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Looking at the Arrow Site—Close Up

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For at least 350 years, remnants of 37 compound arrows made of carrizo (cane) and hardwood have remained in high crevices in a canyon wall in the Colorado Desert of southern California. This paper provides the results of a 2001 study of this phenomenon. Research in museum collections, ethnographic data, early historical texts, and new radiocarbon determinations support the hypotheses that (1) the arrows were shot into the crevices with a bow; (2) the arrows were made by and shot by Kumeyaay people; and (3) the Arrow Site is a result of a single incident rather than repetitive traditional events. Several other instances of arrows placed in out-of-the-way niches and crevices are explored, as well as possible reasons for the creation of the site.

REPORTS OF INTACT ARCHAEOLOGICAL ARROWS in southern California are rare. Reinman et al. (1960) found four arrow foreshafts bundled together with a long, hooked stick and a wood fire hearth (fire drill) within a rockshelter near Coyote Mountain (also known as Carrizo Peak) within traditional Kumeyaay lands. The foreshafts had one sharpened end and were very weathered. A fragment of cane within the same shelter may have been part of a mainshaft.

Even more rare are reports of arrows within crevices or cracks. An exhaustive search of the literature produced a few examples, mostly involving crevices within caves. These examples from Baja California, Arizona, and New Mexico were described by Barter and Consiglio (1987:11–15). Edward Davis reported that he saw ancient arrows sticking into crevices in a cave ceiling in Baja California, near Comodú (*Lost and Found* 2013:96). One arrow at the San Diego Museum of Man, identified as being Luiseño or Cupeño, was found before 1918 stuck in a cactus in Pala, California. As far as we are aware, non-cave-environment archaeological occurrences have not been reported elsewhere.

The Arrow Site, in the San Diego County portion of Anza-Borrego Desert State Park (ABDSP), has been known to archaeologists at California State Parks (CSP) since the late 1970s, when it was first discovered (Fig. 1). An arrow was found on the surface of a wash, and after a

search for its source, it was determined that it had fallen from a crevice high on a rock wall above the spot where it was found. After more careful inspection of the rock wall, portions of what appeared to be many arrows were found protruding from three crevices in the same rock wall. In 1982, seven fragmented arrows were removed from the lowest of the three crevices (Fig. 2). These, along with the original fallen arrow, were the subject of a short article by Robert Begole (1985) and a subsequent CSP report (Barter and Consiglio 1987). Consequently, a more thorough investigation was carried out in 2001 by CSP. In 2007, an article in the *Journal of California and Great Basin Anthropology* (*Lost and Found* 2007) suggested that more information was needed about the site, since it represented an uncommon occurrence. This article is a response.¹

Arrows remained *in situ* with weathered portions extending from three crevices formed by fractures in the rock wall of a deeply incised wash (canyon). The 2001 CSP study allowed us to more completely describe the arrows and their methods of construction, obtain additional radiocarbon dates, compare the arrows with those in several museum collections, explore possible ethnic associations, and consider possible ways the arrows were placed in the crevices, as well as the reasons why the site existed.

The specific goal of the 2001 fieldwork was to further document and study the arrows that remained

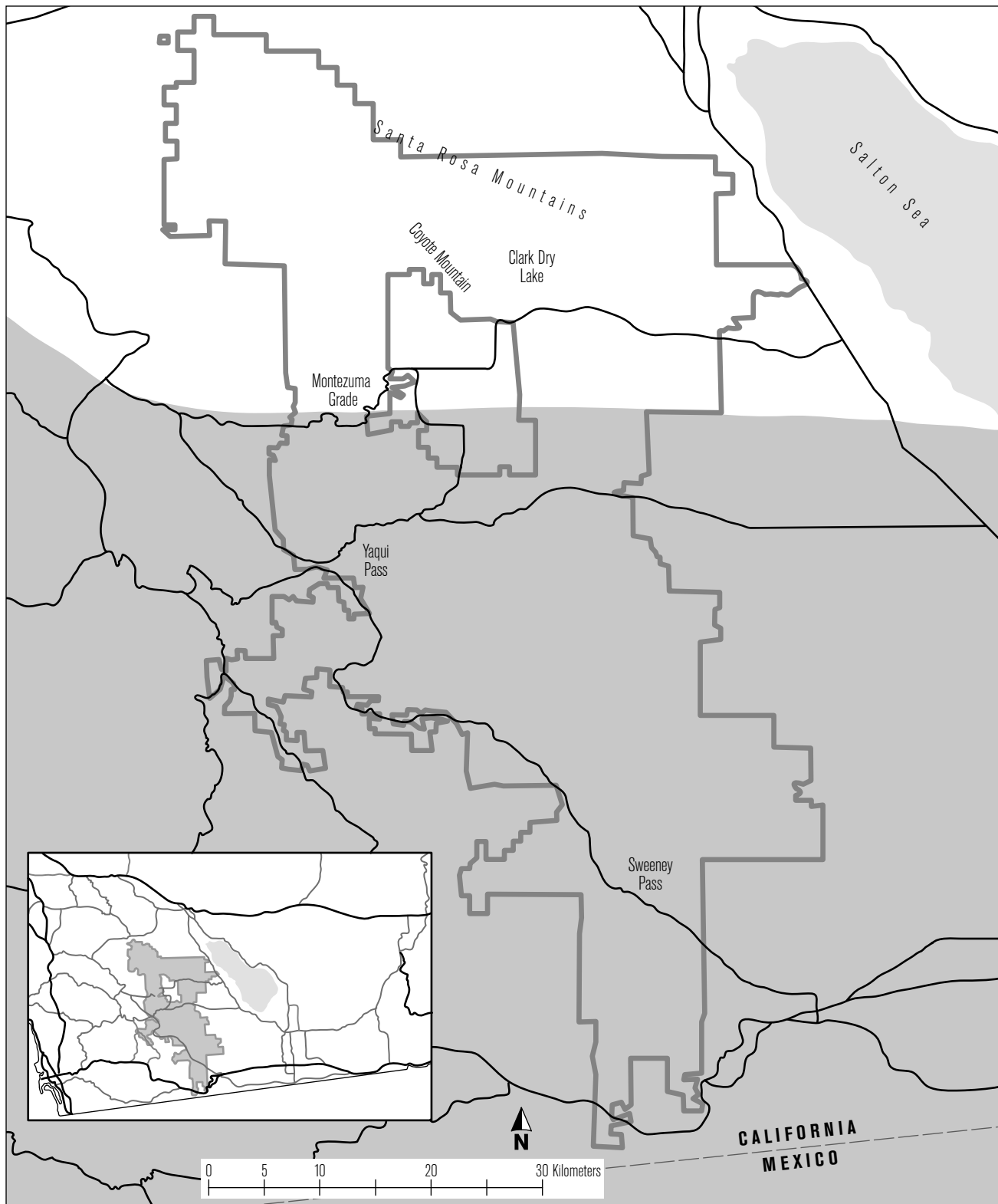


Figure 1. Location of Anza-Borrego Desert State Park (ABDSP), Colorado Desert District, California State Parks in southern California region, west of the Salton Sea. Wide grey outline indicates ABDSP boundary. Light area in the northern part of the Park is ancestral Cahuilla land; dark area in the southern part of the Park is ancestral Kumeyaay land. Map by Geographics, Inc.



Figure 2. Two of the arrows removed from the crevices in 1982. All of those removed are in the collections of the Begole Archeological Research Center, Anza-Borrego Desert State Park, Colorado Desert District, California State Parks, Cal. Photograph by J. Schneider.

in situ, since both Kumeyaay and Cahuilla consultants recommended that the remaining arrows not be removed. This was the first opportunity archaeologists had to closely approach the arrow-bearing crevices for study (Fig. 3). The remaining arrows were left in place, in spite of the strong likelihood that they would fall and be destroyed due to ongoing rock weathering, organic material degradation, tectonic events, and natural erosion.

SITE SETTING

Organic materials such as arrows do not often survive in the archaeological record. When they do, it is usually within a special environment that is dry and protected. The Arrow Site is one of these special environments—the arrows are protected by a slight overhang and further preserved by coatings of bat urine or guano. During our study of the arrows, we noted that many were covered with what appeared to be an organic substance to which silt adhered. Due to this camouflaging, the arrows had likely gone unrecognized.

The nearly vertical (and sometimes overhanging) rock wall within which all three crevices are located rises nearly 100m. from a deeply incised wash that continues to be subject to periodic flash-flooding and active erosion (Abbott 2001). The rock wall is composed of weakly-consolidated sedimentary deposits with abundant faults and fractures. Undercutting of the wall occurs when the wash contains water, and it is continual and progressive. Huge masses of the weakly compacted wall occasionally fall into the wash, only to be washed away by the next flash-flood. The crevices holding the arrows are all within a 70m. horizontal span of the rock wall. In this paper, we identify each crevice by its relative position on



Figure 3. Crevice (central) with arrows extending from it. Scale is in 10 cm. intervals. Photograph by J. Schneider. Anza-Borrego Desert State Park, Colorado Desert District, California State Parks, Cal.

the north-south trending canyon wall: northern crevice, central crevice, and southern crevice. Each crevice is formed by a slight overhang of its upper edge, leaving a small horizontal gap between upper and lower edges (see Fig. 3). Bat guano can be seen spilling from the crevices where the arrows are located, and it is known that a bat population inhabits the site.

The greater region, at least that part that lies at a lower altitude, is extremely arid and contains typical Colorado Desert vegetation and fauna. Within the immediate area of the Arrow Site, creosote bush (*Larrea tridentata*), seasonal grasses, and cacti (*Opuntia* spp.) are present. There are no water sources nearby. At the few spring-fed oases within ABDSP and along major drainages (e.g., Palm Canyon, Coyote Canyon, Carizzo Wash, and San Felipe Wash), there are native palm trees (*Washingtonia filifera*), arrowweed (*Pulchea sericea*), desert ironwood (*Olneya testota*), willow (*Chilopsis linearis*), and mesquite (*Prosopis* spp.); ocotillo (*Fouquieria splendens*), agave (*Agave deserti*) and a variety of shrubs and grasses are generally present on slopes of alluvial fans. Mesquite thickets are present in several valley locations, and mesquite-covered sand dunes were abundant in times past. Mesquite was an important food resource for native people, as well as providing firewood and material for tools and shelters. Most of these plants and others had cultural and economic value to the inhabitants of the area. The lowering of the water table in the lowlands of ABDSP and the surrounding region has resulted in the death of many of the stands of mesquite in recent times. Most importantly, the immediate context of the Arrow Site would not be one of optimal residential occupation

in past times, while other areas, within 5–6 kilometers, would have supported residential occupation.

MUSEUM SPECIMENS

Arrows from the Arrow Site were originally compared to arrows in the collections at the San Diego Museum of Man (Barter and Consiglio 1987). In addition, we visited several other museum collections in the region and contacted curators at some distant venues for comparative data. Ethnographic and archaeological specimens were examined and photographed. Table 1 presents a compilation of the collected data. Museum-specimen arrows identified as being associated with a specific cultural group were especially valuable.

Our comparative study led to the following observations. First, the arrows made by inland southern California groups tended to be compound arrows composed of a mainshaft and a foreshaft from differing plants. Arrows made by the Mohave (as representative of Yuman groups living along the Colorado River) were simple arrows; the entire arrow was made from one piece of hardwood. Second, Mohave arrows tended to have prominent pigment decorations, while the inland southern California groups tended to have less decoration, and that mostly confined to the fletching area. Third, at least one of the museum specimens was produced specifically for the tourist trade. Fourth, some museum arrows were ‘reconstructed’ from parts of several different arrows. Finally, some museum arrows had been incorrectly reassembled and/or had proportional inaccuracies.²

Little distinguished the arrow-manufacturing technologies of several inland southern California groups; e.g., the Kumeyaay, the Cahuilla, and the Luiseño. Most arrows were compound and most had self-pointed wooden foreshafts; only a few had stone points. The Mohave arrow-manufacturing technology can be separated from that of other regional groups; their arrows were of simple design and were more highly decorated. Two Chemehuevi arrows we examined were very similar to those of other inland southern California groups. Indigenous groups of the desert regions of California, although they might differ linguistically and socio-politically, often shared similar technologies. Based on available data, there is little reason to doubt that the arrows at the Arrow Site are of local origin and were

made and used by either Kumeyaay or Cahuilla people, who are known to have lived within what is now ABDSP.

HOW AND WHY WERE THESE ARROWS PLACED IN THIS LOCATION?

We generated several hypotheses regarding the way in which the arrow shafts were introduced into the crevices, as well as the possible significance or purpose of the site (Barter and Consiglio 1987; Schneider 2001). Hypotheses A, B, and C are concerned with the functional parameters of the Arrow Site; hypotheses D and E are concerned with the manner in which the arrows were introduced into the crevices; and hypotheses F and G are concerned with the timing of the event(s) that resulted in the creation of the site.

Hypothesis A. This is a ceremonial or ritual site, and the arrows were introduced into the crevices by persons for specific but unknown reasons.

Hypothesis B. The site represents a place where indigenous people developed or tested their skill with bows and arrows; i.e., it required skill to get an arrow to enter and stay in the crevices.

Hypothesis C. The arrows were introduced into the crevices because of the presence of bats in the crevices. The spiritual beliefs of the indigenous peoples may have included an association of bats with night and darkness, the underworld, flight, or other characteristics. A physical connection between humans and bats may have established a spiritual connection.

Hypothesis D. The arrows were introduced into the crevices by climbers who lowered themselves from the canyon top and placed the arrows in the crevices manually. After placement, climbers lowered themselves to ground level.

Hypothesis E. The arrows were introduced into the crevices by individuals walking or climbing up a ramp formed by a separated or sloughed block section of canyon wall.³

Hypothesis F. The arrows were introduced into the crevices during a single ceremonial event or demonstration of skill.

Hypothesis G. The arrows were introduced into the crevices on a number of separate occasions.

We pursued our research with these hypotheses in mind.

Table 1
ARROWS IN MUSEUM COLLECTIONS

Museum and Catalog Number	Cultural Affiliation	Arrow type	Length (cm.)	Diameter (cm.)	Fletching	Sinew	Decoration	Comment
Agua Caliente Cultural Museum 1994.002.004	Desert Cahuilla made by Cupeño; may be atlatl dart	Likely mainshaft of complex; foreshaft is missing	78	1	Spiral with split feather; sinew bound at each end	Sinew-bound at notch end	—	Modern replica. No foreshaft present.
Agua Caliente Cultural Museum 1994.002.001	Desert Cahuilla made by Cupeño; may be atlatl dart	Likely mainshaft of complex; foreshaft is missing	74	0.7	Spiral with split feather; sinew bound at each end	Sinew-bound at notch end	—	Modern replica. No foreshaft present.
Agua Caliente Cultural Museum 1994.002.001	Unknown, but attributed to Indio by BIA	Compound: cane mainshaft (broken) with large hardwood foreshaft	Foreshaft extends 29 cm. from mainshaft	Foreshaft: 1.2–0.7 taper Mainshaft: 1.3	Broken and missing proximal portion	Sinew-bound at end of mainshaft	—	This arrow appears to be very robust, especially the foreshaft. The foreshaft sharpened to point.
Agua Caliente Cultural Museum 1994.002.003	Possibly made by Willie Pink	Simple; made of hardwood (rose or chamise)	67	Unknown, on display at Spa Hotel	3-feather fletching that is bound with sinew at either end and glued along length	Obsidian point (apparent Rose Spring) is hafted with sinew	—	This arrow appears to be a modern attempt to reconstruct a “typical” arrow.
Field Museum Accession 749, #63598-	Cahuilla (Indio) 2 arrows	Compound: cane mainshaft, hardwood foreshaft	Unknown	Unknown	3-feather fletching with only the ends bound down with sinew. Each feather set at diagonal.	Sinew-bound at the distal end of the mainshaft	Appears to be black pigment or mastic on mainshaft under the fletching	Specimens appear to be quite old and authentic. Both arrows are complete, although portions of the fletching are missing.
San Diego Museum of Man #1928-15-67	Kumeyaay from “Matawhya” (Mataguay), San Diego County	Compound: Mainshaft is <i>Phragmites communis</i> foreshaft is hardwood	93.4 total length including foreshaft	Not available	3-feather fletching with only the ends bound down with sinew	Sinew and resin used for binding	Red pigment applied between fletching	Resharpened clear quartz DSN projectile point hafted on foreshaft with sinew and resin.
San Diego Museum of Man #1928-15-68	Kumeyaay from “Matawhya” (Mataguay), San Diego County	Compound: Mainshaft is <i>Phragmites communis</i> foreshaft is missing	Not available	Not available	3-feather fletching with only the ends bound down with sinew	Sinew and resin used for binding	Red pigment applied between fletching	Only mainshaft of compound arrow.
San Diego Museum of Man #1974-28-3	In cactus near Pala, San Diego Co. before 1918; Luiseño or Cupeño	Compound: Cane mainshaft; wood foreshaft	Total length: 81; mainshaft 56.6; foreshaft extends 27 from mainshaft	Not available	None remains	Mainshaft bound with sinew at the point of insertion of foreshaft	Proximal end of foreshaft has darkened area; may be mastic?	This is the only archaeological specimen held at this museum.
San Diego Museum of Man #1958-48-6 a–f	6 arrows made about 1908; from the Viejas Reservation (Barona)	Compound: cane mainshaft; sharpened wood foreshaft	89–91	Not available	2-feather fletching; held in place with sinew	Bound with sinew and coated with pitch at point of insertion and at the first joint in cane below the cut (sinew-bound in 2 places at distal end of mainshaft)	Black pigment decorates fletching area in zigzag design; foreshaft may be stained red	All 6 arrows. Of identical construction. Likely made by the same individual.

Table 1 (Continued)
ARROWS IN MUSEUM COLLECTIONS

Museum and Catalog Number	Cultural Affiliation	Arrow type	Length (cm.)	Diameter (cm.)	Fletching	Sinew	Decoration	Comment
San Diego Museum of Man #1957-25-38, -39, -40	3 arrows identified as Southern California Mission Indian	Compound: Mainshaft is described as arrow weed; foreshaft as pointed hardwood	85-87.6 total length; available mainshaft is 71	Not available	2-feather fletching, not spirally set; held in place with sinew	Bound with sinew only in 1-place at the far distal end of mainshaft	—	
San Diego Museum of Man #1957-25-41	Southern California Mission Indian	Compound: Mainshaft is cane; foreshaft is pointed hardwood	Total length is 91	0.64	2-feather spiral fletching	Bound with sinew only in one place at the distal end of mainshaft	—	
San Diego Museum of Man #1931-20-9	Kumeyaay	Compound: Mainshaft is cane; foreshaft is pointed hardwood	Total length is 67	Not available	Fletched, but method not available	Foreshaft set into mainshaft with pitch	—	This arrow not inspected in 2001/may have been on display in museum.
San Diego Museum of Man #1931-20-10	Kumeyaay	Compound: Mainshaft is <i>Phragmites</i> ; foreshaft is pointed hardwood	Total length is 94; length of mainshaft is 70	Not available	2-feather spiral fletching	Foreshaft set into mainshaft with pitch and bound with sinew; proximal end of mainshaft reinforced with sinew and pitch	Smeared with black pigment in fletching area; pitch?	
San Diego Museum of Man #1931-20-11	Kumeyaay	Compound: mainshaft is <i>Pragmites</i> ; foreshaft is hardwood tipped with green chert DSN point (detached)	Total length 94; mainshaft is 73.7	Not available	2-feather spiral fletching	Bound with sinew and pitch at distal end of mainshaft	Black pigment applied to fletching area before arrow was fletched; red pigment applied to joints in cane mainshaft; red pigment lines parallel to mainshaft	This arrow fairly unique if it had a stone tip. However, this was not in place.
San Diego Museum of Man #1950-3-2	Probably Kumeyaay	8 compound arrows: mainshafts of cane; foreshafts of pointed hardwood	Not available, but most are longer than the #1958 specimens	Not available, but most mainshafts and foreshafts are of greater diameter than the #1958 specimens	No fletching remains	Bound with sinew and mastic at two places at the distal end of the mainshaft	—	
San Diego Museum of Man #1946-9-143	Kumeyaay	Compound: cane mainshaft; hardwood foreshaft	Total length 81	Not available	2-feather fletching bound with sinew	Not available	—	This arrow not available for inspection.
San Diego Museum of Man #1946-9-144	Kumeyaay	Compound: <i>Phragmites</i> mainshaft; hardwood foreshaft	Total length 84	Not available	No feathers remain	Bound with sinew at the distal end of mainshaft	—	This arrow has a larger diameter and heavier foreshaft than other arrows; not quite the same — more “crude.”
San Diego Museum of Man #1946-9-145	Kumeyaay	Simple: all hardwood with sharpened point	70.5	Not available	3-feather fletching (only partial remains)	Not available	2 bands of red pigment at the proximal end of shaft	Impression is that this arrow may have been made for sale to tourists or collectors.

Table 1 (Continued)
ARROWS IN MUSEUM COLLECTIONS

Museum and Catalog Number	Cultural Affiliation	Arrow type	Length (cm.)	Diameter (cm.)	Fletching	Sinew	Decoration	Comment
San Diego Museum of Man #1946-9-146	Kumeyaay	Simple: all hardwood with blunt distal end	61	Not available	2-feather fletching	Not available	—	This arrow not available for inspection.
San Diego Museum of Man #1941-13-8	Kumeyaay; made about 1910 by "Diegueno Indian" at Volcan Reservation	4 (of 7) arrows, Compound: <i>Phragmites</i> mainshafts; hardwood foreshafts with stone points	Total length, Not on average is 86; most foreshafts are 24; one foreshaft is 37	Not available	3-feather fletching, but badly decomposed	Sinew is used to haft points; no sinew used to reinforce at foreshaft insertion	Red pigment, longitudinal spiral decoration applied before fletching at proximal end of mainshaft; also at distal end of mainshaft	Likely most "authentic" (K. Hedges). Stone DSN projectile points: 1 wonderstone, 2 fragmented dark chert, 1 grey chert.
San Diego Museum of Man #1946-9-142	Kumeyaay	Compound: cane mainshaft; hardwood foreshaft	84	Not available	2-feather fletching	Bound with sinew	—	Arrow not available for inspection.
San Diego Museum of Man # Jes. 4419	Unknown	Compound: <i>Phragmites</i> mainshaft; pointed hardwood foreshaft	Unavailable	Unavailable	2-feather spiral fletching	Bound with sinew and coated with red pigment at distal end of mainshaft	Red pigment wavy decoration in fletching area; Joints in cane have red pigment applied; as does point of insertion of foreshaft; foreshaft has splotching red pigment.	Pigment is applied abundantly to this specimen. However, no information is available about source of this arrow.
San Bernardino County Museum #A5-370B	Serrano; collected at San Manuel Reservation before 1938	Simple of hardwood; part of "child's" bow and arrow set	49	Not available	—	—	—	"Child's play set"—not fully technological example.
San Bernardino County Museum #A5-948B	Luiseno (no provenience information available)	Simple of hardwood, whittled to a point; part of "child's" bow and arrow set	45.7	Not available	2-feather fletching with remains of sinew binding	Remnants of sinew at proximal end	Red pigment on proximal end	
San Bernardino County Museum #A64-657, -658, -659	"Panamint" (likely Chemehuevi, according to D. Schroth)	3 arrows: 2 compound with <i>Pragmites</i> mainshafts and hardwood foreshafts; 1 of cane is poorly and incorrectly reconstructed	Not available	Not available	—	—	—	3rd arrow is reconstructed with a non-original obsidian point hafted in the notch end of the remains of a cane mainshaft.
San Bernardino County Museum #A159-23-E	Mohave	Simple: hardwood with metal point	72.4	Not available	2-feather fletching	—	Black and red pigment decorations	Donated in 1961.
San Bernardino County Museum #A1448-2C	Mohave	Simple: hardwood with sharpened point	90	Not available	2-feather fletching	—	Black and red pigment decorations	Donated in 1961.

Table 1 (Continued)
ARROWS IN MUSEUM COLLECTIONS

Museum and Catalog Number	Cultural Affiliation	Arrow type	Length (cm.)	Diameter (cm.)	Fletching	Sinew	Decoration	Comment
San Bernardino County Museum (catalog # not available)	Mohave 3 arrows	Simple: with metal points	Not available	Not available	2-feather fletching bound with sinew	Sinew on fletching	Black and red pigment decorations	Donated in 1961.
San Bernardino County Museum #A159-23 A-D	Mohave 4 arrows	Simple; hollow reed without points	Not available	Not available	2-feather fletching	—	Black and red pigment decorations	Same lot as #A159-23-E, but without metal tip.
San Bernardino County Museum #A159-15 A-C	Mohave 3 arrows	Simple: hardwood; 2 are sharpened to point; 1 has a slot to receive a metal point	Not available	Not available	2-feather fletching bound with sinew	Sinew on fletching	Black and red pigment; distal ends are painted with red pigment	
San Bernardino County Museum (catalog # not available)	Unknown	Compound: with <i>Pragmites</i> mainshaft and pointed hardwood foreshaft	Total length 111; foreshaft 13	Not available	—	Sinew binding on foreshaft	Red pigment on tip of foreshaft	Donated by G .A. Smith.
San Bernardino County Museum (catalog # not available)	"Mohave" 3 arrows (no provenience information)	Simple: sharpened to point	Not available	Not available	No information	No information	Painted light blue with red, white, and blue horizontal stripes	Made for the tourist trade.
San Bernardino County Museum #A1900-89	Mohave 4 arrow-set (no provenience information)	Simple: hardwood with sharpened tips	Not available	Not available	2-feather fletching, bound with sinew	Sinew bound at tip as well as used for fletching	Painted	Made for tourist trade; set is bound together with cloth.
San Bernardino County Museum #A1900-92	Mohave Bow and 2 arrow set (no provenience information)	Simple: Hardwood with sharpened tips	Not available	Not available	2-feather fletching, bound with sinew	Sinew bound at tip as well as used for fletching	Painted	Bow beautifully decorated with diamond design; smaller than #A1900-89.
San Bernardino County Museum #A1448-2 A-P	"Mohave" 15 arrows (no provenience information)	Simple: hardwood with sharpened tips	Average length is 90	Not available	2-feather fletching bound with sinew	1 arrow has split distal end bound with sinew, in addition to fletching sinew	Black and red pigment	Apparently a set.
San Bernardino County Museum #A365-373 A-E	"Mohave" Bow and 4-arrow set (no provenience information)	Simple: hardwood with slots for metal points; one metal tip in place	Arrows too short to be fully functional	Not available	—	—	—	Made for tourist trade. Not functional. Bow made from milled wood. 1985 donation.

THE ETHNOHISTORY AND ETHNOGRAPHY OF SOUTHERN CALIFORNIA ARROWS

The Arrow Site is unique in terms of its setting and the number of arrows present. For these reasons, a detailed study of the ethnohistoric and ethnographic literature on arrow use by the native peoples of southern California was undertaken, which included a search for any mention of arrows being used in games of skill or in rituals.

Ethnohistoric Accounts

Early Spanish expeditions crossing the Colorado Desert provide brief glimpses of Kumeyaay and Cahuilla arrows, bows, and other hunting equipment. Most of what is known is contained in the diaries of Captain Juan Bautista de Anza and the Franciscan priests who accompanied his expeditions to explore and settle California in the mid-1770s. These diaries were translated

and published in a five-volume set by Herbert E. Bolton, a University of California historian. Bolton also retraced and documented Anza's route through field research in the 1920s (Bolton 1930, 1931).

During Anza's first expedition across the Colorado Desert in 1774, he made some observations about bows and arrows used by Indians of the region. From the Colorado River to Mission San Gabriel, the expedition was accompanied by two Quechan (Yuma) men. On the night of March 10, while the expedition was camped at San Sebastian (a settlement at a *cienega* in what is now Imperial County, California), Anza insisted that the Quechan and Cahuilla embrace each other, despite the fact that the two groups were at war at that time. As a celebration of peace between the two tribes, they broke "the few arrows which they were carrying" (Bolton 1930:II:83). Anza then briefly compared the arrows of the Cahuilla to those of the Quechan: "They [the Cahuilla] are superior to these [the Quechan] in the greater abundance of bows and arrows, although of the worst kind and construction, whereby they are seen to be equal" (Bolton 1930:II:83).

A few days later (March 14) Anza observed more than 100 Indians, most likely Cahuilla, at Santa Catharina (Lower Willows Spring) in Coyote Canyon (in today's ABDSP) and remarked: "...only one [man] was seen with an arrow, but even he had no bow" (Bolton 1930:II:88). Anza then stated that each man carried a rabbit stick, which was thrown with considerable accuracy. Anza's observations about the paucity of bows and arrows among the Cahuilla and the greater reliance on rabbit sticks for hunting, at least during the late winter when the expedition passed through their territory, was confirmed by Father Juan Díaz, who accompanied the first expedition. "We have seen no other weapons here than a club which they make in the shape of a sickle and use for hunting hares and rabbits, to which it seems they are greatly inclined" (Bolton 1930:II:283).

On his return trip through Coyote Canyon later in the spring of 1774, Anza mentioned in his diary that several Indians (likely Cahuilla) shot arrows at his horses:

On the march which we made today, in the neighborhood of some hills, some arrows were surreptitiously shot at the riding animals which were being driven loose, and three of them were slightly wounded. An effort was made to see who had shot the arrows and they were found to be four heathen [Bolton 1930:II:227].

Arrows were also shot at Father Garcés, who passed through the same area ahead of the party, as Anza noted when he arrived at Santa Catharina Spring (Bolton 1930:II:227). Father Garcés observed on March 12, 1774, that the "Cajuenches" (Cahuilla) in the vicinity of San Gregorio used rabbit sticks (*macanas*) to kill rabbits and deer, but he did not mention bows and arrows (Bolton 1930:II:341–342). Garcés, however, briefly noted the presence of spears: "Some carry a lance with a good point, which appears to be a weapon of war" (Bolton 1930:II:342).

During Anza's second expedition through the Colorado Desert in 1775, Father Pedro Font briefly noted the use of bows and arrows in his diary for Wednesday, December 13, at San Sebastian Marsh: "They use bows and arrows, although the latter are few and inferior" (Bolton 1930:IV:130–131).

Ethnographic Descriptions of Arrows and the Development of Archery Skills

The Arrow Site is situated near the boundary between two ethnographic groups, the Kumeyaay (formerly known as the Kamia, Southern Diegueño, and/or Tipai) and the Cahuilla (see Barker 1976:Fig. 2; Bean 1978:Fig. 1; Gifford 1931:Plate I; Heizer and Whipple 1971:Map 1; Kroeber 1908, 1925; Luomala 1978:Fig. 1). Thus, the cultural affiliation of the people who made and used the arrows at the Arrow Site could have been either of these groups or even others traveling through the area. Ethnographic studies were reviewed and are excerpted below; each of the studies has its limitations.

Kumeyaay (Kamia). Edward W. Gifford (1931) described the arrows manufactured and used by the Kumeyaay who occupied the Imperial Valley in southeastern California:

War arrows were of two types, a straight arrowweed shaft and a cane arrow with an arrowweed foreshaft. Both had stone points attached with sinew. According to Charles Beans (ca. 60-year-old, Kamia), the point was made of stone derived from the mountains and was shaped entirely by percussion with another stone, no bone flaker being used. Three or two half-feathers from a large hawk were lashed with deer sinew to the base of both types of arrow. Red and black encircling bands were painted on the feathered portion of the shaft. A gum, which forms as an excrescence on the roots of certain old arrowweed plants was used to glue the feathers in place. This gum was not used

in attaching the foreshaft of the cane arrow. The foreshaft was merely shoved into the cane [Gifford 1931:28–29].

Gifford (1931:45) also noted that “Men and boys contested in distance shooting with bow and arrow. Targets were not shot at, according to [Charles] Beans. There was no umpire for the distance contest.”

Kumeyaay (Southern Diegueño). Leslie Spier (1923) described arrows used by the Southern Diegueño as follows:

Arrows (*'kopa'l*) were made of arrow weed provided with a wooden foreshaft, or entirely of wood. The latter are more effective against big game. The length of the reed shaft is from the tip of the middle finger to the head of the humerus. The length of the foreshaft is estimated: it protrudes about 15 cm. Wooden arrows are 5 cm. longer than the reed shaft. Smaller reed arrows, about 6 cm. shorter than the above (measured between the same points but with the elbow bent) which are provided with longer pointed foreshafts, are used for quail, rats, squirrels, and rabbits [Spier 1923:351].

Cahuilla. David Prescott Barrows (1900) provided the first detailed description of Cahuilla arrows:

Two sorts of arrows, *whi-al-em*, were used. One is made of two pieces; the shaft of the jointed hollow reed, *pakal* (*Phragmites communis*), which has a strong culm [stalk], five to ten feet high. It grows in wet places and along stream banks and is closely related to “pampas grass.” The end or point of the arrow is made of mesquite wood hardened in the fire, or of the greasewood, *sanka* (*Adenostoma sparsifolium*), and is inserted into the hollow end of the shaft and fastened there with glue and sometimes with sinews wrapped around it. Two feathers are attached to the shaft. This two-piece arrow is identical with that made by the Yumas, Cocopahs, Chemehuevi, Mojaves, Yampais, and Panamints. The Coahuillas also make an arrow from the shoot of a species of wormwood, which grows abundantly throughout the Cabeson valley and surrounding mountains, *hang al* (*Artemisia ludoviciana*, Nutt.). These shoots are peeled, notched and pointed and straightened with the teeth. This arrow is unfeathered [Barrows 1900:50].

Another detailed description of Cahuilla arrows was written by Albert L. Kroeber, based on data he collected from Indian reservations near Highland, Banning, and Indio around 1907 or earlier:

The arrows are of two types, being made either of a straight shaft of wood sharpened at the end, or of cane with a wooden foreshaft. The wooden arrow

is typical of the Mohave, while the cane arrow is attributed by them to the neighboring Chemehuevi and Paiute of Shoshonean stock. At the present day the wooden arrow seems more frequent among the Cahuilla. Used only for small game, neither form has a stone or metal point. It is not unlikely that such may have been the custom also in the old days, even in the case of arrows intended for war. The Mohave state that stone arrow-points were not regularly used by them, and that their ordinary war arrow was the simple sharpened shaft of wood. They appear to regard the stone arrow-point as typical of their Shoshonean neighbors.

The Cahuilla wooden arrow is said by Dr. Barrows [1900:50] to be made from wormwood, *Artemisia ludoviciana*. This is similar to the plant used by the Mohave, *Pluchea sericea*. The arrow is about three feet long. One end is sharpened, the other notched and feathered. All the arrows seen had only two feathers. This may be due to their being intended only for small game. The Mohave used a two-feather arrow for similar inferior purposes, but a three-feathered one for war.

The cane arrow is similarly notched and feathered. It consists of three or four joints of cane three-eighths or half an inch in diameter. At the front end a piece of wood is let into the hollow cane, which is then wrapped about with sinew. This piece of wood, which tapers to a point, projects from the cane some six or eight inches [Kroeber 1908:58–59].

A few Cahuilla ethnographic accounts indicate that “men ...demonstrated their skill with bow and arrow” (Bean and Lawton 1965:9; also see Bean 1978:580; Kroeber 1908).

Quechan (Yuma). C. Darrell Forde (1931) described the skills involved in archery contests among the Quechan (Yuma):

Archery contests were formerly frequent. A slim bundle of arrowweed tips, 2 or 3 inches in diameter, was thrown out as far as possible from the group of archers. It was stuck up in the ground where it fell and the competitors shot at it in turn. Those that hit the bundle received an arrow from each of the other players. This continued until one archer had all the arrows. The winner now threw the bundle into the air and shot at it with the arrows won from the others. If he hit the bundle, he kept the arrow; if he missed, the arrow was returned to its original owner [Forde 1931:132].

Forde noted that skillful arrow-shooting and dodging was practiced by young boys as part of warfare training. “They played arrow games and target shooting. Two parties were lined up facing each other and told to shoot

with blunt arrows in turn, so that they might acquire skill in dodging arrows” (Forde 1931:173).

Ethnographic Information on Arrows Involved in Hunting Ceremonies

Barter and Consiglio (1987:13–15) reviewed ethnographic data on arrows found in crevices elsewhere in western North America. Although there were only a few cases, these are from crevices within rockshelters, and some may have been inserted for ceremonial purposes (e.g., Ellis and Hammack 1968).

Matilda Coxe Stevenson (1904) reported that the Zuni shot arrows into a crevice on Corn (or Thunder) Mountain, which is located near the main Zuni pueblo. “To ensure success in the hunt arrows are shot into a vertical fissure in an inaccessible rock on the west wall of Corn Mountain. A hundred or more arrows were to be seen in this cleft in 1879” (Stevenson 1904:439).

Mary Hallock Foote’s memoir about her Western experiences (Paul 1972) briefly noted that arrows were shot into a crack in what was known as Arrow Rock near Boise, Idaho (Arrow Rock Dam was later completed nearby in 1915):

And there should have been a picture of our fishing camp that summer on the beach below the Atlanta Trail, where the Indians’ Arrow Rock crowds the trail, sheer shaft split down the middle. Into that dark crack the Indians on their hunting or war parties would shoot arrows to discourage the intentions of any evil spirit watching them from that crack [Paul 1972:284].

No other instances of shooting arrows to ensure hunting success, to ward off evil spirits, or for other ceremonial purposes have been found in the ethnographic literature of southern California and the West. Such a pattern, however, may have been more common than reported.

Summary of Ethnohistoric and Ethnographic Data

Ethnohistoric and ethnographic accounts for tribes in southern California and the surrounding desert regions provide some insights into the manufacture and use of arrows that pertain to the Arrow Site specimens. These data suggest several lines of evidence for discerning the nature of the arrow fragments that remain today in the rock crevices at the Arrow Site and the reasons why people may have shot them.

The ethnographic data on arrows for the tribes in southern California are summarized in Table 2. The data are based on the ethnographic studies cited above for the Kumeyaay and Cahuilla, as well as on the following sources for other southern California tribes: Lusiseño (Kroeber 1925:650; Sparkman 1908:205–206); Quechan (Bee 1983; Forde 1931:171; Trippel 1889:576–577); Cocopa (Gifford 1933:273–274; see also Williams 1983:107); Mohave (Kroeber 1925:751; Stewart 1983:64); Serrano (Drucker 1937:15–16); Chemehuevi (Kroeber 1925:597); and Tipai (Drucker 1941:118).

First, although Spanish ethnohistorical observations made by Anza and the Franciscan priests who passed through the Anza-Borrego Desert in the mid-1770s depict the bows and arrows of the Kumeyaay and Cahuilla as poorly constructed, these descriptions do appear to suggest that the arrows did not have stone points and probably had sharpened wooden tips. However, the Spanish accounts were not detailed enough to discern if the arrows were simple or compound types.

Second, ethnographic data for a number of tribes in southern California and adjacent regions indicate that two types of arrows were generally manufactured and used, namely (1) a simple wooden shaft sharpened to a point, and (2) a compound cane arrow with a wooden foreshaft. Although the Kumeyaay and Cahuilla possessed both types of arrows, a statement by Kroeber (1908:58) suggests that the Cahuilla mainly used the simple wooden arrow (but see the arrow in Fig. 4 made in 1931 by Francisco Patencio). Since the fragmentary arrows observed and recovered at the Arrow Site are all compound arrows made of cane with sharpened wooden foreshafts, this evidence suggests that the arrows at the Arrow Site are probably Kumeyaay arrows, but that is still not entirely settled.

Although both Kroeber and Barrows agreed that two types of arrows were made and used by the Cahuilla—a wooden arrow sharpened at one end and a compound arrow of cane or reed with a wooden foreshaft—Barrows (1900:50) indicated that the compound arrow was “identical to those used by a number of neighboring tribes (Yumas, Cocopahs, Chemehuevi, Mojaves, Yampais, and Panamints).” Kroeber (1908:58), however, wrote that the simple wooden arrow was “more frequent among the Cahuilla” at the time of his study, and the type was “typical of the Mohave.”

Table 2
SUMMARY OF ETHNOGRAPHIC DATA ON ARROWS FOR SOUTHERN CALIFORNIA TRIBES

Tribe	Linguistic Family and Stock	Simple Arrow: Arrowweed Main Shaft ^a			Compound Arrow: Cane Main Shaft ^b			References
		Sharp End	Stone Point Attached	Blunt End for Birds	Lacks Foreshaft	Hardwood Foreshaft	Foreshaft w/ Stone Point	
Cahuilla	Takic; Uto-Aztecan	+ ^c	+	—	—	+	—	Barrows 1900:50; Hooper 1920:358–359; Kroeber 1908:57–59, 1925:704; see also Bean and Bourgeault 1989:34–35; Bean and Lawton 1965:8
Kumeyaay (So. Diegueno)	Yuman; Hokan	+ ^d	—	— ^e	—	+ ^d	—	Spier 1923:351–352
Kumeyaay (Kamia)	Yuman; Hokan	+	+	+	—	+	+	Gifford 1931:28–29
Luiseno	Takic; Uto-Aztecan	+	—	—	—	+ ^f	+	Kroeber 1925:650; Sparkman 1908:205–206
Quechan (Yuma)	Yuman; Hokan	+	+	—	—	+	—	Forde 1931:171; Trippel 1889:576–577
Cocopa	Yuman; Hokan	+	+	+ ^g	—	+	—	Gifford 1933:273–274; see also Williams 1983:107
Mohave	Yuman; Hokan	+	—	+ ^g	—	—	—	Kroeber 1925:751; Stewart 1983:64
Serrano	Takic; Uto-Aztecan	+	+	—	—	—	—	Drucker 1937:15–16
Chemehuevi	Numic; Uto-Aztecan	—	—	—	—	+	+	Kroeber 1925:597
Tipai (So. Diegueño in Northern Baja)	Yuman; Hokan	—	—	+ ^g	—	+	+	Drucker 1941:118

^aArrowweed (*Pluchea sericea*).

^bCommon cane (*Phragmites communis*) was used by most groups.

^cCahuilla used “wormwood” (*Artemisia ludoviciana*) instead of arrowweed (Barrows 1900:50; Kroeber 1908:58, 1925:704).

^dSpier (1923:351) lists “arrow reed” but then describes two types of arrows, suggesting they are both most likely arrowweed and *Phragmites* cane.

^eBlunt arrows (‘*kupa’l gewunwun*) not made by Southern Diegueno, but they are known as Yuma projectiles” (Spier 1923:352).

^fInstead of *Phragmites* cane, Luiseno arrows usually consisted of another cane (*Elymus condensatus*) with a foreshaft of chamise (=greasewood) (*Adenostoma fasciculatum*) (Kroeber 1925:650; Sparkman 1908:205–206).

^gData on “blunt” and/or “crossed-stick bird arrows” from Drucker (1941:119, 184).

As the ethnographic accounts indicate (see Table 2), both the Kumeyaay and Cahuilla manufactured and used two types of arrows, but the one-piece simple wooden arrow was apparently more common among the Cahuilla, at least according to Kroeber. The arrows at the Arrow Site are the compound type with a wooden foreshaft. This, along with the location of the Arrow Site, suggests that they are Kumeyaay arrows.

METHODS AND FIELDWORK

The site was visited on two occasions prior to the commencement of fieldwork. We also visited local museums that had Cahuilla, Kumeyaay, and Mohave arrows in

their archaeological or ethnographic collections (see Table 1 and discussion above). Data collected included the types of plant, animal, and pigment materials used for arrows (if this could be determined), the technology of construction, and other information that might be useful in scientifically substantiating the cultural affiliation of the arrows at the Arrow Site.

Through consultations with both Cahuilla and Kumeyaay groups, it was agreed that Ms. Carmen Lucas, Kwaaymii Elder (of the larger Kumeyaay group), would participate in and advise on the project because of her clan’s close association with the lands that are now ABDSP.

All fieldwork took place on June 1–2, 2001. The authors, along with Ms. Lucas and a photographer, used

a mechanized boom lift to access the crevices where the arrows are located. The platform of the boom lift was raised to the level of each of the crevices and brought as close as possible to the canyon wall (see Fig. 3). Data collected included the number of arrows in each crevice; their length, diameter, and other characteristics; height above the present ground surface; and the horizontal extent of each crevice. Using a flashlight, we inspected the interiors of the crevices to determine if additional materials were present. A miniature video camera with an internal light source was also used to visualize crevice interiors, a procedure that was only partly successful since the diameter of the camera (1.5 in. or ca. 4 cm.) was too great for it to be fully inserted into the crevices. However, with the aid of a video monitor on which we could see what the camera was capturing, and with some experimentation and practice, excellent VHS videotape footage was obtained of crevice interiors as well as of those arrow portions within the crevices. The video recordings allowed us to further study the crevice interiors at a later time.⁴

After the observational and data-recording activities were completed, a small sample from four arrows—two from each of the two lower crevices—was taken for radiocarbon dating and wood identification. Each sample was numbered, logged, and bagged.

ANALYTICAL METHODS

The arrows still in place at the Arrow Site, as well as those previously collected, were studied and described, and all data on the technological processes involved in their manufacture, the plant materials used, and the radiocarbon dating of the samples recorded.

Identification of Plant Materials

The type of wood present in the samples from the four *in situ* arrows and the previously acquired specimens from the site was tentatively identified through the collective efforts of Andrew Sanders, (then) Curator at the University of California, Riverside Herbarium, (then) Associate State Archeologist Joan Schneider, and ABDSP Botanist Larry Hendrickson.

Radiocarbon Determinations

Four newly collected samples were submitted for accelerator mass spectrometry (AMS) radiocarbon age deter-

minations by removing fragments of sufficient weight for at least one AMS analysis from each sample. The remaining intact portions of the arrows are curated at the Begole Archaeological Research Center (BARC) at ABDSP. The original seven arrows that were the subject of the 1987 study and report are curated at the same location. A fragment of one arrow in the ABDSP collections (622-1-549b), previously dated by Beta Analytical, was also submitted to Rafter Radiocarbon Laboratory as a test of the accuracy of previous determinations.

Comparisons of Manufacturing Methods

Available technological references (e.g., Campbell 1999: 276–294; Mason 1894), as well as data collected from museum and repository collections, were used to both compare and reconstruct how the arrows at the Arrow Site were probably made and used.

RESULTS OF FIELDWORK AND ANALYSES

Thirty-seven (37) arrows were present in the three crevices at the time of our 2001 fieldwork. Tables 3–7 present the data collected in the field from each of the three crevices at the Arrow Site. Barter and Consiglio (1987), studying the crevices through enlarged photographic images, thought that 41 arrows were *originally* present and that 34 remained in place, while seven were in the ABDSP collections. The discrepancy between the number of arrows reported in the 1987 study (41 total) and those counted by us in 2001 (44 total) is likely because our close-up investigation and ability to see within the crevices was more accurate than long-range photography.

Table 3
DATA FROM THE ARROW SITE CREVICES

	Height from Present Ground Surface	Horizontal Length of Crevice	Number of Arrow Fragments in Place 5/2001	Number of Arrows Visible Outside the Crevice
Crevice 1 (Northern)	7.7 m. (25.26 ft.)	112 cm. (44.1 in.)	13	11
Crevice 2 (Central)	12.3 m. (40.35 ft.)	160 cm. (63.0 in.)	22	18
Crevice 3 (Southern)	13.8–14.15 m. (45.28–46.42 ft.)	71 cm. (27.25 in.)	2	2

Table 4
ARROW DATA FROM THE NORTHERN AND LOWEST CREVICE GROUP

Arrow No.	Distance from Northern Edge of Crevice [cm.]	Length Extending from Crevice [cm.]	Maximum Diameter of the Exposed Portion—Min. Diameter [cm.]	Arrow part(s)	Other	Visibility Outside the Crevice	Comments
1 ^a	4.0	19.0	0.9 -0.35			yes	—
2	13.0	11.5	0.8 -0.4	Foreshaft		yes	—
3	15.0	19.5	0.7 -0.4	Foreshaft		yes	—
4	17.0	7.0	1.1	Mainshaft		yes	<i>Phragmites</i>
5 ^a	21.0	17.0	1.2	Mainshaft		yes	<i>Phragmites</i>
6	33.0	4.5	0.8	Mainshaft		yes	<i>Phragmites</i>
7	34.5	5.0	0.8	Mainshaft		yes	<i>Phragmites</i>
8	55.5	0.1	—	Mainshaft		Not visible	<i>Phragmites</i>
9	55.5	8.0	1.0	Mainshaft	Extends into crevice >15 cm.	yes	<i>Phragmites</i>
10	86.0	3.8	1.0	Mainshaft		yes	<i>Phragmites</i>
11	88.0	0.0	—	Mainshaft		Not visible	<i>Phragmites</i>
12	91.0	4.0	1.1	Mainshaft		yes	<i>Phragmites</i>
13	92.5	9.0	1.1	Mainshaft			<i>Phragmites</i>

^aArrow from which radiocarbon date was obtained.

Table 5
ARROW DATA FROM THE CENTRAL CREVICE GROUP

Arrow No.	Distance from Northern Edge of Crevice [cm.]	Length Extending from Crevice [cm.]	Maximum Diameter of the Exposed Portion [cm.]	Arrow Part(s)	Other	Visibility Outside the Crevice	Comments
1	0.0	12.00	0.8	Foreshaft	Hardwood	+	At 150° slant
2	5.0	7.00	1.0	Foreshaft		+	
3	20.0	3.50	0.7	Foreshaft		+	
4	21.0	5.00	0.7	Foreshaft		+	
5 ^a	21.5	3.50	0.7	Foreshaft		+	
6	22.5	5.00	0.9	Foreshaft		+	
7	23.5	8.00	1.2	Main shaft	<i>Phragmites</i>	+	Sinew binds portion of shaft within crevice
8	27.0/0	Not visible	--	Foreshaft		Not visible	Viewed with mini-videocam
9	30.5	1.50	1.0	Main shaft	<i>Phragmites</i>	+	
10 ^a	31.0	8.00	0.8	Foreshaft		+	
11	32.0	10.00	0.7	Foreshaft		+	
12	41.0	Not visible	--	Foreshaft		Not visible -	Might be fragment of same foreshaft as 13; viewed with mini videocam
13	41.0	Not visible	--	Foreshaft			Might be fragment of same foreshaft as 12
14	52.0	6.00	0.9	Foreshaft and Mainshaft	Hardwood and <i>Phragmites</i>	+	Foreshaft visible; main shaft within crevice

Table 5 (Continued)
ARROW DATA FROM THE CENTRAL CREVICE GROUP

Arrow No.	Distance from Northern Edge of Crevice [cm.]	Length Extending from Crevice [cm.]	Maximum Diameter of the Exposed Portion [cm.]	Arrow Part(s)	Other	Visibility Outside the Crevice	Comments
15	75.0	Not visible	Ca.1.0	Main shaft	<i>Phragmites</i>	Not visible	Seen with mini videocam
16	80.0	4.25	Ca. 1.0	Main shaft	<i>Phragmites</i>	+	Shaft is split
17	88.0	3.00	0.5	Foreshaft	Hardwood	+	Very sharp tip
18 ^a	89.5	7.50	1.1	Mainshaft?	<i>Phragmites</i>	+	
19	90.0	10.00	Ca.1.1	Mainshaft	<i>Phragmites</i>	+	Shaft is split
20	91.0	4.00	1.1	Mainshaft	<i>Phragmites</i>	+	
21	93.0	12.50	1.1	Mainshaft	<i>Phragmites</i>	+	
22	95.0	10.00	0.85	Foreshaft	Hardwood	+	

^aArrow from which radiocarbon date was obtained.

Table 6
ARROW DATA FROM THE SOUTHERN AND HIGHEST CREVICE GROUP

Arrow No.	Distance from Northern Edge of Crevice [cm.]	Length Extending from Crevice [cm.]	Maximum Diameter of the Exposed Portion [cm.]	Arrow Part(s)	Other	Visibility Outside the Crevice	Comments
1	18.5	Not visible	1.2	Mainshaft	<i>Phragmites</i>	not visible	Sinew binding on portion within the crevice. Seen with mini videocam.
2	71.0	5	1.2	Mainshaft	<i>Phragmites</i>	+	Squashed flat by rock.

Table 7
ARROW PORTIONS PRESENT AT THE ARROW SITE

Crevice	Foreshafts Only	Mainshafts Only	Mainshaft and Foreshaft	Other Evidence
Northernmost	3	10	6 ^a All previously removed from crevice	Arrow 9 (mainshaft) extends more than 15 cm. into the crevice.
Central	12	8	2 ^a One previously fallen from crevice	Arrow 7 (mainshaft) has sinew binding on portion within the crevice.
Southernmost	—	2	—	Arrow 1 (mainshaft) has sinew finding on portion within the crevice.

^aArrow from which radiocarbon date was obtained.

Our study shows that in every case only portions of the arrows are now present and that those portions include both the foreshafts and mainshafts of compound arrows (Fig. 4). Only foreshafts are present in some cases, with the mainshafts likely having weathered away and/or fallen to the surface of the wash below. In other cases, portions of the mainshafts remain attached to the foreshafts; these often have sinew bindings still holding them together. No fletching or notches (nocks) remain on any of the arrows. There was no indication that stone arrow points were

ever attached to the arrows. The mainshafts consist of a locally available cane (*Phragmites* sp.; Munz and Keck 1959); the foreshafts are of hardwood. Below, we discuss the identification of hardwoods using our comparative collection of local materials.

The mean maximum diameter of the portions of the remaining mainshafts is 1.12 cm. and that of the foreshafts 0.74 cm. (Tables 4–6). These differences in diameter reflect the technology of arrow construction (see Fig. 4). Hardwood foreshafts were bi-pointed, with

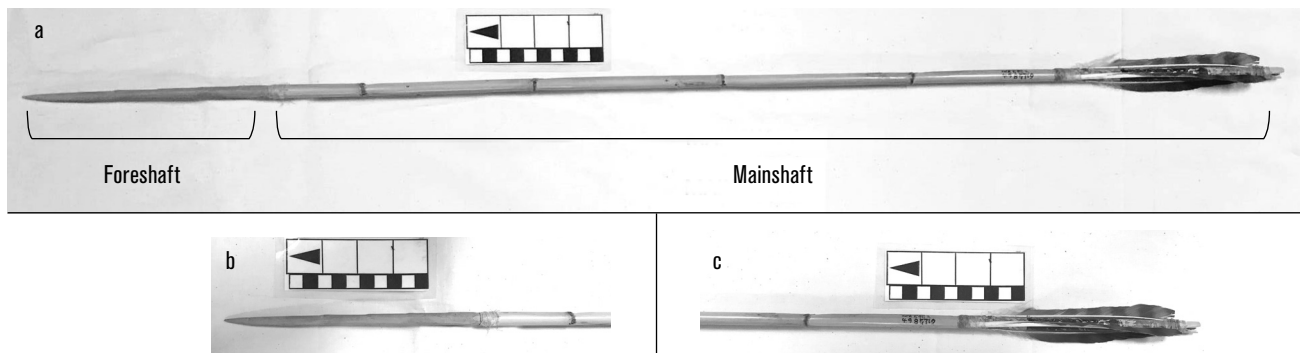


Figure 4. Arrow made by Francisco Patencio in 1931 at the request of Elizabeth Campbell. Patencio was a long-time traditional Agua Caliente Cahuilla leader. Campbell wanted this arrow and other implements to compare with archaeological fragments she was finding in her fieldwork. (a) The complete compound arrow composed of a cane mainshaft and hardwood foreshaft. (b) Closeup view of the distal end of the arrow (foreshaft) showing how the foreshaft was inserted into the cane mainshaft and the sinew binding on the mainshaft. (c) Closeup view of the proximal end of the arrow (mainshaft) with feather fletching. All scales are 10 cm. Photographs by J. Schneider. Arrow is in the Campbell Collection at Joshua Tree National Park, Twentynine Palms, Cal.

one sharpened end inserted into the hollow core of the *Phragmites* mainshaft and the other pointed end extended distally as the “business end” or point. The mainshaft was prepared by cutting the cane between two of its natural joints. After the joint was prepared and the foreshaft inserted, sinew wrapping was applied as a reinforcement, both at the cut edge of the cane (above the joint in the cane) and just below the joint (see Figs. 2 and 4). Since the foreshaft was jammed down into the hollow of the cane, the sinew bindings prevented the cane from splitting and further secured the foreshaft. Although no fletching remains on any of the arrows at the Arrow Site, we learned from our museum research that feather fletching, as well as mastic, could also be applied with sinew wrappings.

Identifying Arrow Materials

One goal of our study was to identify the materials used to make the arrows. We noted above that all the mainshafts present were made of cane (*Phragmites* sp.). The identification of the hardwood foreshafts was more problematic. We developed a comparative collection of local fresh woods described ethnographically as being used in the region for arrows—these included willow, arrowweed, wild rose, mesquite, mulefat, and elderberry. ABDSP botanist Larry Henrickson provided and identified the majority of the comparative samples, while the remainder were gathered by Schneider in ABDSP and then verified by Henrickson. Each comparative sample

was tagged and inspected both macroscopically and under a 10–20× binocular microscope. Drawings and notes were made of the branching and leaf patterns on the fresh specimens. Cross-sections of all specimens were observed and drawn (Fig. 5).

Since a close examination of the foreshafts remaining in the crevices was not possible, only three (3) foreshaft samples collected for radiocarbon dating and five (5) foreshaft portions of the arrows collected earlier by Park staff, as well as the single fallen arrow that had originally led to the discovery of the site, were examined in the same manner—nine (9) specimens in all. Table 8 shows the results of our comparative study of the hardwood foreshafts.

All of the identifications presented here should be considered tentative; however, it is clear that more than one type of wood was used to make the foreshafts. Our analysis compared the patterns of stem and leaf scars in new growth of the six plant species available in the nearby desert or in adjacent uplands. In the case of arrowweed, desert willow, and mulefat, new shoots are very straight and have minimal branching. While wild rose also follows this pattern, the plant has thorns, and the thorn and leaf-scar patterns were not observed on the foreshafts that we examined in the archaeological collection. New mesquite growth is not necessarily straight, but several of the specimens in the collection may have been made from mesquite. No matches were found for elderberry branch and leaf scars. In conclusion, we found that (1) a variety

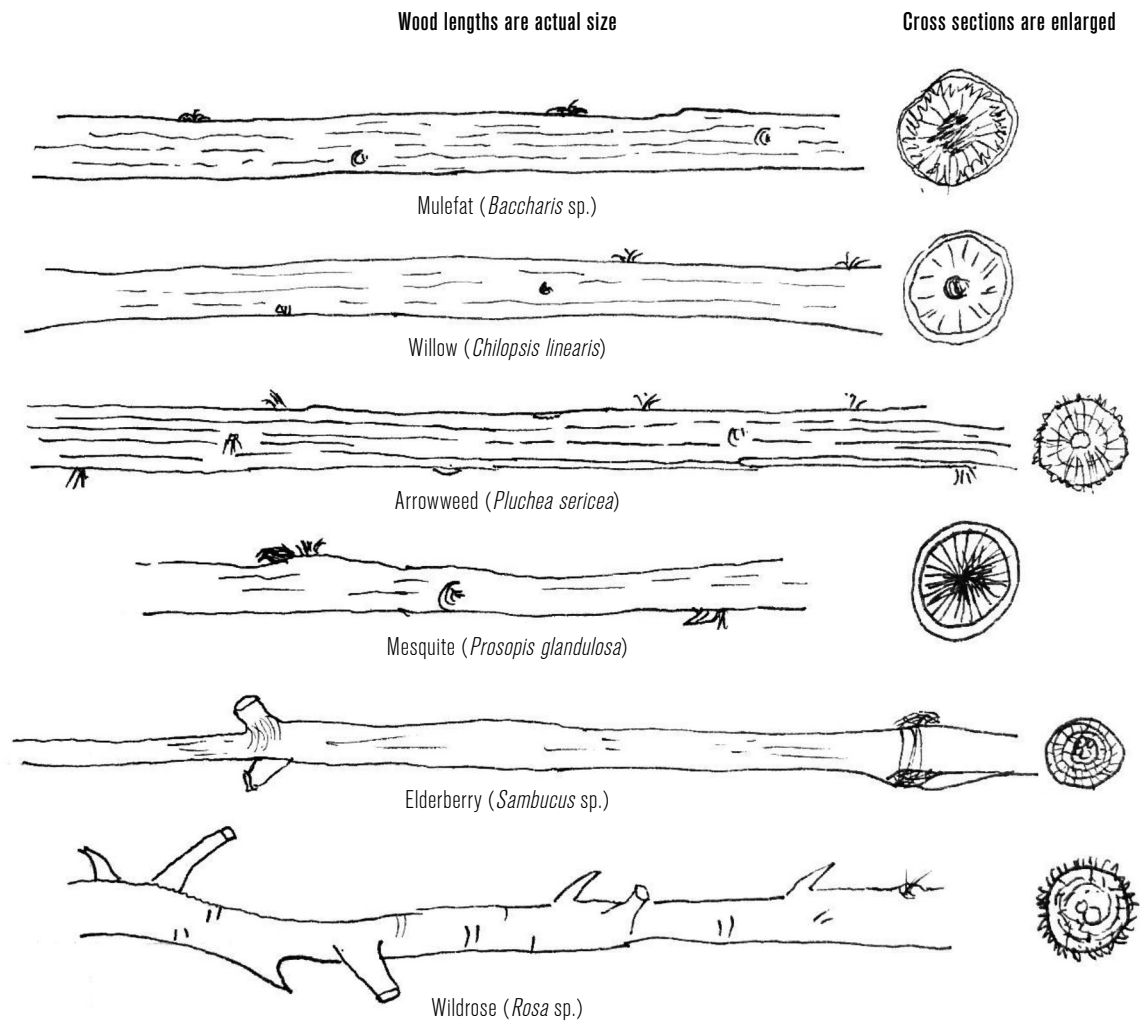


Figure 5. Sketches of six different local plant materials from which arrows were made, according to ethnographic data.

Table 8
IDENTIFICATION OF HARDWOOD ARROW FORESHAFTS IN THE ABDSP COLLECTIONS

Catalog Number	Specimen Type	Description	Tentative Identification
622-1-873	Foreshaft and mainshaft articulated	First arrow to fall; compound; sinew binding Mainshaft is <i>Phragmites</i>	Mulefat
622-1-945a	Mainshaft	Loose sinew binding attached; portion of compound arrow. Mainshaft is <i>Phragmites</i>	N/A
622-1-945b	Foreshaft	Portion of compound arrow; radiocarbon date	Arrow weed or mulefat
622-1-945c	Foreshaft	Portion of compound arrow; definitely not arrow weed or willow	Mulefat
622-1-945d	Foreshaft	Portion of compound arrow; few landmarks; radiocarbon date	Willow?
622-1-945e	Foreshaft	Portion of compound arrow; different characteristics compared to <i>f, g, h</i>	Arrow weed?
622-1-945f	Foreshaft	Portion of compound arrow; looks like second-year growth with both stem and leaf scars; very woody; has undulations; not similar to any other foreshaft	Mesquite? Or other unknown
622-1-945g	Foreshaft	Portion of compound arrow; tip is fire-hardened; similar to <i>f</i>	Mesquite? Or other unknown
622-1-945h	Foreshaft	Has notch with residue that may be mastic; may be remains of haft of stone point; may be the same wood as <i>f</i>	Mesquite? Or other unknown

of woods were used to make the hardwood foreshafts, and (2) the foreshafts in the ABDSP collections were made from mulefat, desert willow, arrowweed, and perhaps mesquite or a similar hardwood.

Placement of the Arrows

A closer look at the portions of the arrows remaining *in situ*, as well as those arrows in the ABDSP collections, helped us to determine how the arrows entered the crevices and possibly why. Because of the site's setting, it seemed possible that the arrows may have been manually inserted into the crevices rather than shot from a bow. Because rapid down-cutting of the wash adjacent to the rock wall where the crevices are located has been documented (Abbott 2001), it is possible that native people could have reached the crevices and placed the arrows within them directly. Abbott, for example, noted (2001) that at the time the arrows were inserted (i.e., about 400 years ago), the floor of the wash may have been a few meters higher. Moreover,

...the archers would have had a higher stream floor, and thus, less vertical distance for their arrows to travel. Furthermore, there is a strong possibility that the archers were able to walk up rock-fall masses and be even closer to their bat guano-stained fracture targets before shooting their arrows. Alternatively, the rock-fall masses could have been voluminous enough to allow climbing up to the fractures and directly inserting the arrows by hand [Abbott 2001: 1–2].

Table 7 presents a summary of the portions of the arrows remaining in the crevices, comprising 15 hardwood foreshafts, 20 cane mainshafts, and 8 joined foreshafts and mainshafts. The various possible scenarios involved are conceptualized in Figure 6, showing the possible position of each element present either within or extending from the crevices.

The arrows remaining *in situ* fall into three of four categories, as shown in Figure 6. Fifteen arrows (15) are represented only by the foreshaft of the compound arrow; no mainshaft remains (Fig. 6a). The exposed end of the foreshaft is sharpened, as is its opposing end. These arrows could have been either shot or pushed into the crevice. The mainshaft has weathered away, leaving both ends of the foreshaft exposed. It is certain that the proximal end (with fletching) of these arrows was never present in the crevice.

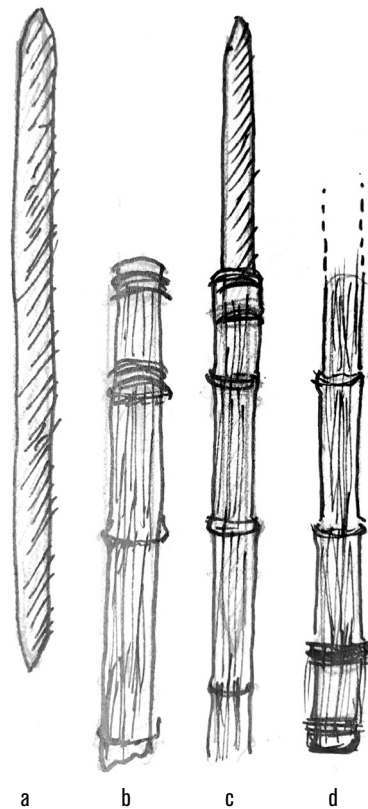


Figure 6. Sketch of four different scenarios that would account for the specific portions of compound arrows that are *in situ* at the Arrow Site.

In 20 other instances, only the cane mainshaft remains protruding from the crevice (Fig. 6b), and no foreshaft is present. These arrows could have been (1) shot (point upward) or (2) otherwise placed within the crevices (either point upward or downward). In the first instance, portions of the cane mainshaft could have weathered away, releasing the foreshaft, which is thinner but more durable than the cane mainshaft. The foreshaft may have dropped to the ground and been lost, leaving the mainshaft in place. In the second instance, the arrow could have been placed in the crevice with the proximal (fletched) end upwards, leaving the exposed foreshaft and part of the mainshaft exposed outside the crevice, to weather and fall to the ground below. We saw no indication of feather fletching on any arrows within the crevices. Alternatively, the arrows may not have been the compound type and were composed totally of cane; this is unlikely, given the results of our museum and ethnographic research (see above). In short, if only the mainshaft is present, it suggests that either the foreshaft

Table 9
RADIOCARBON DETERMINATIONS OF ARROWS FROM THE ARROW SITE

Laboratory Number	Specimen	Location	Conventional Radiocarbon Age	Median Probability	2-Sigma Range
NZA 14286	Arrow #18	Central crevice	320 ± 65 B.P.	387 B.P.	517 B.P. – 257 B.P.
NZA 14287	Arrow #10	Central crevice	370 ± 55 B.P.	415 B.P.	525 B.P. – 305 B.P.
NZA 14288	Arrow #1	Northern crevice	401 ± 65 B.P.	440 B.P.	570 B.P. – 310 B.P.
NZA 14289	Arrow #5	Northern crevice	507 ± 65 B.P.	537 B.P.	667 B.P. – 407 B.P.
NZA 14290	622-1-945b ^a	Northern crevice	366 ± 75 B.P.	407 B.P.	557 B.P. – 257 B.P.
Beta 16531	622-1-945b ^a	Northern crevice	300 ± 75 B.P.	369 B.P.	519 B.P. – 219 B.P.
Beta 16532	622-1-945d	Central crevice	320 ± 75 B.P.	383 B.P.	533 B.P. – 233 B.P.

Note: NZA Calibration: INTCAL98_14C (Stuiver 1998).

^aDated by two radiocarbon laboratories: Beta and Rafter, this was intentional to check accuracy.

dropped out after the arrow was inserted into the crevice, or (as is less likely) the arrow was placed in the crevice with the fletched end upward.

In eight (8) instances, both the foreshaft and the mainshaft of the arrow are present (Fig. 6c). These arrows could have been shot or otherwise placed in the crevices, but with the foreshaft upwards or leading. The mainshaft portion, with fletching and notch, has since weathered away, leaving only the distal parts of the arrows containing the articulation of the foreshafts and mainshafts in place. We saw the articulated mainshaft attached below the “business end” of the foreshaft. This, however, does not make it certain that the arrow was shot into this position; it could have also been placed in the crevice manually.

In no instances were arrows present corresponding to Figure 6d, with only the distal portion of the mainshaft present and no foreshaft. Remnants of sinew bindings would have been present. The absence of such a specimen supports our argument that the arrows were shot rather than pushed into the crevices.

Radiocarbon Determinations

Two radiocarbon dates on the arrows were already available, from arrows that had previously fallen or been removed from the crevices (Barter and Consiglio 1987 and Table 9). The additional radiocarbon dates were obtained to determine if the time range of the activities at the site was wide or narrow. Four additional dates from *in situ* arrows were acquired during our 2001 work; small samples from exposed portions of arrows were taken specifically for this purpose and sent to Rafter

Radiocarbon Laboratory in Wellington, New Zealand, a laboratory that specializes in the pretreatment of wood for AMS dating (see Table 9).

We looked at the radiocarbon data to evaluate the possibility that a specific recurrent activity took place at the site over an extended period of time, perhaps as part of a traditional ritual activity over hundreds or thousands of years. Radiocarbon ages are measures of the variability of a number of factors, expressed statistically. As succinctly expressed by Bednarik (2002:1225), radiocarbon results are conventionally expressed as a determination with a + error factor, signifying that there is only about a 68 percent (i.e., 1 sigma) chance that the true age falls within that time range. In Table 9, we present the radiocarbon determinations as calibrated by Rafter Radiocarbon Laboratory for each of the five samples analyzed. The median calibration ages range between A.D. 1413 and A.D. 1581. We also express these median dates over a two-sigma range, indicating about 99 percent accuracy. These ranges overlap over a two-sigma range and therefore may represent a single event or a series of traditional events occurring over a period of a few hundred years.

DISCUSSION AND INTERPRETATIONS OF THE ARROW SITE

The Arrow Site is, as far as we know, a unique archaeological phenomenon in southern California, and perhaps the entire Desert West. The data acquired during this study have added little to our understanding of the

functional aspects of the Arrow Site. Although the ethnographic literature hints at ritual or ceremonial aspects to some archery, a preponderance of evidence suggests that target practice and games of skill were regular activities among indigenous peoples of inland southern California. Furthermore, there are several accounts of games of chance and the placement of bets on the results of these games. When queried on her thoughts about the Arrow Site, Carmen Lucas (Kwaaymi cultural expert) suggested that competitive archery was common in times past and that sometimes individuals or families were known for their skills (personal communication 2019). If we were to choose one interpretation of the activity that resulted in the Arrow Site as we see it today, we would suggest that the arrows were shot into the crevices with a bow as part of a game of chance or test of skill. This interpretation is supported by our observation that there is no reason to suspect that any of the arrows in place today were inserted other than with the point upwards, as if shot from a bow.

The apparent skill needed to shoot the arrows into as small an opening as those of the crevices does not seem to have been an impossible or even an unusual ability (cf. Bartlett 1854, II:237–238; Hamilton 1982:107–113). One must remember that what we see today at the Arrow Site represents only the successful attempts, not those that failed. Furthermore, there is good reason to suspect that the distance from the ground to the crevices was less in the past than it is today because of the active, ongoing downcutting of the wash below the crevices. We do know that the arrows were inserted with a good deal of force; one, even today, extends more than 15 cm. into the crevice.

One might ask why the significant time invested in the gathering of materials and the fabrication of compound arrows would be expended in a game of chance. Perhaps more significance was given to the game than we can now discern. Perhaps these were hunting arrows that were made for the hunt, but were used in practice because the size, weight, and construction of an arrow would have influenced the draw and release of the bow and the subsequent flight of the arrow during an actual hunt. Perhaps the game of skill or chance was as culturally important as the hunt itself.

Our data do not support the scenario that the arrows were shot into the crevices during separate events that were widely separated in time. The radiocarbon dates and

their statistical error range may not support a long-term ceremonial or spiritual tradition lasting more than a few centuries, but it does not rule out a less protracted series of events reflecting a specific tradition.

Our ethnohistoric, ethnographic, and museum research suggests that there is little reason to doubt that the arrows were made and used by indigenous people living in the immediate area of the site just prior to European contact, a time period consistent with the radiocarbon dates for the arrows. The Kumeyaay are the group most closely associated with the location of the Arrow Site. The Cahuilla are a secondary possibility, but the limits of Cahuilla ancestral lands, at least as we recognize them today, lie slightly to the north. Our research has shown that both of these indigenous groups made and used the types of arrows found at the Arrow Site, and also used local materials in identical ways in manufacturing their arrows.

CONCLUSIONS

The Arrow Site is unique in that it still contains the remnants of 37 arrows lodged in crevices formed by cracks in a canyon wall bordering a deeply incised wash. The prognosis is poor for the survival and preservation of the arrows remaining *in situ*, but the decision to allow them to remain in their original context was made through consultation between California State Parks and contemporary Native Americans. The arrows were likely shot into the crevices between about 537 B.P. and 370 B.P. (A.D. 1413 and A.D. 1581). All were compound arrows consisting of a bi-pointed hardwood foreshaft inserted into a cane mainshaft reinforced with sinew wrappings. No other associated cultural materials were found within the crevices. None of the arrows were ever equipped with stone arrowpoints. The remaining *in situ* arrows, along with fragments of other arrows that were previously collected or had fallen from the crevices, represent an extremely unusual example of late prehistoric indigenous technology and activities.

Although the specific reasons why the arrows were shot into the three rock crevices at the Arrow Site may never be fully understood, we suggest—on the basis of our current data—that the explanation may very well lie in the fact that hunters and warriors in desert regions of southern California and the desert Southwest are known

to have been frequently involved in archery contests and other games of skill. Alternatively, the arrows may have been shot into the crevices to ensure a successful hunt or discourage malevolent spiritual forces.

NOTES

¹While the fieldwork was conducted in 2001 and a technical report was completed at that time (Schneider and James 2001), the present article represents a broader exploration of the data in response to the *JCGBA* article (*Lost and Found* 2007).

²Examples of proportional inaccuracies would include such things as (1) having foreshafts and mainshafts of widely divergent diameters, or (2) having most of an arrow composed of a foreshaft with only a very short mainshaft.

³Such active processes as the sloughing, dislodgment, displacement, and erosion of sections of the canyon wall are regularly observed. After a section separates and slides downward, it is ultimately washed away by periodic flooding. This has been observed during a time span of 30 years (Abbott 2001).

⁴Both the edited videotape and an added sound track are available for study at the Begole Archeological Research Center, Anza-Borrego Desert State Park.

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