Journal of California and Great Basin Anthropology
Vol. 18, No. 1, pp. 131-154 (1996).

Analytical Perspectives on a Protohistoric Cache of Ceramic Jars from the Lower Colorado Desert

JAMES M. BAYMAN,[1] Dept. of Anthropology, Univ. of Hawaii, Honolulu, HI 96822.
RICHARD H. HEVLY, Dept. of Biological Sciences, Northern Arizona Univ., Flagstaff, AZ 86011.
BOMA JOHNSON, Bureau of Land Management, Yuma District Office, Yuma, AZ 85365.
KARL J. REINHARD, Dept. of Anthropology, Univ. of Nebraska, Lincoln, NE 68588.
RICHARD RYAN, 381 South Linx Creek Rd., Prescott, AZ 86303.

A cache of hermetically sealed ceramic jars found in the Lower Colorado Desert was examined using chronometric dating, pollen and macrofossil extraction, design analysis, and water retention experimentation. The cache apparently dates to the protohistoric fifteenth through seventeenth centuries. Findings from these studies contribute to knowledge in four problem areas: (1) ceramic jar function and use-history; (2) storage technology and caching behavior; (3) ceramic dating and chronology; and (4) symbolic iconography. Biotic remains from inside the jars document their use for transporting a variety of riverine and desert plants, before they were finally filled with flowers and seeds, and placed in a small cave in the Trigo Mountains. A stylized bird painted on one of the jars implies that iconography imbued the cache with ritual meaning.

IN 1984, the recovery of a cache of hermetically sealed complete and restorable ceramic jars provided an exceptional opportunity to address issues related to ceramic jar function and use-history, storage technology and caching behavior, ceramic dating and chronology, and symbolic iconography in the Lower Colorado Desert. A total of five jars (three of which were sealed with organic resin) was recovered from a small cave in the Trigo Mountains, approximately three miles east of the current channel of the Lower Colorado River (Fig. 1). Through radiocarbon dating, pollen and macrofossil extraction, water retention experimentation, and painted design analysis, the use-life of a small assemblage of ceramic jars was explored.

Although it was initially hypothesized that the jars were used for long-term storage of water, evidence suggests that the jars were used by protohistoric peoples (fifteenth through seventeenth centuries) for a variety of purposes. Evidence discussed below suggests that the use-history of the vessels (both prior to and subsequent to water storage) was quite complex, and that the vessels were used for a variety of economic, as well as noneconomic, purposes. This evidence is used to suggest that although all of the vessels were used for similar purposes (i.e., transporting plant products and/or carrying water) during their active circulation, their contents varied when they were finally deposited in the cave. These analyses expand our understanding of protohistoric native peoples and their lifeways in the Lower Colorado Desert.

LOCATION AND ENVIRONMENT

The jars were recovered from a small cave (Site No. R:10:87 [BLM Yuma]) on the northwest slope of the Trigo Mountains, a range of Cretaceous andesites and Mesozoic schists near Cibola, Arizona (Fig. 1). This portion of the Lower Colorado Desert is extremely arid, re-

Fig. 1. Map of Lower Colorado River Valley showing the location of Site No. R:10:87.

ceiving only 12.7 cm. average rainfall each year (Shreve and Wiggins 1977). Vegetation in the area is typical of the Lower Sonoran life zone, including desert scrub, cacti, leguminous trees, and perennials. The climate has changed only slightly since the Late Pleistocene, with prehistoric conditions similar to those found today (Cole 1986).

CULTURAL BACKGROUND

Ceramics were first produced in the Lower Colorado River Valley by prehistoric horticulturalists known as the Hakataya (Schroeder 1957, 1958) or the Patayan (Rogers 1945; Colton 1947; Harner 1958). Prehistoric archaeological remains (ceramic horizon) from this region date consistently to the period between ca. A.D. 600 and 1500, followed by the protohistoric/ethnohistoric period (A.D. 1500 to 1900). During the ethnohistoric period, numerous Yuman tribes developed from the broader Lower Colorado Patayan tradition, including Quechan, Halchidhoma, and Mohave.

According to their own oral history (e.g., Emerson 1971), the Quechan were located near the confluence of the Colorado and Gila rivers prior to the arrival of the Spaniards. At the same time, the Mohave lived at the interface of present-day Arizona, Nevada, and California (Fig. 1). Ethnographic accounts of Mohave Indians who inhabited this region indicate that visits to the interior desert were brief and primarily conducted to gather plant foods and to hunt large game (e.g., Castetter and Bell 1951), as well as for trade and interaction with neighbors (Russell 1908), and the undertaking of military missions (e.g., Dobyns 1957; Kroeber 1974).

That ethnographic (as well as prehistoric) visits to the desert were brief has been confirmed by the small and ephemeral remains identified by archaeological surveys conducted in areas away from the Lower Colorado River (e.g., Rogers 1939; Schroeder 1952; Schaefer and Elling 1987a, 1987b; Shelley and Altschul 1989). During the protohistoric and historical periods, the river valley was initially exploited by the Quechan and the Mohave. After A.D. 1500, the Halchidhoma moved into the Cibola Valley between the Quechan and Mohave (Dobyns et. al. 1963:137). Three centuries later, in 1825, the Quechan and the Mohave expelled the Halchidhoma from the valley.

Whether the ceramic cache was deposited by the Quechan, Mohave, or Halchidhoma is not immediately clear. Chronometric dating of the cache (see below) suggests that it was most likely deposited by Halchidhoma peoples, sometime between A.D. 1500 and 1800.

CACHE RECOVERY AND ANALYSIS

Condition of Recovered Jars

When the cache was discovered, the five ceramic jars (Figs. 2 and 3, Table 1) were in

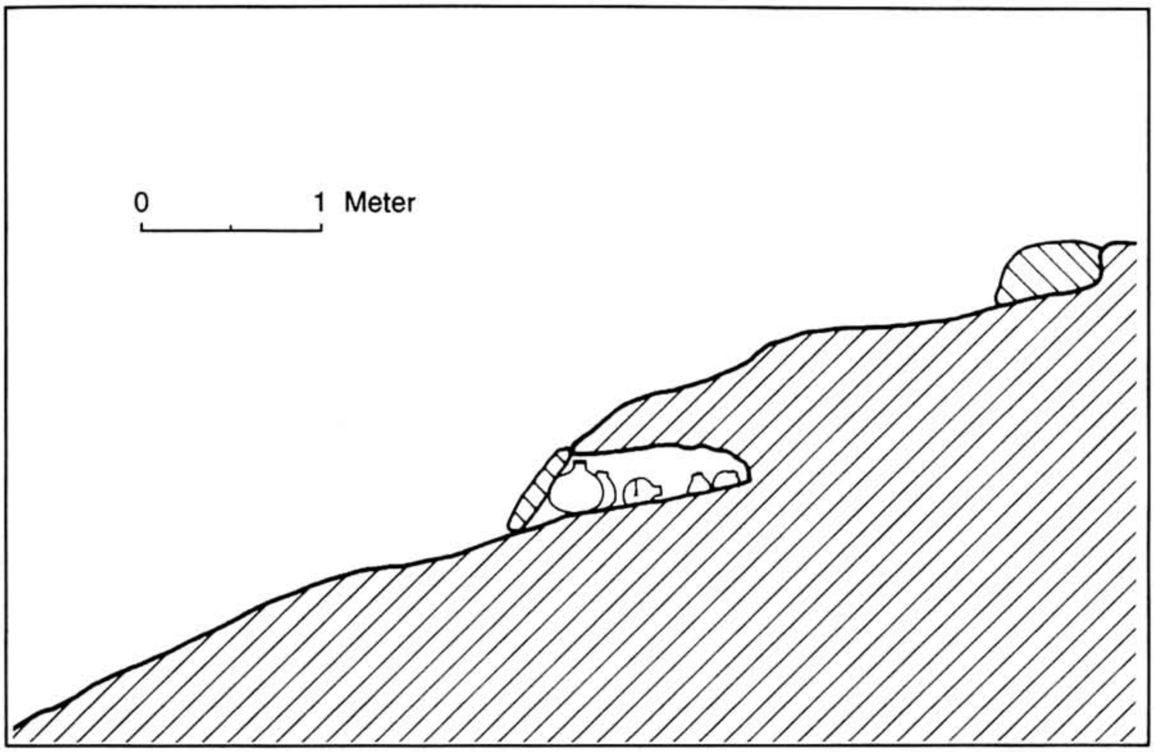

Fig. 2. Schematic profile of jar cache in cave.

varying states of preservation, and the ceramic lids for two of the jars (3 and 5) had been punctured or perforated. Jar 1 was fully intact, and its aperture was sealed with a perforated sherd disk and resin. Jar 2 was also intact, and its aperture was covered with resin and a sherd disk. Jars 3 and 4 were partially covered by a large stone. Apparently, this stone had sheared from the cave ceiling, breaking Jars 3 and 4, sometime after the deposition of the cache. Fragments of Jar 3 were lying near a detached, perforated sherd disk, and the jar was partially restored following its removal from the cave. Jar 4 was fully restored except for its nonperforated sherd-disk cover, which was found detached and encrusted with resin. Jar 4 also had a crack on its body which had been sealed with resin. Jar 5 was found lying on its side, and it also had a resin-sealed crack on its body. The resin-sealed disk cover on Jar 5 was in place and had been perforated.

Ceramic Chronology and Classification

Chronological placement of the three major periods for Lower Colorado pottery is based on scant chronometric and stratigraphic data (Waters 1982; Bayman and Ryan 1988). Fortunately, recent work by Schaefer (1994a, 1994b) and others has refined the degree of temporal control for this ceramic tradition. According to Waters's (1982) earlier system, Period I is relatively dated to ca. A.D. 500 to 1000, Period II to ca. A.D. 1000 to 1500, and Period III to post-A.D. 1500. The placement of Period I is based on Hohokam intrusives (e.g., Santa Cruz Red-on-buff) at two stratigraphic localities and radiocarbon dates from house fill and roasting pit fill contexts, elements that are absent at Period II and III sites (Waters 1982:283). Although the temporal break between Patayan II and III was originally based on a date for the final recession of Lake Cahuilla in California

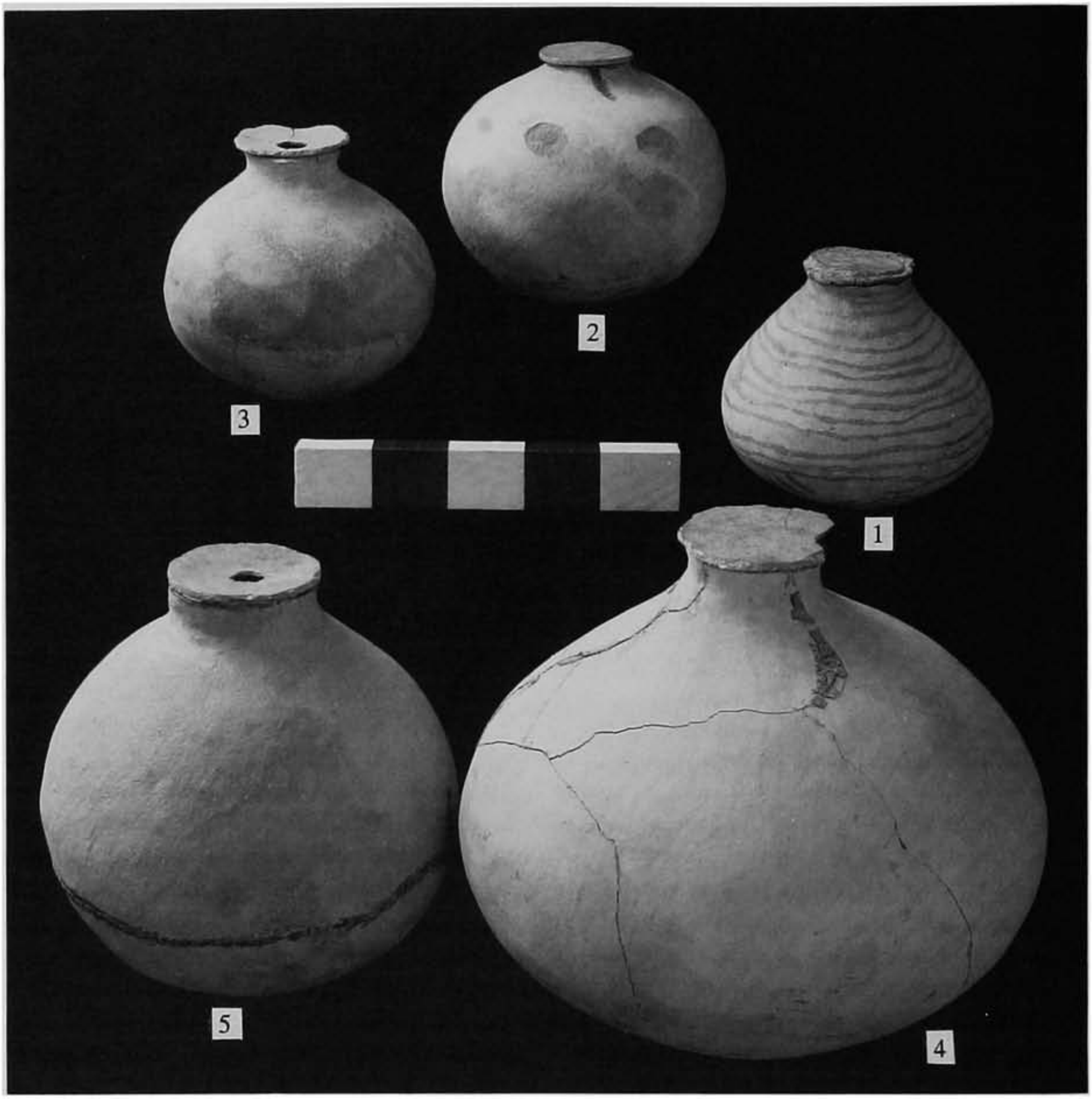

Fig. 3. Reconstructed ceramic jars (photograph by Peter Bloomer). Jar numbers in photograph correspond to descriptions in text. Scale is 25 cm.

(Waters 1982), Schaefer (1994a:72, 1994b:84-85) suggested that Patayan II lasted until a fifth and final recession of the lake at approximately A.D. 1650.

The ceramic jars were classified according to morphological form and temporal period following Waters's (1982) revision of Rogers's (1945) Patayan ceramic typology (Table 1, Fig. 4). Diagnostic traits of his typology include surface treatment, jar rim and form, and temper (Rogers 1945; Waters 1982:281). Period I ceramics have traits such as direct (nonrecurved) rims with notching, burnished and red-slipped exteriors, punctate and incised decorations, lug and loop

Table 1
DESCRIPTIVE DATA FOR CERAMIC JARS FROM THE TRIGO MOUNTAINS CACHE

Jar No.	Ceramic Type	Rim Type	Maximum Height, Diameter, Aperture (cm.)	Temper/Inclusions
1	Colorado Red-on-buff	recurved	19 x 17 x 6	sand and tremolite
2	Colorado Buff	recurved	20.5 x 19 x 5	temper appears to be the same as Jar 4
3	Colorado Buff	recurved	19 x 18 x 5.5	sand
4	Colorado Buff	recurved	33 x 30 x 6.5	sand, tremolite (white crystal), and metasediment or igneous spars
5	Colorado Buff	direct	25 x 27 x 8	temper appears to be the same as Jar 4

handles, and a distinctive shoulder. Several of these traits are absent on Period II and III ceramics, which are noted for their recurved rims, stucco finish, and greater abundance of fine-lined geometric designs (Rogers 1945a:188). On the basis of their recurved rims with flattened lips (with the exception of Jar 5) and relatively fine manufacture (well-smoothed surfaces), all five jars in the cache appear to fit within Period III of Rogers's typology.

Changes in Period III ceramics are somewhat subtle and generally consist of refinements of Period II traits, except for the striking addition of reinforced rim bands on some vessels, as well as a new form—a high-necked, small-mouthed water jar. The five vessels in the Cibola cache, however, do not have particularly high necks or reinforced rim bands. At least some Period III ceramics date to the Protohistoric Period, especially those with reinforced rim bands. Although specific types have been proposed within these three major Colorado Buff ware periods, these types are often difficult to identify, and a lack of consensus exists among different ceramic analysts (e.g., Rogers 1945; Schroeder 1952, 1958; Waters 1982). Nevertheless, the kinds of temper and/or inclusions that are evident in the paste of the broken vessels (Jars 3 and 4), as well as all of the ceramic disk lids, indicate that they fit within the Colorado Buff ware type (M. Waters, personal communication 1984) (Table 1). Typological classification of Jars 1, 2, and 5 was more difficult since they are intact. However, a provisional assessment was possible by examining areas of the vessels that are chipped, or have spall fractures. Jar 1 appears to be Colorado Red-on-buff, and Jars 2 and 5 appear to be Colorado Buff ware.

Radiocarbon Dating

Although this developmental classification provides a general guide for temporally dating Lower Colorado Buff ware ceramic assemblages, additional chronometric dates are essential to refine the existing chronological framework. The organic resin used to seal the jars provided a rare opportunity to obtain radiocarbon dates for ceramic vessels.

Samples of resin (in excess of 20 mg. each) from Jars 1, 4, and 5 were submitted to the NSF-Arizona AMS Facility at the University of Arizona for tandem accelerator radiocarbon dating (Table 2). Prior to dating these three jars, Period III ceramics were only tentatively dated. These dates are especially important, since they provide a temporal anchor for ordering the entire ceramic chronology (Bayman and Ryan 1988). Chronometric dates for Jar 1 (260 $\pm$ 120 RCYBP [AA-1201]) and Jar 4 (280 $\pm$ 50 RCYBP [AA-1200]) fall between the fifteenth and seventeenth centuries, the protohistoric hori-

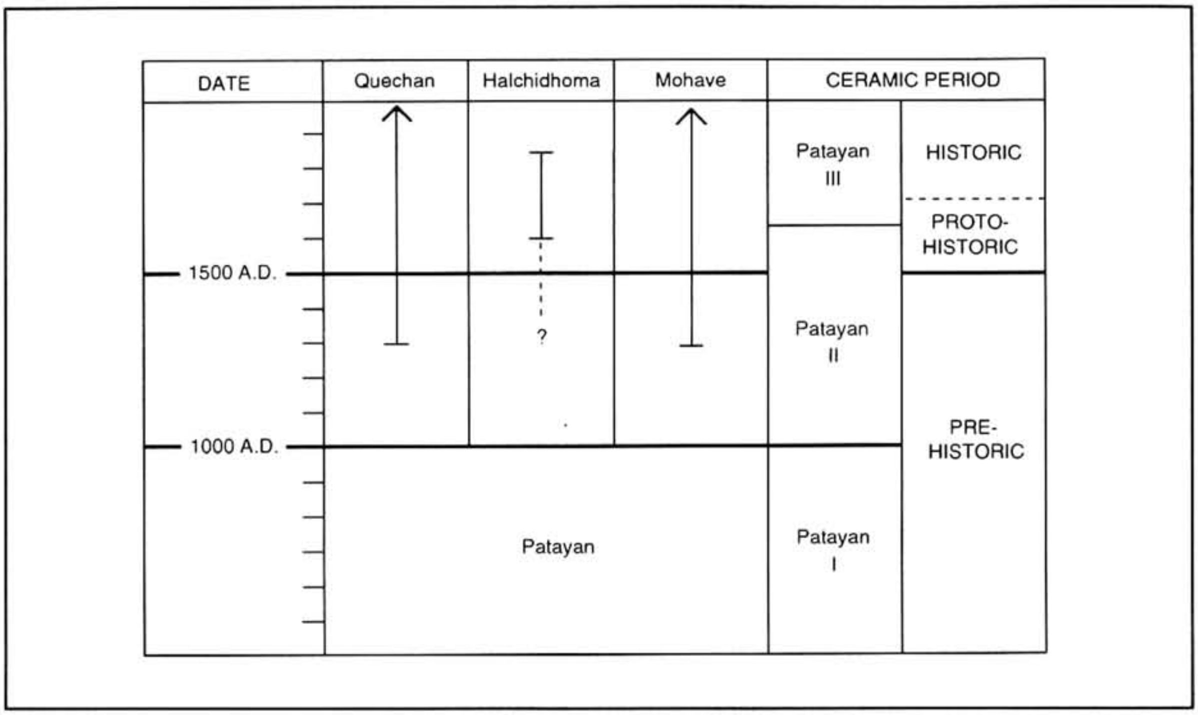

Fig. 4. Culture history periods and Lowland Patayan ceramic chronology.

zon of the Patayan. A somewhat earlier date was obtained from resin on Jar 5 (580 ± 170 RCYBP [AA-1202]).

The early date for Jar 5 is not easily explained, since it is within the range (at one sigma) for Period II (ca. A.D. 1000 to 1500), and the dates from the other two jars are more recent. If the date for Jar 5 is correct, it suggests that this jar was deposited in the cave well before the remaining jars, or that it had much longer use-life (perhaps as an heirloom). This apparent lack of concordance among the dates could also indicate that the cache was a commemorative location, and that individual jars were placed there on an episodic basis, rather than all at one time. Alternatively, and more likely, material inside the pitch (i.e., wood charcoal) is not actually contemporaneous with the active use-life of Jar 5. Wood charcoal was present in the resins sealing the jars, and may have yielded a date preceding the actual manufacture and use of this jar (see Schiffer 1986).

Moreover, whether the age of the pitch is contemporaneous with the use of the jars cannot be ascertained. It seems likely, however, that "fresh" resin from living sources (trees or lac insects) would have been used, since it probably would have been easier to fashion onto vessels than older, dry materials from dead sources.

Pollen and Macrofossil Analyses

The pollen analyses for this cache of jars followed standard techniques developed in the American Southwest (e.g., Hevly 1964, 1970, 1981; Schoenwetter 1964, 1967; Hevly et al. 1965; Samuels 1965; Schoenwetter and Doerschlag 1971; Hevly and Johnson 1974; Hevly et al. 1978; Scott 1979; Bohrer 1981; Fish 1985). Analyses for this study were chiefly focused on comparing pollen proportions among samples from the cave floor and the jars, and between 37 previously analyzed modern pollen samples from open soils of the Sonoran Desert (Schoenwetter and Doerschlag 1971). A count of 200 grains

Table 2
RADIOCARBON DATING OF RESINS FROM THE TRIGO MOUNTAINS JARS

Jar No.	Lab No.	Radiocarbon Age	Calibrated Age[a]
1	AA-1201	260 ± 120	1 sigma: A.D. 1480 to 1950 2 sigma: A.D. 1420 to 1950
4	AA-1200	280 ± 50	1 sigma: A.D. 1520 to 1656 2 sigma: A.D. 1480 to 1799
5	AA-1202	580 ± 170	1 sigma: A.D. 1264 to 1450 2 sigma: A.D. 1043 to 1650

[a] The calibrated dates, based on the Stuiver and Becker (1986) curve, were refined with an unpublished computer program at the NSF-Arizona AMS facility at the University of Arizona. These dates were reported in 1990 through personal communication from Rosemary Maddock, Administrative Assistant at the AMS facility.

from sediment in the cave (96% wind-dispersed, and 4% insect-dispersed) is comparable to that reported for enclosed rock recesses without animal or human middens, and provided a baseline for comparison with pollen recovered from the jars.

The primary goals of the pollen and macrofossil analyses were to: (1) determine the source of the organic resin that sealed the jars; (2) identify pollen from botanical remains that were potentially carried or stored in the jars; and (3) examine potential pre- and postdepositional biotic activities that may have affected the organic content of the jars.

Extraction Methods. A pollen wash solution comprised of soapy, acidified (10% HCl) distilled water was poured into Jars 1 and 5 through their perforated sherd disk covers, swirled within each jar to remove pollen, spores, and microscopic particles adhering to the walls of each jar, and then poured into 500 ml. glass beakers. Since the aperture of Jar 2 was especially well-sealed, the pollen wash solution was injected through a small crack in the jar base with a hypodermic needle, and drained into a glass beaker. The interior surfaces of each broken jar (i.e., Jars 3 and 4) were rinsed with distilled water to remove modern contaminants, then washed with the soapy, acidified solution to remove ancient pollen and spores, which was then poured into a beaker.

Pollen extraction was also completed on a collection of rodent feces, insect feces, and mummified insect pupae within Jar 5 (Table 3), since these remains might contain evidence of the original jar contents, especially if stored plant remains were consumed and excreted by these animals. Finally, procedures were undertaken to extract any pollen or macroscopic botanical or faunal remains from a cave floor control sample (Table 4). The cave floor data provided baseline values against which the jar data could be compared.

Results of Pollen and Macrofossil Analyses of Jars 1 through 4. Pollen washes from the jar interiors yielded 56 pollen types (Table 5), whereas the cave floor control sample and the pupal and fecal samples from Jar 5 collectively contained only 15 types. These disparities indicate that human behavior played an important role in the introduction of certain types of pollen into Jars 1 through 4. This pollen was most likely accumulated before the jars were placed in the cave. Many types of pollen from both the

Table 3
MACROFOSSIL REMAINS RECOVERED FROM JAR 5

Botanical Remains	Vertebrate Remains	Invertebrate Remains
Sphaeralcea seeds (n = 2)	lizard skeletons (n = 2)	lepidoptera pupae (n = 17)
Eriogonum seeds (n = 2)	rodent skeleton (n = 1)	dipteran pupal case fragment
Opuntia seed (n = 1)	lizard feces (n = 25)	formicid feces
Asteraceae seed (n = 1)	rodent feces (n = 30)	mite exoskeleton fragments, eggs
plant hash: anthers, stem/leaf cuticles, fibers, hairs, fungal hyphae, sporangia, and spores		

jars and the other samples (i.e., control, pupal, and fecal) derive from plant taxa common to desert environments.

More importantly, there are marked contrasts between the pollen from the jars and pollen from other contexts (cave control sample, resin, and sediment). For example, samples from Jars 1 through 4 included pollen from aquatic herbs and riparian trees that were lacking in the other samples. Plants that produce such pollen still grow along the Colorado River, and might have been collected by protohistoric peoples using the jars. Even if the jars were not actually used to collect riparian plants, such pollen could be introduced into them if they were used in settlements near the river. The presence of *Zea mays* pollen in Jar 2 is also intriguing: although corn pollen is often transported, it does not travel more than a few meters from its plant (Jones and Newell 1946; Raynor et al. 1972). Presumably, these jars were used by people who subsisted on both cultivated and wild plants.

Moreover, every jar specimen contained several types of pollen aggregates (wind and animal dispersed) and anther fragments, indicating that flowers were once present in the vessels. Aggregates and anther fragments from these jars are derived from grass (Poaceae), sunflower (Asteraceae), creosote bush (*Larrea* spp.), Malvaceae, globe mallow (Sphaeralcea), and legume (Fabaceae-Mimosoid) types. Notably, no pollen aggregates occurred in the cave floor sediment, or in the fecal remains in Jar 5. Jars 1 through 4 yielded 13% to 26% insect-transported pollen, three to six times the amount found in the cave floor control sample, but slightly less than half the amount found in Jar 5.

The insect-transported pollen, pollen aggregates, and anther fragments are not likely to have been transported by wind or nonhuman animals while they were cached. Rather, the insect-transported pollen, pollen aggregates, and anther fragments most likely represent a residuum of human use of the jars (i.e., storage of seeds and flowers) prior to their deposition in a cache in the Trigo Mountain cave.

Results of Pollen and Macrofossil Analyses of Jar 5. Unlike samples from Jars 1 through 4, Jar 5 contained macroscopic material, including flower parts such as anthers, several seed types, and fragments of stem and leaf cuticle, fiber, and hairs (Table 3). These probably represent a residuum of the plants that were contained in the jar at the time it was cached. These plants were possibly reduced to residuum by lepidopteran larvae, mites, ants, and mice, as the remains of all of these animals were recovered (see Table 3). Alternatively, the insects could have been stored in this jar for use as food (see Fenenga and Fisher 1978; Sutton 1988).

The presence of these remains, along with a small amount of sediment in Jar 5 (which was lying on its side in the cave), suggests that a

Table 4
POLLEN COUNTS AND PERCENTAGES FROM FLOOR AND JAR 5

Pollen Type	Cave Floor (Count/%)	Jar Wash (Count/%)	Jar Dirt (Count/%)	Rodent Feces (Count/%)	Formicid Feces (Count/%)	Lepidopteran Pupae (Count/%)
Pinus (large)	1/0.5	2/0.9	1/0.5	–	–	–
Pinus (small)	14/7.0	7/3.2	4/2.0	–	1/0.6	1/0.6
Juniperus	4/2.0	–	1/0.5	1/0.6	–	–
Quercus	3/1.5	–	–	–	–	–
Celtis	–	2/0.9	–	–	–	–
Ephedra	3/1.5	2/0.9	–	–	–	–
Poaceae	42/21.0	23/10.8[b]	35/17.8[b]	5/3.2	4/2.5	6/4.0
Cheno-Am	66/33.0	16/7.5[b]	17/8.6[b]	4/2.0	11/7.1	10/6.3
Plantago	–	–	–	1/0.6	–	–
Asteraceae Artemisia	–	6/3.8	3/1.5	–	–	–
Asteraceae (low spine)	60/30.0	64/30.0	47/23.5[b]	63/40.0	56/36.4	95/59.4
Asteraceae (high spine)[a]	6/3.0	50/23.0[b]	70/35.5	20/13.0	58/37.6	13/8.7
Asteraceae Liguliflorae[a]	–	–	–	–	1/0.6	–
Sphaeralcea[a]	1/0.5	7/3.3	12/6.1	61/39.0	12/7.8	10/6.3
Cactaceae[a]	–	5/2.3	1/0.5	–	1/0.6	–
Polemoniaceae[a]	–	–	1/0.5	2/1.5	10/6.4	1/0.6
Boerhaavia[a]	1/0.5	9/4.4	–	–	–	19/11.9
Prosopis[a]	–	4/2.0	–	–	–	4/2.5
Cericidium[a]	–	2/1.0	4/2.0	–	–	1/0.6
Brassicaceae[a]	–	1/0.5	–	–	–	–
Fabaceae[a]	–	1/0.5	–	–	–	–
Euphorbiaceae[a]	–	1/0.5	–	–	–	–
Larrea[a]	–	1/0.5	–	–	–	–
Rhamnaceae[a]	–	9/4.2	1/0.5	–	–	–
Fouquieria[a]	–	2/0.9	–	–	–	–
Solanaceae[a]	–	3/1.4	–	–	–	–
Eriogonum[a]	–	1/0.5	–	–	–	–
Rumex	1/0.5	–	–	–	–	–
Total Pollen	202	218	197	157	154	160
Wind-transported %	96.0	57.2	57.9	43.9	46.1	70.0
Insect-transported %	4.0	42.8	42.1	56.1	53.9	30.0

[a] Insect-transported pollen. All such taxa flower during the spring season, but some continue to flower through summer.

[b] Pollen aggregates.

Table 5
POLLEN COUNTS AND PERCENTAGES FROM JARS 1 THROUGH 5

Pollen Type	Control (Count/%)	Jar 1 (Count/%)	Jar 2 (Count/%)	Jar 3 (Count/%)	Jar 4 (Count/%)	Jar 5a[a] (Count/%)	Jar 5b[a] (Count/%)
Pinus (large)	1/0.5	5/1.7	--	1/0.4	12/3.5	3/0.6	--
Pinus (small)	14/7.0	15/6.2	8/3.0	1/0.4	8/2.3	11/2.4	2/0.4
Juniperus	4/2.0	1/0.3	3/1.1	2/0.8	14/4.1	1/0.2	1/0.2
Ephedra	3/1.5	6/2.0	5/1.9	5/2.0	5/1.5	2/0.4	--
Quercus	3/1.5	2/0.7	--	1/0.4	1/0.3	--	--
Simmondsia	--	--	1/0.4	1/0.4	--	--	--
Salix[bc]	--	--	--	1/0.4	2/0.6	--	--
Juglans[c]	--	--	--	--	1/0.3	--	--
Alnus[c]	--	--	--	--	1/0.3	--	--
Celtis	--	--	3/1.1	1/0.4	3/0.9	--	1/0.7
Fraxinus[c]	--	--	--	--	1/0.4	--	--
Vitis[bc]	--	--	--	1/0.4	--	--	--
Cyperaceae[c]	--	--	--	1/0.4	--	--	--
Typha[c]	--	--	--	--	4/1.2	--	--
Juncus[c]	--	--	--	--	2/0.6	--	--
Poaceae (small)	42/21.0	14/4.9[d]	22/8.3[d]	30/12.3[d]	66/19.1[d]	56/12.1[d]	7/1.5
Poaceae (large)	--	--	2/0.8	2/0.8	1/0.3	2/0.4	--
Zea (large)	--	--	3/1.1	--	--	--	--
Plantago	--	--	1/0.4	3/1.2	--	--	1/0.2
Cheno-Ams	66/33.0	91/31.6	137/51.5	25/10.2	60/17.4	33/7.1[d]	25/5.4
Asteraceae Artemisia	--	3/1.0	5/1.9	7/2.8	3/0.9	22/4.8	--
Asteraceae (low spine)	60/30.0	73/25.3[d]	42/15.8[d]	110/45.1[d]	116/33.6[d]	105/22.7[d]	214/45.8
Asteraceae (high spine)[b]	6/3.0	42/14.6[d]	16/6.0[d]	28/11.5[d]	22/6.3[d]	160/34.6[d]	91/19.5
Asteraceae Liguliflorae[b]	--	--	--	--	--	--	1/0.7
Yucca[b]	--	1/0.3	--	--	--	--	--
Eriogonum[b]	--	--	--	--	1/0.3	--	--
Berberis[b]	--	3/0.9	2/0.8	--	--	--	--
Boerhaavia[b]	--	1/0.3	--	--	--	9/1.9	19/4.1
Rumex[b]	1/0.5	--	--	2/0.8	--	2/0.4	--
Cleome[b]	--	--	--	7/2.8	--	--	--
Mimosa[b]	--	4/1.4	2/0.8	--	--	--	--
Cercidium[b]	--	3/0.9	--	--	--	3/0.6	1/0.2
Prosopis[b]	--	1/0.3	--	--	--	--	4/0.8

(Table continued on next page.)

Table 5 (Continued)
POLLEN COUNTS AND PERCENTAGES FROM JARS 1 THROUGH 5

Pollen Type	Control (Count/%)	Jar 1 (Count/%)	Jar 2 (Count/%)	Jar 3 (Count/%)	Jar 4 (Count/%)	Jar 5a[a] (Count/%)	Jar 5b[a] (Count/%)
Larrea[b]	--	1/0.3	4/1.5	--	2/0.9	1/0.3	--
Rhus[b]	--	--	--	1/0.4	--	--	--
Sphaeralcea[b]	1/0.5	--	--	3/1.2	--	19/4.1	83/17.8
Oenothera[b]	--	1/0.3	--	--	1/0.3	--	--
Opuntia[b]	--	2/0.7	--	1/0.4	5/1.5	4/0.9	1/0.2
Ceroid Cactus[b]	--	--	--	3/1.2	2/0.6	2/0.4	--
Fouquieria[b]	--	--	--	--	--	2/0.4	--
Janusia[b]	--	--	2/0.8	--	--	--	--
Brassicaeceae[b]	--	--	--	1/0.4	3/0.9	1/0.2	--
Polemoniac[b]	--	1/0.3	1/0.4	--	1/0.3	1/0.2	13/2.8
Lamiaceae[b]	1/0.5	--	1/0.4	1/0.4	1/0.3	9/1.9	3/0.6
Rosaceae[b]	--	--	--	1/0.4	--	--	--
Fabaceae[b]	--	1/0.3	2/0.8	--	2/0.6	1/0.2	--
Euphorbiaceae[b]	--	1/0.3	4/1.5	--	2/0.6	1/0.2	--
Rhamnaceae[b]	--	--	--	4/1.6	--	10/2.2	--
Apiaceae[b]	--	--	--	--	3/0.9	--	--
Boraginaceae[b]	--	16/6.6	--	--	--	--	--
Solanaceae[b]	--	--	--	--	--	3/0.6	--
Total Pollen	202	288	266	244	345	463	467
Wind-transported %	96.0	72.9	87.2	78.7	87.0	50.8	53.7
Insect-transported %	4.0	27.1	12.8	21.3	13.0	49.2	46.3

[a] The Jar 5a sample represents pooled data from the interior wash and sediment samples. Jar sample 5b represents pooled data from the fecal and lepidopteran pupae samples.
[b] Insect-transported pollen. All such taxa flower during the spring season.
[c] Aquatic herbs or riparian tree pollen.
[d] Pollen aggregates.

lizard and a mouse had entered the jar through its perforated disk seal, consuming some of the contents of the jar (e.g., seeds). Additional degradation of these biotic remains by fungi may have also occurred, since microscopic remains of fungal hyphae, sporangia, and spores were present. Thus, the integrity of the biotic assemblage of Jar 5 is compromised.

Nevertheless, some insights regarding the contents of Jar 5 merit provisional consideration. In contrast to the cave floor sample, there is a notably low proportion of wind-pollinated taxa (45% to 70%) in the jar, as well as a proportion of insect-transported taxa (36% to 56%) that exceeds the mean of modern soils by two to five standard deviations. In fact, insect-dispersed pollen in Jar 5 is several orders of magnitude greater than in the cave floor sediment, or from within Jars 1 through 4 (Tables 4 and 5). A high proportion of insect-transported pollen is typical of both human and packrat middens, and of disturbed habitation and agricultural plots in the Southwest (Fish 1985). The lack of any midden in the cave is therefore significant.

Even though some of the insect-transported pollen in Jar 5 might have been introduced by nonhuman agents (e.g., rodents, lizards), it is notable that pollen aggregates found in the sediment and interior wash samples were lacking in fecal remains. In short, the relatively high proportion of such pollen indicates some contribution to the contents of the cache by people. One likely function of this jar was for plant transportation and storage, and the macroscopic plant remains are likely to be the source of these high proportions of insect-dispersed pollen.

The storage of insects is also plausible since the remains of lepidopteran larvae, mites, and ants were also recovered from within Jar 5 (see Table 3). Archaeological and ethnographic research has documented that insects were a valued food source among native people in California, the Great Basin, and the Southwest (Fenenga and Fisher 1978; Sutton 1988). Moreover, insects (and insect by-products) were also used for ornamental, medicinal, and ritual purposes, as well as for their economic value (Fenenga and Fisher 1978:84).

Resin Analysis. Preliminary analyses were undertaken to try to determine the constituents of the resin used to seal the jars,[2] since such information would provide additional insight on storage technology and caching behavior in the Lower Colorado Desert. Products used by Native Americans for making mastics/sealants include pitch (sap) from various pines (*Pinus* spp.), junipers (*Juniperus* spp.), and brittlebush (*Encelia farinosa*), as well as the glue from simmering the horns, hide scrapings, and tendons of bighorn sheep (*Ovis canadensis*) and other animals (Sutton 1990:262; Fox et al. 1995:365). Mastic was also obtained from the creosote lac scale insect (*Tachardiella larrae*) found on the branches of the creosote bush (*Larrea tridentata*) (see Sutton 1990).

Because the resin used to seal the jars failed to dissolve after four weeks in alcohol, it is unlikely that it was derived from a gymnosperm (e.g., conifer) if the resin was, in fact, derived from a plant. That the resin quickly dissolved in potassium hydroxide indicates it was more likely derived from an angiosperm, if it was from a plant. Although pollen was exceptionally rare in two small samples of resin that were examined (0.1 gram each), microscopic examination disclosed that the resin was impregnated with wood fragments, charcoal, plant cuticles from a woody-stemmed species of plant (perhaps mesquite or creosote bush), and pollen.[3] Native American use of resins for sealing storage vessels is well-documented ethnographically in southwestern Arizona (Castetter and Underhill 1935).

Water Retention Experiment

We originally hypothesized that the Trigo Mountain cache was for water storage, perhaps by riverine-based parties of plant collectors or hunters traveling through the desert, or for watering cultivated plants. The Mohave sometimes carried water in jars to irrigate their fields when soil moisture was inadequate (Castetter and Bell 1951:240). In fact, pollen from riparian trees and aquatic herbs was indeed recovered from the jars (although no algal remains were present). However, a water retention experiment provided strong evidence that the jars were not highly effective containers for long-term water storage.

After thoroughly saturating the ceramic fabric of Jar 1 (the most intact vessel) with distilled water, its water retention capability was compared to that of a glass beaker. Both the glass beaker and Jar 1 were filled with 100 mL. of water. After 24 hours, Jar 1 retained only 26 mL. of water, leaking most of it through the jar wall fabric where it evaporated, whereas the glass beaker retained most of its water. Spier (1933:105-106) noted that water carrying and storing jars were porous, and that seepage and evaporation kept water cool for drinking.

No additional experiments were undertaken with the other jars, so it is unknown how their water retention capability would perform against Jar 1. A similar water retention experiment on a Tumco Buff jar by Shelley and Altschul (1989) indicated that the jar was quite suitable for long-term water storage. It is important to note, however, that the ceramic disk cover on Jar 2 was well sealed, suggesting that this vessel was, in fact, used to cache some type of substance. Thus, it is possible that some Lower Colorado Buff ware jars were appropriate for long-term water storage, whereas other jars were only effective for short-term transportation of water, for plant watering, or for drinking.

INTERPRETATION OF THE CACHE

Jar Function and Use-History

Analyses of biotic remains (particularly pollen, pollen aggregates, and anther fragments) suggest that the Trigo Mountain jars were used to transport and/or store a variety of fresh flowering plant materials, or juicy processed plant material containing pollen (Bohrer 1981). This does not preclude the possibility that one or more of the jars was taken on visits to water sources, such as springs or rivers. Jars 2, 3, and 5 each contained pollen from spring-flowering plants that grow in aquatic settings.

Many of the recovered pollen types (n = 56) are derived from plants whose flowers, fruits, and seeds were used by native peoples in the Sonoran Desert for food, beverages, and medicine (Table 6). No fewer than 32 pollen types were found in Jar 3 (Table 5). Of these 32 pollen types, some were found only in trace amounts (less than 3%) while others were relatively abundant. The trace pollen could reflect the use of the jar for various purposes before being filled with flowering plants, sealed with resin and sherd disks, and placed in a cache.

For example, fruits of *Opuntia* and ceroid cacti, wolfberry (*Lycium*-Solanaceae), and graythorn (*Condalia*-Rhamnaceae) were gathered in southern Arizona and used to prepare beverages (Castetter and Underhill 1935). The presence of sugars in these fruits would ensure that some pollen from these plants would adhere to the interior walls of ceramic jars, and thus may account for the recovery of such pollen in the Trigo Mountain cache.

Some traces of pollen reflect the use of the jars in an agricultural context (note the occurrence of *Zea mays* in Jar 2 and in the resin samples.[3] *Zea mays* pollen was also present in the two Trigo Mountain jars reported by Shelley and Altschul (1989:101). The other varieties of pollen suggest that the jars were used to transport plant products from multiple ecological zones, perhaps during plant-gathering expeditions.

Environmental settings from which the various types of pollen originated include pond or stream edges (note the presence of Cyperaceae, *Fraxinus*, *Salix* [willow], *Juncus*, and Vitaceae in Jar 3) and woodlands (note the presence of *Quercus* [oak], *Juglans*, and *Alnus* in Jar 4). The presence of pollen derived from *Ephedra* (Mormon tea), *Prosopis*, *Cercidium*, *Larrea* (creosote), Sphaeralcea, Cactaceae, and *Mimosa*-Acacia indicate that the jars were extensively used in the desert. The recovery of pine pollen is also intriguing: desert groups such as the Cocopa and Yuma in California and Arizona obtained pinon nuts through trade or direct acquisition (Castetter and Bell 1951:197-198). Aggregates and anther fragments from grass (Poaceae), sunflower (Asteraceae), creosote bush (*Larrea*), and legume (Fabaceae-Mimosoid) offer further evidence that the ceramic jars were used to transport or store a variety of plant products.

Although the exact cultural mechanisms responsible for the entry of such diverse plant re-

Table 6
HARVEST SEASONS AND POTENTIAL USES OF POLLEN BEARING PARTS OF ENTOMOPHILOUS PLANTS FROM THE TRIGO MOUNTAINS SITE BASED ON SOUTHWESTERN ETHNOGRAPHIC RECORDS[a]

Plant Taxa	Season of Harvest						Ethnographic Uses							
	Flowers			Fruits and Seeds			Flowers				Fruits and Seeds			
	Spring	Summer	Fall	Spring	Summer	Fall	Food	Drink	Curing	Technology	Food	Drink	Curing	Technology
Agavaceae	+	--	--	--	+	+	+[b]	+	--	(+)	+	(+)	--	(+)
Anacardiaceae	+	--	--	--	+	--	--	--	--	--	+	+	--	--
Apiaceae	+	--	+	--	+	+	(+)	--	--	--	(+)	--	--	--
Asteraceae														
high spine	--	+	+	--	--	+	(†‡)[c]	(†‡)	(†‡)	--	(†‡)	(†‡)	(†‡)	--
Liguliflorae	+	+	--	--	+	--	(+)	(+)	(+)	--	(+)	(+)	(+)	--
Berberidaceae	+	--	--	--	+	--	--	--	--	--	+	--	+	--
Boraginaceae	+	--	--	--	+	--	(+)	--	--	--	(+)	--	--	--
Brassicaceae	+	--	--	--	+	--	(+)	--	--	--	+	--	--	--
Cactaceae														
Opuntoid	+	+	--	--	+	--	+‡	--	--	--	+‡	+	--	--
Ceroid	+	+	--	--	+	--	+‡	+‡	--	--	+‡	+‡	--	--
Capparidaceae	--	+	--	--	--	+	(+)	--	--	--	+	--	--	(+)
Euphorbiaceae	+	+	--	--	+	+	--	--	--	--	--	--	(+)	+
Fabaceae														
Mimosoid	+	+	--	--	+	+	+	--	--	--	(+)	(+)	(+)	--
Caesalpinoid	+	--	--	--	+	--	--	--	--	--	(+)	--	(+)	--
Papillinoid	+	+	--	--	+	--	--	--	--	--	(+)	--	(+)	--
Fouquieriaceae	+	+	--	--	+	+	--	+	--	--	--	+	--	--
Lamiaceae	+	+	--	--	+	--	(+)	(+)	(+)	--	(+)	(+)	(+)	--

(Table continued on next page.)

Table 6 (continued)

HARVEST SEASONS AND POTENTIAL USES OF POLLEN BEARING PARTS OF ENTOMOPHILOUS PLANTS FROM THE TRIGO MOUNTAINS SITE BASED ON SOUTHWESTERN ETHNOGRAPHIC RECORDS[a]

Plant Taxa	Season of Harvest						Ethnographic Uses							
	Flowers			Fruits and Seeds			Flowers				Fruits and Seeds			
	Spring	Summer	Fall	Spring	Summer	Fall	Food	Drink	Curing	Technology	Food	Drink	Curing	Technology
Liliaceae	+	--	--	--	+	--	+	--	--	--	+	--	--	--
Loasaceae	+	--	--	--	--	--	--	--	--	--	--	--	--	--
Malphigiaceae	+	--	--	--	+	+	(+)	--	--	--	(+)	--	--	--
Malvaceae	+	+	--	--	+	+	(+‡)	--	--	--	(+‡)	--	(+‡)	--
Nyctaginaceae	+	+	--	--	+	+	(+)	--	--	--	(+)	--	--	--
Onagraceae	+	+	--	--	+	+	+	--	--	--	(+)	--	--	--
Polemoniaceae	+	--	--	--	+	+	(+)	--	--	--	(+)	--	--	--
Polygonaceae	+	--	--	--	+	--	(+‡)	--	(+‡)	--	(+‡)	--	(+‡)	--
Portulacaceae	+	+	--	--	+	+	(+)	--	--	--	(+)	--	--	--
Rhamnaceae	+	--	--	--	+	--	--	--	(+)	--	+	--	(+)	--
Rosaceae	+	--	--	--	+	--	--	--	(+)	--	+	--	(+)	--
Salicaceae	+	--	--	--	+	--	--	--	(+)	--	--	+	(+)	(+)
Solanaceae	+	+	--	--	+	+	--	--	(+)	--	+	+	(+)	+
Vitaceae	+	--	--	--	+	--	--	--	--	--	+	+	--	--
Zygophyllaceae	+	+	--	--	+	+	--	--	(+)	--	--	--	(+)	(+)

[a] From Coville (1892), Barrows (1900), Reagan (1929), Castetter (1935), Castetter and Underhill (1935), Curtin (1949), Castetter and Bell (1951), and Weber and Seaman (1985).

[b] + = Use inferred by the presence of dispersed pollen recovered from vessel interiors. Parentheses indicate that pollen, fruit, or seeds could have been incidentally gathered with vegetative parts.

[c] † = Use inferred by the presence of pollen aggregates and dispersed pollen from vessel interiors. ‡ = Seeds or small, dry, one-seeded fruits occurred with pollen and other macroscopic remains in Jar 5.

mains in the jars are unknown (but may include exchange and/or plant collecting), there is evidence that the jars were used to carry plants obtained from both riverine and desert settings.

Storage Technology and Caching Behavior

The ethnographic and archaeological record of the Lower Colorado Desert and environs (e.g., the Great Basin) indicate that storage in ceramic vessels was practiced for economic as well as ritual purposes. Although economic storage is more easily detected using archaeological methods, Spier (1933:106) and Forde (1931: 166) reported that scalps obtained during warfare in the Lower Colorado Desert were cached in specially made ceramic jars, and covered with plates. Since the scalps contained great power for evil, they were carefully hidden away (Forde 1931:166).

There is even more evidence for food storage. Food storage technology in the Great Basin and American Southwest included stone-lined pits (Wilke and McDonald 1989), unlined pits within and outside of structures, aboveground granaries, and sealed ceramic jars. A key goal of this traditional storage was to minimize food loss due to moisture, fungi, insects, or rodents (Wilke and McDonald 1989: 50). Euler and Jones (1956) argued that covering ceramic jars with sherd disks and resin was an effective method of hermetic sealing. By achieving airtight closure, prepared foodstuffs are better preserved. The Trigo Mountain caches are examples of this kind of storage technology.

Caching of food (or water), raw materials, and tools away from habitation settlements by mobile gathering and hunting societies and sedentary horticultural societies has been archaeologically and ethnographically documented throughout the Greater Southwest (e.g., Campbell 1931; Treganza 1947; King 1976; Janetski 1979; Swenson 1984; Wilke and McDonald 1989; Wolley and Osborn 1989; Geib 1990) and the Plains (e.g., Kornfeld et. al. 1990) of North America. This record implies that food caching was a technological strategy for guarding against seasonal or interannual productive shortfalls, and as a backup supply of food in the event of raiding, warfare, theft, or as supplies for travelers. Along the Colorado River, food and seed were stored in ceramic caches inside caves for protection against seasonal flooding (Castetter and Bell 1951:245).

Even small caches can be used to store relatively substantial amounts of food. Shelley and Altschul (1989:101-102) used volume estimates to infer that a 10.5-liter Tumco Buff ware jar in the Trigo Mountains could have stored a supply of corn meal (5,460 g.) worth about 19,000 calories. This corn would have been sufficient to feed an adult for 9.69 days, or a one-year-old child for 24.23 days (Shelley and Altshul 1989: 101-102).

Function of the Trigo Mountain Cache

Despite the archaeological and ethnographic evidence, determining the function of the Trigo Mountain cache remains problematic. Binford (1980) proposed that collectors and foragers practiced contrasting organizational strategies. Since collectors are residentially stable, they deploy task-specific groups (e.g., hunters, plant gatherers) to collect and return with resources for consumption at their residential base. By contrast, foragers are mobile, and "map on" (or move) to resource-rich areas. Rather than inhabit a primary base camp, mobile communities occupy a series of camps—each with its own set of resources. Clearly, each organizational strategy entails a different set of storage behaviors.

Binford's (1980) framework has utility for interpreting the Trigo Mountain cache. Historical horticultural groups practiced floodwater farming on the margins of rivers and supplemented their diet with foods that were gathered and hunted in the desert mountain ranges (Castetter and Bell 1951). The current location of the cave where the cache was found is approximately three miles east of the Lower Colorado River. Even if the course of the river has changed from protohistoric times, it is likely that the cache was still some distance from riverine habitation settlements, where agricultural was practiced. Despite this distance, the presence of corn (*Zea mays*) pollen in these jars suggests that the cache was systemically linked to a horticultural settlement near the river.

It is highly plausible that the Trigo Mountain cache was used to store food to buffer groups against shortages caused by resource shortfalls. Food shortages were also caused by endemic warfare, which was common during the sixteenth and seventeenth centuries (Spier 1933). The importance of caching emergency food and water reserves may have increased in the Protohistoric Period, at a time of potential population growth in the Colorado River Valley following the desiccation of Lake Cahuilla west of the river sometime in the 1500s (Waters 1982:56-62) or later 1600s (Schaefer 1994a).

As Schaefer (1994:74a) pointed out, however, a diversity of adaptive strategies and flexible settlement patterns enabled people to occupy the Lake Cahuilla area well after its desiccation. Moreover, Dobyns (1981, 1983) and Ramenofsky (1987), as well as others, noted that the sixteenth century was a watershed of European disease contact. Catastrophic population losses during the seventeenth century (or earlier; see Preston 1996) imply that protohistoric population along the Lower Colorado River was actually lower than in prehistory. Nevertheless, storage of food in ceramic jars, and caching of such vessels, could have taken place regardless of whether population was increasing in the Protohistoric Period.

The evidence that water was stored in some of the vessels (e.g., Jars 2 and 4) is equivocal. The water retention experiment on Jar 1 indicated that it was not effective for long-term water storage. However, although Jars 2 and 4 were well-sealed, they contained no macroscopic plant material.

Iconography and Design Symbolism

The elaborate design on one of the jars suggests the cache could have had a ritual function, even though some pollen found inside the jars indicates that they were once used for economic purposes. The role of ritual or iconography in mitigating potential food shortages and other life crises has not generally been examined by archaeologists working in the Lower Colorado Desert. Ceramic design iconography provides a potential avenue for exploring this issue.

For example, a red design painted on the base of Jar 1 contains a series of connected, four-prong "rake" or "comb" elements (Fig. 5). This composite rake motif is commonly found in petroglyphs and pictographs throughout the Greater Southwest, as well as elsewhere in North America. Exactly what the rake motif represents remains to be conclusively demonstrated, but it has often been interpreted as symbolic of a bird's wings or of flight (Eliade 1964; Bean and Vane 1978; Hedges 1985; Smith 1985). The painted parallel lines on the remainder of the vessel form concentric circles that are relatively symmetrical. Although no particular meaning can be readily inferred from this motif, such geometric designs are typical in the Lower Colorado Desert.

Dreaming was an important feature of Historic Period religious life among Lower Colorado River societies (e.g., Halchidhoma, Maricopa) (Spier 1933; Kroeber 1963). The spirits encountered in dreams were primarily birds, and these spirits conferred special powers, such as the ability to cure sickness or heal wounds (Spier 1933:249-251). Moreover, birds play an important role in the Mohave creation oral tradition (Kroeber 1963:50-68). Perhaps the apparent stylized bird on Jar 1 embued the cache with ritual meaning, if ceramic iconography in

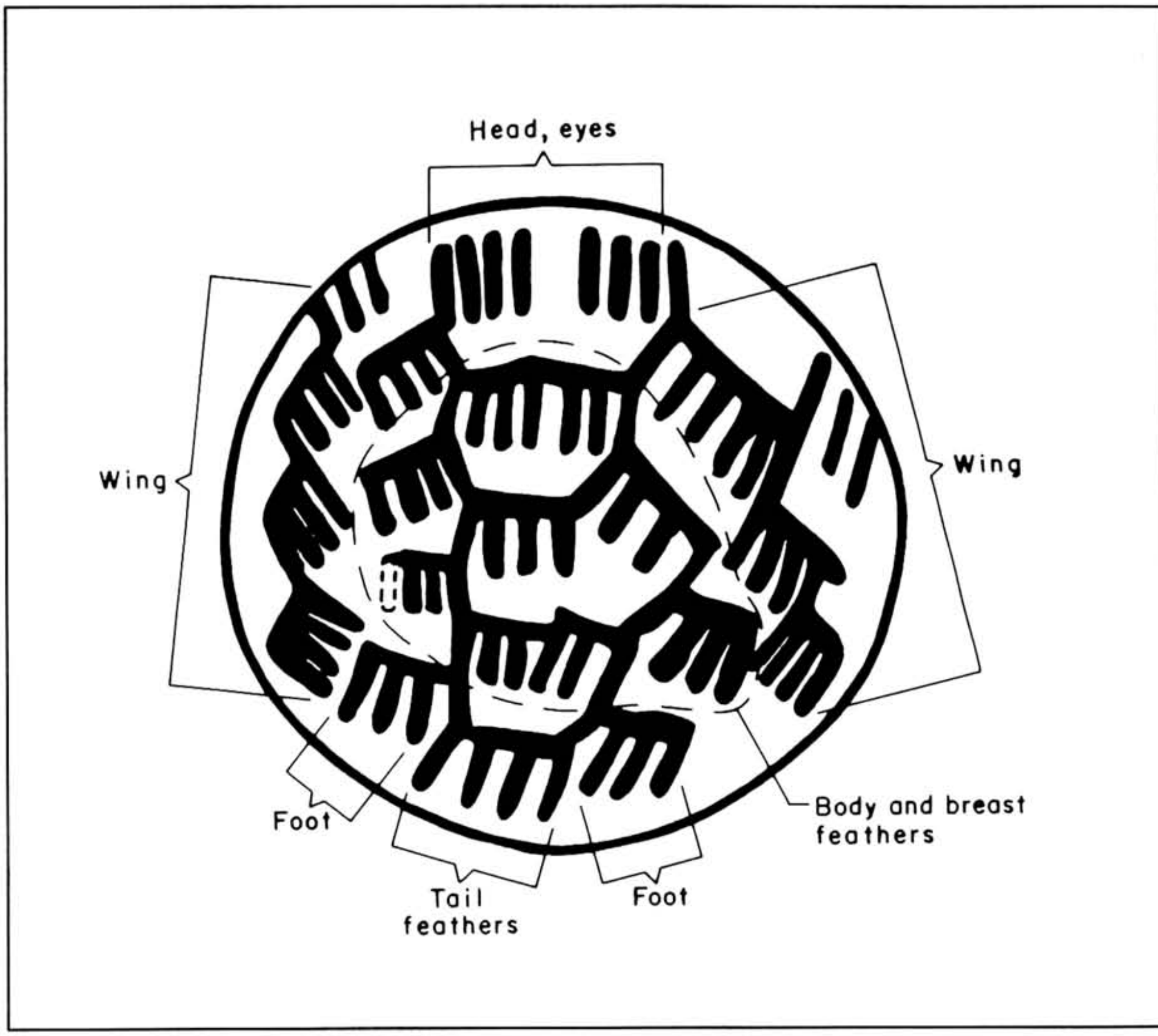

Fig. 5. Colorado Red-on-buff design on Jar 1, showing inferred stylized bird motif.

the Lower Colorado Desert is comparable to native rock art in some areas of California. Kroeber (1925:938) pointed out that Yokuts and Chumash rock art coincide with an area where hallucinogenic plants were used in shamanistic rituals (Hedges 1992:81). Perhaps painted ceramics in the Lower Colorado River Valley carried many of the same messages as ritual rock art.

Another theme associated with the flight of large birds is a pan-Native American tale about a great deity, who descended from the heavens to guide human endeavors (Honore 1961; Hansen 1963; Waters 1972). After teaching peoples in many parts of the Americas, this deity ascended back into the heavens, leaving a promise to return in the future (Pigeon 1974; Sejourne 1976). The eagle in North America, the quetzal bird in Mesoamerica, and the great condor of South America serve as tangible symbols of the descent and ascension of this divine being. The return of this deity out of the sky is viewed as a great bird coming from the heavens to the earth (Nicholson 1967; Brundage 1974). Eagle dances held among some tribes (e.g., Hopi, Zuni) are contemporary examples of the reverence toward this being (Nequatewa 1936; Waters 1970).

These great birds are symbolic of earthly man's assurance that a greater power and life exist in the heavens above, and that through these symbols, humans are able to communicate with these eternal powers.

If the rake design elements on Jar 1 are examined from this iconographical perspective, an image of a stylized bird is disclosed (Fig. 5). As such, it is plausible that the cache was embued with a ritually meaningful function. Moreover, evidence for storage of flowers in some of the jars corroborates this interpretation of a nonutilitarian purpose for the jars upon their placement in the cache. While a variety of alternative hypotheses (e.g., stylistic signalling) could be entertained for interpreting decorated Lower Colorado River ceramics, such discussion is beyond the scope of this study.

SUMMARY AND CONCLUSIONS

Storage of plant remains in sealed jars was apparently a common practice in the Lower Colorado River Valley and neighboring areas during prehistoric and protohistoric times, given the number of caches that are documented in southern California (e.g., Campbell 1931; Wilke et al. 1977; Swenson 1984; Sutton et al. 1987) and western Arizona (e.g., Euler and Jones 1956; Shelley and Altschul 1989). This storage technique was quite effective for preventing food loss due to moisture, fungi, insects, and rodents, or even theft. The caching of reserves of food in desert caves away from horticultural villages along the river provided "insurance" against seasonal or interannual productive shortfalls, or loss through raiding, theft, and warfare. This stored food could also be consumed by hunting or trading parties en route to neighboring desert areas that were located away from the Colorado River.

Analysis of the cache in this study has offered insights into the use-history of a small assemblage of ceramic jars, and has also provided chronometric dates for Period III Colorado Buff ware. These jars contained pollen from riverine and desert settings, and were apparently used for transporting, and perhaps even storing, flowering plants prior to their terminal deposition in a cache in the Trigo Mountains. Sometime later, the contents of at least two of the jars (3 and 5) were retrieved by puncturing the sealed ceramic lids. It is not known why some of the jars were opened; however, the act of puncturing the seals and leaving the jars behind could reflect a ritual function. Conversely, it may reflect the relatively low economic value of ceramic vessels, since they were not retrieved for subsequent reuse.

It is clear that Protohistoric Period ceramic jars were necessary for adapting to the harsh conditions of the Lower Colorado River Valley and its adjoining deserts. Although it remains to be conclusively demonstrated whether the Trigo Mountains cache also reflected ritual behavior, such analyses merit further exploration, given the ethnographic insights on this issue. Despite the fact that noneconomic activity is difficult to document archaeologically, ceramic design iconography is a promising and largely untapped avenue for considering this dimension of native survival in the Lower Colorado Desert. Analysis of the Trigo Mountains cache contributes new perspectives on this and related topics.

NOTES

1. Authors' names are alphabetized to reflect the collaborative nature of the research.

2. Additional characterization analyses of resins from these vessels will be undertaken by Mark Q. Sutton and his associates using gas chromatography (GC) and combined gas chromatography/mass spectrometry (GC/MS). Previous analyses of these substances from archaeological and ethnographic artifacts in the Great Basin have proven to be a valuable technique for discriminating among different kinds of insect-derived and plant-derived resins (Sutton 1990; Fox et al. 1995; Stacey et al. 1996).

3. Pollen recovered from two samples of pitch (0.1 g. each) included: six Poaceae, four *Zea mays*, two Pinaceae, one Malvaceae (globe mallow), and one Asteraceae (sunflower ragweed type).

ACKNOWLEDGEMENTS

We owe a special thanks to Gregory Glacken and the G. E. Smart family for reporting the Trigo Mountains cache to Richard Ryan, and to Boma Johnson of the Bureau of Land Management (BLM). The BLM (Yuma District) released funding for radiocarbon dating. These dates were provided by the NSF-Arizona AMS Facility, University of Arizona. Thanks are due to Robert Euler and the late Albert Schroeder for examining the cache at the 1984 Pecos Conference (Flagstaff, Arizona), and offering their insights on Lower Colorado Buff ware ceramics. Michael Waters conducted a formal classification of the jars, for which we are grateful. Figures 1, 2, 4, and 5 were drafted by Ronald Beckwith and Jo Lynn Gunness. We also appreciate comments on initial drafts of this paper by Carl Halbirt and Miriam Stark. Finally, thoughtful suggestions on ways to improve this paper, as well as additional bibliographic sources, were offered during the review process by Jerry Schaefer, Mark Q. Sutton, Jill Gardner, and an anonymous reviewer for the *Journal*. Despite the above assistance, the final responsibility for any errors or shortcomings is ultimately ours.

REFERENCES

Barrows, David Prescott
1900 The Ethno-botany of the Coahuilla Indians of Southern California. Chicago: University of Chicago Press.

Bayman, James, and Richard Ryan
1988 Lower Colorado Buffware and the Protohistoric Period in Southern Arizona. Pottery Southwest 15(l):1-4.

Bean, Lowell J., and Sylvia B. Vane
1978 Shamanism: An Introduction. In: Art of the Huichol Indians, Kathleen Berrin, ed., pp. 118-128. New York: Harry N. Abrams, Inc.

Binford, Lewis R.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. American Antiquity 45(1):4-20.

Bohrer, Vorsila L.
1981 Methods of Recognizing Cultural Activity from Pollen in Archaeological Sites. The Kiva 46(3):135-142.

Brundage, Burr Cartwright
1974 The Phoenix of the Western World: Quetzalcoatl and the Sky Religion. Norman: University of Oklahoma Press.

Campbell, Elizabeth W. Crozer
1931 An Archaeological Survey of the Twenty-Nine Palms Region. Los Angeles: Southwest Museum Papers No. 7.

Castetter, Edward F.
1935 Ethnobiological Studies in the American Southwest I, Uncultivated Native Plants Used as Sources of Food. The University of New Mexico Bulletin (Biological Series) 4(3).

Castetter, Edward F., and Willis H. Bell
1951 Yuman Indian Agriculture: Primitive Subsistence on the Lower Colorado and Gila Rivers. Albuquerque: University of New Mexico Press.

Castetter, Edward F., and Ruth M. Underhill
1935 The Ethnobiology of the Papago Indians. Ethnobiological Studies in the American Southwest II, Ethnobiological Studies of the Papago Indians. University of New Mexico Bulletin (Biological Series) 4(3).

Cole, Kenneth L.
1986 The Lower Colorado River Valley: A Pleistocene Desert. Quaternary Research 25(3):392-400.

Colton, Harold S.
1947 The Patayan Problem in the Colorado River Valley. Southwestern Journal of Anthropology 1(1):114-121.

Coville, Frederick V.
1892 The Panamint Indians of California. American Anthropologist 5(4):51-353.

Curtin, Leonora S. M.
1949 By the Prophet of the Earth—Ethnobotany of the Pima. Santa Fe: San Vicente Foundation.

Dobyns, Henry F.
1957 Thematic Changes in Yuman Warfare. In: Cultural Stability and Cultural Change, Proceedings of the 1957 Annual Spring Meeting of the American Ethnological Society, Verne F. Ray, ed., pp. 46-71. Seattle: American Ethnological Society.

1981 From Fire to Flood: Historic Human Destruction of Sonoran Desert Oases. Ballena Press Anthropological Papers No. 20.

1983 Their Number Became Thinned. Knoxville: University of Tennessee Press.

Dobyns, Henry F., Paul H. Ezell, and Greta S. Ezell
1963 Death of a Society: The Halchidhoma. Ethnohistory 10(2):105-161.

Eliade, Mircea
1964 Shamanism: Archaic Techniques of Ecstasy. New York: Bolligen Foundation.

Emerson, Lee
1971 Petroglyphs of Ancient Man. The Indian Historian 4(1):5-8.

Euler, Robert C., and Volney Jones
1956 Hermetic Sealing as a Technique of Food Preservation Among the Indians of the American Southwest. Proceedings of the American Philosophical Society 100(1):87-99.

Fenenga, Gerrit L., and Eric M. Fisher
1978 The Cahuilla Use of *Piyatem*, Larvae of the White-lined Sphinx Moth (*Hyles lineata*), as Food. The Journal of California Anthropology 5(1):84-90.

Fish, Suzanne K.
1985 Prehistoric Disturbance Floras of the Lower Sonoran Desert and Their Implications. American Association of Stratigraphic Palynologists, Contribution Series 16:77-88.

Forde, C. Daryll
1931 Ethnography of the Yuma Indians. University of California Publications in American Archaeology and Ethnology 28(4).

Fox, Andrew, Carl Heron, and Mark Q. Sutton
1995 Characterization of Natural Products on Native American Archaeological and Ethnographic Materials from the Great Basin Region, U.S.A.: A Preliminary Study. Archaeometry 37(2):363-375.

Geib, Phil R.
1990 A Basketmaker Tool Cache from Lower Glen Canyon. The Kiva 55(3):265-277.

Hansen, L. Taylor
1963 He Walked the Americas. Amherst: Amherst Press.

Harner, Michael J.
1958 Lower Patayan Phases in the Lower Colorado Valley and Colorado Desert. Berkeley: University of California Archaeological Survey Reports No. 42.

Hedges, Ken
1985 Rock Art Portrayals of Shamanic Transformation and Magical Flight. In: Rock Art Papers, Vol. 2, Ken Hedges, ed., pp. 83-94. San Diego Museum Papers No. 18.

1992 Shamanistic Aspects of California Rock Art. In: California Indian Shamanism, Lowell John Bean, ed., pp. 67-88. Ballena Press Anthropological Papers No. 39.

Hevly, Richard H.
1964 Pollen Analysis of Archaeological and Lacustrine Sediments from the Colorado Plateau. Ph.D. dissertation, University of Arizona.

1970 Botanical Studies of Sealed Storage Jar Near Grand Falls, Arizona. Plateau 42(4): 150-156.

1981 Pollen Production, Transport and Preservation: Potentials and Limitations in Archaeological Palynology. Journal of Ethnobiology 1(1):39-54.

Hevly, Richard H., and C. D. Johnson
1974 Insect Remains from a Prehistoric Pueblo in Arizona. The Pan-Pacific Entomologist 50(3):307-308.

Hevly, Richard H., Mary L. Heuett, and Stanley J. Olsen
1978 Paleoecological Reconstruction from an Upland Patayan Rock Shelter, Arizona. Journal of the Arizona-Nevada Academy of Science 13(3):67-78.

Hevly, Richard H., Peter J. Mehringer, Jr., and Harrison G. Yokum
1965 Modern Pollen Rain in the Sonoran Desert. Journal of the Arizona Academy of Science 3(3):123-135.

Honore, Pierre
1961 In Quest of the White God. London: Hutchinson & Company, Ltd.

Janetski, Joel C.
1979 Implications of Snare Bundles in the Great Basin and Southwest. Journal of California and Great Basin Anthropology 1(2): 306-321.

Jones, W. D., and L. C. Newell
1946 Pollination Cycles and Pollen Dispersal in Relation to Grass Improvement. University of Nebraska Agricultural Experiment Station Research Bulletin 148.

King, Thomas J., Jr.
1976 A Cache of Vessels from Cottonwood Spring (Riv-937). The Journal of California Anthropology 3(1):136-142.

Kornfeld, Marcel, K. Akoshima, and George C. Frison
1990 Stone Tool Caching on the North American Plains: Implications of the McKean

Site Tool Kit. Journal of Field Archaeology 17(3):301-309.

Kroeber, Alfred L.
1925 Handbook of the Indians of California. Bureau of American Ethnology Bulletin 78.

1963 Seven Mohave Myths. University of California Anthropological Records 11(1).

1974 Mohave Indians: Aboriginal Territory and Occupancy of the Mohave Tribe. New York: Garland.

Nequatewa, Edmund
1936 Truth of a Hopi and Other Clan Stories of Shungopovi. Flagstaff: Society of Science and Art.

Nicholson, Irene
1967 Mexican and Central American Mythology. London: Paul Hamlyn Books.

Pigeon, Little Gray Owl
1974 Cry of the Ancients. Independence, MI: Harold Publishing Company.

Preston, William
1996 Serpent in Eden, Dispersal of Foreign Diseases Into Pre-Mission California. Journal of California and Great Basin Anthropology 18(1):2-37.

Ramenofsky, Ann F.
1987 Vectors of Death: The Archaeology of European Contact. Albuquerque: University of New Mexico Press.

Raynor, Gilbert S., E. C. Ogden, and J. V. Hayes
1972 Dispersion of Corn Pollen from Experimental Sources. Agronomy Journal 64(4): 420-427.

Reagan, A. H.
1929 Plants Used by the White Mountain Apache Indians of Arizona. Wisconsin Archaeologist 8(4):143-161.

Rogers, Malcolm J.
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum Papers No. 3.

1945 An Outline of Yuman Prehistory. Southwestern Journal of Anthropology 1(2):167-198.

Russell, Frank
1908 The Pima Indians. In: Twenty-sixth Annual Report of the Bureau of American Ethnology, 1904-05. Washington: Government Printing Office.

Samuels, Robert
1965 Parasitological Study of Long-Dried Fecal Samples. In: Contributions of the Wetherill Mesa Archaeological Project, Douglas Osborne, assemb., pp. 175-179. Memoirs of the Society for American Archaeology No. 19.

Schaefer, Jerry
1994a The Challenge of Archaeological Research in the Colorado Desert: Recent Approaches and Discoveries. Journal of California and Great Basin Anthropology 16(1):60-80.

1994b The Stuff of Creation: Recent Approaches to Ceramics Analysis in the Colorado Desert. In: Recent Research Along the Lower Colorado River: Proceedings from a Symposium Presented at the 59th Annual Meeting of the Society for American Archaeology, Anaheim, California, April 1994, Joseph A. Ezzo, ed., pp. 81-100. Tucson: Statistical Research, Technical Series No. 51.

Schaefer, Jerry, and C. Michael Elling
1987a Cache and Quarry: Archaeological Deposits in the Trigo Mountains, Yuma County, Arizona. Report on file at the Bureau of Reclamation, Boulder City, Nevada.

1987b Archaeological Investigations on the Yuma Proving Ground: A Survey of Lithic Quarries and Chipping Stations in the North Cibola Range. Report on file at the Army Corps of Engineers, Los Angeles District.

Shelley, Steven D., and Jeffery H. Altschul
1989 Paleoenvironments and Archaeology of the Trigo Mountains: Data Recovery in the Hart Mine and Cibola Quarry Areas, Yuma County, Arizona. Tucson: Gray Literature Press.

Schiffer, Michael B.
1986 Radiocarbon Dating and the "Old Wood" Problem: The Case of the Hohokam Chronology. Journal of Archaeological Science 13(1):13-30.

Schoenwetter, James
1964 The Palynological Research. In: Alluvial and Palynological Reconstruction of Environments, Navajo Reservoir District, James Schoenwetter and F. W. Eddy, eds., pp. 63-105. Museum of New Mexico Papers in Anthropology 13.

1967 Pollen Survey of the Chuska Valley. In: An Archaeological Survey of the Chuska Valley and Chaco Plateau, New Mexico, A. H. Harris, James Schoenwetter, and A. H. Warren, eds., pp. 72-103. Museum of New Mexico Research Records 4.

Schoenwetter, James, and Larry A. Doerschlag
1971 Surficial Pollen Records from Central Arizona I: Sonoran Desert Scrub. Journal of the Arizona Academy of Science 6(3):216-221.

Schroeder, Albert H.
1952 A Brief Survey of the Lower Colorado River from Davis Dam to the International Border. Report on file at the National Park Service, Regional Office, Santa Fe.

1957 The Hakataya Cultural Tradition. American Antiquity 23(2):176-178.

1958 Lower Colorado Buffware. In: Pottery Types of the Southwest, Ceramic Series No. 3D, Harold S. Colton, ed. Flagstaff: Museum of Northern Arizona.

Scott, Linda
1979 Palynological Investigations of Fifteen Vessels from MV820, Mesa Verde National Park. Report on file at Mesa Verde National Park, Cortez, Colorado.

Sejourne, Laurette
1976 Burning Water: Thought and Religion in Ancient Mexico. Berkeley: Shambhala.

Shreve, Forrest, and I. L. Wiggins
1977 Vegetation and Flora of the Sonoran Desert. Stanford: Stanford University Press.

Smith, Ron
1985 Rock Art of the Sierra de San Francisco: An Interpretive Analysis. In: Rock Art Papers, Vol. 2, Ken Hedges, ed., pp. 33-54. San Diego Museum Papers No. 18.

Spier, Leslie
1933 Yuman Tribes of the Gila River. Chicago: University of Chicago Press.

Stacey, Rebecca, Andrew Fox, Carl Heron, and Mark Q. Sutton
1995 Chemical Characterisation of Resins Used by Native Americans in the Southwestern Great Basin, USA. In: Resins: Ancient and Modern, Margot M. Wright and Joyce H. Townsend, eds., pp. 100-105. Edinburgh: The Scottish Society for Conservation & Restoration.

Sutton, Mark Q.
1988 Insects as Food: Aboriginal Entomophagy in the Great Basin. Ballena Press Anthropological Papers No. 33.

1990 Notes on Creosote Lac Scale Insect Resin as a Mastic and Sealant in the Southwestern Great Basin. Journal of California and Great Basin Anthropology 12(2):262-268.

Sutton, Mark Q., Christopher B. Donnan, and Dennis L. Jenkins
1987 The Archaeology of Southcott Cave, Providence Mountains, California. Journal of California and Great Basin Anthropology 9(2):232-250.

Stuiver, Minze, and Bernd Becker
1986 High-Precision Decadal Calibration of the Radiocarbon Time Scale, A.D. 1950-2500 B.C. Radiocarbon 28(2B):863-910.

Swenson, James D.
1984 A Cache of Mesquite Beans from the Mecca Hills, Salton Basin, California. Journal of California and Great Basin Anthropology 6(2):246-252.

Treganza, A. E.
1947 Possibilities of an Aboriginal Practice of Agriculture Among the Southern Diegueno. American Antiquity 12(3, Part 1): 169-173.

Waters, Frank
1970 Masked Gods: Navajo and Pueblo Ceremonialism. New York: Ballantine Books.

1972 Book of the Hopi. New York: Ballantine Books.

Waters, Michael R.
1982 The Lowland Patayan Ceramic Tradition. In: Hohokam and Patayan: Prehistory of Southwestern Arizona, Randall H. McGuire and Michael B. Schiffer, eds., pp. 537-570. New York: Academic Press.

Weber, Steven A., and P. David Seaman (eds.)
1985 Havasupai Habitat. Tucson: University of Arizona Press.

Wilke, Philip J., and Meg McDonald
1989 Prehistoric Use of Rock-Lined Cache Pits: California Deserts and Southwest. Journal of California and Great Basin Anthropology 11(l):50-73.

Wilke, Philip J., Thomas W. Whitaker, and Eugene Hattori
1977 Prehistoric Squash (*Cucurbita pepo* L.) from the Salton Basin. The Journal of California Anthropology 4(1):55-59.

Wolley, Anne M., and Alan J. Osborn
1989 An Isolated Storage Vessel at Site 42SA20779 in Glen Canyon National Recreation Area: Adaptive Storage and Caching Behavior in the Prehistoric Southwest. Report on file at the National Park Service, Lincoln, Nebraska.