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Archaeological Discovery Of Two Wooden Bows From The Coso Range, Inyo County, California

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Archaeological survey within the Coso Mountains resulted in the discovery of two wooden bows. The artifacts were cached in a rock crevice, and appear to represent sinew-backed, reflexed bows commonly used by Native peoples throughout much of the Great Basin. Due to rapid declines in the use of bow-and-arrow technology brought about by the introduction of guns during the historic period, ethnographic specimens and accounts of how bows were made and used are quite rare. Moreover, it appears that the Coso bows represent the only complete or near-complete examples ever recovered from an archaeological context in southern California and the western Great Basin. This paper provides a detailed description of these unusual artifacts, and outlines the probable techniques used in their manufacture.

A *large-scale archaeological survey of the Coso pinyon zone* at Naval Air Weapons Station, China Lake, was conducted by Far Western Anthropological Research Group, Inc. in 1998. Prehistoric site densities were extremely high (one site per 12.7 acres of survey) and included pinyon camps (some with house structures), pinyon caches, hunting camps, and numerous concentrations of rock art. The results of this survey are reported elsewhere (Hildebrandt and Ruby 1999, 2004), and provide important new information regarding the initiation of intensive pinyon harvesting within the southwestern Great Basin.

One of the most intriguing aspects of the project was the discovery of two wooden bows cached in a rock crevice at archaeological site CA-INY-5491. As will be discussed in more detail below, they appear to be finished or near-finished examples of sinew-backed, reflexed bows commonly used throughout the Great Basin. Although a small number of these implements were collected from Paiute-Shoshone peoples by early ethnographers, the Coso bows appear to represent the only archaeological specimens ever reported from California or the western Great Basin. An analysis of perishable remains collected from local rock shelters reveals no evidence for bows or bow fragments (Clewlow et al. 1995; Hillebrand 1974; Meighan 1953; Panlaqui 1974; Wallace 1978; Wallace and Taylor 1955), nor does a broader review of archaeological sites in California or the western Great

Basin (Elston 1986; Moratto 1984; Warren 1984; Warren and Crabtree 1986). The purpose of this paper is to provide a detailed description of these rare artifacts and discuss how they were manufactured and used. To accomplish this goal, we rely heavily on an earlier study of bow stave trees by Wilke (1988); this excellent piece of research should be read along with the current paper.

ETHNOGRAPHIC SPECIMENS

A major problem in the study of Great Basin archery is the lack of ethnographic information on the production and use of bows. Whereas many women's crafts and technologies maintained economic viability well into the 19th Century and could be observed in historic times (e.g., the manufacture of basketry), men's crafts declined in economic importance rather quickly as new jobs associated with ranching, mining, and the fur trade became available (Wilke 1988). This was particularly the case with archery, as the introduction of guns to Great Basin peoples led to the replacement of traditional weaponry by at least 1870. By the time ethnographers turned their attention to traditional archery, the manufacture of reflex bows had essentially become a lost art in the western Great Basin region (Wilke 1988:4).

According to the few ethnographic accounts available, various species of wood were used in the Great Basin for the production of bows. These included mountain mahogany (*Cercocarpus ledifolius*), serviceberry (*Amelanchier* sp.), juniper (*Juniperus* sp.), chokecherry (*Prunus* sp.), oak (*Quercus* sp.), maple (*Acer* sp.), birch (*Betula* sp.), willow (*Salix* sp.), mesquite (*Prosopis* sp.), and "locust" (possibly *Robinia* sp.); all but willow were probably made into sinew-backed bows. Although the local availability of particular timber species largely dictated which wood was used in a given area, juniper is identified as the favored wood among nearly all Northern and Southern Paiute, Western (Nevada) Shoshoni, Owens Valley Paiute, Ute, and Gosiute; the Tubatulabal and Kawaiisu of the southern Sierra Nevada also used juniper for the manufacture of bows (Wilke 1988).

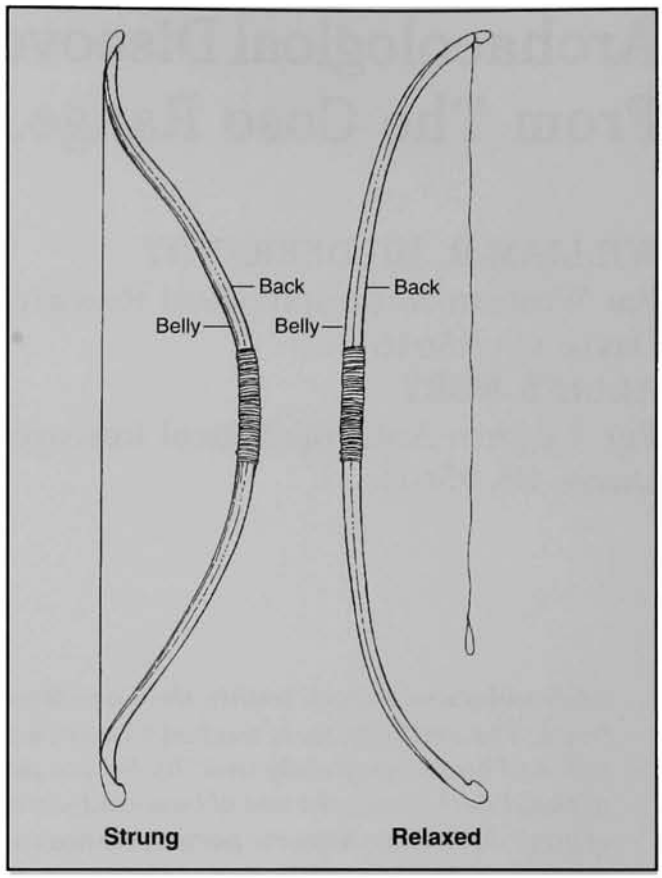


Fig. 1. Schematic Illustration of a Reflexed Bow.

Wilke's (1988) research indicates that there are 14 sinew-backed bows curated at the U.S. National Museum attributed to the Southern Pauite; however, these were collected from groups living in northwestern Arizona, southeastern Nevada, and western Utah (Powell Collection; Fowler and Matley 1979). Wilke (1988) also notes a single bow curated at the Eastern California Museum in Independence (thought to be from Owens Valley), and another at the Hearst Museum at U.C. Berkeley, attributed to the Panamint Shoshone. All of these bows are fashioned from a single piece of wood (stave) and tend to be about one meter in length, though some ethnographic reports indicate that lengths varied between three and four feet (ca. 90-120 cm). When unstrung, they are strongly reflexed in the handle and recurved at the ends (i.e., curved away from the archer;

Fig. 1), and all are reinforced with sinew glued onto the backs; some of these specimens also have sinew wrappings around the nocks (see also Bates 1978:21).

WILKE'S BOW STAVE TREES

Due to the lack of detailed ethnographic information on the manufacture of sinew-backed bows in the western Great Basin, Wilke (1988) conducted a survey of Utah juniper trees in Mineral County, Nevada, with the goal of finding wood suitable for a bow-replicating study. During the project, he discovered several bow-stave trees, which allowed him to develop a series of hypotheses regarding the aboriginal selection of parent trees, methods of stave preparation and seasoning, stave removal, and the care and possible management of the favored trees.

Most of the bow-stave trees were relatively large, and straight-grained on at least one side of the trunk; large, straight-grained branches were also sometimes used. Radial curves in the grain seemed to have been acceptable, probably because the stave could be modified later by heating and bending. Small knots were avoided when possible, and large ones were never incorporated into the stave.

Wilke (1988) found that the typical bow stave extraction scars were linear and marked by deep transverse V-shaped cuts on each end. These cuts would halt growth of the tree between the two cuts, allowing the intervening wood to season and shrink without twisting and cracking. After removal of the wood by the bowyer, a rough trough-shaped groove following the grain of the wood would remain.

The V-shaped cuts were typically 6-8 cm. wide and 3 cm. deep, and were probably made with stone chisels and hammerstones, as both of these artifact types were found in association with some of the modified trees (Wilke 1988:16-17). After the cuts were made, the stave was presumably left on the tree to season; the length of the seasoning period is unknown, and replicative studies will probably be required to determine the optimal period of aging. After the seasoning process, the staves were removed using an asymmetrical, V-shaped cut into the face of the tree. One side of the cut was made straight into the tree's face, while the other side was cut at a more oblique angle to facilitate removal of the stave. The stave was split from the tree with a pry tool that was inserted into the stave removal notch. The interior of the stave would eventually become the belly of the bow, and the exterior, weathered side of the stave would become the bow's back. It was important that the exterior of the bow retain the growth-rings evenly for the length of the bow, as they provided the bow's tensile strength. A fracture would likely occur where the growth rings were disrupted.

MODERN SINEW-BACKED BOW MANUFACTURE

Despite the lack of ethnographic descriptions of bow manufacture from the western Great Basin, there is a great deal of information available from individuals that currently build them (e.g., Allely 1992; Hamm 1989; Laubin and Laubin 1980). Jim Hamm has published an outstanding guide to constructing a variety of traditional bows, including a reflexed, sinew-backed variety similar to those used in the Great Basin (Hamm 1989). A review of these methods is quite instructive, because the process outlined by Hamm (1989) results in bows that are quite similar to those found in the Coso Range, and provides the reader with an appreciation of the detailed tasks required to create this rather complex form of aboriginal technology.

After obtaining the raw bow stave, the first step is to orient the back of the bow toward the outside of the tree, and reduce this surface down to a single growth ring. By shaving down the back to a single, continuous growth ring, the bow is given extra strength and durability, as cutting through multiple rings would create cleavage planes between the rings where the bow could split. With certain types of woods (e.g., yew), it can also be advantageous to have an exterior ring of sap wood, for extra strength

and flexibility (Hamm 1989:32).

Because "a bow has to spring back to [its original] shape when an arrow is released, the faster this recovery takes place the faster a bow will shoot an arrow. One way to speed up this recovery is to bend the wood and 'set back' the handle of a bow and 'recurve' its tips" (Hamm 1989:37). By shaving the back of the bow down to a single growth ring, however, the stave is initially quite straight, requiring the wood to be bent to create the set back handle and recurved tips (i.e., the reflexed configuation of the bow). Bending of the bow is accomplished by heating the wood (often with steam) and bending it over the knee at the handle and at the tips. If the bow has a natural twist to it (i.e., a propeller twist), this can also be straightened during this phase of manufacture.

Some preliminary form of nocking is required for the next step, so that the bow can be strung and tillering can begin. "Tillering involves taking wood off the belly of the bow to the desired weight while keeping both limbs evenly balanced" (Hamm 1989:41). Once the bow is balanced and possesses the desired draw-strength, sinew is added to the back of the bow. Sinew backing is an outstanding addition to the bow, as it "will cure almost any problem on the back of the bow, such as knots, cutting through the grain, or cracks" (Hamm 1989:49). Moreover, as the sinew dries on the back of the bow, it shrinks, increasing the reflex and overall power of the implement.

Sinew is usually obtained from the thin sheet of tissue on the backstrap of a deer, or from the lower leg (i.e., the Achilles tendon). After the sinew has been dried, it is carefully pounded and separated into long, string-like fibers. Glue is produced by boiling hide shavings and sinew scraps in water for about 24 hours, adding additional water when necessary. After roughing up the back of the bow, bundles of the sinew are dipped in the warm glue and spread on the back of the bow. Multiple coats are applied, and approximately ten warm, dry days are required before the bow can be used (Hamm 1989).

Sinew nocking is not a technique used by Hamm (1989), but appears to have been a common aboriginal approach, judging from the ethnographic bows noted in the Powell collection (Fowler and Matley 1979), and one observed at the Eastern California Museum. This technique was also recognized by Craig Bates in his analysis of a Sierran Miwok bow (Fig. 2), in which he observed that:

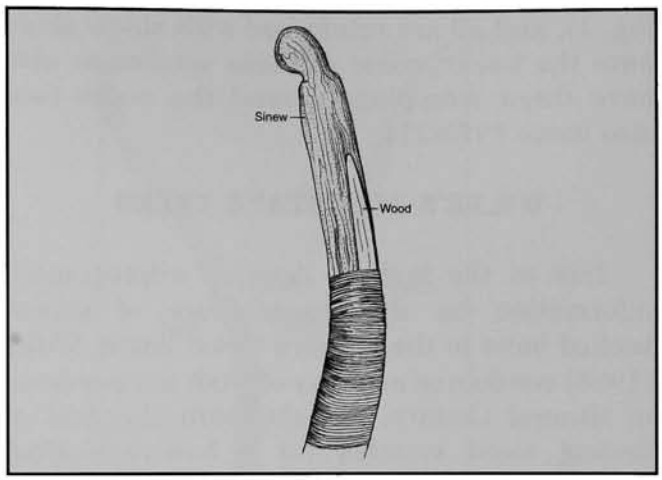


Fig. 2. Detail of Sinew Nocking from a Bow Curated at the San Diego Museum of Man (from Bates 1978).

> the sinew backing, ...on the ends, is brought around the belly of the bow so that the last 2.5 cm at each end are covered with sinew. This sinew then extends beyond the wood at the end of the bow and is folded back in such a manner as to produce a small hook. These hooks, approximately 2.5 cm in length, serve as nocks for the bowstring.... The layers of sinew forming these nocks become exceedingly hard and rigid – almost wood-like in strength, but more resilient [Bates 1978:1].

An identical approach to bow manufacture and sinew nocking is evidenced by a specimen housed at the Eastern California Museum (A1280.1). This bow looks exactly like the one described by Bates (1978); unfortunately, however, the exact origin of the specimen is unknown, as it was obtained as a trade item at a local store sometime near the turn of the century. Rose Black (1861-1940) ran the store in Big Pine, and accepted a wide range of

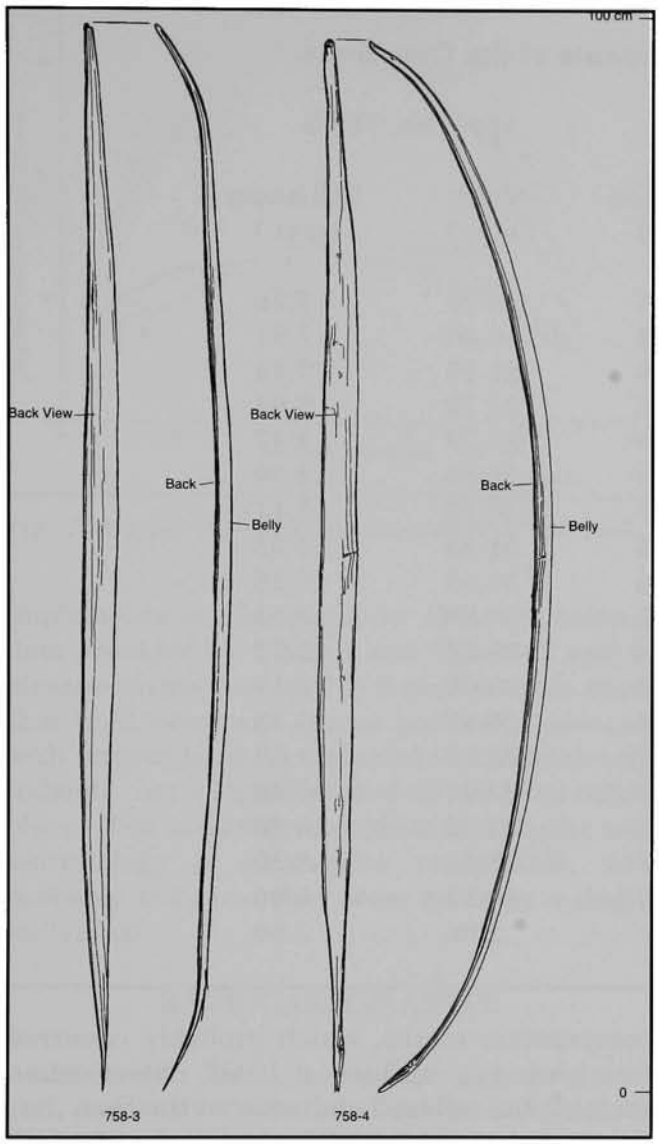


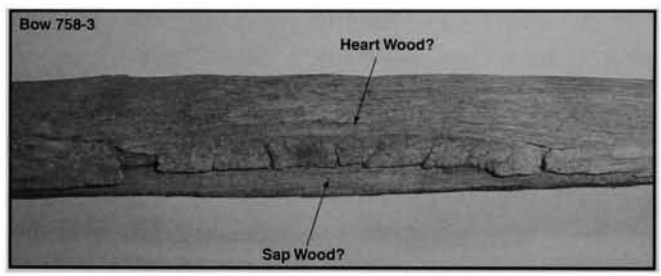
Fig. 3. Wooden Bows Recovered from the Coso Target Range.

materials in exchange for groceries and other items. Notes associated with the bow say it was used in the Indian wars of the 1860s (Beth Porter, personal communication).[1]

THE COSO BOWS

The two Coso bows were recovered from CA-INY-5491, a small habitation site located on a pinyon-covered hillslope containing several large granitic outcrops and boulders. A relatively rich assortment of flaked and ground stone tools were observed on the surface, as was a single hearth feature and a discrete pocket of midden. A single Rose Spring projectile point was also recovered, and represents the only temporally diagnostic artifact found at the site. Both of the bows were found under a natural granite "ledge" within a cluster of large boulders, and were not visible from above. A crew member (Brad Mitchell), who had been instructed to check this area, noticed them when he bent down and ran his hand under the rocks. The bows were clearly cached in this location.

Both specimens are finely made (Fig. 3), and appear to be finished, or near-finished, reflexed, sinew-backed bows. Specimen 758-3 is 99.0 cm. long, and 3.1 cm. wide and 1.3 cm. thick at the grip (Table 1). It is evenly tapered from the grip



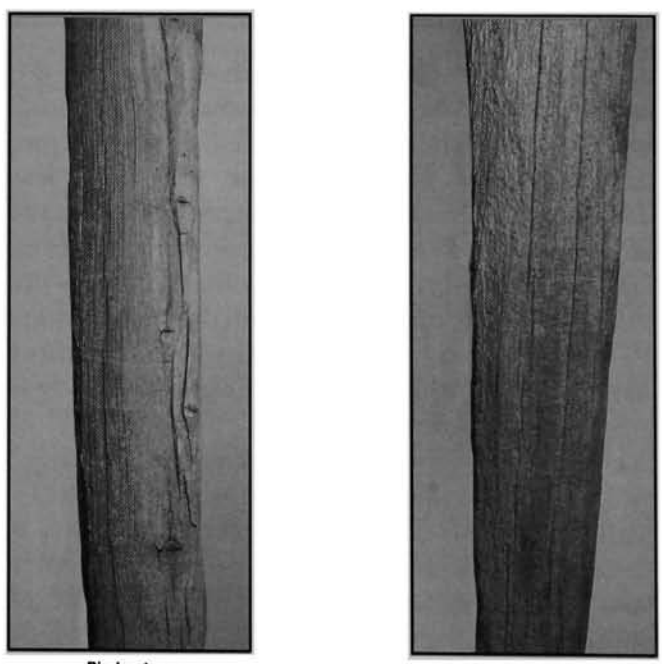


Figure 4. Close-up of wood grain on the Coso Bows.

Table 1. Systematic Measurements of the Coso Bows.

	Spec. No. 758-4		Spec. No. 758-3	
Length along bow (cm.)	Width (mm.)	Thickness (mm.)	Width (mm.)	Thickness (mm.)
5	13.87	8.25	12.21	7.76
10	18.05	10.04	16.40	7.91
15	23.10	11.16	21.15	9.44
20	24.29	12.66	23.74	9.84
25	27.84	12.99	26.29	11.47
30	30.00	13.08	28.03	12.39
35	31.18	13.89	30.10	13.11
40	31.35	14.61	31.43	13.05
45	32.82	14.36	30.69	13.25
50	32.47	13.76	30.88	13.33
55	31.39	13.54	29.53	12.92
60	29.72	13.14	29.00	13.17
65	27.52	12.49	26.67	13.15
70	25.46	11.17	25.07	11.69
75	22.33	11.42	23.71	10.28
80	18.41	9.22	21.12	10.28
85	12.87	7.08	15.61	8.30
90	8.16	5.77	10.81	6.06
95	—	—	2.96	2.80

to its ends, the latter measuring less than 2.0 cm. in width. The ends lack formal nocking and, given their rather thin, pointed configuration, this probably indicates that the bow was designed for sinew nocks. It appears to be made of juniper wood, and is plano-convex in section; i.e., the back of the bow (the side that faces the prey) is flat and the belly rounded. The ends are clearly recurved (probably through steaming and bending), while the remainder of the body is only slightly reflexed.

Specimen 758-4 is 103.5 cm. long, and 3.3 cm. wide and 1.4 cm. thick at the grip (Table 1). Although plano-convex in section, the back is not as flat as that of the other bow. The entire bow is reflexed, with slightly greater curvature at the ends. Like Specimen 758-3, the ends lack nocking, and the bow is finely tapered from the handle to the ends. One end shows small compression marks, which probably occurred from bending against a fixed object when creating the reflexed character of the bow.

Hamm's (1989) emphasis on the need to shave the back of the bow down to a single growth ring, and that an outer ring of sap wood would be preferable in some cases, appears to be borne-out by both of the Coso bows. A clear disconformity between growth rings is exposed on the lateral edge of Specimen 758-3 (Fig. 4), where slight damage to the bow exposes the interface between what appears to be an exterior exposure of sap wood and the interior heart wood. Specimen 758-3 is less clear, but it does have a series of small pin-knots exposed on its back (perhaps indicative of sap wood), but no evidence of this phenomena on its belly where the interior wood can be seen.

The symmetrical, graceful nature of these

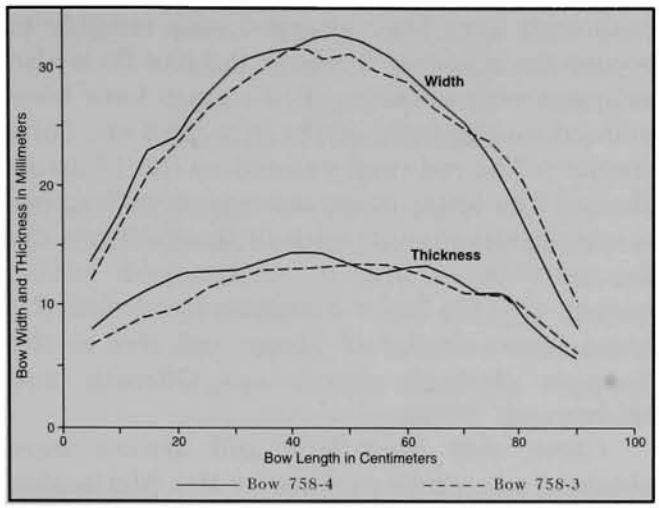


Fig. 5. Morphological Characteristics of the Coso

implements is illustrated by the dimensional data provided by Table 1 and Figures 5 and 6. Measurements recorded at 5 cm. intervals show that both bows are almost perfectly balanced with respect to width and thickness, and clearly indicate that a high degree of tillering has taken place. The consistency of their overall size and morphology is also quite remarkable, and probably indicates they were made by a single individual.

RADIOCARBON ASSAY

Specimen 758-3 has splintering along one end, and a sliver was detached for radiocarbon dating (Sample #Beta-127024). Due to its small size, an AMS date was obtained resulting in a conventional date of 80±60 BP and calibrated ranges of A.D. 1670-1780 or A.D. 1795-1945 (at 2 sigma, 95% probability). Given the low resolution of these estimates, we can only conclude that the bows are less than 300 years old, and probably predate the first historic intrusion into the area, when guns replaced the bow and arrow throughout eastern California (ca. A.D. 1870).

DISCUSSION

The Coso bows are truly remarkable finds, both with respect to their rare occurrence in the archaeological record and their refined morphology. To our knowledge, these are the first singew-backed bows ever reported from an archaeological setting in California or the western Great Basin, and their presence in a rock crevice on an open air site adds to their exceptional qualities, as wooden objects are usually restricted to dry caves and rock shelters where they are protected from rainfall, frost, and other adverse environmental conditions.

Whether they are finished objects that have lost their sinew backing, sinew nocks, and leather handles to the ravages of time, or represent near-finished preforms ready for final preparation is difficult to determine. The latter alternative seems plausible, as both of their backs lack the roughed up surfaces conducive for the application of sinew, and it seems unlikely that finished sinew-backed bows would be cached in such a fashion, as rodents and dampness could compromise the condition of the sinew (Wilke, personal communication). The caching of near-finished blanks is also fully consistent with Wilke's (1988) original study of the bow stave trees, as it was probably necessary to keep a constant supply of bow staves seasoning on their parent trees, as well as

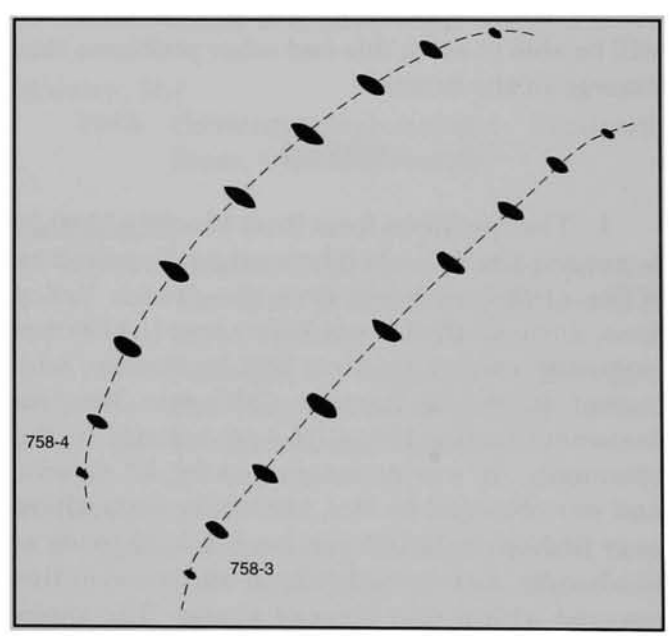


Fig. 6. Three Dimensional Cross-section of the Coso Bows.

cached rough-outs and items ready for final production and use. As should be clear from the forgoing discussion, replacement of a high quality, sinew-backed bow did not happen overnight.

The Coso bows are also exceptional because they provide a rare opportunity to evaluate our knowledge of an ancient craft no longer practiced by local Indian people. Wilke's (1988) original study of bow-stave trees, combined with Hamm's (1989) modern production of sinew-backed bows, provides several interesting hypotheses about what the aboriginal implements must have been like. Discovery of the Coso bows has verified most of the reconstructions of these scholars, particularly their overall size, exposure of a single growth ring on the back of the bow, and shaping of the implement with heat-treatment. The Coso bows and some of the ethnographically collected specimens, however, differ from modern reconstructions in their narrow/thin tips and use of sinew nocking. Why many of the aboriginal bows are so strongly tapered and lack the carved nocking of the modern versions is currently unknown, but it's possible that the sinew nocks were more durable and longer-lasting. Hopefully, with additional study of the Coso bows, and of the few ethnographic specimens still in existence, we will be able to solve this and other problems that emerge in the future.[2]

NOTES

1. The specimen from Rose Black (A1280.1) is not the sinew-backed bow originally noted by Wilke (1988) as being from the Owens Valley area. Instead, the Owens Valley bow (A178) was originally owned by Mrs. Will McGrosky, who loaned it to the Eastern California Museum sometime in the 1930s (it now belongs to the Museum). It was accompanied by 12 arrows, and was obtained by Mrs. McGrosky somewhere near Bishop. It is 104 cm. long, 4.4 cm. wide at the handle, has sinew backing, and wooden tips covered with a thin layer of sinew. The sinew tips are slightly grooved (nocked) for the bow string, which is made from woven sinew, and both ends have been wrapped with rawhide to secure the sinew to the bow; the handle is also wrapped with rawhide. Red stripes have been painted on the belly of the bow, and are quite similar to the red rings painted on the 12 arrow shafts. The latter items are tipped with rather crude obsidian points with little affinity to the Desert Side-notched or Cottonwood series; instead they are larger triangular forms with flat bases (most similar in shape and size to the Saratoga Springs series; see Gilreath and Hildebrandt 1997).

Given that both bow and arrows were obtained as a single package by Mrs. McGrosky, and the arrows do not match the late prehistoric/protohistoric point types of the region (see Bettinger 1989; Hildebrandt and Ruby 1999), it seems likely that the McGrosky collection was manufactured in the historic period for trade/sale. Moreover, the bow does not match the basic morphology of the Coso bows and, therefore, has questionable utility as a model for late prehistoric/protohistoric bow manufacturing in the local area.

2. The final place of curation for the Coso bows has yet to be determined. Contact the cultural resources staff at Naval Air Weapons Station, China Lake for additional information on this subject.

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