bow-and-arrow. Six of the 12 Elko points (50%) post-date ca. 1600 B.P. Four Elko points were found in Stratum 6, dating between 3060 and 2510 B.P.; thus, 10 of the 12 Elko points (83%) post-date ca. 3100 B.P. at Pie Creek Shelter. A total of 7 of the 8 Gatecliff points (88%) pre-date ca. 3350 B.P., and these 7 points were bracketed by dates of ca. 4000 to 3350 B.P. All of the Humboldt, large side-notched, and untyped leaf and stemmed varieties pre-date ca. 3900 B.P.

[e] At lower South Fork Shelter, all 38 Elko Corner-notched and Elko-Eared points were found at least six inches above the layer dated to ca. 3300 B.P. Thus, a total of 145 of the 150 Elko points (97%) from Pie Creek Shelter, James Creek Shelter, South Fork Shelter, and Swallow Shelter was recovered from sediments that post-date ca. 3500 B.P. The single purported "Elko" point associated with a large side-notched point and a 5800 B.P. date at Upper South Fork Shelter (Spencer et al. 1987) may, in fact, be a Gatecliff point. However, as indicated above at Pie Creek Shelter, James Creek Shelter, and Swallow Shelter there are hints that Elko points may have occasionally been produced before ca. 3500 B.P. in northeastern Nevada, albeit in very low numbers. A statistical comparison of obsidian hydration measurements on Elko and Gatecliff points reported in Hockett (1995) showed that hydration bands on Elko points were significantly thinner than those on Gatecliff points, suggesting again that the vast majority of Elko points post-date Gatecliff points in northeastern Nevada.

[f] At Bonneville Estates, Schroedl and Coulam (1989) typed several side-notched points that exhibit convex bases and "keyhole" notches in the base as Elko-Eared points in the ca. 6000 B.P. layer. These points clearly are not Elko Series, and probably represent a new form of side-notched point as yet unnamed in the region. Interestingly, Schroedl and Coulam (1989) noted that similar points were also recovered from the lower strata at both Danger Cave (Jennings 1957) and Hogup Cave (Aikens 1970). Thus, this unnamed point style probably has a distribution over much of the Bonneville Basin. On-going excavations at Bonneville Estates, with its 10,000 B.P.+ cultural record, may clarify this issue and will add a substantial amount of information to the body of data contained in the table above; in particular, numerous dates have been obtained on Late Holocene (post 4500 B.P.) occupations in the shelter, all of which will be reported at a later date.

[g] At Deer Creek Cave, all that can be securely stated is that human occupation likely began by the latest Pleistocene. Several hundred projectile points were recovered from the cave, and six C-14 dates were obtained from separate hearths found within the main excavation block. Five of these six radiocarbon dates were in chronological order, but one date of ca. 4200 B.P. was obtained between two other hearths that dated to ca. 2650 and 2585 B.P. Based on the provenience of the projectile points and the C-14 dates, the evidence from Deer Creek Cave would suggest that Desert Side-notched points are 4,000 to 5,000 years old and Elko Corner-notched points are 10,000 years old and contemporaneous with Great Basin Stemmed points, neither of which is likely. Ziegler (1963:16) reports that marmot (*Marmota flaviventris*) remains were second to mountain sheep (*Ovis canadensis*) in abundance, and marmot bones were found up to 20 inches below the hearth dated to ca. 10,100 B.P. In all probability, marmots actively burrowed deep into the cave's sediments, rendering the stratigraphic integrity of the cave's deposits in serious question; as a result, we consider this site to be a poor case study of projectile point chronology.

vessels were locally manufactured. Fremont ceramics ceased to be manufactured anywhere in the Great Basin after about 600-500 B.P.

Beginning about 600-500 B.P. in the north-central Great Basin, the Eagle Rock Phase is characterized by Desert Side-notched (DSN) and Cottonwood Triangular projectile points, as well as Intermountain Brownware ceramics (Pippen 1986). DSN points may mark the initial spread of Numic-speaking groups (e.g., Shoshone, Paiute, Ute, Goshute) across the Great Basin from a homeland near modern Death Valley, California (see Rhode and Madsen 1994). Intermountain Brownware ceramics were manufactured throughout the Intermountain West at this time.

As mentioned above, there are two general types of ceramics that have been identified in the north-central Great Basin: "Intermountain Brownware" and "Fremont". Intermountain Brownware is a general term that refers to many Great Basin ceramics manufactured after about 600 B.P. It is a utilitarian ware that is generally brown in color, often exhibiting rough or uneven outer walls with straight to slightly convex rims (Figure 2). In northeastern Nevada, Intermountain Brownware vessels take various forms from large 'flowerpots' with rounded, cone-like bases to flat-bottomed pots that may exhibit basketry impressions on the underside of the base. Most Intermountain Brownware vessels are undecorated, although fingernail impressions are present on some. In almost all cases, Intermountain Brownwares from northeastern Nevada were made with the coil-and-scrape technique, and scraping marks are often visible on the interior and exterior walls, adding to the 'rough' texture of finished vessels.

Figure 2. Typical Intermountain Brownware vessel that post-dates ca. 500 B.P. in northeastern Nevada. Note the irregular outer walls and relatively straight rim. This specimen was reconstructed from a site located in the Cherry Creek range west of the Goshute/Dolly Varden ranges.

Intermountain Brownwares stand in stark contrast to the relatively diverse suite of Fremont vessels manufactured before ca. 600 B.P. Fremont utilitarian wares take various forms from plain brown and gray wares to thick-walled corrugated vessels. However, even the plain wares manufactured before 600 B.P. in the Great Basin generally exhibit relatively even and smooth walls, although some of the so-called "Promontory" ware manufactured in the Great Salt Lake region around 500-700 B.P. is relatively crude (Madsen and Simms 1998). Many Fremont vessels also take the form of jars or jugs, often exhibiting 'flaring' or curved neck rims rather than the straight-walled rims of most Intermountain Brownwares. Fremont painted bowls and cups, reminiscent of some Anasazi wares, are common in many horticultural villages.

In the absence of artifacts such as projectile points and features such as datable hearths, it is becoming increasingly clear that temper and paste are poor mediums to classify and identify broken Great Basin plain wares (Dean 1987; Lyneis 1994; Madsen and Simms 1998). This is because early (pre-600 B.P.) and late (post-600 B.P.) vessels were often manufactured with the same or similar local materials within individual valley systems. As a result, vessel characteristics such as rim shape and wall preparation, as well as possible associations with other types of material items such as projectile points, probably are better mediums to classify Great Basin ceramics. In the absence of reliable C-14 dates, however, some vessels that are represented at individual sites by small samples and body sherds only remain difficult to classify with certainty (e.g., Fremont-like or Intermountain Brownware-like).

The Maggie Creek Phase in the north-central Great Basin chronologically overlaps the early phases of ceramic production and the establishment of Fremont horticultural villages throughout Utah and portions of east-central Nevada. Ceramic production may have begun as early as 1500 B.P. in the eastern Great Basin (Janetski et al. 1997; Madsen and Simms 1998), but Fremont horticultural villages with adobe architecture did not appear until 1000 to 1200 B.P. (Madsen and Simms 1998). Painted Fremont wares are not known to pre-date ca. 1000 B.P. in the eastern Great Basin, and appear to be associated with the fluorescence of villages in the central and northern portions of the Fremont complex, as well as with a period of upheaval and greater Anasazi influences stemming from the south (Madsen and Simms 1998). Corrugated ware is currently unknown from Fremont sites located around the Great Salt Lake (Madsen and Simms 1998:301), and could have been traded into the north-central Great Basin from elsewhere at about the same time as painted wares, perhaps from villages located in east-central Nevada or central/southern Utah.

In the north-central Great Basin the earliest securely dated Maggie Creek Phase occupations occur at James Creek Shelter (ca. 900-1250 B.P.; Madsen 1990) in the Upper Humboldt River drainage and at Oranjeboom Cave (ca. 1100-1200 B.P.; Buck et al. 2002) near the Nevada-Utah border (Table 1; Figure 1). These two sites also contain the only securely dated Fremont ceramics from the region. King (1994) found both painted and plain gray wares in Ruby Valley, and, based on the dating of nearby hearths, suggested that Fremont wares may have been manufactured there as early as 1400 B.P.; however, the palimpsest nature of these Ruby Valley sites render this interpretation unsubstantiated at this time. Other sites containing Fremont plain ware ceramics such as 'Great Salt Lake Gray' or 'Promontory Ware', have been found in undated surface contexts near the Nevada-Utah border (e.g., Seldomridge 1985; Murphy 1990; Moore 1994; Arkush 1999; Hockett et al. 1999), near the beginning of Loray Wash five miles northeast of Oasis (Seldomridge 1985), and along the eastern flank of the Cherry Creek Mountains. Portions of three Snake Valley Black-on-Gray painted bowls or cups have been recovered from three undated open-air sites. One is located near the Nevada-Utah border on the eastern flanks of the Goshute Mountains (analyzed as sample 12 below). Another site, 26EK2828 is the same site as the one mentioned above near Oasis that also produced

Fremont plain wares (Seldomridge 1985). The third site is located in Ruby Valley (Murphy 1983). Pieces of broken Fremont corrugated jars have been found at two locations in northeastern Nevada, including the Dolly Varden Range west of the Goshute Mountains at Deer Springs (Figure 1), and at site 26EK1846 near the town of Wells along the Humboldt River (Brown and Rusco 1987).

If all of the Maggie Creek Phase ceramics from northeastern Nevada were manufactured elsewhere and traded into the region, and if horticulture was never adopted there, then it would be unwise to argue that sites exhibiting pre-600 B.P. ceramics were left behind by groups that were part of the Fremont Behavioral Complex, except in a peripheral way as trading partners. On the other hand, if Fremont-style ceramics were locally manufactured in northeastern Nevada, and if they occur with Fremont-style projectile points, then this may indicate more complex cultural, behavioral, and/or biological affiliations with Fremont groups located near the center.

Unfortunately, it has not been determined whether the broken vessels found at Maggie Creek Phase sites such as James Creek Shelter (Elston and Budy 1990) and Oranjeboom Cave (Buck et al. 2002) were locally manufactured, or if they represent trade wares manufactured elsewhere and carried into the region. Resolving this issue is one of the goals of the analysis described here.

The Eagle Rock Phase has been viewed as the first definitive evidence for local ceramic production in the central and north-central Great Basin (reviewed in Rhode 1994). Tuohy (1973) suggested some time ago that plain wares diffused from south to north across the Great Basin. This idea, however, was challenged in the mid-1980s by the discovery of plain wares dating between 1000 and 1200 B.P. in northern regions such as southern Idaho (Holmer and Ringe 1986) and southwest Wyoming (reviewed in Smith 1992). Plain wares, in fact, may be youngest in those regions closest to the proposed origin of the Numic Spread near Death Valley because they are all Intermountain Brownware vessels. The ceramic tradition would have spread from those regions nearest the Fremont or Anasazi peoples. This influence simply may not have reached the western fringes of the Great Basin until between 1500 and 600 B.P. Rhode (1994), for example, reports that the oldest securely dated plain wares from Owens Valley in the western Great Basin may be no older than ca. 400 B.P., while the oldest plain wares from Yucca Mountain in southern Nevada date to ca. 900 B.P. at the Sever Tanks site. And, as mentioned, plain wares have been dated between 1000 and 1200 B.P. across a vast region of northern Utah, southern Idaho, and southwest Wyoming adjacent to the region exhibiting Fremont ceramics dating to at least ca. 1500 B.P.

The earliest securely dated Eagle Rock Phase occupation in northeastern Nevada occurs at the Carorra's Camp site northeast of Battle Mountain at ca. 600 B.P. No ceramics were recovered from this site. Of the 14 well-dated, single component Eagle Rock Phase occupations, 13 (93 percent) date to 500 B.P. or younger (see Table 1). The oldest securely dated Intermountain Brownware ceramics come from Little Boulder Basin at sites such as Round Mountain Camp, northeast of Battle Mountain, at ca. 500 B.P. (Table 1).

Regarding projectile points, Rose Spring and Eastgate styles are associated with the early Fremont ceramics in Utah, southwestern Wyoming, southern Idaho, western Colorado, and northeastern Nevada (see Madsen and Simms 1998:301 for a review), and they are also common in some Fremont horticultural villages. They are also commonly found at small, short-term foraging camps that lack ceramics throughout the Great Basin. Because these points are so common in both Fremont and non-Fremont contexts beginning about 1300 years ago in the north-central Great Basin, they are not considered a Fremont-style artifact here because they are not 'diagnostic' of groups participating in the Fremont Behavioral Complex. Fremont-style points that are diagnostic of this complex include side-notched (Uinta, Bear River, Nawthis), basally-notched (Parowan), and concave-base (Bull Creek) varieties (Holmer and Weder 1980; Holmer 1986). Prior to the excavations at Scorpion Ridge that recovered a Nawthis point, no other arrow point style previously recovered in Fremont villages had been identified in northeastern Nevada.

The chronological distribution of projectile points in this region is somewhat ambiguous, but patterns are evident. The data in Table 1 show that most of the dart and spear point styles pre-date the Late Archaic at ca. 1200-1300 B.P. These point styles include varieties of stemmed, large side-notched, and Pinto-like, as well as Humboldt, Gatecliff and Elko Series. Greater than 90 percent of all Elko dart points from well-dated contexts date between ca. 3500-1700 B.P., and they generally post-date Gatecliff points, although they occasionally are found in Late Archaic contexts in cave and rockshelter settings. Obsidian hydration dating generally corroborates these interpretations (Hockett 1995). Elko points are also commonly found in Fremont horticultural villages that post-date ca. 1200 B.P. in Utah and east-central Nevada (e.g., Talbot et al. 2000; Wilde and Soper 1999). Thus, the association of this dart point style with Late Archaic Eastgate or Rose Spring arrow points is to be expected at some locales, and their association does not necessarily imply a multi-component occupation.

THE SCORPION RIDGE SITE

The Scorpion Ridge site (26EK7123) is located approximately 3 km (2 mi) southeast of Elko, Nevada (Figure 1), between two small ridgetops at approximately 1760m (5800 ft) above sea level in the Elko Hills. The Elko Hills are draped with big sagebrush and Utah juniper trees, and they separate the Humboldt River drainage to the northwest from the western slopes of the Ruby Mountains to the southeast. The Elko Hills consist of extensive chert deposits, and in surface area are second only to the Tosawihi Quarries (Elston and Raven 1992) in the availability of concentrated, artifact-quality chert in northeastern Nevada. The Scorpion Ridge site is located in the Elko Hills Chert Source Area, although there are no bedrock outcroppings of artifact-quality material within the boundaries of the site.

Ridgetops in the region, including Scorpion Ridge typically consist of sediments that are shallow and Late Holocene in age. These sediments consist of very loose, powdery, tannish-brown silts that are usually no more than 10-20 cm thick. They are typically unstratified and overlie weathered rhyolitic bedrock.

A total of 88 square meters was excavated at the Scorpion Ridge site during the summer of 2001. All but one of the projectile points, all of the ceramics and faunal remains, and the two hearth features were found at Locus 1, where 53 contiguous square m surrounding the two hearth features were excavated.

The Scorpion Ridge site represents a single-component, Maggie Creek Phase assemblage. The two AMS dates retrieved from charcoal collected from two separate hearth features located within Locus 1 suggest that the site was occupied approximately 1200 B.P. (Beta 157186; 1290 ± 40 B.P. 660-790 cal A.D. and Beta 164705; 1200 ± 40 B.P. 710-910 cal A.D.). In addition, the 15 Eastgate points (Figure 3) surrounding the two hearths are consistent with a Maggie Creek Phase occupation. Other than an Elko-Eared point recovered from Locus 1, the remaining projectile point (see Figure 3) matches the form and description of Nawthis Side-notched points previously identified from Fremont village sites in central and southern Utah such as Bull Creek (Jennings and Sammons-Lohse 1981:66, Figure 35c,d), Round Spring (Metcalf and Overturf 1993:34, Plate 7g-l), Icicle Bench (Talbot et al. 1999:40, Figure 1.36c), Huntington Canyon (Montgomery and Montgomery 1993:311, Figure 8.2), Backhoe Village (Madsen and Lindsay 1977:39, Figure 22L), and Radford Roost (Talbot et al. 1999:104, Figure 2.23h-k), as well as in east-central Nevada at Baker Village (Fergusson and Eccles 1999:125, Figure 46h, l).

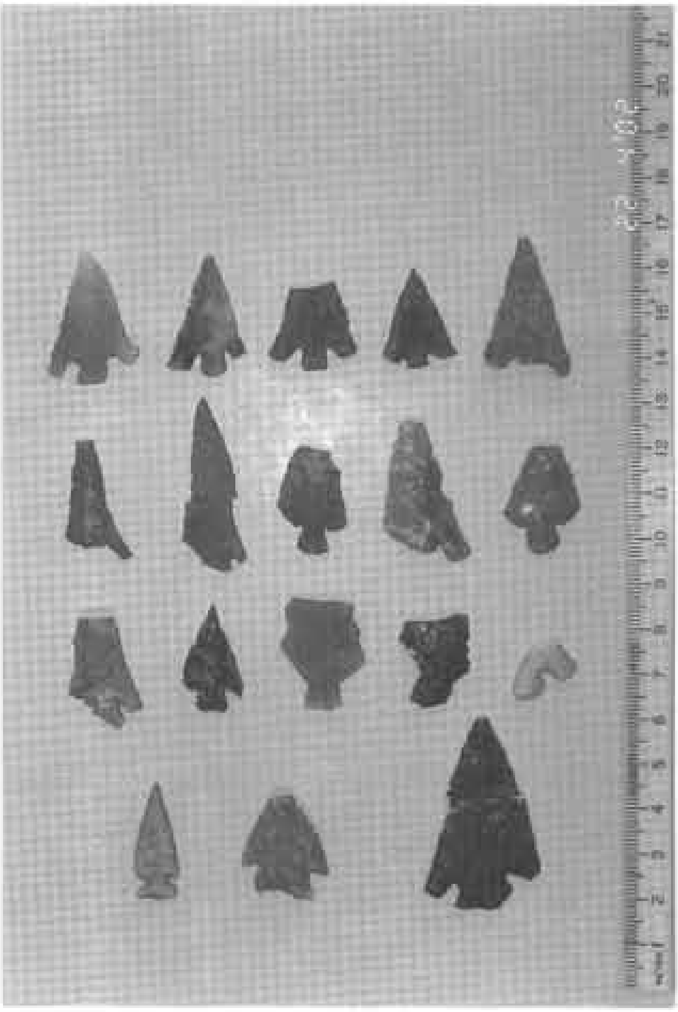

Figure 3. The projectile points recovered from the Scorpion Ridge site. The top three rows show the 15 Eastgate points plus the point tip refit (second row from the top, second point from the left). Bottom row shows the Nawthis Side-notched point (left) and the Elko-Eared point (center) from Locus 1, as well as the Elko Corner-notched point and point tip refit (right) found in another area of the general site boundaries.

Figure 4. Two rim sherds (top row) and four body sherds exhibiting drill holes from the Scorpion Ridge site. Note the curved rim that belonged to a flaring neck jar typical of Great Salt Lake Gray vessels. The straighter rim is typical of those found on Fremont corrugated wares (Bill Fawcett, personal communication 2002).

As recently reviewed in Madsen and Simms (1998:302), Nawthis Side-notched points are generally thought to post-date 900 B.P., and they are primarily distributed in the southern Fremont region. The side-notched point from Scorpion Ridge matches the descriptions and illustrations of Nawthis Side-notched points too closely to warrant the creation of a new point style in the central Great Basin based on a single artifact. Thus, we prefer to argue that Nawthis Side-notched points are older and more widely distributed than previously acknowledged.

In addition to the 17 identifiable projectile points, 10 middle-to-late stage bifaces, seven cores, four pieces of groundstone, 858 pieces of debitage, 145 ceramic sherds, and 306 faunal specimens were recovered from the site. All of the lithic artifacts were made from local cherts available in the Elko Hills. The bifaces, cores and abundance of relatively large pieces of debitage suggest that lithic reduction focused on the production of tool blanks rather than tool repair and maintenance. The faunal remains consist of the extensively fractured remains of a single deer (*Odocoileus hemionus*) carcass, which was butchered, cooked, and eaten at the site. Many of the bones are burned, and the extensive fracturing suggests that the long bones were broken open for marrow. The grinding stones could have been used to process plant foods, aid in the processing of the deer carcass, or both.

Other than the Nawthis Side-notched point, a characteristic of the Scorpion Ridge site is the presence of nearly 150 plain ware sherds. They are relatively thin (mean thickness = 4mm), the outside surfaces are smooth and even, and two rim sherds do not resemble those typically found on Intermountain Brownware vessels, particularly the rim sherd from a flaring neck jar (Figure 4). The straight rim sherd (Figure 4) resembles those typically found on Fremont corrugated vessels (Bill Fawcett, personal communication 2003). In short, vessel shape and manufacturing technique suggest that the vessels from Scorpion Ridge most closely resemble "Great Salt Lake Gray" Fremont wares. As a result, chemical and petrographic analyses were conducted to investigate whether the Scorpion Ridge Fremont ceramics were locally manufactured or traded into the region from elsewhere. The results of these studies are reported below.

CERAMIC ANALYSIS: SCORPION RIDGE AND BEYOND

A total of 22 sherds and three temper samples was investigated by optical petrography, inductively coupled plasma (ICP), inductively coupled plasma-mass spectrometry (ICP-MS) and scanning electron microscopy (SEM). Petrographic microscope analysis focused on the identification of mineral and rock fragments in the ceramic sherds and potential temper source samples, while sample examination using the SEM focused on the mineral concentrations in the potential source sample fine silt and clay fractions and sherd paste. These optical methods combined with geochemical analysis by ICP and ICP-MS concentrated on the classification of shard components.

The primary goal was to determine whether the Scorpion Ridge vessels were manufactured locally or brought into the region from elsewhere by comparing chemical and petrographic analyses of a variety of plain and painted wares from within and outside of the north-central Great Basin with the geology of the local bedrock. This analysis determined the mineralogical and geochemical composition of the plain wares recovered from Scorpion Ridge and other nearby sites in the Upper Humboldt drainage, as well as Fremont plain and painted wares recovered near the Nevada-Utah border in east-central and north-eastern Nevada. The potential temper sources all came from the Elko Hills or the nearby Ruby Mountains within 50 km of the Scorpion Ridge Site. While we are aware that the temper analysis is not likely to yield the precise location of the temper used to make the Scorpion Ridge vessels if they were manufactured locally, these studies, when combined with knowledge about the geological composition of the parent bedrock in the Upper Humboldt drainage, will assist in our interpretations.

Ceramic samples 1-3 (see Table 2) were recovered from Scorpion Ridge. Although refitting of individual sherds proved to be unsuccessful, the two distinct rim sherds suggest that at least two vessels were broken and deposited within Locus 1. Samples 4, 5, and 7 were recovered from small, open-air lithic scatters along the Humboldt River within about 16 kilometers of the Scorpion Ridge site. Samples 6 and 8 were recovered from open-air lithic scatters on the eastern side of the Ruby Mountains in Ruby Valley, approximately 40 km east of Scorpion Ridge. Samples 9 and 10 were from plain wares recovered from the Baker Village Fremont site (Figure 1) in east-central Nevada (Wilde and Soper 1999). Samples 11 and 12 represent a Great Salt Lake Gray sherd and a Snake Valley Black-on-Gray sherd recovered along the Nevada-Utah border on the eastern flanks of the Goshute Mountains in Nevada, south of Wendover and directly east of Oranjeboom Cave (Figure 1). Samples 13 and 14 were plain wares found embedded in a 750 B.P. hearth at the Wells Dump site (Figure 1) and associated with Eastgate projectile points (Murphy 1988). Samples 15-22 were found at the Elko Dump site, which is located less than five km north of Scorpion Ridge (Vierra and Langheim 2002). One temper sample was collected from the Elko Hills near Scorpion Ridge, and two within Harrison Pass on the western flanks of the Ruby Mountains, approximately 50 km southeast of Scorpion Ridge.

Table 2. Location of ceramic sherds and potential temper sources studied.

Sample Number	Site/Location	Sample Type
		Ceramics
1	Scorpion Ridge	brown ware
2	Scorpion Ridge	brown ware
3	Scorpion Ridge	brown ware
4	CRNV-11-5248	brown ware
5	CRNV-11-3644	brown ware
6	CRNV-11-6937	brown ware
7	CRNV-01-3586	brown ware
8	CRNV-11-6911	brown ware
9	Baker Village	Fremont utilitarian ware
10	Baker Village	Fremont utilitarian ware
11	CRNV-11-8979	Great Salt Lake Gray ware
12	Goshute Mountains	Snake Valley Black-on-Gray
13	Wells Dump	brown ware
14	Wells Dump	brown ware
15	CRNV-12-9371 Unit 13	brown ware
16	CRNV-12-9371 Unit 13	brown ware
17	CRNV-12-9371 Unit 13	brown ware
18	CRNV-12-9371 Unit 13	brown ware
19	CRNV-12-9371 Unit 3	brown ware
20	CRNV-12-9371 Unit 3	brown ware
21	CRNV-12-9371 Unit 3	brown ware
22	CRNV-12-9371 Unit 2	brown ware
		Temper Sources
T1	Elko Hills	temper source
T2	Harrison Pass/Ruby Mtns.	temper source
T3	Harrison Pass/Ruby Mtns.	temper source

Optical petrography was accomplished on an Olympus Vanox-Pol petrographic microscope with DC290 digital camera interface into a Macintosh computer. Smear slides were made from the potential temper source samples and a point count modal analysis was made to study the mineralogical population. The modal analysis methodology was similar to what we used for petrographic thinsections. Modal data collection from petrographic thinsections utilized .255 mm traverse horizontal and vertical grid spacing between data points. In all of our petrographic modal analyses we collected grain shape for only quartz, and mineralogical identification for all other minerals for each data point on the grid. The total modal point count varied among the different samples from 230 points to 1729 points.

ICP and ICP-MS were run at XRAL Laboratories in Toronto, Canada. ICP-MS analysis was chosen because of our interest in obtaining a large list of elements with low detection levels. It would also have been acceptable to use neutron activation and/or XRF analysis to obtain similar results. Thirty-six elements proved to be in sufficient concentrations above the detection limits in both the sherd and potential source temper samples to be useful in preliminary provenance analysis (Table 3). All of the thirty-six elements in the sherd and potential temper samples were subject to a hierarchical cluster analysis employing the use of SPSS-10 statistical software. This analysis produced a dendrogram (Figure 5) of the sherds and the potential source tempers showing the linkage between groups. There are a total of four clusters loaded in two major cluster groups (A and B).

Cluster Group A is composed of plain wares from the upper Humboldt River drainage system. Cluster 1 in Cluster Group A is composed of seven sherds consisting of the Scorpion Ridge site, Wells Dump site, site 9371 and site 3581. Cluster 2 in Cluster Group A is composed of eight sherds consisting of sites 9371 and 5248.

Cluster Group B is composed of Fremont painted and plain ware ceramics found near the Nevada and Utah border, along with plain ware from Ruby Valley and one plain ware sample (sample 5) from site 3644 located in the upper Humboldt River drainage. Cluster 3 in Cluster Group B is composed of a Ruby Valley plain ware and a Fremont painted bowl from the Goshute Mountains. Cluster 4 contains Fremont plain ware pottery from Baker Village, a Fremont plain ware sherd from site 8979, a Ruby Valley plain ware and the one sample of plain ware that does not cluster with its neighbors from the Humboldt River drainage.

Geochemical analysis of the tempers did not provide compelling correlations between the pottery sherds and the potential temper samples. However, it is apparent that the temper used to manufacture the sherds from Scorpion Ridge likely derives from a source area close to the two temper samples analyzed from the Ruby Mountains.

Petrographic analyses of the temper source samples were made by slide examinations (Table 4). Modal point counts were made on all samples. Optical petrographic data for the sherds are presented in Tables 5 and 6, and Figures 6 through 9. Scanning electron microscope micrographs of Fremont plain ware pottery, as well as plain ware from Scorpion Ridge and Wells Dump, are provided in Figure 10.

The three temper samples studied (Table 4 and Figure 6) divided into three different rock types: T1 is dominated by a conglomeratic and hematite cemented novaculitic chert; T2 is a classic diorite gruss; and T3 is a granodiorite gruss. Biotite mica is not a major component of any of these rock types even though it is a major component in the Brownware ceramic sherds.

The ceramic sherds can be relatively easily classified with respect to tempering components in the coarse fraction. The coarse fraction is classified here as a grain size equal to and greater than coarse silt (31 microns in diameter). However, the presence or absence of temper in the fine fraction (less than 31 microns in diameter) clay component is quite difficult to assess petrographically, as it is unclear which inclusions occur naturally in the clay and which were added as temper. In general, the optical petrography

Table 3. Ceramic sherd and potential temper source sample geochemistry by ICP and ICP-MS analysis.

Sample	Mg	Al	P	K	Ca	Sc	Ti	Cr	Mn	Fe	Ba	Ce
Method	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	MS*	MS*
Units	%	%	%	%	%	ppm	%	ppm	ppm	%	ppm	ppm
D.L.**	0.01	0.01	0.01	0.01	0.01	5	0.01	10	10	0.01	0.5	0.1
1	1.00	8.73	0.04	3.87	0.76	15	0.46	95	492	4.04	1352.1	102.9
2	1.06	8.91	0.01	3.88	0.69	15	0.46	92	441	4.05	1450.8	119.3
3	1.01	8.84	0.02	3.81	0.63	15	0.46	94	512	4.09	1300.4	120.2
4	0.88	10.07	0.10	2.84	1.16	11	0.43	28	589	4.08	1038.5	114.1
5	0.64	8.68	0.11	2.91	1.43	10	0.28	51	587	2.94	727.9	88.9
6	0.85	8.17	0.05	2.79	3.37	9	0.30	39	556	2.53	773.9	59.9
7	1.03	10.18	0.05	2.48	1.04	16	0.49	90	559	4.96	732.3	141.2
8	0.66	9.05	0.08	2.87	1.52	9	0.23	27	333	2.71	882.6	51.1
9	1.36	11.49	0.12	2.07	2.66	13	0.58	32	375	4.25	1765.7	73.3
10	1.72	7.69	0.90	3.40	5.76	9	0.37	35	516	2.83	725.5	87.5
11	0.77	7.65	0.05	1.61	1.68	14	0.43	72	209	2.73	1113.5	69.8
12	0.85	13.70	0.05	2.55	0.69	7	0.33	17	203	3.10	1257.7	194.9
13	1.03	9.30	0.03	2.71	1.14	15	0.46	76	537	4.25	1166.0	155.9
14	1.08	9.49	0.03	2.68	1.17	15	0.48	78	602	4.40	1001.8	106.0
15	0.92	9.44	0.12	2.80	1.82	11	0.43	24	427	4.04	1990.0	145.0
16	0.96	9.36	0.06	2.57	1.96	11	0.47	27	452	4.11	1880.0	161.0
17	0.90	9.97	0.11	2.90	1.93	11	0.46	27	471	4.31	1970.0	150.0
18	0.91	9.40	0.12	2.64	1.83	12	0.42	26	460	4.05	1800.0	131.0
19	0.87	9.11	0.08	2.22	1.62	13	0.37	37	520	3.53	1020.0	104.0
20	0.91	9.50	0.14	2.45	1.73	12	0.36	40	553	3.70	1330.0	118.0
21	0.84	9.82	0.09	2.66	1.71	12	0.42	31	544	3.78	1220.0	96.4
22	1.03	9.69	0.23	2.84	1.63	14	0.42	46	608	3.83	978.0	184.0
T1	0.04	0.83	0.01	0.24	0.02	<5	0.05	25	36	0.13	933.0	15.1
T2	0.27	7.77	0.03	4.52	0.68	<5	0.14	<10	415	1.29	2130.0	48.8
T3	0.10	6.63	0.02	3.93	0.76	<5	0.08	<10	108	0.56	1091.9	33.0
dup-T1	0.03	0.83	<0.01	0.23	0.01	<5	0.05	26	34	0.13	927.7	15.0

Sample	Co	Cs	Cu	Dy	Er	Eu	Gd	Ho	La	Lu	Nd	Ni
Method	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
D.L.**	0.5	0.1	5	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.1	5
1	13.2	16.0	20	7.10	4.45	1.76	8.63	1.52	56.6	0.70	50.7	38
2	13.8	17.7	25	7.78	4.48	1.96	9.83	1.60	63.3	0.75	55.4	38
3	14.3	17.6	19	7.95	4.72	2.06	10.10	1.70	64.0	0.75	57.5	40
4	9.3	10.3	30	5.81	2.92	1.60	7.26	1.14	54.7	0.44	43.6	22
5	9.6	5.2	24	4.14	2.35	1.14	6.33	0.84	45.0	0.37	35.9	32
6	8.1	6.5	19	3.83	2.09	0.89	4.46	0.76	30.0	0.31	24.1	20
7	15.2	4.7	35	7.47	3.81	1.72	10.90	1.46	73.3	0.51	62.6	34
8	5.7	4.7	16	4.15	2.07	0.92	4.55	0.81	27.3	0.29	22.3	19
9	11.7	28.9	23	2.93	1.65	1.13	4.20	0.59	29.8	0.24	27.0	34
10	8.6	12.5	28	3.61	2.11	1.35	5.56	0.73	45.8	0.34	36.8	21
11	13.7	9.0	20	5.50	3.18	1.54	6.40	1.17	34.5	0.48	33.3	34
12	4.4	61.7	11	2.47	0.79	2.08	6.81	0.37	83.9	0.12	66.8	25
13	14.5	4.4	34	8.39	3.98	1.87	12.70	1.64	79.3	0.54	69.3	41

Sample	Co	Cs	Cu	Dy	Er	Eu	Gd	Ho	La	Lu	Nd	Ni
Method	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
D.L.**	0.5	0.1	5	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.1	5
14	14.3	4.1	31	6.69	3.49	1.47	8.98	1.32	55.8	0.52	48.3	36
15	<10	8.6	20	5.70	2.70	1.84	7.40	0.98	69.0	0.33	58.6	21
16	21.0	10.9	46	7.30	3.50	2.24	9.00	1.31	81.0	0.41	66.6	31
17	16.0	8.5	21	5.60	2.70	1.87	7.50	1.05	76.0	0.34	59.7	17
18	24.0	11.4	31	5.20	2.60	1.76	7.10	0.96	63.0	0.32	51.9	24
19	17.0	7.3	29	5.70	2.90	1.50	6.60	1.03	49.0	0.39	42.5	25
20	11.0	7.1	28	5.60	2.90	1.52	6.80	1.04	60.0	0.41	47.9	29
21	20.0	7.3	21	5.90	3.20	1.54	7.10	1.14	41.0	0.47	42.5	17
22	11.0	8.6	22	6.20	3.20	1.73	7.50	1.16	105.0	0.41	60.8	21
T1	<0.5	0.5	9	0.96	0.59	0.34	1.16	0.17	8.5	0.11	7.8	6
T2	2.8	3.8	<5	1.69	0.85	1.05	2.12	0.30	25.8	0.17	17.9	<5
T3	1.2	2.3	9	1.74	0.91	0.83	2.18	0.30	19.5	0.14	14.5	<5
dup-T1	0.5	0.5	8	1.07	0.53	0.35	1.24	0.19	8.6	0.11	7.2	6

Sample	Pb	Pr	Sm	Sr	Tb	Th	Tm	U	V	Y	Yb	Zn
Method	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*	MS*
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
D.L.**	5	0.05	0.1	0.1	0.05	0.1	0.05	0.05	5	0.5	0.1	5
1	16	13.83	9.3	127.3	1.29	19.8	0.64	4.22	71	43.0	4.4	77
2	23	15.56	10.4	122.5	1.44	21.9	0.69	4.44	74	46.7	4.6	75
3	16	15.71	10.7	109.8	1.52	23.5	0.70	4.58	71	47.1	4.8	76
4	35	12.32	8.4	243.0	1.11	27.1	0.46	9.56	72	31.9	2.9	149
5	36	10.28	7.0	261.6	0.93	24.6	0.35	6.02	57	21.9	2.1	100
6	34	6.84	4.7	478.8	0.69	13.0	0.32	5.69	48	22.4	2.1	99
7	26	17.62	12.1	165.7	1.52	29.2	0.53	8.38	88	38.7	3.4	156
8	33	6.35	5.0	224.9	0.77	11.7	0.28	2.80	33	22.6	1.9	93
9	31	7.63	4.7	243.0	0.60	27.2	0.25	4.50	63	16.6	1.6	116
10	38	10.43	6.3	409.4	0.77	27.2	0.31	8.68	64	22.1	2.1	129
11	20	8.67	6.7	237.8	0.94	12.2	0.50	2.84	79	32.4	3.2	67
12	27	20.21	10.7	231.1	0.77	44.6	0.10	1.50	23	8.1	0.8	101
13	31	19.04	13.2	210.0	1.77	37.5	0.56	7.76	82	42.9	3.7	108
14	31	13.26	9.4	184.3	1.34	23.6	0.50	5.90	75	37.3	3.3	110
15	<20	16.10	10.5	387.0	1.00	29.3	0.40	5.60	78	29.0	2.4	100
16	<20	18.60	12.4	368.0	1.30	33.9	0.50	5.70	79	36.0	3.0	110
17	26	17.10	10.2	412.0	1.00	32.0	0.40	5.70	77	28.0	2.5	103
18	23	14.40	9.5	373.0	1.00	27.3	0.40	5.60	77	26.0	2.3	106
19	28	11.60	7.9	229.0	1.00	20.3	0.40	3.90	86	27.0	2.6	94
20	29	12.80	8.5	255.0	1.00	22.8	0.40	4.00	84	28.0	2.7	96
21	22	10.90	8.8	259.0	1.00	21.1	0.50	4.30	80	30.0	3.0	79
22	22	18.50	9.6	222.0	1.00	27.9	0.50	4.50	99	30.0	3.0	108
T1	<5	2.02	1.5	223.9	0.17	1.7	0.08	1.09	31	4.6	0.5	28
T2	26	5.39	3.1	459.3	0.33	14.3	0.13	1.70	12	8.0	1.0	55
T3	14	4.23	2.9	299.5	0.34	9.4	0.11	1.46	9	7.9	0.8	38
dup-T1	<5	2.13	1.6	228.0	0.18	1.9	0.09	1.12	30	4.9	0.6	23

Notes: * MS = ICP-MS **D.L.= detection limit

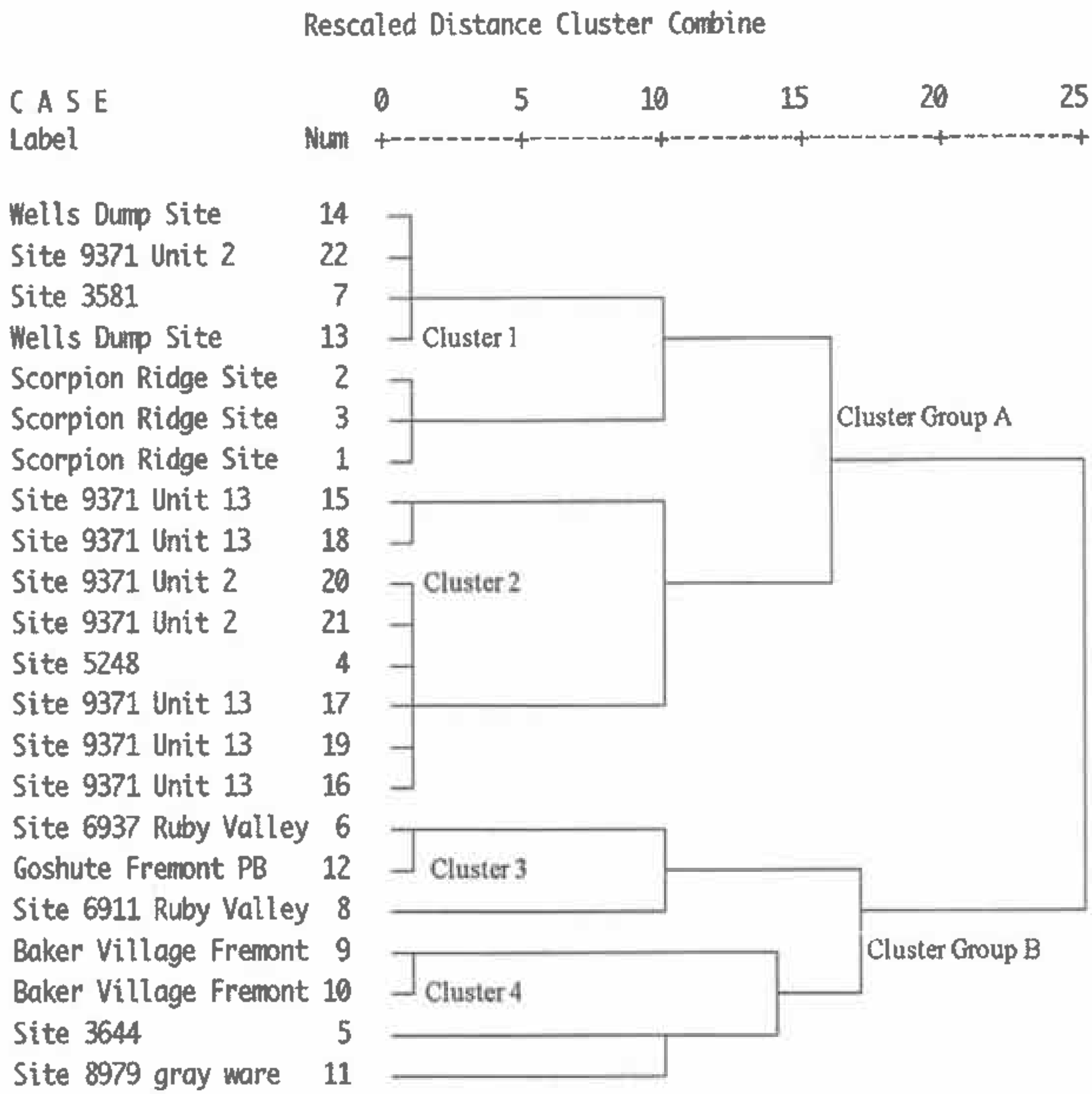

Figure 5. Hierarchical cluster analysis dendrogram using average linkage (between groups) for the following 36 elements: Mg, Al, P, K, Ca, Sc, Ti, Cr, Mn, Fe, Ba, Ce, Co, Cs, Cu, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Ni, Pb, Pr, Sm, Sr, Tb, Th, Tm, U, V, Y, Yb, and Zn. Chemical data were obtained by ICP and ICP-MS analysis. Cluster Group A contains upper Humboldt drainage brown wares from site 9371, the Wells Dump site, the Scorpion Ridge site, and sites 3581 and 5248. Cluster Group B contains Ruby Valley brown wares, gray ware, and Fremont pottery.

Table 4. Modal petrography of the non-clay mineral components in the potential source tempers studied.

Sample	% Quartz Monzonite	Granodiorite (No Biotite) %	Diorite %	% Biotite-Granodiorite	% Quartz IRF Consertal Texture
Temper 1	0.00	0.00	0.00	0.00	0.00
Temper 2	0.00	0.00	71.15	0.00	0.00
Temper 3	0.00	33.83	0.00	0.00	15.41

Sample	Perthite %	Plagioclase %	K-Feldspar %	% Quartz Sub-Rounded to Rounded	% Quartz Sub-Angular to Angular
Temper 1	0.00	0.35	0.17	9.86	2.60
Temper 2	0.00	24.11	0.00	0.00	1.19
Temper 3	0.38	24.81	17.67	0.00	6.02

Sample	Biotite %	Volcanic Glass %	Accessory Minerals %	Calcite %	% Clay Balls	% SRF Novaculites
Temper 1	0.00	0.00	1.21	0.00	0.00	83.91
Temper 2	0.40	0.00	3.16	0.00	0.00	0.00
Temper 3	0.00	0.00	1.88	0.00	0.00	0.00

The total number of grains counted for each sample was: Temper 1 = 578, Temper 2 = 253, and Temper 3 = 266.

supports the geochemical observations made in the dendrogram in Figure 5.

All of the plain wares studied from the upper Humboldt River drainage system are tempered with a schistose biotite-granodiorite. This includes sample number 5 from site 3644 (Figure 9). The only significant difference between sherd number 5 and the other Humboldt River drainage plain ware is the quantity of biotite in the fine fraction (less than coarse silt grain size) as shown in Table 6. Scorpion Ridge, Wells Dump, site 9371, site 5248, and site 3586 plain wares have fine fraction silt sized biotite concentrations ranging from about 30 to 70 percent, whereas the sherd (#5) from site 3644 has a fine-grained biotite content of only about 1 percent. This is actually a very significant difference in the overall petrography of these samples, and as such, sherd (#5) from site 3644 does not fit the normal pattern of tempering in the Humboldt River drainage system.

The schistose biotite granodiorite temper has several distinguishing attributes (Figures 6, 7 and 10). It is characterized by a very large concentration of biotite flakes and books with various igneous rock fragments (IRF) having the overall general composition of a granodiorite (20-30 percent quartz + 10-35 percent [plagioclase + alkali feldspar] + biotite). The IRFs consist of one or more of the following:

1. Foliated biotite plus quartz clumps with consertal texture (intergrown grain boundaries).

Table 5. Modal count, percent temper and paste and percent biotite in the fine-grained (less than coarse silt sized fraction) paste of the pottery sherds studied.

Sample	Modal Count	% Temper > Coarse Silt	% Paste < Coarse Silt	% Biotite in Paste
1 Scorpion Ridge	906	65	35	71
2 Scorpion Ridge	1025	68	32	68
3 Scorpion Ridge	933	66	34	67
4 Site 5248	874	60	40	41
5 Site 3644	361	39	61	1
6 Site 6937, Ruby Valley	423	44	56	2
7 Site 3586	850	61	39	63
8 Site 6911, Ruby Valley	396	42	58	3
9 Baker Village, Fremont	280	37	63	0
10 Baker Village, Fremont	308	35	65	0
11 Site 8979, gray ware	230	29	71	0
12 Goshute Mtns., Fremont	612	45	55	2
13 Wells Dump	846	67	33	52
14 Wells Dump	655	65	35	58
15 Site 9371 Unit 13	250	68	32	65
16 Site 9371 Unit 13	250	67	33	66
17 Site 9371 Unit 13	250	70	30	63
18 Site 9371 Unit 13	250	74	26	70
19 Site 9371 Unit 2	250	65	35	30
20 Site 9371 Unit 2	250	65	35	33
21 Site 9371 Unit 2	250	55	45	30
22 Site 9371 Unit 3	250	60	40	30

2. Quartz clumps with consertal texture.
3. Quartz plus feldspar with consertal textures.
4. Biotite plus feldspar.
5. Feldspar and quartz included with micro-biotite crystallites (poikilitic texture).
6. Perthitic feldspar with quartz and sometimes poikilitic biotite.
7. Foliated biotite plus feldspar plus quartz with feldspar and quartz aggregates having classic consertal textures.

The actual source rock is plutonic, possibly modified by contact metamorphism. Although we are unable to type the exact source locality from the Upper Humboldt ceramic samples, it is almost certain that the original rock is local, given the dominance of biotite granodiorites in Elko County (Coats 1987) and the spatial distribution of these wares in the local sites. These local rock outcrops even include metamorphic rocks such as a biotite schist in the East Humboldt Range and a biotite granodiorite gneiss in the Ruby Mountains (Coats 1978:78-79).

In contrast, plain wares from Ruby Valley (samples 6 and 8, Figure 9, Tables 5 and 6) are tempered with monzonite IRFs (alkali feldspar equals plagioclase feldspar and quartz is less than 5 percent,

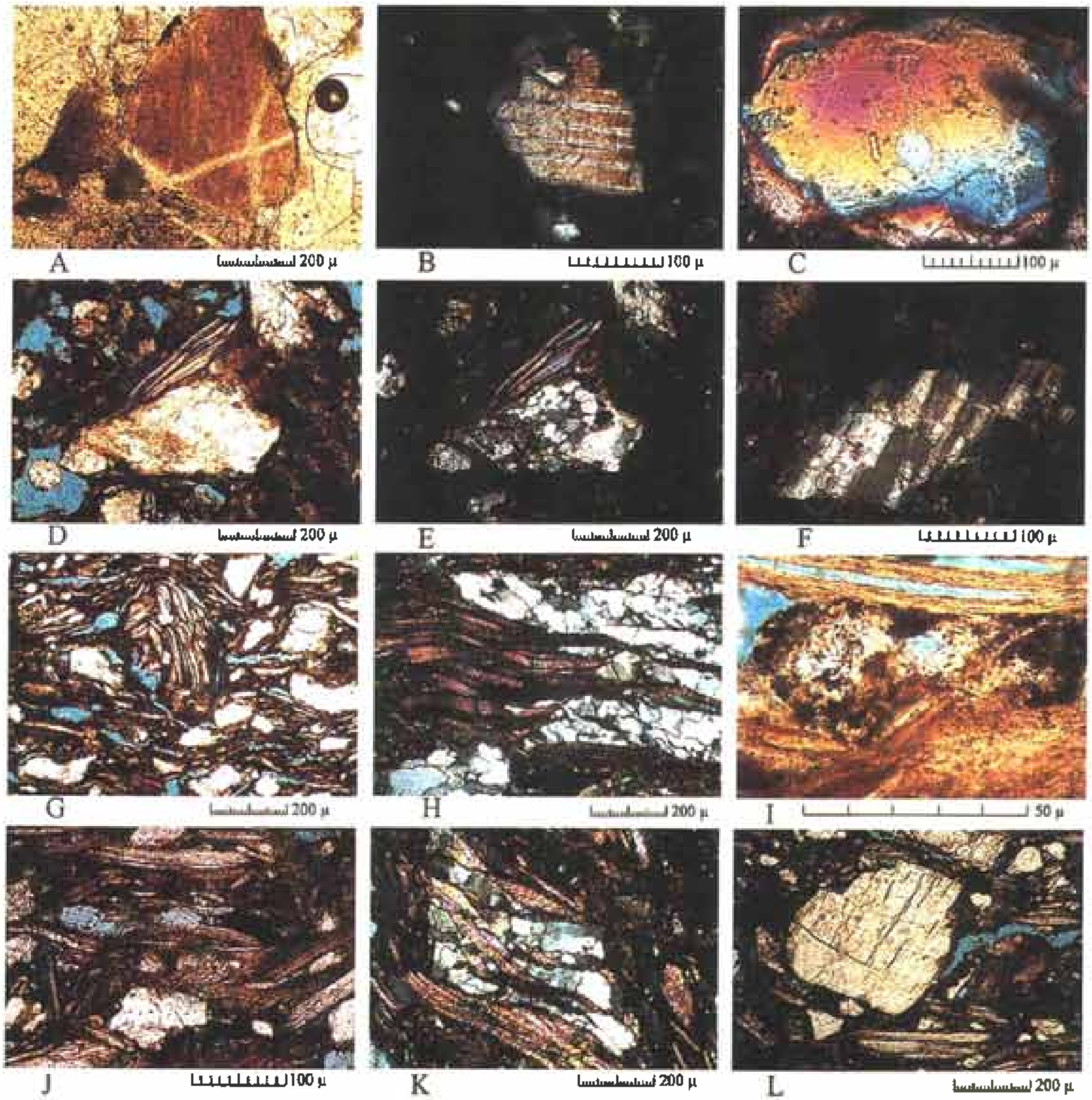

Figure 6. Digital photomicrographs of the temper samples (T1-T3), and three brown ware ceramic samples from the Scorpion Ridge site in the Humboldt River drainage system.

A: Temper T1 from Elko Hills is dominated by novaculitic chert as mudstones through conglomerates. Some appear as hematite cemented while others are fairly free of iron oxyhydroxides but are fracture filled with mega-quartz (K, plain polarized light, scale as shown).

B: Temper T2 from Harrison Pass in the Ruby Mountains is dominated by a plagioclase diorite with minor quartz, biotite and other accessory minerals. The plagioclase grains appear to be partially weathered (L, cross polarized light, scale as shown).

C: Temper T3 from Harrison Pass in the Ruby Mountains is dominated by a granodiorite that contains interlocking quartz grains and quartz-feldspar clumps in a consertal texture. Individual subangular quartz grains also occur (M, cross polarized light, scale as shown).

D-F: Sample 1 is tempered with a schistose biotite-granodiorite that consists of both plagioclase feldspar (F, cross polarized light, scale as shown) and microcline in about equal amounts. The feldspars are associated with quartz in a classic consertal texture (grain boundaries are intergrown). The IRFs (A and B) show foliation, but the quartz and feldspar grains are not elongated (D, plain polarized light; E, cross polarized light, scale as shown). Biotite (D and E) is dominant in both the fine grain size fraction (less than coarse silt) as well as in the IRFs and coarse to very fine sand sized mineral temper.

G-I: Sample 2 is tempered with a schistose biotite-granodiorite that is composed of plagioclase, microcline and biotite with minor accessory minerals such as magnetite, pyroxenes and amphiboles. Biotite is dominant as a mineralogical constituent (G, plain polarized light, scale as shown) and in part dictates the shape and orientation of the ceramic pores. Biotite forms as individual sheets and as stacks or books of mica (G) in addition to being a major constituent of the foliated IRF's (H, cross polarized light, scale as shown). The paste fraction contains fairly common carbonaceous organics (I, plain polarized light, scale as shown), sometimes observed in the pores (as one might observe with an organic tempered ceramic), while other organic material is just in the paste.

J-L: Sample 3 is tempered with a schistose biotite-granodiorite that is composed of plagioclase, microcline and biotite. Occasionally the feldspars are perthitic (L, plain polarized light, scale as shown). Again the biotite dominates the temper and fine fraction of the ceramic (J, plain polarized light, scale as shown) and is present in the IRFs (K, cross polarized light, scale as shown). The quartz and feldspar are mostly observed as individual mineral temper grains, but can also be located as two or more minerals in small IRFs.

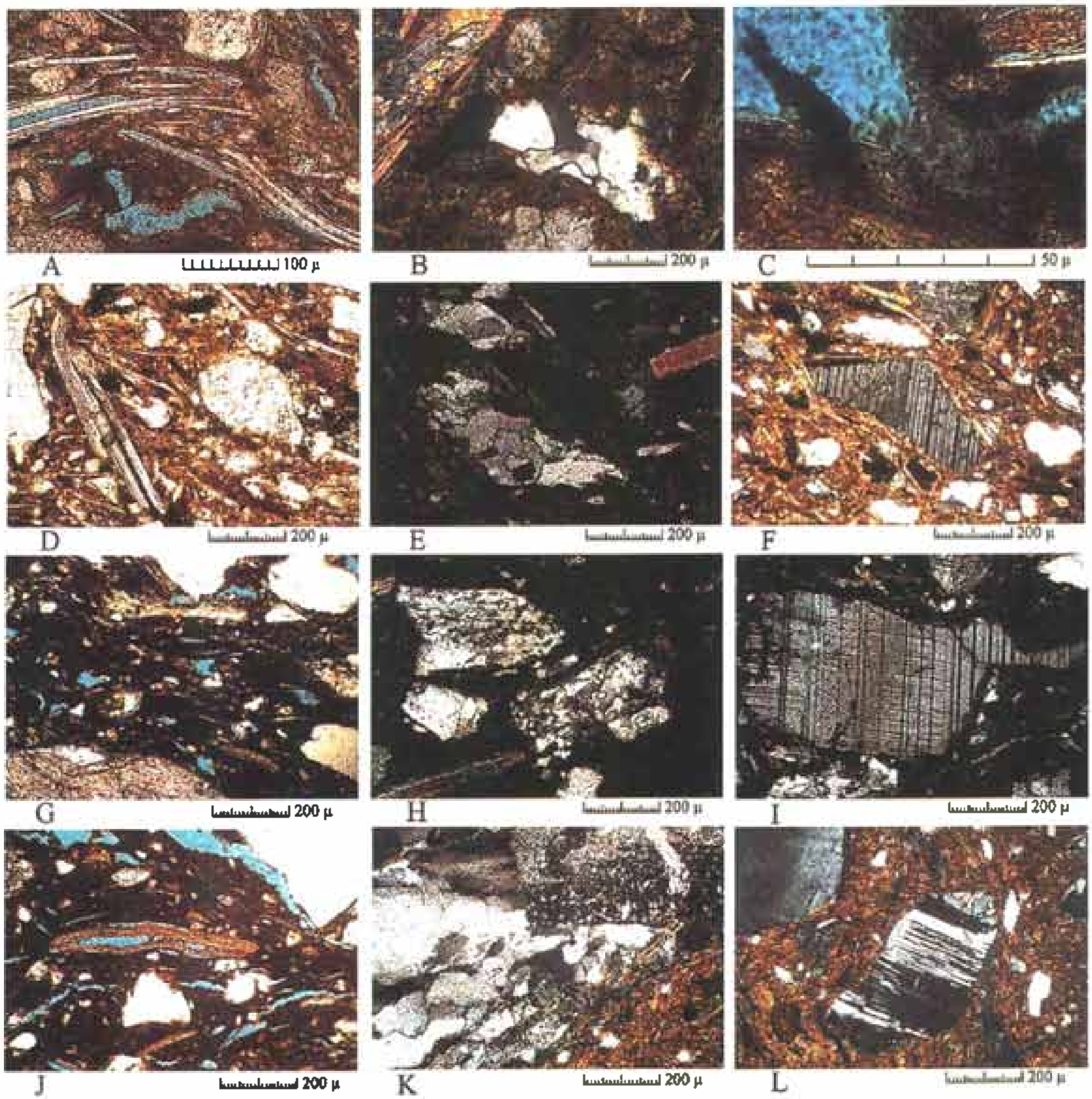

Figure 7. Digital photomicrographs of four brown ware ceramic samples from the Humboldt River drainage system.

A-C: Sample 13, from the Wells Dump site, is tempered with a schistose biotite-granodiorite consisting of microcline and plagioclase feldspars, quartz and biotite with minor accessory minerals such as magnetite, amphiboles and pyroxenes. Biotite is ubiquitous as individual sheets and as mica books (A, plain polarized light, scale as shown). The quartz and quartz feldspar portion of the granodiorite has a distinctive consertal texture (B, cross polarized light, scale as shown). Organics are common in the paste as well as in the pores of the ceramic (C, plain polarized light, scale as shown). Sample 13 is very similar to the sherds studied from the Scorpion Ridge site, with just slightly less biotite in the temper and the fine fraction.

D-F: Sample 14, from the Wells Dumps site, is tempered with a schistose biotite-granodiorite consisting of microcline and plagioclase feldspars (F, cross polarized light, scale as shown), quartz and biotite with minor accessory minerals. The IRFs (E, cross polarized light, scale as shown) vary in size from very fine sand to very coarse sand, and are dominant in the fine to medium sand size range. The quartz and feldspars show classic consertal textures in the IRFs. Biotite dominates the temper and fine fractions of the ceramic (D, plain polarized light, scale as shown). This sample is very similar to sample 13 above.

G-I: Sample 7, from site CRNV-01-3586, is tempered with a schistose biotite-granodiorite that contains plagioclase (I, cross polarized light, scale as shown), microcline (G, larger temper grains are microcline, plain polarized light, scale as shown), quartz and biotite. Most of the IRFs in this section are dominated by quartz and quartz-feldspar fragments exhibiting consertal textures (H, cross polarized light, scale as shown). Biotite sheets and books are dominant in the temper and fine fraction paste of the ceramic. This sample is very similar to sherds from the Scorpion Ridge site.

J-L: Sample 4, from site CRNV-11-5248, is tempered with a schistose biotite-granodiorite. The larger very coarse-grained sand sized IRFs contain perthitic feldspars that are included with biotite clumps (K, cross polarized light, scale as shown). These IRFs also contain quartz-feldspar (microcline and plagioclase) zones that have classic consertal textures. This sherd contains medium sand size feldspars as single temper grains (J, microcline feldspar in the upper right corner of the photograph, plain polarized light, scale as shown). Most of the feldspars, however, are fine to very fine sand sized (L, plagioclase feldspar, cross polarized light, scale as shown). Biotite dominates the temper (J) and the fine-grained portion of the ceramic. This sample is similar to ceramics from the Wells Dump site.

Table 6. Modal petrography of the ceramic pottery samples studied.

Sample Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
% Rock or Mineral Component														
IRF: Schistose Biotite-Granodiorite*	4.19	4.10	3.32	3.09	4.99	0.00	3.06	0.00	0.00	0.00	0.00	0.00	3.66	6.56
Monzonite**	0.00	0.00	0.00	0.00	0.00	5.44	0.00	7.83	0.00	0.00	0.00	3.10	0.00	0.00
VRF: Basalt;	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.03	0.00	0.00	0.00	0.00
Sideromelane-lava flow glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.07	0.00	0.00	0.00	0.00	0.00
SRF: Hematite Cemented Siltstone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00
Silica Cemented Sandstone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.26	0.00	0.00	0.00
Chert Novaculite	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	7.50	0.00	0.00	0.00	0.00	0.00
Feldspars: Perthite	0.55	0.88	1.61	2.40	1.11	0.71	1.64	1.01	0.00	0.00	0.87	4.58w	2.72	2.75
Plagioclase	19.21	20.29	20.69	18.76	32.41	29.78	19.18	34.85	38.57	24.35	10.87	35.95w	21.75	19.24
Microcline	20.53	21.76	22.40	20.02	20.22	30.97	21.53	32.07	0.36	0.00	6.96	38.56w	25.65	20.61
Quartz: Rounded with Overgrowth	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.48	0.00	0.00	0.00
Angular to Subangular Quartz	18.10	16.78	17.04	18.65	9.42	14.42	17.88	9.85	4.29	2.91	6.09	6.86	19.27	21.07
Other: Biotite	35.10	33.56	32.90	33.52	27.98	9.93	33.65	9.34	0.00	0.00	0.00	5.07	24.82	27.94
Accessory Minerals	2.32	2.63	2.04	3.55	3.88	7.80	3.06	4.29	23.21	23.70	3.48	5.88	2.13	1.83

Notes: IRF = igneous rock fragment VRF = volcanic rock fragment SRF = sedimentary rock fragment
* IRFs with distinctive consertal textures ** IRFs with anhedral textures w = weathered mineral grains (pitted feldspars)

Samples from Site 9371 were treated differently than the samples in the above table. The percent of biotite was determined and the other minerals and rock components were treated as being present or absent. The results of these analyses are similar to the Scorpion Ridge (sample numbers 1,2 and 3) and the Wells Dump Sites (samples 13 and 14). The percentage of biotite for Site 9371 samples ranged from 15 to 37 percent and averaged 26 percent by volume.

minerals ranging from 10 to 25 percent). The mafic accessory minerals are biotite, magnetite, hornblende and minor pyroxenes. The biotite content for this rock is significantly lower than that for the schistose biotite fabrics. This is very conspicuous in the fine-fraction where only two to three percent biotite is observed. The IRF textures range from anhedral to subhedral granular and are distinctively different than the consertal textures observed in the granodiorites from the upper Humboldt drainage. In addition to the IRF temper, the Ruby Valley plain wares have minor concentrations of sedimentary rock fragment (SRF) cherts.

The Fremont painted ware from the Goshute Mountains (Tables 5 and 6, Figure 8) was tempered with monzonite with very highly weathered (pitted) feldspars, a low biotite content in the fine fraction (about two percent) and a higher content (about five percent) in the coarse fraction temper. Most of the accessory minerals are amphiboles. The quartz content was under seven percent. This temper would be difficult to distinguish from that of the Ruby Valley plain wares from just petrographic observations, except that the feldspars are highly weathered.

The Baker Village sherds (Tables 5 and 6, Figures 8 and 10), however, are very distinctive from a petrographic viewpoint as they are tempered with basaltic volcanic rock fragments (VRFs). Sherd number 9 is tempered with sideromelane (basaltic glass) with abundant magnetite and well-formed calcic-plagioclase phenocrysts. The VRF grains are dominantly subrounded in shape and appear to be weathered from the glassy portions of a basalt flow. Sherd number 10 is tempered with fine-grained glassy basalt that contains calcic-plagioclase and pigeonite (pyroxene). Quartz is present in both sherds studied from Baker Village.

The Fremont plain ware from site 8979 has by far the most distinctive temper of all of the sherds studied here (Tables 5 and 6, Figures 8 and 10). The temper is a simple quartz sand, where almost every fine to medium sand sized, subrounded, sedimentary grain contains a very well rounded quartz sand grain interior surrounded by a quartz overgrowth cement. The overgrowth cement is not chalcedony or chert (not from a novaculitic sandstone) and has the classic optical attributes of a mega-quartz cement. It is very likely that this temper is sourced from a lithified dune sandstone, similar in appearance to the Navajo Sandstone of central Utah, although at present there are not enough data to be able to type this sherd to a specific source temper location.

Together, petrographic and geochemical data provide compelling evidence that the upper Humboldt River drainage plain wares from the Scorpion Ridge site, Wells Dump site, and sites 5248, 3586, and 9371 are all similar. Furthermore, it appears that all of these plain wares are locally produced from clay and temper sources that have not yet been pinpointed in the field. Butler (1986), Pippin (1986), and Tuohy and Strawn (1986), among others, have not reported any similar tempering of plain wares from other surrounding locations. The dominant temper for the plain wares studied here is an easily characterized schistose biotite-granodiorite that has a classic consertal texture and is partially foliated. Temper grain sizes range from coarse silt to very coarse sand and average in the fine to medium sand size range. This material is greatly different than the Fremont utilitarian plain wares and one painted ware studied.

Carbonaceous material is prevalent in the fine fraction of most of the plain ware ceramics studied. The presence of this organic material indicates that the sedimentary source of the clay component is most likely a soil/lake bed or near surface sedimentary horizon. It is unlikely that the clays were derived from an outcrop of hydrothermally altered feldspathic igneous rock. Differences in clay sources may be responsible for the variations observed between the geochemistry of sample 5 (site 3644) and that of its neighboring upper Humboldt River drainage plain wares, even though the tempering agents appear to be similar. It is also important to note that if petrography were the only tool used for the ceramic analysis, sample

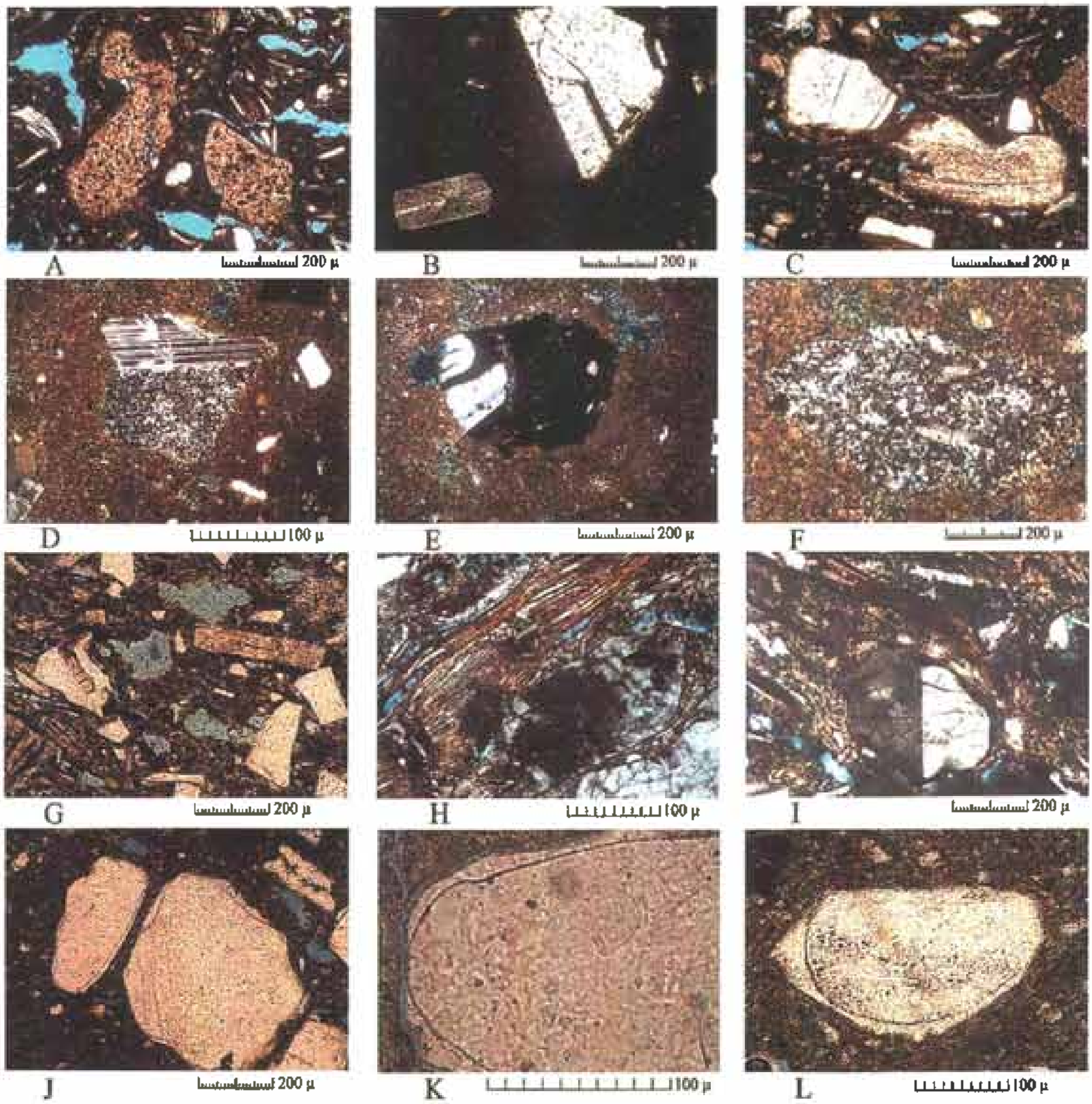

Figure 8. Digital photomicrographs of Fremont brown wares from Baker Village (samples 9 and 10), the painted ware from the Goshute Mountains (sample 12), and gray ware from site CRNV-11-8979.

A-C: Baker Village sample 9 is tempered with sideromelane (basaltic glass) that is slightly hydrated but not palagonitic. The VRFs are mostly subrounded and do not appear to be crushed (A, plain polarized light, scale as shown). They contain both fine-grained magnetite (A) and large plagioclase (B, cross polarized light, scale as shown) phenocrysts. Individual mineral grains in the temper are dominated by plagioclase (A). An additional temper constituent is bedded chert (C, novaculitic mudstone, plain polarized light, scale as shown). Most of the fine-sand sized chert appears as subrounded to subangular grains; however, smaller grains appear to be quite angular. Magnetite is not common as an individual temper grain, but is present as very fine sand. Quartz is present as very fine sand to silt (A, C).

D-F: Baker Village sample 10 is tempered with fine-grained basalt that contains fairly large plagioclase phenocrysts (D, cross polarized light, scale as shown). Most of the plagioclase feldspar, however, is present as small acicular laths in a matrix that is quite glassy. Magnetite is prevalent as small crystallites, and pyroxenes (pigeonite) are somewhat rare. Only a few VRF grains of volcanic glass were observed (E, cross polarized light, scale as shown); these are similar to sample 9. Most of the VRF temper grains ranged from rounded (F, cross polarized light) to subangular in shape. Individual temper mineral grains are dominated by plagioclase. Quartz is present as very fine sand to silt (D, E, and F).

G-I: Goshute Mountains sample 12 is tempered with monzonite IRFs and weathered feldspars and biotite (H, cross polarized light, scale as shown). The feldspars are mostly very angular (G, plain polarized light, scale as shown), but occasional more rounded grains (I, plagioclase feldspar, cross polarized light, scale as shown) occur. Most of the feldspar is pitted and weathered. Quartz is present as very fine sand sized grains and does not appear to be sourced with the feldspars. IRFs present are all clusters or feldspar grains.

J-L: Gray ware sample 11 is tempered with subrounded quartz sand that has overgrowths and is from a dune sandstone source. The original sand below the overgrowth is very well rounded (K, plain polarized light, scale as shown). The sand ranges from fine to medium sand size and, for the most part, appear to be naturally weathered (J and L, plain polarized light, scale as shown) as there are no angular breaks. Occasionally, the grain is broken (L) due to an internal fracture in the original quartz sand, but most of the time the grains are weathered at the quartz cement. The overgrowth cement is quartz and not chalcedony or opal-CT. As a consequence, it appears that the original source for this material is a sedimentary sand weathered from a lithified dune sand outcrop and not a novaculitic chert sandstone.

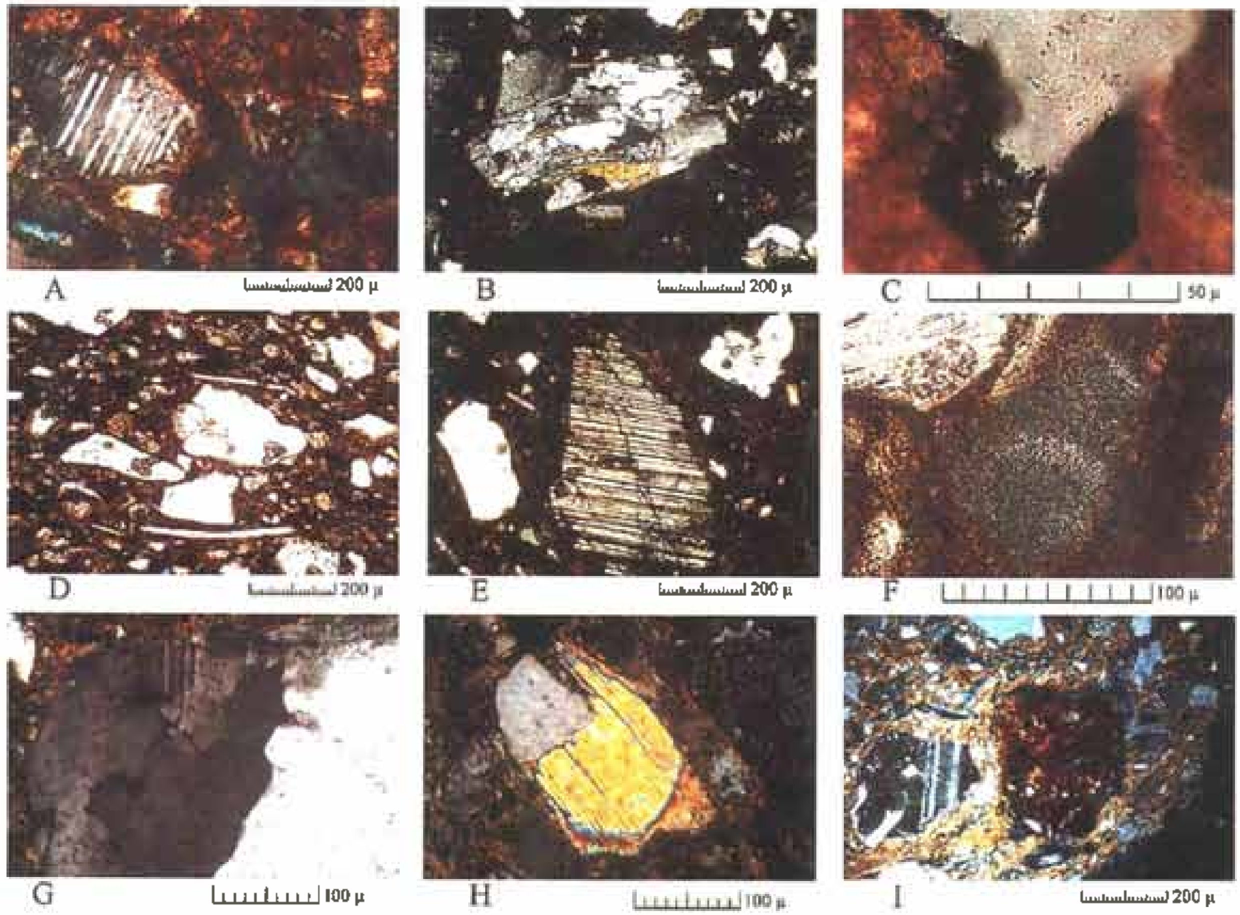

Figure 9. Digital photomicrographs of three brown ware ceramic pottery samples: A-C: sample 5, site CRNV-11-3644 from the Humboldt River drainage system; D-F: sample 6, site CRNV-11-6937 from Ruby Valley; and G-I: sample 8, site CRNV-11-6911 from Ruby Valley.

A-C: This sample is tempered with a schistose biotite-granodiorite that consists of both plagioclase feldspar (A, cross polarized light, scale as shown) and microcline in about equal amounts associated with quartz in a consertal texture (B, cross polarized light, scale as shown). The paste fraction contains an abundance of carbonaceous organic material (C, plain polarized light, scale as shown) in voids and in the vitrified clay component.

D-F: This sample is tempered with a monzonite with minor amounts of novaculitic chert (F, plain polarized light, scale as shown). These monzonite IRF (igneous rock fragments) are dominated by microcline with very minor quartz (D, plain polarized light, scale as shown) and plagioclase (E, cross polarized light, scale as shown). The biotite occurs mostly as larger temper grains and is not dominant in the fine silt sized fraction.

G-I: This sample is also tempered with monzonite (G, anhedral feldspars, cross polarized light, scale as shown) with very minor amounts of fine sand sized SRFs that are dominated by hematite cemented angular quartz siltstones (I, cross polarized light, scale as shown). Some of the IRFs are composed of both biotite and microcline (H, cross polarized light, scale as shown).

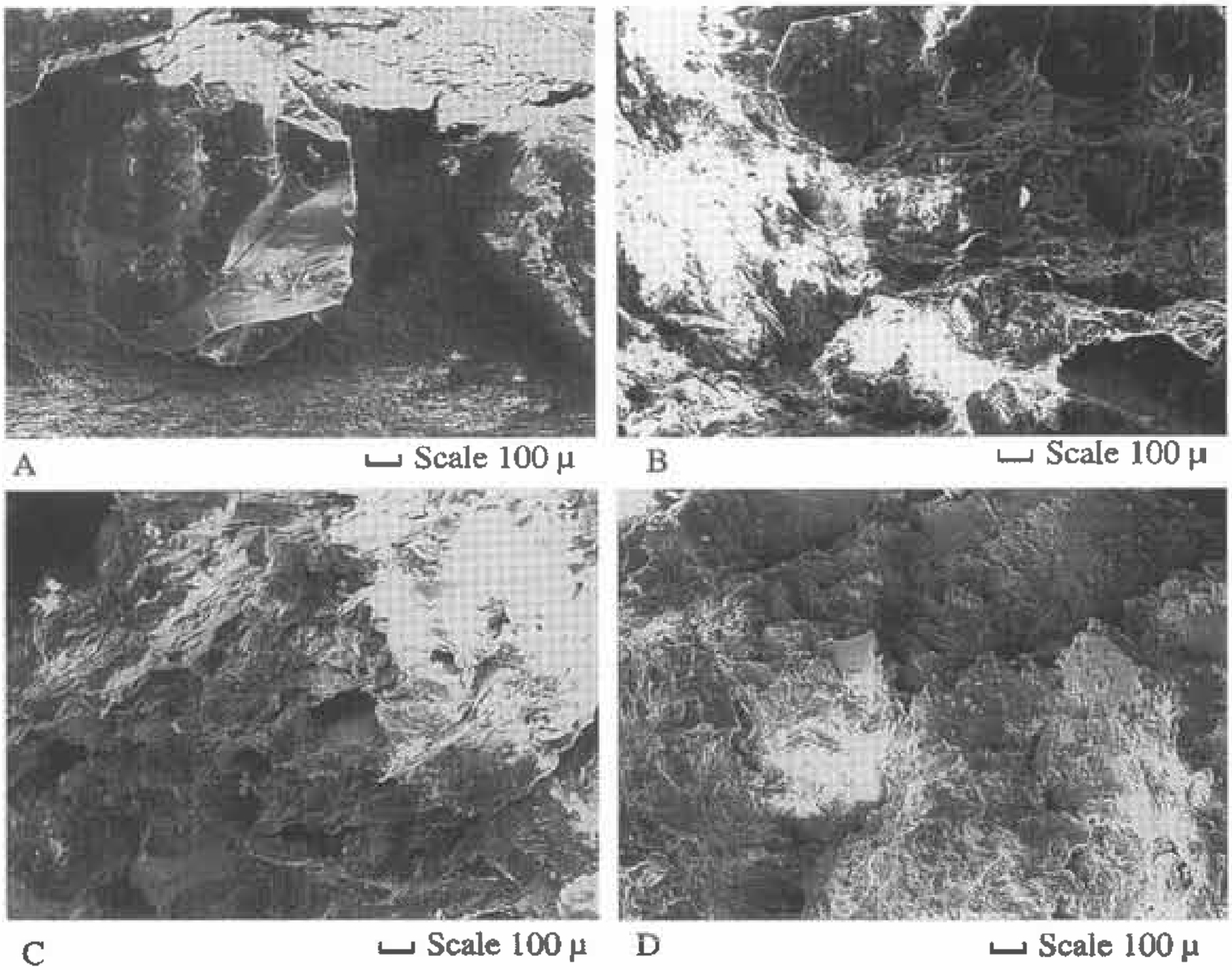

Figure 10. Scanning electron microscope (SEM) images of freshly broken surfaces of Fremont gray and brown ware, and brown ware from Scorpion Ridge and Wells Dump, all taken at the same magnifications.

A. SEM backscatter image from a freshly broken edge of sherd #11, gray ware, from site 8979, showing a well rounded, very coarse sand sized sedimentary quartz grain in a fine paste matrix with only minor void space; scale as shown.

B. SEM backscatter image from a freshly broken edge of sherd #9, Fremont, from the Baker Village site, showing plagioclase feldspar and VRF temper grains with common elongated pore space; scale as shown.

C. SEM backscatter image from a freshly broken edge of sherd #2, brown ware, from Scorpion Ridge site showing, biotite and IRF (quartz-dominated biotite granodiorite) temper grains in a fine paste matrix with very common elongated pores.

D. SEM backscatter image of a freshly broken edge of sherd #13, from Wells Dump site, showing large biotite grains and IRF (quartz-feldspar-biotite granodiorite) temper grains in a fine paste matrix with some elongated and irregular shaped pores.

plain ware samples from the upper Humboldt drainage. This would have had misleading implications.

The dune sandstone sand tempered Fremont plain ware from site 8979 is likely not a locally produced ceramic, but may have its origins in central or south central Utah (Navajo Sandstone or Carmel Formation). At present we cannot define any similar sources in Nevada.

For the most part it appears that the plain wares investigated here were manufactured from local materials. In this study, two local tempering materials have been identified for plain ware manufacture. These are a schistose biotite-granodiorite from the upper Humboldt River Drainage, and a monzonite with biotite from Ruby Valley. Both rock types have similar nonplastic mineralogical characteristics from a stylistic viewpoint as well as with respect to shrink-swell characteristics during ceramic firing. Temper variability in plain ware is emphasized by the limited petrographic and geochemical information in the open literature (Pippin 1986; Tuohy and Strawn 1986), which seems to suggest that the plain wares with specific tempers are confined to limited geographic districts. Within that local ceramic manufacture universe or lithologic district there is also some degree of mineralogical variation observed. For the upper Humboldt River drainage system the quantity of biotite in the ceramic temper varies among different features within a single site and from site to site, suggesting that there is variability in the temper source and the idiosyncratic behavior of potters. This variability may prove to be a temporal and spatial tool in the interpretation of cultural attributes with respect to pottery use and manufacture and with respect to overall exchange.

DISCUSSION AND CONCLUSION

As Madsen and Simms (1998) recently summarized, one of the material characteristics commonly employed to identify Fremont sites is plain gray ware ceramic vessels with flaring neck jars. One of these vessels was found at Scorpion Ridge together with a Nawthis Side-notched point in a context radiocarbon dated to about 1200 B.P. Petrographic and geochemical data provide compelling evidence that the Upper Humboldt River drainage plain wares were manufactured from local materials, regardless of vessel shape, manufacturing technique, or age. Butler (1986), Pippin (1986), and Tuohy and Strawn (1986), among others, have not reported any similar tempering of plain wares from other surrounding locations. This material is also greatly different than the Fremont wares studied from outside of the Upper Humboldt drainage along the western margins of the Bonneville Basin. It is almost certain that the Scorpion Ridge site documents that Fremont ceramics were locally manufactured in the central Great Basin as early as 1200 B.P.

This extends the known age of locally manufactured ceramics in the north-central Great Basin by seven centuries. In contrast, other sites such as 8979 suggest that Fremont wares were also traded into the region from elsewhere, perhaps from as far away as central Utah. The chemical and petrographic analyses reported here suggest that these methods may assist in distinguishing locally-made plain wares from those traded into the region.

At a regional scale, the Scorpion Ridge site is representative of a relatively early period of Fremont foraging cultures, perhaps before the establishment of adobe villages in the northwestern Fremont region. By at least 1200 B.P., Fremont ceramics may have been locally manufactured across a vast region that extended from the central Great Basin to western Wyoming and Colorado, and from southern Idaho to southern Utah. It seems unlikely that all of these early Fremont ceramic-manufacturing groups adopted the village lifestyle, although in some cases it is probably impossible to distinguish between base camps created by full-time Fremont foragers and temporary, task-specific camps created by hunting and gathering parties sent out from sedentary villages (see also Simms 1986). Importantly, this study suggests that the presence of

Importantly, this study suggests that the presence of ceramics is not a clear indicator to distinguish between the two subsistence/settlement strategies.

By all indications, the inhabitants of the Scorpion Ridge site were participating in the Fremont Behavioral Complex. Unfortunately, whether the cultural links in material remains between the Scorpion Ridge inhabitants and those Fremont groups at the center extended to close biological affiliations created by direct migration into regions west of the Bonneville Basin, or by the exchange of marriage partners, remains elusive.

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COMMODITY FLOW AND NATIONAL MARKET ACCESS: HISTORICAL ARCHAEOLOGY IN SALT LAKE COUNTY

Jakob D. Crockett, Department of Anthropology, University of South Carolina, Columbia, SC 29208

The Commodity Flow Model is an effective method for predicting the composition of late nineteenth and early twentieth century household assemblages. By utilizing a supply-side economic perspective, observed archaeological patterns are firmly linked to the culturally derived variable of market access, increasing our understanding of the spatial distribution of household consumer goods. Through an alternate application of the model, a new and successful method for determining changes in consumer preference for locally manufactured household goods is demonstrated. By way of intersite comparisons, a new pattern of changes in the national market is revealed. Primary data come from two early twentieth century trash deposits located in Salt Lake County, Utah (Seddon 2001).

This research examines patterns of household consumption from a supply-side economic perspective. By explaining assemblage composition in terms of the geographic location (*market access area*) of a historic period site, this research relates observed archaeological patterns to cultural behaviors by analyzing supply-side commodity flows utilizing the Commodity Flow Model proposed by Riordan and Adams (1985).

The main premises of this study are that a site's geographic location within the national market significantly affects the composition of late nineteenth and early twentieth century household assemblages, and the Commodity Flow Model is a useful tool in predicting the spatial distribution of household consumer goods within the national market system. A revised version of Cabak and Groover's (1993) hypothesis concerning temporal changes in the distribution of consumer goods within the national market is tested using data from two early twentieth century trash deposits located in Salt Lake County, Utah, as well as comparisons to sites elsewhere. These deposits were excavated under the direction of Matthew T. Seddon (2001) in November of 2000 by SWCA Environmental Consultants for the Utah Department of Transportation (UDOT) while conducting work on Interstate 15 (I-15). This study also presents a method for evaluating changes in consumer preference for locally manufactured consumer goods.

COMMODITY FLOW

The geographer Allen Pred (1970) studied how manufactured goods are produced and distributed, and proposed a Commodity Flow Model based on the relationships between the producers of manufactured goods and consumer access to those same goods. Geographers use the term *commodity flow* to describe how goods move from manufacturer to consumer. Commodity flows are composed of several factors, including the *type* of goods being manufactured, the geographical *location* of the producer, the geographical *location* of the consumer, the *transportation network* used to move the goods from manufacturer to consumer, and the *volume* of goods moving from producer to consumer.

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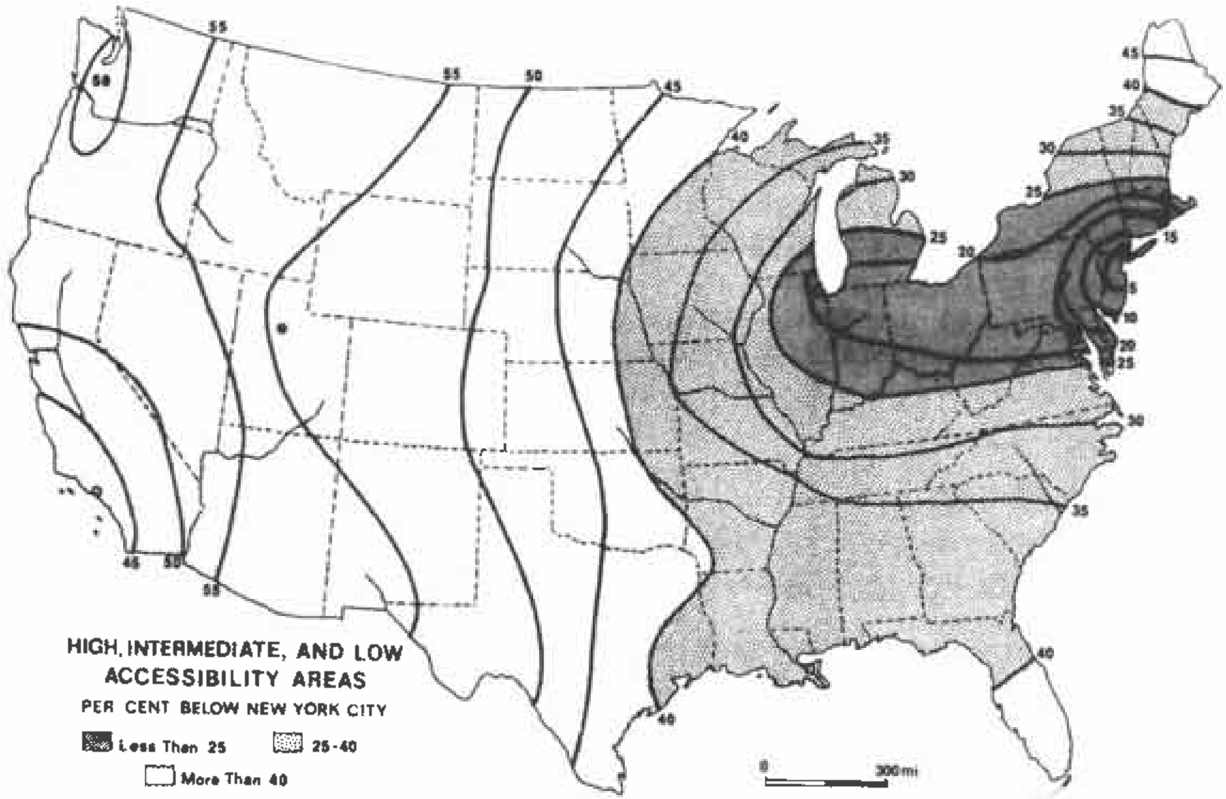

Figure 1. Map showing how Pred (1970) divided the country into access areas and percentages.

A particular commodity flow is the link between a manufacturer and an area of consumption. For example, one might look at a particular flow that exists between a glassmaker in New York City and a rural town in Nevada. This flow would be composed of the commodity type (glass), the number of goods being moved (the volume), and how those goods moved from New York City to Nevada (the transportation network). It is further possible to look at how the components of a particular commodity flow (type, volume, and/or transportation) changed over time.

When looking at commodity flows on a regional, national or international level, it is the *sum* of particular flows that are analyzed. For example, one might investigate commodity flow from the Northeast to the Southwest or from Western Europe to America. In this case, all flows (and their components) are combined to produce an overall picture of how goods move from producer to consumer.

Pred (1970) developed a typology of commodity flows based on Industry Type and Market Access. Industry Type is divided into three categories. *Raw Material and Power Oriented Industries* extract raw materials to be transported elsewhere for manufacture into finished goods. *Market Oriented Industries* serve regional and national markets. *Labor Related or Agglomeration Economies* manufacture finished goods that either have very low production costs per unit or are of such high value that transportation costs are not a factor.

Using a land and sea transportation network, Pred arbitrarily defines *market access* as the percent of access below New York City. Figure 1 shows how Pred divided the country into areas and percentages. These areas are High Access (0 to 25 percent below New York City), Intermediate Access (25 to 40 percent below), and Low Access (more than 40 percent below). In other words, Pred assumes that the residents of New York City have full access to goods manufactured in the High Access Area and that consumers living away from New York City have less than full access to those same goods. For instance, a consumer living in Utah has 50 percent less access to goods than a consumer living in New York City. At the turn of the century, 65 percent of all U.S. manufacturing was located in the High Access Area (Riordan and Adams 1985).

Pred argues that market access is a function of both the transportation network and population size. Economy of scale causes people living in high population areas to have greater access to goods than those in more rural areas since small stores cannot afford a wide variety of goods (a function of both market size and demand level). Market Oriented Industries are analyzed in this study, and in High Access Areas can distribute their goods the furthest. Industries of the same type located in Intermediate or Low Access Areas are not able to compete in High Access Areas, since they would not be able to overcome transportation costs, and are therefore confined to regional markets within the same Access Area.

THE COMMODITY FLOW MODEL

Timothy B. Riordan and William H. Adams (1985) developed Pred's Commodity Flow Model further. They hypothesize that "when located in different geographic regions, sites having the same access to the national market will show greater similarity to each other than to sites having different access, even when located in the same region" (1985:8). Comparing artifact frequency by access area, they measured the total *volume* of goods moving from local, regional, and national manufacturers to a particular consumption area. This volume of goods is independent of the actual number of flows. For example, a single manufacturer in a given access area producing 1,500 objects of a particular type would be the same as ten manufacturers in the same access area each producing 150 objects of the same type. It is the *volume* of goods moving that is important.

Riordan and Adams predict that sites in High Access Areas will be comprised mostly of artifacts originating within the High Access Area, with few artifacts from other areas. Sites within the Intermediate Access Area will show a high percentage of goods from High Access Areas, since they can overcome transportation costs, but will have very few artifacts manufactured in Low Access Areas because transportation costs are too high to remain competitive. Sites within Low Access Areas should also show a high percentage of goods from High Access Areas, but will also have a high percentage of goods made within Low Access Areas since transportation distances, and therefore costs, are low. Fewer goods originate within Intermediate Access Areas at these sites, as these manufacturers can neither match the distribution of High Access Area manufacturers nor the low transportation costs of local producers.

In 2001 Adams and colleagues extended Pred's original Commodity Flow Model to include Alaska as part of the Low Access Area. Using data from several sites in interior Alaska, they not only compared artifact frequency by access area, but also compared company frequency by access area, ignoring artifact totals. When company frequency is compared by access area, the total *number* of flows that exist between local, regional and national manufacturers and a particular consumption area are measured, which is independent of the volume of goods moving within these flows. For example, ten manufacturers in a given access area each producing 100 objects of a particular type would generate the same result as ten manufacturers in the access area each producing 500 objects of the same type. It is the actual *number* of links, or flows, that exist between various manufacturing locations and a particular consumption area that is important. Adams and colleagues suggest that this approach avoids biases

Table 1. Past Studies, Artifact Frequency by Access Area.

Access Area	N	%	N	%	N	%	N	%	N	%
	Silcott		Waverly		Bay Springs		Sandy Ground		Ashley Plantation	
Low	222	23.0	3	1.5	-	-	2	0.6	12	3.0
Intermediate	198	20.5	67	32.5	6	28.6	-	-	93	23.2
High	546	56.5	136	66.0	15	71.4	328	99.4	295	73.8
Total	966	100	206	100	21	100	330	100	400	100
	Homestead 1		Homestead 2		Homestead 3		Logging Camp		Railroad Camp	
Low	7	26.9	13	28.3	12	15.0	32	38.5	14	10.5
Intermediate	10	38.5	1	2.2	11	13.7	18	21.7	109	81.3
High	9	34.6	32	69.5	57	71.3	33	39.8	11	8.2
Total	26	100	46	100	80	100	83	100	31	100
	Peoria 1834 – 1880		Peoria 1880 – 1910		Peoria 1910+		Fairbanks (artifact freq.)		Fairbanks (company freq.)	
Low	-	-	1	3.0	1	1.3	53	27.9	21	24.1
Intermediate	2	12.5	8	23.5	23	30.3	27	14.2	15	17.3
High	14	87.5	25	73.5	52	68.4	110	57.9	51	58.6
Total	16	100	34	100	76	100	190	100	87	100

and colleagues suggest that this approach avoids biases caused by reuse, artifact breakage, and individual preferences.

Melanie A. Cabak and Mark D. Groover (1993) applied the Commodity Flow Model to data from Peoria, Illinois on the edge of the High Access Area boundary. Breaking the assemblage into chronological periods based on changes in the transportation network (Table 1), Cabak and Groover hypothesize that different areas developed at different rates and that over time manufacturers in Low and Intermediate Access Areas will increase their commodity flows at the expense of manufacturers in High Access Areas, since these more regional manufacturers will have had longer to develop. Their hypothesis will be explored further in light of the Salt Lake County data.

PAST RESEARCH

Past studies utilizing the Commodity Flow Model on nineteenth to mid-twentieth century artifact assemblages are introduced below to provide some background for comparison with the Salt Lake County assemblages. A major economic shift from household production to household consumption occurred during the second half of the nineteenth century (Speulda and Bowyer 1996:3). Each study utilizes roughly contemporaneous assemblages that post-date this economic shift. For the purpose of this study, only the results regarding Market Oriented goods manufactured within the U.S. are presented. Due to differences in assemblage sizes, percentages of artifact or company totals are used in the analysis.

Sandy Ground, Waverly Plantation, Bay Springs, Silcott

Riordan and Adams (1985) utilize data from four sites to measure the *volume* of goods flowing into different consumption areas (Table 1). Sandy Ground was founded in the 1850s by African-American oystermen on Staten Island near New York City in the High Access Area (ca. 1890 – 1910). At Waverly Plantation, located in Mississippi along the Tombigbee River within the Intermediate Access Area, four tenant farmer houses and related areas were excavated (ca. 1900 – 1950). Bay Springs, also in Mississippi and within the Intermediate Access Area, was a small community centered around two mills and a thread factory (ca. 1840 – 1890). The general store and several domestic structures were excavated in Silcott, a rural town along the Snake River near Clarkston, Washington in the Low Access Area (ca. 1880 – 1930).

At Sandy Ground, 99.4 percent of the artifacts came from High Access Areas and only .6 percent from Low Access Areas. No artifacts were recovered from the Intermediate Access Area. Waverly Plantation derived 66 percent of goods from High Access Area manufacturers, 32.5 percent from Intermediate Access Areas, and only 1.5 percent from Low Access Area producers. Bay Springs revealed a similar pattern, with 71.4 percent of goods originating in the High Access Area and 28.6 percent from Intermediate Access Area producers. No artifacts were recovered from Low Access Area manufacturers. Silcott had 56.5 percent from High Access Areas, 20.5 percent from Intermediate Access Areas, and 23 percent from Low Access Area manufacturers.

Ashley Plantation

Richard D. Brooks (unpublished, but described in Adams et al. 2001) used data from Ashley Plantation in South Carolina, located in the Intermediate Access Area (Table 1). Combining artifacts from three tenant farmer houses, two dwellings and a mill, ca. 1876 to 1950, Brooks found that 73.8 percent of the artifacts originated in the High Access Area, 23.2 percent in the Intermediate Access Area, and only 3 percent from Low Access Area manufacturers.

Oregon Sites

In 1996, Lou Ann Speulda and Gary C. Bowyer used data from three homesteading sites, a logging camp, and a railroad construction camp in Oregon, a Low Access Area, to test the model (Table 1). At the three homesteading sites, goods from High Access Areas accounted for 34.6 to 71.3 percent of the assemblages, while Intermediate Access Area goods accounted for 2.2 to 38.5 percent and 15 to 28.3 percent of the goods from Low Access Area manufacturers. The logging camp site (ca. 1922 – 1931) derived 39.8 percent of goods from High Access Area manufacturers, while 21.7 percent came from the Intermediate Access Area. Low Access Area contribution of 38.5 percent was nearly identical to the High Access Area. At the railroad construction camp site, occupied from 1923 to 1926, only 8.2 percent of the goods originated from within the High Access Area, whereas the majority of goods, 81.3 percent, came from the Intermediate Access Area. The Low Access Area accounted for 10.5 percent of the total goods (minus the tobacco can data).

Fairbanks, Alaska

Adams et al. 2001 used data from Fairbanks, Alaska to test the Commodity Flow Model further and presented an alternate method for evaluating commodity flow. Fairbanks was founded in 1901 and soon became the center of the mining district. In 1992-1993 a cabin, two saloons, a warehouse, and a trash deposit were excavated (ca. 1901 – 1941). Since Pred did not include Alaska in his original model, Adams and colleagues treated Alaska as a Low Access Area. Comparing artifact frequency by access area (Table 1), High Access Area manufacturers accounted for 58.5 percent of the assemblage, while only 13.3 and 28.2 percent of the artifacts came from Intermediate and Low Access Areas, respectively.

Table 2. Summary of 42SL327 Assemblage Artifacts (MNI) Associated with Identifiable Trademarks

Manufacturers in High Access Areas (42SL327)

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
A.H. Heisey Glass Co.	Glass	Newark	OH	1893 - 1958	High	3
American-Bottle Co.	Glass	Chicago Toledo	IL OH	1905 - 1929	High	4
Anchor Pottery Co.	Ceramic	Trenton	NJ	1894 - 1926	High	2
Anchor Pottery Co.	Ceramic	Trenton	NJ	1908 - 1927	High	2
A.S. Hinds Co.	Glass	Bloomfield	NJ	1875 - *	High	2
Atlas Glass Co.	Glass	Washington	PA	1896 - 1964	High	4
Ball Bros. Co.	Glass	Muncie	IN	1858 - 1904	High	3
Ball Bros. Co. (aqua jars)	Glass	Muncie	IN	1888 - 1937	High	76
Ball Bros. Co.	Glass	Muncie	IN	1888 - *	High	22
Ball Bros. Co.	Glass	Muncie	IN	1908 - 1922	High	1
Ball Bros. Co. ("BALL" w/o underscore)	Glass	Muncie	IN	1920 - 1937	High	11
Bell Fruit Bottle Co.	Glass	Fairmount	IN	1910 - *	High	1
Buck Glass Co.	Glass	Baltimore	MD	1909 - 1961	High	2
Burnett's Standard Flavor Extracts	Glass	Boston	MA	1855 - 1900	High	2
Brockway Glass Co.	Glass	Brockway	PA	1925 - *	High	1
Bromo Seltzer, Emerson Drug Co.	Glass	Baltimore	MD	1891 - *	High	15
Carpenter-Morton Co.	Glass	Boston	MA	1904 - *	High	1
Carter's	Glass	Erie	PA	1850 - *	High	2
C.C. Thompson Pottery Co.	Ceramic	East Liverpool	OH	1910 - 1920	High	1
Chas. H. Fletcher's Castoria	Glass	NYC	NY	1890 - *	High	2
Chesebrough Mfg. Co./Vaseline	Glass	unknown	NY	1870 - *	High	2
Chesebrough Mfg. Co.	Glass	NYC	NY	1870 - 1947	High	4
Chesebrough Mfg. Co.	Glass	NYC/Brooklyn	NY	1870 - *	High	2
Colonial Co.	Ceramic	East Liverpool	OH	1903 - 1929	High	1
Curtice Brothers Co.: Preservers	Glass	Rochester	NY	1870 - *	High	9
Diamond Glass Co.	Glass	Royersford	PA	1888 - *	High	18
Dresden Pottery	Ceramic	East Liverpool	OH	1908 - 1915	High	1
Dr. Jayne's Vermifuge	Glass	Philadelphia	PA	1894 - *	High	2
Dr. Peter Fahrney & Sons	Glass	Chicago	IL	1867 - 1900	High	2
Dr. R.V. Pierce's Medicines	Glass	Buffalo	NY	1870 - 1915	High	1
East Trenton Pottery	Ceramic	Trenton	NJ	1888 - 1905	High	1
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1900 - 1948	High	2
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1901 - 1963	High	4
E.R. Durkee & Sons	Glass	NYC	NY	1877 - 1904	High	1
Fairmount Glass Works Inc.	Glass	Indianapolis	IN	1930 - 1945	High	4
French China Co.	Ceramic	Sebring	OH	1898 - 1929	High	4
French China Co.	Ceramic	Sebring	OH	1905 - 1915	High	2
Glover's Imperial Mange Remedy	Glass	NYC	NY	1870 - *	High	1
Guernsey Cooking Ware	Ceramic	Cambridge	OH	1909 - 1923	High	1
Higgin's Inks	Glass	Brooklyn	NY	1850 - *	High	2
Hires Household Extract: The Charles E. Hines Co.	Glass	Philadelphia	PA	1876 - *	High	2
H. J. Heinz Co.	Glass	Pittsburgh	PA	1860 - 1869	High	3
H. J. Heinz Co.	Glass	Pittsburgh	PA	1888 - *	High	10
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1869 - *	High	20
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1897 - 1918	High	2
Homer Laughlin China Co. - Golden Gate	Ceramic	East Liverpool	OH	1897 - 1905	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1900 - 1910	High	7

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1909 - 1915	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1914 - *	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1915 - 1919	High	3
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1916 - 1919	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1917 - 1919	High	2
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1917 - 1919	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1917 - 1929	High	1
Horlick's Malted Milk	Glass	Racine	WI	1883 - *	High	2
Hygeia	Glass	Millville	NJ	1894 - 1938	High	2
Illinois Glass Co.	Glass	Alton	IL	1916 - 1929	High	65
Kerr Glass Mfg. Co.	Glass	Chicago	IL	1909 - 1912	High	1
Kivlan & Onthank	Glass	Boston	MA	1919 - 1925	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1854 - 1929	High	4
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1890 - 1900	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1890 - 1905	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1900 - 1907	High	2
Knowles, Taylor & Knowles	Ceramic	East Liverpool	OH	1905 - 1929	High	2
Knowles, Taylor & Knowles	Ceramic	East Liverpool	OH	1908 - 1914	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1917 - 1927	High	1
Knowles, Taylor & Knowles	Ceramic	East Liverpool	OH	1918 - 1927	High	1
Knowles, Taylor & Knowles	Ceramic	East Liverpool	OH	1923 - 1927	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1925 - 1927	High	1
Knowles, Taylor and Knowles, Co.	Ceramic	East Liverpool	OH	1926 - 1927	High	1
Larkin Co.	Glass	Buffalo	NY	1850 - *	High	1
Lewis Boyd	Glass	NYC	NY	1869 - 1950	High	58
L.H. Thomas	Glass	Chicago	IL	1900 - 1930	High	2
Lysol: Lehn and Fink Inc.	Glass	Bloomfield	NJ	1890 - *	High	3
MAINE (Knowles, Taylor and Knowles)	Ceramic	East Liverpool	OH	1885 - 1905	High	1
Mayer Pottery Co.	Ceramic	Beaver Falls	PA	1915 - 1930	High	1
Maryland Glass Co.	Glass	Baltimore	MA	1907 - *	High	2
National China Co.	Ceramic	East Liverpool Salineville	OH OH	1900 - 1929	High	1
Ohio China Co.	Ceramic	East Palestine	OH	1896 - 1902	High	1
Onondaga Pottery Co.	Ceramic	Syracuse	NY	1897 - 1935	High	1
Owens Bottle Co.	Glass	Toledo	OH	1911 - 1929	High	1
Owens-Illinois	Glass	Toledo	OH	1929 - 1954	High	1
Owens-Illinois (Duraglas)	Glass	Toledo	OH	* - *	High	1
Parke, Davis & Co.	Glass	Detroit	MI	1862 - 1875	High	4
Philips Milk of Magnesia	Glass	Glennbrook	CN	1872 - *	High	3
Pope-Gosser China Co.	Ceramic	Coshocton	OH	1903 - 1958	High	1
Root Glass Co.	Glass	Terre Haute	IN	1901 - 1932	High	1
Sanford Ink	Glass	Chicago	IL	1857 - 1930	High	8
Scott's Emulsion	Glass	NYC	NY	1890 - *	High	2
Smalley Fruit Jar Co.	Glass	Boston	MA	1915 - 1919	High	1
Smith-Philips China Co.	Ceramic	East Liverpool	OH	1916 - 1926	High	2
T.A. McNicol	Ceramic	East Liverpool	OH	1913 - 1929	High	5
Taylor, Smith & Taylor	Ceramic	East Liverpool	OH	1901 - 1915	High	1
Taylor, Smith & Taylor: Verona China	Ceramic	East Liverpool	OH	1905 - 1920	High	2
Taylor, Smith & Taylor Co. - Pennova	Ceramic	East Liverpool	OH	1910 - 1920	High	2
Taylor, Smith & Taylor Co.	Ceramic	East Liverpool	OH	1914 - 1921	High	1
Taylor, Smith & Taylor (Avona)	Ceramic	East Liverpool	OH	1916 - 1925	High	3
Thatcher Mfg. Co.	Glass	Elmira	NY	1910 - 1924	High	5
Tonto Co.	Glass	Providence	RI	* - *	High	1
United States Pottery Co.	Ceramic	Wellsville	OH	1899 - 1920	High	1
Whitall-Tatum & Co.	Glass	Millville	NJ	1857 - 1935	High	6

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
Whittemore	Glass	Boston	MA	1904 - *	High	3
William Franzen & Sons	Glass	Milwaukee	WI	1900 - 1929	High	37
Subtotals High Access Area						**526**
Manufacturers in Intermediate Access Areas (42SL327)						
Adolphus-Busch	Glass	St. Louis	MO	1904 - 1910	Intermediate	14
Alexander H. Kerr Mfg. Co.	Glass	Sand Springs	OK	1915 - 1946	Intermediate	2
Aurelius S. Hinds	Glass	Portland	ME	1890 - 1925	Intermediate	1
Ballard's Snow Liniment	Glass	St. Louis	MO	1880 - *	Intermediate	2
Bartlett-Collins Glass Co.	Glass	Sapulpa	OK	1914 - *	Intermediate	2
Chamberlain Medicine Co.	Glass	Marion & Des Moines	IA	1879 - 1930	Intermediate	3
Coca Cola (General Coca Cola marks)	Glass	Atlanta	GA	1886 - *	Intermediate	2
Garrett & Co.	Glass	Norfolk	VA	1835 - *	Intermediate	1
Obear-Nester Glass Co.	Glass	E. St. Louis	IL	1894 - 1915	Intermediate	1
Schram	Glass	St. Louis Hillsboro	MO IL	1906 - 1925	Intermediate	2
Sealfast	Glass	Upland	IN	1912 - 1924	Intermediate	1
Streator Bottle & Glass Co.	Glass	Streator	IL	1881 - 1905	Intermediate	1
Subtotals Intermediate Access Area						**32**
Manufacturers in Low Access Areas (42SL327)						
Alexander H. Kerr & Co.	Glass	Los Angeles	CA	1904 - *	Low	3
A. Schiling and Co.	Glass	San Francisco	CA	1881 - 1947	Low	4
Ben Schloss	Glass	San Francisco	CA	1913 - *	Low	2
Clover Leaf Dairy	Glass	Salt Lake City	UT	1905 - 1964	Low	3
Coca Cola (Salt Lake City)	Glass	Salt Lake City	UT	1905 - *	Low	1
Denhalter (H. Denhalter & Son)	Glass	Salt Lake City	UT	1885 - 1893	Low	1
Denhalter (Trade Mark Denhalter)	Glass	Salt Lake City	UT	1910 - 1947	Low	5
Empire China Co.	Ceramic	Burbank	CA	1910 - *	Low	41
Frank J. Hewlett Beverage Co.	Glass	Salt Lake City	UT	1904 - *	Low	3
Illnois Pacific Glass Co.	Glass	San Francisco	CA	1902 - 1930	Low	3
Illnois Pacific Coast Co. (was Pacific Glass Co.)	Glass	San Francisco	CA	1930 - 1932	Low	2
J.A. Folger & Co.	Glass	San Francisco	CA	1908 - *	Low	1
Kerr	Glass	Los Angeles	CA	1920 - 1940	Low	1
Kerr Glass Mfg. Co.	Glass	Portland	OR	1904 - 1909	Low	6
Pacific Coast Glass Works	Glass	San Francisco	CA	1902 - 1924	Low	1
Salt Lake City Brewing Co./ Porcelain Bottle Stopper	Glass	Salt Lake City	UT	~1871 - 1910	Low	1
Schramm-Johnson Drugs	Glass	Salt Lake City	UT	1909 - 1942	Low	5
The Salt Lake City Soda Water Co.: Red Seal Brand	Glass	Salt Lake City	UT	1904 - *	Low	5
Wakelee's Cameline	Glass	San Francisco	CA	1857 - *	Low	1
West Side Pharmacy	Glass	Salt Lake City	UT	1906 - 1934	Low	1
Wiles-Horne Drug Co.	Glass	Salt Lake City	UT	1908 - 1921	Low	2
Subtotals Low Access Area						**92**

When Adams and colleagues compared company frequency by access area, 61.9 percent of the manufacturers shipping goods into Fairbanks were located in High Access Areas, 11.9 percent were in Intermediate Access Areas, and 26.2 percent were in Low Access Areas. If this new method of utilizing company frequencies is valid the results should be similar to those of Salt Lake County.

SALT LAKE COUNTY BACKGROUND

The first major wave of European-Americans settled the Salt Lake valley in 1847. Salt Lake County's population soon grew along with mining and railroad industries, expanding from just over 11,000 in 1850 to more than 86,000 by 1870 (Sillitoe 1996). According to the 1870 census (Sillitoe 1996), 69 percent of the heads of households in Salt Lake County were foreign born. By 1874 shortly after the arrival of the railroad, 25 percent of the population was non-Mormon, which "included most of the valley's wealthy citizens" (Sillitoe 1996:75). By the early decades of the twentieth century nearly 60 percent of the population was non-Mormon. In addition to the great number of immigrants from Western and Eastern Europe, the 1890 census reported 271 Chinese residents in Salt Lake City proper (Sillitoe 1996).

During these early years, Salt Lake County more closely approximated other larger metropolitan areas, more so than it does today, where "the media captures the diversity maintained by small numbers and broadcasts images of varying cultures, lifestyles, and religious ideas throughout the Intermountain West" (Sillitoe 1996:6). Donald L. Hardesty (1991:30) suggests that the Intermountain West can best be understood "by interpreting the region as a dynamic periphery of an evolving American world system."

THE SALT LAKE COUNTY ASSEMBLAGES

In 2000 SWCA Environmental Consultants, under the direction of Matthew T. Seddon (2001), excavated two historic-period sites encountered by the Utah Department of Transportation while conducting work on I-15 in Salt Lake County, Utah. The first site (42SL327) is located at 900 West and 2100 South, and is a large historical trash deposit. A total of 650 glass and ceramic artifacts with U.S. makers' marks traceable to the location of manufacture were recovered (Table 2). The deposit seems to be the result of a single dumping event, as stratigraphic variation was minimal. The deposit is composed mainly of domestic debris, although there may be a commercial component as well, evidenced by the presence of hotelware and other commercial refuse. Datable artifacts, including newspapers, indicate that the deposit was created between 1915 and 1930, although the origin of the deposit is unknown. Archival research conducted by SWCA failed to yield any reference to the deposit. Seddon (2001:151-152) suggests that the deposit may be the result of non-edible trash from surrounding neighborhoods being used as fill during road construction in the 1920s, a practice apparently common during the first half of the twentieth century in the Salt Lake valley.

The second site (42SL309), discovered at 2800 South and I-15, may be an unofficial dump or landfill located in a marsh area. Archival research conducted by SWCA failed to yield any information regarding the site's function, although the deposit was capped with sterile clay, indicating that the site was known. A total of 3,481 traceable glass and ceramic artifacts manufactured in the U.S. were recovered (Table 3), and the Owens-Illinois companies accounted for nearly 1,500 of the glass artifacts, almost 44 percent of the total assemblage. Stratigraphic variation within the deposit was minor and seems to be the result of either a single dumping event or very rapid accumulation. Datable artifacts, including many newspapers, suggest

Table 3. Summary of 42SL309 Assemblage Artifacts (MNI) Associated with Identifiable Trademarks.

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
Manufacturers in High Access Areas (42SL309)						
Albert Pick Co., Inc.	Glass	Chicago	IL	* - *	High	1
Albert Pick Co., Inc.	Ceramic	Chicago	IL	1926 - 1950	High	6
American-Bottle Co.	Glass	Chicago	IL	1905 - 1929	High	3
		Toledo	OH			
Armstrong Cork, Glass Div.	Glass	Lancaster	PA	1938 - 1969	High	17
Anchor-Hocking	Glass	Lancaster	OH	1938 - *	High	31
A.S. Hinds Co.	Glass	Bloomfield	NJ	1875 - *	High	5
Atlas Glass Co.	Glass	Washington	PA	1896 - 1964	High	2
Ball Bros. (aqua jars)	Glass	Muncie	IN	1888 - 1937	High	41
Ball Bros. Co.	Glass	Muncie	IN	1888 - *	High	89
Ball Bros. Co. (Perfect Mason)	Glass	Muncie	IN	1910 - 1959	High	2
Ball Bros. Co. (Hiram Walker & Sons)	Glass	Muncie	IN	1919 - 1969	High	4
Ball Bros. Co. ("BALL" w/o underscore, aqua)	Glass	Muncie	IN	1920 - 1937	High	8
Ball Mason Jar ("Mason" written in same cursive font as word "Ball")	Glass	Muncie	IN	1909 - 1937	High	2
Bailey-Walker China Co.	Ceramic	Bedford	OH	1922 - 1943	High	3
Best Foods Reg. Design Patent 80918	Glass	Terre Haute	IN	1930 - *	High	55
Brockway Glass Co.	Glass	Brockway	PA	1925 - *	High	15
Bromo Seltzer, Emerson Drug Co.	Glass	Baltimore	MD	1891 - *	High	10
Buck Glass Co.	Glass	Baltimore	MD	1909 - 1961	High	7
Buffalo China	Ceramic	Buffalo	NY	1901 - *	High	1
Canada Dry Ginger Ale Co.	Glass	NYC	NY	1930 - *	High	4
Carr-Lowrey Glass Co.	Glass	Baltimore	MD	1920 - 1963	High	5
Chesebrough Mfg. Co.	Glass	NYC	NY	1870 - 1947	High	4
Chesebrough Mfg. Co.	Glass	NYC/Brooklyn	NY	1870 - *	High	14
Chester Hotel China, Taylor, Smith & Taylor	Ceramic	East Liverpool	OH	1908 - 1930	High	1
Curtice Brothers Co.: Preservers	Glass	Rochester	NY	1870 - *	High	2
Diamond Glass Co.	Glass	Royersfield	PA	1888 - *	High	53
Dr. Peter Fahrney & Sons	Glass	Chicago	IL	1867 - 1900	High	1
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1900 - 1948	High	16
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1901 - 1963	High	10
Edwin M. Knowles China Co. (Ivory Color)	Ceramic	East Liverpool	OH	1927 - *	High	4
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1930 - 1948	High	16
Edwin M. Knowles China Co.	Ceramic	East Liverpool	OH	1931 - 1963	High	6
Fairmount Glass Works Inc.	Glass	Indianapolis	IN	1930 - 1945	High	11
Fairmount Glass Works Inc.	Glass	Indianapolis	IN	1945 - 1960	High	29
Federal Glass Co.	Glass	Colombus	OH	1900 - *	High	7
Foster-Forbes Glass Co.	Glass	Marion	IN	1929 - *	High	2
Fraunfelter China	Ceramic	Zanesville	OH	1923 - 1939	High	2
French China Co.	Ceramic	Sebring	OH	1898 - 1929	High	2
Glenn A. Mengle ("R" inside of sun)	Glass	Brockway	PA	1935 - *	High	3
Guernsey Cooking Ware	Ceramic	Cambridge	OH	1909 - 1923	High	1
Hall China Co.	Ceramic	East Liverpool	OH	1903 - *	High	3
Harriet Hubbard Ayer	Glass	NYC	NY	1907 - *	High	3
Hart Glass Man. Co.	Glass	Dunkirk	IN	1918 - 1938	High	2
Hazel-Atlas	Glass	Wheeling	WV	1920 - 1964	High	412
Hires Household Extract: The Charles E. Hines Co.	Glass	Philadelphia	PA	1876 - *	High	1
H.J. Heinz Co.	Glass	Pittsburgh	PA	1860 - 1869	High	5
H.J. Heinz Co.	Glass	Pittsburgh	PA	1872 - 1875	High	1
H.J. Heinz Co.	Glass	Pittsburgh	PA	1888 - *	High	32
H.J. Heinz Co.	Glass	Pittsburgh	PA	1900 - 1943	High	5
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1869 - *	High	16
		Newell	WV			
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1877 - *	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1900 - 1910	High	3
		Newell	WV			
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1915 - 1919	High	1
Homer Laughlin China Co.	Ceramic	East Liverpool	OH	1917 - 1919	High	2
		Newell	WV			

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
Homer Laughlin China Co. - Empress	Ceramic	East Liverpool	OH	1920 - *	High	2
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1922 - 1929	High	3
Homer Laughlin China Co.	Ceramic	East Liverpool Newell	OH WV	1923 - 1929	High	2
Homer Laughlin	Ceramic	East Liverpool Newell	OH WV	1929 - 1929	High	1
Homer Laughlin China Co. - Tudor Rose	Ceramic	East Liverpool	OH	1945 - 1955	High	3
Illinois Glass Co.	Glass	Alton	IL	1916 - 1929	High	42
Knowles, Taylor and Knowles Co.	Ceramic	East Liverpool	OH	1854 - 1929	High	2
Knowles, Taylor & Knowles	Ceramic	East Liverpool	OH	1905 - *	High	6
Knox Glass	Glass	Knox	PA	1917 - *	High	8
Leigh Potters, Inc.	Ceramic	Alliance	OH	1927 - 1932	High	3
Lewis Boyd	Glass	NYC	NY	1869 - 1950	High	150
Limoges China Co.	Ceramic	East Liverpool	OH	1910 - 1955	High	2
Lummis Glass Co.	Glass	NYC	NY	1940 - 1955	High	3
Lysol: Lehn and Fink Inc.	Glass	Bloomfield	NJ	1890 - *	High	2
Maryland Glass Co.	Glass	Baltimore	MD	1907 - *	High	131
Mayer Pottery Co.	Ceramic	Beaver Falls	PA	1915 - 1930	High	7
Maywood Glass Co.	Glass	Compton	CA	1930 - *	High	3
Mount Clemens Pottery	Ceramic	Mount Clemens	MI	1915 - 1987	High	5
The Musterole Co.	Glass	Cleveland	OH	1906 - *	High	3
Northam Warren Corporation	Glass	Stamford	CT	1912 - 1960	High	13
Onondaga Pottery Co.	Ceramic	Syracuse	NY	1871 - 1966	High	9
Onondaga Pottery Co.	Ceramic	Syracuse	NY	1897 - 1935	High	2
Onondaga Pottery Co.	Ceramic	Syracuse	NY	1925 - 1959	High	1
Onondaga Pottery Co.	Ceramic	Syracuse	NY	1929 - 1959	High	1
Owens Bottle Co.	Glass	Toledo	OH	1911 - 1929	High	22
Owens-Illinois	Glass	Toledo	OH	1929 - 1954	High	1418
Owens-Illinois Company	Glass	Toledo	OH	1929 - 1954	High	1
Owens-Illinois Glass Co.	Glass	Toledo	OH	1932 - 1954	High	2
Owens-Illinois Glass Co. Plant #10	Glass	Toledo	OH	1936 - *	High	86
Owens Illinois - Duraglas	Glass	Toledo	OH	1940 - *	High	1
Owens Illinois (Duraglas)	Glass	Toledo	OH	1940 - *	High	8
Parke, Davis & Co.	Glass	Detroit	MI	1862 - 1875	High	1
Philips Milk of Magnesia	Glass	Glennbrook	CT	1872 - *	High	23
Pierce Glass Co.	Glass	St. Mary's Hamburg	PA NY	1905 - 1917	High	11
Pope-Gosser China Co.	Ceramic	Coshocton	OH	1903 - 1958	High	3
Porcelier Manufacturing Co.	Ceramic	East Liverpool	OH	1927 - 1954	High	1
Pyrex	Glass	Corning	NY	1915 - *	High	10
Reed Glass Co.	Glass	Rochester	NY	1927 - 1956	High	9
Resinol Chemical Co.	Glass	Baltimore	MD	1895 - *	High	1
Root Glass Co.	Glass	Terre Haute	IN	1901 - 1932	High	2
Royal China Co.	Ceramic	Sebring	OH	1934 - *	High	1
Salem China Co.	Ceramic	Salem	OH	1929 - *	High	1
Sanford Ink	Glass	Chicago	IL	1857 - 1930	High	7
Shenango China Co.	Ceramic	New Castle	PA	1901 - *	High	1
Smith-Phillips China Co.	Ceramic	East Liverpool	OH	1918 - 1929	High	1
S-P Laboratories/Owen-Illinois Glass Co.	Glass	Toledo	OH	1929 - 1954	High	1
Squibb	Glass	Brooklyn	NY	1858 - *	High	5
Steubenville Pottery Co.	Ceramic	Steubenville	OH	1879 - 1959	High	1
Steubenville Pottery Co. China	Ceramic	Steubenville	OH	1910 - 1920	High	1
Swindell Bros.	Glass	Baltimore	MD	1869 - 1959	High	1
Syracuse China Co.	Ceramic	Syracuse	NY	1933 - *	High	1
Taylor, Smith & Taylor (Avona)	Ceramic	East Liverpool	OH	1916 - 1925	High	1
Taylor, Smith & Taylor	Ceramic	East Liverpool	OH	1920 - 1972	High	1
Taylor, Smith & Taylor Co.	Ceramic	East Liverpool	OH	1930 - *	High	3
Taylor, Smith & Taylor Co.	Ceramic	East Liverpool	OH	1935 - 1981	High	1
Thatcher Man Co.	Glass	Elmira	NY	1900 - 1946	High	1
Thatcher Mfg. Co.	Glass	Elmira	NY	1910 - 1924	High	1
Thomas Wightman Bros. & Co.	Glass	Pittsburgh	PA	1871 - 1895	High	1

Manufacturer	Type	City	State/Country	Mfg. Date	Access Area	N
Turner Bros. Co.	Glass	Terre Haute	IN	1910 - 1929	High	3
Warwick China Co.	Ceramic	Wheeling	WV	1884 - 1951	High	1
Wellsville China Co.	Ceramic	Wellsville	OH	1910 - 1927	High	1
Whitall-Tatum & Co.	Glass	Millville	NJ	1935 - 1938	High	60
William Franzen & Sons	Glass	Milwaukee	WI	1900 - 1929	High	2
W.M. McCully & Co.	Glass	Pittsburgh	PA	1841 - 1886	High	1
Woodbury Glass Works	Glass	Woodbury	NJ	1882 - 1896	High	17
W.S. George Pottery	Ceramic	East Palestine	OH	1909 - 1960	High	3
W.S. George Pottery	Ceramic	East Palestine	OH	1927 - 1927	High	1
W.T. Rawleigh Mfg. Co.	Glass	Freeport	IL	1925 - 1936	High	2
Subtotals High Access Area						**3106**
Manufacturers in Intermediate Access Areas (42SL309)						
Adolphus-Busch	Glass	St. Louis	MO	1904 - 1910	Intermediate	2
Alexander H. Kerr Mfg. Co.	Glass	Sand Springs	OK	1915 - 1946	Intermediate	5
Bartlett-Colins Glass Co.	Glass	Sapulpa	OK	1914 - *	Intermediate	1
Chamberlain Medicine Co.	Glass	Marion & Des Moines	IA	1879 - 1930	Intermediate	1
Garrett & Co.	Glass	Norfolk	VA	1835 - *	Intermediate	1
Knox Glass Bottle Co. of Mississippi	Glass	Jackson	MS	1932 - 1953	Intermediate	3
Lauren Glass Works	Glass	Laurens	SC	1911 - *	Intermediate	3
Liberty Glass Co.	Glass	Sapulpa	OK	1918 - *	Intermediate	1
Obear-Nester Glass Co.	Glass	E. St. Louis	IL	1894 - 1915	Intermediate	6
Obear-Nester Glass Co.	Glass	E. St. Louis	IL	1915 - *	Intermediate	29
Schram	Glass	St. Louis	MO	1906 - 1925	Intermediate	1
Upland Glass Co.	Glass	Upland	IN	1890 - 1909	Intermediate	2
Subtotals Intermediate Access Area						**55**
Manufacturers in Low Access Areas (42SL309)						
Alexander H. Kerr & Co.	Glass	Los Angeles	CA	1904 - *	Low	6
Ben Schloss	Glass	San Francisco	CA	1913 - *	Low	1
Clover Leaf Dairy	Glass	Salt Lake City	UT	1905 - 1964	Low	1
Coca Cola Bottling Co.	Glass	Phoenix	AZ	1948 - *	Low	3
Coors Porcelain	Ceramic	Golden	CO	1910 - 1939	Low	1
Crown Products Corp. Sani-Clor	Glass	San Francisco	CA	1925 - 1938	Low	3
Denhalter (Trade Mark Denhalter)	Glass	Salt Lake City	UT	1910 - 1947	Low	12
Empire China Co.	Ceramic	Burbank	CA	1910 - *	Low	1
Gladding, McBean & Co.	Ceramic	Los Angeles	CA	1934 - 1962	Low	1
Glass Containers Corp.	Glass	Fullerton	CA	1935 - 1940	Low	6
Glass Containers Corp.	Glass	Fullerton	CA	1945 - *	Low	52
Illnois Pacific Glass Co.	Glass	San Francisco	CA	1902 - 1930	Low	12
Latchford-Marble Glass Co.	Glass	Los Angeles	CA	1939 - 1957	Low	15
Long Beach Glass Co.	Glass	Long Beach	CA	1920 - 1933	Low	12
Maywood Glass Co.	Glass	Compton	CA	1940 - *	Low	1
Nehi Bottling Co.	Glass	Unknown	AZ	1929 - 1946	Low	1
Northwestern Glass Co.	Glass	Seattle	WA	1932 - *	Low	2
Owens-Illinois PacificCoast Co.	Glass	San Francisco	CA	1932 - 1943	Low	116
Pacific Coast Glass Works	Glass	San Francisco	CA	1902 - 1924	Low	2
Pacific Coast Glass Works	Glass	San Francisco	CA	1925 - 1930	Low	16
Purex LM (Latchford Marble Glass Co.)	Glass	Los Angeles	CA	1939 - 1957	Low	49
The Salt Lake City Soda Water Co.: Red Seal Brand	Glass	Salt Lake City	UT	1904 - *	Low	2
Southern Glass Co.	Glass	Vernon	CA	1917 - 1931	Low	4
Utah Bottling Works	Glass	Salt Lake City	UT	* - *	Low	1
Subtotals Low Access Area						**320**

Table 4. Salt Lake County Assemblages.

	Artifact Freq.		Artifact Freq.		Company Freq.		Company Freq.	
	42SL327		42SL309		42SL327		42SL309	
Access Area	N	%	N	%	N	%	N	%
Low	92	14.2	320	9.2	18	18.6	22	19.3
Intermediate	32	4.9	55	1.6	12	12.4	11	9.6
High	526	80.9	3106	89.2	67	69.0	81	71.1
Total	650	100	3481	100	97	100	114	100

a date range between 1931 and 1943. The deposit is composed mainly of domestic debris, although there is evidence of a commercial component (hotel ware, etc.) (Seddon 2001:152-154).

Both deposits appear to be a sampling of Salt Lake County households (Seddon 2001:154) in terms of socioeconomic status and ethnicity. Neither deposit seems to represent a single ethnic group and the faunal analysis indicates a variety of socioeconomic classes are represented in both deposits, although middle to lower status groups form the majority.

RESULTS

A comparison of artifact frequency by access area for site 42SL327 shows that 80.9 percent of the total number of recovered artifacts originated within the High Access Area, 14.2 percent of the goods came from the Low Access Area, while the least number of goods (4.9 percent) were from the Intermediate Access Area (Table 4). Site 42SL309 revealed a similar pattern (Table 4). Here, 89.2 percent of the goods were from the High Access Area, 9.2 percent were from the Low Access Area, while only 1.6 percent of household consumer goods originated within the Intermediate Access Area.

The company frequency by access area for site 42SL327 shows that 69 percent of the companies manufacturing consumer goods imported into Salt Lake County were located within the High Access Area, 18.6 percent were located within the Low Access Area, while 12.4 percent were in the Intermediate Access (Table 4). Site 42SL309 revealed a similar pattern (Table 4). Here, 71.1 percent were in the High Access Area, 19.3 percent were from the Low Access Area, and only 9.6 percent were from the Intermediate Access Area.

DISCUSSION

The Commodity Flow Model

If the Commodity Flow Model is a valid way of determining the degree in which the geographic location of a site within the national market influences the composition of late nineteenth and early twentieth century household assemblages, then there should be a close fit between the model's predicted pattern of artifact distribution and the observed archaeological pattern. In addition, the Salt Lake County assemblages should reveal a pattern similar to those of other Low Access Area sites. Specifically, when artifact frequency is compared by access area, the highest frequency of artifacts will originate within the High Access Area. The next most frequent manufacturing location will be the Low Access Area, with the least frequent production location of household consumer goods coming into the region from the Intermediate Access Area.

The Salt Lake County assemblages clearly fit the pattern predicted by the Commodity Flow Model for the spatial distribution of household consumer goods within the national market and compare well with Silcott, Washington, Fairbanks, Alaska, and with two of the three Oregon sites. At these Low Access Area sites, the artifact frequencies of High Access Area manufacturers ranged from 56.5 to 71.3 percent, the Intermediate Access Area ranged from 2.2 to 20.5 percent, and the Low Access Area producers had a range of 15 to 28.3 percent.

One of the Oregon homestead sites and the railroad construction site investigated by Speulda and Bowyer (1996), however, fit neither the model's prediction nor the archaeological patterns exhibited by other Low Access Area sites. I agree with their suggestion that these differences may be the result of variables not accounted for in the Commodity Flow Model, such as site function. Additionally, I suggest the possibility that the folks living in the railroad camp were receiving company goods, bought directly from Intermediate Access Area manufacturers shipped along a transportation network owned by the company itself. The railroad camp therefore is not an open market, which the Commodity Flow Model assumes.

Using the approach of Adams et al. (2001) comparing company frequency by access area, the spatial distribution of manufacturers should be comparable to the spatial distribution of artifacts. The highest percentage of manufacturers should be found within the High Access Area, followed by Low Access Area producers and, lastly, Intermediate Access Area manufacturers accounting for the smallest percentage of represented companies. The Salt Lake County assemblages, once again, clearly fit the expected pattern, further supporting the accuracy of both versions of the model.

The National Market

The importance of the Salt Lake County data becomes apparent when the two assemblages are compared to assess the changes over time in both the *number* of commodity flows between various manufacturing locations and Salt Lake County and the *volume* of goods from these manufacturing locations flowing into the region. These data also give insights into national economic and market changes occurring during the early twentieth century. Using data from Peoria, Illinois in the Intermediate Access Area, Cabak and Groover (1993) suggest that different areas developed at different rates and that over time manufacturers in Low and Intermediate Access Areas will increase their commodity flows at the expense of manufacturers in High Access Areas, since these more regional manufacturers will have had longer to develop.

When the Salt Lake County data are added to the Peoria data, however, a new pattern emerges. Looking at changes in artifact frequency over time, the High Access Area increased its volume of goods flowing into the area by just over eight percent, while the volume of goods from both the Low and Intermediate Access Areas decreased. This suggests that either regional manufacturers could not compete with the established manufacturers in the High Access Area, or there was a shift in the consumer preference for goods manufactured in the East. But when Owens-Illinois is taken out of the 42SL309 assemblage, a different picture emerges. The large volume of goods flowing along this single commodity link from the High Access Area obscures what is happening nation wide. Owens-Illinois contributed 1,418 glass artifacts to the deposit. Removing these artifacts reveals that both the High and Low Access Areas increased their distribution of goods at the expense of the Intermediate Access Area. This pattern is even clearer when we look at changes in company frequency over time. The number of Low Access Area companies represented in the assemblages increased .7 percent (from 18 to 22). The number of companies located in the High Access Area increased by 2.1 percent (from 67 to 81). The frequency of

Table 5. Glass-Only Artifacts, Salt Lake County Assemblages.

	Artifact Freq.		Artifact Freq.		Company Freq.		Company Freq.	
	42SL327		42SL309		42SL327		42SL309	
Access Area	N	%	N	%	N	%	N	%
Low	51	10.0	317	16.7	17	22.4	21	23.3
Intermediate	32	6.3	55	2.9	12	15.8	11	12.2
High	426	83.7	1522	80.4	47	61.8	58	64.4
Total	509	100	1894	100	76	100	90	100

Intermediate Access Area companies decreased by 2.8 percent (from 12 to 11).

Based on the above results, combined with Cabak and Groover's Peoria data, I suggest that over time Intermediate Access Area manufacturers will increase their flows at the expense of the High Access Area, but an increase in flows in Low Access Areas will be at the expense of the Intermediate Access Area. This result will occur because neither Intermediate nor Low Access Area manufacturers are able to overcome the distribution networks already established by High Access Area manufacturers and because the transportation costs for Low and Intermediate Area manufacturers are competitive only within their own region.

Local Versus National Goods Preference

The Commodity Flow Model not only reveals the differential distribution of consumer household goods over time within the national economy, but is also a useful way of evaluating changes in consumer preference for locally manufactured goods. By applying the Commodity Flow Model to goods produced using materials and technologies independent of geographic location, changes in the preference for locally versus nationally marketed goods can be more easily studied. A good example of a manufacturing process equally available to all is the glass industry. Ceramics, on the other hand, are not good indicators of changing preference for locally produced goods because the location of these manufacturers is determined largely by raw resource availability. Consequently, comparable manufacturers are not able to develop in other access areas, necessitating the import of these goods from non-local manufacturers, such as those in East Liverpool, Ohio, where quality clay is abundant.

This method was applied to the Salt Lake County data (for consistency's sake, these glass-only assemblages are minus Owens-Illinois products). Changes in consumer preference for locally or regionally manufactured household goods using artifacts produced with techniques and materials common to all areas (glass in this case) were combined with the Commodity Flow Model. Table 5 lists the results of this analysis. When glass artifact frequency is compared by access area, the residents of Salt Lake City increased the number of regionally produced goods purchased from 10 to 16.7 percent, at the expense of both the High and Intermediate Access Areas. When companies producing glass goods are compared by access area, 22.4 percent of the companies are in the Low Access Area (Table 5). This increases to 23.3 percent in the later assemblage. But, when looking at all types of artifacts in assemblage, only 18.6 percent of the total number of companies in the earlier deposit were from the Low Access Area and only 19.3 percent in the later assemblage (Table 4). These results clearly only 19.3 percent in the later assemblage (Table 4). These results clearly demonstrate that the residents of Salt Lake County preferred to purchase household consumer goods from regional companies (when available) rather than distant companies producing goods for the national market.

CONCLUSION

The Commodity Flow Model, based on this new data from Salt Lake County, expands our ability to explain the archaeological record by relating observed archaeological patterns to the culturally derived variable of market access. The Commodity Flow Model reveals the relationships between access to material goods, a residents' acquisition of these goods, and the subsequent composition of archaeological assemblages in an open market system. By looking at patterns of household consumption from a supply-side economic perspective we can increase our understanding of the relationships between people and material culture.

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Photo Essay

THE BOTANICAL PARTS OF THE PATTERSON BUNDLE: AN HERBALIST'S DISCOVERY

Merry Lycett Harrison, Millcreek Herbs LLC, 2930 Millcreek Road, Salt Lake City, UT 84109
Photographs by **Jim Blazik**

DISCOVERY

In the early 1980s, Thompson's Springs residents Bryce and Margaret Patterson were hiking in a remote area of the Book Cliffs near Green River, Utah, when they noticed a thin strand of leather under a knee-high rock ledge. Margaret dug around it to see what it was and followed it through soil and layers of juniper bark to discover a large, leather wrapped bundle that she took home. The Pattersons kept it for several years and Margaret explained to me that she tried to keep all the contents intact.

After Bryce's passing, Margaret gave the bundle to U.S. Bureau of Land Management (BLM) Moab

The empty Patterson Bundle with some of its contents in the display case at the Moab office of the BLM. Initially, when the author noticed the root bundle she was unaware that it came from this large assortment of artifacts from the Patterson Bundle.

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The author with what remains of the contents of the Patterson Bundle.

Field Archaeologist, Bruce Louthan. Louthan accompanied Margaret to the place where she found the bundle, but he found no signs of a burial, habitation, or other cultural material. A display of the bundle's leather wrapping and many of the artifacts it contained was arranged in a glass case in the foyer of the BLM office in Moab. Sadly, a few very substantial pieces of the Patterson bundle were stolen from the display case, among them a stone blade and an extensive length of delicate "quill wrapped trim" (Louthan 1990).

Louthan (1990) describes the contents of the bundle that include a wide assortment of items, such as a spoon shaped implement made of horn, decorative trim of leather and seeds, a necklace of bone and juniper seed, a stone blade, and an arrowhead. Louthan wrote, "The arrowhead resembles a Desert Side-notched type whose sides appear to have been reworked." There are two deer antler tip flakers, a ball of pine pitch, a pair of moccasins, a strand of deer dewclaws, four whorls of uniformly stripped bark, pouches of stones, red ochre, and much more. Louthan reports one category as "Miscellaneous Pouches" which were small bundles that held a variety of botanical and faunal material. These individual leather wrappings in themselves are interesting and deserve further study. Some appear to be fragments of leather clothing because they have finely stitched seams and delicate fringe, seemingly of indigenous materials.

A bit of the outside leather wrapping of the bundle was radiocarbon dated and returned a conventional radiocarbon age of 400 ± 70 B.P. (Louthan, 1990). The calibrated age range for this date is cal A.D. 1408 – 1649 (Calibrated at 2 sigma with the program CALIB 4.3 [Stuiver and Reimer 2000]).

My interest in the Patterson Bundle was sparked when I noticed one of these smaller bundles in the display case. It appeared to contain roots. As a trained clinical herbalist who harvests roots of wild plants to use in my pharmacy, my curiosity was piqued. I obtained permission from Louthan to more closely examine this grouping and knew at first glance that one of the roots was from osha, *Ligusticum porteri,* that grows in the mountains near Moab. It is a very potent medicinal herb that I use to help relieve respiratory symptoms. I wondered if the other roots could be from such useful medicinal plants. Permission to study the contents of the Patterson Bundle came with the stipulation that I report my findings to the BLM. My primary focus would be to try to identify the botanical parts. The results of my research were first published in Harrison (2002).

A MEDICINAL PERSPECTIVE

In all, there are four separate bundles that contain mostly roots that are exquisitely preserved. It is obvious that they had been extracted from the ground and wrapped with extreme care because even the tiniest rootlets were still attached. They were thoroughly cleaned, with hardly a grain of dirt or sand left on them. The fact that there was nothing exotic to Utah in the bundle suggests that the plants would likely have been gathered locally. That is, the distance people could travel on foot before the introduction of the horse.

Louthan wrote that one of the roots was dock *(Rumex hymenosepalus).* This plant is used to tan hides, but the thumb-sized piece of root thought to be dock was insufficient to tan much leather. He reported that another root was rabbitbrush, *(Chrysothamnus sp.),* a common plant in the region with a root used as chewing gum, among other things. These suggestions were interesting, but as an herbalist, I considered the plants for their availability, medicinal value, and possible use. I wondered why would anyone go to the trouble to dig up, clean, dry, wrap, bury, and store a root like rabbitbrush that was in great abundance around them.

I did not think the roots were used as food because the amount stored was varied and small. The quantities are, on the other hand, reasonable for treating an ailment. The variety intrigued me as I could tell the roots were not all from the same plants. The way they were wrapped was also of interest. One small bundle had several different types of roots in it. This might suggest that the plants in it were used together. Another bundle had a compacted mass of roots that were all the same kind. Understanding that medicinal plants generally grow in a variety of bioregions (e.g., wetlands, pinyon/juniper woodland, mountains), they cannot all be harvested at the same time because their availability and potency vary with season, temperature, habitat, and elevation. Having separate bundles for some of the herbs, therefore, makes sense because they had to be harvested, cleaned, dried, and stored in a timely way. This line of thinking kept my focus on looking for plants I know to have therapeutic value.

METHODS AND INVENTORY OF THE BOTANICAL PARTS OF THE PATTERSON BUNDLE

The botanical material was identified primarily using morphological comparison. Because most herbarium specimens do not have roots attached, I had to go to the field over several years to collect plants when they were recognizable with roots intact to create my own herbarium. After digging these up, I cleaned and dried them and took them into the BLM for close examination under a 10x to 25x dissecting microscope.

The Patterson Bundle with its leather exterior wrapping and the small herb bundles and basketry materials that were inside. The small leather strand in the foreground is attached to the wrapping and is what Margaret Patterson noticed under the rock ledge.

This is Pouch 8, the largest herb bundle from the Patterson Bundle. It contains three different kinds of roots and a yucca leaf. The stone blade might have been used to scrape or cut the roots into smaller pieces to create a dose or preparation.

Because the old roots are so well preserved, distinguishing features such as size, color, form, texture, and root type could all be scrutinized. Characteristics of the roots like the crown, root hairs, rootlets, bark or epidermis, and structure were closely examined. I began with the plants I knew, but over my three years of research, I also investigated plants at random out of necessity when a match seemed impossible to find. Below is the inventory of my findings based on this method. The findings are organized by category, and according to which component of the bundle they are from. The inventory numbers (e.g., "Pouch 8") are those assigned by the BLM.

Herbs

Pouch 8. This is the leather-wrapped herb bundle that caught my eye in the display case. At first glance it appeared to have at least a dozen or more finger-sized pieces and a few smaller fragments of roots, sticks, and a large piece of what looked like bark. Upon closer examination, I discovered that these many pieces could be laid end to end to recreate three, whole, exquisitely preserved roots that were obviously from three different plants. There is a small stone blade included with this combination, which suggests that the roots were scraped or cut into smaller pieces to make an infusion or other preparation. The amount of herb in this bundle would be sufficient to treat one or perhaps a few people, depending on how sick they were and how long the illness lasted.

Osha *(Ligusticum porteri)* is from the Apiaceae family and is also known as bear root. I recognized it at once (perhaps the way an archaeologist recognizes the cultural origin of an arrowhead or pottery sherd). My first inclination was to smell it to see if there was any trace of the distinctive, spicy odor that is a helpful identifying characteristic. After so many centuries it had dissipated. The root's appearance, however, had many distinguishing features such as root hairs at the crown, very dark brown color, wrinkled texture and the usual tough, smooth, cord-like center of the root. This plant grows at higher elevations, usually between 7,000 and 10,000 feet. It grows in the La Sal Mountains near Moab, Utah, so it is available in the region where the bundle was found.

Osha is "one of the best treatments for viral infection" and is particularly effective against respiratory conditions brought on by a cold or the flu (Moore 1979:121). Like many herbs, osha has other applications and is considered sacred by some indigenous cultures. My ethnobotany teacher, Enrique Salmon, told me that the Tarahumara Indians chew it for endurance on their long runs through the mountains, and I have seen it used in sweat lodges. It is sprinkled on the hot rocks in the center of the lodge and the pungent smell permeates the dark, steamy space.

Pleurisy root *(Asclepias tuberosa)* is from the Asclepiadaceae or milkweed family and is also known as butterflyweed. It is a powerful medicinal herb that is used as a cough remedy as an expectorant (Moore 1979:130). It is also muscarinic, meaning that it can increase secretions and cause vasodilation, gastrointestinal stimulation and other parasympathetic effects (classroom lecture by Michael Moore, Southwest School of Botanical Medicine, 1998). According to *A Utah Flora*, it grows in mountain brush and pinyon-juniper communities between 4,000 to 6,500 feet in elevation in Grand and San Juan counties (Welsh 1993:60). It blooms with beautiful orange flowers in late May or June and attracts butterflies. Only the root is useful. Daniel Moerman in his authoritative book, *Native American Ethnobotany*, documented that the Navajos used it ceremonially as a "chant lotion", and that an infusion was used for dog or coyote bites (Moerman 1998:109). Unfortunately I was unable to find a specimen in the wild and had to resort to ordering roots from an organic grower that I dried and used for comparison under the microscope.

A remarkable feature of this root is that it is very long and slender so it penetrates deep into the ground. It would have been difficult to dig up without the root breaking off. A complete taproot was found in the bundle and it had been severed to create equal lengths in storage. Furthermore, the tiniest fragile rootlets, which are the thickness of coarse linen thread, are still attached, and some are several inches long. This clearly reveals that this root, as well as the others, was dug with extraordinary care and skill so it could be lifted from the earth in its entirety.

Balsam root *(Balsamorhiza sagittata)* is from the Asteraceae family. It is a sturdy, thumbsized piece of the top of the taproot and includes the crown, which contributed to its identification. Stanley L. Welsh, curator of the Brigham Young University herbarium, confirmed my identification. Balsam root grows in abundance between 4,000 and 6,000 feet and it too, is available in the La Sal Mountains. Michael Moore compares its usefulness to that of the *Echinacea* plant common to the plains. It is an immunostimulant and can inhibit respiratory viruses. The best seasons to gather the root are spring and fall as it becomes very

Botanical parts that at first looked like a collection of sticks and twigs turned out to be just a few roots that could be laid end to end to recreate the whole ones. The fact that tiny rootlets are still attached attests to the extreme care with which the roots were dug and stored.

This close-up shows the mass of roots the author believes is from the Stream Orchid, *Epipactis gigantea*. The details of the leather wrapping show stitch holes and worn places. The shape suggests it is from a worn out moccasin.

tough during the summer when the energy of the root goes into developing the aerial part of the plant (Moore 1998).

Yucca leaf *(Yucca sp.)* is from the Agavaceae family. Welsh identified it as the base of a yucca leaf. Various species of yucca grow in the hot, dry, lower elevations of the area where the bundle was found. This finger-sized section looks like a curved piece of smooth, stiff bark. Because it appears to have scrape or wear marks on one edge, it may have been used as an implement, or perhaps particles were scraped off for ingestion. I knew of the use of yucca root for arthritis inflammation, but I came across a study that showed yucca leaf protein exhibits antiviral activity (Hayashi et al. 1992:323-333). Daniel Moerman claims the Navajos used the leaves in a tea to help reduce vomiting (Moerman 1998:604).

Pouch 3. The leather wrapping on this bundle is thicker than most of the other wrappings. It is soft, pliable, and appears to be colored or dyed red. This wrapping is remarkable because it is so different from the others. It contains the top several inches of two roots that have the same texture, color, and form as the large example of pleurisy root in Pouch 8.

Pouch 9. This small leather pouch has fine fringe attached to the wrapping. Inside are small chips of bark or wood. These are in fact from the broken base of the large balsam root in Pouch 8. They fit like puzzle pieces onto it. Why these chips were preserved in a separate pouch is unknown. Perhaps they comprise an individual dose. Whatever the purpose, the root seems to have been valued greatly to store the bits so carefully.

Pouch 2. The leather wrapping of this pouch looks like the heel of a worn out moccasin. Of particular interest is the way the shape of the leather conforms to the shape of the cluster of roots within. The roots are from the Stream Orchid, Helleborine *(Epipactis gigantea)*, of the Orchidaceae family. It grows in moist, shady places and I have seen it along Mill Creek near Moab at an elevation of 4,500 feet. It is a powerful herb that has many applications including tachycardia, migraines, and poison ivy, to name a few. It can ease tension and is helpful as a buffer to pain (Moore 1997). Michael Moore recommends using it in the place of the rare lady slipper *(Cypripedium sp.)* that is good for nervous tension and related ailments (Moore 1998). Daniel Moerman claims that the Navajo used the plant in a girl's puberty rite and that it was used to purify a newborn infant (Moerman 1998:213).

Other Materials

There are four whorls of uniformly stripped bark that appear to be suitable for making baskets. Item 53 is Sumac *(Rhus trilobata)*. Items 52, 54, and 55 are willow *(*possibilities are *Salix amygdaloides, S. eriocephala, S. interior,* and *S. lucid).*

Seeds of the juniper berry *(Juniperus sp.)* were found and were used with bone, leather, and other materials.

Juniper bark served to protect and preserve the bundle wrapping and contents. Margaret Patterson reported that she dug through substantial layers of it to get to the bundle. Judging from the high level of preservation, it was very effective at repelling insects.

There are also 16 small plastic bags that contain very small fragments of dirt and plant parts that perhaps collected in the bottom of the bundle. A spoon handle of wood is also present.

SEEKING CONTEXT

I cannot say how or for what purpose the plants were used, but they do represent some of the most potent and effective botanical medicine the area has to offer. All of the plants are available within the region where the bundle was found. To further ascertain the context of the bundle, Jack Broughton at the University of Utah identified the faunal material. Five small bundles contained cottontail rabbit foot bones, a tail of a short-eared owl, the skin of a small mammal, the headless body of a native trout, a rabbit arm bone, and an unidentifiable body part. This left me questioning if these are the kinds of items usually found in a "subsistence kit." What use could they possibly have had? Instead, is this someone's medicine bag whose materials were used together in healing efforts or ceremonies?

RECOMMENDATIONS FOR FURTHER STUDY

The Patterson Bundle presents an extensive and rare assemblage of well-preserved cultural elements that may lead to greater understanding and knowledge beyond just what the contents *are*. I will use the plant osha to illustrate this potential. Because osha grows so high in the mountains, we know its availability was limited to certain seasons. The plant dies back in the winter so it cannot be identified until late June or July. Furthermore, the root's potency is strongest after it has gone to seed in the late summer. Knowing this helps us to determine how people traveled the land in order to be in the right place at the right time to harvest specific, valuable plants.

Study of the "spoon" could reveal it was a multipurpose instrument. Some curious aspects about it include a small, irregularly shaped hole in the bottom of the bowl that is approximately 1.5 – 3 mm wide. Perhaps it was a strainer to separate tough, woody plant material from a tea or infusion. Then there are two similar niches opposite each other on the rim. At first I imagined they looked like the type of wear that a small child could have caused by frequently biting down on it. Then, under the microscope I could see what looked like signs of wear on the backside of the spoon at the niches as if something had been firmly drawn through them. Perhaps a pollen wash of the spoon would reveal its primary use.

It may also be worthwhile to use carbon dating on some of the wrappings and contents of the smaller bundles. With so little known about the use and purpose of these artifacts, it cannot be assumed that everything is the same age.

The faunal elements are unusual and quite remarkable, particularly the headless trout and owl tail. What use or significance could they have had? Interestingly, there are several well-known owl images in rock art in the region where the Patterson bundle was found, and they have substantial tails.

When I completed my analysis, I shared my findings with my herb teacher, Michael Moore. "This is winter medicine," he commented. He called the herb collection "elegant" in its simplicity and usefulness. I believe what he meant is that these are the herbs that would be most useful to treat a range of health problems, but especially the bronchial conditions that are so common to the people during the cold winter months in a high, dry, desert climate.

Throughout my solitary study, one question stayed with me. Where are the other herb bundles? When I began, I called museums, curators, and scholars in surrounding states to see if they had anything similar. I even interviewed a law enforcement authority whose job it was to retrieve illegally collected artifacts. The answer was always no. I searched the storage bags and boxes at the Edge of the Cedars Museum in Blanding, Utah, but found only the pinyon pine nuts and yucca fiber one would expect. I even contacted the Smithsonian's new National Museum of the American Indian in Washington, D.C. I spoke with Patricia Nietfeld, the supervisory museum specialist in charge of collections management. She did not know of any similar bundles or collections of botanical material in their collections. It is a curious thing to me that plants were such an important part of indigenous people's lives, yet there are not more herb bundles or collections to study. Are there some in boxes labeled "unknown plant material" or as is the case of the Patterson Bundle, were they presumed to be for subsistence when they may have been medicinal?

I believe that there is much to be learned by knowing what plants the people used and I hope that more herb bundles can be recognized and studied in the future. Measures should be taken to provide extraordinary care to preserve and keep safe this remarkable assemblage in its *entirety*. It is a collection rich in materials that through further study may help to better define the culture from which it came.

As of January 2004, the Patterson Bundle is curated at the Utah Museum of Natural History, Salt Lake City. The final disposition of the bundle will be determined through consultation between the U. S. Bureau of Land Management and Native American tribes.

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PUMP ORGAN REEDS: ARCHAEOLOGY, HISTORY, AND MUSIC COME TOGETHER AT THE FRARY SITE

Ronald J. Rood, Utah Assistant State Archaeologist, Division of State History, Antiquities Section, 300 Rio Grande, Salt Lake City, UT 84101
rrood@utah.gov

Archaeological testing on Antelope Island State Park at a small homestead known as the Frary Site produced several metal artifacts linking one small but significant aspect of homestead life to the archaeological and historical record. In the case of the Frary Site and these particular small metal artifacts, archaeology and history come together under a tangible and familiar aspect of many people's lives: music. Whether performed by professionals, garage bands, a church choir, or played and sung around the house or campfire with family and friends, music is something most of us can appreciate.

Although a review of the archaeological evidence for musical instruments is beyond the topic at hand, the first musical instrument used by the earliest humans may have been one rock bashed against another in a repeated rhythm. The oldest dated musical instruments in the world were found at the early Neolithic site of Jiahu in China, where six nearly complete flutes and fragments of 30 more were dated to almost 9,000 years ago (Zhang et al. 1999). Since the dawn of humanity, music has likely been an important aspect of human life.

THE FRARY SITE, 42DV56

Alice Frary and her husband George established a homestead on Antelope Island in 1891. Antelope Island, now a Utah State Park, is located roughly five miles northwest of downtown Salt Lake City (Figure 1). According to Roberts (1981) the Frary Homestead consisted of a small, three-room cabin along the eastern shore of the island, roughly four miles from the larger Fielding Garr Ranch (Figure 2). The Frary Site now consists of several features evident on the surface, including the foundation of the house, evidence of several additional structures, a surface scatter of artifacts indicative of residential, farming, and ranching activities, and the alleged grave of Alice Frary.

George Frary made his living by prospecting, farming, and ranching, and by transporting people and livestock to the island in his boat. Alice looked after their six children, several of whom were born on the island, and she maintained the household. Holt (1996:10) writes:

> George was gone a lot with his sloop, doing more sailing than farming. The children were happy with lots of room to play, and flowers to pick in the spring and summer. The mother, being a school teacher, taught them well. She played a small organ while George and the children sang favorite songs.

In September 1897 Alice Frary became ill from what may have been a burst appendix (Roberts 1981). George, desperate to help, sailed his boat across Farmington Bay to Syracuse to get needed medicine from Ogden. On his way home, a storm capsized his boat. George, thrown into the lake, lost the medicine. He spent the night clinging to the capsized boat, and in the morning he found his way to shore (Strum

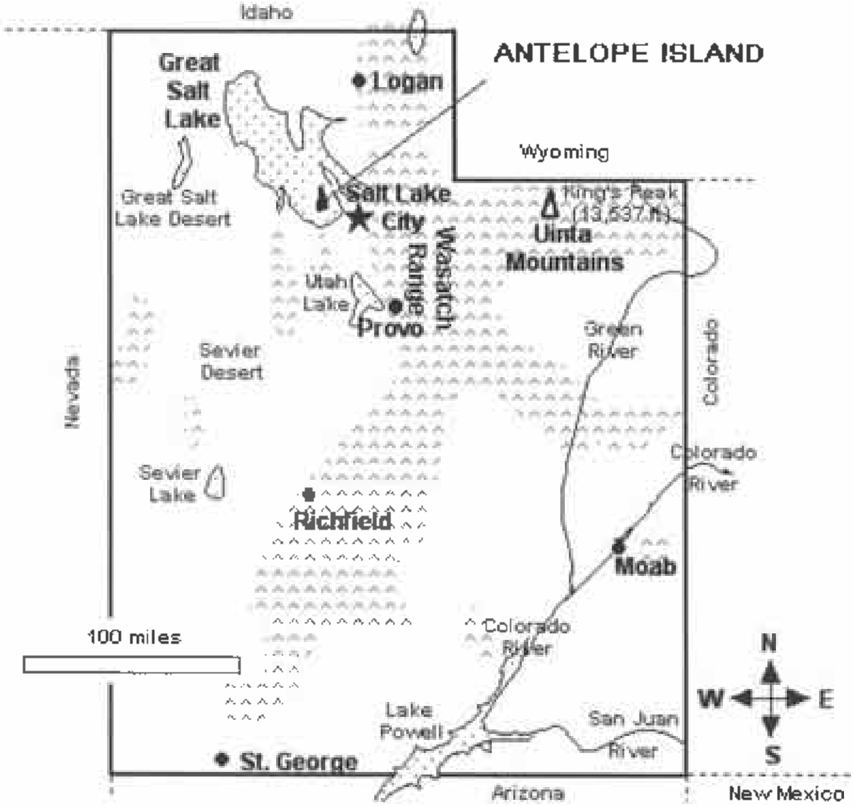

Figure 1. Location of Antelope Island in relation to Salt Lake City.

Figure 2. Map of Antelope Island showing the location of the Frary Site.

2002:138). Some accounts suggest that as George reached Antelope Island his wife had already died (Roberts 1981). Others suggest he found his wife fading and nearly dead (Holt 1996). In either case, Alice died on September 3, 1897, at the age of 38 (Adamson 1941). Alice Frary was buried "a few rods from the house" on the island she loved (Holt 1996). A monument marking her alleged burial spot remains at the site (Figures 3 and 4).

After the death of Alice, the family stayed on the island for some years (Roberts 1981). George continued to build boats and explore the Great Salt Lake. At some point after his wife's death, the older children asked if the family could leave the island so that the younger children could receive a better education (Holt 1996:12). George Frary agreed, and:

> It was a sad day, indeed, when they left their dear island home. A cow and her calf, a mule and two horses were left behind. A few pieces of furniture and the *precious organ* sat alone in the house. It took them a while to realize they would never be back to live in this humble cottage again (Holt 1996:12, emphasis added).

ARCHAEOLOGY AND THE FRARY SITE

During the summer of 1995, archaeologists from the Utah Division of State History, Antiquities Section conducted some limited test excavations at the Frary Site, assisted by members of the Utah Statewide Archaeological Society, and under a cooperative agreement with Utah State Parks. The goal of the excavation was to gain archaeological information that would aid State Parks in future development and interpretation of the Frary Site for the public. At the same time, test excavations were completed at the Fielding Garr Ranch located several miles south of the Frary Site. Antiquities Section archaeologists Kevin Jones, Dave Schmitt, and Jim Dykman directed the excavations. A preliminary report on some of the materials recovered during the excavations at both sites is presented in Heap (2000).

Five one-meter square test pits were excavated at the Frary Site. Three of these were placed within Feature 2, described as a roughly rectangular but incomplete rock alignment and thought to be part of the house. The three test pits (numbers 1 – 3) within Feature 2 produced numerous artifacts. Heap (2000) notes several varieties of window and bottle glass, china, several shell and glass buttons, and thousands of metal fragments. Although a detailed analysis of the artifacts has not been completed, the assemblage from Feature 2 is consistent with use as a household. Several of the metal artifacts from this collection became the subject of an independent study project conducted by students from Salt Lake Community College (Parrish and Overall 1998).

METAL ARTIFACTS FROM THE FRARY SITE

Heap (2000) reports that over 1100 metal artifacts were recovered from the Frary Site. Eight metal artifacts from test pit 3 in Feature 2 raised special interest because during the fieldwork and early phases of the analysis, nobody knew what they were. The excavators described these only as "brass items" or "brass clips." The eight items look very similar in shape and overall appearance, but they differ, in some cases ever so slightly in length. They can be described as thin pieces of metal, flat on one end and rounded on the other, with a rectangular-shaped indentation on the flat end. All have a slender opening along the center of the long axis, and all have a flexible strip of metal attached to the flat end and extending along the rectangular opening. A search through old Montgomery Ward and Sears catalogs and other historic retail catalogs provided no clues on the origin or function of these items.

Once in the laboratory the items were cleaned with water and vinegar. This removed additional residue, and we noted each of these artifacts had letters and symbols engraved into the ends. Individual

Figure 3. Photograph of the Alice Frary gravesite. The view is to the northeast toward the town of Clearfield, Utah.

Figure 4. Detail of the plaque placed at the Frary gravesite by the Syracuse Historical Commission.

Table 1. Measurements (in mm) of Eight Metal Artifacts from the Frary Site, 42DV56.

LENGTH	WIDTH	THICKNESS	NOTATION
61.4	10.6	2.2	F
45.7	10.6	2.2	B-
38.9	10.6	2.2	A#
38.4	10.6	2.2	B
38.0	10.6	2.2	C
37.2	10.6	2.2	D#
36.6	10.6	2.2	D
35.8	10.6	2.2	E

measurements and the letters or notations are presented in Table 1.

The letter notations on the items provided our first real clue about the function of these artifacts because the letters and associated symbols indicated musical notations. A trip to a piano store in Salt Lake City confirmed that these were reeds used to produce sounds in a pump or wind reed organ (Parrish and Overall 1998).

Organ reeds may be a rare component of historic archaeological assemblages. However, one other site in the Salt Lake City area has produced a similar artifact. Abram Sorensen, age 11, found numerous metal and ceramic artifacts, including at least one organ reed while digging in his backyard (personal communication 2003). This site is designated as 42SL357, is currently being documented, and appears to be a residential trash dump dating to the early 1900s.

THE PUMP ORGAN

Pump organs were invented around 1835, but the principle had existed for hundreds of years. The ancient Chinese used a reed organ in the form of a mouth instrument. In the 1800s, technological advancements included using the vacuum principle to push air over the reeds to make sounds (Knupp 1999). Reeds are typically made of brass and are divided into several sections (Figure 5). The rounded portion is the front of the reed and is termed the "toe." The flattened end, which is attached to the frame, is termed the heel, and the vibrating part is the tongue. The depressed area at the heel is part of the attachment and is termed the "reed pan" (Knupp 1999). A bellows or foot pump pushes a stream of air over the reed, causing the tongue to vibrate and produce the sound. Figure 6 shows the eight reeds recovered from the Frary Site.

During the latter part of the nineteenth century, several companies made pump organs for the consumer market. Popular brands included Estey, Kimball, and Farrand and Windsor (Figure 7). In 1895, the Mongomery Ward catalog sold several models of Windsor organs for between $37.00 and $63.00, including shipping (Montgomery Ward and Company, Catalog and Buyers Guide 1895:238). Unfortunately, the reeds from the Frary Site give no indication of the type or brand of organ represented.

THE HISTORIC RECORD AND ARCHAEOLOGY

Sometimes historical accounts and the archaeological evidence don't match up (e.g., Hardesty 1997:61-62). However, in the case of the Frary Site, historic accounts about the Frary family abandoning their homestead and leaving behind their organ are

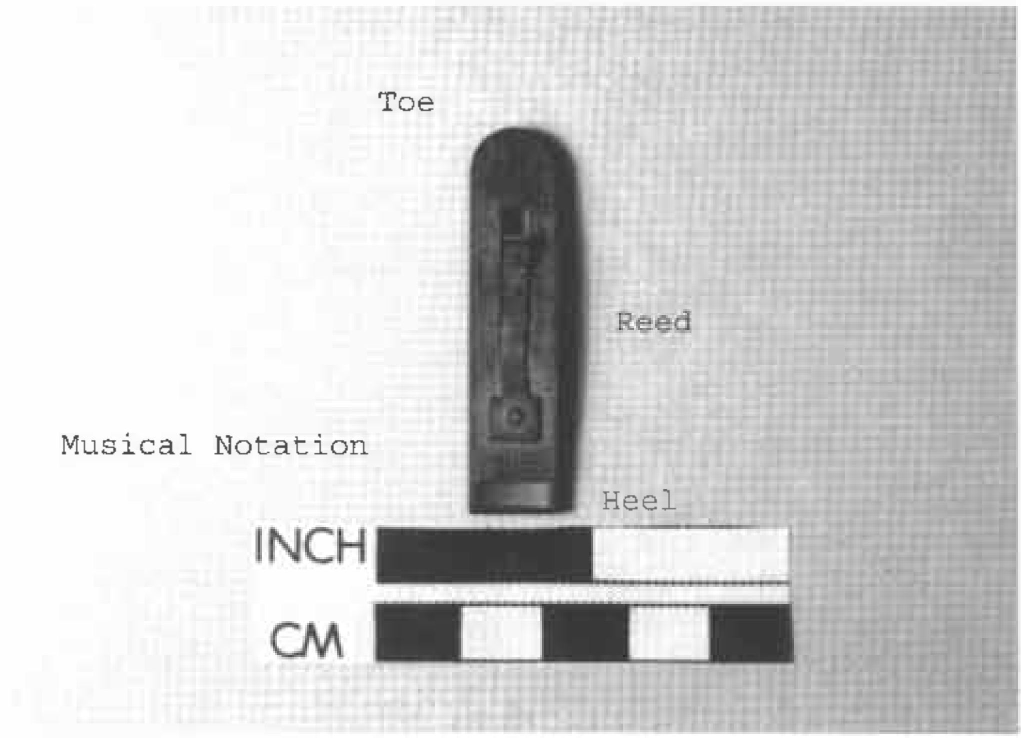

Figure 5. Example of an organ reed showing reed nomenclature.

Figure 6. Assemblage of organ reeds from the Frary Site.

Figure 7. Example of a pump organ from an 1895 Montgomery Ward catalog.

borne out by archaeological research. A single test unit within the Frary house produced eight organ reeds representing eight keys on the organ that Alice Frary played while her children and husband sang along. These artifacts represent a tangible connection to one small, yet familiar aspect of homestead life at the Frary Site.

A main goal of archaeologists should be to educate the public about our field and to provide insight and topics that link the archaeological assemblage to aspects of modern life.

> George Frary doesn't live on the island now. His old house is falling down and rain leaks through the rotten roof onto the furniture that he never moved. The window glass is all gone and on windy nights when landlubbers put into his little cove with their motorboats they keep at a safe distance from the old cabin. Stray breezes blowing through the reeds of his old organ make sounds that unnerve even the bravest men (Kelly 1936).

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GREAT SALT LAKE V-EDGE COBBLES

Dann J. Russell, Promontory/Tübaduka Chapter, Utah Statewide Archaeological Society, 2581 W. 5000 S., Roy, UT 84067

Some ground stone pieces recovered from excavated sites on the northeastern shoreline of Great Salt Lake appear to exhibit a unique ground edge. Personal observations during the Great Salt Lake Wetlands Project and the Willard Burial Recovery revealed a large number of stones with this same edge. My aim here is to better document these artifacts by summarizing the existing information, provide photographs and illustrations, and discuss some possibilities for the use of these artifacts.

V-EDGE COBBLES FROM EXCAVATED SITES AND BURIAL RECOVERY SITES

A number of stones from the Levee and Knoll sites are described as having:

> beveled surfaces that are flat to slightly convex and quite smooth . . . . several may occur on a single stone. Characteristically, two surfaces from different planes converge at approximately the same angle to form a marked keel (Fry and Dalley 1979:59, 60).

Fry and Dalley classify the stones into two types. Class I stones are rounded or disk-shaped with the keel around most, if not all, of the circumference edge. Class II stones are elongate with the beveled keel on one or both ends (Fry and Dalley 1979:47, 59, 60, 78).

Documentation of the Bear River No. 1, 2, 3, and Injun Creek sites also reported the abraded surface on these types of cobbles. For instance, at Injun Creek there were cobbles with "battered and abraded surfaces on otherwise unworked, roughly fist-sized roundish river cobbles . . . . " (Aikens 1966:40).

At other sites during the Great Salt Lake Wetlands Project and Burial Recovery, Mark Stuart of Utah Statewide Archaeological Society referred to both types as "V-edge cobbles" because of their characteristic "V-edge" keel. I report these stones as V-edge cobbles and where possible classify them as Type I or Type II. The material of choice is quartzite, but a few were made of granite or sandstone.

Table 1 summarizes data from the area. The first seven sites were subject to large areas of excavation. The remaining sites were summarily recorded as part of an emergency recovery of human skeletons. V-edge cobbles are so common that more detailed surface counts and excavation would significantly increase the sample size.

PHOTOGRAPHIC EVIDENCE

Figure 1 shows various sizes of Type I V-edge cobbles, all made of common quartzite. These were located on site 42BO1071 during the October 2001 burial recovery project west of Willard Bay, Utah (Lambert and Simms 2003). The entire circumference of nearly all specimens indicates a distinct V-edge keel that is smooth and somewhat convex. Figure 2 shows the top left cobble in several views as it is rotated from its major plane, to just less than 30 degrees, and then to 90 degrees on edge. Next to each view is an illustration showing in gray shading the portion of the stone that is ground smooth. The convex keel is clearly visible in the last view. A cross-sectional illustration of the convex keel with ground edges is shown in Figure 3.

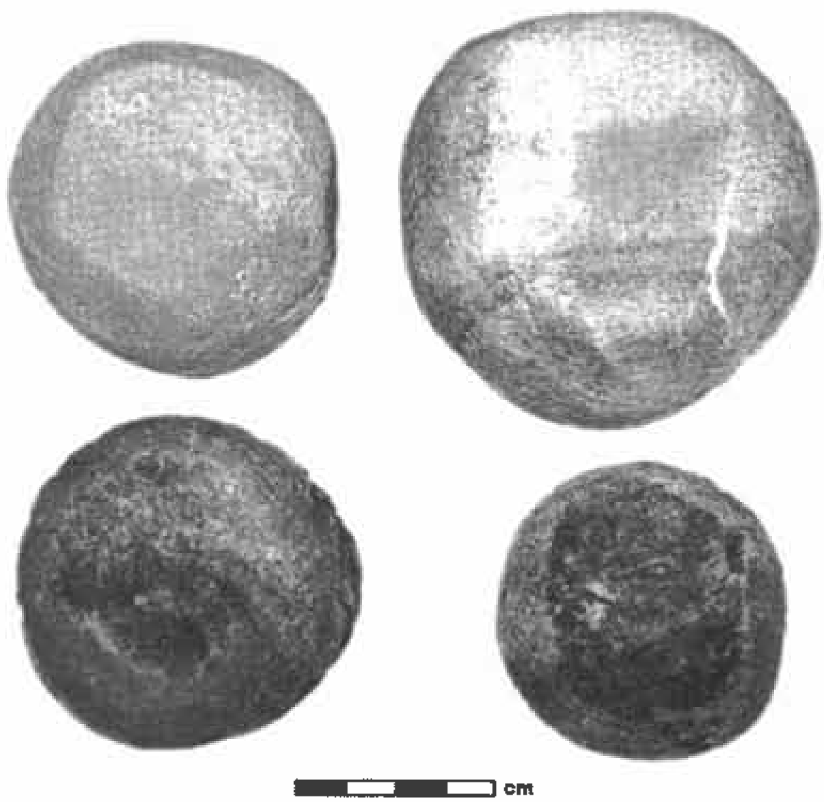

Figure 1. Examples of Type I V-edge cobbles, 42BO1071.

Table 1. V-edge Cobble Data from Great Salt Lake Sites.

Site	V-edge Cobble Type I	V-edge Cobble Type II	V-edge Cobble Totals	Slate Artifact Totals	Reference
Rear River No. 1	3	3	6	7	Aikens, 1966:68,70
Rear River No. 2	32	16	48	46	Aikens, 1967:51,52
Rear River No. 3	8	2	10	41	Shields and Dalley, 1978:83,91
Injun Creek	180	29	209	32	Aikens, 1966:40,45
Early Levee	—	—	6	12	Fry and Dalley, 1979:48
Late Levee	7	2	9	18	Fry and Dalley, 1979:58,59
Knoll	5	2	7	13	Fry and Dalley, 1979:78,79
42WB048	—	—	numerous	—	Simms et al. 1991:29
42WB185	—	—	10	a few	Simms et al. 1991:33 and IMACS site form
42WB317	—	—	8+	—	Simms et al. 1991:40 and IMACS site form
42WB324	—	—	2	not documented	Simms et al. 1991:50
42BO580	—	—	numerous	none	Simms et al. 1991:55 and IMACS site form
42WB144	—	—	2	none	Simms et al. 1991:57 and IMACS site form

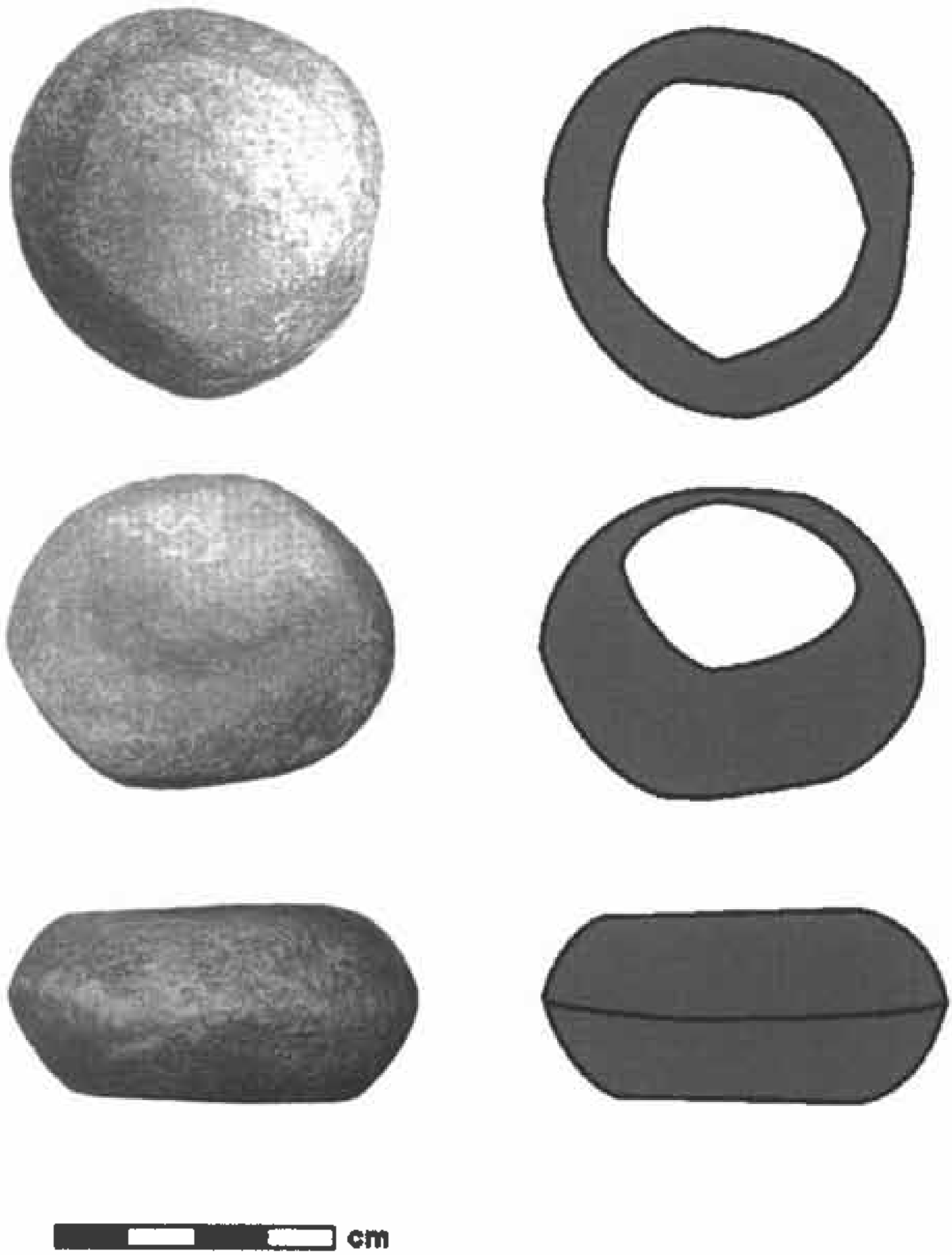

Figure 2. A Type I V-edge cobble in several views. Gray shading identifies the portion of the cobble that is ground smooth.

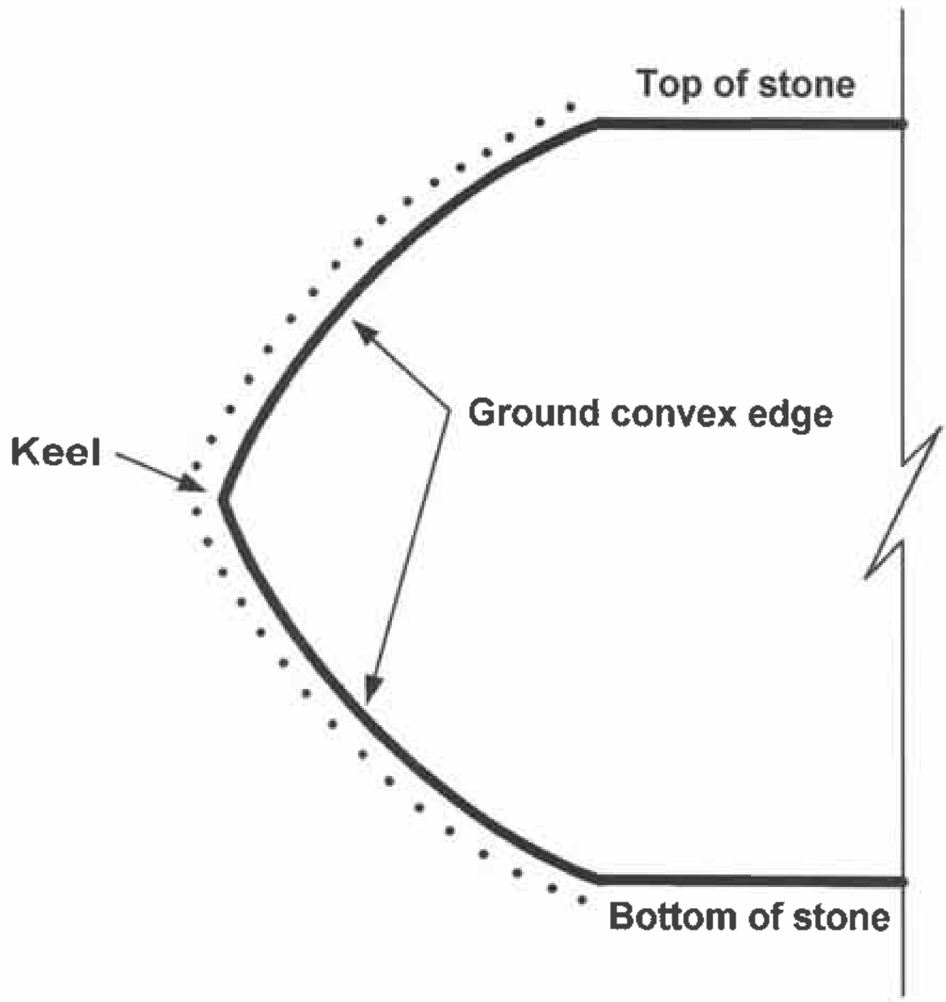

Figure 3. Illustration showing cross section of cobble pictured in Figure 2.

Figure 4 shows various sizes of Type II V-edge cobbles, also made of common quartzite. The specimen at the top left is from 42WB151, found during the Ogden/Weber River Marsh Survey in 1989 (Russell et al. 1989). The other three are from 42BO1071. Both ends of these examples exhibit the convex keel as shown in Figure 5 and illustrated in Figure 3.

The cobbles shown in Figure 6 are from 42BO1071 and indicate another characteristic not mentioned by Fry and Dalley. They appear to have "flakes" or chips of material removed from the edge prior to abrading. Aikens reports cobbles from the Injun Creek site with "battered and abraded surfaces on stones of discoidal shape, which may be either naturally of that form or *so fashioned by the removal of large flakes* from a cobble" (Aikens 1966:40, emphasis mine). Some evidence of flaking can be seen in the photographs of V-edge cobbles from the late component at the Levee site (Fry and Dalley 1979:59) and from the Bear River No. 3 site (Shields and Dalley 1978:84). The abrading appears to intrude into the chipping suggesting that it was done afterwards. Furthermore, the chipping and abrading patterns are different than the pecking pattern one finds on pecking and hammer stones. The Type II cobble shown in the middle of Figure 6 clearly shows a flake that terminated

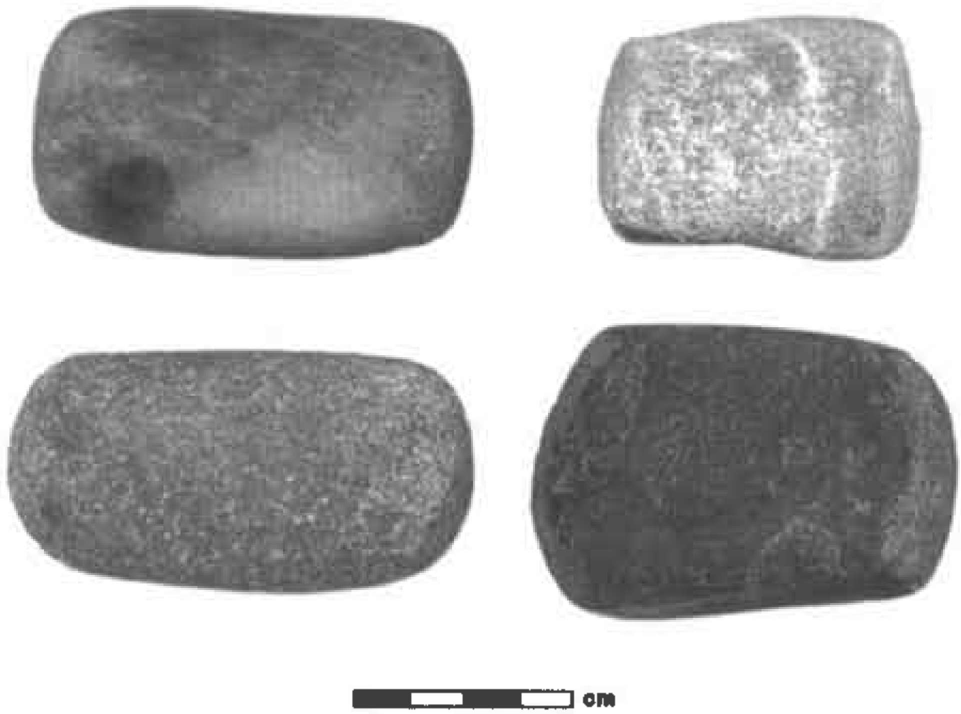

Figure 4. Examples of Type II V-edge cobbles. Specimen at top left is from 42WB151. Others are from 42BO1071.

Figure 5. V-edge cobble showing the convex keel, 42BO1071.

Figure 6. V-edge cobbles with flakes removed from the edge prior to abrading, 42BO1071.

in a hinge fracture. The flakes may be natural, but their location and association with the abrasions suggests human manufacture. Figure 7 highlights this cobble and illustrates the flake scar, the ground surface in light gray, and battered portions in black.

DISCUSSION

Numerous V-edge cobbles are found at prehistoric sites along the northeastern shore of Great Salt Lake. They appear to be unique to these wetlands since none are known from Utah Lake (Joel Janetski, personal communication). What were they used for?

Fry and Dalley suggest one possible use. They discovered through limited experimentation that the cobbles could be used for reducing and shaping ground slate artifacts, another kind of tool common to the wetlands. They speculate that the cobble is reduced at about the same rate as the slate to produce an abrasive powder that aids in the reduction of the slate. Slate artifacts from the Bear River area, particularly knives, showed crosscutting striations that were nearly identical to the surface characteristics produced through experimentation on scrap slate (Fry and Dalley 1979:60).

Another use for these cobbles was suggested by David Madsen and Lamar Lindsay (Mark Stuart, personal communication). They performed several experiments in the late 1980s on cattail roots and found that the cobbles were excellent for removing the spongy outer layer of the root to expose the inner, edible portion of the root. Stuart and one of his students at Roy High School further explored this hypothesis for a High School Science Fair project. Were these stones used to produce slate implements or process plant materials? It is possible they were used for both.

Since slate implements such as knives and etched tablets are diagnostic of Great Salt Lake Fremont and V-edge cobbles are unique to this area, they may be related as Fry and Dalley suggest (Marwitt, 1970:145). However, other comments by them concerning slate implements at these sites tend to be somewhat contradictory. They state for example:

> Of twelve specimens, seven thin pieces of slate have sharp edges that show some polish and blunting from use . . . . Five specimens have slightly sinuous edges and may have been retouched by flaking. However, none were *formed or modified* to any great degree by flaking or *grinding*, although one fragmentary example shows grinding on one surface (Fry and Dalley, 1979:48, emphasis mine).

They also state:

> The knife . . . . is heavy, crude, and made from poor quality slate. It has two *minimally ground cutting edges* along ca. half its length . . . . " (Fry and Dalley, 1979:58, emphasis mine).

My informal observations at sites during various projects indicate that there is a high ratio of V-edge cobbles to slate artifacts, and in some cases, no slate artifacts are found in association with V-edge cobbles. No attempt was made to quantify this ratio because these were only surface observations, but the relationship between V-edge cobbles and slate artifacts is not clear.

My observations also indicate that the number of whole and broken manos increases with the number of V-edge cobbles. I concur with Aikens and others such as Mark Stuart that some stones seem intentionally shaped into a "V-edge" keel. Perhaps these are just one variation of ground stone manufacture. Given that ground stone scatters are often associated with plant use, and V-edge cobbles are frequently part of these scatters, perhaps the cobbles were used in a way indicated by Madsen and Lindsay's experiments. Pollen washes on V-edge cobbles may help resolve this question. Table 1 suggests that more slate implements and V-edge cobbles will be found in buried contexts as wetland sites are excavated. More samples from subsurface contexts such as trash areas, house floors, living areas and such, and from different kinds of sites should improve our understanding. Certainly

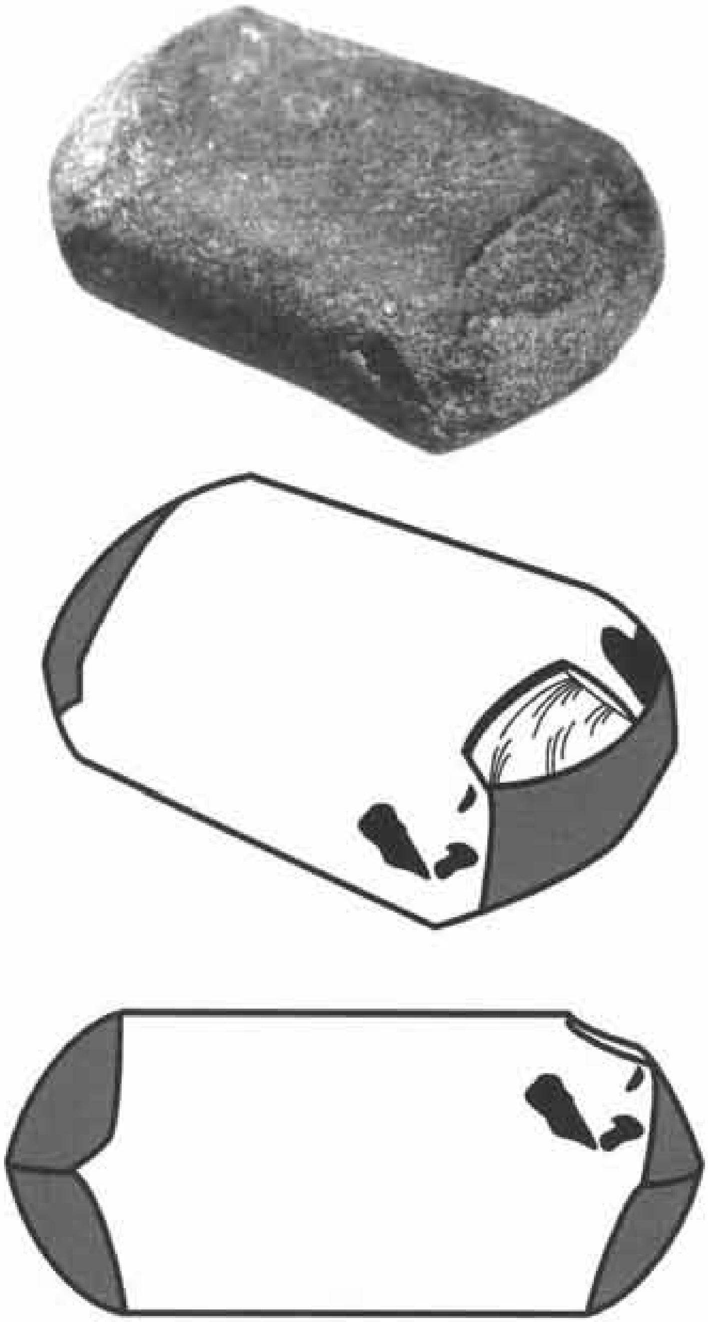

Figure 7. V-edge cobble in Figure 6 showing the flake scar, the ground surface (light gray), and the battered portions (black).

archaeologists should be more aware of the study of V-edge cobbles as the wetlands bordering the Great Salt Lake are developed and mitigation plans are formulated. This little-studied artifact may offer new insights into the lifestyles of the native peoples using the lake resources.

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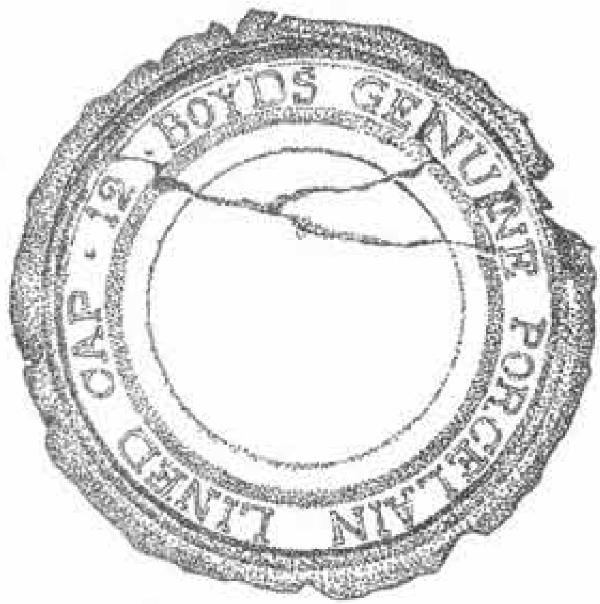
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Reports

THE DESHA CAVES: RADIOCARBON DATING AND COPROLITE ANALYSIS

Phil R. Geib and Michael R. Robins, Navajo Nation Archaeology Department, Northern Arizona University, Box 6013, Flagstaff, AZ 86011

In the summer of 1930, Irwin Hayden excavated two caves along the east side of Desha Canyon, then known as Cornfield Canyon, on the northern edge of the Rainbow Plateau in southeast Utah (Figure 1). His excavation of Desha Caves 1 and 2 was part of the Van Bergen Expedition of the Los Angeles County Museum of Natural History. The expedition also excavated at the large Tsegi Phase (late Pueblo III) site of Segazlin Mesa (see Lindsay et al. 1968). Rumor has it that Byron Cummings, who had dug on Segazlin Mesa previously, was displeased to find outsiders working on 'his' site and sent the expedition packing. Excavation of the two caves ensued; evidently they were unclaimed or of little interest to Cummings. Both sites produced artifacts similar to those described by Guernsey and Kidder (1921; Kidder and Guernsey 1919) from Basketmaker II caves near Kayenta, Arizona.

Allan Schilz (1979) incorporated Irwin Hayden's (1930) unpublished manuscript on the two caves into a Master's thesis, in which he presented an analysis of the recovered remains. Because Schilz did not radiocarbon date any artifacts or other remains for his study, the age of Basketmaker occupancy of both sites remained unknown, but was assumed to fall within the first half millennium of the Christian era. With the revelation that Basketmaker II remains from the type sites of White Dog Cave and Kinboko Caves 1 and 2 are as old as 600 cal B.C. (Smiley et al. 1986; Smiley 1994:Table 1), there was reason to suspect similar antiquity for the Desha Caves. The age of the Basketmaker remains at both sites has relevance for our broader understanding of the Archaic-Formative transition on the Colorado Plateau and in this specific case for the transition on the Rainbow Plateau as it relates to a moderate-size excavation project along the Navajo Mountain road, N16 (Geib et al. 2003). The N16 excavations included 17 open sites with Basketmaker II components (see Geib and Spurr 2000, 2002 for preliminary summaries). We were interested in learning the temporal relationship between the rockshelter-using Basketmaker II and the open sites we had excavated along the road right-of-way.

THE SITES

The Desha Caves are located on the northern portion of the Rainbow Plateau at an elevation of about 1414 m surrounded by a blackbrush and grass plant community (Figure 2). This portion of the plateau consists of a northward-sloping dissected tableland of the Kayenta Formation dotted with knobs, fins, and larger cliff-forming remnant masses of Navajo

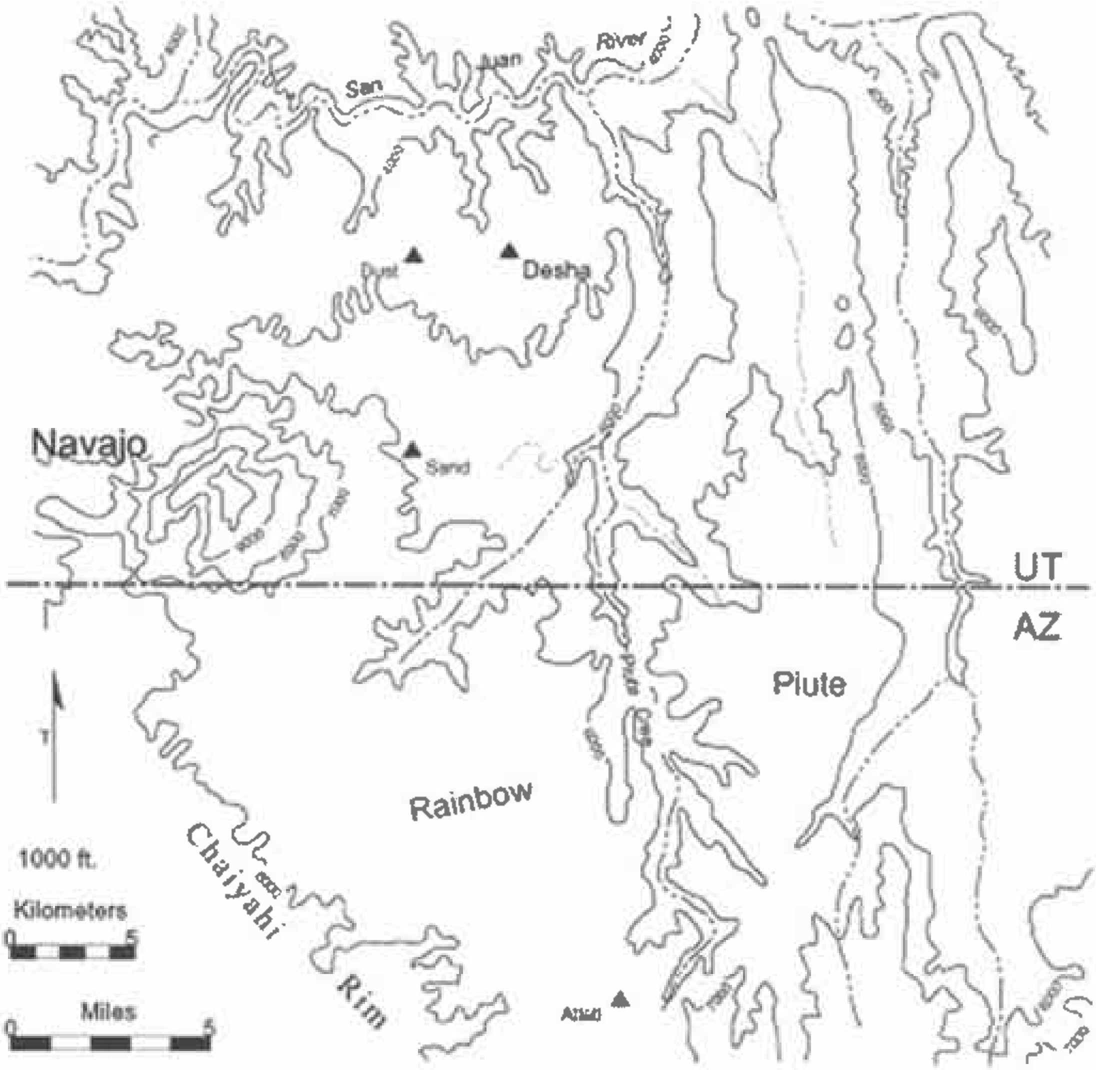

Figure 1. Map of the Rainbow Plateau and environs in southeast Utah and northeast Arizona showing the location of the Desha Caves and other Basketmaker II cave sites mentioned in the text.

Sandstone. As is typical of the region, the caves occur within this sandstone, in this particular case as perched alcoves some 30 m above the contact with the Kayenta Formation. The climb into Cave 1 is moderately treacherous, but assisted by hand and toe holds that appear modern (i.e., cut by Hayden or local Navajo), but that likely follow a prehistoric route. Cave 2 has walk-in access.

The Navajo Sandstone cliff containing the caves faces west across the ledgy Desha Canyon, which cuts into the underlying Kayenta Formation and drains northward into the San Juan River (now Lake Powell). Three major branches of this canyon merge just west of the caves, less than 2 km away, and here there is a small farming oasis supported by springs. Navajo farmers still maintain irrigated fields in this area and did so at the time of Hayden's excavation, hence his name of Cornfield Canyon. Numerous and diverse prehistoric water control features in Desha Canyon reveal that Anasazi farmers used this oasis far more

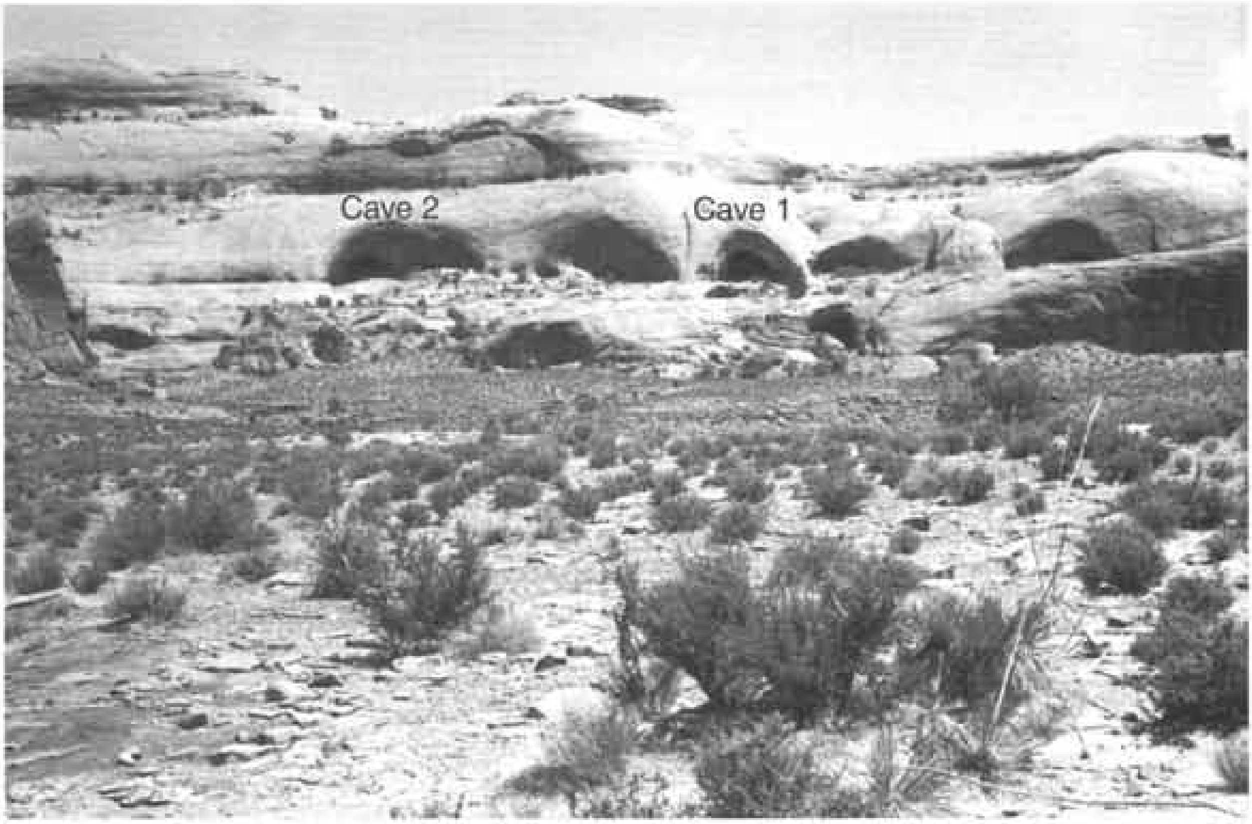

Figure 2. View of the Desha Caves from the blackbrush covered flat immediately west of the sites (view to east). The caves occur within a remnant of Navajo Sandstone that rests upon a tableland of the Kayenta Formation (foreground). Photo by Alexander J. Lindsay, courtesy of the Museum of Northern Arizona.

extensively (more acreage in production) than modern farmers (Lindsay et al. 1968:136-137). This is the likely area where Basketmakers raised the produce stored at the Desha Caves; the rest of the local landscape in this area is ill-suited to farming and well below the dry-farming belt. Immediately across Desha Canyon from the Desha Caves is Dust Devil Cave, a site best known for its early Archaic remains (Ambler 1996; Lindsay et al. 1968), but also containing many Basketmaker II cists.

Hayden's excavation of Desha Caves 1 and 2 revealed 33 slab-lined storage cists with a combined storage capacity of about 12 cu m (Figure 3). This estimate is based on calculations from feature dimensions given in Tables 1 and 2 of Schilz (1979:19, 23). The estimate excludes two cists in Cave 1 for which no measurements were provided. Schilz (1979) reports 21 cists in Cave 1 and 12 in Cave 2. Eight of these had no mortar or other caulking between the upright slabs, but the rest had some material sealing the spaces. Juniper bark or other vegetation was packed between slabs of 18 cists; fiber-tempered mortar sealed the spaces of 3 cists; mortar without fiber was used for another 3 cists; 1 had slab fragments as chinking.

The two cists in Cave 2 constructed of fiber-tempered mortar are still well preserved (Figure 4), even though the excavators effectively pedestalled both by removing all surrounding matrix. Both are quite large (ca. 1.9 and 1.1 cu m) and had roofs of poles covered with mortar. The one cist like this in Cave 1 is only partially intact and Hayden listed it as partially destroyed, so its current condition is perhaps somewhat

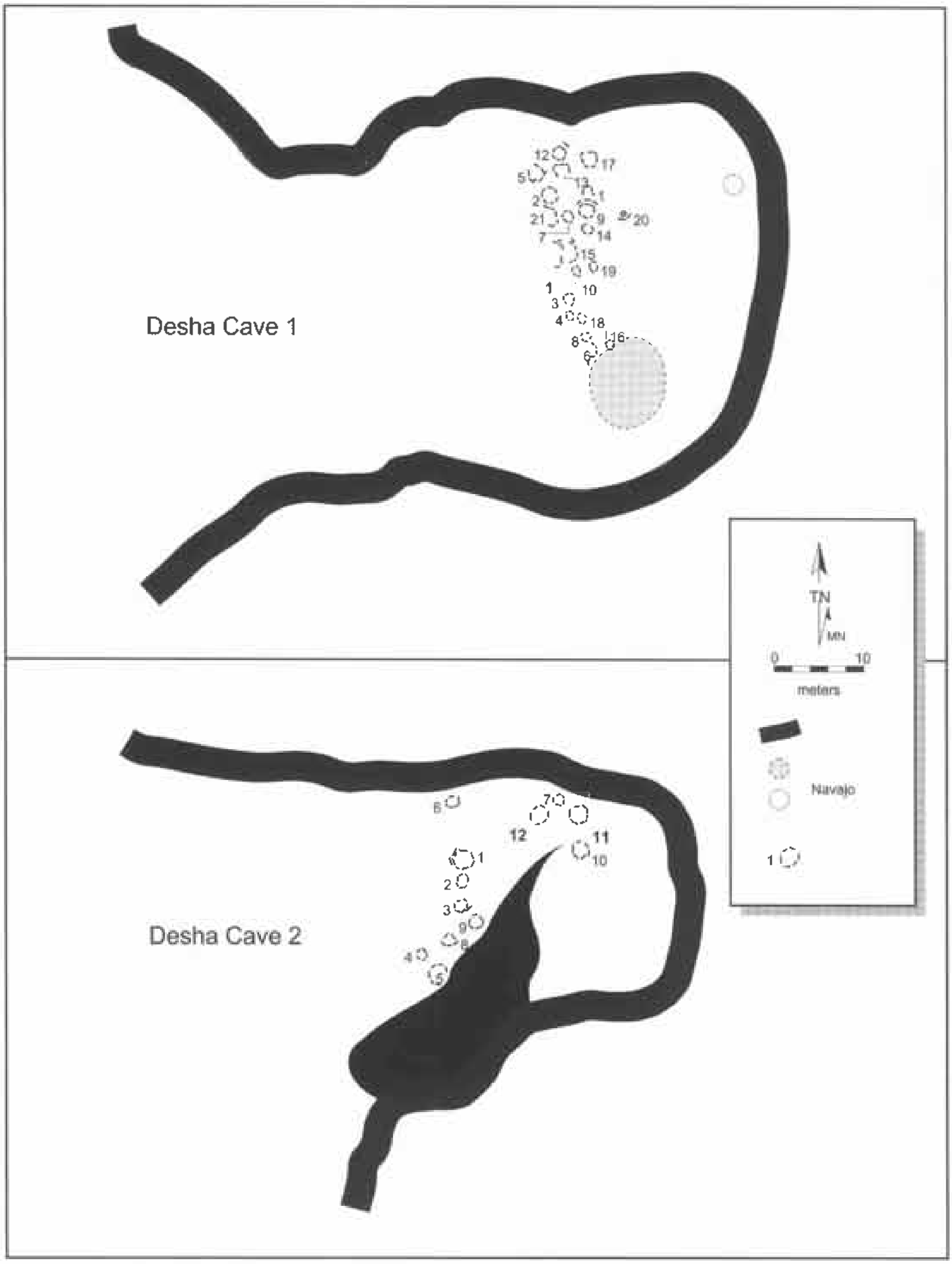

Figure 3. Plan maps of the Desha Caves as drawn by Irwin Hayden (1930; redrawn from Schilz 1979) with the excavated cists numbered and the dated cists shown in bold. Their ^{13}C ages are shown on Table 1 and in Figure 6.

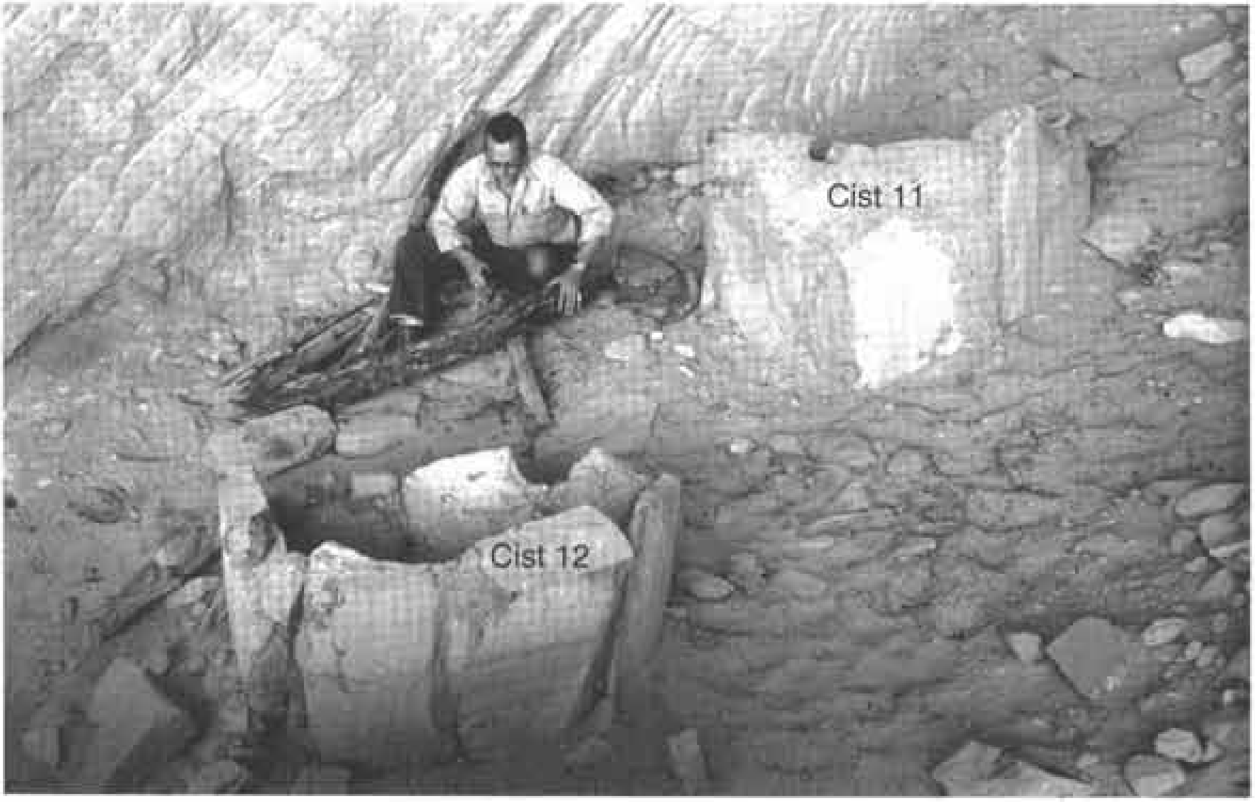

Figure 4. View of the large cists in Desha Cave 2 that are sealed with fiber-tempered mortar. A young Dick Ambler during the Glen Canyon project is cutting discarded roof support timbers for tree-ring dating. The cists look little different today. Photo by Alexander J. Lindsay, courtesy of the Museum of Northern Arizona.

as originally found. The cists lacking mortar have varyingly disappeared into a chaotic jumble of sandstone slabs, though it is possible to identify several of them.

As was common in those days, the excavators used a broadside technique on both sites, with virtually no attention paid to natural strata. Consequently, the artifacts described by Schilz (1979) are not a pure Basketmaker assemblage, but a varying admixture of Puebloan remains (perhaps earlier and later materials as well). Only items that are characteristically Basketmaker II, such as the four-warp wickerwork sandals, twined bags, and hafted side/corner-notched dart points, are reasonably assumed to be part of the Basketmaker II components of each cave. The recovered diagnostic remains are no different than the bulk of materials reported by Guernsey and Kidder (1921; Kidder and Guernsey 1919, 1922), thus culturally the sites fit Matson's (1991, 1999) western Basketmaker II pattern. There also appears to be an adaptive fit because of the numerous storage cists and corncobs at the caves. As reported below, the largest and most formally constructed of the cists at both sites, those well-sealed with bark-tempered mortar, date to the Basketmaker II interval, and thus it is highly probable that the smaller and simpler cists are also Basketmaker II. The random selection of two corncobs from Cave 1 for radiocarbon dating likewise produced assays within the Basketmaker II interval, and thus much of the corn from the site is also likely part of this component.

RADIOCARBON SAMPLES AND RESULTS

The senior author surface-collected radiocarbon samples from both sites during the winter of 1997 while searching the general region for packrat middens as part of a paleoenvironmental study for the N16 project (Koehler 2002). The collection was approved by the Navajo Nation Historic Preservation Department (letter dated 23 January 1997). One emphasis was the three cists constructed with fiber-tempered mortar: Cist 1 of Cave 1, and Cists 11 and 12 of Cave 2. Extraction and dating of vegetation (juniper bark) from the clay would provide estimates of the time of construction, with the realization that the features may well have had an extended interval of use after being built. The mortar samples were collected from the features without significant impact, although in the case of Cist 1, Cave 1 the feature was already in poor condition. The mortar samples were heavily tempered with bark, thus a modest weight of mortar produced a sizable amount of bark for dating: 23.8 g of bark from Cist 1, Cave 1, 57.2 g of bark from Cist 11, Cave 2 and 87.2 g of bark from Cist 12, Cave 2. The samples were cleaned of clay simply by pounding them with a hammer and then dry screening; the dating laboratory washed the bark and performed standard pretreatment.

Hayden found bast (probably mostly juniper bark) or grass caulking in many of the cists, and this too would have provided good estimates of the age of construction. None of this organic caulking was visible

Figure 5. Sole surface of the four-warp wickerwork sandal from the corncob pile in Desha Cave 1 and radiocarbon dated. This heel fragment has full width and one inact warp selvage (knotted); an sZ_2 cord of yucca fibers looped around the right outer warp served as a heel tie. The weft consists of partially crushed yucca leaves with some of the parenchyma removed (leaves were perhaps also split). The warp consists of similarly treated yucca leaves that were loosely z-twisted into two yarns, then loosely S-twisted to form each warp.

Table 1. Radiocarbon Determinations for Desha Caves 1 and 2.

Cave No.	Feature No.	Material Dated	Sample No.	Conventional ^{14}C Age	d ^{13}C (‰)	Calibrated 1 s Range	Calibrated 2 s Range
1	none	corncob	Beta-102492	1840 ± 50	-9.3	60-240 AD	60-340 AD
1	none	yucca sandal	Beta-175652	1800 ± 40	-21.9	130-320 AD	120-350 AD
1	none	corncob	Beta-102493	1730 ± 60	-9.3	240-390 AD	130-430 AD
1	Cist 1	juniper bark	Beta-102494	1670 ± 80	-20.9	250-530 AD	130-570 AD
1	none	human feces	Beta-175650	1660 ± 60	-23.7	260-530 AD	240-540 AD
1	none	human feces	Beta-175651	1640 ± 60	-23.5	260-540 AD	250-560 AD
2	Cist 12	juniper bark	Beta-102496	1880 ± 60	-22.8	70-220 AD	0-320 AD
2	Cist 11	juniper bark	Beta-102495	1590 ± 70	-22.5	390-560 AD	260-630 AD

Note: calibrations based on OxCal Version 3.5 (Bronk Ramsey 1994, 1995)

in the cist remnants as they exist today (at least without some excavation) and it is doubtful that such samples were collected back in 1930.

Additional dating samples came from the back of Cave 1 where there is a large pile of maize cobs along with human feces (coprolites) and a few other remains. Within this pile we found a small white slip of paper with "Cave 1" hand-scrawled in ink, which we believe was intended to designate the general provenience of these excavated but uncollected remains. Corncobs and feces evidently had little scientific value in 1930, at least for this expedition. From this pile we culled nine cobs, then randomly selected two of the nine for dating purposes. After measuring and describing the cobs, large portions of each were submitted for assay (16.1 g and 24.9 g) with the butt ends saved for future analysis or other studies. Also collected from the pile were eight human coprolites and a small portion (heel end) of a four-warp wickerwork sandal of yucca fibers (Figure 5). Portions of the two largest coprolites were submitted for assay along with a minute portion of the sandal.

The samples were submitted to Beta Analytic for pretreatment and dating, with all but the sandal sample analyzed by conventional counting; the sandal was dated by AMS. The results are presented in Table 1 along with calibrated age ranges at one and two sigma using the OxCal Program Version 3.5 (Bronk Ramsey 1994, 1995). All dates have been corrected for isotopic fractionation based on measured delta ^{13}C values. The assays range in age from 1880 B.P. for Cist 12 of Cave 2 to 1590 B.P. for Cist 11 of the same cave; these two adjacent and similarly constructed cists bracket the rest of the dates, all from Cave 1. One of the Cave 1 corncobs and the sandal are statistically the same age as Cist 12. It might be reasonable to group a few of these individual assays if it could be shown that they belong to the same depositional event such as corncobs from the same harvest or from a relatively brief occupation. However, we lack such contextual information, and because both Basketmaker II and Puebloan temporal diagnostics were recovered, there is every reason to suspect that the shelters had lengthy occupations. Consequently, each date should be treated as an individual estimate of the potential time span of when the sites were used. The calibrated two-sigma date span for all eight assays is A.D. 0 to 630 (Figure

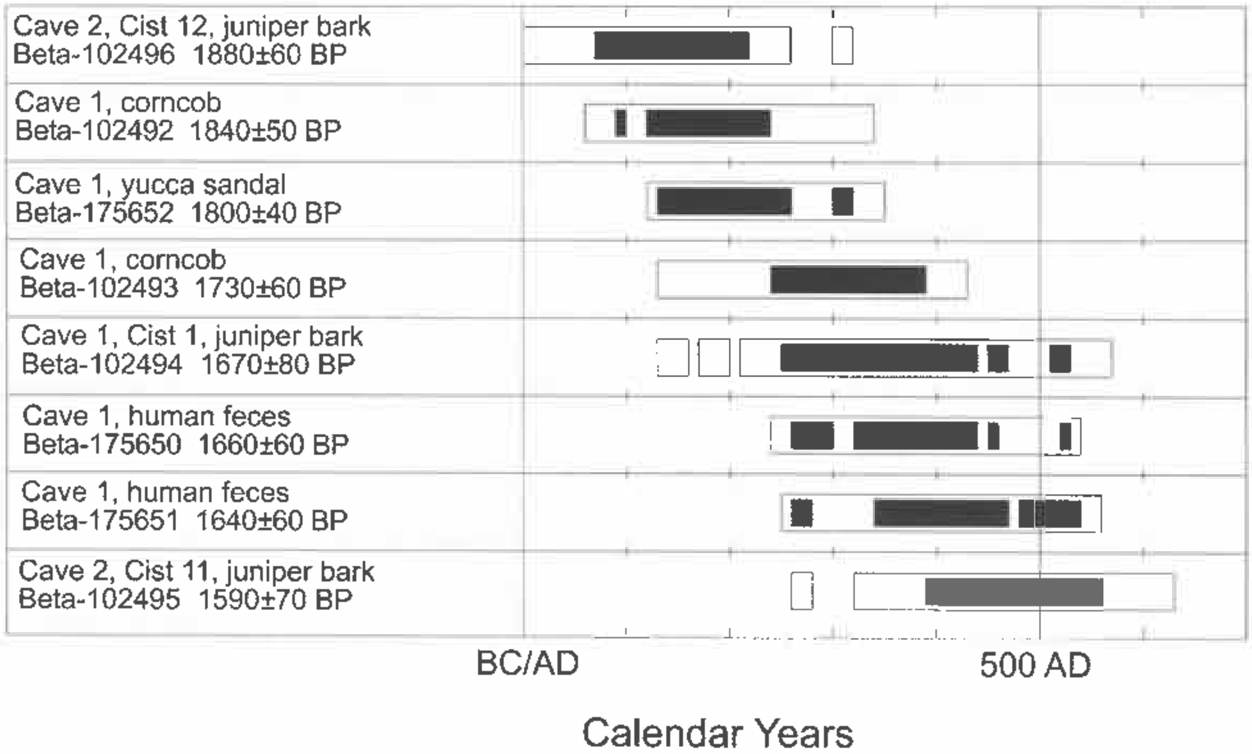

Figure 6. Plot of the calibrated radiocarbon dates from the Desha Caves based on the OxCal Program, Version 3.5.

6); if the two caves are treated individually then the calibrated two-sigma date span for Cave 1 is A.D. 60 to 570 and A.D. 0 to 630 for Cave 2. These assays fall within the latter portion of the local Basketmaker chronology for the Rainbow Plateau, which extends from roughly 400 cal B.C. to cal A.D. 600, a chronology based on 90 radiocarbon dates, with more than half of these on maize (Geib and Spurr 2000, 2002).

FECAL SAMPLES AND RESULTS

The eight coprolites recovered from the excavation discard pile in Cave 1 all met the requirements for determining human origin (shape, color and smell on rehydration, constituents). Each fecal specimen was weighed, photographed, and described prior to dissection, then processed following the method outlined in Fry (1985). The remaining portions of each coprolite (> 5 gm) were archived for future pollen analysis and other research. After soaking and dissection in a weak solution of trisodium phosphate, the samples were air dried in chiffon bags and then sorted through 5 mm, 1 mm, and .5 mm geologic screens. Each fraction was examined under a 10-40 x binocular microscope with identifications based on comparative collections and identification manuals (e.g., Martin and Barkley 2000; Hickman 1993).

Initial inspection revealed that all of the samples were dominated by a single taxon. Time constraints did not allow for the constituents of each specimen to be counted or weighed, instead we used an approximate ranking of taxa within each sample, followed by ranking of all taxa within the assemblage. This approach retains the importance of specific taxa within the remains of actual "meals" that would otherwise be diluted in a ubiquity rank. For example, two of the feces are almost entirely composed of bugseed (*Corispermum hyssopifolium*) seeds. Because bugseed only occurs in two samples, this taxon would score low in ubiquity, obscuring its dietary significance.

The results of the fecal analysis are given in Table 2. Taxa fall into three general ubiquity classes: high (68 percent), medium (38-25 percent), and low (13 percent). Ricegrass is the single taxon of high ubiquity and it has the highest ranking, which clearly indicates that the seed of this grass was an important dietary item. Ricegrass grows prolifically in sandy soils, and during years of good winter and spring precipitation produces an abundant harvest of seeds in early summer (about late June around the Desha Caves). This grass will occasionally produce a second crop in fall if summer rains are good. Prior to the arrival of cattle in the American Southwest, ricegrass formed almost pure stands, with "old-timers" telling of rangelands that resembled fields of grain (USDAFS 1988:148). Ricegrass seeds were evidently always important to farmers on the Colorado Plateau because they provided a predictable harvest during a critical lean period when last year's crops were depleted but the current planting had yet to produce (Bohrer 1975:199).

The medium ubiquity class includes dicotyledonous plant fibers, unidentified plant material, bulb tissue, and seeds of goosefoot, bugseed, squash, sunflower, and groundcherry. Dicotyledonous fiber may have originated from the consumption of goosefoot and amaranth leaves. The bulb tissue is possibly onion or sego lily, both of which are common in sandy areas around the Desha Caves. The unidentified plant material might derive from the consumption of squash, because the two feces consisting largely of this material (samples 2 and 8) also contained squash seeds.

Table 2. Rank Order of Taxa from Eight Coprolites from Desha Cave 1.

Taxon	Common Name	1	2	3	4[2]	5	6	7[3]	8	Score	Ubiquity
Stipa hymenoides	ricegrass	5		5		5	5		2	22	63%
Fibers (dicot)		3		1	2					6	38%
Unid Plant Material			5					2	5	12	38%
Chenopodium sp.	goosefoot	2		2		2				6	38%
Corispermum sp.	bugseed				5			5		10	25%
Cucurbita pepo	quash/pumpkin		2						2	4	25%
bulb epidermis		3		3						6	25%
Helianthus sp.	sunflower				1			1		2	25%
Physalis sp.[1]	ground cherry			3					2	5	25%
Amaranthus sp.	amaranth								1	1	13%
Descurania sp.	tansy mustard		1							1	13%
Cleome sp.	beeweed								1	1	13%
Insect			2							1	13%
Small bone frags.			2							2	13%

[1] Seeds and fruit.

[2] Portion dated, 1660±60 B.P. (Beta 175650).

[3] Portion dated, 1640±60 B.P. (Beta 175651).

While bugseed (*Corspermum hyssopifolium)* is present in just two feces, it constitutes the dominant seed remains in both and appears to have been consumed raw. This tumbleweed-like annual grows in sandy areas and dunes, producing large quantities of seeds, which become available in the fall (September). We have observed *C. hyssopifolium* growing in disturbed sandy areas along canyon bottoms in places such as Chevron Creek and Canyon de Chelly (both in northern Arizona). In neither case could this species be said to be abundant, however it has probably been heavily reduced by the introduction of livestock and non-native invasive plants. The fact that *C. hyssopifolium* occurs in coprolites recovered from Archaic and Formative strata at Cowboy Cave (Hogan 1980:Table 1) indicates that this species was far more abundant in prehistoric times. This species, like amaranth and goosefoot, also may have been cultivated (Hunter 1997), or encouraged to grow in and around fields and gardens. *C. hyssopifolium* was also observed in Basketmaker II coprolites from Boomerang Shelter (Robins 2000) and in all sediment samples from that site (Robins and Smiley 1998), constituting the second most commonly encountered species in coprolites and sediment samples. Stem pieces with attached leaves were also common in the sediment samples, indicating that plants were harvested nearby.

The mature seeds of squash (*Cucurbita pepo*) are present in two feces. *C. pepo* is regarded as the oldest domesticated squash to arrive in North America, and was the only species of squash grown by the Basketmakers (see Cutler and Whitaker 1961). Other species did not appear until Pueblo II times (ca. A.D. 1000). Both of the feces contain crushed raw seeds and sample 2 also contains a nearly complete charred squash seed. If the unidentified plant material that occurs in great abundance in both feces with the squash seed is actually digested squash flesh, then consumption of entire fruits is indicated, something that may have happened during the fall harvest season for pumpkins. It is also possible that green fruits were eaten well before harvest time. If the unidentified plant material is not from squash flesh, then the seeds may have been leftover after planting and therefore consumable.

None of the eight feces contained corn remains. The absence of maize is a probable reflection of seasonality and site type. It suggests that the feces were deposited during the growing season when wild plant foods were plentiful, yet stored corn supplies were low.

Amaranth, mustard, and beeweed seeds occurred in single feces and in very low amounts. The charred tansy mustard *(Descurania sp.)* seeds present in one sample may represent the remains of an earlier meal, although any heavily ground seeds would have been more fully digested and thus escape detection at this level of analysis.

DISCUSSION

The radiocarbon assays reported here indicate that both of the Desha Caves were used during the first half millennium of the Christian era, during the late Basketmaker II period. Does this mean that the sites were not used earlier? Given that the Basketmaker II artifacts from the Desha Caves are virtually identical to those reported by Guernsey and Kidder (1921, Kidder and Guernsey 1919), some might expect initial Basketmaker II use of the sites to be as early as the age for Basketmaker II remains from sites such as Kinboko Caves 1 and 2, at around 600 cal B.C. (Smiley 1994:Table 1). Assuming a temporal progression in the nature of storage facility construction, it could be argued that we skewed our sample towards the most recent end of the Basketmaker II occupation by dating just the large, most formally constructed cists. Simpler cists, those built with just slabs or slabs chinked with bark, might be earlier, but this remains to be seen. Dating of corncobs, human feces and the sandal fragment from Cave 1 was one means to check for earlier remains, but these too date relatively late in the Basketmaker II sequence. If earlier remains are rarer than those of late Basketmaker II, many more items would need to be dated to reveal the earlier specimens. Nonetheless, the dates reported here are compatible with all other assays on Basketmaker II remains from caves on the Rainbow Plateau, which are later than cal A.D. 100: Dust Devil Cave (Geib 1996:Table 11), Sand Dune Cave (Geib 2003:Table 1) and Atlatl Rock Cave (Geib et al. 1999:Table 1). On the Rainbow Plateau, there is no evident temporal priority of shelter use over open settlements. Excavations within the N16 right of way demonstrate that open Basketmaker II habitations (pithouse settlements) and other site types in the same area date back to at least 300 cal B.C. (Geib and Spurr 2000, 2002). This contrasts with Smiley's (1998:99-100) suggestion that early Basketmakers preferred shelters and that open-air settlements were not established until after the time of Christ. On the Rainbow Plateau, shelter use is only one part of the Basketmaker II settlement organization, wherein open pithouse habitations figured prominently from the beginning of Basketmaker presence on the plateau at around 300 cal B.C.

As with other Basketmaker II groups, the Desha Caves inhabitants relied on wild food plants, especially ricegrass and bugseed, but also amaranth and goosefoot, sunflower, ground cherry, tansy mustard, including the seeds, leaves, and stems of many of these plants. Data also indicate consumption of insects and small mammals and/or reptiles. In spite of the bias introduced through sample size, as well as the inherent "vagaries" of coprolite analysis (see Hogan 1980:201), two trends are worth noting (although we cautiously add that further research and larger samples are needed). Seasonality of plant availability indicates that the caves were occupied during the early part of the growing season, suggesting that the caves functioned as agricultural fieldcamps. Ricegrass in particular is an indicator of early summer presence, since this resource has a brief harvest window that would have been over by the middle of July in normal years. The absence of maize in the Desha Cave feces is uncommon among Basketmaker II coprolite samples where maize is present in significant quantities (Aasen 1984; Androy 2003; Robins 2000). However, these other samples come from sites that were likely used for winter habitation, which does not appear to have been the case for the Desha Caves. If, as many researchers suspect, the goal of Basketmaker maize farming was to provide food essential for winter survival, then maize may be absent from the Desha Cave feces because the sites were not used as winter residences.

This study arose as a modest attempt to provide a chronology for Basketmaker II use of two caves excavated over 70 years ago. Among other issues, this allowed us to establish the temporal relationship between open Basketmaker II habitations on the Rainbow Plateau and these shelters. The dates also provide the beginnings of a temporal framework for the abundant remains recovered from the sites and housed at the Los Angeles County Museum of Natural History. Such collections increase in research value every year as looters destroy what few shelters remain untouched. Modern excavations of sites with excellent organic preservation are scarce and when permitted the efforts are quite limited in scope or even restricted to looter holes and backdirt piles. The collections made during the late nineteenth and early twentieth centuries cannot be duplicated and are irreplaceable for many types of research questions. The scientific value of the museum collections is also enhanced by the realization that the Basketmaker II stage spans more than a millennium. Given the large time span, there must be temporal changes in various classes of material culture, subsistence, and other aspects of past lifeways that have yet to be identified, something that will require many direct dates on existing collections as well as restudy of the sites from which the collections came.

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AN APPARENT CASE OF TREPONEMAL DISEASE IN A HUMAN BURIAL FROM THE NORTHERN GREAT SALT LAKE

Silvia E. Smith, Department of Anthropology, University of Utah, Salt Lake City, UT 84112-0060
Silvia.Smith@anthro.utah.edu

Buck Benson and Patricia M. Lambert, Department of Sociology, Social Work and Anthropology, Utah State University, Logan, UT 84322-0730

The skeleton of a male adult (Burial 1) with layered, bony lesions on most of his arm and leg bones was recovered near Willard Bay during salvage excavations conducted by Utah State University (USU) in October, 2001 (Lambert and Simms 2003). One of a number of complete or partial skeletons found eroding from lake bed deposits at 42BO1071, Burial 1 was one of five individuals discovered in Area 1 (Figures 1 and 2). A second male adult from this area (Burial 2), also had superficial (periosteal) bone lesions on a couple of leg bones.[1] The proximity of the burials to each other and the similarity of their lesions suggest that both men may have been affected with the same disease. Although previous researchers have reported periosteal

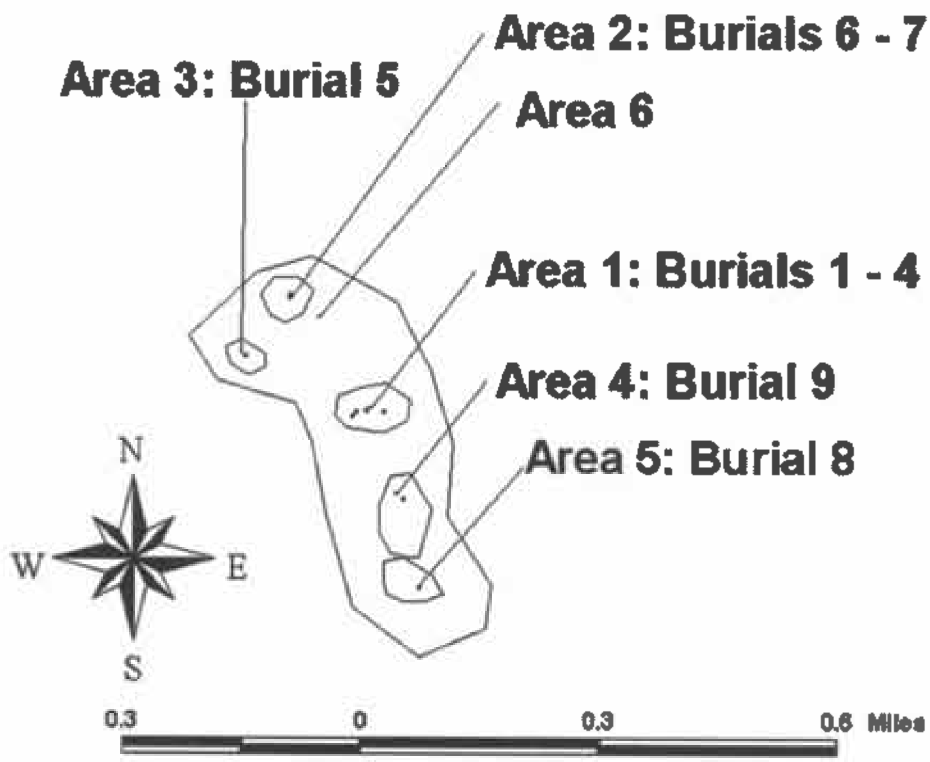

Figure 1. Map of 42BO1071.

Figure 2. View of 42BO1071 from the northwest showing areas 1, 2, and 3.

lesions in human skeletal remains from other locations in the Great Basin (Larsen and Hutchinson 1999; Nelson 1999), none has ever specifically identified a disease that might account for these lesions. The purpose of this paper is threefold: 1) to review the osteological evidence for disease in these two individuals; 2) to explore the possibility that bone lesions in these individuals were caused by treponematosis, an infectious disease widely documented elsewhere in prehistoric North America; and 3) to investigate why a disease such as treponematosis might be present in the Willard Bay sample but not in others from the Great Basin region.

THE WILLARD BAY SAMPLE

The primary goal of the Willard Bay excavation was to salvage human remains exposed to disturbance from natural processes such as sun exposure and wave action, as well as from human activities such as all-terrain vehicle (ATV) use and hunting blind construction. When human skeletons or isolated bones were located, the sediments surrounding the bone(s) were removed to assess whether the remains were still in their primary burial context. Exposed remains were excavated and transported to a laboratory at USU for sorting, stabilization, analysis, and temporary curation. No effort was made to locate sub-surface features or unexposed burials.

A total of ten individuals (Burials 1 through 9 and Isolate 3) were recovered from 42BO1071 (Table 1). Eight were from primary burial contexts and one (a cranium) was identified in a small pile of human bones left by people who likely encountered remains on the surface while using the area for recreational purposes. One individual was represented exclusively by a fragmented right femur that did not belong to any of the identified adults in the vicinity. All skeletons had sustained some damage and varied from poor to good in terms of bone condition and completeness of the skeleton. Of the 10 individuals represented in the sample, eight were adults (three female and five male), one was a probable adult, and one was a child of 6.5

Table 1. Description of Burials from 42BO1071.

Area	Burial Number	Condition	Age(yrs)	Sex	Orientation (Head/trunk)	Burial Type	Burial Position	Comments
1	1	Fair-Good	42±5	M	E	Primary	Semi-flexed, on right side	Burial pit evident. Possibly covered with bulrush matting.
	2	Fair	48±5	M	S	Primary	Flexed, on left side	Well-defined burial pit. Small bird point found with burial.
	3	Good	6.5±2	?	ENE	Primary	Flexed, on left side, head bent back	Burial pit evident. Adult humerus found on surface appears to belong to Burial 2. Bits of bulrush with burial.
	4	Good	38±5	M	SW	Primary	Semi-flexed, prone. Legs bent back	No burial pit detected. Charcoal concentration beneath trunk of body. Some bones burned.
3	5	Fair	38±5	F	SE	Primary	Flexed, on left side	No burial pit detected. Desert Side-notched point on west side of body.
2	6	Fair	55±5	M	SE	Primary	Flexed, supine	No burial pit detected. Pottery fragment recovered with bones.
	7	Poor	36±6	F	?	Disturbed Primary (scatter)	?	Natural and human disturbance. Most bones spread across 1.6 m x 0.8 m area. R. humerus & femur found at a distance. Originally considered isolate finds 1 & 2.
5	8	Poor	30+	F	?	Disturbed (pile)	?	Cranium found in pile with male mandible & a few long bones (Bur. 9). Burial 8 does not represent a discrete burial.
4	9	Fair-Good	36±6	M	SW	Primary	Flexed, on left side	Burial pit in midden, some bones found in pile, as above. Stone ball in close proximity to hand, small biface in SE corner of burial pit.
1	IF 3	Isolate	>18	?	-	Disturbed		Right femur, sun-bleached and fragmented

years. The burial positions varied, with flexed on the left side being the most common.

Various laboratory techniques were employed in the analysis of the Willard Bay sample. Visual assessments were complemented by radiography and microscopy. An inventory was completed for each burial, and age and sex were determined whenever possible using standard osteological criteria (Buikstra and Ubelaker 1994). Identifications of pathological conditions were made with reference to Ortner and Putschar (1985), Ortner (2003), and Buikstra and Ubelaker (1994). Radiographic images of several skeletal elements from Burial 1 were taken at the Veterans Administration Bone and Joint Laboratory in Salt Lake City and analyzed by Dr. Jeffrey Job at Logan Regional Hospital in Logan, Utah. Microscopic observations and photographic images of some pathological lesions were made using a Nikon SM 2800 microscope at the Veterans Administration Bone and Joint Laboratory in Salt Lake City.

Figure 3. Desert Side-notched point.

Comparative dating using two Desert Side-notched projectile points (Figure 3) found associated with Burials 2 and 5 suggests that the 42BO1071 burials post-date A.D. 1000, although the contemporaneity of burials has not yet been fully established (Lambert and Simms 2003). Both Fremont and Late Prehistoric sites are common in this area between A.D. 500 and historic contact. Similarities found between burial positions of some Willard Bay burials and radiocarbon-dated, Fremont burials recovered during the Great Salt Lake Wetlands study of 1991 (Simms et al. 1991) suggest that the remains are Fremont in affiliation. For example, Burial 3, found a few meters east of Burial 1 (Figure 1), exemplifies the same characteristics as Burials 22 and 70 from the 1991 project (Simms et al. 1991).

The time range of A.D. 500 to historic contact includes the Fremont period, during which intensive agricultural practices were used in conjunction with the exploitation of wetland resources. The Fremont period was characterized by an increase in nucleated settlements and population density within the Great Salt Lake wetlands, which could have facilitated the maintenance and spread of communicable diseases such as treponematosis (Hudson 1965; Powell 2000).

PERIOSTEAL LESIONS AS AN INDICATOR OF DISEASE

Periostitis, the immediate physiological cause of the external bone lesions seen in Burials 1 and 2, is a condition in which the periosteum, a thin, tough membrane that surrounds bones, becomes inflamed. This response can result from a number of irritants that act to separate the periosteum from underlying bone, including fluid accumulation, clotting blood, and pus (Eyre-Brook 1984). The periosteum responds to such insults by developing a layer of new, woven bone (periosteal lesion) on the cortical (external) surface of the bone (Simpson 1985). This new bone has a porous, web-like structure that, with healing, becomes incorporated into the normal bone matrix and may only be evident as a bump or other irregularity on the external surface of the bone. Many pathological conditions can stimulate this bony response, including traumatic injury, bacterial infection, circulatory disorders, scurvy, and tumors (Cook 1976; Mandell and Harcke 1986; Ortner 2003; Wang et al. 2003), and differential diagnosis is not always possible because lesions caused by different disorders may be quite similar (Ortner 2003). However, the extent, location, and specific characteristics of periosteal lesions can sometimes facilitate diagnosis in dry bone specimens. It is just such a combination of features that suggests that the lesions in Burial 1, and possibly those of Burial 2, were caused by infection with a treponemal disease reminiscent of endemic syphilis.

ENDEMIC SYPHILIS: EPIDEMIOLOGY AND OSTEOLOGICAL MARKERS

Endemic syphilis is an infectious disease involving skin, cartilage, and bones. One of four treponemal infections known worldwide today (also venereal syphilis, yaws, and pinta), endemic syphilis is a chronic infection of childhood contracted through skin to skin contact, such as might occur during play, or through the sharing of contaminated drinking vessels (Koff and Rosen 1993; Steinbock 1976). Of the four modern treponemal syndromes, endemic syphilis is the form of the disease found today in hot and dry environments (Steinbock 1976), such as those characterizing the Great Salt Lake region of Utah, and tends to propagate in village environments under conditions of poor hygiene and crowding (e.g., Aufderheide and Rodriguez-Martin 1998; Hudson 1965; Koff and Rosen 1993). Clinical signs of the disease include small skin papules or ulcers in the early stages of infection. Later stages may see a return of more widespread skin and mucosal lesions as well as skeletal involvement, which may occur five or more years after initial infection (Aufderheide and Rodriguez-Martin 1998; Koff and Rosen 1993; Powell 1998) and continue into middle age (Cook 1976). The morbidity and mortality rates for this communicable disease are lower than that for venereal syphilis, and infected individuals usually live well into adulthood (Powell 2000).

The primary skeletal manifestations of endemic treponematosis are periosteal lesions, sometimes quite extensive and disfiguring, on external surfaces of long bones — particularly those of the lower leg (tibias and fibulas) (Aufderheide and Rodgriguez-Martin 1998; Baker and Armelagos 1988; Koff and Rosen 1993; Ortner 2003; Powell 1988, 2000; Steinbock 1976). They may also be found on arm and hand bones, as well as on the clavicles (collarbones) and less commonly on other bones (Figure 4a) (Koff and Rosen 1993; Ortner 2003; Powell 2000; Rost 1942; Steinbock 1976). These lesions primarily affect the shafts rather than the joint surfaces of the long bones, and it is not uncommon for excess bone to form within the marrow cavities as well (Rost 1942).

In archaeological samples where the presence of treponematosis has been firmly established, fiberbone (woven appearance, unhealed) lesions have been found to be more common in the remains of children and adolescents, whereas sclerotic lesions (smooth, hardened, healed) are most common in adults, particularly with advancing age (Powell 1988:168).

In cross-section, remnant signs of layering and varying degrees of remodeling from repeat episodes of periosteal inflammation and subsequent bone formation may be observed in lesions of some duration (usually those of adults). These osseous microstructures are indicative of a relatively low-level, ongoing chronic disease process (Walker et al. 2004). Destructive lesions of the cranial vault and face may also be present (Koff and Rosen 1993; Steinbock 1976), but are less common than in the venereal form of the disease (Ortner and Putschar 1985; Powell 1988, 2000).

Evidence of treponemal disease has been documented in a number of prehistoric populations throughout North America, including those from California (Lambert 1993; Walker et al. 2004), the

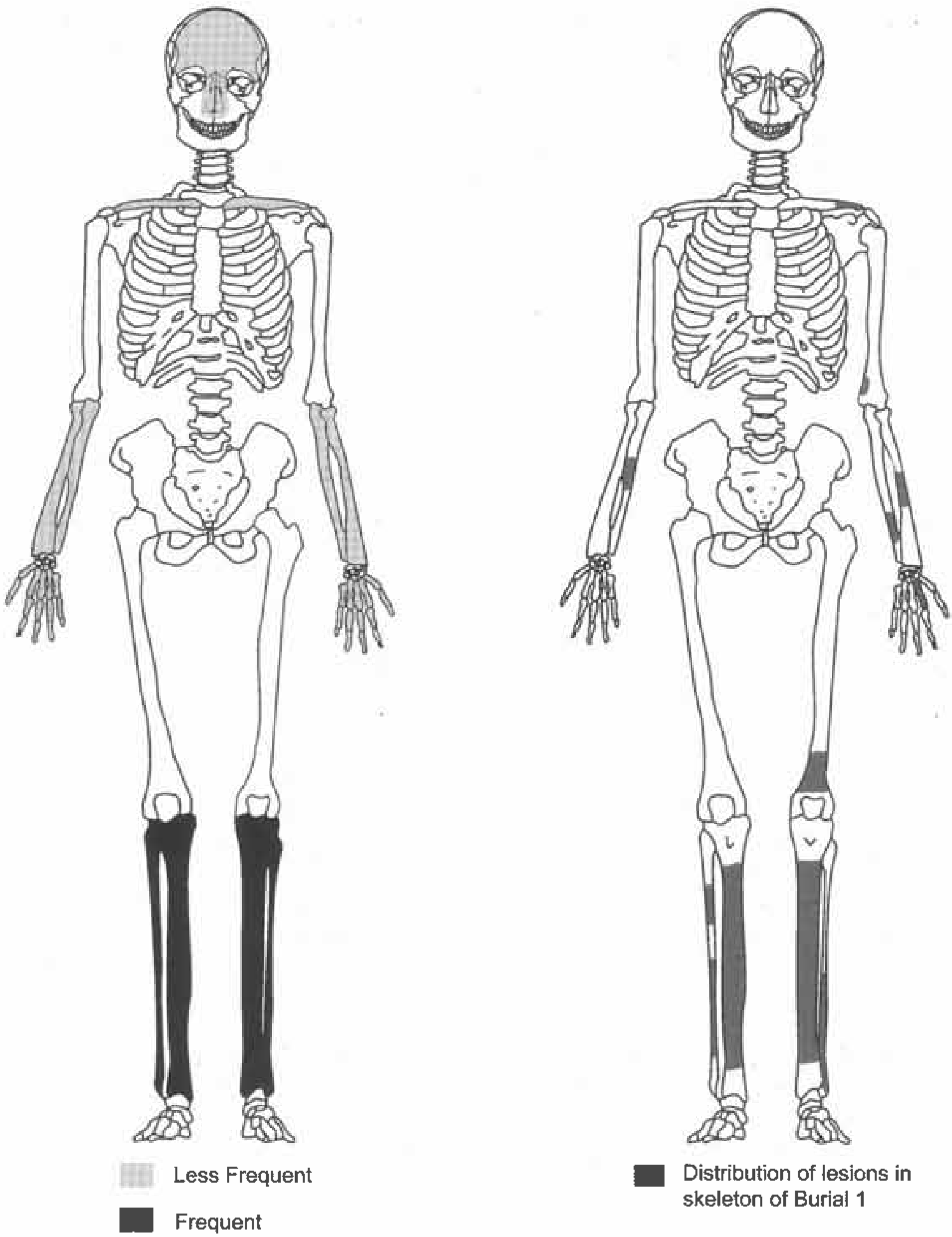

Figure 4. Left: Distribution of skeletal lesions in endemic syphilis (Steinbock 1976). In yaws, the femur and humerus are more commonly affected. Right: Distribution of skeletal lesions in Burial 1 from 42BO1071.

Southwest (Lambert 1999), Midwest (e.g., Cook 1979; Schermer et al. 1994), Southeast (Lambert 2000; Powell 1988, 2000; Reichs 1989), and Northeast (e.g., Elting and Starna 1984). Because differentiation among the three modern forms of treponematosis known to cause bone lesions (yaws, endemic syphilis, venereal syphilis) is difficult osteologically, and because ancient forms of the disease might not correspond exactly to any modern treponemal syndrome (Powell 2000), many of the reported North American archaeological cases have been more broadly classified as treponematosis without any attempt at more specific diagnosis (Baker and Armelagos 1988; Powell 1989, 2000). In the case of the Willard Bay sample, both environmental context and lesion type and distribution are considered in differential diagnosis.

Treponematosis was present in North America as early as the Late Archaic period (3000 to 4000 B.P.) (Powell 2000; Walker et al. 2003), but appears to have flourished in populations post-dating A.D. 1000 as a result of the shift to a more sedentary lifestyle associated with agriculture and other specialized economies (Powell 2000; Walker et al. 2004). The establishment or expansion of trade networks between villages may have aided in the spread and increasing prominence of this communicable disease (e.g., Armelagos et al. 1990; Powell 2000).

OSTEOLOGICAL EVIDENCE FOR TREPONEMATOSIS IN THE WILLARD BAY SAMPLE

Burial 1 from the Willard Bay sample has pathological bone lesions similar to those described for chronic, endemic syphilis, which suggests they may have been caused by this disease or a prehistoric form closely reminiscent of it (Figure 4). The skeleton has extensive and/or disfiguring periosteal lesions of both tibias and fibulas, and radiographic (x-ray) imaging reveals that both periosteal (external) and endosteal (internal) bone surfaces are involved in some cases (Figure 5). More localized periosteal lesions are also present on the lateral end of the left clavicle, the lower shafts of several arm bones (left humerus, left and right ulnas, left radius), the lower shaft of the left thigh bone (femur), and the shaft of one left hand bone (metacarpal).[2] These lesions are healed or healing and show signs of repeat episodes of deposition (Figure 6). Burial 2 also has remodeled periosteal lesions of the right tibia and left fibula. Although not particularly diagnostic, these lesions are consistent with minor bone involvement seen in many cases of endemic syphilis (Koff and Rosen 1993). If the bone lesions in these two individuals were indeed caused by endemic syphilis or a related form of treponematosis, it is likely that others in the village were also infected with this highly infectious pathogen (Powell 2000), but had not developed osteologically visible signs of the disease.

Periostitis is not the only pathological condition evident in the Willard Bay sample, and other lines of evidence provide a broader picture of diet, health, and activity patterns for these Willard Bay residents (Lambert and Simms 2003). The presence of dental disease (dental caries and periodontal disease) in the sample from 42BO1071 is particularly relevant to the scope of this paper, because it suggests that at least some individuals were consuming and presumably growing corn. Dental caries, an infectious disease process that results in the formation of cavities in tooth enamel, has been found to positively correlate with the adoption of maize agriculture in many regions of the New World, a correlation generally accepted to reflect the consequences of a shift to a less varied, carbohydrate-rich diet emphasizing refined corn foods (Larsen 1997).

Carious lesions are present in three of eight (scorable) adult dentitions in the Willard Bay sample. Regarding Burials 1 and 2, the individuals central to this discussion, Burial 1 had lost most teeth in life, possibly due to dental disease, and Burial 2 had carious lesions in two of the six teeth that could be scored for this condition. This dental evidence suggests their diet may have included corn, which in turn implies they

Figure 5. Radiograph of the right tibia, Burial 1.

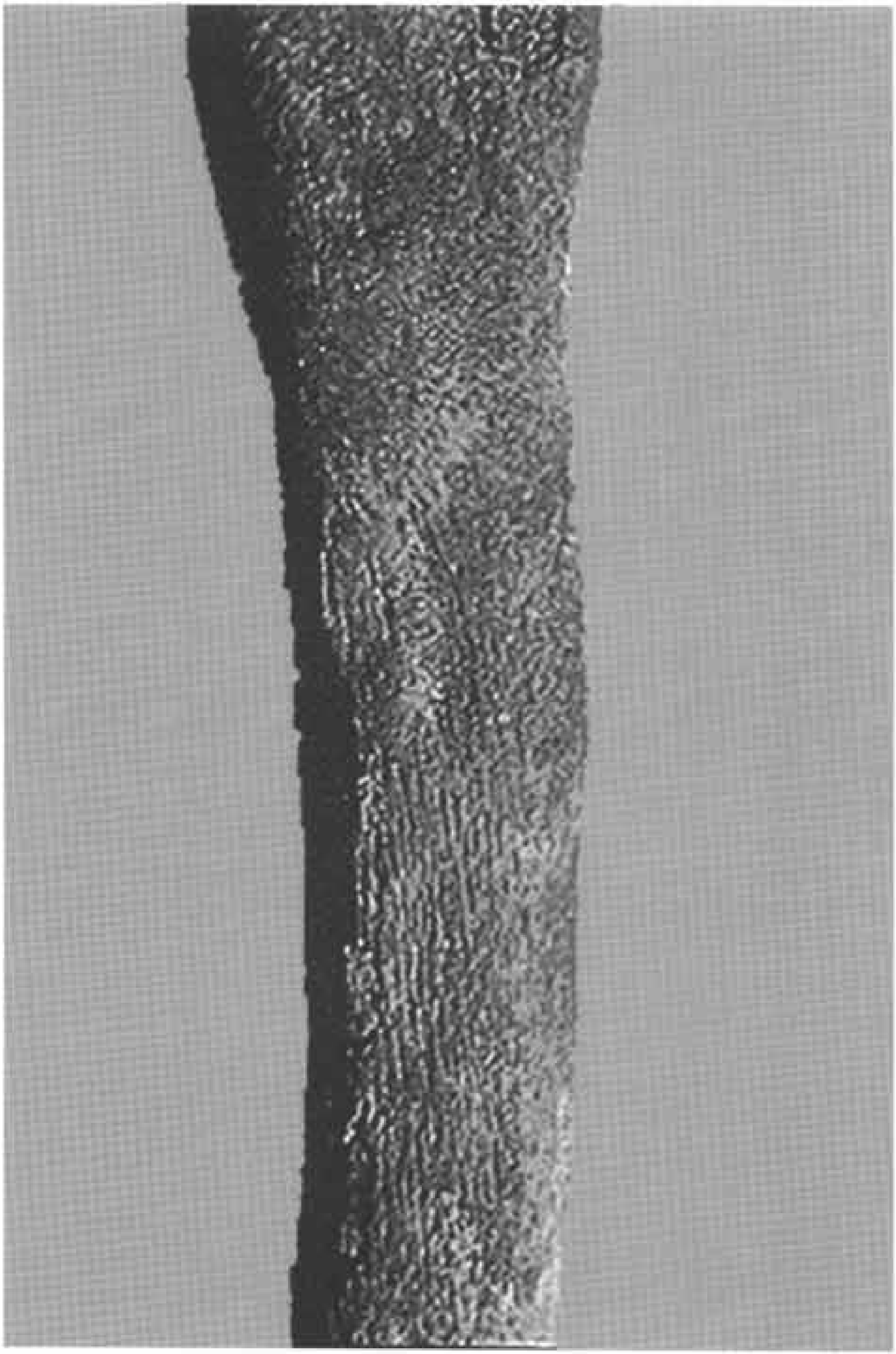

Figure 6. Periosteal lesion on midshaft of the left tibia, Burial 1.

may have lived in a sedentary village for all or part of each year. As indicated above, village life would have enhanced the maintenance and spread of infectious diseases such as treponematosis, because sedentary villages are more crowded and unhygienic than hunter-gatherer camps. Children, the primary reservoir for endemic treponemal organisms (Koff and Rosen 1993), also tend to be more numerous and contacts between them more frequent and intimate in sedentary villages (Hudson 1965:893). The association of Desert Side-notched points with skeletons exhibiting dental caries opens the possibility that at least some of the individuals in the Willard Bay sample were semi-sedentary hunter-gatherers who depended on wetland resources and practiced seasonal agriculture, regardless of cultural affiliation (Simms 1999).

COMPARATIVE STUDIES

Although treponematosis has not previously been documented in the Great Basin, other prehistoric skeletal samples from this region have produced evidence that hints at the presence of this disease. Periosteal lesions have been recorded in individuals from two other prehistoric skeletal collections from the Great Basin: the Carson Desert and Malheur Lake samples. Radiocarbon dates obtained from human bone and other organic materials date individuals from the Carson Desert sample between 270 B.C. and A.D. 1644 (Kelly 1999). Included were the remains of over 400 individuals. Of the 61 adults/subadults whose remains included at least one tibia, 10 had periosteal lesions of this skeletal element. A total of 13 tibias were affected in a total sample of 84 bones. While these data are not conclusive, they at least suggest that treponemal disease was present in the Carson Desert region prehistorically. Perhaps the most compelling case in this sample was that of a male adult, whose skeleton had periosteal lesions on all major long bones, including most or all of the shafts of the right femur and both tibias and fibulas, as well as more localized lesions on the right clavicle, left ulna, right radius, and left femur (Larsen and Hutchinson 1999:91; Clark S. Larsen, personal communication 2003).

The Malheur Lake sample was radiocarbon-dated to the period from 160 to 1830 years B.P. This sample presented a different frequency and distribution of periosteal lesions: children had the highest frequency of periosteal lesions overall (45.5 percent), followed by adults (44.1 percent) and subadults (33.3 percent). A total of 23 individuals were affected by osteoperiostitis and about half of these had at least one affected tibia (Nelson 1999). Although it is likely that periosteal lesions had multiple causes in this sample, it is possible that some were caused by endemic syphilis (Brian E. Hemphill, personal communication 2003). The absence of cranio-facial lesions in the Malheur Lake sample (as in the Carson Desert and Willard Bay samples) is inconclusive because cranial lesions are much less common than periosteal lesions in endemic forms of treponematosis.

While the Carson Desert and the Malheur Lake samples provide evidence for the presence of one or more diseases/disorders resulting in periosteal lesions, remains from an area geographically much closer to Willard Bay produced no such evidence. The Great Salt Lake Wetlands Project, a salvage project undertaken between 1990 and 1992 by Simms and collaborators (1991; Simms 1999), ultimately recovered the remains of a minimum of 85 individuals. Radiocarbon dating of human skeletons placed most of these individuals within a 600 year period, between A.D. 700 -1300 (Simms 1999). None of the 20 individuals whose remains included at least one tibia (38 tibias in all) had periosteal lesions on this skeletal element. While this could be due to the poor preservation of affected burials, other factors such as time period and lifestyle might explain differences observed between samples.

Given the association of Desert Side-notched points with the two individuals from the Willard Bay sample, it is possible that some or all of the Willard individuals were people with a lifeway and cultural context different from that of the Fremont who comprised the Great Salt Lake Wetlands sample. These kinds of questions can only be resolved through chemical analysis of human bone: AMS radiocarbon dating on a fragment of bone from each burial to accurately determine its age; stable carbon isotope analysis on a few grams of bone to estimate the role of corn in the diet; and DNA analysis of bone to evaluate the genetic relationships among ancient and modern populations. To date these analyses have not been permitted, but would surely increase the importance of these skeletal remains for understanding Utah's past.

CONCLUDING REMARKS

Burial 1, a male adult from the Willard Bay sample, exhibits pathological skeletal lesions suggestive of endemic syphilis. A second adult male also has lesions consistent with this disease. This diagnosis is supported by the appearance, healing status, and distribution of the lesions in these individuals, as well as by the dating and geographic location. Although periosteal lesions have been documented in remains from the Carson Desert of Nevada and at Malheur Lake in eastern Oregon, this infection has never before been specifically identified in a prehistoric Great Basin population. This could be due to the absence of osteological evidence, or it could reflect different analytic foci that did not emphasize differential diagnosis of disease conditions. Future research should be aimed at reexamining extant data and human skeletal material with an eye toward identification and verification of this disease, as well as the continued description and assessment of pathology in new skeletal material as it emerges from the archaeological record.

Acknowledgements. We would like to thank Steve Simms, who co-directed the Willard Bay salvage project. For their assistance with the fieldwork, thanks are also due to Kevin Jones and Ron Rood of the Utah Division of State History, Dann Russell and Mark Stuart from the Utah Statewide Archaeological Society, and six archaeology students from Utah State University: Carrie Benson, Brent Groth, Jr., Amy Gudmundson, Kandus Linde, Kylie Lower, and Ryan Waterfall. The radiographic analysis of the Willard Bay human remains was greatly facilitated by Shannon Novak, Derinna Kopp, and the staff at the Veterans Administration Bone and Joint Laboratory in Salt Lake City, and by Dr. Jeffrey Job at Logan Regional Hospital, all of whom leant their time and expertise to this endeavour. Clark Larsen and Brian Hemphill kindly provided insights into health and the possible existence of treponematosis in other regions of the Great Basin, and we thank them for sharing their knowledge of the physical anthropology of this region.

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NOTES

1 A third individual from a separate area (Area 2) has a very small periosteal 'lesion' on a lower leg bone. However, this spot of excess bone is not clearly pathological and so is not considered further here.

2 This individual also has a small periosteal lesion on the external surface of the right hip bone (ilium) that was unhealed and quite distinct from all other periosteal lesions. Although it could be related to the disease process responsible for the remodeled lesions in this individual, it is also possible that it resulted from a distinct disease that was active at the time of death.


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Book Reviews

Kaibabitsinüngwü: An Archaeological Sample Survey of the Kaiparowits Plateau, by Phil R. Geib, Jim H. Collette, and Kimberly Spurr. Bureau of Land Management Cultural Resource Series No. 25, Grand Staircase-Escalante National Monument Special Publications No. 1. Salt Lake City. 2001. 480 pages, 46 color plates, 45 black and white plates, 23 illustrations, 25 maps, and 4 appendices. Available from: GSENM Kanab Visitor Center (435) 644-4680 or BLM St. George Interagency Office (435) 688-3246. $35.00 *paper*

Reviewed by: **Alan D. Reed,** Alpine Archaeological Consultants, Inc., Montrose, CO 81402-2075

Kaibabitsinüngwü is quite a mouthful for a report title. In conversations, I will probably refer to it by its subtitle, as I lack much experience with Native American languages outside of the Ute place names of my home area. My objections to *Kaibabitsinüngwü* essentially end at the report title, and the rest of the report by Phil Geib, Jim Collette, and Kimberly Spurr is clearly written and rich in archaeological data and insightful interpretation.

The report describes the results of a sample-oriented archaeological survey conducted between 1998 and 2000 by the Navajo Nation Archaeology Department (NNAD) for the Bureau of Land Management. The study area is part of the newly created Grand Staircase-Escalante National Monument in south-central Utah. Aside from its spectacular scenery, the monument contains large quantities of archaeological sites, as evidenced by previously conducted inventories. These were insufficient for adequately characterizing the monument's cultural resources, however, necessitating additional inventory, designed to permit extrapolation of settlement trends over broad areas.

The overall sampling approach was dictated by the scope-of-work issued by the Bureau of Land Management. The approach called for the inventory of 16,000 acres, using 100 units that each encompassed a quarter-section (160 acres). This constituted a two percent sample of the 800,000-acre study area. Implementation of the sampling strategy is described in considerable detail in Chapter 4. NNAD archaeologists elected to employ a stratified random sample to best achieve the project's goals. A stratified random sample was chosen so that topographic settings strongly suspected to have few sites, such as canyons and heavily dissected areas, could be avoided in favor of settings more conducive for human settlement. Use of sampling strata also increased the understanding of variation of site densities within key areas, and also permitted skipping areas with especially poor access.

The Kaiparowits Plateau consists of a series of benches that are divided east to west by canyons and north to south by cliffs. The benches, characterized by gentle slopes, comprised the various strata. Nine strata were chosen. Units within each stratum were divided into 160-acre quadrats, which were then randomly selected, with each stratum treated like an independent sample. The number of quadrats selected within each stratum reflected the proportion that that stratum constituted of the sampling universe. The sampling approach had considerable ramifications. First, the nine strata covered 185,640 acres, or 23 percent of the 800,000-acre study area. This means that over three-quarters of the study area was outside of the sample strata. The sampling approach, then, by no means was aimed at assessing settlement patterns for the whole study area. The sample provided insight into settlement patterns within the nine sample strata, and provided abundant site information, but provided little indication of settlement patterns in the canyons, badlands, and other outlying areas. The selection of relatively large quadrats also had an impact on project results. Although the use of large quadrats reduced travel time and minimized the "edge effect," the large size of the quadrats resulted in the selection of comparatively few quadrats, and those tended to be more widely scattered than had the sampling approach been based on the selection of numerous, small quadrats. This may affect the understanding of variability caused by small-scale environmental variation.

Chapters 1 through 4 provide important contextual information and describe field and sampling methods. Chapter 5 presents the results of the testing program. Thirteen sites were subjected to test excavations, primarily to derive dates to test the utility of site dating methods based on the condition of nondiagnostic artifacts and cultural features. Site descriptions and site maps are included, as well as thorough discussions of recovered cultural materials. The chapter includes sections on faunal bone analysis by Andrea Miller and on macrobotanical analysis by Lisa Huckell. Miller's section on taphonomy is especially well written.

Radiocarbon analysis formed the basis for chronological interpretations. The project archaeologists subjected radiocarbon samples to macrobotanical analysis prior to processing to select twigs and annuals – short-lived plants or plant parts that accumulated atmospheric carbon over a short period. These materials were then subjected to AMS or conventional radiocarbon analysis, thereby avoiding the "old wood problem" inherent in radiocarbon sampling of long-lived tree trunks. The refined dating method produced high-quality dates, furthering research objectives. Somewhat as an aside, the authors mention that high-quality radiocarbon data from the Rainbow Plateau just east of the Colorado River suggest that radiocarbon dates of juniper seeds may be on the order of 100 to 200 years older than radiocarbon dates from maize, when the same components are examined. Examination of the Rainbow Plateau data does not seem to bear this out (Geib and Spurr 2000, Table 9.1). The calibrated ranges for the radiocarbon dates obtained from maize and from juniper seeds essentially overlap; both materials should continue to be regarded as excellent candidates for radiocarbon dating.

Summaries of the cultural features and artifacts found by survey personnel comprise Chapter 6. Cultural features are dominated by small thermal features, but a few masonry room blocks, middens, granaries, and slab-lined cists were also found. The discussion of artifacts is especially insightful. Because the sampling strategy compelled archaeologists to examine widely scattered areas within the project area, a good understanding of the raw lithic material resources was achieved. Local lithic materials were distinguished from nonlocal materials. NNAD analysts subjected lithic samples to heat treatment experiments, and thereby were able to understand patterns in prehistoric heat treatment of lithic materials. Of the 978 projectile points discovered by the surveyors, 315 were collected. Projectile points were placed into conventional typologies, and many of the collected specimens were photographed. The photographs are high quality and, coupled with summary statistics for point types, will be useful to other researchers. Only 12 percent of the aboriginal sites in the study area yielded ceramic artifacts. Ceramics were found at 38 percent of the sites in one survey stratum (Collet Top), an area that supported comparatively sedentary Anasazi horticulturalists. Classification of sherds was greatly facilitated by collecting "nips" in the field for removal to the laboratory for microscopic examination. Because temper is often an important variable for classification, and because microscopic examination is far superior to any type of field examination, the reader can have a high confidence in the classification scheme. Ceramic types attributable to the Virgin Anasazi, Kayenta Anasazi, and Fremont were identified, among others.

The discussion of Shinarump series ceramics, an Anasazi variety, is especially useful considering the problems that regional ceramists have had applying the series' types to ceramic artifacts. The chapter also describes a Paiute winnowing tray fragment and a horn flaker, perishable artifacts seldom found during archaeological surveys. Both were found in rockshelters.

Chapters 7 and 8 describe the settlement patterns for the various archaeological units. Sites were classified into functional types, such as semi-permanent habitations, residential camps, processing camps, hunting camps, reduction loci, and storage caches. Distributions were examined by sample stratum and through time. Of the 689 aboriginal sites identified on the project, 46 percent were attributed to the Archaic. Early, middle, and late Archaic components were identified in nearly equal frequencies. Seventeen percent of the aboriginal components were attributed to Formative groups. Both Fremont and Virgin Anasazi units were represented. The Fremont occupation was not intensive and predated the Anasazi occupation by approximately 150 years (McFadden 1998). The southern portion of the Kaiparowits Plateau is thought to represent the southern extent of Fremont logistical forays. The Anasazi occupation is better represented. Two strata, Collet Top and Fiftymile Mountain, were evidently the primary locus of dry-land Anasazi horticulture and semi-permanent habitation; other strata evinced variation in overall settlement patterns, though most were occupied on a short-term basis. The Post-Formative period includes approximately 13 percent of the aboriginal sites recorded. Post-Formative period sites probably representing occupations by the Southern Paiute, indicated foraging activities by relatively small groups of people.

Interpretations of prehistoric settlement patterns were strengthened through the use of innovative techniques for determining site age. NNAD archaeologists were able to ascribe many of the sites they discovered to archaeological units based on the projectile point or ceramic types found on site surfaces. During the first field season, however, they noted several variables that seemed related to site age that were seldom considered by other archaeologists working in the region. If these variables could be determined to be reliable age indicators, then prehistoric sites lacking surface diagnostic artifacts could be attributed to some other chronological category than "unknown." The surveyors noted that site age seemed to be reflected by the degree of patination and calcium carbonate encrustation on flakes and tools, by the condition and degree of scattering of cultural materials (especially grinding implements), and by the presence/absence of charcoal and the size of charcoal pieces in surface hearths and in middens.

A sample of 13 sites was selected for test excavation to test the reliability of these variables for site dating. The selected sites were thought to reflect variation in site age, as indicated by the alternate dating variables, and had exposed features suitable for chronometric dating. The radiocarbon dates obtained during testing supported the ages suggested by the alternative dating variables. Sites were successfully classified into broad temporal units, such as Post-Formative, Formative, and Archaic. Investigators found that sites with artifacts encrusted with calcium carbonate (caliche) more than .5 mm thick tended to date to the Archaic stage, whereas thinner encrustations indicated a more recent age. Chalcedony artifacts were especially useful for patination studies. Archaic sites tended to yield heavily patinated artifacts; Formative sites tended to have artifacts with little or no patination; and Post-Formative artifacts lacked any patination, appearing to be freshly chipped. These observations even permitted surveyors to identify debitage concentrations of different ages on sites, in the absence of conventional diagnostic artifacts. Ground stone artifacts, especially metates, tended to exfoliate or break with increasing exposure to the elements. Whole or broken metates tended to be recent, whereas metates reduced to small fragments were usually found in Archaic contexts. Charcoal within features exposed on the surface also demonstrated increased degradation with age. Charcoal in Post-Formative hearths tended to be as large as a fingernail and somewhat rounded. Within Formative hearths, charcoal had weathered to small flecks. Surface hearths at Archaic sites lacked charcoal flecks, but contained homogenous charcoal-stained soil.

The authors acknowledge that a variety of factors affects all the alternative dating variables, and thoroughly discuss these factors. Overall, however, the alternate dating variables were found to be useful, and especially confident results would result when multiple lines of evidence pointed to the same conclusion. The alternate dating method would benefit from additional chronometric dating, however, because the project's testing phase was rather limited. Because the authors' alternative dating methods are logical and easy to apply, they may have utility outside of the Kaiparowits Plateau study area, a premise that merits consideration by others.

Chapter 9 discusses the 39 Euroamerican sites recorded by the project. The highlight of the chapter is a comprehensive presentation of the Euroamerican and aboriginal history of the Kaiparowits Plateau. Most of the sites consisted of Euroamerican camps associated with the early twentieth-century ranching industry. Other common site types included historic inscriptions and corrals. I had only one quibble with this section; most of the historic camps were dated by means of measuring evaporated milk cans. Evaporated milk cans are commonly found at historic sites, and some (e.g., Simonis 1997) have proposed that cans of different sizes were manufactured at different times, thereby making them useful for cross-dating. Other historical archaeologists object to using evaporated milk cans for cross-dating purposes, citing evidence that cans of different sizes were manufactured throughout the historic period in question (Jonathon Horn, personal communication 2003). Historical archaeologists should carefully scrutinize the practice of using evaporated milk cans to determine site age, and then publish their results in a refereed journal.

Chapter 10 includes a summary of inventory results, an examination of the sampling strategy's effectiveness, and recommendations for future work. Several appendices are attached. Appendix B presents raw site data that will be especially useful to other researchers.

An assessment of a work must, in part, be based on whether the objectives developed prior to the project were achieved. Geib and his colleagues defined two major objectives for their project: first, to provide federal land managers with an indication of the distribution of historic properties within a portion of the Grand Staircase-Escalante National Monument; and second, to better understand human use of various environmental zones within the study area. The first objective was driven by Section 110 of the National Historic Preservation Act, which requires federal agencies to identify historic properties on lands under their jurisdiction. Certainly, proper management of the newly defined national monument is contingent on knowing the nature of all its constituent resources, and the sample-oriented cultural resource inventory is an important first step toward that goal. The completion of a sample-oriented inventory by no means achieves compliance with Section 110, however, as the law seems to demand identification of *all* significant cultural resources within the domain of a federal agency. Cultural resources are almost always managed within an economic and political milieu, however, and the intensive cultural resource inventory of the new national monument, or even its 800,000-acre Kaiparowits Plateau study area, would be an enormously expensive undertaking. This initial two percent inventory of the Kaiparowits Plateau study area is a laudable start, and clearly demonstrates the Bureau of Land Management's commitment to compliance with Section 110 and thoughtful management of cultural resources.

The project's second stated objective, to better understand settlement and land-use patterns within various environmental zones and periods in the study area, is also achieved, at least to some degree. As the authors point out in Chapter 1, modeling of settlement behavior can be conducted at multiple levels. One common approach examines why people might have selected a particular point for occupation. This approach usually considers the environmental and topographic variables represented at a site and compares and contrasts those variables to nonsite locations in the general area. This approach can result in the formulation of probabilistic statements for site potential at other geographic points within the study area. A second approach and the one used by the NNAD archaeologists, considers a space larger than a point as the unit of study. The nine geographic strata employed in the sampling scheme all have different densities and distributions of natural resources as the result of the interplay of a host of environmental factors, such as elevation, soils, and precipitation, and so may have been differently attractive to the prehistoric and historic occupants of the region. A project objective, therefore, was to determine how site densities varied between strata, and to examine general environmental attributes that might account for the variation. Geib and his co-authors admit that superior settlement pattern modeling could probably have been achieved through the definition of sampling strata based on other suites of environmental data, such as isoplethic productivity maps based on the resources important for human use. Unfortunately the authors found that such data were unavailable in the study area and that project funds were insufficient for developing such databases.

The sample survey of the nine strata provided excellent data regarding the density and types of cultural resources within the sampling universe. Site densities ranged from .7 to 12.2 sites per 160 acre sample unit. The authors note that the low sampling fraction precluded a thorough understanding of the variation in site densities between sample units, and present recommendations for additional inventory to achieve that understanding. The inventory resulted in the identification of 710 sites, a large enough sample to permit examination of variation in site types of various functions. The discussions of site distributions by functional type provided insight into past land use patterns. Variation in site type through time and across the sampling strata was examined. Through these analyses, the objectives of understanding the distribution, diversity, and density of sites in the study area were realized. Small-scale factors affecting site distributions, such as those commonly considered in settlement modeling approaches that use points, rather than areas, as the unit of study, were not identified. One would not know, for example, whether all semi-permanent residences were situated on canyon rims or spread out across mesa tops. The absence of such information, however, is not a shortcoming of the work, but simply a reflection of the overall project objectives and sampling approach. Chapter 1 implied that variation in natural resources might explain variation in site distributions. Such an explanation was not achieved; though densities of artifacts, features, and sites of varying functions and affiliations were examined by stratum, the authors did not fully relate the reasons for variation in a theoretical context.

Kaibabitsinüngwü is a Class II, sample-oriented cultural resource inventory report, prepared in response to historic preservation legislation. Does the report deserve a spot in your library? My opinion is an emphatic "yes," for those with an interest in the cultural resources of southern Utah. Like other large-scale inventory reports, *Kaibabitsinüngwü* provides information about the distribution and density of sites ascribed to various archaeological units, basic information for students of Utah's archaeology. Because the Kaiparowits Plateau is along a zone of interface between peoples representing major archaeological units, such as the Fremont and the Anasazi, and the Virgin and the Kayenta Anasazi, the basic culture history is especially interesting and inspires additional research to explain the apparent archaeological variation. Like the best of archaeological inventory reports, *Kaibabitsinüngwü* examines the functions of sites in the context of the natural and social environment and produces a tenable model of settlement patterns and basic subsistence practices. The work not only contributes to our understanding of a geographic region, but also describes an innovative method for dating sites on survey where diagnostic artifacts or features are absent. Although the alternate dating method may not work equally well in all areas, it is worthy of consideration on other projects. The report is well edited, well written, and has especially nice graphics. It also succeeds because the project budget was sufficiently large to permit the authors to go the "extra mile" in developing contexts for discussions and for thorough consideration of all project data. The volume is an outstanding example of an inventory report.

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Stone Age Spear and Arrow Points of the Southwestern United States,
by Noel D. Justice. Indiana University Press, Bloomington, Indiana. 2002. 427 pages, 34 figures, 8 color plates, 52 maps. $59.95 *cloth*

Stone Age Spear and Arrow Points of California and the Great Basin,
by Noel D. Justice. Indiana University Press, Bloomington, Indiana. 2002. 531 pages, 37 figures, 8 color plates, 53 maps. $59.95 *cloth*

Reviewed by: **Pat Paeper,** Utah Valley Chapter, Utah Statewide Archaeological Society

Anyone who has sat with an unidentified point in hand while poring over reference works will appreciate these books. As in his previous books in this series, Noel Justice takes great care to construct classifications and to organize his material in a manner that leads the researcher easily to the desired section.

The color plates are placed close to the front of the books, and a chart containing a numbered outline of each point shown accompanies every plate. Further, each point is identified and briefly described, including the material used in its manufacture. The site where it was found and the collection where it now resides are also identified, and the corresponding drawing, illustrated in the body of the book, is referenced.

A useful identification key follows the color plates. Each general type, which the author has grouped as "clusters", is shown in silhouette, making it a simple matter to go directly to the most appropriate section in the body of each book.

While some of the material is repetitive out of necessity, the general introduction in each book is long and richly detailed. The author begins with an explanation of how he determined each cluster classification, basing it on similar shapes, comparable ages, and distribution. Where appropriate, the clusters are then further divided into types based on variations within the clusters. Thus, the Clovis Cluster stands alone while the Northern Side-notched Cluster breaks down into the Northern Side-notched, Sudden Side-notched, San Rafael Side-notched and the Ventana Side-notched. Similar clusters or types are also referenced when appropriate.

The introductions in each of the two books not only cover the organizational concepts but include illustrated discussions of projectile point manufacture and weapon technology for each geographic area. The introductions end with a brief overview of current knowledge and theories about the earliest Americans.

The body of the books are just as detailed and well organized. Each cluster and type of point is introduced with an overview, followed by Age and Cultural Affiliation, Distribution (including a map), and Morphological Correlates (names or other descriptions of points that share the same range of variation as the cluster or type being discussed). A generous sampling of the variations in each cluster and type is illustrated with crisp, life-size drawings, labeled in the same manner as the color plates. If further information is needed, an appendix near the back of each book gives the measurements for every point in millimeters.

Professionals and avocationists alike will find these books invaluable aids when working to identify projectile points and cutting tools. And, given the overlapping distribution of some point types in these two geographical areas, these books will work well when used as companion references.

Tracing the Past: Archaeology Along the Rocky Mountain Expansion Loop Pipeline, by E. Steve Cassells. Published by Alpine Archaeological Consultants, Inc., Montrose, Colorado. 2003. ISBN 0-9743137-0-X. 40 pages with many maps and illustrations. $6.95 *paper.*

Reviewed by: **Ronald J. Rood,** Utah Assistant State Archaeologist, Antiquities Section, 300 Rio Grande, Salt Lake City, UT 84101

Large cultural resource management (CRM) projects often produce new and significant archaeological information about a region. More often than not this information is included in technical reports written by archaeologists for archaeologists. While these detailed reports are necessary, they are often of little or no use to the general public. Some of the archaeological information may be published in professional journals accessible to the advanced avocationist, but again, the general public is not informed. This lack of communication to the public about archaeological work is especially unfortunate since it is the public, through taxes and utility costs, paying for all of this research.

It has been demonstrated time and time again that the general public has a real interest in the science of archaeology (Pokotylo and Guppy 1999; Ramos and Duganne 2000). Archaeology as a profession, and especially CRM archaeology, is getting better at keeping the public informed and educated about ongoing archaeological research. *Tracing the Past* is a recent publication providing information about the past using data provided by large CRM projects (see Iroquois Gas Transmission System 2000; Janetski 1998; Wright and Silversmith 2002).

The Rocky Mountain Expansion Loop Pipeline, 412 miles in length, required a large archaeological effort in Utah, Colorado, and New Mexico, with Alpine Archaeological Consultants and Woods Canyon Archaeological Consultants conducting the fieldwork. Part of the mitigation plan included the production of a report written for the general public. Alpine and Woods Canyon contracted with E. Steve Cassells, author of the popular text *The Archaeology of Colorado* (Cassells 1997) to write and produce *Tracing the Past.*

The writing style is appropriate for young people, perhaps as young as fourth grade, and adults; however, there are some confusing statements in the volume. For example, on page 6 Cassells writes, "Brian Fagan once said that archaeologists are storytellers." This is true, but for the general reader perhaps looking at an archaeological topic for the first time, who is Brian Fagan? Including a reference or two from Fagan in the *Suggested Readings* section would have been appropriate. I would also question the prose on page 31 stating, "Life in earlier times was not always nasty and brutish." Life now is not all fun and games either, nor was it in the past. In fact, modern life is sometimes nasty and brutish. For the public at large, terms like "nasty" and "brutish" may evoke a picture of the cave-dwelling dolt using a club to subdue his women and muttering in unintelligible grunts and groans. If the idea is to present a well-rounded picture of past life, then the humanity of past life and the fact that humans during prehistoric times were pretty much like us modern folks are essential to highlight. Terms that perpetuate stereotypes in a document written for the general public should be avoided.

Tracing the Past is an attractive volume with color photographs of artifacts and archaeologists at work. The volume is a wonderful mix of color, photography, graphics, and text. Unfortunately, in a couple of places, the color of the background makes the text difficult to read. For the most part, Cassells leaves out unnecessary jargon, and a glossary of terms is provided in the back. In discussing the history of American archaeology, he does mention *culture history* studies, *processual archaeology* and *post-processual approaches,* terms that are all a bit confusing and unnecessary for the general reader. I would have simply described archaeology as a science using scientific methods and the formulation and testing of hypotheses with a main goal or focus being to determine how people lived day-to-day in the past. Defining *post-processual* archaeology as "attempting to deduce what the early people were thinking" (page 6) may be correct, but for a general audience it may provide more confusion and foster a lack of trust from the reader.

Cassells starts out by explaining what archaeology is, how it is done, who does it and why, and who pays for it. He makes a distinction between "academic archaeology" and cultural resource management and correctly points out that it is CRM that employs most of the archaeological community. His discussion of CRM, including site survey, evaluation, consultation with state and federal agencies, treatment plans and data recovery is good. However, there is no mention of consultation with Native American tribes, something that in recent years has become a required and significant aspect of large archaeological projects. Cassells states (page 7) that it is not uncommon for archaeological sites "to be deemed unimportant." This of course is true, but for the non-archaeologist reader, some explanation (e.g., erosion, lack of context, previous damage) about what makes a site unimportant would have been useful.

There is very little in *Tracing the Past* about post-field analysis and interpretation. One photograph of an archaeologist sitting at a desk is included, but all of the other photographs are field shots. Laboratory analysis is underrepresented, as is a discussion of the detail that goes into an archaeological project. Copies of field maps and notes could have been presented along with a discussion about how archaeologists actually take a site apart and then reconstruct in the laboratory using both field and laboratory analyses.

In a section called "Marching Through Time Along the Pipeline Route," Cassells offers an overview of the cultural history of the Colorado Plateau. An illustrated time-line would have been a useful visual addition to this section. There are also sections about dating methods, Smithsonian site numbers, wild plants, stone and bone tools, the use of tobacco in prehistory, culturally scarred trees, dog burials, and Euro American artifacts. Appropriate archaeological examples from the pipeline work are included.

The last chapter of this volume is entitled "*So What?*" For me, this was a disappointing section. Over a few pages, Cassells comments on why cultural resource studies are important and why cultural sites need to be protected. Simply stating the over-used assertion that a failure to understand the past will lead to repeating the mistakes of the past (page 36) is not enough to argue that cultural resource studies are important. The last sections, called "What the Rocky Mountain Pipeline Taught Us," and "What Does It All Mean?" are somewhat confusing and lacking in detail. The sidebar on page 38 showing how many specialized samples were processed is confusing and seems to be out of place. So what if there were four "protein residue samples" or eight "instrumental neutron activation analyses" run if there is no discussion of what these analyses can offer the archaeologist.

In five short paragraphs, Cassells sums up what archaeological excavations along this pipeline taught us. Although the paragraphs are concise, the explanations on how the archaeologists came to those conclusions are hard to recognize.

Cassells writes that thousands of artifacts were recovered (by the way, fragments of animal bone are artifacts too) and those from "government" land now "rest in a museum." This would have been a good opportunity for Cassells to explain why artifacts are curated and held in museums. The way this is presented suggests to the uninformed reader that once artifacts are analyzed, they are put away forever and not studied again.

After someone reads *Tracing the Past*, they may want to know more about archaeology or perhaps find a way to get involved with archaeology. The suggested readings section is fine, but a list of museums, places to visit, and contacts for local avocational archaeological societies or groups would have been a welcome addition.

Tracing the Past is an attractive volume, but I'm not sure it tells a story that the general public will find compelling. Making archaeology come alive to a general audience requires some linkage of modern life to the past. Cassells alludes to this, but I'm afraid *Tracing the Past* falls short. In spite of what I consider shortcomings, I recommend *Tracing the Past* as a useful volume for understanding how archaeology is funded in North America. Further, it provides a basic overview of Colorado Plateau archaeology, both prehistoric and historic, and I can see this volume as an asset for elementary and middle school educators and for the public at large.

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Utah Archaeology uses a modified version of *American Antiquity* style, the journal of the Society for American Archaeology. Authors submitting manuscripts are requested to follow *American Antiquity* style, especially for reporting dates, measurements, headings, in-text citation, and references. Either consult a previous issue of *Utah Archaeology* or see the October 1992 issue of *American Antiquity*, which contains a complete style guide and is available in many libraries. If you do not have access to a copy please contact one of the editors.

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Steven R. Simms
Anthropology
Utah State University
Logan, UT 84322–0730
(435) 797–1277
ssimms@hass.usu.edu

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