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Editor

Todd J. Braje, Ph.D.
Department of Anthropology • San Diego State University • San Diego, California

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Front cover: Olivella dama *and* Oliva undatella *Spire-removed beads from San Diego County (photos by Chester D. King).*

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A Note From The Editor

TODD J. BRAJE

This issue of the *Journal of California and Great Basin Anthropology* (*JCGBA*) will mark my first as editor. It is with great excitement and a deep sense of responsibility that I take over the editorship from Dr. Lynn Gamble. Her leadership over the last six years has allowed *JCGBA* to thrive and consistently produce top-quality research that highlights the diverse and complex history of California and the Great Basin. My primary goal as editor will be to continue to nurture this tradition. The *JCGBA* is the only academic publication in the far west that features articles from all four subfields of anthropology—linguistics, biological anthropology, cultural anthropology, and archaeology. With anthropology departments fissioning around the country due to financial constraints and philosophical and theoretical differences, I see the *Journal* as a way to share our research within and across disciplines. When reading the *JCGBA* manuscripts that cross my desk, I often am reminded that despite the application of very different methods and analytical tools, our discipline is held together because we have much to offer one another, and an understanding of the human condition requires a holistic perspective.

I will work to make improvements to the *Journal* that will allow us to keep pace with the evolving nature of academic publishing. I hope to institute changes to our submission process, to streamline the peer-review timeline, and to bring our procedures in line with other prominent academic journals in California and around the country. Additionally, I am interested in occasionally publishing thematic issues that confront important anthropological issues in California and the Great Basin. I encourage scholars with an interest in guest editing or proposing a thematic issue to contact me.

While change is prominent on my mind, thankfully much has stayed the same. Tom Blackburn will continue as associate editor. He orchestrates much of the behind-the-scenes work in copy-editing, scheduling, and manuscript management. Lowell Bean and Kim Carpenter also will continue as associate editors, helping with manuscripts and providing critical guidance. Victoria Kline and Kathleen Wise will maintain their roles with the *Journal*. Victoria is our managing editor and tirelessly sees to the smallest details that are essential for bringing each high-quality issue to press. Finally, the professional and clean layout of each issue is largely due to Kathleen Wise's expertise. I would be unable to do my job as editor without the support of each and every one of these individuals.

I am honored and excited to begin my tenure as editor of the *Journal of California and Great Basin Anthropology*. I appreciate the support of the Editorial Board and their confidence in selecting me. I will do my very best to maintain the high-quality of the *Journal* and the important legacy of the Malki Museum.

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The Children of Rogers Lake: Knap Time as a Clue to Site Function in the Western Mojave Desert

MICHAEL R. WALSH
Cotsen Institute of Archaeology, University of California, Los Angeles

Learning a craft by trial and error leaves an identifiable signature in the material record, one that crosscuts time periods, cultures, and crafts. Novice training is also strongly correlated with specific non-material variables, including the makeup of the student-teacher population, the location, and the timing of novice training. Based on intrinsic characteristics, an assemblage of projectile points from the western Mojave Desert is attributed to novices learning to knap. Inferences are derived from this assemblage regarding resident site population, the likely season of site occupation, and therefore the likely site function. It is suggested that, no matter the specific craft, identification of novice artisan training areas may provide a valuable clue to hunter-gatherer site demography, seasonality, and resource acquisition.

We have begun to recognize novice artisans in prehistory (Bamforth and Finlay 2008; Ferguson 2008; Geribàs et al. 2010). This has not only enhanced our ability to explain variability in artifact assemblages (Arnold 2011), it provides a voice to a neglected segment of society, children and adolescents (Finlay 1997; Högberg 2008; Shea 2006; Stapert 2007). In addition, as we shall see, novice work may provide clues to site function and seasonal settlement patterns.

Scholars have securely identified novice work areas dedicated to learning a wide variety of crafts, and there appear to be numerous material correlates to learning any craft through trial and error (e.g., Arnold 2011; Bagwell 2002; Crown 2002; Milne 2005). With a growing number of case studies revealing common rules for the material by-products of novice training, it has become feasible to identify novice activities based on assemblage attributes alone. But novice work also appears to correlate strongly with specific social, behavioral, and demographic contexts. Although these contexts may differ from craft to craft, the location, timing, and makeup of the teacher-student population is consistent for any given craft. Because the location, timing, and constituent population of most hunter-gatherer sites correspond to specific site functions during a tightly-scheduled seasonal round, a novice training assemblage alone may provide a clue to site function and season of occupation. I propose to illustrate this assertion using data recovered from CA-LAN-1585, a Late Prehistoric site near Rodgers Lake in the western Mojave Desert (Fig. 1).

What follows is a brief cross-cultural outline of the material correlates of artisan training as well as the consistent settings of novice training locations. Next we will examine an unusual assemblage of projectile points and other lithic artifacts recovered from LAN-1585. The assemblage meets several of the criteria commonly used to identify novice training. In light of this we can suggest the functional context of the site within the annual subsistence round prevalent during the Late Prehistoric period in this portion of the Desert West.

CORRELATES OF CRAFT TRAINING

Material Evidence of Novice Training

Virtually all scholars have cited clear qualitative differences between the skill levels of expert and novice artisans (Arnold 2011; Crown 2002:111, 115; Eren et al. 2011:234; Ferguson 2008:57–60; Pigeot 1990:132; Stahl 2008). "Quality" can be difficult to quantify, but several measures have been proposed for stone knapping in particular. Most of these are loosely related to artifact

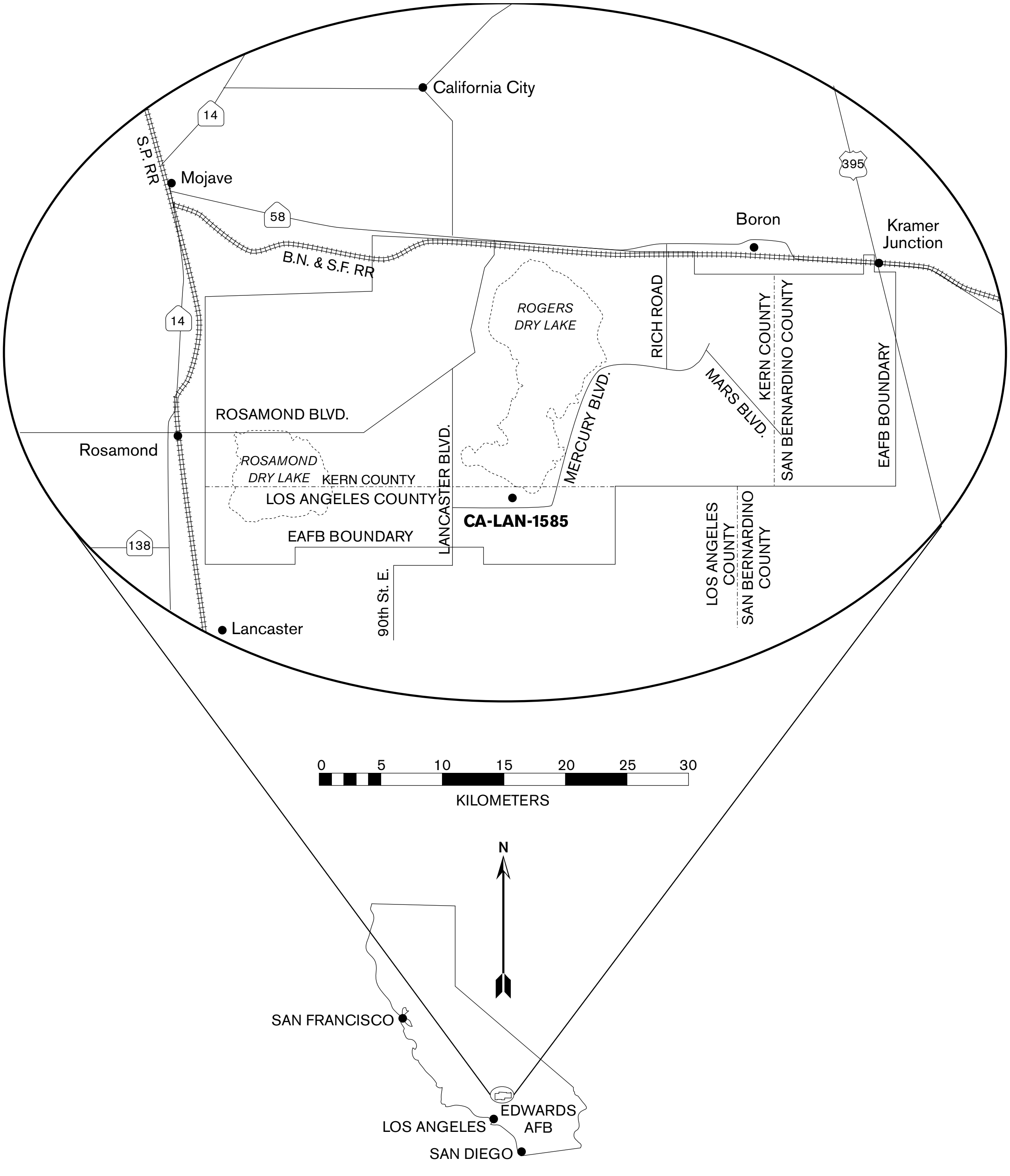

Figure 1. General location of CA-LAN-1585.

symmetry in cross-section, profile, and silhouette (Shea 2006:213). Biface thinning, for example, is a difficult task to master, and it can be measured by the ratio of biface thickness to width (Ferguson 2008:60–61). Effective pressure flaking is equally difficult for novices because it requires a combination of experience and strength. Core-refitting has revealed repetitive mistakes in striking angles, improper flake sequences, poor platform preparation, and both excessive and inadequate striking force (Bamforth and Finlay 2008:6; Geribàs 2010:2861; Milne 2005:331; Pigeot 1990:132; Shelly 1990:191–192; Tehrani and Reide 2008:324). Novice-made artifacts may be typologically accurate but unusually small, have an "expedient" character, or show conspicuously sinuous edge lines (Milne 2005:334; Shea 2006:213–214). Novices also leave behind inordinate amounts of waste material (Shea 2006:213), as well as large numbers of unfinished or broken artifacts (Arnold 2011). The novice assemblage may be intermingled with expertly-made, presumed heuristic examples, and novice and expert alike often discard the artifacts at the manufacturing location (Milne 2005:334; Pigeot 1990:138; Tehrani and Reide 2008:324). Thus, dual "quality" suggests an educational, not an economic assemblage.

Novices may create artifacts with attributes that appear to be "nonsensical," the byproduct of simple repetition of one or a few facets of artifact manufacture. For example, very young potters in the Puebloan Southwest may begin by forming ceramic balls, mud pies, and snakes for the simple goal of learning to create symmetrical objects (Bagwell 2002:94). It is no great leap to imagine the "snake" as a precursor to the clay fillet used to manufacture coiled pots. Similarly, Arnold (2011) has noted multiple holes drilled in single shell walls, apparently the result of a repetitive exercise in boring holes and in handling a bead drill. Analogously, either percussion or pressure flaking may be practiced with wholesale disregard for artifact form, the goal simply being one of learning to wield a hammerstone or pressure-flaking tool.

Novices make use of substandard raw materials, including waste materials discarded by experts (Arnold 2011; Crown 2002:123; Ferguson 2003, 2008:53; Shea 2006:214). Indeed, they may use raw materials that are altogether inappropriate for tool use. In this regard, a modern stone-knapping experiment made use of fired-clay bricks as surrogate cores and blanks (Geribàs et al. 2010:2859). The bricks were suitably isotropic to provide consistent conchoidal fractures, and thus proved a useful medium for instruction. Finally, novices may use substandard tools of the trade, particularly when the manufacturing tools are costly or easily broken (Stapert 2007:21). Note that all of these factors will feed into the overall low "quality" of novice assemblages.

In the end, "quality" is essentially an evaluation of "…aesthetics, symmetry, regularity, and precision…" (Bamforth and Finlay 2008:4). In making these evaluations, however, we must be aware of the fact that experts may experiment with elaborate forms (Costin and Hagstrum 1995) or attempt to show-case their relative talents (Olausson 2008). Either may result in numerous failures, despite a high level of artisan skill. We must also recognize that stone knappers produce measurable variations in debitage assemblages no matter their level of experience (Williams and Andrefsky 2011), and that even experts exhibit innate differences in individual talent and motor skill (Eren et al. 2011). It must be added that novices obviously should improve with practice. Individuals should show improved skill over a potentially lengthy apprenticeship, eventually but imperceptibly grading into "expert" at their craft. Thus, a cohort of novices may show a wide range of skill levels. Clearly, the earliest stages of learning are the most discernible.

To summarize, a novice assemblage should be identifiable as such through multiple measures. These include the combined subjective and objective evaluation of artifact quality, attention to raw material selection, and assessment of discard patterns. It should be obvious that all or even most of the above attributes may not be revealed by any single artifact. Analyses should therefore be assemblage-based, but as importantly should maintain regional perspectives of contemporary assemblages, as well as a grasp of the "normal" variation among artifacts of a given type. Identification of novice artisans may well depend on the experience level of the *archaeologist*.

Location, Demography, and Timing of Novice Training

Novice training is usually located where raw materials are abundant or easily accessed (Arnold 2011; Milne 2005:337–338). This includes permanent or semi-permanent villages where raw materials may be stockpiled (Thomas 1983:73). However, the use of discarded or substandard materials by novice artisans impacts and relaxes this stipulation to some degree, and perhaps "expendable" raw materials is the more relevant guideline. Crafts are taught only where and when the "appropriate" people gather, meaning the teacher(s) and the student(s) (Shea 2006:213). The key is to identify the "appropriate" population for a given craft, which will vary by gender, but may also vary depending on whether crafts are performed at the household level or by true craft specialists (Arnold 2011; Costin and Hagstrum 1995). Archaeologists are adept at making these distinctions for most crafts, and I will not belabor this issue.

In addition, there must be available discretionary time for the appropriate population (Arnold 2011; Milne 2005:337; Pigeot 1990:138). It must be emphasized that discretionary time for training in the present sense is limited to time available for tool manufacture. It is recognized that overall "training" is multi-faceted and an ongoing and complex process—learning to make a projectile point is just a step in learning to *hunt*, but it is the point that leaves the most visible archaeological remnant. Given the many gender-fixed resource collection strategies, as well as the myriad of other gendered activities, men and women (and boys and girls) may have entirely different periods and locations of discretionary time.

It is perhaps simplest to identify the "appropriate" teaching population, while the "student" population is less clear. For instance, for present purposes it is assumed that all or most adult hunters made projectile points and bifaces for personal use, and that they taught these crafts to their male children. However, it is not possible to suggest at what age novice training began. Ferguson (2008:61) has emphasized the necessity for hand and forearm strength, particularly for pressure flaking, and found it to be measurably variable even among adult novices. However, Shea (2006:213) has suggested that 10-year olds are able to muster the strength, coordination, and cognitive focus for some knapping. Indeed, Högberg (2008:118) observed that a modern *six-year old* was able to reproduce crude but recognizable tool forms using direct and bipolar percussion. It is quite likely the case that training in stone knapping and other crafts began quite early in life, perhaps first as imitative and unsupervised "play" (Bagwell 2002:94; Ferguson 2008:53; Findlay 1997:207; Högberg 2008:116–117). It is not feasible to suggest an age at which training became formalized.

In summary, the prerequisites for novice training include the presence of teachers and students, discretionary time for that particular population, and access to raw materials. While these appear to approach the level of truism, they are nontrivial *necessary preconditions* to craft training. As absolute requirements, independent evidence for craft training is essentially *predictive* of these preconditions. Thus, the identification of craft training areas on their own terms may be used to reconstruct the primary functions of sites, which I shall argue shortly are apt to converge most frequently at only a limited number of seasonally- and functionally-specific sites. We proceed now to a brief discussion of the Late Prehistoric site LAN-1585.

CA-LAN-1585

In order to avoid repetitive citation, all descriptive statements made concerning LAN-1585 are documented in Walsh and Green (2002:179–203).[1] The site lies within a large dune complex approximately 1.3 km. southwest of Rogers Lake, within the confines of Edwards Air Force Base (Fig. 1). The site consists of a sparse artifact deposit limited almost entirely to the surface, covering some 88,000 m.^{2}, but primarily concentrated in three discrete activity loci. The primary focus here is on a single locus, Locus 1 (Fig. 2), which revealed all of the artifacts under present discussion, and over 90% of the total artifact inventory at the site. The locus is spread over shifting dune sands lying atop a sterile clay hardpan. Dunes are of fine-grained homogenous sand rising above the pan to heights ranging from 40 cm. to over 100 cm. Subsurface remains are very scant, averaging less than a single artifact per 10 cm. level for each of four 1 m. x 1 m. excavation units in Locus 1. In all cases, subsurface artifacts consisted solely of debitage.

Flaked and ground stone tools observed in surface contexts at Locus 1 suggest bi-gender activities. Ground stone includes one whole and six fragmentary manos and one large metate clearly suggesting "site furniture." A small rectangular piece of abraded green slate suggests a pendant fragment; in addition, five weathered fragments of marine shell were located on the surface. One shell fragment is *Haliotis* sp. nacre, while the others are too small to identify beyond "cockle or scallop" and "clam." None of the shell shows any form of purposeful modification, and all may be detritus from ornament or other artifact manufacture. Obviously marine shell, as well as the green slate, is definitively exotic to the site locale. There are no hints of structural remains, nor were any

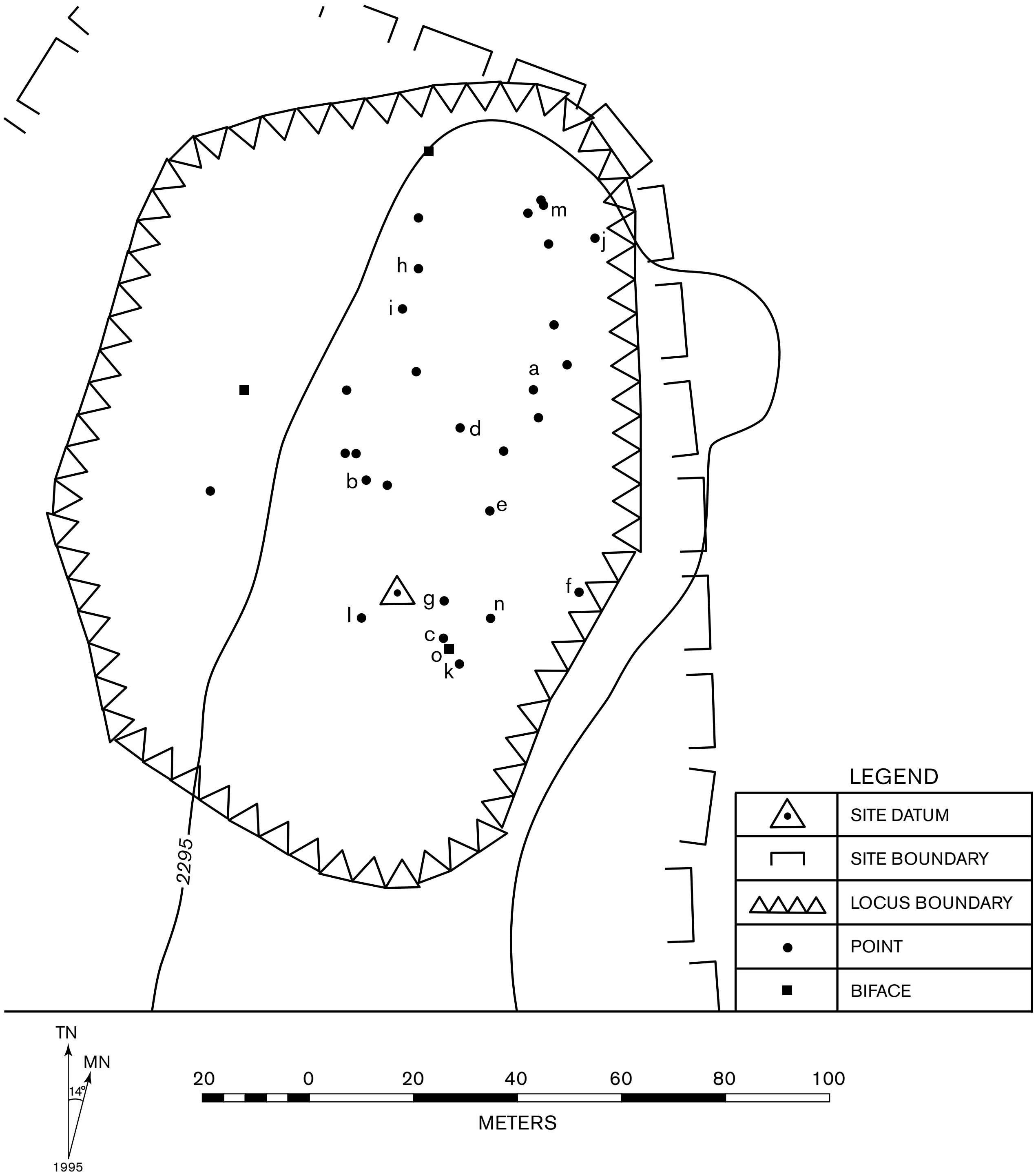

Figure 2. Locus 1, CA-LAN-1585.

discrete hearths observed, despite a few widely-scattered local stones that may be fire-affected. Small charcoal flecks and just six charred bone fragments were widely distributed throughout the vertical profiles of the test excavations. None of the bone fragments were identifiable to species, but in every case fragment size suggests a very small rodent. The site overall suggests limited occupation of short duration by one or a very few families.

All chronological indicators (artifact types and obsidian hydration data) point to the Late Prehistoric

(A.D. 1100–historic; Sutton et al. 2007:242–243). Locus 1 yielded 28 projectile points or point fragments, of which 20 were sufficiently intact to fit into the Cottonwood series (Triangular and a single Leaf-shaped specimen). The remaining eight unknown points were fragments, but based on estimates of parent-artifact size were all potentially derived from Cottonwood points. The site at large yielded just one additional point fragment, a non-diagnostic tip. Several bifaces were recovered, none of which appears to show use-related edge-wear. In all, Locus 1 shows a truly remarkable number and concentration of points and bifaces for the region at large (cf. Earle et al. 1997:153–154), made all the more intriguing by the suggestion of *short-term occupation and little or no evidence for game hunting or processing*. The points, and a selected biface, will be the focus of the discussion that follows.

Cottonwood Projectile Points at LAN-1585

It must be stated at the outset that this particular study is plagued by the very nature of the primary artifact type under evaluation. Cottonwood points may be the *worst* imaginable type for quantifying novice-related variation in the loose notion of "quality." The minimalist character of Cottonwood Triangular points from the Mojave Desert is practically their most salient feature. A serviceable Cottonwood point can be (and frequently was) made through only minor modification of a simple waste flake of suitable shape and size. Indeed, their minimalist character led to an early belief that Cottonwood points were a simple stage in the manufacture of Desert Side-notched points (Justice 2002:367). Definitively "finished" points presumed to be expertly made may exhibit one or more of the characteristics expected of novice-made pieces, and especially may show inattention to strict artifact symmetry (see Lanning 1963:Plate 7; Rozaire 1962). On a more positive note, the minimalist character of Cottonwood points reduces the need for multi-staged manufacture, and so it is unlikely that crude specimens simply represent an early stage of manufacture.

That caveat in place, a selection of points from LAN-1585 shows obvious extremes in skill levels (Fig. 3). These are purposefully placed in a sequence of visibly descending "quality" (Fig. 3a through Fig. 3n), and the gradient in apparent skill-level highlights the difficulty in drawing a definitive line between "expert" and "novice" in mid-range, despite the ease in distinguishing between the extremes. It also underscores the difficulty in studying novice activities utilizing small sample sizes, and the utter futility of attempting to do so for any single artifact.

Attempts to generate multivariate criteria for assessing point quality had little success. The most convincing quantitative co-variables appeared to be measures of point symmetry and pressure flaking prowess, admittedly an awkward marriage of interval scale and presence-absence data. Symmetry here was measured in relationship to an imaginary line formed along the point base and one drawn directly from the basal mid-point through the point tip—that is, directly along the long axis of the point. Asymmetry was indicated by the amount of deviation from perpendicular (90 degrees). Pressure flaking prowess was indicated by flake scars removed with sufficient force to reach or cross the longitudinal (center) axis of the main body of the point (Ferguson 2008:60–61). A total of 14 points in the assemblage were sufficiently intact to reliably measure deviation from symmetry (not all of these are illustrated). In five cases where even a single pressure flake scar reaches or exceeds the center axis, symmetry is less than five degrees removed from the perpendicular (e.g., Fig. 3a, b, c, and d). Conversely, in all eight cases where flake scars fail to reach the center axis of the point body (e.g., Fig. 3i, j, and l), symmetry exceeds five degrees of deviance. In only one example (not illustrated) did flake scars fail to reach the midline of a symmetrical point. This latter observation highlights the inherent difficulty in studying Cottonwood quality—manufacture from simple cortex-free flakes may eliminate the need to reveal pressure flaking prowess. Nevertheless, while I claim no persuasive statistical relationship for this small sample, a mild pattern emerges where pressure flaking prowess may have contributed to increased point symmetry. There may be promise in this direction with a larger sample size, and the symmetry-flaking prowess measure may be worth pursuing in other artifact types as well.

The novice correlate of "artifact thinning," as measured by the ratio of artifact width to thickness, utterly fails with regard to the present collection. This is almost certainly due to the manufacture of Cottonwood points from simple, relatively small flakes, a fact that essentially determines point thickness. Flake selection

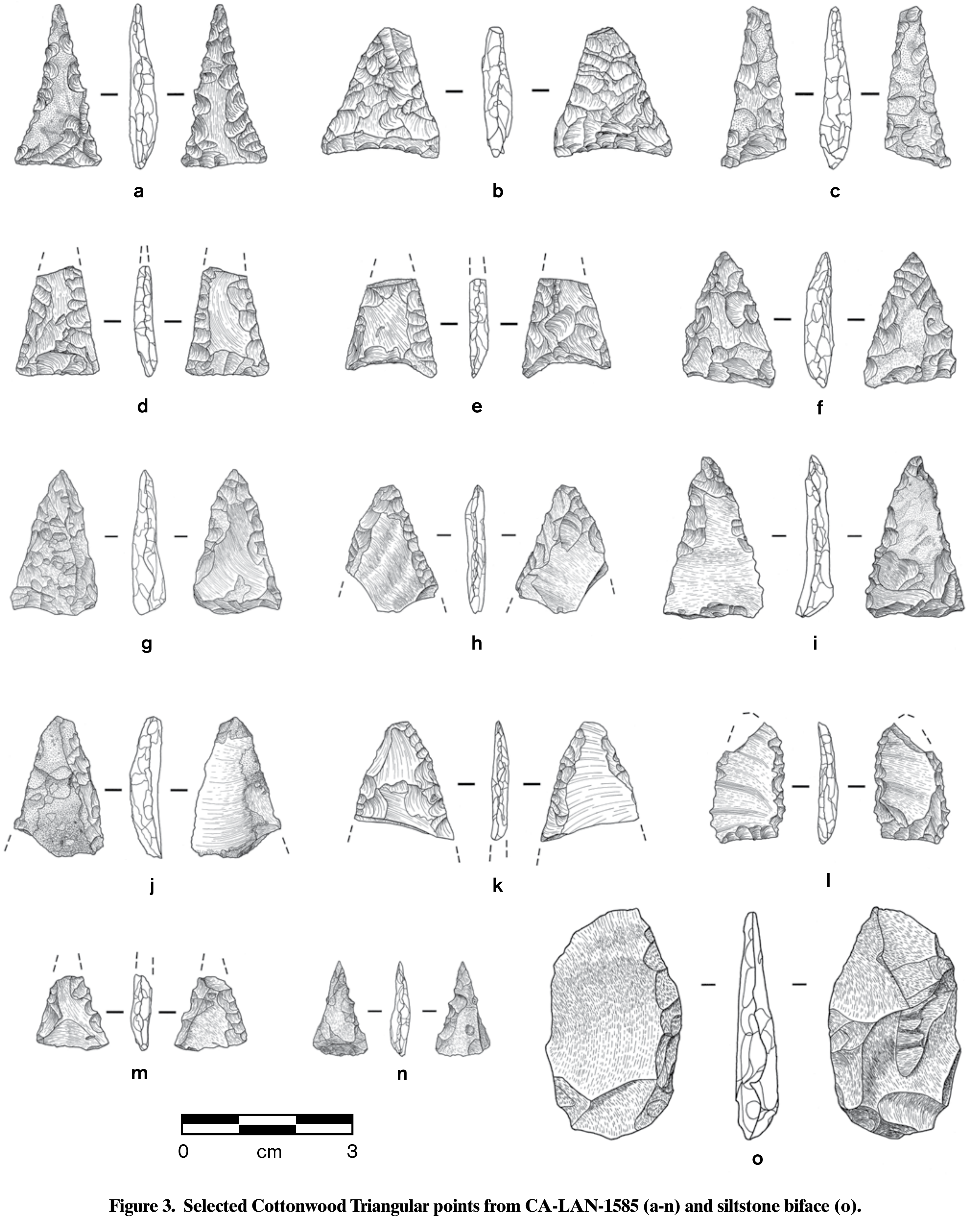

Figure 3. Selected Cottonwood Triangular points from CA-LAN-1585 (a-n) and siltstone biface (o).

is the primary determinant of point thickness. Larger or more complex point types or bifaces are probably better suited to certain tests of skill level (Eren et al. 2011:234).

Selection of sub-standard flakes appears to have some utility in distinguishing among points in the assemblage. Six specimens (21%) have bases formed from hinge or step fractured flakes (e.g., Fig 3i, and j), a likely consequence of a mistake in the initial removal of the flake blank from the core, because point manufacture appears to have been limited to pressure-flaking alone. Several points appear to exhibit an expedient character (e.g., Fig. 3i, j, and l). Breakage rate is high (n = 21, 75%). Unfortunately, it is not always possible to distinguish breakage through use, breakage during manufacture, or simple selection of a broken flake from the outset.

Points at LAN-1585 are mostly of chert (n = 21, 75%). Chert was obtained at various source localities surrounding Edwards AFB, the largest and nearest located in the Bissell Hills some 10 km. to the northeast of LAN-1585. There are no topographical or other impediments to chert collection from this or any other chert source. The identical spectrum of chert sources is observed in waste materials from the vast majority of sites at Edwards AFB, attesting to the low cost of importing chert. Rhyolite is next in frequency in the point assemblage (n = 4, 14%). Volcanic materials occur sporadically over this portion of the western Mojave Desert in the form of small outcrops and occasional lag deposits (Dibblee 1960). Identical materials are common at sites in the region, again suggesting a low cost. One point fragment is of chalcedony. Chalcedony is problematic in its origin, although raw chalcedony nodules have been reported along the eastern and southeastern margins of Rogers Lake (Walsh et. al 2001:27). Definitively exotic materials include a whole point made of obsidian and a fused shale tip fragment (neither is illustrated). The nearest obsidian sources lie in the Coso Hills to the north (Gilreath and Hildebrandt 1997), and several fused shale sources are known for eastern Ventura County (Hughes and Peterson 2009). Perhaps not surprisingly, both the obsidian point and the fused shale fragment appear to have been expertly flaked. It is reasonable to suggest that points using waste materials readily at hand were worked by novice and expert alike, but that experts alone made use of exotic materials.

Novice artisanship is indicated by one biface that blurs the categories of “inappropriate material” and “nonsensical” (Fig. 3o). It is made of friable *siltstone* with a Mohs hardness under 2.5 (fingernail) and would be inappropriate for a cutting task of any sort. The siltstone shows isotropic flaking properties, however, and may have provided a suitable practice piece for either flaking or for wielding a hammerstone or baton (recall the modern experiment using clay bricks). A use of discarded flakes as point “blanks,” as well as a use of inappropriate materials such as siltstone, would certainly have alleviated the cost of materials used by novices.

Finally, the distribution of the 28 points over the site locus bears emphasis. Locus 1 covers a total of approximately 14,100 m.^{2}, but it is clear that the points are clustered within less than half this area (Fig. 2). This is a remarkable number of points for any site in the region, and a truly extraordinary number in such a restricted space. It may be reasonably suggested that the points were manufactured at their place of discovery. Although field protocols did not call for fine-screening methods, one-eighth-inch mesh screening of four excavation units and controlled surface collection at five locations at Locus 1 fortuitously revealed 16 very small pressure flakes, all of chert (Walsh and Green 2002: Appendix B). We can never know how many or even whether selected points were retained when the site was abandoned, but the points remaining in the archaeological deposit have the bimodal character of a teaching assemblage made and casually discarded on the spot.

For Cottonwood points in particular, multiple measures of novice artisanship are called for, and very small numbers of points should be approached only with caution. There is no “magic formula” for identifying a novice-made point, or one within any other artifact form. The critical observations will surely vary from artifact type to artifact type, and examples within certain artifact forms will be easier to identify as “inexpert” than others based on intrinsic qualities, especially artifact complexity. With no suggestion that the artifact “type” is invalid in any way, it may be worthwhile nevertheless to examine “point blanks” and other “unfinished” artifact forms with a fresh eye. In the present case, the combination of varied levels of flaking prowess, asymmetry, use of substandard and waste materials, discrete spatial distribution, casual discard, and use of inappropriate materials is highly suggestive of novice training. We proceed now to the behavioral correlates of novice training.

SEASONAL SCHEDULES IN THE WESTERN MOJAVE DESERT

CA-LAN-1585 clearly dates to the local Late Prehistoric period, post-A.D. 1100–historic times. This is based on the exclusive manufacture of Cottonwood points as well as on obsidian hydration dates from the site that suggest an occupation as late as A.D. 1500–1600 (Walsh and Green 2002:199). Most scholars agree that by this time known ethnographic territories were fully in place, and many or most subsistence practices conformed to patterns observed in the ethnographic present (Arnold and Walsh 2010:134-135). The precise ethnographic affiliation for this portion of the western Mojave Desert remains something of an open question, however, principally because this region was a vaguely defined hinterland for various ethnographic peoples better known for their core territories in the mountains and foothills to the west, south, and north. Reasonable arguments have been made for peopling by the Kitanemuk (Blackburn and Bean 1978:564; Kroeber 1925:611; Sutton 1993:3–4), the Desert Serrano or Vanyume (Earle 1990; Earle et al. 1997:60), and the Kawaiisu (Underwood 2006; Zigmond 1986:399).

This is no minor issue, because our best ethnographic models of local cultural ecology derive from Numic populations, particularly the Owens Valley Paiute, the Shoshone, and the Kawaiisu (Arnold and Walsh 2010:134–136; Bettinger 1999:49–51; Steward 1933, 1938). The Takic-speaking Kitanemuk and Serrano are quite a bit more obscure, particularly in their desert contexts. Moreover, the Owens Valley may be the most productive environment in the entire Great Basin (Thomas 1983:32, 34). Even setting aside ethnic issues, models derived from the Owens Valley may be only vaguely applicable to the somewhat less salubrious western Mojave Desert. Nevertheless, it has been suggested that the Kitanemuk, for example, shared more cultural traits with their Numic neighbors to the north than with their linguistic relatives to the south (Blackburn and Bean 1978:564). In any case, for lack of a practical alternative, the basic model of Late Prehistoric subsistence practices and scheduling for the Owens Valley and Numic-speakers is applied here.

The signature adaptation of the Late Prehistoric is the “processor’s” strategy (Bettinger 1999; Bettinger and Baumhoff 1982:488–489). In this strategy, productive patches of plant foods were exploited intensively and exhaustively for the purpose of generating surpluses for use during the lean winter months. Tree crops and grass seeds that could be obtained in surplus quantity supplanted a reliance on large game and generalized daily foraging (the “traveler’s” strategy). The annual round involved an extended residence by most or all community members in permanent or semi-permanent winter villages, located at or very near water, and stocked with stores obtained during the previous year (Thomas et al. 1986:266). By early spring, with stores dwindling or gone, near-village forays were made for edible greens, roots, and berries (Zigmond 1986:400). By late spring and early summer, more distant forays were made in search of grass seeds and tree crops that could be exploited intensively during extended stays (Coville 1892:352–353; Moerman 1998:437; Thomas et al. 1986:266). Often the target resource was processed on-site for greater efficiency in transport to storage facilities at the winter village (Driver 1937:68–69; Thomas et al. 1986:267). These sites had the character of “satellite” villages which—in the Owens Valley—may have been occupied for a month or more (Arnold and Walsh 2010:136; Basgall and Giambastiani 1995; Bettinger 1999:50; Steward 1938), although it is unlikely that Mojave Desert satellite villages were occupied for more than a few days. Summer likely saw populations atomized into single-family groups or small bands employing a modified “traveler’s” strategy, featuring short-term residence but always with the goal of garnering a surplus at productive locales at or near widely-scattered springs. The fall ripening of tree crops such as piñon nuts, acorns, and mature mesquite beans saw a return to the satellite village strategy of exhaustive exploitation. Fall was the usual occasion for rabbit drives as well, generally a community-wide and even a multi-community affair (Thomas et al. 1986:268).

SITE FUNCTION AT LAN-1585

An extended residence in winter villages provided the greatest opportunity for novice training, in terms of having an appropriate population in residence, some available discretionary time, and stockpiled raw materials. Just as clearly, LAN-1585 is *not* a winter village. A winter village should exhibit relatively substantial domestic dwellings, plentiful site furniture of wide variety, distinctive work areas, diverse tool manufacture and repair, ceremonial items and ceremonial or public spaces, storage (including a stockpiling of raw materials), luxury and trade items, dedicated refuse areas including middens, and perhaps cemeteries (Hector 1990; Steward 1933:238; Thomas 1983:73). A short-term early spring or high summer foraging location is similarly contraindicated owing to site furniture and non-utilitarian items (Thomas 1983:85).

Instead, LAN-1585 has the appearance of a satellite village, a much scaled-down version of the winter village, with some (but not all) of the features of a winter village (Bettinger 1999:50; Walsh and Green 2002:200–201). These indicators at LAN-1585 include site furniture (metate, manos) and a small amount of luxury, trade, or non-utilitarian items (slate pendant fragment, shell fragments). To this list I will add *the presence of a novice-training assemblage* suggestive of an extended stay. The question is—which functional type of satellite village is represented? This question subsumes the reciprocal issues of both the targeted resource and the precise season of occupation.

The primary resources amenable to intensive and exhaustive exploitation in this portion of the Mojave Desert include Joshua tree (*Yucca brevifolia*), mesquite (*Prosopis glandulosa*), and ricegrass (*Oryzopsis hymenoides*). At present, mesquite is rare in the immediate vicinity of LAN-1585, represented by a few small, impoverished stands within a few kilometers of the site. However, modern agriculture has lowered the local water table dramatically. A survey from the early twentieth century shows numerous flowing wells—now long dry—in and around the Rogers Lake area (United States Geological Survey 1908), so mesquite in the Late Prehistoric was undoubtedly more plentiful. Joshua trees are abundant to this day in the vicinity of LAN-1585, as is ricegrass (Computer Sciences Corporation 1994:219). Mesquite was targeted in both the spring and the fall, while Joshua and ricegrass was exploited from the spring into the very early summer months.

Mesquite, Fall

Green mesquite beans and blossoms were collected in the spring but were consumed immediately (Bean and Saubel 1972:108; Fowler 1986:67; Rhode 2002:19). Neither green beans nor blossoms were amenable to storage as a surplus. Mature mesquite beans gathered in the late summer and early fall, however, provided a storable winter staple for many desert groups (Bean and Saubel 1972:109; Driver 1937:68–69; Fowler 1986:67; Moerman 1998:437; Rhode 2002:20; Thomas et al. 1986:267; Zigmond 1981:54). Processing into meal on-site eased the burden of transport to winter villages, and was done using deep, typically wooden or bedrock mortars and long, cylindrical chisel-ended pestles (Fowler 1986:67; Lanning 1963:247). Fall mesquite collection was typically an activity that engaged the entire family in collecting pods, clearing brush and pruning, and hunting small game that shared an attraction to the mature pods (Anderson 2005:316; Bean and Saubel 1972:115). At LAN-1585, ground stone consisted solely of a metate and several manos at Locus 1, and a small pestle (12.4 cm. in length) recovered from the site at large (Walsh and Green 2002:195). Evidence for fall mesquite processing is lacking. Moreover, it is unlikely that over a few days' time at most, either men or boys enjoyed ample discretionary time required for novice training. It appears unlikely that the site represents a fall mesquite collection camp.

Joshua Tree, Spring

Joshua tree harvesting was largely confined to the middle and late spring (Mead 2003:450). Blossom pods and their seeds, as well as artichoke-like "hearts" formed by new growth at branch tips, were eaten (Coville 1892:353). However, Joshua products could neither be consumed immediately nor dried and stored unless they were cooked, a process requiring fairly elaborate rock-lined pit ovens closely tended over a period of two days and nights (Rhode 2002:102; Moerman 1998:618, fn. 84; Zigmond 1981:69). Given the paucity of fire-affected rock at the site, it is unlikely that Joshua was the target resource for an intensive processor's camp here.

Grass Seeds, Late Spring-Early Summer

Ricegrass provided an important subsistence staple, and it was harvested in the very late spring or early summer (Rhode 2002:174). Women alone were responsible for collecting and processing the hard seeds. Ripe seeds were whisked into burden baskets with wicker seed-beaters (Coville 1892:353), or bunches of grass were cut with a sharp-edged wooden stick to be threshed by beating with sticks and winnowed in basketry trays (Kelly 1964:41; Rhode 2002:174–172; Steward 1938:32; Zigmond 1981:47). The seeds were eaten dry (Zigmond 1981:46), or processed into flour using a mano and metate (Kelly 1964:42). Flour was mixed with water to form a mush, which could be consumed immediately or formed into cakes and dried for storage (Moerman 1998:370–371; Rhode 2002:174). As a significant winter staple, ricegrass was a common target resource for processor's camps (Basgall and Giambastiani 1995; Bettinger 1999:50; Mead 2003:282; Zigmond 1981:46). Note that the only preserved remnants of ricegrass harvest and processing are stone manos and metates. Both artifact forms are present at LAN-1585.

I suggest that another preserved artifact assemblage points equally to ricegrass harvest—a novice stone-knapper's training area. In 1932, Isabel Kelly described a Southern Paiute encampment that today would be recognized as a "processor's camp" in search of a surplus for winter. She quoted a consultant's assessment of the division of labor in this manner: "The women [worked]; the men hunted rabbits and sat around" (Kelly 1964:44). It appears that among the potential resources at LAN-1585, men and boys had the greatest amount of discretionary (free) time during ricegrass exploitation.

SUMMARY

CA-LAN-1585 consists of a low-density artifact deposit that dates to the Late Prehistoric period in the western Mojave Desert. It is confined mainly to surface materials, but reveals a variety of flaked and ground stone artifacts and other materials suggesting activities that cross-cut gender lines and involve both utilitarian and non-utilitarian artifacts. This range of items is characteristic of sites occupied for an extended duration for the purpose of intensively and exhaustively exploiting resources in and around the site. It is thus highly suggestive of a processor's temporary encampment, one dedicated to collecting surplus resources for use as winter stores. The site does not meet the standard of "satellite village" set by the resource-rich Owens Valley to the north, but reflects an analogous strategy "writ small" due to the diminished resource base and lower population density of the western Mojave Desert.

The site also reveals an unusual configuration, frequency, and spatial distribution of Cottonwood Triangular points. Many of these points meet the expectations for tools made by novices, drawn from material correlates that cross-cut cultures, time frames, and crafts. Among these expectations are inexpert flaking technique, use of substandard or discarded raw materials, use of wholly inappropriate materials, lack of utilization, and an apparent casual discard of practice pieces by novice and expert alike. This latter dualistic quality of the discarded points may be the most provocative evidence for novice training at the site (see also Milne 2005:334; Pigeot 1990:138; Tehrani and Reide 2008:324).

In addition to these material expectations, there are strong behavioral and contextual correlates of novice-training which cross-cut cultures, time frames, and crafts. Having reasonably identified a novice assemblage, it is possible to narrow the field of appropriate contexts (site functions) for training sessions. In the present case, a restricted number of resources were potential targets for intensive and exhaustive exploitation by Late Prehistoric populations in this portion of the western Mojave Desert. These resources varied by season, by the method and labor force required for exploitation, and by their processing requirements. Only one of these site functions—serving as a processor's camp dedicated to ricegrass collection in the late spring or early summer—is reasonably consistent with the general site assemblage *and* the presence of a novice knapping area.

Finding novice assemblages may be difficult in many contexts, and may be uncommon in any event. It must be emphatically stated that the presence of the appropriate teacher-student population, ample discretionary time, and expendable raw materials *does not* guarantee that novice training would take place at a location. Instead, where novice activities are identified through independent means, it may be reasonably assumed that the other three correlates (appropriate population, free time, materials) were in place. Village sites are clearly apt to be the most promising localities for identifying such assemblages; larger sample sizes and wider varieties of select artifact types should improve our ability to identify—and to quantify—novice assemblages in more concrete terms.

With these measures in hand, identifying novice-made artifacts wherever they occur may be fruitfully applied to sites of somewhat more elusive site function than the winter village. The implications that novice assemblages may have for anthropological archaeology are substantial and need not be limited to accounting for assemblage variability, nor even to the modest inferences about site function and seasonality suggested here.

NOTES

[1] Artifacts are held at the Curation Facility, Base Historic Preservation Office, Edwards Air Force Base, California.

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A Refined Shell Bead Chronology for Late Holocene Central California

RANDALL G. GROZA
Cultural Surveys Hawaii, Inc., P.O. Box 1114, Kailua, Hawaii, 96734

JEFFREY ROSENTHAL
Far Western Anthropological Research Group, 2727 Del Rio Place, Davis, California, 95616

JOHN SOUTHON
Earth System Science, University of California, Irvine, Irvine, California, 92697

RANDALL MILLIKEN
Consulting in the Past, 302 E. 14th Street, Davis, California, 95616

In central California, a sequence of late Holocene cultural phases has long been recognized through the seriation of different shell-bead types. Calendrical dating of this sequence has, however, been in doubt. Based on the direct accelerator mass spectrometry (AMS) dating of 140 stylistically distinct Olivella *shell beads, we present a refined late Holocene cultural chronology for central California that replaces Bennyhoff and Hughes' (1987) Scheme B. This study uses an empirically-derived* ΔR *value of 260 ± 35 to calibrate marine shell dates, revealing a series of short 125- to 620-year-long shell-bead style horizons from cal A.D. 200 through approximately cal A.D. 1835, following a 1,500-year-long period where little change in shell-bead styles is apparent. The new chronology supports long-recognized shifts in hunter-gatherer culture, and identifies an unexpected delay in the acceptance of bow and arrow technology in lowland central California until cal A.D. 1020–1265.*

Beginning in the middle Holocene (ca. 3,500 cal B.C.), stylistically distinct beads made from the shell wall of purple olive snail (*Olivella biplicata*) became one of the most common burial accompaniments in prehistoric central California, and they were widely traded, reaching as far east as the central Great Basin (e.g., Bennyhoff and Heizer 1958; Bennyhoff and Hughes 1983, 1987; Hughes and Bennyhoff 1986; Vellanoweth 2001). Over millennia, the number and type of *Olivella* shell beads placed in central California graves varied greatly, and specific combinations of bead types (i.e., *shell-bead style horizons*[1]) have proven to be particularly good indicators of different time periods and cultural phases (Bennyhoff and Hughes 1987).

Because *Olivella* beads from the Pacific coast of California are found as far inland as eastern Nevada, Utah, and New Mexico, they have traditionally been important for cross-dating regional site components across much of far western North America (e.g., Bennyhoff and Heizer 1958; Bennyhoff and Hughes 1987; Hughes and Bennyhoff 1986). However, calendrical dating of shell beads from late Holocene central California has been imprecise, despite over one hundred years of formal archaeological study and fifty years of site-by-site radiocarbon dating (Groza 2002). Moreover, the presumed ages of different combinations of shell beads in central California (Bennyhoff and Heizer 1958; Bennyhoff and Hughes 1987; Elsasser 1978; Milliken and Bennyhoff 1993) do not conform to the accepted timing of equivalent shell-bead style horizons in the Santa Barbara Channel area, just 250 kilometers to the south (cf., King 1990). This is especially troubling, as many of the shell bead types found in central California are thought to have originally been manufactured in the Santa Barbara Channel region (Arnold 1987; Arnold and Graesch 2001; Bennyhoff and Hughes 1987; Eerkens et al. 2005; Hughes and Milliken 2007; King 1990; Vellanoweth 2001).

Lacking well-founded evidence for the age of shell-bead style horizons in central California, archaeologists have been constrained in their efforts to understand the precise timing of cultural changes and the processes responsible for these transformations. Further, without proper chronological control, inter-regional cross-dating using shell beads will ultimately prove unreliable. To remedy this situation, we have constructed a chronology for central California based on direct AMS dating of 140 *Olivella* beads, derived primarily from discrete mortuary features. The new chronology incorporates 299 observations on the ages of different shell-bead types and recognizes various combinations of *Olivella* shell-bead styles as diagnostic of at least 10 separate shell-bead style horizons in central California after 1,750 cal B.C.

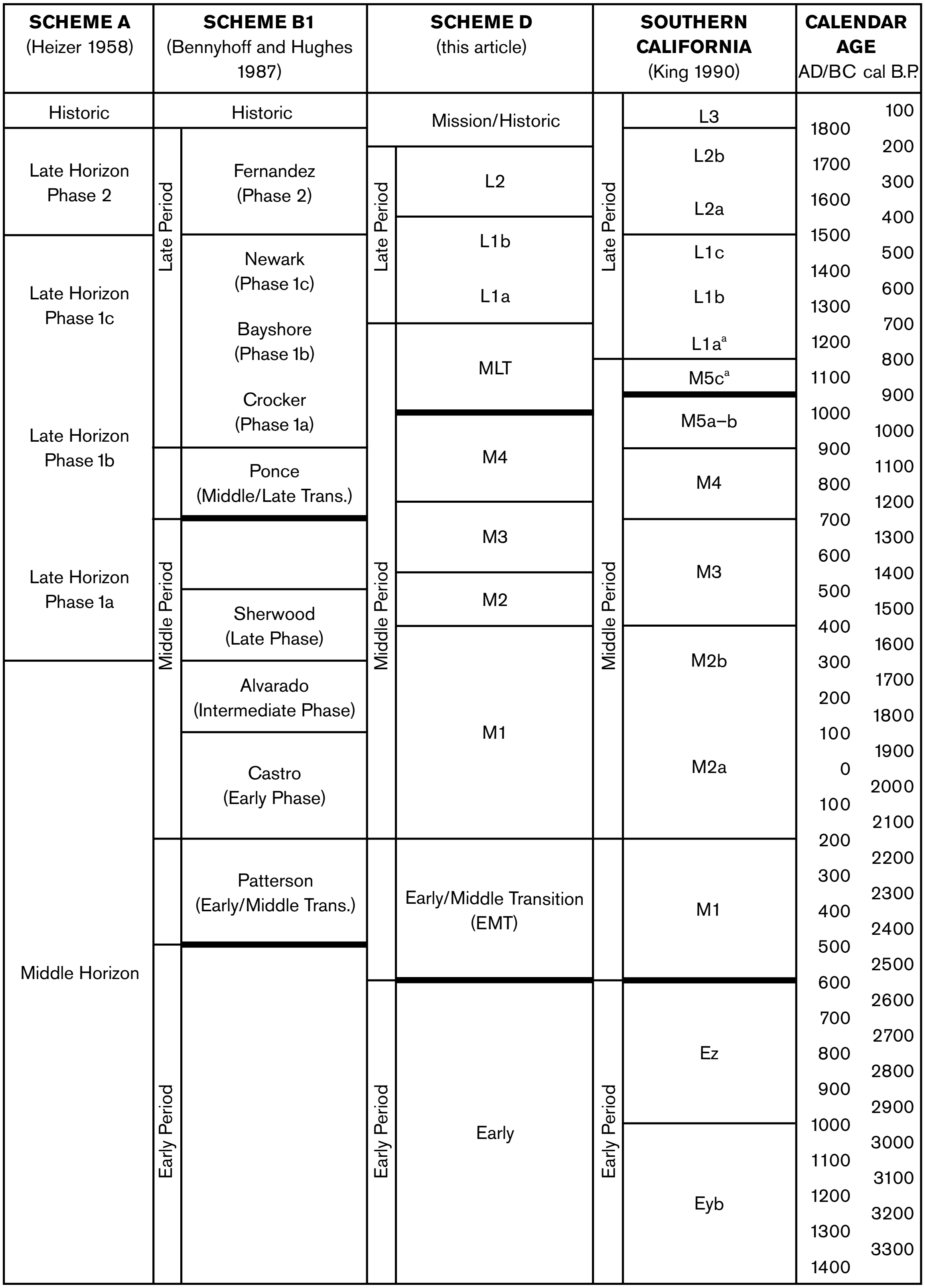
ALTERNATIVE DATING SCHEMES IN CENTRAL CALIFORNIA

In the 1930s, Lillard, Heizer, and Fenenga (1939) identified artifact types that marked a succession of prehistoric "cultural horizons" in central California's lower Sacramento Valley—the Early, Middle, and Late horizons. In that same publication, Lillard, Heizer, and Fenenga (1939:12) developed the first formal typology for California shell beads. Beardsley (1948, 1954:11) later demonstrated basic similarities between artifact types found in the San Francisco Bay area and the lower Sacramento Valley, extending the three-horizon sequence across a large portion of central California. He also modified Lillard et al.'s *Olivella* bead typology, distinguishing 14 time-diagnostic types. Although these researchers were among the first to recognize differences in artifact styles and other traits as evidence for cultural changes in central California, they did not speculate on the actual dates of those changes.

It was not until the late 1940s that Robert Heizer (1949; Cook and Heizer 1947:218) constructed the first timeline of culture change in central California, based on inferred deposition rates in shell mounds around San Francisco Bay. Just prior to the widespread use of radiocarbon dating, Heizer (1949:39) predicted that the beginning of the Middle Horizon would fall at 1,500 B.C. and the beginning of the Late Horizon at A.D. 500. Between 1950 and 1957, Heizer sent charcoal and calcined human bone from this region to various newly-founded radiocarbon labs. Based on 17 resultant dates, Heizer (1958) argued for the general confirmation of the Early-Middle-Late period chronology he had published in 1949. Bennyhoff and Hughes (1987:147) later labeled Heizer's chronology Dating Scheme A, now considered the "long" chronology (Fig. 1).

During the 1960s and 1970s, James A. Bennyhoff refined the central California shell bead typology and conducted detailed seriations of grave lots in the San Francisco Bay and lower Sacramento Valley-Delta regions. Changes over time in *Olivella* bead types that accompanied burials allowed Bennyhoff to discern a series of successive phases and sub-phases within the stratigraphically-complex mound sites from these areas. By the mid-1970s, Bennyhoff had developed an alternative "short" chronology, termed Scheme B, based on 180 radiocarbon dates derived primarily from terrestrial charcoal, but including dates on bone collagen and—rarely—marine shell. Scheme B distinguished twelve phases and sub-phases associated with the Early, Middle, and Late periods of the Late Holocene, some only 200 to 300 years in duration (Fig. 1). This scheme further refined major period breaks, and indicated that the Early Period lasted until 500 B.C., the Middle/Late Period Transition began at A.D. 700, and the Late Period did not begin until A.D. 900. Bennyhoff's final *Olivella* bead typology and Dating Scheme B were eventually published in 1987 (Bennyhoff and Hughes 1987).[2]

Although Dating Scheme B has been widely accepted and employed throughout central California and the Great Basin, several problems exist with this chronology. Most significantly, the majority of radiocarbon dates used by Bennyhoff lacked a clear association with the shell-bead lots he was attempting to place in time. Instead, most of these dates were derived from charcoal samples, either recovered near mortuary features or within associated depositional strata, but not clearly related to the burial event. This created a great deal of uncertainty in the timing of important phase shifts, and led Bennyhoff to reject a number of dates he thought were either too early or too late to be associated with a particular cultural phase (Groza 2002). Further, none of the radiocarbon dates used by Bennyhoff to construct Scheme B was ever subjected to $\delta^{13}C$ correction or calibrated. Additional discrepancies also existed between bone collagen dates used by Bennyhoff



Note: [a]Southern California M5c and L1a *Olivella* beads are comparable to those of Northern California's Middle/Late Transition.

Figure 1. Comparison of Alternate Dating Schemes

and dates from the same bone obtained decades later (see Bouey 1995). Our investigation was designed to clarify these ambiguities.

METHODS

The current study examines the age of *Olivella* shell beads recovered from 36 archaeological sites in the wider San Francisco Bay region of central California (Fig. 2). Bead classes and types were identified based on the Bennyhoff and Hughes (1987) *Olivella* shell-bead typology, as well as revisions to the Class F Saddle-bead typology described in the recently published *Olivella* shell-bead guide developed by Milliken and Schwitalla (2009). Study results were derived from more than 37 different *Olivella* bead types and sub-types, ranging in age from the Early Period of the late Holocene to the historical Early Mission Period. Included are 120 AMS dates obtained from individual *Olivella* beads, sampled as part of the current study by the Center for Accelerator Mass Spectrometry (CAMS) at Lawrence Livermore National Laboratory (Groza 2002; Ruby 2007), as well as 20 dates from beads sampled by Beta Analytic, Inc. for several recent cultural resource mitigation projects (Milliken 2008; Thompson 2002; Thompson et al. 2003; Wiberg 2005). Also included are five standard radiometric dates obtained on multiple beads of the same type recovered from burials at SCL-690 (Hylkema 2007). Many of the directly-dated beads originated from discrete grave lots that also contained other bead styles. Because of these direct associations, our study includes an additional 154 observations on the ages of different bead types in circulation at the time of burial. This co-association elevates the total number of dated bead types to nearly 300, forming a substantial basis for the revised chronology presented below.

Factors Guiding Bead Sample Choice

The 120 *Olivella* beads sampled at CAMS were carefully chosen to include a broad range of important central California types thought by Bennyhoff to be the most temporally diagnostic (see Bennyhoff and Hughes 1987). The majority of beads were selected from discrete burial contexts that also contained other time-sensitive artifact types or additional bead styles, or had previously been radiocarbon-dated by other means. Only a small number of the dated beads originated as unassociated midden finds. *Olivella* beads were obtained from six central California academic institutions and from private consulting companies. Beads sampled by Beta Analytic, Inc. were chosen to date specific contexts for the purposes of individual site investigations.

Sample Pretreatment and AMS Procedure

Each bead analyzed by CAMS was pretreated with hydrochloric acid and rinsed with deionized water to remove surface contaminants. The remaining shell material was dried, weighed, and converted to CO^2 by reaction with phosphoric acid. Samples were then reduced to graphite and subjected to AMS analysis (Taylor 1997:78–91). Beta Analytic, Inc.'s (2010) pretreatment and AMS procedures are very similar to CAMS.

The resultant dates (^{14}C ages) were determined following the conventions of Stuiver and Polach (1977). Based on two samples from the first suite of ten beads tested at CAMS, a value of 1.0 for $\delta^{13}C$ was applied to generate the conventional dates. CAMS ran $\delta^{13}C$ ratios for five samples; measurements ranged from 0.9 to 1.7, resulting in an average of 1.4 ±0.4. Beta Analytic tested $\delta^{13}C$ for each sample; their results averaged 0.7±0.5. Therefore, an assumed ratio of 1. 0 appears adequate for all samples.

Calibrating Local Marine Carbon Reservoir Effect

The current study employs Marine04 (Hughen et al. 2004) with CALIB 5.0.2 to calibrate all of the resultant dates (Stuiver and Reimer 1993; Stuiver et al. 2005). Groza (2002) originally calibrated the first 104 CAMS dates with CALIB 4.4 using a ΔR of 225±35 (see Stuiver and Reimer 1993). A comparative value of 290±35 was also applied, after Ingram and Southon (1996). However, the ΔR of 290 produced dates much more modern than expected (Groza 2002:105) given the known manufacturing date for Needle-drilled *Olivella* disk beads, Class H. These beads were made by the Chumash of the Santa Barbara Channel region between cal A.D. 1770 and 1816 (Bennyhoff and Hughes 1987:135) and are the most recent type in the *Olivella* sequence. The application of a ΔR of 225±35 (Groza 2002) generated dates for Needle-drilled beads that were almost 100 years too old. The current study employs a ΔR of 260±35,

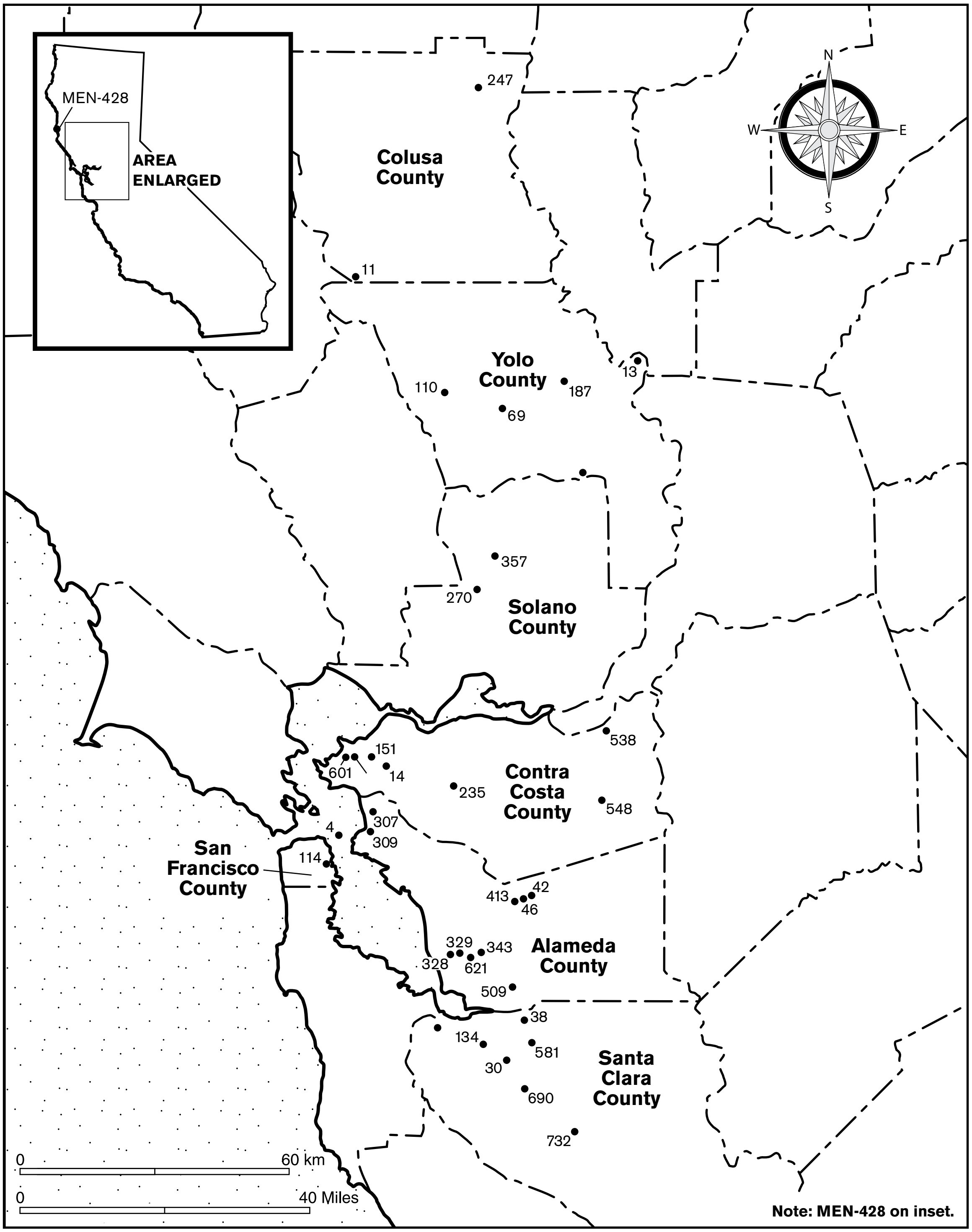


Figure 2. Location of Central California Sites Where Dated *Olivella* Beads Were Recovered

which reconciles the calibrated AMS date and the known age of Needle-drilled disk beads.

RESULTS: DATING SCHEME D SHELL-BEAD STYLE HORIZONS

A new chronology based on the calibrated AMS results from 140 individual *Olivella* beads and standard radiometric dates from five mass bead-lots is shown as Dating Scheme D in Figure 1 and detailed in Tables 1 through 4.[3] Also enumerated in Tables 1 through 4 are all associated beads and bead types, as well as all other artifacts from each dated context. Because individual grave lots often included more than a single bead style, the age of the dated bead could be applied to all associated bead types from that lot. This provided 299 observations on the temporal duration of use. As many as 50 dates are associated with some bead types (e.g., Type F3a, Square Saddles; Table 5), whereas others are associated with as few as five dates (e.g., Type K, Callus; Table 5).

As indicated in Figure 3, most bead types provide a very tight and continuous cluster of dates marking their main period(s) of use. However, some notable deviations occur. For example, a single Type E Lipped bead is associated with a date of cal A.D. 1273 from Burial 127 at ALA-329, about 300 years earlier than all other Lipped beads. In this context, the single Lipped bead was associated with an otherwise pure lot of 456 M2 Pendants. The radiocarbon date originated from one of these latter beads. It appears the odd Lipped bead is intrusive in this context, as 18 other burial lots dating between cal A.D. 1265 and cal A.D. 1520 contained no Lipped beads. Likewise, three Saddle bead variants (i.e., F3a, F2cd, and F2b), all from the same burial lot (i.e., Burial 2, SOL-270), are associated with a date of 83 cal B.C. This is about 530 years older than the next oldest date associated with this same bead type. In this instance, the actual specimen dated from the bead lot was a Type C3 Split Oval bead, which appears to have a much earlier period of manufacture than the Saddles, a fact borne out by numerous other dates from both bead classes. We interpret the dated specimen as a possible heirloom, included in a much younger bead lot; however, it could have been introduced into the burial matrix by rodent burrowing or redeposited with the original burial fill. The combination of types in this particular burial assemblage would otherwise place it in Horizon 2 of the Middle Period, dating between cal A.D. 420 and 585 (Fig. 3).

Despite these few problems, the combined results indicate that certain bead styles were used for as little as 65 to 200 years (Class H Needle-drilled and Class E Lipped), while others were used for as long as 800 to 850 years (Type G Saucers and Type F3a Narrow Saddles [previously known as Square Saddles]). As indicated in Figure 3, the current data set reveals unique combinations of bead types in circulation over comparatively short time-spans in central California, providing temporal resolution on the order of 120 to 260 years for phases dating after cal A.D. 420 (Fig. 1). The current results also indicate that Horizon 1 of the Middle Period (200 cal B.C.–cal A.D. 420) lasted for more than 600 years, while the Early/Middle Period Transition could have been as short as 300 years (500–200 cal B.C.) or as long as 680 years (i.e., 880–199 cal B.C.). The timing of the Early Period continues to be the least understood, but it lasted a minimum of 865 years (i.e., 880–1,746 cal B.C.). The overall duration of these horizons seems to indicate that the pace of cultural change—at least as it relates to new shell-bead types—increased substantially after cal A.D. 420 in central California (see also White 2003).

Our data generally confirm the sequence of shell-bead types reported by Bennyhoff and Hughes (1987), but some significant differences in the ages of shell-bead style horizons and their associated cultural phases are apparent, including some shifting of the Middle Period phase order. Below we interpret these results, including discussions of bead-type assemblages, the sites from which they were derived, other insights, and continuing problems with the exact timing of period shifts. For current purposes, we continue to refer to each period as bead style-horizons, rather than cultural phases, as we did not consistently evaluate the changes in other artifact styles that are inherent in Bennyhoff's phase definitions (e.g., Elsasser 1978).

Early Period Bead Horizon: Possibly 2,100–600 cal B.C.

The anticipated results for Early Period Thick Rectangle beads based on Scheme B (Bennyhoff and Hughes 1987:149) are 3,000–500 cal B.C. Our four earliest dates, 1,746–1,591 cal B.C. (Table 4), derive from midden

Table 1

RADIOCARBON DATES ON TIME-SENSITIVE *OLIVELLA* SHELL BEADS FROM THE HISTORIC/MISSION PERIOD THROUGH LATE PERIOD BEAD HORIZON 1A

						CALIB 5.0.2[d]		Count of *Olivella* Bead Types Associated with Dated Bead												
Lab Number	Site (CA-)[a]	Feature[b]	Dated Bead	δ^{13}C[c]	^{14}C Age	Median	2-sigma Range	H	E	K	M2	M1	D	C7	C2/3	G1	F3b	F3a	F4	Other Time-sensitive Artifacts
Historic/Mission Period Bead Horizon (A.D. 1770–1835)																				
B-177327	YOL-069	B. 06	G1	0.7	750±40	A.D. 1836	A.D. 1712–1949	49	–	–	–	–	–	–	–	1	–	–	–	CSDB (830); *H.* beads (45)
C-78745	SCL-030	Pit	H1b	1*	780±40	A.D. 1803	A.D. 1693–1910	1	–	–	–	–	–	–	–	–	–	–	–	–
C-79487	SCL-030	Pit	H1b	1*	790±40	A.D. 1792	A.D. 1684–1908	1	–	–	–	–	–	–	–	–	–	–	–	–
B-179712	YOL-069	B. 03	H2	1.4	790±40	A.D. 1792	A.D. 1684–1908	74	–	–	–	–	–	–	–	–	–	–	–	CSDB (12)
B-177337	YOL-069	B. 84	H1b	0.5	800±40	A.D. 1783	A.D. 1674–1905	2676	–	–	–	–	–	–	–	–	–	–	–	CSDB (44); *H.* beads (9)
B-177331	YOL-069	B. 16	H1a	0.8	810±40	A.D. 1774	A.D. 1665–1904	56	–	–	–	–	–	–	–	–	–	–	–	CSDB (653); magnste bds (58)
Late Period, Bead Horizon 2 (A.D. 1520–1770)																				
C-80287	ALA-329	B. 24	E2a2	1*	815±30	A.D. 1766	A.D. 1664–1897	–	555	–	–	–	–	–	–	–	–	–	–	–
B-191548	YOL-197	Midden	E2a3	0.9	840±40	A.D. 1745	A.D. 1628–1900	–	1	–	–	–	–	–	–	–	–	–	–	–
C-80288	ALA-329	B. 37	E1b1	1*	850±30	A.D. 1729	A.D. 1624–1883	–	5	–	–	–	–	–	–	–	–	–	–	–
C-79710	ALA-509	Feat. 2	E1b1	1*	870±30	A.D. 1698	A.D. 1565–1833	–	12	–	–	–	–	–	–	–	–	–	–	Human/dog co-cremation
C-82182	COL-011	Pit	E3a	1*	870±30	A.D. 1698	A.D. 1565–1833	–	1	–	–	–	–	–	–	–	–	–	–	–
C-80299	ALA-329	B. S-123	E1b1	1*	920±30	A.D. 1639	A.D. 1515–1725	–	?	–	–	–	–	–	–	–	–	–	–	(notes unavailable)
C-80907	ALA-329	B. 45	E3b1	1*	955±30	A.D. 1604	A.D. 1506–1688	–	99	–	–	–	–	–	–	–	–	–	–	–
B-191545	YOL-197	Midden	E3a	0.8	1000±30	A.D. 1570	A.D. 1479–1662	–	1	–	–	–	–	–	–	–	–	–	–	–
Late Period, Bead Horizon 1b (A.D. 1390–1520)																				
C-80286	ALA-329	B. 78	M2a	1*	1090±30	A.D. 1488	A.D. 1418–1594	–	–	–	58	380	–	–	–	–	–	–	–	*H.* square ornaments
C-80302	CCO-235	B. 19	K1	1*	1095±30	A.D. 1484	A.D. 1413–1591	–	–	36	–	–	–	–	–	–	–	–	–	*H.* effigy ornaments
C-80293	CCO-235	B. 22/39	K1	1.7	1145±30	A.D. 1449	A.D. 1380–1522	–	–	9	–	–	–	–	–	–	–	–	–	–
C-80303	CCO-235	B. 35/36	K1	1*	1150±40	A.D. 1445	A.D. 1338–1524	–	–	68	–	9	–	–	–	–	–	–	–	–
C-79703	YOL-187	B. 02	M2a	1*	1160±30	A.D. 1438	A.D. 1341–1504	–	–	–	60	3	–	–	–	–	–	–	–	Serrate arrow point
C-80906	ALA-329	B. 023	M2a	1*	1160±30	A.D. 1438	A.D. 1341–1504	–	–	–	76	–	–	–	–	–	–	–	–	Serrate arrow point
C-79711	ALA-329	B. 126	K1	1*	1180±30	A.D. 1424	A.D. 1331–1486	–	–	78	–	–	–	–	–	–	–	–	–	–
C-79486	YOL-187	B. 02	M2a	1*	1200±80	A.D. 1405	A.D. 1270–1548	–	–	–	60	3	–	–	–	–	–	–	–	Serrate arrow point
C-80904	CCO-235	B. 24/25	K1	1*	1205±35	A.D. 1403	A.D. 1317–1471	–	–	7	–	–	–	–	–	–	–	–	–	–
Late Period, Bead Horizon 1a (A.D.1265–1390)																				
C-80903	SCL-038	B. 51	M2a	1*	1225±40	A.D. 1388	A.D. 1306–1461	–	–	–	1042	–	–	–	–	–	–	–	–	*H.* effigy ornaments
B-044244	SCL-690[e]	B. 24	A1	1*	1250±60	A.D. 1372	A.D. 1300–1441	–	–	–	–	282	1	–	–	200	–	–	–	Wide rectangle *H.* pendant
C-80285	ALA-329	B. 49	M1a	1*	1255±30	A.D. 1370	A.D. 1300–1441	–	–	–	45	509	–	–	–	–	–	–	–	*H.* effigy ornaments
C-80682	CCO-235	B. 21	M1a	1*	1270±45	A.D. 1361	A.D. 1281–1446	–	–	–	–	2151	–	–	–	–	–	–	–	*H.* effigy ornaments
C-80905	ALA-329	B. 79	M2a	1*	1330±30	A.D. 1316	A.D. 1239–1408	–	–	–	50	276	–	–	–	–	–	–	–	*H.* effigy ornaments
C-79482	ALA-329	B. 226	M1a	1*	1380±40	A.D. 1274	A.D. 1174–1387	–	–	–	–	1880	–	–	–	–	–	–	–	Serrate arrow point
C-79479	ALA-329	B. 127	M2a	1*	1380±50	A.D. 1273	A.D. 1159–1400	–	1	–	456	–	–	–	–	–	–	–	–	Corner-notched arrow point
C-80292	CCO-235	B. 32	M1a	1*	1385±30	A.D. 1271	A.D. 1170–1349	–	–	–	–	585	–	–	–	–	–	–	–	*H.* bar-scored ornaments
C-80902	SCL-038	B. 166	M1a	1*	1390±25	A.D. 1267	A.D. 1176–1334	–	–	–	–	455	–	–	–	–	–	–	–	–

Notes: [a]County-based site trinomial identifications assigned by the California Historic Resources Survey; [b]Burial feature references designated by "B.", other provenances variously indicated; [c]Inferred δ^{13}C corrections (always 1.0) are marked with "*"; [d]Dates calibrated with CALIB 5.0.2 (Marine04), with $\Delta R = 260 \pm 35$; [e]SCL-690 dates are radiometric, based on lots of up to 30 beads of a single type; CSDB = clam shell disk bead; magnste bds = magnesite beads; *H.* = *Haliotis*

Table 2

RADIOCARBON DATES ON TIME-SENSITIVE *OLIVELLA* SHELL BEADS FROM THE MIDDLE/LATE TRANSITION PERIOD AND MIDDLE PERIOD BEAD HORIZON 4

						CALIB 5.0.2[d]		Count of *Olivella* Bead Types Associated with Dated Bead												
Lab Number	Site[a]	Feature[b]	Dated Bead	δ^{13}C[c]	^{14}C Age	Median	2-sigma Range	H	E	K	M2	M1	D	C7	C2/3	G1/5	F3b	F3a	F4	Other Time-sensitive Artifacts with Dated Bead
Middle/Late Transition Bead Horizon (A.D. 1020–1265)																				
C-82179	YOL-013	B. 03	C2	1*	1395±30	A.D. 1263	A.D. 1165–1337	–	–	–	–	–	1	20	77	–	–	–	–	–
B-046645	SCL-690[e]	B. 55	A1	1*	1450±50	A.D. 1212	A.D. 1069–1308	–	–	–	–	359	4	–	–	–	–	39	–	–
C-79480	ALA-329	B. 239	M1a	1*	1460±40	A.D. 1206	A.D. 1076–1296	–	–	–	–	3154	–	–	–	–	–	–	–	Serrate arrow point
B-044250	SCL-690[e]	B. 39	D1	1*	1460±60	A.D. 1200	A.D. 1053–1310	–	–	–	–	3	1693	66	23	1575	–	–	–	–
C-82178	YOL-013	B. 02	G5	1*	1475±35	A.D. 1192	A.D. 1070–1284	–	–	–	–	66	2	–	123	122	–	72	–	Ear spools (2)
C-82177	YOL-013	B. 02	M1a	1*	1555±30	A.D. 1113	A.D. 1021–1224							(repeat feature)						
C-79705	ALA-042	B. 236	C7	1*	1480±30	A.D. 1188	A.D. 1071–1279	–	–	–	–	20	–	50	50	–	–	–	–	–
C-79709	ALA-042	B. 280	C3	1*	1490±30	A.D. 1178	A.D. 1063–1272	–	–	–	–	–	–	–	163	–	–	–	–	–
C-79706	ALA-042	B. 055	D2	1*	1510±30	A.D. 1156	A.D. 1051–1258	–	–	–	–	–	24	–	–	–	–	–	–	Dart point
C-79704	ALA-042	B. 066	M1a	1*	1520±30	A.D. 1146	A.D. 1044–1250	–	–	–	–	264	–	–	–	–	–	–	–	–
B-169840	CCO-538	B. 02-12	F3a1	0.8	1530±40	A.D. 1136	A.D. 1031–1253	–	–	–	–	546	–	–	–	55	921	726	100	Ear spools
C-79712	ALA-046	B. 08	F3a1	1*	1530±40	A.D. 1136	A.D. 1031–1253	–	–	–	–	–	–	–	–	–	–	91	35	–
C-79483	ALA-329	B. 251	D1	1*	1540±40	A.D. 1127	A.D. 1023–1247	–	–	–	–	–	5	33	3	–	–	–	–	–
C-80899	ALA-042	B. 192	C2	1*	1545±30	A.D. 1122	A.D. 1028–1229	–	–	–	–	–	190	67	6	–	–	–	–	–
C-78738	ALA-042	B. 259	M1a	1*	1550±30	A.D. 1118	A.D. 1025–1226	–	–	–	–	900	–	100	–	–	–	–	–	Ear spools (2)
C-78737	ALA-042	B. 259	M1a	1.5	1560±40	A.D. 1110	A.D. 1002–1229							(repeat feature)						
C-78739	ALA-042	B. 259	M1a	1*	1560±40	A.D. 1110	A.D. 1002–1229							(repeat feature)						
C-79708	ALA-042	B. 259	C3	1*	1560±40	A.D. 1110	A.D. 1002–1229							(repeat feature)						
C-78736	ALA-042	B. 259	M1a	1*	1580±40	A.D. 1092	A.D. 983–1219							(repeat feature)						
B-44247	SCL-690[e]	B. 41	M1a	1*	1570±50	A.D. 1102	A.D. 977–1240	–	–	–	–	1433	7	–	–	–	–	260	–	Bar-scored *H.* orns.
B-169839	CCO-538	B. 02-3	F3a1	0.7	1580±40	A.D. 1092	A.D. 983–1219	–	–	–	–	4	–	–	–	24	30	21	–	–
C-79707	ALA-042	B. 111	M1a	1*	1610±30	A.D. 1058	A.D. 950–1179	–	–	–	–	162	–	–	25	–	–	10	–	–
B-44245	SCL-690[e]	B. 31	G1	1*	1640±70	A.D. 1025	A.D. 845–1208	–	–	–	–	3	3	144	1	2748	–	–	–	–
Middle Period, Bead Horizon 4 (A.D. 750–1020)																				
C-79713	ALA-046	B. 07	F3a1	1*	1650±40	A.D. 1013	A.D. 895–1154	–	–	–	–	–	–	–	–	–	–	44	13	*H.* wide-rectangle orns.
C-80294	ALA-329	B. 250	F4d	1.1	1665±30	A.D. 998	A.D. 887–1116	–	–	–	–	–	–	–	–	–	–	325	403	*H.* wide-ovate orns.
C-80295	ALA-329	B. 250	F3a2	1*	1735±30	A.D. 929	A.D. 810–1029							(repeat feature)						
C-80915	SCL-134	B. 24	G5	1*	1680±30	A.D. 983	A.D. 859–1080	–	–	–	–	–	–	–	–	11	–	–	–	–
C-79485	ALA-329	B. 244	F4c	1*	1680±40	A.D. 981	A.D. 840–1104	–	–	–	–	–	–	–	–	–	–	103	118	–
C-79484	ALA-329	B. 244	F4d	1*	1760±40	A.D. 900	A.D. 776–1025							(repeat feature)						
B-169838	CCO-538	B. 02-1	F4c	1.4	1690±40	A.D. 971	A.D. 825–1079	–	–	–	–	–	–	–	–	480	937	693	240	Ear spools
C-79051	CCO-269	B. 37A	G5	1*	1710±40	A.D. 952	A.D. 814–1054	–	–	–	–	–	–	–	–	33	23	20	18	Ear spools; Hal. rect. orn.
C-79481	ALA-329	B. 143	F3b1	1*	1730±40	A.D. 932	A.D. 799–1039	–	–	–	–	–	–	–	–	–	6	1	–	*H.* wide-rect. orns.
C-80910	ALA-329	B. 240	F3b2	1*	1750±40	A.D. 911	A.D. 784–1027	–	–	–	–	–	–	–	–	–	150	391	60	*H.* wide ovate orns.
C-80289	ALA-329	B. 265	F3a2	1*	1760±30	A.D. 901	A.D. 785–1012	–	–	–	–	–	–	–	–	106	128	404	–	–
C-122454	SOL-357	B. 210	F3a1	1*	1760±35	A.D. 901	A.D. 782–1019	–	–	–	–	–	–	–	–	–	265	424	901	data unavailable
C-122453	SOL-357	B. 208	F4d	1*	1785±35	A.D. 871	A.D. 744–996	–	–	–	–	–	–	–	–	–	18	71	111	*H.* wide-rect. orns.
C-122455	SOL-357	B. 232	F4a	1*	1810±35	A.D. 844	A.D. 721–972	–	–	–	–	–	–	–	–	–	358	3222	5370	*H.* wide-rect. orns.
C-80914	SCL-134	B. 13	G5	1*	1820±35	A.D. 833	A.D. 710–960	–	–	–	–	–	–	–	–	1226	–	–	–	–
C-81892	CCO-014	B. 05	F4c	1*	1835±25	A.D. 816	A.D. 700–923	–	–	–	–	–	–	–	–	–	60	139	86	–
C-80297	ALA-343	B. 01-90	F3a1	1*	1850±35	A.D. 800	A.D. 685–916	–	–	–	–	58	–	–	–	–	96	65	–	Bone spatulae
C-81893	CCO-014	B. 12	F4d	1*	1855±30	A.D. 793	A.D. 689–904	–	–	–	–	–	–	–	–	–	103	334	463	Ear spools; *H* rect. orns.

Notes: [a]County-based site trinomial identifications assigned by the California Historic Resources Survey; [b]Burial feature references designated by "B.", other provenances variously indicated; [c]Inferred δ^{13}C corrections (always 1.0) are marked with "*"; [d]Dates calibrated with CALIB 5.0.2 (Marine04), with ΔR = 260±35; [e]SCL-690 dates are radiometric, based on lots of up to 30 beads of a single type; *H.* = *Haliotis*; rect. orns. = rectangular ornaments

Table 3

RADIOCARBON DATES ON TIME-SENSITIVE *OLIVELLA* SHELL BEADS FROM THE MIDDLE PERIOD BEAD HORIZON 3 AND MIDDLE PERIOD BEAD HORIZON 2

Lab Number	Site[a]	Feature[b]	Dated Bead	δ13C[c]	14C Age	CALIB 5.0.2[d]		Count of *Olivella* Bead Types Associated with Dated Bead												Other Time-sensitive Artifacts with Dated Bead
						Median	2-sigma Range	M1	D	C7	C2/3	G5	F3b	F3a	F2cd	F2a	F2b	F4	G2/3	
Middle Period, Bead Horizon 3 (A.D. 585–750)																				
C-80296	ALA-343	B. 01-168	F3b2	1*	1905±40	A.D. 747	A.D. 654–879	–	–	–	–	–	14	–	–	–	–	–	–	–
B-177104	SFR-004	B. 06	F3a2	0.7	1910±40	A.D. 742	A.D. 649–874	87	–	–	–	–	50	231	45	–	–	–	–	*Haliotis fulgens* tear drop orns.
B-177103	SFR-004	B. 06	F3a2	0.6	1960±40	A.D. 696	A.D. 591–810						(repeat feature)							
C-89448	MEN-428	Midden	M1a	0.8	1920±30	A.D. 731	A.D. 646–844	1	–	–	–	–	–	–	–	–	–	–	–	–
C-80684	SFR-114	B. 02	F3a1	1*	1935±35	A.D. 718	A.D. 621–830	–	–	–	–	–	489	2769	–	–	–	–	–	Mica; bone spatula; dart pt
C-89443	ALA-343	B.86-12	M1a	1*	1940±35	A.D. 714	A.D. 617–824	2	–	–	–	6	88	8	–	–	–	–	–	*H.* rectangle orns.
C-89444	ALA-343	B.86-12	F3b1	1*	1965±35	A.D. 691	A.D. 592–795						(repeat feature)							
C-89446	ALA-343	B.86-26	F3b1	1*	1970±30	A.D. 686	A.D. 597–785	–	–	–	–	1	471	–	–	–	–	–	–	Mica; *H.* rectangle orns.
C-89445	ALA-343	B.86-19	F3b1	1*	1970±30	A.D. 686	A.D. 641–729	33	–	–	–	–	574	110	–	–	–	–	–	Mica
C-89447	ALA-343	B.86-28	F3b1	1*	1995±30	A.D. 664	A.D. 573–765	–	–	–	–	–	328	36	–	–	–	–	–	Mica; bone spatula
C-80683	ALA-343	B.01-97	F3a1	1*	2010±35	A.D. 651	A.D. 549–753	71	–	–	–	2	9	160	–	–	–	–	–	–
C-80685	SFR-114	B. 10	F3a1	1*	2020±35	A.D. 642	A.D. 534–744	–	–	–	–	–	110	2098	–	–	–	–	–	–
C-81897	CCO-151	B. 60	F3a1	1*	2035±30	A.D. 630	A.D. 525–720	–	–	–	–	–	–	116	–	–	–	9	–	–
C-81896	CCO-151	B. 27	F3b2	1*	2055±30	A.D. 613	A.D. 491–695	–	–	–	–	–	367	–	–	–	–	–	–	Mica
Middle Period, Bead Horizon 2 (A.D. 420–585)																				
C-80913	SCI-581	B. Gr-5	F3a1	1*	2085±35	A.D. 584	A.D. 540–652	–	–	–	–	76	–	307	42	–	–	–	75	–
C-79049	CCO-269	B. 29	F3a1	1.1	2090±40	A.D. 578	A.D. 529–651	–	–	–	–	–	–	31	14	2	10	–	–	–
C-80912	SCI-581	B. So-9	F3a2	1*	2095±30	A.D. 575	A.D. 530–643	–	–	–	–	–	–	37	–	–	–	10	–	–
C-89449	ALA-413	U.5 130 cm.	F3a2	1*	2095±35	A.D. 574	A.D. 525–645	–	–	–	–	–	–	1	–	–	–	–	–	–
B-197489	SFR-004	B. 28	F2d	1.0	2110±40	A.D. 557	A.D. 492–623	–	–	–	–	–	–	–	65	21	15	–	–	–
B-197490	SFR-004	B. 28	F2d	0.7	2120±40	A.D. 546	A.D. 492–623						(repeat feature)							
C-79056	ALA-413	B. 34	G2a	1*	2120±30	A.D. 548	A.D. 486–607	–	–	–	–	–	–	–	–	–	–	–	5660	*H.* nacrous disks
C-122459	ALA-413	B. 34	G2a	1*	2170±35	A.D. 497	A.D. 436–557						(repeat feature)							
C-122458	ALA-413	B. 22	G2a	1*	2130±35	A.D. 536	A.D. 472–597	–	–	–	–	–	–	–	–	–	–	–	148	*H.* nacrous disks
C-78742	ALA-413	B. 23	G2a	1*	2130±40	A.D. 536	A.D. 469–599	–	–	–	–	–	–	–	–	–	–	–	108	
C-78741	ALA-413	B. 23	G2b	1*	2160±40	A.D. 506	A.D. 441–568						(repeat feature)							
C-78743	ALA-413	B. 23	G2b	1*	2190±40	A.D. 476	A.D. 415–548						(repeat feature)							
C-78740	ALA-413	B. 23	G2b	1*	2210±40	A.D. 451	A.D. 391–535						(repeat feature)							
C-89450	ALA-413	U.5 150 cm.	F3a2	1*	2150±35	A.D. 516	A.D. 451–573	–	–	–	–	–	–	1	–	–	–	–	–	–
C-79055	ALA-413	B. 25A	F2b	1*	2150±40	A.D. 515	A.D. 448–576	–	–	–	–	–	–	5	2	3	4	–	23	–
B-197487	SFR-004	B. 22	F2c	-0.2	2150±40	A.D. 515	A.D. 448–576	–	–	–	–	–	–	2	39	14	20	–	–	–
B-197488	SFR-004	B. 22	F2d	-0.5	2200±40	A.D. 464	A.D. 404–542						(repeat feature)							
C-81895	CCO-151	B. 28	F3a2	1*	2160±30	A.D. 506	A.D. 446–561	–	–	–	–	–	–	35	–	–	–	7	–	Bone spatula
C-79057	ALA-413	U.5 100 cm.	F4c	1*	2160±40	A.D. 506	A.D. 441–568	–	–	–	–	–	–	–	–	–	–	1	–	–
C-122456	ALA-413	B. 25	G2b	1*	2170±35	A.D. 497	A.D. 436–557	–	–	–	–	–	–	–	–	–	–	–	28,335	Bone wands
C-79054	ALA-413	B. 25	G2b	1*	2240±40	A.D. 413	A.D. 336–485						(repeat feature)							
C-122457	ALA-413	B. 25	G2a	1*	2275±35	A.D. 370	A.D. 301–434						(repeat feature)							
C-89452	ALA-413	U.5 150 cm.	G2a	1*	2175±40	A.D. 491	A.D. 429–558	–	–	–	–	–	–	–	–	–	–	–	1	–
C-89451	ALA-413	U.5 130 cm.	G2a	1*	2180±30	A.D. 487	A.D. 431–548	–	–	–	–	–	–	–	–	–	–	–	1	–
C-79053	ALA-413	B. 24	F2a	1*	2180±40	A.D. 486	A.D. 424–554	–	–	–	–	–	–	288	352	128	512	–	–	–
C-79478	ALA-329	B. 104	F2a	1*	2180±40	A.D. 486	A.D. 424–554	–	–	–	–	–	–	3	2	2	2	–	–	–
C-78744	ALA-413	B. 60	F2a	1*	2190±40	A.D. 476	A.D. 415–548	–	–	–	–	–	–	109	784	720	567	–	–	–
C-79050	CCO-269	B. 34	F2a	1*	2190±40	A.D. 476	A.D. 415–548	–	–	–	–	–	–	10	18	67	21	–	–	–
C-81894	CCO-151	B. 41	F2a	1*	2205±30	A.D. 458	A.D. 404–531	–	–	–	–	–	–	8	117	52	23	–	–	–
C-79048	CCO-269	B. 11	F2b	0.9	2210±40	A.D. 451	A.D. 391–535	–	–	–	–	3	–	4	20	2	20	–	–	Mica

Notes: [a] County-based site trinomial identifications assigned by the California Historic Resources Survey; [b] Burial feature references designated by "B.", other provenances variously indicated; [c] Inferred δ13C corrections (always 1.0) are marked with "*"; [d] Dates calibrated with CALIB 5.0.2 (Marine04), with ΔR = 260±35; *H.* = *Haliotis*; rect. orns. = rectangular ornaments

Table 4

RADIOCARBON DATES ON TIME-SENSITIVE *OLIVELLA* SHELL BEADS FROM MIDDLE PERIOD BEAD HORIZON 1 AND EARLY PERIOD BEAD HORIZON

Lab Number	Site[a]	Feature[b]	Sample Bead	$\delta^{13}C^{c}$	^{14}C Age	CALIB 5.0.2[d] Median	CALIB 5.0.2[d] 2-sigma Range	M1	D	C7	C2/3	G5	F3b	F3a	F2cd	F2a	F2b	G2/3	L	Other Time-sensitive Artifacts with Dated Bead
Middle Period, Bead Horizon 1 (200 B.C.–A.D. 420)																				
C-80686	ALA-621	B. 01-10	C3	1*	2250±30	A.D. 400	A.D. 270–533	–	–	–	63	–	–	–	35	–	10	45	–	–
C-80900	ALA-328	B. 58	C3	1*	2280±30	A.D. 364	A.D. 237–491	–	–	–	15	–	–	–	–	–	–	406	–	–
C-80911	ALA-328	B. 138	C3	1*	2285±40	A.D. 358	A.D. 219–512	–	–	–	209	–	–	–	–	–	34	37	–	–
C-122451	SCL-354	B. 02	G2b	1*	2285±35	A.D. 358	A.D. 224–495	–	–	–	–	–	–	–	–	–	–	272	–	–
C-122452	SCL-354	B. 02	G2b	1*	2360±35	A.D. 272	A.D. 140–405						(repeat feature)							
C-79052	CCO-601	B. 11	G3b	1*	2310±30	A.D. 330	A.D. 198–446	–	–	–	–	–	–	–	–	–	–	1718	–	–
C-80909	ALA-328	B. 142	G3b	1*	2345±35	A.D. 291	A.D. 154–418	–	–	–	–	–	–	–	–	–	–	166	–	–
C-80908	ALA-328	B. 14	G2a	1*	2355±30	A.D. 278	A.D. 148–403	–	–	–	–	–	–	–	–	–	–	54	–	–
C-82183	SOL-270	B. 13	G3b	1*	2395±25	A.D. 226	A.D. 107–352	–	–	–	–	–	–	–	–	–	–	38	–	Steatite disks
C-80300	SCL-732	B. 35	G2b	1*	2425±35	A.D. 193	A.D. 72–334	–	–	–	–	–	–	–	–	–	–	34	–	–
C-80901	ALA-328	B. 58	C2	1*	2480±30	A.D. 130	A.D. 14–253	–	–	–	15	–	–	–	–	–	–	406	–	–
C-80687	ALA-621	B. 01-04	C2	1*	2495±35	A.D. 113	13 B.C.–A.D. 244	–	–	–	20	–	–	–	–	–	–	–	–	–
C-80301	SCL-732	B. 59	G2b	1*	2495±30	A.D. 112	5 B.C.–A.D. 241	–	–	–	–	–	–	–	–	–	–	57	–	–
C-82184	SOL-270	B. 06	G2a	1*	2525±30	A.D. 77	41 B.C.–A.D. 210	–	–	–	–	–	–	–	–	–	–	139	–	Steatite disks
C-82180	YOL-110	B. 11	G5a	1*	2640±30	59 B.C.	181 B.C.–A.D. 67	–	–	–	–	104	–	–	–	–	–	–	–	Steatite disks
B-147194	ALA-309	B. 41	G2b	0.8	2640±40	59 B.C.	195 B.C.–A.D. 82	–	–	–	–	–	–	–	–	–	–	212	–	(notes unavailable)
C-82186	SOL-270	B. 02	C3	1*	2660±35	83 B.C.	214 B.C.–A.D. 65	–	–	–	9	–	–	4	26	–	23	–	–	–
C-82185	SOL-270	B. 15	G2a	1*	2680±30	106 B.C.	252 B.C.–A.D. 35	–	–	–	–	–	–	–	–	–	–	152	–	Steatite disks; *H.* disks
C-80290	COL-247	B. 6	G2a	1*	2745±35	198 B.C.	343–56 B.C.	–	–	–	–	–	–	–	–	–	–	38	–	–
Early Period/Middle Period Transition (about 600–200 B.C.)																				
(No beads tested)																				
Early Period, Bead Horizon (about 2100–600 B.C.)																				
C-81891	ALA-307	B. 62	L2b	1*	3320±35	880 B.C.	1006–780 B.C.	–	–	–	–	–	–	–	–	–	–	–	30	–
C-81889	ALA-307	B. 49	L2b	1*	3565±35	1204 B.C.	1358–1047 B.C.	–	–	–	–	–	–	–	–	–	–	–	162	*H.* rectangular beads
C-82181	COL-247	Unit A	L2b	1*	3585±35	1232 B.C.	1376–1078 B.C.	–	–	–	–	–	–	–	–	–	–	–	1	–
C-81890	ALA-307	B. 51	L2b	1*	3735±35	1408 B.C.	1524–1274 B.C.	–	–	–	–	–	–	–	–	–	–	–	71	*H.* rectangular beads
C-81888	ALA-307	B. 42	L2b	1*	3765±35	1441 B.C.	1574–1315 B.C.	–	–	–	–	–	–	–	–	–	–	–	164	–
B-186026	CCO-548	Midden	L2b	1.7	3900±40	1591 B.C.	1732–1453 B.C.	–	–	–	–	–	–	–	–	–	–	–	1	–
B-186024	CCO-548	Midden	L2a	0.2	3920±40	1616 B.C.	1760–1471 B.C.	–	–	–	–	–	–	–	–	–	–	–	1	–
B-186025	CCO-548	Midden	L3	1.0	3940±40	1641 B.C.	1786–1491 B.C.	–	–	–	–	–	–	–	–	–	–	–	1	–
B-186023	CCO-548	Midden	L2a	1.0	4020±40	1746 B.C.	1894–1601 B.C.	–	–	–	–	–	–	–	–	–	–	–	1	–

Notes: [a]County-based site trinomial identifications assigned by the California Historic Resources Survey; [b]Burial feature references designated by "B.", other provenances variously indicated; [c]Inferred $\delta^{13}C$ corrections (always 1.0) are marked with "*"; [d]Dates calibrated with CALIB 5.0.2 (Marine04), with $\Delta R = 260 \pm 35$; *H.* = *Haliotis*

exposed in a creek bank at the Vineyards site (CCO-548) in eastern Contra Costa County (Wiberg and Clark 2004).

The best-documented site containing type L Thick Rectangles is the West Berkeley site (ALA-307), a bayshore shellmound. Four beads from that site produced dates between 1,440 and 880 cal B.C. Wallace and Lathrop (1975) reported five charcoal dates from the same depths as our four *Olivella* beads, and Ingram (1998) reported nine more charcoal dates from the same strata, supporting the early end of our Scheme D chronology. Three of the directly-dated L2b Thick Rectangles from equivalent depths were between 160 and 109 years younger than the midden charcoal. This is not surprising, since the beads were placed in burial pits dug into the slightly older strata.

Table 5

SUMMARY OF CALIBRATED AMS DATES ASSOCIATED WITH DIFFERENT *OLIVELLA* BEAD STYLES

Class/TypeName	Range	Mean	Median	Count
H – Needle-Drilled Disk	A.D. 1774 to A.D. 1836	A.D. 1797	A.D. 1793	6
E – Lipped	A.D. 1273 to A.D. 1766	A.D. 1628	A.D. 1668	9
K– Cupped	A.D. 1403 to A.D. 1484	A.D. 1441	A.D. 1445	5
M2 – Thin Rectangle, Pendant	A.D. 1273 to A.D. 1488	A.D. 1390	A.D. 1397	8
M1– Thin Rectangle, Sequin	A.D. 651 to A.D. 1488	A.D. 1109	A.D. 1127	36
D – Split Punched	A.D. 1025 to 1372	A.D. 1171	A.D. 1157	11
C7– Split Amorphous	A.D. 1025 to A.D. 1263	A.D. 1133	A.D. 1118	11
C2/3 – Split Drilled/Oval	83 B.C. to A.D. 1263	A.D. 797	A.D. 1086	16
G1/G5 –Tiny/Irregular Saucer	59 B.C. to A.D. 1836	A.D. 916	A.D. 962	20
F3b – Small Narrow Saddle	A.D. 613 to A.D. 1136	A.D. 807	A.D. 793	25
F3a – Large Narrow Saddle	A.D. 451 to A.D. 1212	A.D. 777	A.D. 742	49[a]
F2cd – Rough Saddles, Rectanguloid/Elliptic Symmetric	A.D. 400 to A.D. 742	A.D. 527	A.D. 501	16[a]
F2a – Rough Saddle, Rectanguloid Oblique	A.D. 451 to A.D. 578	A.D. 501	A.D. 486	12
F2b – Rough Saddle, Elliptic Oblique	A.D. 358 to A.D. 578	A.D. 483	A.D. 486	14[a]
F4 – Smooth Saddle	A.D. 506 to A.D. 1138	A.D. 862	A.D. 901	19
G2/3 – Saucer/Ring	198 B.C. to A.D. 584	A.D. 331	A.D. 432	30
L – Thick Rectangle	1746 B.C. to 800 B.C.	1440 B.C.	1516 B.C.	9

Notes: Class and type after Milliken and Schwitalla (2009); [a]Does not include associated date of 83 B.C.

Scheme D tentatively brackets the Early Period Bead Horizon at 2,100–600 cal B.C. Until additional samples are obtained, we slightly modify the beginning of the Early/Middle Transition back 100 years to 600 cal B.C.

Early/Middle Transition Bead Horizon (EMT): 600–200 cal B.C.

Beginning after the EMT, rectangular *Olivella* beads were replaced by circular forms, although there is growing evidence that few if any wall beads were used in central California during this interval (see e.g., Rosenthal 1996; Wiberg 2002). *Olivella* bead types C1 Beveled and F1 Oval Saddles are thought to be exclusive to the EMT by Bennyhoff and Hughes (1987), while types C2 Split-drilled, C3 Split Oval, G1 Tiny Saucer, and G2 Normal Saucer are thought to occur occasionally in the EMT, but are not limited to it (Bennyhoff and Hughes 1987:122–123, 129, 132; see also Elsasser 1978:39, 40).

No C1 Beveled or F1 Oval Saddle *Olivella* beads have yet been subjected to direct AMS radiocarbon dating due to their rarity. *Olivella* bead types C3 and G2 have not been found to date to the EMT, lending support to the idea that wall beads were rarely used in central California during this interval. Current data suggest a much longer transitional phase than indicated by Bennyhoff and Hughes (1987), possibly extending from ca. 880 to 199 cal B.C. However, without additional evidence, we slightly modify the Dating Scheme B time-bracketing of the EMT to 600–200 cal B.C.

Middle Period, Bead Horizon 1 (M1): 200 cal B.C.–cal A.D. 420

Bennyhoff and Hughes (1987:149) bracket the Middle Period, Phase 1, at 200 B.C.–A.D. 100. *Olivella* beads for Scheme D's comparable Bead Horizon M1 include C2 Split-drilled, C3 Split Ovals, G2 Normal Saucers, G3 Rings, and G4 Face-ground Saucers (Bennyhoff and Hughes 1987:122–123, 132–133). Additionally, poorly-shaped G5/6 Oval and Irregular Saucers occasionally date to the Early Phase, but can be present in all phases of the Middle Period.

Scheme D brackets Bead Horizon M1 between 200 cal B.C. and cal A.D. 420, significantly longer than Dating Scheme B's comparable bead horizon. Our Bead Horizon M1 sample includes 19 AMS dates from 18 features at nine sites (Table 4). The temporal distribution of dates is surprisingly long. However, it is apparent from Table 3 that pure lots of G2 Saucers continue into the subsequent phase, creating ambiguity in the seriation of

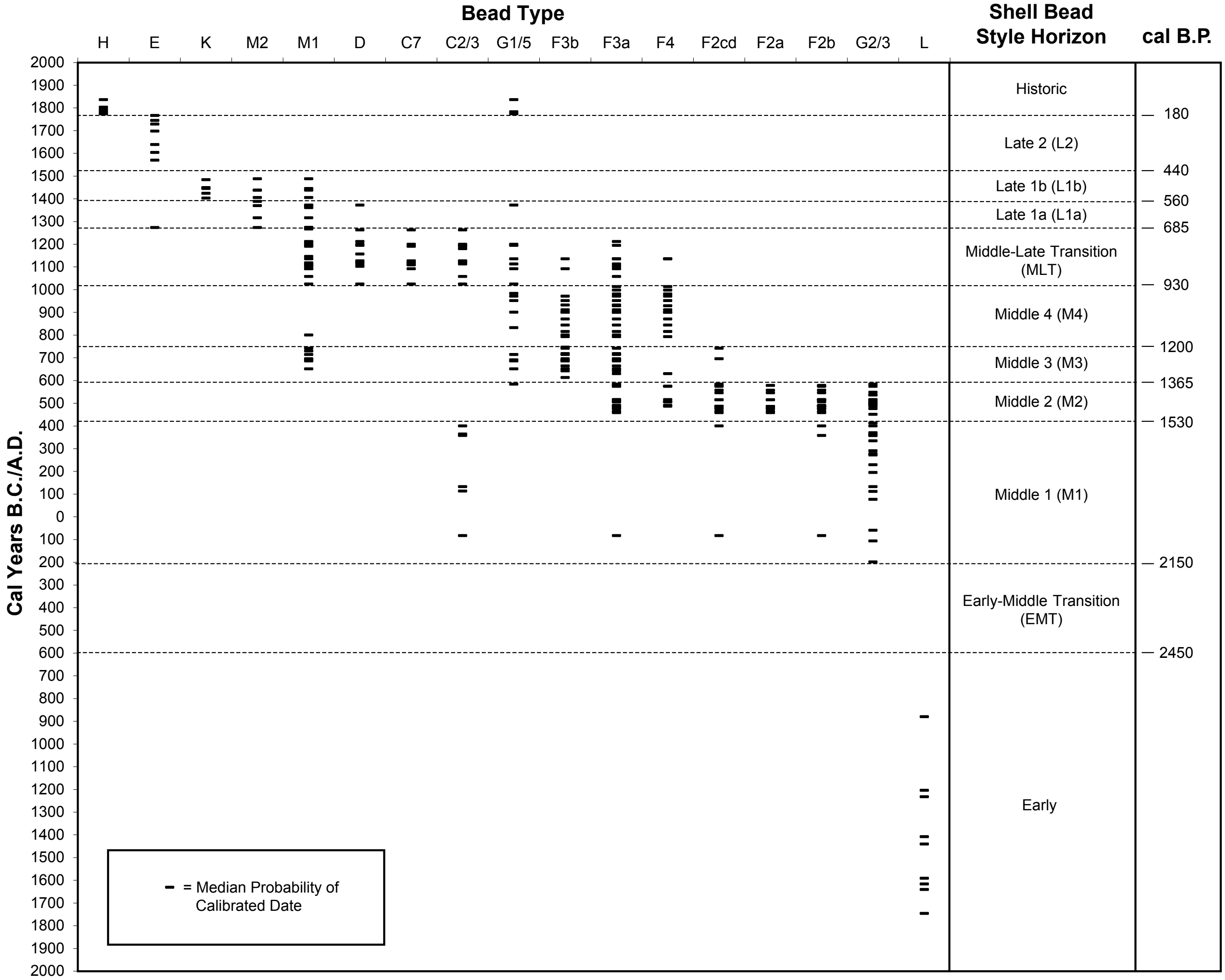


Figure 3. Seriation of AMS Dates Associated with Different *Olivella* Bead Types

these assemblages without radiocarbon dates. This overlap is expressed stratigraphically at site ALA-413, where three pure Saucer bead lots, normally assigned to Bead Horizon M1, were interred subsequent to two *Olivella* Saddle lots associated with Bead Horizon M2 (Wiberg 1988). This temporal overlap is perhaps not surprising, as G2 Saucer beads were manufactured in southern California throughout all phases of the Middle Period and into the Late Period (King 1990:120–133, 149–151, 179–184). Class F Saddle beads were made exclusively in central California (Bennyhoff and Hughes 1987:130, 155; King 1990:130; Rosenthal 2011a), beginning in the Intermediate phase (M2) of the Middle Period. Saucer beads found in central California after the early Middle Period (M1) were likely obtained from southern California.

Middle Period, Bead Horizon 2 (M2): cal A.D. 420–585

The *Olivella* bead sequence becomes more complicated in Bead Horizon M2 than Bennyhoff and Hughes (1987) realized. Their Middle Period Intermediate Phase (our M2 Bead Horizon) is distinguished by wide, chipped- and ground-edge *Olivella* Saddle beads with tiny perforations, including Type F2a Full Saddles (Bennyhoff and Hughes 1987:130) and Type F2b Round Saddles (Bennyhoff and Hughes 1987:130–131). When actual bead lots from this period are examined, bead templates vary across forms that fit Bennyhoff and Hughes' (1987) descriptions of F2a, F2b, F2c, and F2d beads; all are wide Saddles, but some are diagonally-shaped and others are quite bisymmetrical. These wide *Olivella* Saddles do not occur in southern California (King 1990:130), and represent a divergence between the southern and central California bead exchange networks (see Fig. 1) and bead-making traditions.

Bennyhoff and Hughes (1987) seriated a change from the *Olivella* F2a/F2b "wide" Saddles during their Intermediate Phase to mixed Saddle lots of F2a/F2b Wide Saddles and F3a/F3a2 Modified Saddles (renamed Narrow Saddles by Milliken and Schwitalla [2009:40]) during their subsequent Late Phase of the Middle Period. By "mixed Saddles" Bennyhoff and Hughes (1987:131) did not mean that two bead types were mixed, but that the Saddle bead template was changing to include an array of beads that varied from wide silhouettes to narrow or long silhouettes. They recognized components with mixed Saddles as representative of the Middle Period Late Phase, dated by Scheme B to A.D. 300–500, immediately following the Intermediate Phase, dated to A.D. 100–300.

Our Bead Horizon M2 sample includes 30 dated beads from 17 contexts at six sites (Table 3), ranging in age between cal A.D. 420 and cal A.D. 585. Radiocarbon-dated bead lots demonstrate that mixed Saddle-bead horizons actually appear at two separate times within the Middle Period (Groza 2002); a similar mixture of wide and narrow bead silhouettes marks Bead Horizons M2 and M4. Milliken and Schwitalla (2009:43) now make a distinction between chipped-edge wide Saddles, referred to as Rough Saddles (retaining the F2 type designation), and ground-edge, wide, bisymmetrical saddles, referred to as Smooth Saddles, reclassified as Type F4. Radiocarbon-dated bead lots demonstrate that differences in edge finish have chronological significance (Fig. 3). Type F4 Smooth Saddles (e.g., F4a, F4b, and F4c) and Type F3 Narrow Saddles occur together during Bead Horizon M4, without Rough Saddles. These two types also occur with Rough Saddles during Bead Horizon M2 (Milliken and Schwitalla 2009:49). However, mixed Saddle bead lots which include Type F2 Rough Saddles are only associated with Bead Horizon M2 (Fig. 3). Because of these newly identified differences, artifact assemblages that Bennyhoff (in Elsasser 1978:39, 40) called the Sherwood Facies on San Francisco Bay and the Brazil Facies in the lower Sacramento Valley are a combination of artifact types from these two temporally-separate *Olivella* bead horizons (i.e., bead horizons M2 and M4).

Radiocarbon dating revealed additional differences between Bead Horizon M2 and Bennyhoff and Hughes' (1987) Intermediate Middle Period. Pure lots of G2 Saucer Beads at site ALA-413 (associated with Burials 22, 23, 25, and 34), thought to be the exclusive markers for Bead Horizon M1, date well into Bead Horizon M2, as late as cal A.D. 550 (Table 3). Furthermore, Type F3a Large Narrow-Saddle beads occur throughout the period defined for Bead Horizon M2, dating as early as cal A.D. 451. This suggests that pure, Wide Saddle lots (Bennyhoff and Hughes [1987] Type F2a/F2b) are not the exclusive markers of Bead Horizon M2, as originally proposed.

As a result, we do not distinguish subdivisions of Bead Horizon M2, as do Milliken and Schwitalla (2009:8, 42–43), who identify Middle Period Phase 2A by the exclusive presence of wide Rough Saddle beads, types F2a and F2b.[4] Furthermore, no burial lot in the current sample contains F2a and F2b Rough Saddles in the absence of other bead forms. The earliest dated contexts that include Rough Saddles are Burial 138 at ALA-328 and Burial 01–w10 at ALA-621, dated cal A.D. 358 and cal A.D. 400, respectively. These latter two contexts also include C3 Split Oval and G2 Saucer beads. Dated beads in both of these burial lots are Split Ovals, which were most common in Bead Horizon M1. If the dated beads are heirlooms that remained in circulation for several decades beyond their period of manufacture, it may explain the slightly early date associated with the Rough Saddles in these lots.

Alternatively, if a Middle Period Phase 2A can be distinguished, these bead lots suggest it may have begun by cal A.D. 350, and is characterized by the earliest Rough Saddles (F2a/F2b), but also includes C3 Split Ovals and G2 Saucers. Although pure Rough Saddle bead lots at sites such as ALA-413, CCO-141, CCO-269, and SCL-581 may represent an early sub-phase of Bead Horizon M2, several examples from the current data set indicate that uniform assemblages of the same bead type can occur during any interval in which a particular bead is used. As described above, pure Saucer bead lots are associated with both bead horizons M1 and M2, and pure Sequin bead lots, Type M1a, occur in both the Middle Late Transition and Horizon 1 of the Late Period (see Tables 1 and 2). While we believe that pure lots of Rough Saddles Types F2a and F2b date to Bead Horizon M2, there is currently no radiocarbon evidence to support a sub-phase distinction for this assemblage (cf. Milliken and Schwitalla 2009).

Middle Period, Bead Horizon 3 (M3): cal A.D. 585–750

Dating Scheme D documents a pure Type F3 Narrow Saddle bead horizon immediately following the "mixed" Saddle bead horizon described in the section above. Bennyhoff (1986) argued that central California people made and traded smaller and narrower Saddle beads over time during the Middle Period. Eventually, components appeared with modified Saddle-bead lots that contained no "wide" saddles at all.

Thirteen dates for the "pure" Narrow Saddle horizon, Bead Horizon M3, come from four sites in the San Francisco Bay area (Table 3): single component SFR-114 (Yerba Buena Center); a single component area of multicomponent site ALA-343 (Fremont BART); and multicomponent sites CCO-151 (Sobrante) and SFR-4 (Yerba Buena Island). Bead lots of F3b Small Narrow Saddle beads predominate over bead lots of F3a Large Narrow Saddles. Occasionally, very rectangular Olivella Type M1a Normal Sequins appear as outliers in the saddle populations, their earliest appearance. That these Sequins represent a distinct early occurrence is confirmed by a dated M1a bead from the midden at MEN-428 on the Pacific coast near Fort Bragg, one of the earliest examples of this type (Table 3). A few bead lots also contain easily distinguishable Type G5/6 Irregular Saucers, beads probably traded north from the Monterey Bay area (Bennyhoff and Hughes 1987). The F2c/F2d Rough Saddles associated with SFR-4 Burial 6 may be heirlooms, although SFR-4 Saddle beads were stylistically different from those in any other bead lot and may represent a distinct subtype.

Dating Scheme D dates Bead Horizon M3 to cal A.D. 585-750. This pure Narrow Saddle horizon is followed by a second Middle Period mixed Saddle horizon, discussed below.

Middle Period, Bead Horizon 4 (M4): cal A.D. 750–1020

The presence of a second mixed saddle-bead horizon, not predicted in the Scheme B chronology, is probably the most striking result of our study. As mentioned previously, Bennyhoff (1986) incorrectly presumed that native central Californians gradually changed their *Olivella* bead template through time from shouldered rectangles (types F3a and F3b) to the sharp-cornered rectangles (Class M), marking the first phase of the Late Period. Bennyhoff's type site for his "mixed saddle" only bead horizon was the single-component Sherwood site (CCO-14). Based on his seriation interpretations, Bennyhoff identified the CCO-14 component as the Late Phase of the Middle Period in Scheme B, prior to the Terminal Phase with its Sobrante Facies of "pure modified saddles" (now Narrow Saddles). Under Scheme B, components of this Late Phase of the Middle Period date to A.D. 300–500 (Bennyhoff and Hughes 1987:149).

The seriation problem became evident when two AMS dates on wide, bisymmetric saddles from CCO-14 dated to a later time than beads from any of the pure Narrow Saddle bead lots of our Bead Horizon M3 (Tables 2, 3). AMS results from ALA-329, CCO-538, and SOL-357 confirmed the presence of a "mixed saddle" *Olivella* bead horizon with ear spools and rectangular abalone artifacts more recent than the "pure narrow saddle" *Olivella* bead horizon. Thus, the last two bead horizons of the Middle Period were inverted. Scheme B's "Terminal Phase" of the Middle Period is Bead Horizon M3 under Scheme D, while Scheme B's earlier "Late Phase" of the Middle Period is Bead Horizon M4 under Scheme D. Another distinction, only apparent once the phase reversal was identified, is the absence of Type F2 Rough Saddles in Bead Horizon M4. The mixed Saddle lots that characterize the end of the Middle Period include only edge-finished beads, now identified as Type F4 (i.e., F4a-d), as well as the Narrow Saddles (F3a), typical of the previous interval. Lastly, mixed Saddle bead lots of Bead Horizon M4 also include Small Narrow Saddle Type F3b, a style that occurs during Bead Horizon M3, but is not present in the earlier mixed Saddle lots of Bead Horizon M2.

In the Scheme D sequence, mixed Saddles first came into favor between cal A.D. 420 and cal A.D. 585, in Bead Horizon M2. They are followed by the pure Narrow Saddles and the Sobrante Facies artifact assemblages dated to cal A.D. 585–750, Bead Horizon M3. Finally, mixed Saddles, without chipped-edge variants, came back into use, along with the Sherwood Facies artifact assemblage, in cal A.D. 750–1020, Bead Horizon M4.

Middle/Late Transition Bead Horizon (MLT): cal A.D. 1020–1265

The MLT is characterized by a wider array of *Olivella* bead-types than any other bead horizon (Rosenthal 2011a). Marker types include C2 Split Drilled, C3 Split

Ovals, C7 Split Amorphous, D1a Shelved Punched, D2 Rectangular Punched, G1 Tiny Saucers, and M1a central-perforated Sequins (Bennyhoff and Hughes 1987; Elsasser 1978:42). Scheme B dates the MLT to A.D. 700–900 (Bennyhoff and Hughes 1987:149).

Our 23 MLT *Olivella* bead dates derive from bead lots with varying mixes of the marker types from single component site ALA-42, split-component site YOL-13, and multicomponent site ALA-329 (Table 2). We also list four standard dates obtained from multiple beads recovered in burial lots at site SCL-690; the site report includes numerous supporting charcoal dates for its MLT component (Hylkema 2007).

Our Dating Scheme D results indicate that the MLT occurred between cal A.D. 1020–1265, bringing the MLT into line with the equivalent bead horizons of the Santa Barbara Channel area, phases M5c and L1a (King 1990:28, 237; see Figure 1).

Late Period, Bead Horizon 1 (L1a and L1b): cal A.D. 1265–1520

Bennyhoff and Hughes (1987) seriated Late Period Phase 1 into three narrow sub-phases on the basis of its marker *Olivella* bead types M1a central-perforated Sequins and M2a end-perforated Pendants. They argued that central-perforated beads alone marked Phase L1a, mixed lots marked Phase L1b, and pure end-perforated lots marked Phase L1c; they also associated *Olivella* type K1 Callus Cups with phases L1b and L1c.

Our dates for Bead Horizon L1 derive from five K1 Callus cups, five M1a central-perforated Sequins, and seven M2a end-perforated Pendants. They come from four sites, including multicomponent sites ALA-329, SCL-38, CCO-235, and YOL-187. We also list one standard radiocarbon date obtained from multiple A1 spire-lopped beads recovered in a burial lot (Burial 24) at multicomponent site SCL-690. Burial 24 is also associated with G1 Tiny Saucers that appear in Middle and Late Period horizons; the single Type D1 Punched bead is intrusive in this context.

The 18 *Olivella* bead dates we assign to Horizon L1 cluster in the temporal order predicted by Scheme B (Table 1). However, our data indicate that the horizon began at cal A.D. 1265, some 365 years later than predicted by Scheme B. The range of AMS dates obtained from burial lots containing both M1a and M2a beads does not support a temporal distinction between these types, as the oldest dated context containing M2a Pendants is just 10 years younger than the oldest M1a Sequin lot. However, while we cannot justify the tripartite division of Bennyhoff and Hughes (1987), two sub-phases are apparent during Late Period Bead Horizon 1. The presence of K1 Cupped beads beginning about cal A.D. 1400 allows the second part of this period (Late Period Bead Horizon 1b, cal A.D. 1390–1520) to be distinguished from the first part (Late Period Bead Horizon 1a, cal A.D. 1265–1390). Like earlier periods, uniform lots of a single bead type do not appear to characterize discrete subphases. Pure lots of M1a Rectangles occur in both the Middle-Late Transition and Late Period Bead Horizon 1a, while pure lots of M2 Pendants occur in both Late Period Bead Horizon 1a and 1b.

Late Period, Bead Horizon 2 (L2): cal A.D. 1520–1770

The Late Period Bead Horizon 2 marker *Olivella* bead is the Class E Lipped series. Bennyhoff and Hughes (1987:127–129) seriated Class E form changes through time, from small Type E1 callus beads without much regular shell wall, through Type E2 with callus and large amounts of shell wall, to Type E3 half-shell beads that came into use in the Early Mission Period. Our key site for Bead Horizon L2 is multicomponent mound ALA-329, where four Class E bead dates derive from burials also containing large numbers of *Olivella* Class A spire-lopped beads, but little else (Table 1). All four burials were from the upper component of the mound. Another tested Class E bead came from a salvage recovery at ALA-342 (also cited as site ALA-573), not far from ALA-329 on the east shore of San Francisco Bay (Fig. 2).

Two other *Olivella* Class E beads dated for this study came from midden at YOL-197, a single component site containing large numbers of clam-shell disk beads, several Class E beads, and some type M3 and M4 Elongate and Trapezoid Pendant beads (this lower Sacramento Valley site was originally identified as SOL-197; Milliken and Shapiro [2006]). The final Class E bead dated for this study came from further north in the Sacramento Valley at COL-11, a site which also contained large numbers of clam-shell disk beads and some magnesite beads (White 2003).

Although we placed our Scheme D bracket for the beginning of the L2 Bead Horizon at cal A.D. 1520,

Table 1 shows a nearly 100-year gap between our youngest L1 bead horizon date (cal A.D. 1488) and our oldest L2 bead horizon date (cal A.D. 1570). As a result, the division between these periods needs additional refinement. However, it is possible that the shift from L1 to L2 bead horizons was marked by a relatively long period without any bead trade. Our eight *Olivella* Class E beads do not line up through time in the order predicted by Bennyhoff and Hughes (1987), from the small Type E1 to the large Type E3 (Table 1).

Historic/Mission Period: cal A.D. 1770–1835

The Mission Period in California commenced with the establishment of the first mission in San Diego in 1769, followed by the settlement of Monterey in 1770. Our samples derive from the Early Mission Period, prior to the evacuation of the last Chumash villagers from the Santa Barbara Channel Islands in 1816. We have six *Olivella* bead dates from the Early Mission context (Table 1). Four of the beads are from key site YOL-69, a single component site that contained mixes of clam-shell disk beads and tiny glass beads, with *Olivella* Class H Needle-drilled disks and abalone pink epidermis disks. Class H beads are thought to have been traded north from the Santa Barbara Channel (Eerkens et al. 2005; Wiberg 2005). Our Scheme D Early Mission Period bead assemblage matches that of Bennyhoff and Hughes' (1987) Scheme B in both composition and temporal duration.

Two Class H Needle-drilled disks came from the 1781–1818 Mission Santa Clara cemetery, SCL-30 (Hylkema 1995). Bead size, edge finish, and calibrated dates match the YOL-69 Class H beads and Class H beads in the Santa Barbara Channel region (see King 1990, 1995). In addition to the two Class H beads recovered during subsurface testing at SCL-30, several other Class H beads, Majolica pottery, and a Desert Side-Notched arrow point were found.

DISCUSSION

Presented here is a refined prehistoric chronology for late Holocene central California that replaces Bennyhoff and Hughes' (1987) Scheme B. The new chronology, Scheme D, is based upon a large sample of AMS dates from temporally-diagnostic artifacts made from a single material, the shell of the purple Olive snail (*Olivella* spp.). Scheme D's bead style-horizons were determined by calibration using ΔR 260 ± 35, a correction factor developed by cross-reference to historic beads of the 1770–1816 era. Because ocean temperature gradients have changed over the last several thousand years, it is likely that differences in carbonate upwelling and shifts in ΔR through time (Culleton et al. 2006; Ingram 1998; Ingram and Southon 1996) affect the resolution of the proposed chronology. This is particularly true for bead styles made from shells that grew in the warmer waters south of Point Conception, versus those that grew on the central and northern California coast where water temperatures are cooler and upwelling is more substantial. There are also likely to be differences in ΔR between shells that grew in open coastal waters and those that grew in estuaries or enclosed bays where ^{14}C-depleted freshwater concentrations are higher (e.g., Ingram and Southon 1996). Additional research on the geographic origins of individual beads and bead styles (e.g., Eerkens et al. 2005, 2009, 2010), in combination with local reservoir corrections, will be necessary to address these potential problems. At this point, however, current evidence supports the timing of the shell-bead horizon shifts associated with Scheme D. The known manufacturing date of the Mission Period Class H Needle-drilled disk beads correlates with dates from the most recent bead horizons described here. Likewise, AMS dates derived from Early Period *Olivella* Class L Thick Rectangles closely match a large number of calibrated terrestrial charcoal dates from the same strata at ALA-307.

As Figure 1 shows, Dating Scheme D does not alter Dating Scheme B in the Early Period and Early/Middle Transition, but departs from it at the first bead horizon of the Middle Period (M1; the *Olivella* Saucer bead horizon) by lengthening that horizon from 300 to 620 years. From then forward, Scheme D bead horizons are shorter than suggested by Scheme B. Our Dating Scheme D solves the problem of the juxtaposition of Late Middle and MLT artifacts by documenting two mixed Saddle bead horizons, one leading directly into the MLT. Furthermore, it largely reconciles central California bead horizons with King's 1990 chronology for southern California (see Fig. 1) and key portions of Jones's (1995) central California coast chronology. Based on research since 1990, King (personal communication 2011) has revised the timing of Phase M5c (i.e., A.D. 1100–1200 or A.D. 1150–1250), bringing it more in line with the age of the MLT, as defined here (i.e., A.D. 1020–1265).

Perhaps the most surprising aspect of the short Scheme D chronology is its implications for the timing of the acceptance of the bow and arrow, first documented in the lower Sacramento Valley in the MLT component at YOL-13, and now dated to post-cal A.D. 1020. The earliest arrow point in the current sample is from MLT Burial 239 at ALA-329, dated to cal A.D. 1206, while the only dart point is also associated with a MLT burial (Burial 55) at ALA-42, dated to cal A.D. 1156. The presence of dart points and the absence of arrow points at MLT site ALA-42 in the Livermore Valley (Tannam et al. 1992; Wiberg 1997), and in MLT components at SCL-690 in the Santa Clara Valley (Hylkema 2007), may suggest that this technology was adopted even later south and west of the Sacramento-San Joaquin Delta and south of the San Francisco Bay, sometime around cal A.D. 1200. This is consistent with Bennyhoff's (in Elsasser 1978) seriation of burial lots from key sites in central California, which indicates that arrow points first appear during Phase 1 of the Late Period at SFR-7 on San Francisco Bay (i.e., Bayshore Facies; Bennyhoff in Elsasser 1978:Figure 5), but are older in the western Delta region, where they co-occur with dart points at CCO-150 during the MLT (i.e., Veale Facies; Bennyhoff in Elsasser 1978:Figure 6). On the eastern side of the Delta, Bennyhoff indicates that arrow points do not occur until Early Phase 1 (Eichenberger Phase; Bennyhoff 1994). Based on our results, the bow and arrow was not widely used in the lowlands of central California until 300 to 400 years or more after this technology was adopted in the Great Basin and Sierra Nevada to the east (e.g., Bettinger and Taylor 1974; Rosenthal 2011b). Dating Scheme D improves our ability to understand the temporal dynamics of that introduction. Further refinements of the central California bead sequence will help us to distinguish gradual from punctuated culture change, internal from external sources of technological and social innovation, and allow for more precise correlations between environmental and cultural changes across much of western North America where Pacific coast shell beads are found.

NOTES

[1] We use the term 'style horizon' in the sense of Willey and Phillips' (1958:32) horizon style: "… a horizon style as the name implies, occupies a great deal of space but very little time. It may be roughly defined as a specialized cultural continuum represented by the wide distribution of a recognizable art style. On the assumption of historical uniqueness of stylistic pattern, coupled with the further assumption that styles normally change with considerable rapidity, the temporal dimension is theoretically reduced to a point where the horizon style becomes useful in equating phases or larger units of culture in time that were widely separated in space."

[2] A third dating scheme, proposed by Elsasser (1978:41) and subsequently labeled Dating Scheme C, was a compromise that split the difference between Heizer's Dating Scheme A and the initial manuscript version of Dating Scheme B (Bennyhoff and Hughes 1987:147). The Dating Scheme D chronology presented here is slightly different than previously published versions (Groza 2002; Hughes and Milliken 2007; Milliken et al. 2007; Milliken and Schwitalla 2009), which were based on different interpretations of the AMS data.

[3] Bead styles listed in Tables 1–4 follow Bennyhoff and Hughes (1987), with revisions by Milliken and Schwitalla (2009). For purposes of complete reporting, we have listed class, type, subtype, and variant information where applicable, for each sampled bead (e.g., E2a3 = Thick Lipped [E2-class], Full Lipped [a-Type], Shelf Edge [3-variant]). Our analysis, however, ignores variant classifications, relying strictly on primary class (e.g., E2 Lipped), type, and subtype designations (see Bennyhoff and Hughes 1987:88) which are shown here to have chronological utility. While it may ultimately be demonstrated that some subtype and variant distinctions originally proposed by Bennyhoff and Hughes (1987) provide additional chronological resolution, reflect separate centers of manufacturing, or reveal distinct geographic distributions, these remain undemonstrated. For complete descriptions of each bead class, type, subtype, and variant see Bennyhoff and Hughes (1987) and Milliken and Schwitalla (2009).

[4] No dates for the Milliken and Schwitalla (2009) iteration of Scheme D are presented in their publication because Table 5 was inadvertently left out. Their missing Table 5 presented the "modified CCTS [central California taxonomic system] temporal bracketing" of bead horizons as compared with other dating schemes. As described by Milliken and Schwitalla (2009:8), Table 5 was based on "Groza's (2002) direct dates, but with a compromise ΔR of 290±35, rather than her original value of 225±35." Their Table 1 is a modified dating scheme, originally presented in Groza (2002:95), that was calibrated with ΔR 225±35, and the temporal brackets therefore are not the same as those under discussion in the Milliken and Schwitalla (2009) publication.

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Beads and Ornaments from San Diego: Evidence for Exchange Networks in Southern California and the American Southwest

LYNN H. GAMBLE
Department of Anthropology
University of California, Santa Barbara
Santa Barbara, CA 93106

CHESTER D. KING
Topanga Anthropological Consultants
P.O. Box 826
Topanga, CA 90290

The study of shell artifacts provides important information concerning economic and political ties between Native American groups over time. California Indian groups participated in wide-ranging exchange networks for thousands of years that involved the trading of shell beads and ornaments. Shell beads and ornaments from the San Diego region provide chronological information concerning numerous sites; more importantly, they also contribute to our knowledge of economic and political networks that included the greater Southwest and the Pacific Coast. Our examination of over 23 assemblages from San Diego County documents the frequent use of beads made in both the Santa Barbara Channel region and in the Southwest, as well as the use of locally-produced shell beads.

SHELL BEADS HAVE BEEN USED IN CALIFORNIA FOR over 10,000 years, and they are found throughout western North America—in the Great Basin, in northern and southern California, and in the Southwest (Bennyhoff and Hughes 1987; Erlandson et al. 2005; Fitzgerald et al. 2005; Gamble 2011; King 1990a). Many disc beads, such as *Olivella biplicata* disc beads, *Olivella biplicata* rough disc beads, *Haliotis rufescens* epidermis disc beads, *Olivella biplicata* lipped beads, *Olivella biplicata* cupped beads, and *Mytilus californianus* disc beads were produced in the Santa Barbara Channel region (Eerkens 2005 et al.; Farmer and La Rose 2009; Gamble and Zepeda 2002; King 1990a; King and Gamble 2008; Vellanoweth 2001). Other beads were made from shells (such as *Olivella dama*) that are found in the Gulf of California.

In this paper, we focus on the bead types found in San Diego County that we have analyzed over the past ten years. Relatively few publications on beads from this region have appeared in peer-reviewed venues (Gamble and Zepeda 2002; King 1990a); a greater number of reports have appeared in the gray literature, conference proceedings, or in dissertations (Carrico and Day 1981; Carrico and Taylor 1983; Gamble 2008; Gamble and King 2004; Gibson 2000a, 2000b; King 2004; King and Gamble 2008; McDonald 1992; Rosen 1994; Zepeda 1999). Such reports are not readily available to a wide audience of scholars, and discussions are often limited to a consideration of beads from one or only a few sites. A primary goal of this paper is to highlight the significance of the trade and conveyance of beads in the San Diego region. The people that lived in the area participated in exchange and political networks that used beads made from shells obtained from the Gulf of California, from the Santa Barbara Channel region, and from other coastal locales in southern California. These networks extended throughout the Southwest, California, and the Great Basin.

ETHNOGRAPHIC BACKGROUND—THE KUMEYAAY AND THE CAHUILLA

The Kumeyaay, the Cahuilla, and the Luiseño lived in the San Diego region at the time of European contact,

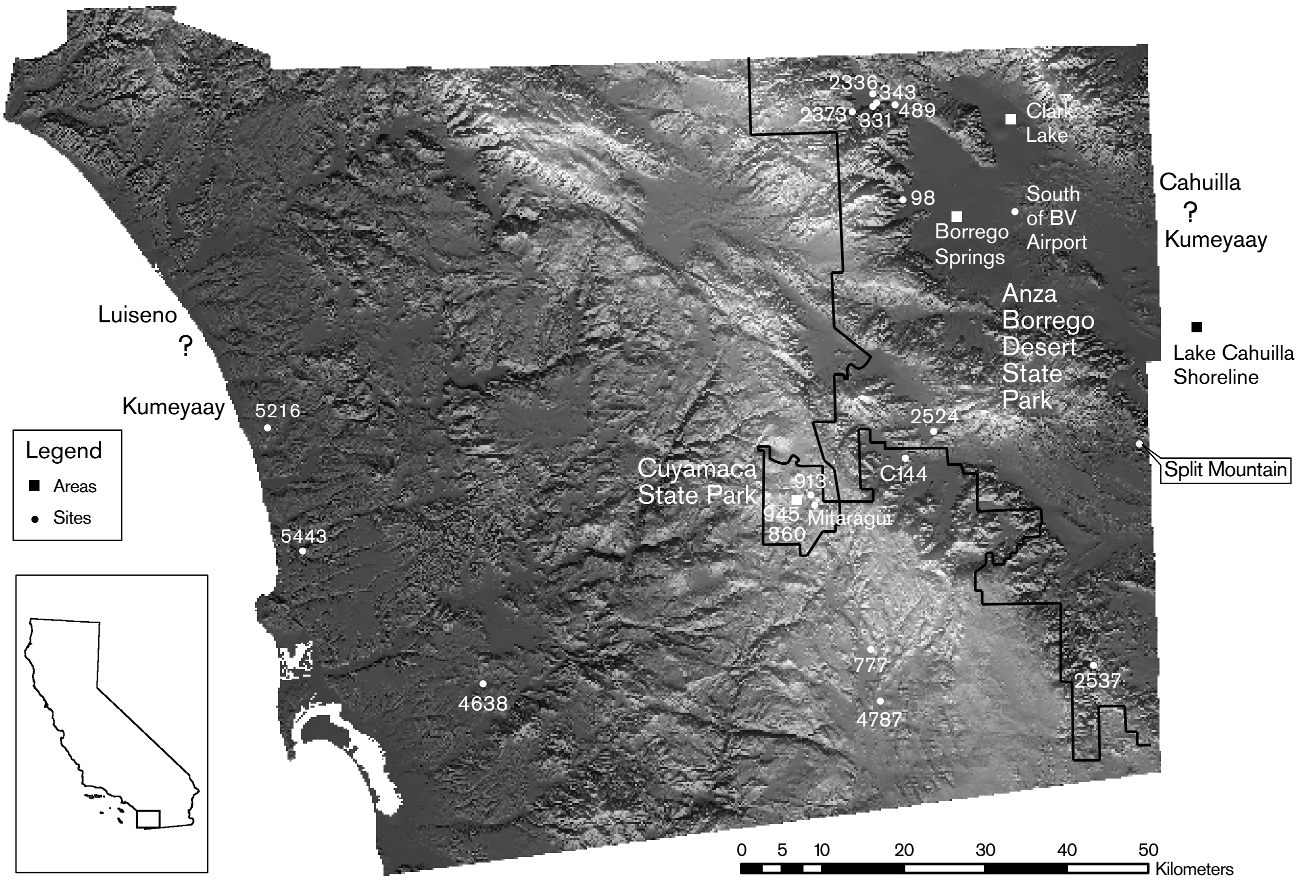

Figure1. Locations of San Diego County sites discussed.

and still do today. Most of the collections that were analyzed for this project are from within the region ethnographically occupied by the Kumeyaay (Fig. 1); therefore, this background discussion focuses on the Kumeyaay and (to a lesser extent) on the Cahuilla. None of the collections we examined are from the Luiseño area. Both the Kumeyaay and the Cahuilla relied primarily on hunting and gathering, although Lawton and Bean (1968) suggest that marginal agriculture existed among the Cahuilla. The Imperial Valley Kumeyaay historically planted maize, beans, teparies, gourds, pumpkins, and melons in the floodplains of the Colorado River.

The Kumeyaay recognized territorial bands, each of which had a central primary village with outlier homesteads (Shipek 1982:297). It is believed that these bands moved seasonally to access food resources (Shipek 1982:297, 1987:7). The leaders or chiefs of the bands, the *kwaapaay*, generally inherited their positions through the male line (Luomala 1978; Shipek 1982:297–298); they advised the band on economic matters, resolved disputes, and oversaw ceremonies. In payment for their services, the *kwaapaay* received food and valuables (Shipek 1987:7–8). The *kwaapaay* and other Kumeyaay officials, including shamans and other religious specialists, had more decision-making powers, more land resources, and more personal valuables (such as shell beads) than other band members (Shipek 1982:299–300).

The Cahuilla were organized into clans composed of three to ten lineages (Bean 1978) that participated in ritual performances, large communal subsistence events, and defensive activities. The *néts*, or the lineage leaders, usually inherited their positions through the male line and were similar to the Kumeyaay *kwaapaay* in their duties. Other important officials included the *páxa'*, the ceremonial leader, and shamans, all of whom were elites in Cahuilla society. The *páxa'* oversaw the ceremonial performers and also insured that people attending ritual events followed the proper protocol in their contributions of food and gifts.

Both the Kumeyaay and Cahuilla cremated the dead during the Late Period (May 1974; True 1970). Beads were frequently associated with the cremated remains, which often were placed in pottery urns (Gamble and Zepeda 2002; King 1995). One of the most important ceremonies among the Cahuilla was the *núkil*, the annual mourning ceremony. Both the Cahuilla and the Kumeyaay practiced a clothes-burning ceremony after the death of an individual. Among the Kumeyaay, all of the belongings of the dead were burned to insure that the spirit did not return for them (Davis 1921:95–97; Heye 1919:14–16; Luomala 1978:603).

Shell beads and ornaments in the San Diego region served as ornamentation that undoubtedly signaled one's rank in society. They also were a form of currency, at least among the Cahuilla (Bean 1978:582), and figured prominently in ceremonies, especially mortuary rituals (Gamble and Zepeda 2002; King 1995). Eastern Kumeyaay or Kamia women reportedly wore clamshell beads or "blue beads" made from Gulf of California species, and men wore strings of small, white clamshell discs or shells in their nasal septums (Gifford 1931:37). Gifford (1931:37) also noted that clamshell beads were traded to the Kamia by the Cocopa.

Among the Cahuilla, the clan chief of each ceremonial group kept several strands of shell beads, usually in association with the clan's sacred bundle (Strong 1929:94–96). One class of shell money was called *witcu* by the Palm Springs Cahuilla. A string of *witcu* was measured from a person's forehead to the ground, then multiplied by four, and was worth 50 cents. One of these was given by the clan chief to each invited clan leader at the end of an image-burning ceremony. This ceremony usually occurred about a year after death. A similar string was returned by each clan head when their clan had a ceremony; as a result, *witcu* were involved in a perpetual series of exchanges. There was also another type of shell money that was called *napanaa* by the Palm Springs Cahuilla. These strings of beads were measured by wrapping the string around the wrist and fingers, and they were sent by all leaders to a clan chief after a death in the clan (Strong 1929: 95); they were worth 20 cents. Alejo Potencio told William Duncan Strong that the beads were traded to the Cahuilla by the Serrano, who received them from the Gabrieleño (Tongva) of San Fernando Mission. In his accounts, the use and distribution of shell beads took place in the context of ceremonies (Strong 1929:94–96).

THE SAN DIEGO COLLECTIONS: THE SAMPLE

Many of the beads described in this paper are from collections curated by California State Parks, while others come from collections in the Collections Management Program at San Diego State University. Some of the collections were donated to State Parks by avocationals and have limited provenience information. Site descriptions vary, because more information is known about some sites and collections than others. In this section, we provide a brief description of each site or accession involving the bead assemblages, organized according to their general regional provenience. The collections that have known provenience information are mapped in Figure 1. The authors, with the help of Scott Justus, Kara Johnson, and other students from San Diego State University (SDSU), analyzed over 2,000 shell beads, shell ornaments, and glass beads.

San Diego Sites West of Cuyamaca Rancho State Park and Anza Borrego

CA-SDI-5216, Woodward. The Woodward site is situated near the coast just east of Escondido and the San Elijo Lagoon (Fig. 1), near a seasonal drainage, and at an elevation of about 100 feet above sea level (Gamble 2008). The site rests on land oriented between two Mexican land grants of the early 1840s; this includes Rancho Las Encinitas and Rancho San Dieguito (now Rancho Santa Fe). The site was first investigated in 1966 and then later in the 1970s. No human remains were identified at the site during the excavations; however, after the faunal remains were examined in 2003, nine calcined bones were discovered, eight of which were human and one probably human. Twenty-four worked shell artifacts were recovered from the Woodward site. An unworked *Olivella biplicata* shell was also found. In addition to the shell beads in Table 1, one *Olivella* sp. oblique spire-removed bead is in this collection, as well as two *Laevicardium elatum* shells, an *Aequipecten circularis* shell, and a cowry shell (*Cypraea spadica*), all of which were possibly worked.

CA-SDI-4638, Bancroft Ranch. The Bancroft Ranch site is situated near Spring Valley, California at an

Table 1

DISTRIBUTION OF COMMON BEAD TYPES BY SITE IN SAN DIEGO COUNTY

	SDI-5216	SDI-4638	SDI-777	SDI-4787	SDI-913	SDI-860	RC 618-X-311	RC 618-X-310	RC 618-X-189	A 622-20-42	Borrego Spr	S of Airport	Clark Lake	625-61-3	622-10-1F & G	Mason V	625-62-2	Harry Ross	Split Mountain	SDI-343	SDI-489	SDI-98	Lake Cahuilla	TOTAL
O. biplicata Rough Disc		1				12	299	116		10	1			1		13			10	3	1	106		**573**
O. biplicata Cupped		4				5		1		66	11	9				1		7			1			**105**
O. biplicata Full Lipped		10		1	69	2					2							12						**96**
O. biplicata Thin Lipped		2				2							22	16		3								**45**
O. biplicata Wall Discs, small										1	4													**5**
O. biplicata Wall Discs, large		13									16					2	2	67						**100**
O. biplicata spire rem	20	57	1	5	26	14			7		27	2				13		10				1	3	**18**
O. biplicata Barrel		1	1																					**2**
O. sp. Barrel				7																				**7**
O. biplicata Cyl.		5																						**5**
Tivela stultorum Disc Beads	2																							**2**
Haliotis rufescens Disc Beads						1	5															1		**7**
Mytilus californicus Disc Beads											1		1			1	2	1						**6**
Haliotis sp. Nacre Disc Beads																		2						**2**
Haliotis sp. Orns.		4	1			1																	2	**8**
Laevicardium sp. Pendant/Shaped				1							1					2								**4**
O. dama Spire Rem	1	26		24	20	6			59		31				196	74		27	6	5			4	**479**
O. dama Barrel		9			16	6		1	183	1	6				33	1	2	10	2	1				**271**
Oliva undatella Spire Removed											2							14						**16**
Glycemeris sp. Arm Bands			2																					**2**
Conus sp. Spire Removed Beads											9													**9**
Conus sp. Cap									4		1				1									**6**
Glass Beads		10			5	5	2				2					1			6	11			12	**54**
TOTAL	**23**	**142**	**5**	**38**	**136**	**54**	**306**	**118**	**253**	**78**	**114**	**11**	**23**	**17**	**230**	**111**	**6**	**150**	**24**	**20**	**2**	**108**	**21**	**1990**

(*O.* = *Olivella*)

elevation of 420 feet above sea level (Fig. 1). The site has been identified as that of a Kumeyaay village called *Meti* (*Neti*) (Carrico and Ainsworth 1974:4). By the 1830s, the village had been abandoned and the valley was used for grazing (San Diego Historical Society 2004). The historian Hubert Bancroft purchased the site in 1885. The village was occupied during the Late and historic periods, and has a significant permanent spring (Gamble 2008). Between 1775 and 1809, 29 people were baptized from the village (Carrico and Ainsworth 1974:5). Less than one month after the first baptisms occurred in 1775, the inhabitants of this and other historic villages burned the San Diego mission and killed Father Luis Jayme and two other Spaniards. We are not sure if any Kumeyaay lived at the site after 1809. Excavations under the auspices of Dr. Paul Ezell of S.D.S.U. began at Bancroft Ranch in 1969 and continued until 1974. Diane Barbolla from Mesa College conducted excavations in 1975, followed by Alana Cordy-Collins with the University of San Diego (U.S.D.) and the University of California at San Diego (U.C.S.D.) in the early 1980s (Gamble 2008).

During the 2000/2001 academic year, 41 human remains from nine units at Bancroft Ranch were repatriated to the Kumeyaay. Other repatriated objects included a cremation platform and associated funerary objects consisting of miscellaneous animal bones. Since that repatriation, 717 human remains or possible human remains were found as a result of examining the faunal remains. Associated funerary objects included a broken olla and 14 burned shell beads. In addition to the 141 beads and ornaments reported in Table 1, a possibly drilled *Argopecten* sp. shell and 32 *Olivella biplicata* whole shells were found at the site (King 2004). The entire chipped stone collection, which was massive, was searched for evidence of any types of small drills that would be suitable for the drilling of holes in disc beads. No bead drills or any type of small drills were found.

CA-SDI-777, Cottonwood. The Cottonwood site is situated east of the Bancroft Ranch site and just southeast of Pine Valley on Interstate 8 (Fig. 1) within traditional Kumeyaay territory. The site was excavated in 1967 and 1968 by U.C.L.A., and then again in 1971 by S.D.S.U. under the direction of Paul Ezell and Ron May, who excavated 51 test units and nine trenches as part of a salvage project (Gamble 2008). A house floor and two cremation hearths were found at the site. Approximately 1,750 fragments of cremated human or possible human remains were found in the faunal remains between 2002 and 2004. Seven worked shell artifacts were found at Cottonwood, five of which are reported in Table 1. The additional shell artifacts were a *Conus californicus* spire bead and an eroded *Olivella* sp. barrel bead. The *Haliotis* sp. ornament had two holes drilled near its center like a button; however, no historic era artifacts were found at the site.

CA-SDI-4787, Buckman Springs. The Buckman Springs site is also known as the historic Kumeyaay village site of *Wikalokal* (which means 'singing rocks' in Tipai). It is situated just south of the Cottonwood site on Interstate 8. It is believed that the site was occupied between about 400 B.C. and A.D. 1890 (Hildebrand and Hagstrum 1995:109). S.D.S.U. excavated over 200 2 m. x 2 m. units (approximately 138.4 cubic meters) at the site in 1971 as part of a Caltrans project (Gamble 2008). Approximately 124 human and possible human remains were found among the faunal remains at the site, in addition to one individual that was identified in the field with 264 associated funerary objects. Forty beads and ornaments were found at the site. The only ones not reported in Table 1 are an *Olivella biplicata* cap bead and an *Olivella* sp. spire-removed bead. Seven of the beads were burned, including three *Olivella dama* spire-removed beads, one *Olivella biplicata* spire-removed bead, and three *Olivella* sp. barrel beads.

Collections from Cuyamaca Rancho State Park

Except for two collections from CA-SDI-860, the Dripping Springs site, and one from CA-SDI-945, the authors have only limited information on the sites or collections from Cuyamaca Rancho State Park that were examined as part of a State Park contract (Gamble and King 2004; King 2004). The beads from the other collections at the Park are from several State Parks accession numbers (see Table 1). Two accessions are from Arrowmakers Ridge (CA-SDI-913), Accessions 618-1-220 and 618-1-221. Three additional accessions curated at the Dyar House at Cuyamaca Rancho State Park were examined for State Parks, Accessions 618-X-311, 618-X-310, and 618-X-189. It is believed that the beads from these collections are from the vicinity of Cuyamaca Rancho State Park. All of the sites at Cuyamaca Rancho State Park are in Kumeyaay territory. The Cedar fire in the fall of 2003 burned the Dyar House, but the beads were preserved because they were still under analysis.

CA-SDI-913, Arrowmaker Ridge. The Arrowmaker Ridge site is on West Mesa at Cuyamaca Rancho State Park at an elevation of approximately 4,560 feet above sea level. According to Breck Parkman's (1983) article on the site, over 5,000 projectile points and 50 steatite arrowshaft straighteners were found at the site, hence its name of Arrowmaker. It is believed that this site was possibly the Kumeyaay historic village of *Pilcha*. The site was excavated by the San Diego Museum of

Man (S.D.M.O.M.) under the direction of Malcolm Rogers between 1934 and 1939; Rogers encountered a number of cremations at the site. In 1949 the site was excavated again by the S.D.M.O.M., but this time under the direction of M. F. Farmer. The site was excavated the following year by the S.D.M.O.M. and the San Diego Anthropological Society under the auspices of M. V. Harding. The beads analyzed in this study are from State Parks Accessions W-220, 221 and 618-701-614. The latter accession is associated with the collector Patrick Shea and consists of five glass beads. Other than the 131 shell and five glass beads reported in Table 1 from Arrowmakers Ridge, there were one *Glycymeris* sp. disc bead, one *Fisurella volcano* limpet callus ring ornament, and five shaped *Laevicardium* sp. shells from the site.

CA-SDI-945, Hual-cui-cuish. CA-SDI-945 is situated at the eastern base of Middle Peak in Cuyamaca Rancho State Park, at the edge of a meadow and pine-oak woodland, and at an elevation of about 4,800 feet. The site is a Late Period site associated with the historic village of *Hual-cui-cuish*. Lynn Gamble excavated at the site in 1999, 2000, and 2001 with a field class from S.D.S.U. Two shell beads, an *Olivella biplicata* full-lipped bead and an *Olivella biplicata* cupped bead, and two shell bead fragments were recovered. The two partial beads are too fragmentary to be identified by type, but are made from *Olivella* sp. shells. This site was not included in Table 1 because there were so few beads in the collection.

CA-SDI-860, Dripping Springs. The Dripping Springs site is situated on an open grassy area with a southeastern exposure; it is surrounded by oak woodland (True 1970:11) and lies at an elevation of about 4,880 feet in Cuyamaca Rancho State Park. Bedrock milling features are common on the granitic outcroppings at the site. True conducted test excavations at the site in the 1970s and identified it as the type-site for the Cuyamaca region. It is one of the largest, if not the largest, sites in Cuyamaca Rancho State Park. True recovered a wide range of artifacts and faunal remains from the site, including historic artifacts, ceramics, chipped stone tools and points, groundstone, shell, and bone. He excavated in both the cemetery and the living areas; most of the remains and associated funerary objects from the cemetery were reburied many years ago before NAGPRA had been enacted. Gamble completed a detailed survey of the site in 1999 and conducted limited excavations (less then two cubic meters) in 2008. The beads reported here are from the excavations undertaken by True and Gamble. Other than the 54 beads in Table 1, a pendant made from *Pecten* sp. shell and a *Saxidomus* sp. bead blank were found at the site.

South Mituragui. Four glass beads collected by Patrick Shea are associated with this site, which is in Green Valley.

Accession 618-X-311. Although there is no clear provenience information about this accession, it is believed that the collection is from Cuyamaca Rancho State Park. All the 306 beads from this accession are reported in Table 1.

Accession 618-X-310. This collection also lacks specific provenience information, but it is probably from Cuyamaca Rancho State Park. The 118 shell beads from this collection are included in Table 1.

Accession 618-X-189. As was true regarding the two previous accessions, this collection lacks provenience information, but it is probably from the Park. All of the 253 beads from this collection are reported in Table 1.

Accession 618-701-611. This accession also lacks detailed provenience information, but it is from Cuyamaca Rancho State Park. There is only one bead from this collection, a *Mytilus californianus* disc bead.

San Diego Sites in Anza Borrego Desert State Park

The beads in this section are from numerous locations in Anza Borrego Desert State Park, and they were analyzed by us to help California State Parks determine what items might be subject to NAGPRA. They include beads collected by Bill Seidel during excavation at SDI-98 and during surveys of other sites in the northwestern portion of Anza Borrego, beads collected by Paul Ezell at Santa Catarina Springs, and beads collected by avocationals who donated them to the Park. Many beads were collected from cremation burials or in the vicinity of cremation burials.

Accession 622-20-42. This collection lacks specific provenience information, but it is probably from Anza Borrego Desert State Park. Seventy-eight beads from this accession are included in Table 1. One additional bead, a possible cupped bead, is also from this accession.

Borrego Springs. The collections from Borrego Springs that we examined include Accessions 625-60-302, 625-60-303 a and b, and 625-60-304. All we know about them is that the artifacts were collected in the vicinity of Borrego Springs/Borrego Sink by Duvall. In addition to the 115 beads reported in Table 1, three *Olivella biplicata* spire-removed fragments were found at the site along with over 20 *Olivella* sp. fragments.

South of Airport. Eleven beads were collected south of the airport in Borrego Springs (Table 1).

Clark Lake. Clark Lake is an old, dry lakebed northeast of Borrego Springs and to the east of Coyote Mountain, in an area traditionally occupied by the Cahuilla. Twenty-three beads collected by Ben McCown are associated with this collection (Table 1).

Accession 625-61-3. This collection is from the D.C. Barbee accession from Anza Borrego. Sixteen thin-lipped beads (Table 1), some of which are fragmentary, are from this accession, as is one *Olivella biplicata* rough disc bead.

Accessions 622-10-1F and 1G. This collection consists of two or three strings of burned beads collected by Jane Thorness in a dune site in Anza Borrego that contained a metate, a mano, and a small olla that had been repaired. All 230 beads are reported in Table 1.

Mason Valley. The beads from Mason Valley in Accession 622-4-23 were collected by Lloyd Findley. In addition to the 111 beads reported in Table 1, there was one pendant made from *Trachycardium quadragenarium* in the collection. Mason Valley is near the Great Southern Overland Stage Route of 1849. The historic site of *Matenoc* (C-144) is situated in Mason Valley (*Matenoc* is the most common spelling of the site in the mission records; it is also know as *Amat Inuk*, *Net Nook*, and *Matnook*) (Gamble and Zepeda 2002; Zepeda 1999); the beads and pendant in Accession 622-4-23 may be from the same site.

Accession 625-62-2. There are six beads associated with this accession (Table 1), none of which has any provenience information, other than the fact that all are probably from the Anza Borrego area and were collected by Ben McCown.

Accessions 622-7-85, 625-66-2, and 625-66-3. These accessions are attributable to Harry D. Ross, who collected them in the Anza Borrego area. Otherwise, little is known about their provenience. All 150 beads are reported in Table 1.

Accession 622-1-69a. Two burned beads were collected by Frizzel from the Anza Borrego area. One was a full-lipped bead and the other was an *Oliva undatella* spire-removed bead. These are not included in Table 1.

Hendrickson House. This consists of a collection of one bead, a *Haliotis rufescens* epidermis disc bead. It is not reported in Table 1.

Split Mountain. The beads from Accessions 622-21-1a and 1b were collected by Wright and Carlsberg in an area near Split Mountain that is traditional Kumeyaay territory. All the beads from this collection are included in Table 1.

CA-SDI-343. The beads from this site, which is in the Coyote Canyon area, were collected by William Seidel in the 1970s. Twenty-two of the 24 beads from this collection are reported in Table 1. The two additional ones are an *Olivella biplicata* medium-wall disc bead and a possible button fragment made of glass.

CA-SDI-489. William Seidel also worked at this site, which is near Coyote Canyon. Only two beads are in this collection (Table 1).

CA-SDI-98. This is the largest collection of beads (n=108, Table 1) from Seidel's investigations. The site is situated in the Borrego Palm Canyon region.

CA-SDI-2600. This site is situated northwest of the Borrego Sink and had one ornament, a *Lottia limatula* limpet ring ornament.

Lake Cahuilla. The beads from an old shoreline of Lake Cahuilla in Imperial County were collected by Ada Jackson. In addition to the 21 beads reported in Table 1, there are two pendants, one made from *Rangia mendica* shell, and the other made from *Trachycardium quadragenarium* shell.

BEAD AND ORNAMENT TYPES

Research involving the archaeology of central and southern California has resulted in the recognition of a sequence of at least fifteen periods preceding Cabrillo's 1542 voyage and two time periods succeeding it, all prior to the establishment of the missions. These chronological periods are delineated on the basis of changes in ornaments, beads, and other artifacts (King 1990a). Figure 2 indicates the approximate duration of each recognized time period. Shell ornaments are usually larger than shell beads and often lack a small central hole.

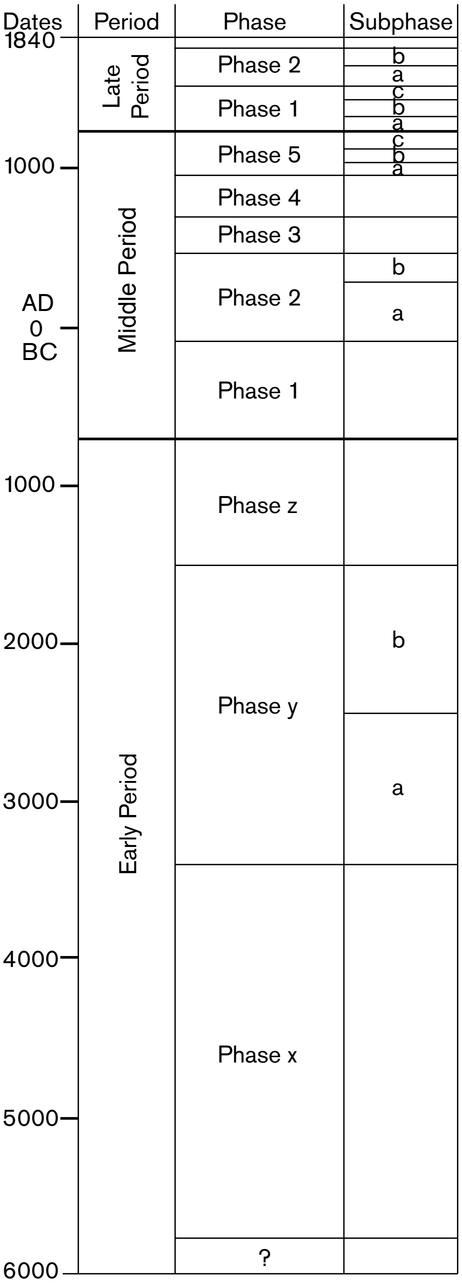

Figure 2. Sequence of time periods recognized in Southern California prehistory. Time periods are based on the sequence of changes in beads and ornaments (King 1990b). Correlations with calendar dates are based on interpretation of Carbon 14 dates and cross-dating with Southwestern and Great Basin sequences. The dates of the beginning and end of many phases and subphases have not been determined. Seriation indicates that the discovered sequence is complete after Phase z of the Early Period. Prior to Phase z, it is probable that beads and ornaments that have been studied do not represent a complete sequence. The bead and ornament sequence discovered for southern California is similar to the sequence discovered in central California (Bennyhoff and Hughes 1987).

We do not provide a complete discussion here on every bead type found in the San Diego area or in the rest of California, nor do we provide their measurements; however, there are some excellent sources of information on the subject. The monograph by James A. Bennyhoff and Richard E. Hughes entitled *Shell Bead and Ornament Exchange Networks Between California and the Western Great Basin* (1987) contains a typology of the kinds of *Olivella* shell beads found in California and the Great Basin, and includes both metric descriptions and temporal information. However, this significant work does not include descriptions of beads other than *Olivella* beads, nor is it focused on some *Olivella* bead types that are more common in southern California. Chester King, in a monograph entitled *The Evolution of Chumash Society* (1990a), systematically records artifacts from burial lots in the Santa Barbara Channel region and documents thousands of shell beads, stone, and bone beads. In this publication, King provides detailed descriptions of bead types, and includes information on how to identify them, their dimensions, and their temporal contexts. His discussion covers the many types of *Olivella* shell beads found in the Santa Barbara Channel region, as well as over 21 other types of shell beads. A third source, Bob Gibson's "An Introduction to the Study of Aboriginal Beads from California" (1992), provides even more detailed information on how to distinguish the many types of shell beads found in California. This is a one of the best sources of information available on how to distinguish one bead type from another, with detailed discussions on the often subtle differences between bead types.

Pacific Coast Shell Beads and Ornaments

Pacific Coast shell beads include *Olivella biplicata* disc beads, *Olivella biplicata* rough disc beads, *Haliotis rufescens* epidermis disc beads, *Olivella biplicata* lipped beads, *Olivella biplicata* cupped beads, and *Mytilus californianus* disc beads. Most of these types were manufactured in the Santa Barbara Channel region and were traded over a large area of the western United States. It is well documented that the Chumash manufactured large quantities of shell beads and traded them over long distances, both within and outside of California (Arnold and Munns 1994; Bennyhoff and Hughes 1987; King 1990a). Similarities in the diameters, perforation sizes,

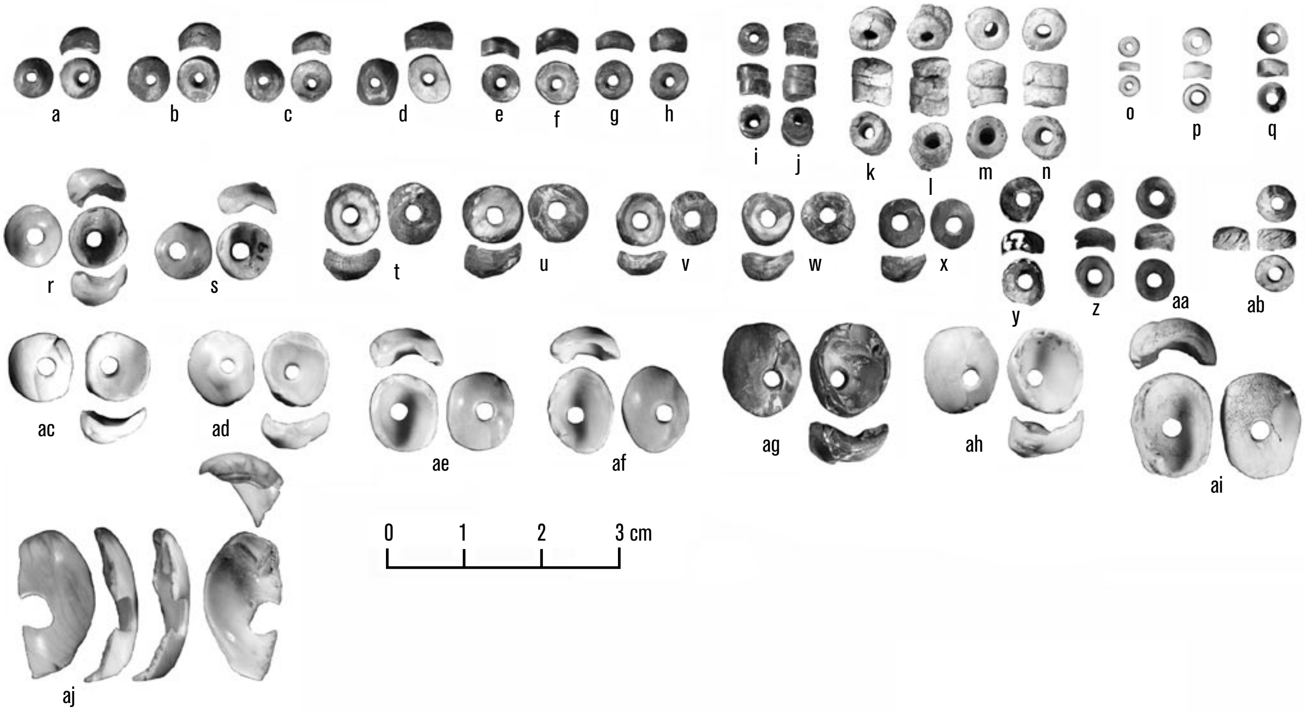

Figure 3. ***Olivella biplicata*** **Cupped (a–q), Thin-lipped (r–x), Cylinder (y–ab), Full-lipped (ac-ai), Split-punched (aj) beads to scale.**

and thicknesses of the disc beads found in the San Diego region and those of beads manufactured by the Chumash support the conclusion that the Chumash made most of the disc beads and traded them to the Kumeyaay and to other North American Indians in California, the Great Basin, and elsewhere.

During the Late Period, the callus of the *Olivella biplicata* shell—which had previously been discarded during bead manufacture—was used to make several types of shell beads. Beads in the collections analyzed here include the more common types traded from the Santa Barbara Channel during the Late Period. The first type of bead used in the Late Period was made entirely from the upper portion of the shell callus. These beads are round in shape, have a relatively consistent thickness along their edges, and have relatively small perforations, usually ranging between 1.2 and 1.5 mm. in diameter. These beads are called cupped beads. At the end of Late Period Phase 1, cupped beads differentiated into small cupped beads with perforations similar to earlier cupped beads, and larger beads with perforations around 2.0 mm. in diameter. These larger beads are called lipped beads. Their thickness varies around the edge of the bead. Over time, lipped beads increased in diameter, the range in thickness of their edges increased, and adjacent portions of the shell wall were included. The perforation moved from being entirely in the callus to the junction of the callus and the wall; eventually it was placed mostly in the wall portion of the bead. Earlier lipped beads with their perforations in the callus are called thin-lipped beads. The later beads, usually with perforations at the juncture of the wall and the callus, are called full-lipped beads. In addition to the three basic types of callus beads, there are some with incised edges that have either parallel oblique or cross-hatched designs.

Olivella biplicata *Cupped Beads (n=106) [K1 (Bennyhoff and Hughes 1987)].* Cupped beads (Fig. 3a–q) were first made at the beginning of the Late Period Phase 1 and were preceded by split-punched beads. They were made up to the time of Spanish colonization, when they were apparently replaced by glass beads. During Late Period Phase 2, the range of diameters decreased to between 2.1 and 3.8 mm. (by Phase L2b). During Phase L2 (possibly earlier), some cupped beads exhibit grinding on their convex (dorsal) surface; occasionally concave surfaces were also incised on their edges. Three cupped beads from SDI-860 and one cupped bead from SDI-4638 have dorsal grinding. All four of these beads have diameters between 2.1 and 3.8 mm. and may have been made during Phase L2. Most cupped beads in the collections, however, appear to be from Phase 1 contexts. The smaller, unburned cupped beads illustrated in Figure 3o-q may have been used during Phase 2 or early Phase 1. Figure 3i-n includes different views of cremated beads that were stuck together and can therefore indicate the way in which they were originally strung.

Table 2 presents information on the diameters of cupped beads from collections at Anza Borrego containing more than one cupped bead. The large cupped beads from Borrego Springs were possibly found associated with the large *Olivella* wall disc beads from the same area and were used during Late Period Phase 1c. Accession 622-20-42 also contained an incised cylinder bead that indicates a Phase L2a context (Fig. 3ab). The cupped beads from this collection also may be Phase L2a types; however, they could be from Phase L1. The nine cupped beads from a site south of the airport are probably Phase L1 beads. One cupped bead was recovered from SDI-945 and is not included in Table 1.

Olivella biplicata *Thin-Lipped Beads (n=46) [E1 (Bennyhoff and Hughes 1987)*]. Late Period Phase 2 is marked by the development of a number of new types of callus beads. Lipped and cylinder beads were first used during Phase 2. Lipped beads frequently include portions of the wall as well as the callus of the *Olivella* shell. The thin-lipped beads used during Phase L2a have roundish outlines and are called round thin-lipped beads. Round thin-lipped beads are illustrated in Figure 3r-aa. The beads labeled 3y-ab can be classed as cylinder beads. Larger cylinder beads were used at the same time as thin-lipped beads. All the thin-lipped beads from Accession 625-61-3 and the Clark Lake collections from Anza Borrego were burned, indicating that they were associated with cremations.

Olivella biplicata *Full-Lipped Beads (n=98) [E2a (Bennyhoff and Hughes 1987)].* Full-lipped beads are usually perforated at the juncture of the wall and the callus, in contrast to earlier thin-lipped beads, which are usually perforated through the callus. Full-lipped beads were made during Late Period Phase 2b. True's Type 3 beads from Cuyamaca are lipped beads (1970:39–40). Sixty-nine burned full-lipped beads were recovered from SDI-913. In addition to the beads from the Cuyamaca collections in Table 1, one more from Cuyamaca at SDI-945 was recovered, as well as one from the Frizzel collection. They were probably made between A.D. 1700–1770. Only one full-lipped bead from the Anza Borrego collection was burned. All of the full-lipped beads from SDI-913 were burned. A selection of full-lipped beads is illustrated in Figure 3ac–ai.

Table 2

DIAMETERS OF ANZA BORREGO CUPPED BEADS.
***= NOT BURNED**

Diameter mm.	622-20-42 no loc.	BV-S. of Airport	Harry D. Ross	Borrego Springs
3.6	1*			
3.7				
3.8	1			
3.9	1			
4.0		1*		1
4.1	1	1		
4.2	2	1	1	
4.3	2			
4.4	10			
4.5	8	1		
4.6	8			
4.7	5	1		
4.8	9	2		
4.9	1	1	1	
5.0			1	
5.1			3	
5.2	2	1		
5.3	2			1
5.4				1
5.5	1			1
5.6	1		1	1
5.7				1
5.8				3
5.9				1
6.0				
6.1	1			
6.2				
6.3				
6.4				1

Olivella biplicata *Oblique Incised Cylinder or Cupped Beads (n=1) [K3 (Bennyhoff and Hughes 1987)].* One obliquely-incised *Olivella* cylinder bead was from Accession 622-2-42. It had been burned and was probably associated with a Phase L2a cremation. The incised bead is illustrated in Figure 3ab.

Olivella biplicata *Split-Punched Beads (n=1) [D1a (Bennyhoff and Hughes 1987)]. Olivella* split-punched beads were used at the end of the Middle Period during

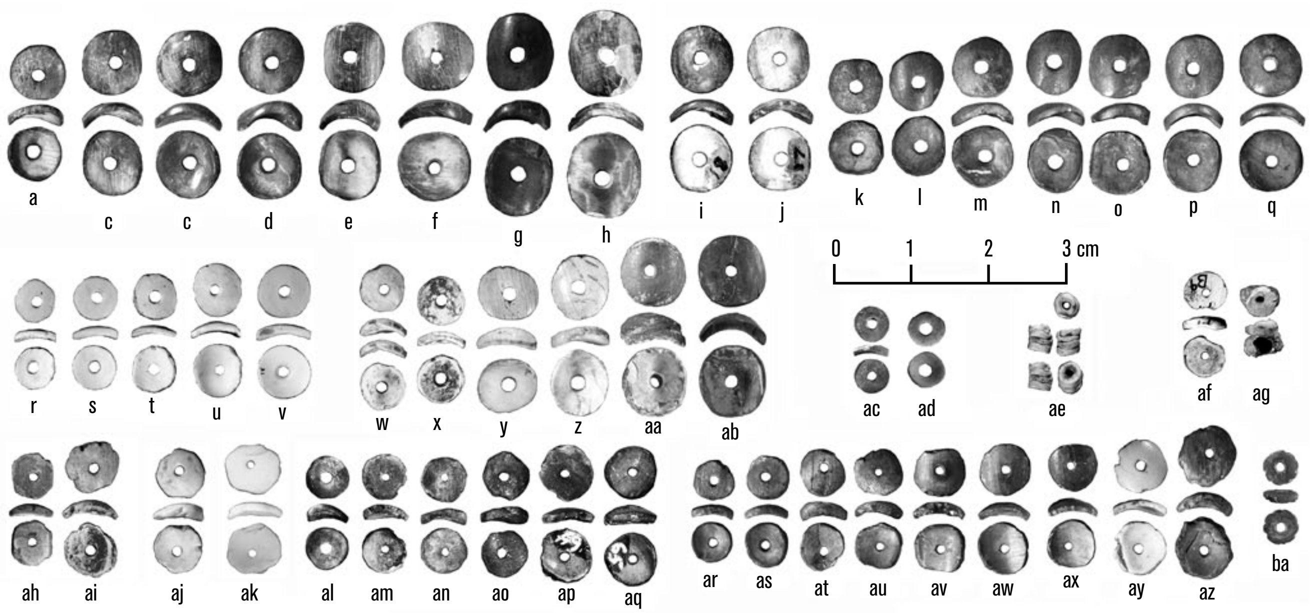

Figure 4. ***Olivella biplicata*** **wall disc beads.**

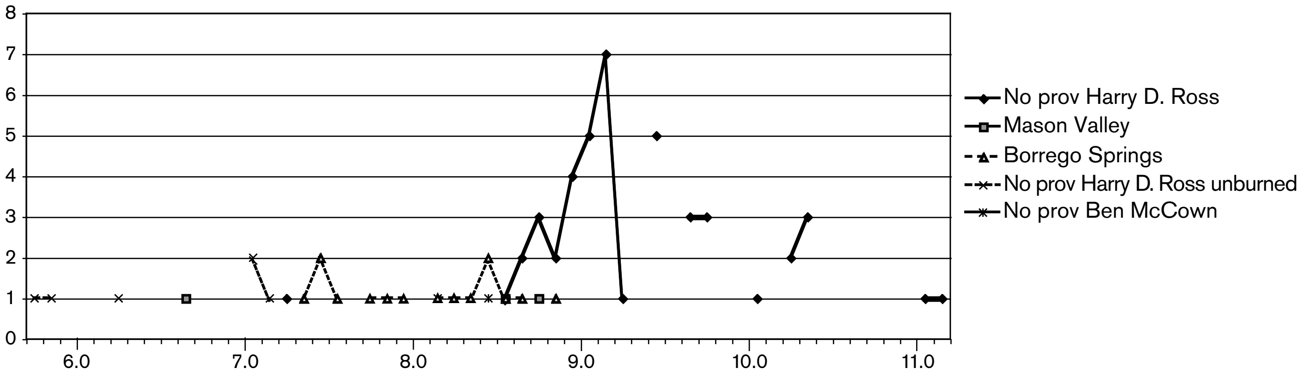

Figure 5. Diameters of large *Olivella* wall disc beads from the Anza Borrego Desert

Phase M5c in southern California. Phase M5c dates to approximately A.D. 1100–1200 (possibly plus 50 years). Phase M5c began immediately after many farming communities in Nevada were abandoned. Middle Period Phase 5c split-punched beads include a portion of the shell callus. It appears that cupped beads were first made at the same time that split-punched beads ceased to be manufactured. A large fragment of a split-punched bead was collected from a Lake Cahuilla shoreline in Imperial County; it is illustrated in Figure 3aj.

Olivella biplicata *Large Wall Disc Beads (n=100) [G2 (Bennyhoff and Hughes 1987)].* Thirteen large *Olivella* wall disc beads were recovered from probable late Phase L1 contexts at the Bancroft Ranch Site (SDI-4638) in San Diego. In addition, the collection from Anza Borrego Desert includes 61 large, burned *Olivella* wall beads collected by Harry Ross, 16 from Borrego Springs, and two from Mason Valley (Fig. 4a–ab). Figure 5 illustrates the ranges and frequencies of different diameters of large wall disc beads. Six unburned *Olivella* large wall disc beads from the Harry Ross collection tend to be the smallest ones in the collections we examined (Fig. 4r–v). The largest are the burned beads from the H. Ross collection (Fig. 4a–h). Burned beads from Borrego Springs are intermediate in size (Fig. 4k–q). Twelve wall disc beads from SDI-4638 were between 6.0 and 9.3 mm. in diameter, and one was 4.7 mm. in diameter. It appears that there was a shift to larger-sized wall disc beads during Phase 1 of the Late Period. This trend ended at the beginning of Phase 2, when lipped beads became clearly differentiated from cupped beads, and large wall disc beads ceased to be manufactured.

During late Phase 1 of the Late Period, before the use of cylinder and thin-lipped beads, relatively large wall disc beads were traded by the Chumash to northern and eastern neighbors. They have been recovered from the Lake Cahuilla shoreline village at La Quinta (Riv-1179) (King 1986a; Sutton and Wilke 1986:145), Van Norman Reservoir (LAN-629) (Foster and Wlodarski 1983; Gates 1977), and the Late Period Santa Monica Mountain Chumash village of *Talepop* (King 1982).

Olivella biplicata *Medium Disc Beads (n=2).* One medium-sized disc bead was found at *Meti* (SDI-4638) (Figure 4ac) and another at Santa Catarina Springs (SDI-343) by Paul Ezell (Figure 4ad). It is probably a Late Period type.

Olivella biplicata *Small Disc Beads (n=5) [G1 (Bennyhoff and Hughes 1987)].* Small disc beads were used during all of the Middle and Late Periods in the Santa Barbara Channel; they are too small to be recovered in eight-mesh screens. Four small disc beads that were calcined and stuck together were recovered with the Borrego Springs collection (Fig. 4ae). The relatively long *Olivella dama* 'barrel' beads associated with these may indicate a late Middle Period date for the beads, although similarly calcined cupped beads and an incised cylinder bead, also from Borrego Springs, may indicate that the small disc beads are from a Late Period Phase 2 context. Another small disc bead is from Accession 622-20-42 from Anza Borrego. Bead lots associated with occupations around Lake Cahuilla during Phase 1 indicate small wall disc beads were used there during Late Period Phase 1a. Lots from FW-1 (FW=Douglas Fain and Phil Wilke collection), FW-11, FW-24, and FW-26 have small-diameter cupped and wall disc beads consistent with the sizes of beads found in Phase L1a contexts in Chumash sites.

Olivella biplicata *Rough Disc Beads (n=573) [H (Bennyhoff and Hughes 1987)]. Olivella biplicata* rough disc beads were the most common type of bead made in Southern California during the Spanish and Mexican mission periods. Including fragments, over 427 rough disc beads are present in the Rancho Cuyamaca State Park collections. Most are from two lots of beads obtained by artifact collectors in or near Rancho Cuyamaca State Park (Table 1). All of these beads were burned and were apparently found with cremations. True's Type 1 beads from Cuyamaca are rough disc beads (1970:39–40). Some 145 beads are from the collections in or near Anza Borrego Desert State Park. Most of these were burned and were probably associated with cremations. A selection of *Olivella biplicata* rough disc beads are illustrated in Figure 4af–az.

Rough disc beads made from the walls of *Olivella biplicata* shells are usually over 4.0 mm. in diameter, and the earliest have relatively parallel-sided holes that are close to 1.0 mm. in diameter. These perforations were apparently made with drills tipped with iron needles. Rough disc beads were probably first made around 1780, and they continued to be made throughout the Spanish and Mexican mission periods. Between 1780 and 1840, rough discs beads generally increased in size; in addition, the degree to which the bead margins were ground smooth decreased, the diameters of perforations became more variable, and perforations became more biconical when compared to early historic beads that usually had straight-sided perforations. The relatively rapid changes in *Olivella biplicata* rough disc beads enables a discrimination of time periods of short duration (Gibson 1976; King 1974, 1985, 1990b, 1990c).

The contexts used to determine the ranges of diameters delineating short time periods include burial lots at *Humaliwu* (LAn-264), areas at the Ventura Mission site (Ven-87), the Santa Barbara Presidio, Santa Inez and La Purisima missions, Mescalitan Island (*Helo'*) (SBa-46), Arroyo Sequit, Smugglers Cove on Santa Cruz Island, the Isthmus at Catalina Island, and many other sites throughout southern and south-central California. Many of these sites were founded or abandoned at known dates; it has therefore been possible to establish a refined chronology of changes in beads used between A.D. 1770 and 1844, utilizing changes in bead diameters and the degree of finish by grinding of the margins of beads (see King and Gamble 2008: Figs. 11 and 12).

The manufacture of shell beads continued at the missions after the abandonment of native villages. The presence of a sequence of beads at the Ventura Mission site (Gibson 1976; King 1990b), the beads from the post-1813 La Purisma Mission site (King 1990c), and ethnographic accounts all indicate the manufacture of beads continued during the later mission period. Luisa Ignacio told Harrington that Father Antonio Ripoll,

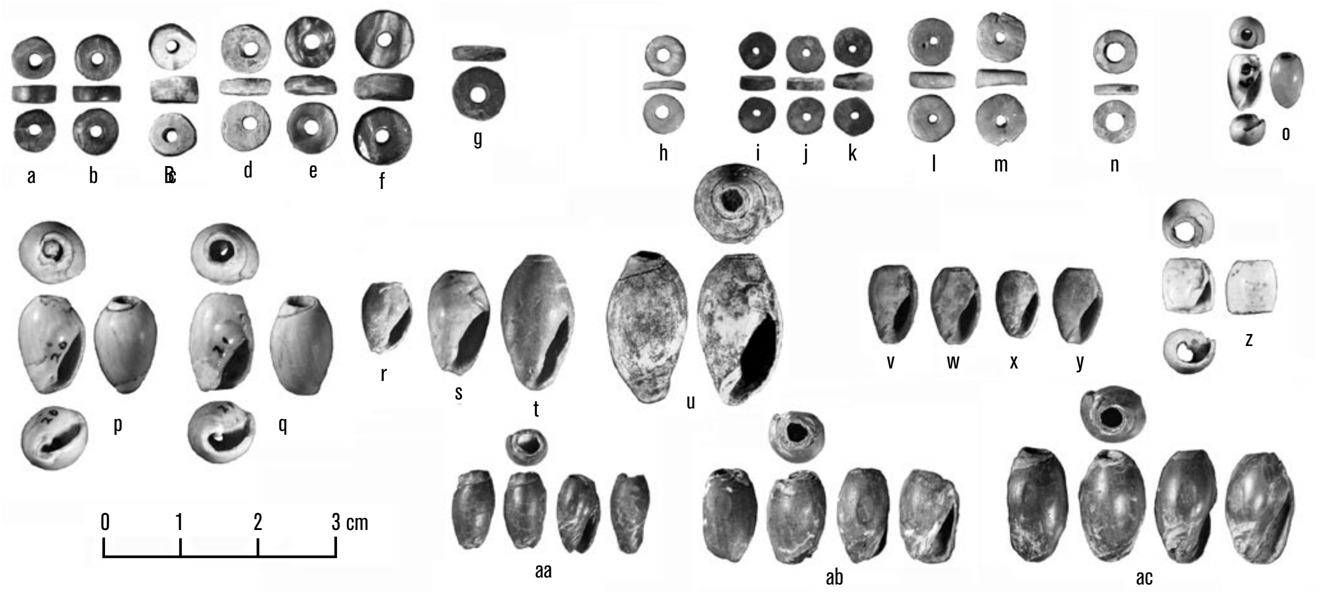

Figure 6. ***Mytilus californianus*** **disc (a–g),** ***Haliotis rufescens*** **epidermis disc (h–m),** ***Haliotis nacre*** **disc (n), and** ***Olivella biplicata*** **Spire-removed beads (o–ac).**

who was at Santa Barbara Mission between 1815 and 1828 (before Luisa was born), ordered the Indians to make shell beads to help pay for fiestas (Hudson et al. 1981:104). Apparently, after the Channel Island villages were abandoned, beads were still being made at the missions. Archaeological evidence demonstrates the manufacturing of beads at Ventura Mission (Gibson 1976). Harrington's ethnographic notes describe the manufacture of beads in the 1840s at the mouth of the Ventura River (Johnson 1991:13–14). The beads recovered from historic sites throughout Southern California are within the ranges of sizes and degrees of finish of beads found at Ventura Mission. Evidence of disc bead manufacturing has not been reported from non-Chumash Late Period sites.

Most of the rough disc beads from Anza Borrego and Cuyamaca are from the Spanish mission period (1769–1821). The beads from the site near Split Mountain appear to be the latest beads in the collections from Anza Borrego, and some of these beads probably date from the Mexican mission period (1821–1834).

Olivella biplicata *Rough Disc Beads with incised edges (n=1).* One incised rough disc bead was found at Cuyamaca State Park (Fig. 4ba). Incised rough disc beads were made during the early Spanish mission period.

*Mussel (*Mytilus californianus*) Shell Disc Beads (n=7). Mytilus californianus* shell disc beads were used from Middle Period Phase 5 until the Spanish invasion, and were made in the Santa Barbara Channel region. Mussel shell disc beads in the size ranges found in the Anza Borrego collection were used in southern California during Middle Period Phase 5a and 5b and Late Period Phase 1b and 1c. One bead from Cuyamaca State Park that is not in Table 1 (Accession 618-701-611) is 7.2 mm. in diameter, 2.0 mm. thick, and has a perforation 1.9 mm. in diameter. The Anza Borrego collection includes six mussel disc beads (Table 1 and Fig. 6a–g). They range between 5.7 and 7.7 mm. in diameter.

*Abalone (*Haliotis rufescens*) Epidermis Disc Beads (n=8).* Abalone epidermis beads were used from the middle of Phase 1 of the Late Period into the historic Spanish mission period. One *Haliotis rufescens* epidermis disc with a biconically-drilled perforation 1.8 mm. in diameter was found at the Hendrickson House site (Fig. 6h). The larger perforation of this bead indicates that it was made before 1780. Five *Haliotis rufescens* disc beads were found with over 299 *Olivella biplicata* rough disc beads and two glass beads in the lot labeled 618-X-311 on West Mesa at Rancho Cuyamaca State Park. They have small perforations and generally have the same diameter (range from 4.9–5.9 mm.) as the *Olivella* rough disc beads in the same collection. All beads with this accession number were burned, apparently in a cremation fire. True's Type 2 beads from Cuyamaca are

Haliotis rufescens disc beads (1970:39–40). Two historic *Haliotis rufescens* epidermis disc beads were found at SDI-98 in the Cuyamacas. They were associated with Olivella rough disc beads of similar age. Abalone epidermis beads made during the historic period have small parallel-sided perforations similar to the perforations of Olivella rough disc beads, with which they are often strung (Fig. 6i–m). Beads ranging in size from 5.5 to 6.2 mm. in diameter were found in the same area at *Talepop* as a concentration of rough disc beads ranging between 5.0 and 6.8 mm. in diameter. It appears that this type was infrequently used during the later Mexican mission period. *Olivella biplicata* rough disc beads and *Haliotis rufescens* disc beads are the types of shell beads most commonly used in southern California during the historic period.

*Abalone [*Haliotis *sp.] Nacre Disc Bead (n=1).* One unburned *Haliotis* sp. nacre disc bead was in the Harry Ross collection (Fig. 6n). This type of bead was most frequently used during Phases 1 and 2 of the Middle Period. The bead may also be a small Late Period ring or disc ornament. It is one of few artifacts in the collection that possibly came from a context earlier than the end of the Middle Period.

Olivella biplicata *Spire-Removed Beads (n=186) [A1 (Bennyhoff and Hughes 1987)].* Eighty-three *Olivella biplicata* spire-removed beads are present in collections from San Diego sites west of Cuyamaca Rancho State Park and Anza Borrego; 47 are from Cuyamaca, and 56 are from the area in and around Anza Borrego Desert State Park (Table 1 and Fig. 6o–ac). Many beads made by removing the spires of *Olivella biplicata* shells were probably manufactured in San Diego County. Most of the spire-removed *Olivella biplicata* beads have little contextual information, and many may have come from Early Period contexts. The relative frequency of beads made by removing the spires of *Olivella biplicata* shells is greatest in early contexts throughout southern California, where they were the dominant type of bead during the Early Period and the first phase of the Middle Period (Gibson 2000b; King 1990a). Compared to many types of beads, there is a high frequency of unburned spire-removed beads. According to May (1974), the practice of cremation in the San Diego region did not occur until about A.D. 900 to 1150. Because many beads from early contexts are not burned, it is probable that some are from early contexts. Six medium-sized burned beads from the Harry Ross collection have abraded areas on opposite sides that indicate they were strung side-by-side in the manner that some *Olivella dama* beads were strung, which also have similar abraded areas on their sides. Three are illustrated in Figure 6aa-ac. The other burned beads in the H. Ross collection are beads used during Late Period Phase 1, and it is therefore probable that these spire-removed beads were used during Late Period Phase 1. *Olivella biplicata* spire-removed beads with abraded areas on opposing sides have also been identified at the historic settlement of *Meti* (SDI-4638). Several sites in Orange County, including ORA-287, ORA-676, ORA-1208 (Gibson and King 1991a), ORA-19, ORA-582, and ORA-855 (Gibson 2000a) had *Olivella biplicata* side-ground beads (King and Gamble 2008). It appears that during the Late Period, people obtained small- to medium-sized *Olivella biplicata* shells along the coasts of Orange and San Diego counties, and used them to manufacture woven beadwork in which shells were strung side by side. This beadwork was similar to beadwork done with *Olivella dama* shells in the Southwestern United States. This type of Californian bead should be looked for in Southwestern archaeological and ethnographic collections.

Haliotis *sp. Ornament Fragments (n=6+).* Abalone shells were used to manufacture ornaments along the California coast; the shells were also traded to interior groups, who also manufactured ornaments. Figure 7a–h illustrates abalone ornaments from San Diego County. Four abalone ornaments were found in the collection from *Meti* (SDI-4638). One is a pendant fragment made from a *Haliotis cracheroderi* that still retains its epidermis (Fig. 7a); another involves fragments from a single central-perforated rectangular nacre ornament (Fig. 7b–c); a third involves fragments of a burned ring-shaped nacre ornament (Fig. 7d–e); and a fourth is a fragment of a shaped piece of nacre (Fig. 7f).

There are also two abalone ornament fragments from a site near the Lake Cahuilla beach line in Imperial County; both lack their outer covering and are all nacre (Fig. 7g–h). The nacre of the ornament illustrated in Figure 7g appears to be from a *Haliotis cracheroderi* shell. Our present knowledge of ornaments from the area is limited, and reconstruction of the ornament shapes and their temporal placement requires further research.

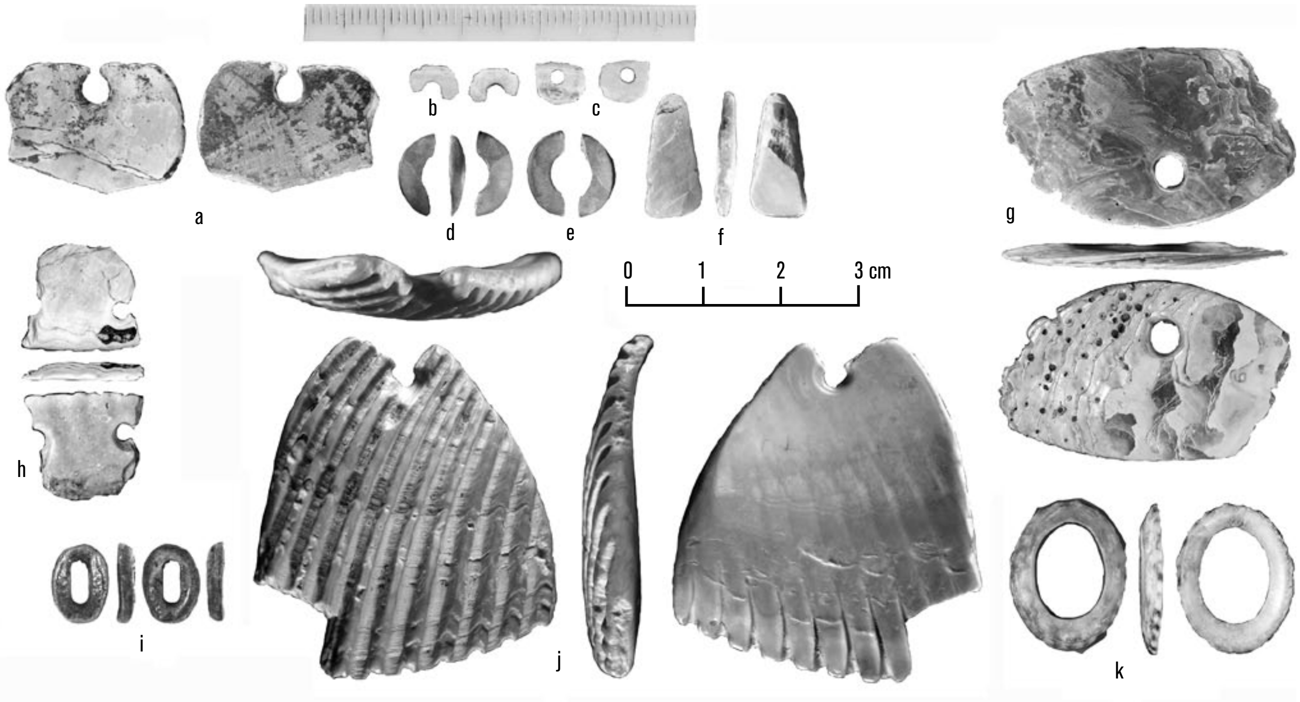

Figure 7. Ornaments from Pacific coast shells.

Trachycardium quadragenarium *Pendant and Fragment (n=2).* One almost whole unburned pendant of *Trachycardium quadragenarium* shell was found at a site on a Lake Cahuilla beach line in Imperial County (Figure 7j). A burned shell fragment of the same material was also found in Mason Valley.

Fisurella volcano *Limpet Callus Ring Ornament (n=1).* One unburned shaped ring from the callus of a volcano limpet is in the Cuyamaca collections at SDI-913 (Figure 7i). Volcano limpet rings were used during the Middle Period in the Santa Barbara Channel, indicating the presence of a Middle Period occupation at SDI-913.

Lottia limatula *Limpet Ring Ornament (n=1).* One unburned ring made from the outer part of a File limpet (*Lottia limatula*) was found at SDI-2600. It probably indicates the presence of a Middle Period occupation. The ring is illustrated in Figure 7k. Its inner edge appears ground.

Beads and Ornaments Made From Gulf of California Shells

Seven hundred and eighty-nine of the beads and ornaments studied were made from shells native to the Gulf of California. Most are types found in Classic Period Hohokam sites and southern California Late Period sites extending to the Los Angeles County coast. The most common beads are made from *Olivella dama* shells. It appears that they were used during the same periods as the beads made from Pacific Coast shells found in the collection.

The best evidence for the manufacture of shell beads at a Kumeyaay site is from IMP-5427, the Elmore site in Imperial County (Rosen 1994). Marty Rosen identified 229 pieces of *Olivella* shell from this protohistoric village site, including 169 fragments of *Olivella* shell bead-making detritus. Seven of these pieces were identified as *Olivella dama*; the others were not identified by species because they lacked diagnostic features. Rosen (1994:4–6 and 15–18) proposed that the type of detritus indicated that spire-removed and barrel beads were being manufactured. Sixty beads or bead fragments were identified in the collection, most of which were not identified by species. The majority of those that were identified to the species level (n=16) were made from *Olivella dama*. Only three beads were made from *Olivella biplicata*; they were all spire-removed beads. Additional evidence for bead making comes from the

Spindrift site (CA-SDI-39); some clam disc blanks were found here, indicating a manufacturing of clam shell disc beads during the Early Period (Farmer and La Rose 2009). In addition, the authors suggest that Olivella spire-removed beads were probably made at the site as well.

Several *Olivella dama* types were identified in our study. One includes shells that have had their spires removed. Another common Late Period type includes shells that have had their spires removed to a greater degree, and their bases ground to form a barrel- or cylinder-shaped bead. The collection also includes a bead made only from the top part of a shell, as well as a less modified spire- and base-removed bead. In southern California, most *Olivella dama* beads similar to the beads from the Anza Borrego Desert and Cuyamaca are from Late Period contexts. They were frequently used during pre-Spanish periods, and became rarer during the Spanish mission period. Seven hundred and fifty-two *Olivella dama* beads were present in the collections studied.

Olivella dama *Spire-Removed Beads (n = 479). Olivella dama* spire-removed beads include shells with spires that were removed by being ground, chipped away, and eroded; the latter could not be identified as spire-ground or spire-chipped. There were very few eroded beads. Fifty-one of the *Olivella dama* spire-removed beads were from sites west of Cuyamaca Rancho State Park and Anza Borrego; 85 were from the Cuyamacas; and 343 were from the Anza Borrego area. Details about the sizes of most of these types can be found in several reports (Gamble 2008; Gamble and King 2004; King 2004).

Olivella dama spire-removed beads were strung in several different ways. Many beads have no facets on their sides or grooves on the edge where the spire was removed, and these were probably strung end-to-end on strings. Some of these are illustrated in Figure 8a–e. These beads may have been strung in line on single strands or may have been used in woven networks, but they were not worn long enough to develop the signs of wear found on some of the other beads. The beads illustrated in Figure 8a-d from the Harry Ross collection and in Figure 8e from Mason Valley were probably strung end-to-end. All the *Olivella dama* beads in these two collections were burned.

Spire-removed beads with abrasion-ground facets on their sides and/or grooves on the edge of the hole where the spire was removed were apparently strung side-by-side (Figure 8g–m). The facets on their sides resulted from abrasion against adjacent beads. The grooves were caused by wear from strings that passed over the edges of the perforated end and rubbed against the edges of the perforations. Figure 8k shows three *Olivella dama* spire-removed beads calcined together from a cremation in a collection from Cuyamaca (Accession 618-X-189) that had a total of 59 burned *Olivella dama* spire-removed beads. The three calcined beads indicate the spire-removed *Olivella dama* beads were strung side-by-side as part of a woven network of beads, as illustrated in Orchard (1975:26–27). It is probable that some of the less well-preserved spire-removed beads were also strung side-by-side, but the evidence for this has been destroyed by erosion and breakage. In the collection from Anza Borrego, fewer *Olivella dama* beads that have signs of being strung side-by-side were burned than those without signs of wear.

Olivella dama *Spire-Ground Base-Chipped Beads (n=1).* One unburned *Olivella dama* spire-removed and base-chipped bead was collected from SDI-331. This bead is less altered than the *Olivella dama* 'barrel' beads. It is illustrated in Figure 8n.

Olivella dama *'Cap' Beads (n=1).* One unburned bead made from the top portion of an *Olivella dama* shell was in the collection from Borrego Springs (Fig. 8o).

Olivella dama *'Barrel' Beads (n=271). Olivella dama* spire-removed and base-ground 'barrel'-shaped beads were identified in the collections studied. These beads were probably strung in strands. The range of sizes and degree of grinding are similar to other *Olivella dama* barrel beads found in Late Period contexts in southern California. Generally more of the shell spire was removed than on the earlier spire- and base-ground *Olivella dama* beads that were used during the Santa Cruz and Sacaton Phases of the Hohokam. They were used during the Late Period and continued to be used during Spanish colonization. Figure 8p–ah indicates the range of variation in the type. The beads of this type from Anza Borrego indicate that there may have been a trend toward thinner beads and the removal of a larger portion of the shell.

Oliva undatella *Spire-Removed Beads (n=17).* Seventeen beads in the collections were made by grinding off the spires of *Oliva undatella* shells (Fig. 8ai–an). All of the beads are burned and are from the Anza Borrego area. The only one not noted in Table 1 is from the Frizzel collection. Gifford (1947:11) reported the presence of

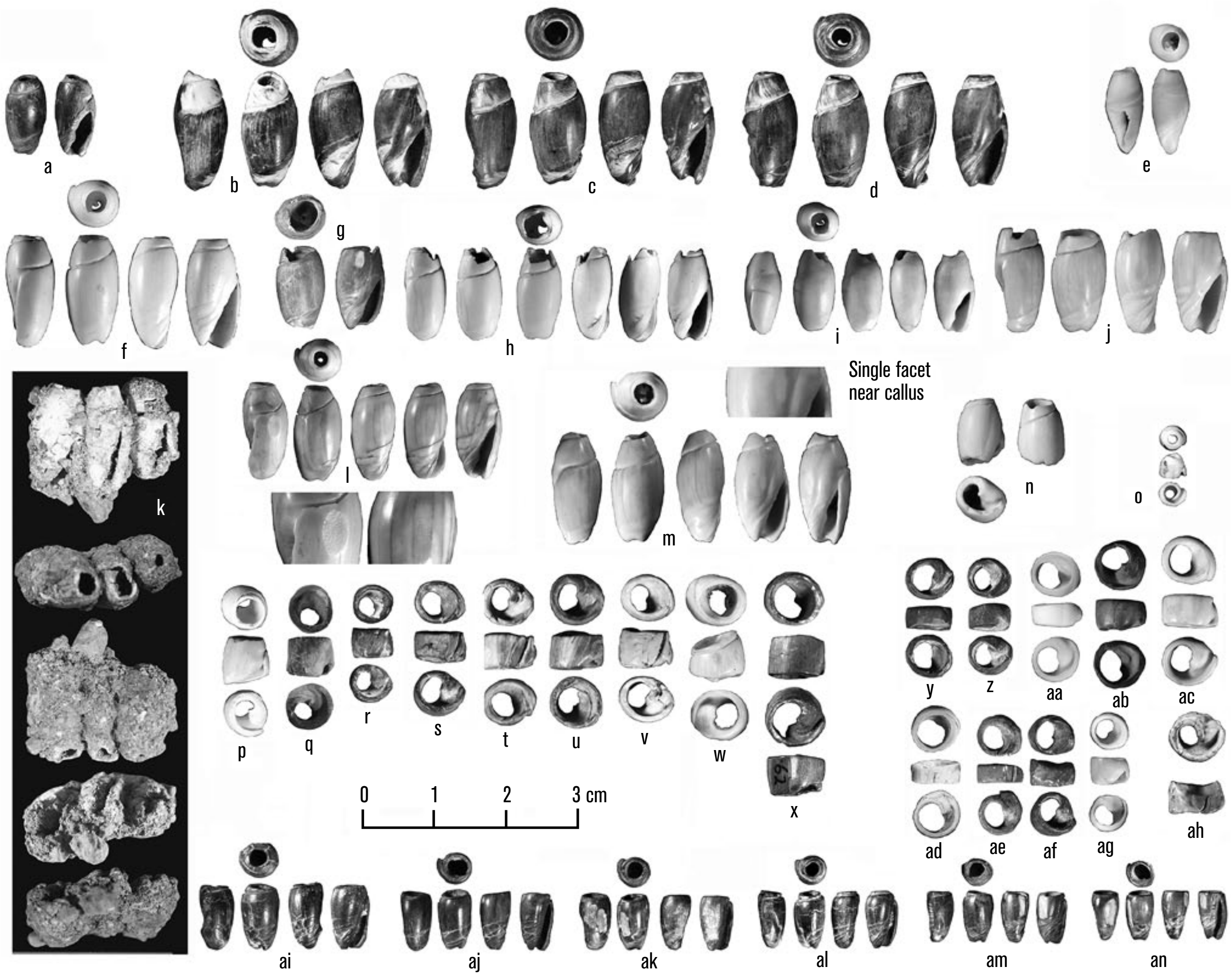

Figure 8. ***Olivella dama*** **spire-removed beads (a–ah).** ***Oliva undatella*** **spire-removed beads (ai–an).**

Olivella undatella as a Gulf species used to make 24 calcined beads with spires and bases removed that were found in sand dunes near Indio. Whether he was actually referring to *Olivella dama* or *Oliva undatella* can only be determined by looking at the collection. He listed no *Olivella dama* beads in his study of the beads at Berkeley. The associations of *Oliva undatella* spire-removed beads with other beads in the Anza Borrego collections indicate they were used during the later part of Late Period Phase 1.

Conus *Beads and Ornaments (n=13)*. The species of *Conus* used for these beads and ornaments has not been identified. They probably are not made from *Conus californicus*, but rather from various other species from the Gulf of California. Jernigan observed that most *Conus* shell artifacts from the Gulf of California were used during the Classic Hohokam Period (ca. A.D. 1100–1450). Although isolated occurrences of *Conus* shells have been found even in Pioneer Period contexts, *Conus* may be considered essentially a Classic Period shell (Jernigan 1978:42, 73). The Classic Period in southern Arizona was contemporary with Middle Period Phase 5c and Late Period Phase 1 in California. Nine *Conus* sp. artifacts were found at Borrego Springs, where large, burned *Olivella* wall disc beads and Olivella cupped beads indicate the presence of a mortuary area used during Late Period Phase 1b or 1c (ca. A.D. 1300–1500). It appears that the *Conus* sp. beads in the collections are made from Gulf of California species. Figure 9a–e illustrates five of these beads. One medium *Conus* shell (#159) with its spire removed was found at SDI-2524. It is illustrated in Figure 9f. A large *Conus* cap bead from Accession 622-10-1f collected by Jane

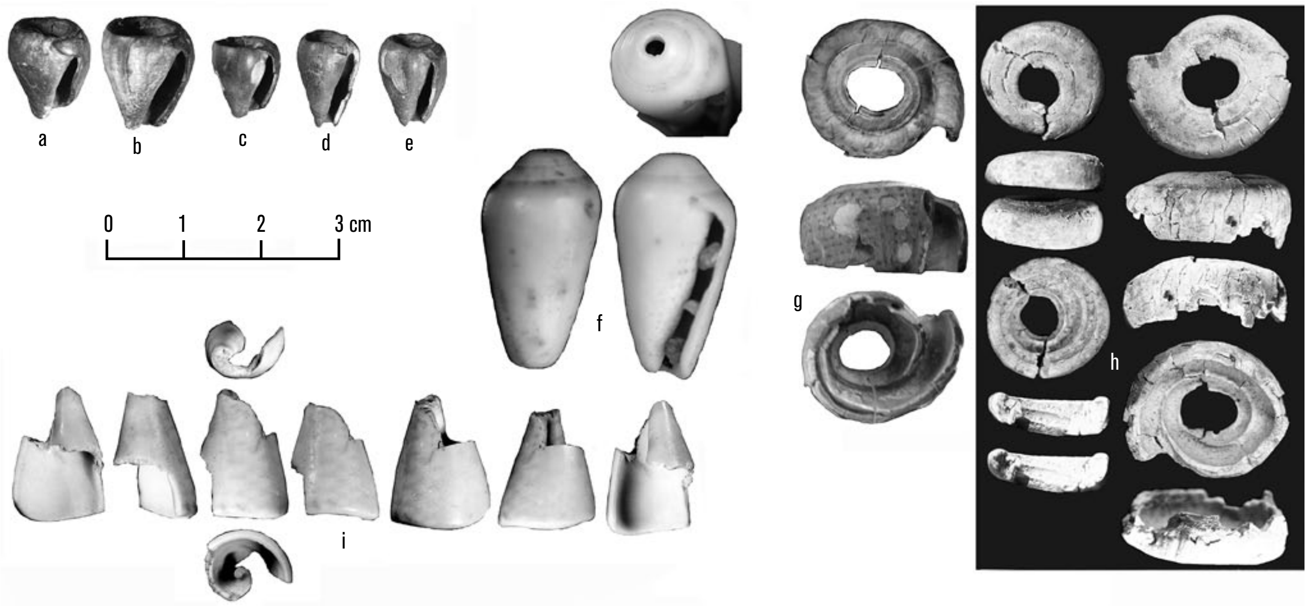

Figure 9. *Conus* sp. beads.

Thorness from the desert is similar to four *Conus* beads associated with a cremation at Cuyamaca State Park (Fig. 9g–h) (Gamble and King 2004; King 2004). The bead has spots and is probably from an Interrupted Cone (*Conus ximenes*). A fragment of a burned bead from Borrego Springs is similar to the whole bead.

There is also one fragment of a *Conus* shell (Fig. 9i) that appears to be a large portion of a pendant or tinkler similar to the tinklers in a necklace collected ethnographically at Isleta Pueblo and illustrated by Orchard (1975:42–43). *Conus* tinklers are present in small numbers throughout the Anasazi sequence, except in Pueblo III, when they are common (Jernigan 1978:162).

*Freshwater Snail (*Physella *sp.) Beads (n=1).* One freshwater snail shell with its spire ground off was found in the collection made by Harry Ross. The shell may have been obtained locally. It is illustrated in Figure 10a.

Rangia mendica *Ornaments (n=3).* *Rangia mendica* is not mentioned as a shell species commonly used in the Southwest; perhaps it was most frequently used along the Colorado River. It lives in brackish water. *Rangia mendica* fossils can be seen on shorelines in the Salton Basin. Their modification by perforation near the hinge and large central perforation is similar to the treatment of other whole shells in the Southwest. There is one *Rangia mendica* shell in the collections with a large perforation in its center (Fig. 10b); it is from an old beach line of Lake Cahuilla in Imperial County (Table 1). Two *Rangia mendica* pendants with small perforations near the shell hinge were collected by Harry Ross from the Anza Borrego region (Fig. 10c–d). It appears that the two pendants may be valves of the same bivalve shell. They are both drilled near the shell hinge.

Glycymeris maculata *with Central Part of Shell Removed (n=1).* A burned (apparently cremated) fragment of a *Glycymeris maculata* ornament was in the collection from Mason Valley. *Glycymeris* shells from the Gulf of California were sometimes modified by perforating a large hole in their center. Both Pecten and (more frequently) *Glycymeris* shells were sometimes perforated with a hole that was from a quarter to a third the diameter of the shell. The hole was placed centrally on the vertical axis and either centrally or more toward the top on the horizontal axis of the shell (Jernigan 1978). The fragment in the collection has been ground and polished along its interior edge, and it appears to be part of a whole shell with a large perforation similar to those described by Jernigan. Figure 10e includes a reconstruction that assumed that the ornament was symmetrical along the axis of the shell and employing a mirror image. The shape of the ground areas indicates that the perforated area had a more complex shape than a circle.

Glycymeris *sp. Shell Arm-Bands (n=2).* Two *Glycymeris* shell arm-band fragments were recovered at the Cottonwood site, SDI-777, west of the Cuyamacas (Fig. 1). This type of arm band was common in the

Figure 10. Freshwater snail bead (a) and Gulf of California shell ornaments (b–e).

Southwest in the Hohokam sequence; McGuire and Howard (1987) suggest that these low-value items may have served to link commoners with elites in the Southwest. Their meaning for the occupants of the Cottonwood site may have been very different, because they are relatively unique in the San Diego region.

Glass Beads (n=54)

Fifty-four glass beads were present in the collections reported here (Table 1). Because we did not consistently examine all of these beads in the same way, and they are not the focus of this paper, we only report them to provide an indication of which sites have evidence of historic era artifacts. More details on some of these are provided elsewhere (Gamble 2008; King 2004; King and Gamble 2008).

CONCLUSIONS CONCERNING PERIODS OF OCCUPATION AND EXCHANGE NETWORKS

The shell beads and ornaments from the San Diego region are significant in that they indicate that the inhabitants of the area participated in exchange and political networks that included both the greater Southwest and the Pacific Coast. They also provide chronological information about numerous sites, some of which have little or no other associated temporal data. Although many collections lack specific provenience and contextual information, insight into the use and distribution of beads and ornaments over time helps us understand ancient sociopolitical and economic interactions in the region.

Most of the beads and ornaments from these collections were probably found with cremations. When detailed provenience is lacking, it is assumed that beads that are in lots and are burned were probably associated with cremated individuals. Zepeda's (1999) study of beads from the historic village site of *Amat Inuk* provides evidence that burned beads were in association with cremated individuals, as is the case with many cremated bead lots in Cahuilla territory (King 1995). The collections from the Anza Borrego desert area and sites west of Rancho Cuyamaca are primarily types made after A.D. 1100 and before 1851. In contrast, collections from Rancho Cuyamaca, except for beads from the Drippings Springs site (SDI-860) and *Hual-cui-cuish* (SDI-945), contain types made after A.D. 1700 and before 1805. There are no types of beads that indicate contexts later than 1851.

Other collections from Anza Borrego State Park also have Late Period shell beads and ornaments, as well as some from earlier contexts. A study of the Indian Hill Rockshelter at Anza Borrego Desert State Park indicates that Early and Middle Period beads similar to types used in the Santa Barbara Channel were used in the Anza Borrego Desert (McDonald 1992; Wilke et al. 1986:102–105). Shell beads collected by State Parks archaeologists in 1977 from the Barrel Springs site in the Lower Borrego Valley, approximately three miles north of Ocotillo Wells, were identified as Late Period types by Robert Gibson (personal communication, 1977). The collection included nine *Olivella* rough disc beads, an *Olivella* thin-lipped round bead, three *Mytilus californianus* disc beads, spire-removed *Olivella biplicata* and *Olivella dama* shells, and spire- and base-removed shells.

Studies of collections from Orange and Riverside counties have documented that most beads in the region are types made on the Santa Barbara Channel Islands (Gibson 1993, 1994, 1995, 1996a, 1996b, 1996c, 1996d, 1998, 1999a, 1999b, 1999c, 2000a, 2000b, 2004; Gibson and King 1991a, 1991b; Gibson and Koerper 2000; King 1986a, 1986b, 1987, 1989, 1995). Our research on beads from the San Diego area demonstrates that the networks in which these beads were involved extended as far south as the Mexican border. It is not yet known if shell beads from the Santa Barbara Channel were used south of the Mexican border, or even how far south and east they occurred, if in fact they were used at all in those areas. We do know that they were traded north to the northern Sacramento Valley and east at least as far as Pecos, New Mexico. It is probable that they were also used in parts of what is now Mexico. Studies of beads from the vicinity of old Lake Cahuilla and Tahquitz Canyon (King 1986a, 1995) indicate that during the Late Period, the same types of beads found in Cahuilla sites in the northern part of Cahuilla territory were used by both the Cahuilla and the Kumeyaay who lived in the Anza Borrego Desert.

Most of the shell beads that were studied that were made from Gulf of California shells are types found in Classic Period Hohokam and protohistoric Pima sites in Arizona. These types were also used in the northern part of the Southwest during Pueblo III and IV. Disc beads made from Gulf of California shells found in Hohokam sites (Haury 1938; Jernigan 1978) are also found in San Diego and other southern California sites; however, they are infrequently found.

The inhabitants of the San Diego region probably produced many of the *Olivella biplicata* spire-removed and barrel beads. Once made, they were used locally, traded, or conveyed to other areas of San Diego County and beyond. Disc beads made from Pacific Coast shells include types made from *Olivella biplicata*, *Haliotis rufescens*, and *Mytilus californianus*. The types of beads made from these shells include *Haliotis rufescens* epidermis disc beads, *Mytilus californianus* disc beads, *Olivella biplicata* disc beads, *Olivella biplicata* rough disc beads, *Olivella biplicata* cupped beads, and *Olivella biplicata* lipped beads. Massive amounts of shell bead-making detritus have been documented in the Santa Barbara Channel region. The similarities in the diameters, perforation sizes, and thicknesses of the disc beads found in the San Diego region and the beads manufactured by the Chumash support the conclusion that the Chumash made most of the disc beads and traded them to the Kumeyaay in the San Diego region and to other North American Indian groups in California, the Great Basin, the Southwest, and elsewhere (Arnold and Munns 1994; Bennyhoff and Hughes 1987; King 1990a). Jelmer Eerkens and his colleagues (2005) examined isotopic signatures of ten *Olivella* beads found in sites in central California and the Owens Valley, and suggested that all ten appeared to have been harvested from the warmer waters south of Point Conception. This is further evidence of the widespread exchange of shell beads made in the Santa Barbara Channel region. The context of their distribution is not entirely understood, but ethnographic and ethnohistoric sources indicate that the Cahuilla used shell beads in the context of ceremonies (Gifford 1931; Strong 1929). Clan leaders exchanged shell beads with other clan leaders during such rituals as the image-burning ceremony. Worked shell beads and ornaments made from Gulf of California shells are also common in the San Diego region. Many of the beads from the studied San Diego collections were burned and were probably originally associated with cremations. Their frequent presence with cremations documents their use in a ritual context.

In summary, the beads and ornaments found in the San Diego region are evidence of exchange networks that integrated groups living in the Southwest, the interior areas of southern California, the southern coast of California, and the Santa Barbara Channel region. Late Period Kumeyaay sites are found along the Pacific Coast, in the interior valleys and mountains, and in the Colorado Desert. The San Diego area is located between the Gulf of California and the Pacific coast, two distinct sources of shell that were used to make beads. Beads made from Gulf of California shells were most frequently used in the American Southwest. They were also used by southern California groups south of the Chumash, and are evidence of participation by southern Californians in networks that were centered in the Southwest. The frequent use of beads made in the Santa Barbara Channel documents the participation of people in San Diego County in larger Californian economic networks, networks that also extended into the Southwest and the Great Basin. People in San Diego County participated in at least two overlapping but separate international economic networks.

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REPORTS

Fremont Period Shell Trade[1]

JAMES A. BENNYHOFF
(Deceased)

RICHARD E. HUGHES
Geochemical Research Laboratory,
20 Portola Green Circle, Portola Valley, CA 94028

This paper reports on and synthesizes what was known, as of 1984, about the conveyance of shell beads during the Fremont Period (ca. A.D. 400–1300) in the eastern Great Basin. Detailed site-specific analyses of extant data indicate that the majority of shell beads imported during this time interval came from Southern California.

During 1982–1984, James Bennyhoff and the junior author were involved in synthesizing what was then known about ethnographic and prehistoric trade throughout various parts of the Great Basin. The results of that effort were published in the Great Basin volume of the *Handbook of North American Indians* (Hughes and Bennyhoff 1986). Because of size limitations, the general editor of the series eliminated major sections of the original manuscript from our *Handbook* chapter. We had hoped to return to these sections, update them, and publish each separately, but other projects intervened, and in 1993 Jim Bennyhoff's death put an end to that possibility. The paper that follows was completed in 1984, and passages from it appear in Hughes and Bennyhoff (1986:251–252). The only major change to the original manuscript has been an updating of bead-type references to conform to the Bennyhoff and Hughes (1987) typology, which was essentially finished by 1984. This complete version of the original Fremont Period Shell Trade section that Bennyhoff and I submitted for the *Handbook* is offered here because it presents a significant amount of previously unpublished material; material that, to my knowledge, has yet to be superseded in depth or detail (see Note 1).

THE FREMONT SHELL TRADE STUDY

The available information on shell trade during the Fremont period (A.D. 400–1300) is very uneven. Nonetheless, we have organized the data to accord with the five Fremont districts, or variants, proposed by Marwitt (1970:Fig. 84, 1986:Fig. 2), within which more than 187 shell artifacts were found at 23 archaeological sites.[2] Frequencies per site ranged from 1–91 ($\bar{\chi}=8$); if the Caldwell necklace (73 beads) is counted as a single occurrence, the average number of beads per site would be five, with a maximum of 23 (from the Evans Mound).

The occurrence of Fremont shell artifacts by district is shown in Table 1; a finer breakdown by district, site, and bead type appears in Table 2; and site-specific references to data presented in Table 2 appear in Table 3. The location of major Fremont sites appears in Marwitt (1986: Fig. 2) and Hughes and Bennyhoff (1986: Fig. 1).

Table 1

FREMONT SHELL ARTIFACTS BY DISTRICT (VARIANT)

District	No. of Sites	No. of Beads	% of Total	No. of Occurrences	% of Total	Definite Imports	% Imported
Parowan	7	44^{+}	23.5	60*	47.6	60*	59.4
San Rafael	3	16	8.6	16	12.7	14	13.9
Sevier	4	11	5.9	11	8.7	11	10.9
Uinta	3	97	51.9	20	15.9	13	12.9
Great Salt Lake	6	19	10.2	19	15.1	3	3
Total	**23**	**187^{+}**	**100.1**	**126**	**100**	**101**	**100.1**

*= A minimum of 24 beads has been assigned to the "several dozen" *Olivella* beads reported by Judd (1919:19). $^{+}$= At least (minimum number).

CAVEATS ABOUT THE DATA AND THE SYNTHESIS

Before proceeding further, we need to comment on problems that have affected our confidence in this synthetic effort. First, most analysts have placed primary reliance on ceramics for dating and seldom illustrate or adequately describe the shell artifacts recovered. The 165 shell beads classified in Table 2 represent at least 21 types, but the inadequate descriptions and reduced photographs in cited literature leave many uncertainties. For example, only five of the "several dozen" shell beads reported by Judd (1919:19) from Paragonah can be classified, and only half (73) of the 147 fragments representing one necklace from Caldwell village (Ambler 1966:65) have been counted (see note accompanying Table 2). Wormington (1955:64) reported ten "whole and fragmentary shells, three perforated at lower end." The latter description suggests *Olivella biplicata* Split End-perforated beads (type C4), but she may have intended Spire-lopped (type A1 or A6). Three of the six *Olivella biplicata* have no description and two fragments were not identified as to genera. Aikens (1966:72) reported three "split bivalve" beads, but the specimen illustrated in Figure 34h looks like an *Olivella* Amorphous (type C7) bead. We may have misinterpreted the brief verbal descriptions provided by Steward (1936:33) and by Sharrock and Marwitt (1967:39–40), but an examination of the actual beads would be needed for accurate *Olivella* bead-type classification using the criteria in Bennyhoff and Hughes (1987). In sharp contrast to both the Southwest and the western Great Basin, only one of 187 Fremont period shell specimens occurred with a burial,[3] and this lack of large grave lots greatly impedes analysis of the different types of beads.

SUMMARY OF EXTANT SHELL BEAD DATA

With the problems outlined above acknowledged, we advance the following tentative summary of extant data on Fremont Period shell trade. By far the largest number of shell artifacts came from the Pacific coast (143 specimens), with 137 beads made from *Olivella biplicata*. Most of the latter probably came from Southern California, but the center of punched-bead manufacture (for types D1 and D2, n=14 specimens) appears to have been the San Joaquin Valley. Both of these regions were served by the Mohave trade route. The single *Olivella baetica* specimen came from northern waters, while the single *Olivella pedroana* is a Southern California species. The rarity of *Haliotis* (two pendants of undetermined species confined to the Parowan district) is in sharp contrast to the 2,144 abalone specimens from the western and southwestern subareas of the Great Basin (Bennyhoff and Hughes 1987:Table 9). Southern California is therefore the probable source for the Fremont *Haliotis* specimens, as it was definitely the source for the *Mitra* (a unique occurrence in the Great Basin) and the *Tivela* specimens.

Definite Gulf of California species were much less frequent (at least 19 specimens, but Judd [1919:19] provided no count for the *Olivella dama* beads at Paragonah). At least 17 *Olivella dama* were documented, while the single *Cerithidea albonodosa* and the single Large Bilobed bead represent unique Great Basin occurrences. These beads doubtless moved along the Colorado River route, controlled by the Hohokam. The absence of *Glycymeris* is a major contrast to its presence in collections of Southwestern shell ornaments (Jernigan 1978: Figs. 9, 20, 53, Plate 1).

The three naiad shells (one *Lampsilia*? and two *Lasmigona*?) from two southwest Colorado sites were unmodified, but had to have been traded from their native Missouri-Mississippi drainage. Although Tower (1945:Frontispiece) placed the southwestern portion of the Colorado Plateau within the limits of trade from the Gulf of Mexico, no Atlantic species have been reported from Fremont sites.

Few of the bead types have a restricted temporal significance in California. The *Olivella* Split Drilled (type C2) bead is a diagnostic Middle Period marker in Central (Bennyhoff and Hughes 1987) and Southern California (200 B.C.–A.D. 1150; King 1982: 47) and could represent the Cub Creek phase (pre-A.D. 800; Jennings 1978:112) at Caldwell Village (Ambler 1966:Fig. 50g). If accurately identified from Steward's (1936:33) description, the two Split Drilled beads from the Beaver site would represent a pre-Summit phase (although a variant of the Oval type discussed below is a possible alternative).

The *Mitra catalinae* bead from the Turner-Look site (Wormington 1955:64) should also be a Middle Period marker type. It appears in phase 3 of the Middle Period (A.D. 300–700) in Southern California (King

Table 2

FREMONT SHELL ARTIFACTS BY SITE AND DISTRICT

District	Parowan								San Rafael				Sevier					Uinta				Great Salt Lake							Total
See Table 3	1	2	3	4	5	6	7		8	9	10		11	12	13	14		15	16	17		18	19	20	21	22	23		
	Evans	Paragonah	Beaver	Marysvale	Kanosh	Garrison	Amy's Shelter	Parowan Total	Poplar Knob	9 Mile Canyon Sky House	Turner Look	San Rafael Total	Backhoe Village	Nephi	Tooele	Grantsville	Sevier Total	Caldwell Village	Pine Springs	48SW94	Uinta Total	Levee	Knoll	Promontory Cave 2	Bear River No. 1	Willard	Injun Creek	Great Salt Lake Total	**TOTAL**
Pacific Coast (*Olivella biplicata*)																													
Spire-lopped						2		2						1			1	1			1								4
Spire-lopped End Perfor.		1						1																					1
Barrel Split																		4			4								4
C2			2					2										1			1								3
Split End-Perfor.	4							4			3	3																	7
C7																									3				3
D1	6	2						8	4			4	1				1												13
D2		1						1																					1
G1							1	1																					1
J? Wall Disk				1	4			5		2		2		3		1	4												11
C3															1		1	83			83								84
Unidentified											3	3																	3
Reworked				2				2																					2
Olivella biplicata total	10	4	2	3	4	2	1	26	4	2	6	12	1	4	1	1	7	89			89				3			3	137
Pacific Coast (other)																													
A1 *O. baetica*											1																		1
A1a *O. pedroana*																		1											1
Haliotis sp.	1				1																								2
Mitra catalinae											1																		1
Tivela sultorum	1																												1
Other Pacific Coast total	2				1						2							1											6
Pacific Coast Total	12	4	2	3	5	2	1	29	4	2	8	14	1	3	2	1	7	90			90				3			3	143
Gulf of California																													
B3. *O. dama*	10	4						14						3			3												17
Cerethidia albonodosa	1							1																					1
Unidentified bilobed													1				1												1
Gulf of California total	11	4						15					1	3			4												19
Great Plains																													
Lampsila?																			1		1								1
Lasmigona?																				2	2								2
Plains total																					3								3
Imported Total	23	8	2	3	5	2	1	44	4	2	8	14	2	6	2	1	11	90	1	2	93				3			3	165
Local																													
Anodonta pendant																						2	3				6		11
Margaratifera pendant																								1					1
Serrated mussel pendant																									3				3
Local Total																						2	3	1	3		6	15	15
Unidentified																													
"Shell disk, unperforated"																										1			1
"Shell pendant"																		1			1								1
"Clam shells"																				3	3								3
Fragments											2	2																	2
Unidentified Total											2	2									4					1		1	7
Site Total	**23**	**8**	**2**	**3**	**5**	**2**	**1**	**44**	**4**	**2**	**10**	**16**	**2**	**6**	**2**	**1**	**11**	**91**	**1**	**5**	**97**	**2**	**3**	**1**	**6**	**1**	**6**	**19**	**187**

Notes: Judd (1919:19) reported "several dozen" *Olivella biplicata* and *Olivella dama* from Paragonah. Only four of these were illustrated in his 1926 report (Plate 46f-i). Multiple types are represented, so only four specimens (and a minimum of four *Olivella dama*) have been tabulated.

Ambler (1966:65) reported that six ovoid beads and 147 fragments represent one necklace found on a floor at Caldwell Village. Only half of the fragments have been counted. If this necklace is counted as one occurrence, there would be only six *Olivella* Oval (type C3) beads and a site total of 14 shell specimens, a figure more in line with the remote Uinta location.

Table 3

FREMONT SITES WITH SHELL ARTIFACTS REPORTED IN TABLE 2

Number	Site	Reference
1.	Evans Mound	Alexander and Ruby 1963: 24; Metcalfe 1982: 89
2.	Paragonah	Judd 1926: Plate 46f-i; MacBain 1956: 54
3.	Beaver	Steward 1936: 33
4.	Marysvale	Gillin 1941: 32
5.	Kanosh	Steward 1936: 33
6.	Garrison	Taylor 1954: 56
7.	Amy's Shelter	Gruhn 1979: 146
8.	Poplar Knob	Taylor 1957: 108
9.	Nine Mile Canyon	Gillin 1955: 21
10.	Turner-Look	Wormington 1955: 64
11.	Backhoe Village	Madsen and Lindsay 1977: 73
12.	Nephi	Sharrock and Marwitt 1967: 39
13.	Toole	Gillin 1941: 32
14.	Grantsville	Steward 1936: 33
15.	Caldwell Village	Ambler 1966: 64
16.	Pine Spring	Sharrock 1966: 111
17.	48Sw94	Sharrock 1966: 95, 109
18.	Levee	Fry and Dalley 1979: 61
19.	Knoll	Fry and Dalley 1979: 79
20.	Promontory Cave 2	Steward 1937: 101
21.	Bear River	Aikens 1966: 72
22.	Willard	Steward 1936: 33
23.	Injun Creek	Aikens 1966: 51

1982:Fig. 7r). King (1982:363) has assigned all *Mitra* to the species *M. idae*, but Gifford (1947:8, type C4) indicates that the smallest specimens are probably *Mitra catalinae*.

The *Olivella* Split Amorphous (type C7) bead is diagnostic of the Middle/Late Period transition phase (A.D. 700–900) in Central California. The three specimens from the Bear River Site No. 1 (Aikens 1966: Fig. 34h) represent the Bear River phase (A.D. 400–1000, Jennings 1978:162) and the radiocarbon date of A.D. 885 ±120 (Holmer and Weder 1980:59) from this site is in agreement with the Central California dating for this marker type.

The *Olivella* Oval (type C3) bead also appears for the last time in California and the western Great Basin during the Middle/Late Period transition phase. The occurrence of a probable necklace (ca. 73 type C3 beads) on the floor of Pithouse 14 at Caldwell Village with Uinta Gray ware sherds and no Anasazi trade wares (Ambler 1966:35–36, 65) supports an early dating, ca. 800–950 (Whiterocks Phase), prior to Ambler's (1966:38) dating of A.D. 1050–1250 based on later Anasazi trade wares found in four other pithouses. We have followed Ambler's oval bead classification, although his Fig. 50p may well be type C2 (pre-A.D. 700), and he indicates (p. 65) that other types may be included in the 147 fragments.

The *Olivella* Shelved Punched (type D1) and *Olivella* Rectangular Punched (type D2) beads are most common in the same Middle/Late Period transition phase in Central California (A.D. 700–900) and Southern California (A.D. 1050–1150; King 1982:7; Phase M5) but persist into early Phase 1 of the Late Period (A.D. 900–1100) in Central California. The single type D1 from Backhoe Village (Madsen and Lindsay 1977:Fig. 43A) would support the earlier dating because the seven radiocarbon dates from this site span A.D. 770–910. The other 13 Punched (types D1 and D2) beads appear to be contemporaneous with early Phase 1 of the Late Period in Central California (A.D. 900–1100) or Phase M5c in Southern California (A.D. 1050–1150; King 1982:47). The four type D1 specimens from the Poplar Knob site (Taylor 1957:108, Fig. 37) were found together on a floor with 15 Mancos Black-on-White sherds (A.D. 950–1050/1200). The six type D1 beads from the Evans Mound (Alexander and Ruby 1963:24, Plate 1i, k) were assigned to the Paragonah phase (A.D. 1050–1175). A similar dating is probable for the three illustrated specimens (two type D1, one type D2) from the Paragonah site (Judd 1926:Plate 46h, i [type D1], g [type D2]). It should be noted that the Shelved Punched type is the most common Fremont shell-bead type, yet no *Olivella* Sequins (type M1), normally associated with type D1 in Central California, appear in Fremont sites. This discrepancy strengthens the San Joaquin Valley source proposed for Punched beads, whereas Sequins were manufactured on the Central California coast and along the north shore of San Francisco Bay. The discrepancy also is apparent in the western Great Basin, where the 20 *Olivella* Sequins were far outnumbered by the 88 Punched beads (types D1, D3; Bennyhoff and Hughes 1987:Table 5).

The tiny *Olivella* saucer bead (type G1 in Bennyhoff and Hughes 1987:132) is not a good time marker in Central California, but it occurred at Amy's Shelter in deposits dated to ca. A.D. 1000–1200 (Gruhn 1979:146, 151).

A date of A.D. 900–1100 can be assigned to the Large Bilobed bead from Backhoe Village (Madsen and Lindsay 1977:Fig. 43b) because this type is most common during the Sacaton phase of the Hohokam (Haury 1976:310).

Fremont peoples occasionally reworked the imported *Olivella biplicata* Spire-lopped beads. The Spire-lopped End-perforated bead (type A6; Judd 1926:Plate 46f from Paragonah) is a new, unique form that had been drilled for suspension. At least two beads from Marysvale (Gillin 1941:Plate Vb, 10, 11) appear to be non-standardized, reworked specimens. The seven type C4, along with eight from the western Great Basin (Bennyhoff and Hughes 1987:Table 6), represent a type not found in California. We should note that Bennyhoff and Heizer (1958:75, type 3b1, Fig. 1, nos. 29–32) lumped types C2 and C4 together as a Middle Period type. The Fremont data clearly indicate that type C4 is later in the Great Basin, contemporaneous with Phase 1 of the Late Period in California.

A total of 15 *Anodonta* or *Margaritifera* pendants represent local freshwater shells, all from the Great Salt Lake district. Another seven specimens represent unidentified "shell." If these 22 specimens are omitted, 101 occurrences represent definite imports, and by this measure the Great Salt Lake district was clearly the most isolated.

SUMMARY AND CONCLUDING COMMENTS

The remaining types in Table 2 lack specific temporal significance, but are compatible with the A.D. 400–1300 time span of the Fremont culture. If meaningful provenience were available for the 187 shell artifacts, a refined phasing might be possible. But for now, an early and late division seems apparent. Six types (*Mitra*, C2, C3, C7, D1, and D2), representing 105 beads (35 occurrences), are definitely early (A.D. 400–950). We can probably add the six other beads from Caldwell Village (types A1, B3, *Olivella pedroana*), although there were seven Anasazi trade sherds at the site (dating to A.D. 1050–1226; Ambler 1966:38). If the three shells from the Plains are added, a total of 114 specimens (69% of the 165 imports) or 44 occurrences (44% of 101) is obtained. By this division, the late Fremont Period (A.D. 950–1300) would be represented by 51 specimens (31%) or 57 occurrences (56%). The frequency of occurrences is preferred here, which indicates a slight increase in shell trade with the south and west, although the change is not as dramatic as the influx of decorated and corrugated Anasazi pottery. Although all five districts received shell beads in the earlier period, no beads reached the Great Salt Lake district or the Uinta (?) district in the later period. This difference supports the conclusion that the majority of the shell beads imported by Fremont peoples came from the Southern California area, rather than from the Gulf of California, east across the western Great Basin or from the north.

NOTES

[1] Since our last collaborations (Hughes and Bennyhoff 1986; Bennyhoff and Hughes 1987), some significant research has been conducted on the dating of Californian shell artifacts and on Fremont shell bead and ornament conveyance. In particular, AMS dates now support a revised chronology for *Olivella* shell beads (termed Scheme "D;" see Groza 2002, Milliken et al. 2007:Fig. 8.4, Hughes and Milliken 2007:Fig. 17.2, and Groza et al. [this volume]) which helps to reconcile the conflict between the dating of similar bead types in Southern California (e.g., King 1982) and Northern California (Scheme B1, Bennyhoff and Hughes 1987). The implication of these new data is that individual types were contemporaneous throughout California and across much of the Great Basin. In addition, the revised "Scheme D" chronology may resolve inconsistencies between the current dating of pottery types and the previous dating of shell bead styles in Fremont period sites (using Scheme B). Furthermore, Chester King (personal communication, 2010) informs me that his research shows that *Olivella dama* Barrel beads ceased being used after the Sacaton Phase of the Hohokam and that there is an apparent cessation of use at Malibu and in the Fremont area at the same time. He notes that Split Punched beads apparently do not occur with *O. dama* Barrels but are found with *O. dama* Spire Ground; that sites (e.g., the Baker site) with predominantly Split Punched beads have few *O. dama* Barrels; and that Split Punched beads are found in Pueblo III contexts and not earlier. Jardine (2007) and Janetski et al. (2011) update what is known of Fremont shell bead occurrences, and the excellent recent summaries by Janetski (2002) and Madsen and Simms (1998) place Fremont studies in a broader perspective.

[2] Those comparing this text with the excerpts published in Hughes and Bennyhoff (1986:251) will probably have noted an error. The monograph attributed to Bennyhoff (1985) in the bibliography of the Great Basin volume of the *Handbook of North American Indians* (p. 750) does not, nor did it ever, exist. Including this citation in the *Handbook* was a decision made by the general series editor. Bennyhoff and I were unable to correct the error before it made its way into print, because chapter authors were not allowed to edit galley proofs.

[3] At the Turner-Look site, one "perforated *Olivella*" was found in the thoracic cavity of a 4–6 year old infant (Wormington 1955:64).

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Archaeological Evidence of Eagles on the California Channel Islands

MARLA DAILY
Santa Cruz Island Foundation, 1010 Anacapa Street, Santa Barbara, CA 93101; marla@scifoundation.org

*Historical records show that bald eagles (*Haliæetus leucocephalus*) once inhabited all eight California Channel Islands. Golden eagles (*Aquila chrysaetos*), however, do not appear in historical records as island residents. This study presents results of a search for prehistoric evidence of eagles in archaeological materials excavated from the California Channel Islands, along with brief biographical notes about the archaeologists who found them. Thirteen eagle talons from three islands were found in archeological collections of four institutions and identified as to species. Ten talons were from Santa Cruz Island, two were from San Nicolas Island, and one was from Santa Rosa Island, and they proved to be a mix of both bald eagle and golden eagle talons. They were found in materials excavated between 1875 and 1928 by Paul Schumacher, Steven Bowers, David Banks Rogers, George Albert Streeter, and Ronald Leroy Olson. One talon was decorated with asphaltum and olivella shell beads; five were drilled with a hole for wearing as adornment; seven appeared to be unmodified. An eagle talon presence in archaeological remains cannot be assumed to be evidence of prehistoric eagle occupation of these islands, as island dwellers had well-developed trade networks through which talons may have been traded. Additional talons and other eagle remains undoubtedly will be identified in the future in faunal remains from Channel Islands archaeological sites.*

The bald eagle (*Haliæetus leucocephalus*) is the largest North American bird of prey. It was first described by Linnæus in 1766, and sixteen years later (1782) became the national bird of the United States, symbolizing freedom, power, and majesty. Eagles have been found to be of great significance in the rituals of some California Native American groups (Kroeber 1925; Miller 1956). James G. Cooper noted that "Dr. Gambel states that they [bald eagles] were held sacred by the Indians, which will in a measure account for their abundance and protection by the natives" (Cooper 1870a:452). It is, therefore, not surprising that eagle talons are represented in cultural materials from archaeological excavations on the California Channel Islands.

Historical records show that bald eagles once inhabited all eight California Channel Islands, although specimen data are lacking for San Nicolas Island[1] (Daily n.d.a). No golden eagles are recorded as historically occupying any of the eight California Channel Islands. Eagles are commemorated in early island place names: Eagle Rock on San Miguel Island; Eagle Rock on Santa Rosa Island; Eagle Canyon on Santa Cruz Island; Eagle Rock on San Nicolas Island; Eagle's Nest and Eagle Reef on Santa Catalina Island; and Eagle Ranch on San Clemente Island. The earliest historical notice of a bald eagle on the California Channel Islands was recorded by William Gambel on his trip to Santa Catalina Island in February, 1843 (Gambel 1846); he reported bald eagles nesting on "precipitous cliffs." James G. Cooper (1870a, 1870b) reported bald eagles as being common and numerous along inaccessible cliffs during his visits to Santa Catalina Island in 1861 and 1863. Cooper noted (1870a) that thirty bald eagles were seen at the north end of Santa Catalina Island on July 9, 1873. Almost three decades after Gambel's first sighting of bald eagles, two specimens were shot on San Miguel Island by George Davidson, Superintendent of the U.S. Coast Survey, and deposited at the Academy of Natural Sciences in Philadelphia in 1871.[2] Just over a century after Gambel's first bald eagle observations, egg-collector Lucien R. Howsley removed the last known set of bald eagle eggs from Santa Rosa Island in 1949.[3] The last known active bald eagle nest was photographed by Alden H. Miller on Santa Rosa Island in March, 1950 (Miller 1950), after which only occasional bald eagle sightings were reported.

STUDY AREA AND METHODS

There are eight islands located off the coast of southern California that comprise California's Channel Islands (Fig. 1). They are divided into two separate groups: the Northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa islands), and the Southern Channel Islands (San Nicolas, Santa Barbara, Santa Catalina, and San Clemente islands). They extend in

Figure 1. California's eight Channel Islands are located off the coast of Southern California.

a northwest to southeast direction for about 160 miles from Point Conception to San Diego, and lie from eleven to sixty miles offshore. The islands range in size from 96 square miles (Santa Cruz Island) to one square mile (Santa Barbara Island), and collectively total approximately 350 square miles of land offshore. These islands, and their accompanying offshore rocks and pinnacles, served as a natural range for the bald eagle until the mid twentieth century (Daily n.d.a). The islands also served as home to a variety of indigenous peoples for more than 13,000 years (Glassow 1977).

Since the nineteenth century, archaeological explorations and excavations have occurred on all eight California Channel Islands, and cultural materials from them have been deposited in museums around the world (Blackburn and Hudson 1990). Until now, however, little mention has been made of eagle remains from island archaeological sites. The search for such evidence was made as an ancillary part of a larger research study on the history of bald eagles on the California Channel Islands. While visiting ornithological and oological collections across the United States in search of eagle specimen material, the opportunity was taken to also examine archaeological collections from the California Channel Islands. In all cases where eagle talons were located in island archaeological materials, none had been correctly identified as to genus and species, and in one case the accession record identification was incorrect.[4] Paul Collins, Curator of Vertebrate Zoology at the Santa Barbara Museum of Natural History, provided all identifications. By using contemporary sets of comparative left/right talons from both bald eagle and golden eagle specimens, positive talon identifications were made.

ARCHAEOLOGICAL FINDS OF EAGLE TALONS ON THE CALIFORNIA CHANNEL ISLANDS

Thirteen eagle talons from three California Channel Islands were located and identified during the course of the study. These talons were located in the following museum collections: Santa Barbara Museum of Natural History, Santa Barbara (6 talons); Phoebe Hearst Museum of Anthropology, University of California, Berkeley (4 talons); American Museum of Natural History, New York (2 talons); and the National Museum of Natural History, Department of Anthropology, Suitland (1 talon). Given the fact that the historical range of bald eagles included all eight islands, one might expect to find bald eagle talons. However, five of the thirteen talons found in archaeological sites on the Channel Islands were from golden eagles.

The thirteen eagle talons were collected on their respective islands between 1875 and 1928. Ten came from Santa Cruz Island, two from San Nicolas Island, and one from Santa Rosa Island (Table 1). The earliest three were collected in 1875 (1 talon) and 1879 (2 talons) by Paul Schumacher and the Reverend Stephen Bowers, respectively. The remaining ten were collected in 1927 (7 talons) and 1928 (3 talons) by David Banks Rogers, his field assistant George A. Streeter, and Ronald L. Olson.

Five of the ten raptor talons found on Santa Cruz Island between 1875 and 1928 were identified as golden eagle, four were bald eagle, and one was probably bald eagle. (The latter specimen was small and somewhat worn, thus making positive identification difficult.) The earliest talon was found by Paul Schumacher (1844–1883) (Fig. 2), who had developed an interest in archaeology while working on the West Coast as an employee of the U.S. Coast Survey. Between 1872 and 1879, Schumacher collected artifacts on at least four of the eight California Channel Islands, and sold portions of his collections to the Smithsonian Institution and to Harvard University's

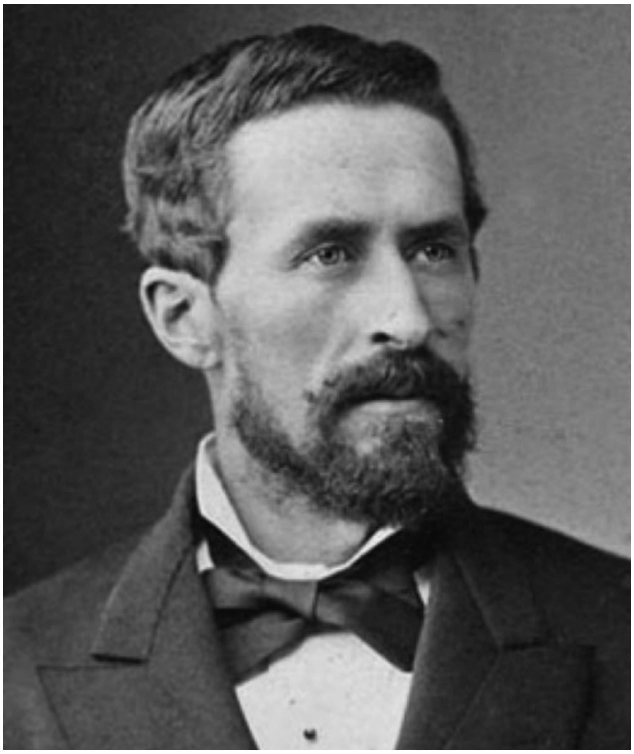

Figure 2. Paul Schumacher (1844–1883). Courtesy of the History Center of San Luis Obispo County.

Table 1

PREHISTORIC EAGLE TALONS FROM THE CALIFORNIA CHANNEL ISLANDS

	Figure	Island	Location	Site	Type	Collector	Excavation Year	Excavation Date	I.D. Number
1.	Fig. 3	Santa Cruz Island			Bald eagle	Paul Schumacher	1875		NMNH A18192-0/004199
2.	Fig. 5	Santa Cruz Island	Coches Prietos		Bald eagle		1927		SBMNH I.1710
3.	Fig. 5	Santa Cruz Island	Coches Prietos		Golden eagle		1927	5/15	SBMNH I.1200
4.	Fig. 5	Santa Cruz Island	Coches Prietos		Bald eagle		1927	5/16	SBMNH I.1131
5.	Fig. 5	Santa Cruz Island		Christies Site #3 Pit N	Golden eagle	David B. Rogers	1927	6/17	SBMNH I.1137
6.	Fig. 5	Santa Cruz Island		Christies Site #3 Pit N	Golden eagle	David B. Rogers	1927	6/17	SBMNH I.1137
7.	Fig. 7	Santa Cruz Island	Forney's	CA-SCrI-I-3	Bald eagle	Ronald L. Olson	1927	7/2–8/13	PHMA 1-30531
8.	Fig. 7	Santa Cruz Island	Forney's	CA-SCrI-I-3	Bald eagle likely	Ronald L. Olson	1927	7/2–8/13	PHMA 1-30531
9.	Fig. 7	Santa Cruz Island	Scorpion Harbor	CA-SCrI-138	Golden eagle	Ronald L. Olson	1928		PHMA 1-37069
10.	Fig. 7	Santa Cruz Island	Scorpion Harbor	CA-SCrI-138	Golden eagle	Ronald L. Olson	1928		PHMA 1-36872
11.	Fig. 10	San Nicolas Island			Bald eagle	Steven Bowers	1879		AMNH 14460
12.	Fig. 10	San Nicolas Island			Bald eagle	Steven Bowers	1879		AMNH 14461
13.	Fig. 11	Santa Rosa Island	Ranch House		Bald eagle	David B. Rogers	1927	8/8	SBMNH I.1577

newly completed (1877) Peabody Museum (Daily n.d.b). In 1875 Schumacher worked on Santa Cruz Island, and a bald eagle talon he collected was among items sold to the Smithsonian.[5] This is the earliest collected talon identified from an archaeological site on the California Channel Islands (Fig. 3). Unfortunately, Schumacher did not provide specific site information. The talon had been drilled with a hole for possible use as an ornament. It is an interesting coincidence that Schumacher excavated this bald eagle talon on Santa Cruz Island in the same year (1875) that Henry Weatherbee Henshaw collected the earliest known bald eagle egg from the California Channel Islands from a nest on Santa Cruz Island.[6]

In 1927, some fifty-two years after Schumacher's Santa Cruz Island bald eagle talon find, anthropologist David Banks Rogers (1868–1954) (Fig. 4) excavated an additional four eagle talons on Santa Cruz Island, three of which were identified as golden eagle (Fig. 5). Rogers had worked for both the Smithsonian Institution and the Heye Foundation in New York before moving to Santa Barbara, where he established the Anthropology Department at the Santa Barbara Museum of Natural History in 1923 (Daily n.d.b). He made his first of many field trips to San Miguel, Santa Rosa, and Santa Cruz islands in March and April of 1927. An Island Fund was established at the museum to support Rogers' island excavations. On May 15, 1927, while working at Coches Prietos (CA-SCRI-1) on the south side of Santa Cruz Island, Rogers found an eagle talon decorated with asphaltum and olivella shell beads in "debris in bank." It was identified as golden eagle.[7] The following day, Roger's field assistant, Santa Barbara native George A. Streeter (1871–1946), found a second talon, this one undecorated (Fig. 5). It was identified as bald eagle.[8] A third talon, also identified as bald eagle, was recovered during the May, 1927 excavations at Coches Prietos.[9] A month later, on June 17, 1927, while working at Christy Ranch (CA-SCRI-257) towards the island's west end, Rogers recovered two additional undecorated and undrilled talons. Both were identified as golden eagle (Fig. 5).[10]

Ronald Leroy Olson (1895–1979) (Fig. 6), joined David Banks Rogers' 1927 excavations on Santa Cruz Island, and spent a total of eleven weeks in the field. He returned to the island for an additional six weeks in 1928 (Olson 1930). Olson worked at a number of sites, including Prisoners' Harbor, Coches Prietos,

Figure 3. Bald eagle talon collected on Santa Cruz Island in 1875 by Paul Schumacher [NMNH A18192-0/004199]. Courtesy of the National Museum of Natural History, Smithsonian. Photo by Brian Burd. Talon identification courtesy of Paul Collins, November 8, 2006.

Figure 4. David Banks Rogers (1868–1954). Photo courtesy of the Santa Barbara Museum of Natural History

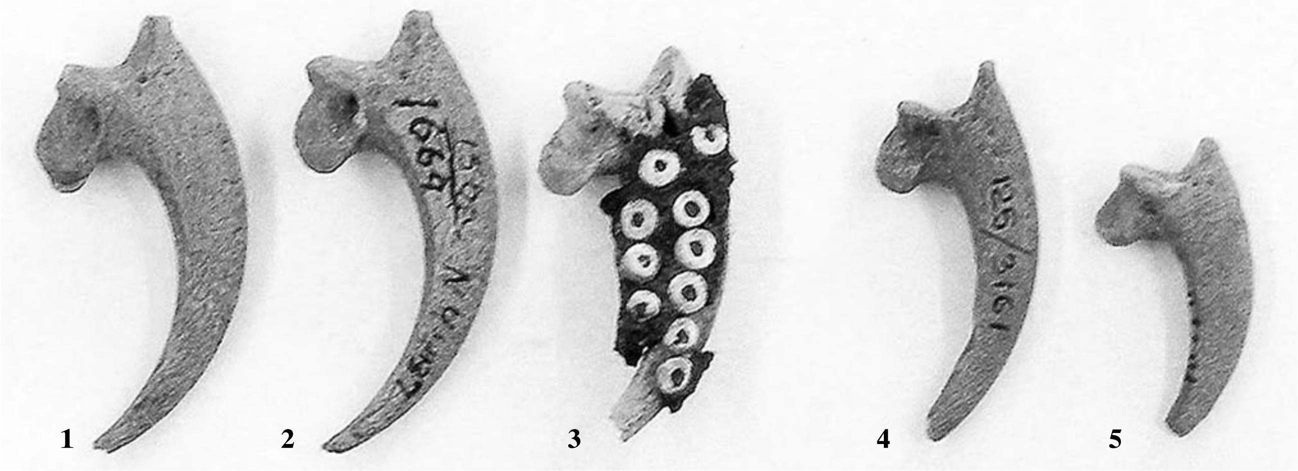

Figure 5. Talons from Santa Cruz Island sites, SBMNH, left to right:

1. **Golden eagle, (CA-SCRI-257), excavated by David B. Rogers on June 17, 1927. "Dual burial." [SBMNH I.1137].**
2. **Golden eagle, (CA-SCRI-257), excavated by David B. Rogers on June 17, 1927. "Dual burial." [SBMNH I.1137].**
3. **Golden eagle, Coches Prietos (CA-SCRI-1), excavated May 15, 1927. Talon with asphaltum inlaid with olivella beads found in "debris in bank." [SBMNH I.1200].**
4. **Bald eagle, Coches Prietos (CA-SCRI-1), excavated on May 16, 1927. "Streeter near garden." [SBMNH I.1131].**
5. **Bald eagle, Coches Prietos (CA-SCRI-1), excavated May 1927. "Unprepared material from various test pits near the garden." [SBMNH I.1710].**

Courtesy of the Santa Barbara Museum of Natural History, Santa Barbara. Photo by Brian Burd, Santa Cruz Island Foundation. Talon identification courtesy of Paul Collins, March 27, 2006.

Figure 6. Ronald Leroy Olson (1895–1979). Courtesy of the Santa Cruz Island Foundation.

Willows, Cañada Cebada, Christy Ranch, Forney's Cove, Johnson's Landing, Morse Point, Poso Creek, between Fry's and Platts harbors at Orizaba, in the Central Valley, and on the east end of the island at both Scorpion Anchorage and Smugglers Cove. His Santa Cruz Island collections were deposited at the Phoebe Hearst Museum of Anthropology, University of California, Berkeley. Olson discovered four eagle talons on Santa Cruz Island (Fig. 7), two at Scorpion Harbor on the island's east end,[11] and two at Forney's Cove on the island's west end.[12] The two talons from Scorpion Harbor were identified as golden eagle. Both were drilled for suspension, and (according to Paul Collins) may have been from the same bird. One talon from Forney's Cove was identified as bald eagle, and the second as likely being bald eagle. Neither was modified.

On November 8, 1879, two eagle talons were excavated on San Nicolas Island by the Reverend Stephen DeMoss Bowers (1832–1907) (Fig. 8), Methodist minister, newspaper publisher, and self-taught archaeological collector. Bowers recognized that prehistoric cemeteries "were rich in archaeological treasures," and thus began excavating burials on various Channel Islands and selling

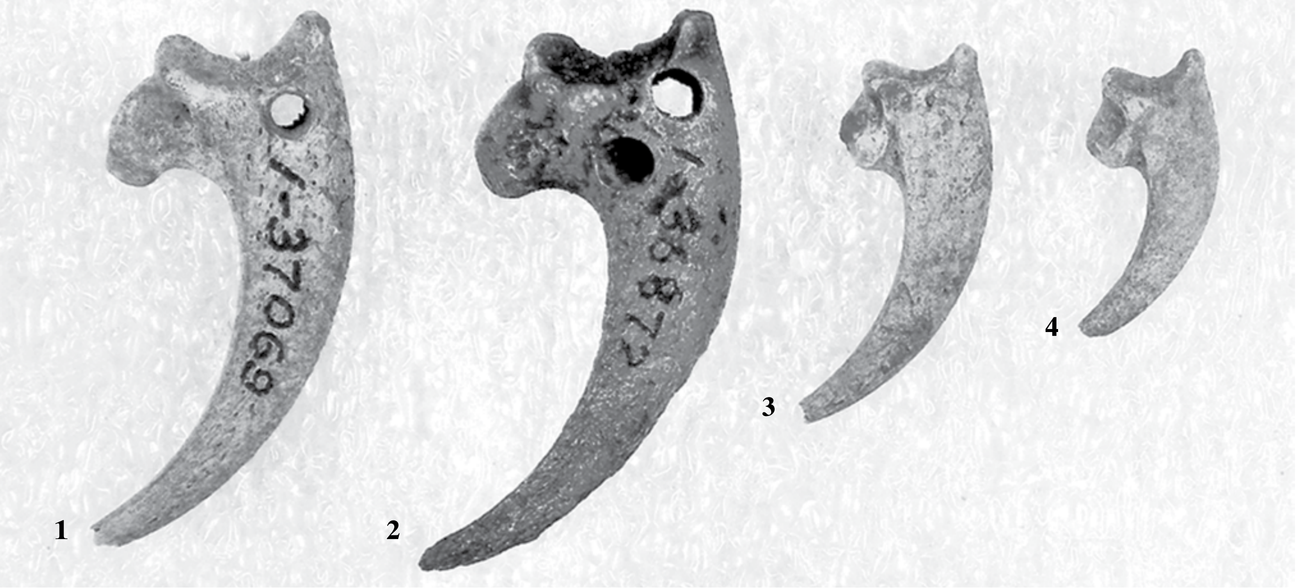

Figure 7. Golden eagle and bald eagle talons collected by Ronald Olson on Santa Cruz Island in 1927 and 1928. PHMA, left to right:

1. **Golden eagle, Scorpion Harbor, excavated in 1928 by Ronald L. Olson; site CA-ScrI-138 [PHMA 1-37069].**
2. **Golden eagle, Scorpion Harbor, excavated in 1928 by Ronald L. Olson; site CA-ScrI-138. Gifford (1940) type specimen "VV." Talons possibly from the same bird [PHMA 1-36872].**
3. **Bald eagle, Forney's, excavated July 2–August 13, 1927 by Ronald L. Olson; site CA-ScrI-3. Possibly female [PHMA 1-30531, larger talon].**
4. **Likely bald eagle, Forney's, excavated July 2–August 13, 1927 by Ronald L. Olson; site CA-ScrI-3. Possibly male [PHMA 1-30531, smaller talon].**

Courtesy of the Phoebe A. Hearst Museum of Anthropology, University of California, Berkeley.
Photo by Brian Burd, Santa Cruz Island Foundation. Talon identification courtesy of Paul Collins, June 28, 2006.

archaeological specimens and skulls to interested buyers (Benson 1997). He collected heavily on San Miguel, Santa Rosa, Santa Cruz, and San Nicolas islands. One of Bowers' customers was a wealthy private collector, James Terry (1844–1912) (Fig. 9). Terry bought a number of San Nicolas Island items from Bowers, including the two talons from San Nicolas Island.[13] Twelve years later, when Terry was named Curator of Anthropology at the American Museum of Natural History in New York, he sold his collection of more than 25,000 artifacts, many of them from California, to the museum. The two San Nicolas Island bald eagle talons were accessioned in 1891 as "bear claws," one of which was "pierced to string for necklace."[14] Terry remained curator for three years (1891–1894), until he had a falling out with the institution's president. The San Nicolas Island talons he had purchased from Bowers remained accessioned in the museum catalogue as bear claws until 2006, when they were positively identified for the author by Paul Collins as bald eagle (Fig. 10).

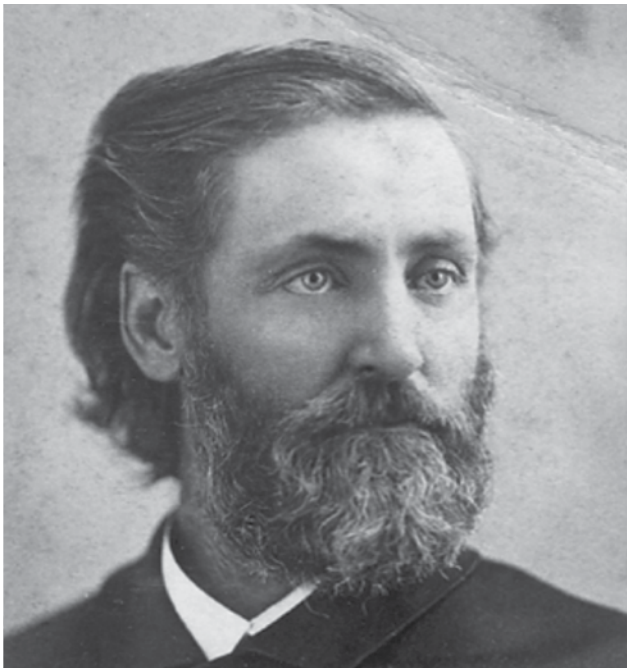

Figure 8. Stephen DeMoss Bowers (1832–1907). Courtesy of the Santa Cruz Island Foundation.

Figure 9. James Terry (1844–1912) [PH1/88]. Photo courtesy of the American Museum of Natural History.

Figure 10. Bald eagle talons collected on San Nicolas Island in 1879 by Stephen Bowers and sold to collector James Terry. [AMNH T/14461, T/14460]. Courtesy of the American Museum of Natural History. Photo by Brian Burd, Santa Cruz Island Foundation. Talon identification by Paul Collins, September 8, 2006.

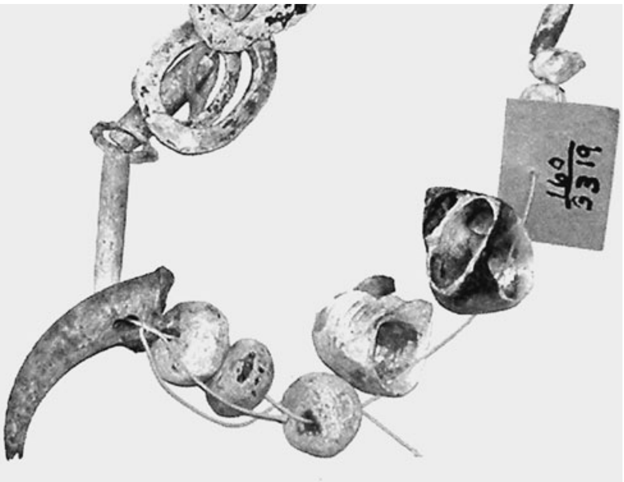

Figure 11. Bald eagle talon on necklace from infant burial, Ranch House, Santa Rosa Island. [SBMNH Rogers I.1577]. Courtesy of the Santa Barbara Museum of Natural History, Santa Barbara. Photo by Brian Burd, Santa Cruz Island Foundation. Talon identification by Paul Collins, March 30, 2006.

On August 8, 1927, Santa Barbara Museum of Natural History archaeologist David Banks Rogers excavated an infant burial at the "Ranch House" on Santa Rosa Island. At a depth of ten feet on the north side of the site, Rogers found a long necklace composed of a number of species of seashells and a drilled eagle talon.[15] The talon was identified as bald eagle (Fig. 11). Much of Rogers' work along the Santa Barbara Channel was described in his 1929 book, *Prehistoric Man of the Santa Barbara Coast*, published by the Santa Barbara Museum of Natural History.

Of the thirteen eagle talons found in archaeological materials from Santa Cruz, Santa Rosa, and San Nicolas islands, five were positively identified as golden eagle. One of the golden eagle talons from Coches Prietos on Santa Cruz Island was decorated with asphaltum and olivella shell beads. Two additional golden eagle talons from Scorpion Harbor on Santa Cruz Island were drilled for stringing, as were two bald eagle talons, one from an unspecified location on Santa Cruz Island and the other from Santa Rosa Island. Because golden eagles do not appear as a resident species in the historical records of the California Channel Islands, it is likely these talons arrived through mainland-island trade. Further research and better identification of talon artifacts are warranted.

NOTES

[1] Howell 1917 listed bald eagles as "abundant" on the California Channel Islands, and noted that C. B. Linton collected a set of bald eagles from San Nicolas Island (Willett 1912). The specimen has yet to be found.

[2] George Davidson, ca. 1871. Two adult bald eagle specimens from San Miguel Island, ANSP #33149; ANSP#33150, Academy of Natural Sciences, Philadelphia.

[3] Lucien R. Howsley, 1949. Last known set of bald eagle eggs from Santa Rosa Island, WFVZ22562.

[4] The misidentified talon was a grizzly bear (*Ursus arctos*) terminal phalange recovered from a site on San Nicolas Island — a rare and significant find.

[5] NMNH A18192-0/004199.

[6] BMNH 1891.3.1.488.

[7] SBMNH I.1200.

[8] SBMNH I.1131.

[9] SBMNH I.1710.

[10] SBMNH I.1137; SBMNH I.1137.

[11] PHMA 1-37069; PHMA 1-36872.

[12] PHMA 1-30531; PHMA 1-30531.

[13] AMNH 14461; ANMH 14460.

[14] AMNH 14461.

[15] SBMNH I.577.

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In Search of a White Bear: An Eccentric Crescent from Sudden Ranch (CA-SBA-208), Northern Santa Barbara County, California

JON M. ERLANDSON
Museum of Natural and Cultural History and Department of Anthropology, University of Oregon, Eugene, OR 97403-1224

Over the years, there has been considerable interest among archaeologists in the distribution, function, and chronology of chipped stone crescents in California and the western United States. Questions about their chronology and function have yet to be fully resolved, but such crescents are widely considered to be Early Holocene or terminal Pleistocene time markers. More than a thousand crescents have been identified from California archaeological sites, but a relatively small percentage have zoomorphic attributes, including a rare 'bear-shaped' specimen now listed as California's official prehistoric artifact. About 20 years ago another bear-shaped crescent in the Lompoc Museum was brought to my attention, a specimen not described in previous syntheses of crescents in California and the Far West. The location of that crescent is now uncertain, but I recently found additional data on the provenience and context of this crescent in two unpublished manuscripts by Clarence Ruth. This rare artifact has an unusual history that sheds light on the development of California archaeology.

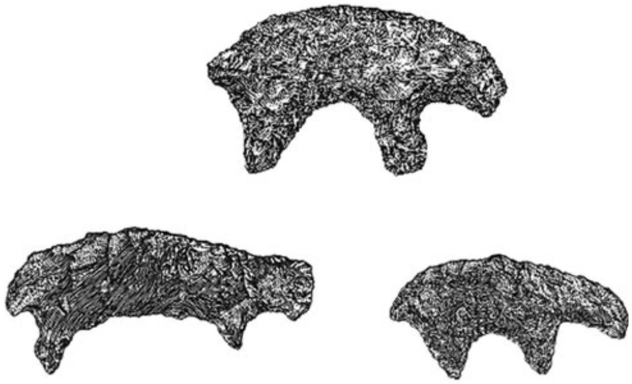

Figure 1. Zoomorphic crescents from CA-SDI-9649 (top) and Santa Rosa Island (bottom). Adapted from Koerper and Farmer (1987). The Santa Rosa Island specimens, curated at the Phoebe Hearst Museum of Anthropology at the University of California, Berkeley, are described as 'animal-form scrapers.'

Chipped stone crescents, one of the more enigmatic artifacts found in California and the western United States (see Beck and Jones 2007:101; Fenenga 1992; Hattori 2008; Mohr and Fenenga 2010; Smith 2008; Tadlock 1966), are often considered to be Early Holocene or terminal Pleistocene time makers. In California, several distinctive types have been defined from coastal sites distributed from Sonoma County to the Mexican border, as well as similar specimens found in the interior portions of the state (see Fenenga 1984; Jertberg 1978; Mohr and Fenenga 2010). Although it is generally agreed that crescents are closely associated with lake, marsh, estuary, and coastal habitats, the function of these distinctive chipped stone artifacts has long been debated, with interpretations ranging from the utilitarian to the symbolic (see Smith 2008). Wardle (1913) and Heye (1921:72) suggested that Channel Island specimens may have been used as surgical tools, for instance, while others have described them as specialized scraping or cutting tools (Fenenga 1984). Some California and Great Basin scholars have interpreted crescents as transverse projectile points, possibly used in bird hunting (see Erlandson and Braje 2008a). Still others, noting the zoomorphic nature of some specimens (Fig. 1), argued that they served as amulets or animal effigies used in "magico-religious activities" (see Koerper et al. 1991:58). The latter group includes a bear-shaped specimen from San Diego County that is the official prehistoric artifact of the state of California (Koerper and Farmer 1987).

Because most crescents in California and the Great Basin have come from surface contexts, or from bioturbated sites that often contain multiple components, their chronology and possible typological changes through time are poorly understood. Nonetheless, for those specimens that have come from stratified contexts or multi-component sites that are well dated, there is a strong correlation between crescents and evidence for early human occupations (i.e., San Dieguito, Western Pluvial Lakes Tradition, Paleocoastal, and Early Milling Stone components) dating between about 12,000 and 7,000 cal B.P, plus or minus a millennium (Davis et al. 2010; Erlandson 1994; Erlandson and Braje 2008b; Fenenga 1984; Jertberg 1978). This includes a specimen found *in situ* at Daisy Cave in a stratum securely dated between about 11,500 and 8,600 cal B.P. (Erlandson 2005). More recently, crescents have been found on the surface in or near several low-density shell middens on eastern San Miguel Island dated to the terminal Pleistocene, between about 12,000 and 11,400 cal B.P. (Erlandson and Braje 2008b; Erlandson et al. 2008, 2011).

Variation in the shape of California's chipped stone crescents, their persistence for several thousand years, and their distribution over a broad area encompassing both coastal and interior regions, suggests that their function may have varied through space and time. Interpreting their function is also complicated by the fact that some specimens appear to be unfinished preforms or fragments broken during manufacture, while others were finished artifacts broken during use. In some cases, after such whole or broken crescents and preforms were discarded, they appear to have been reused for new purposes by early or much later peoples.

Until recently, the most complete synthesis of chipped stone crescents in California was Gerrit Fenenga's (1984) unpublished study of 85 crescents from California. Mohr and Fenenga (2010) recently presented data on over 400 California crescents, and Hopkins (2008, 2010) described another 434 chipped stone crescents from the Tulare Lake area. No precise figures are available, but roughly 2,000 crescents are now known from California archaeological sites (Mohr and Fenenga 2010). Several have been reported from the northern Santa Barbara County coast, including one found in a Milling Stone site near Point Conception (Erlandson 1994:176), another reported by Dillon (1984) from CA-SBA-246 on Vandenberg Air Force Base, and others reported from the Point Sal area (Bertrando 2004:101; Justice 2002:116). In the last 20 years, two crescents have been reported from sites on the western Santa Barbara coast (Erlandson 1994:176; Erlandson et al. 2008:39) and several more from San Miguel and Santa Rosa islands (Braje and Erlandson 2008; Erlandson 2005, 2010; Erlandson and Braje 2008a, 2008b; Rick 2008). Along the Orange County coast, Macko (1998:104–105) reported three crescents from CA-ORA-64 and three more from other sites. Along the San Diego coast, crescents were reported by Koerper et al. (1991:53, 58) and Gallegos and Carrico (1984, 1985), and more recent discoveries have undoubtedly been made.

Many more crescents—especially fragmentary specimens or crescent preforms—recovered from sites along the California coast may have gone unrecognized or undocumented, including numerous specimens located in small local or regional museums. In 1987, Roger Colten, who then directed the Lompoc Museum in northern Santa Barbara County, brought two complete crescents displayed in artifact frames in his museum to my attention. At the time, no provenience information was available for these crescents, one of which could not be located during a 2007 visit to the Lompoc Museum. I still have a photo of this missing crescent, however, which I recently matched with a "bear emblem" of white chert described in two unpublished reports on the archaeology of northern Santa Barbara County written by Clarence 'Pop' Ruth (1936, 1937), whose collections make up the bulk of the Chumash cultural materials housed at the museum. This specimen is of considerable historical interest as the first 'bear-shaped' crescent described from California and one of the few bear-like crescents documented in the Far West.

In this paper, I describe Ruth's 'white bear,' reportedly recovered from the surface of the Sudden Site #2 (CA-SBA-208), a large and possibly multi-component shell midden located on the southern Vandenberg coast not far from Jalama Beach and Point Conception. While describing my search for the white bear, I also explore some of the changes in American archaeology over the decades.

LOCATION AND CONTEXT OF CA-SMI-208

The Sudden Ranch was located along the northern Santa Barbara coast, along a southwest-facing stretch of coast between Point Arguello and Point Conception (Fig. 2). The Sudden Ranch area is now owned by the American people, and is located near the southwest corner of Vandenberg Air Force Base. What Ruth (1936, 1937) called the Sudden Site #2 is located on the west bank of Canada de Jollaru about a kilometer from the coast. Ruth described the site as covering an area approximately 540 feet (ca. 165 m.) long and 300 feet (91.5 m.) wide. His initial account described a large site under active cultivation, where numerous surface finds of "arrow points, knife blades and spear points made from chert show this site to have been of the late culture of

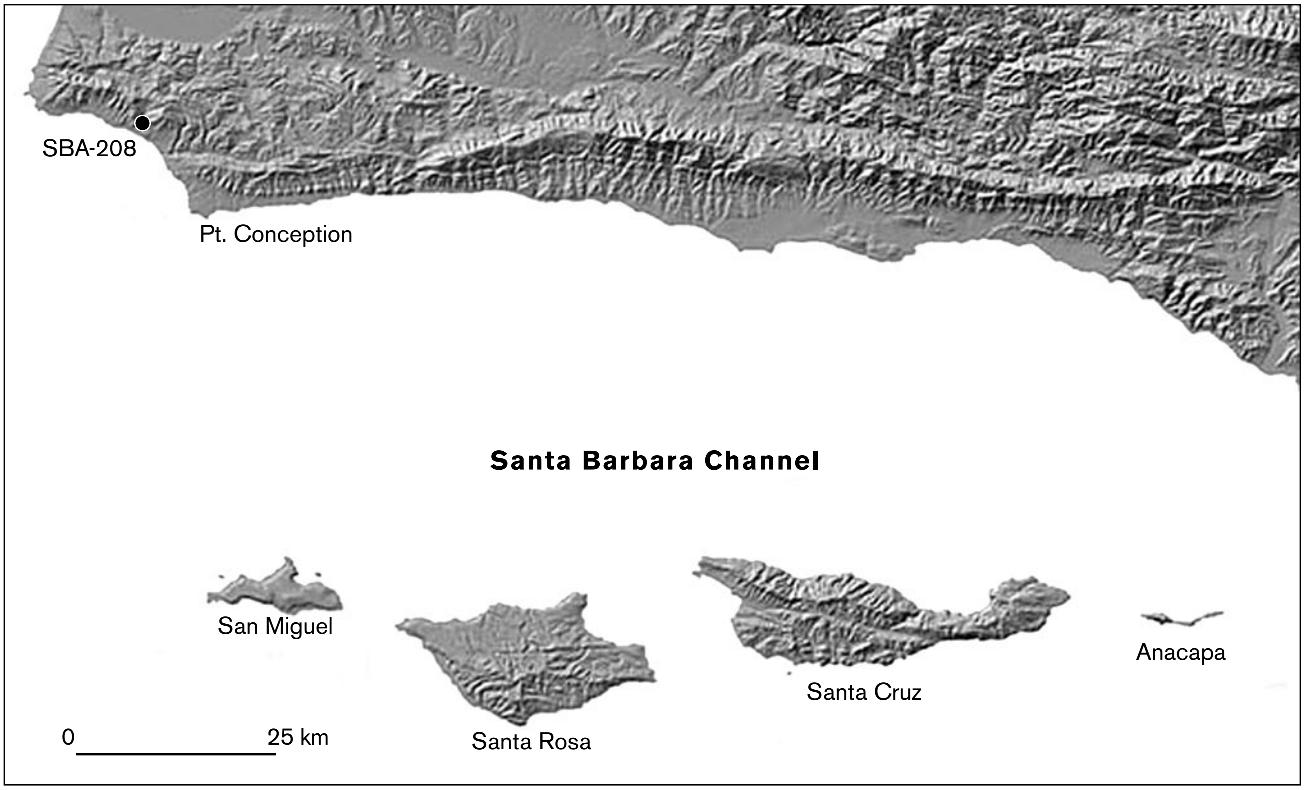

Figure 2. General location of CA-SBA-208.

the Chumash Indians" (Ruth 1936:23). At the time, he noted that no excavations had been done at the site, but illustrated a bear-shaped artifact that presumably came from the site surface. A year later, Ruth (1937) reported on excavations at the site—including his identification and excavation of a Chumash cemetery—and concluded that midden deposits at the site reached a depth of six feet (nearly 2 meters).

Most of the artifacts Ruth (1937) reported from CA-SBA-208 seem consistent with a Late Holocene occupation, but several large sites located along the southern Vandenberg coast contain multiple components, including Early Holocene shell midden deposits (see Erlandson 1994; Glassow 1996). As far as I could determine, no scientific excavations of CA-SBA-208 have occurred since Ruth's work in the 1930s and no radiocarbon dates appear to exist for the site. It is conceivable, therefore, that the chipped stone crescent from CA-SBA-208 is associated with an early occupation of the site, although it could also be a curio or talisman collected elsewhere and used by later Chumash occupants of the site.

DESCRIPTION OF THE SUDDEN RANCH CRESCENT

Among the bifaces Ruth collected from the surface of CA-SBA-208 was one complete crescent made from a "milky white chert," probably a local Monterey chert, which is abundant in the area in both bedrock outcrops or in cobbles on modern beaches or raised marine terraces. Ruth (1936:24) described the crescent as a "Bear Emblem" and listed its dimensions as 2.75 inches (~7.0 cm.) long, 7/8ths of an inch (~2.2 cm.) wide, and a maximum of 3/8ths of an inch (~0.9 cm.) thick (see Fig. 3).

As Fenenga (1992:230) noted for some crescents, the Sudden Ranch crescent when rotated ninety degrees could easily be seen as a small leaf-shaped (foliate) biface modified on one edge through the removal of five notches. These notches create a series of projections or protuberances that resemble 'legs' and provide a characteristic quadripedal zoomorphic form that may look like a bear to some viewers. Whether this shape was intentionally created to resemble a bear cannot be known for certain, especially without a detailed study of

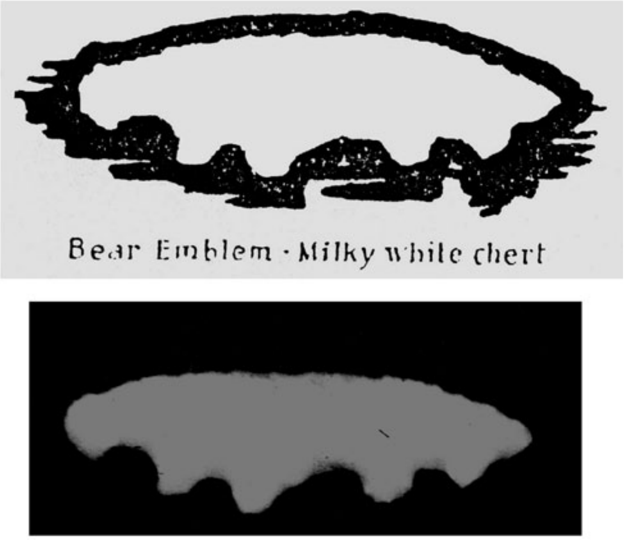

Figure 3. Ruth's (1936) depiction of the 'bear emblem' from CA-SBA-208 (top) and a reversed photographic image of the 'white bear' as displayed in the Lompoc Museum in the 1980s (scale in inches).

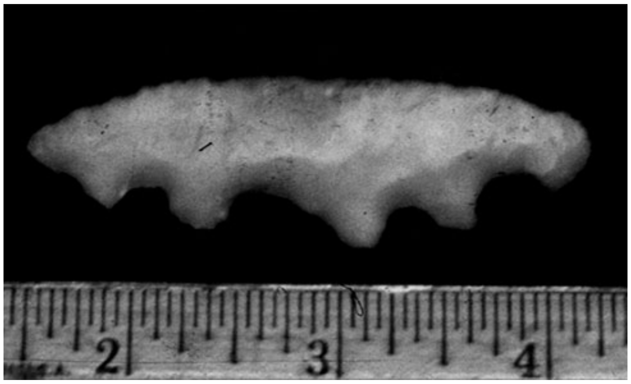

Figure 4. The 'white bear' crescent in a 1987 photo of the specimen in a Lompoc Museum artifact mount (scanned from a color slide by Roger Colten; scale in inches).

its manufacturing sequence or the presence or absence of use wear, hafting residues, etc.

In various typologies developed to classify California crescents, Ruth's 'white bear' falls within Fenenga's (1984) Type 1B, Jertberg's (1986) Type III, and Type 12 in a classification system Albert Mohr developed in the early 1950s (see Mohr and Fenenga 2010). It is at least roughly symmetrical bilaterally, with an arcuate and convex axial blade, and a 'base' containing five notches that define four protuberances or 'legs.' The widest of the notches, a roughly central axial notch, is flanked by two smaller lateral notches on either side of the base. On one side the most lateral protuberance is relatively pointed, while on the other end it is more rounded, creating a partial asymmetry which contributes to the zoomorphic character of the crescent.

Surviving photos or illustrations of the 'white bear' are not of high enough quality to describe the manufacturing techniques involved in its production. Ruth's illustrations show only the outline of the artifact, with none of the flake scars depicted. Only one side of the artifact is visible in the only surviving photo I have found (Fig. 4). Although this entire surface appears to be flaked, with no cortex visible, I cannot be certain that the crescent was bifacially flaked. Several large and relatively steep-sided notching flakes are visible on one side of the artifact, forming the legs, axial notch, and lateral notches. The central or axial notch is not exactly centered or symmetrical, raising the possibility that this could be an unfinished crescent preform. This notion could be supported by the maximum thickness of the artifact as well as other minor asymmetries, including variation in the depths of the lateral notches and the relatively rounded vs. pointed ends of the crescent.

DISCUSSION AND CONCLUSIONS

When Clarence Ruth wrote about a white chipped-stone 'bear emblem' from Sudden Ranch in the 1930s, he was working on his master's degree in archaeology and may have been unaware that similar artifacts had been reported from the Chumash area by Wardle (1913), Heye (1921), and Harrington (1928:101). Alternatively, he may have believed that the Sudden Ranch specimen was unique and different from those previously described from the Santa Barbara Channel area. All of these early researchers worked before the advent of radiocarbon dating or a broad comparative framework that allowed archaeologists to recognize their antiquity or that similar crescentic artifacts were distributed over a broad expanse of California and western North America. Instead, most descriptions of crescents from this time period saw them as unique or rare formal artifacts that merited special consideration or comment.

Even after such comparative frameworks emerged, crescents in California were relatively unusual discoveries, which delayed a widespread understanding of their chronology or cultural significance. Even today, despite pioneering typological studies by Mohr in the 1950s (Mohr and Fenenga 2010), Tadlock (1966), Jertberg (1986), Fenenga (1984), and others, few California archaeologists have found a crescent, are familiar with the various forms they take, or would readily recognize a crescent preform or small fragment. In part this is due to the scarcity of crescents, but it also stems from the continued dearth of more systematic searches for crescents in old or recent collections and the lack of published descriptions and illustrations for many of the crescents that have been found. A recent publication by Fenenga and Hopkins (2010) helps to fill these gaps, but many crescents remain undescribed or unavailable to most scholars, buried in collections or in the gray literature that now dominates California archaeology.

Ironically, on a 2007 visit to the Lompoc Museum that failed to produce Ruth's white bear, I found seven other crescents during a quick search of other museum collections—only one of which I was previously aware of. Two of these crescents were simple lunate forms that reportedly came from somewhere in northern California, but four others were found in containers full of projectile points from northern Santa Barbara County that had not been previously described or displayed. How many more whole or fragmentary crescents from California now reside undescribed in museum or private collections within the state and around the world is anyone's guess. Until these are recognized and described, however, we will not fully understand the distribution, chronology, variability, function, or meaning of crescents in California and the rest of the Far West.

The Sudden Ranch crescent—which escaped the notice of several syntheses of California crescents and early projectile point technologies (e.g., Erlandson 1994; Fenenga 1992; Jertberg 1986; Justice 2002; Tadlock 1966)—also illustrates the difficulties inherent in searching the vast published and unpublished literature available for the archaeology of California. By publishing the information available for the CA-SBA-208 crescent, I bring it to the attention of a broader community of scholars interested in the history of California archaeology, the culture history and early cultural connections of California, the Great Basin, and the broader Far West, and the nature of Paleoindian or 'Early Archaic' technologies.

For now, the 'white bear' from CA-SBA-208 adds to a growing inventory of chipped stone crescents from California and the Far West. Although not wildly eccentric, it clearly deviates enough from the lunate crescents of California and the Great Basin to be classified as an 'eccentric crescent.' Although the Sudden Ranch specimen differs significantly from most Great Basin forms depicted by Tadlock (1966), the basic form differs only slightly from some specimens with slightly concave bases punctuated by smaller lateral notches. As one of the earliest examples of a bear-shaped or zoomorphic crescent in coastal California, it has special historical significance and adds to the relatively small percentage of crescents that may have served a symbolic or ritual function.

On the other hand, preliminary analyses of crescents, crescent fragments, and crescent performs found recently on San Miguel Island also suggest that finished crescents tend to be relatively flat, thin, and symmetrical. The thickness of the Sudden Ranch specimen suggests the possibility that it may have been a preform discarded before it was completed. Thus, its present form may not reflect the symmetry and shape originally intended by the maker. Yet another possibility, especially given the predominantly Late Holocene occupation of CA-SBA-208, is that the Sudden Ranch crescent may have been an ancient artifact picked up and possibly modified for use by later Chumash people as a curio or talisman. If this is the case, it may have been collected because of its zoomorphic shape and possibly modified to further resemble a bear. Without being able to examine the actual CA-SBA-208 crescent, however, such inferences remain largely speculative.

Previously, I have suggested that the similarities of many crescents from the Channel Islands and California's mainland coast—especially lunate forms that cannot truly be described as eccentric—to those from the broader Great Basin and Far West appear to be more important than the differences (Erlandson and Braje 2008b:43). The similarities suggest that some of the major types of crescents from the Channel Islands and the broader Santa Barbara Channel area share close technological, functional, typological, and possibly cultural affinities with crescents found in coastal and lacustrine settings across a large expanse of the western United States—not unlike some of the early projectile points (i.e., stemmed

'Lake Mojave' type points) common to early peoples who lived in the same region (see Beck and Jones 2007; Fenenga 1992). From a technological and cultural historical perspective, therefore, crescents may be nearly as important as Clovis and other fluted points that have garnered much more attention from Paleoindian scholars.

Although some of the more 'eccentric' or zoomorphic crescents from the California coast may have had ritual functions, the context of most crescents associated with known sites suggests that they had a more utilitarian function. The close association of crescents with lakes, marshes, estuaries, and other aquatic habitats suggests that they may have played some role in hunting aquatic animals, potentially including waterfowl and seabirds. Ethnographically, many bird arrows are characterized by broad and blunt tips designed to stun, disable, and knock down birds rather than pierce their bodies. For the California coast, the idea that crescents served as transverse projectile points seems consistent with the relatively large number reported from the Northern Channel Islands, which supported a wealth of sea birds, shore birds, and waterfowl whose bones were used by early maritime peoples for making bone gorges and other artifacts (Erlandson 1994; Rick et al. 2001). Having argued for a primarily utilitarian function for many crescents, however, it would not surprise me if such artifacts were used for multiple purposes in California and the broader western United States. In the case of the CA-SBA-208 crescent, for instance, it is conceivable that it was made by Paleocoastal people to serve as a transverse projectile point, then discarded or reused when its thickness could not be reduced. It could then have been collected and curated by Chumash people who occupied the area millennia later, possibly because they recognized its resemblance to a bear—just as Clarence Ruth (1936, 1937) did centuries later. Hopefully, Ruth's 'white bear emblem' will be found so that a more detailed analysis of the artifact may address some of these issues.

ACKNOWLEDGMENTS

I am grateful to Roger Colten for bringing two crescents displayed at the Lompoc Museum to my attention in 1987 and for help in trying to document their provenience. I thank Lisa Renken for her assistance in searching for Ruth's white 'bear emblem' and documenting the other crescents stored in the Lompoc Museum collections, as well as Victoria Bradshaw and Judson King at the Phoebe Hearst Museum of Anthropology at UC Berkeley for their assistance in my examining two zoomorphic crescents from Santa Rosa Island. Finally I thank Gerrit Fenenga, Beth Smith, Charlotte Beck, and George Jones for sharing their recent research on crescents, as well as Daniel Amick, Eugene Hattori, Lynn Gamble, and the editorial staff for additional help in the review and revision of this paper.

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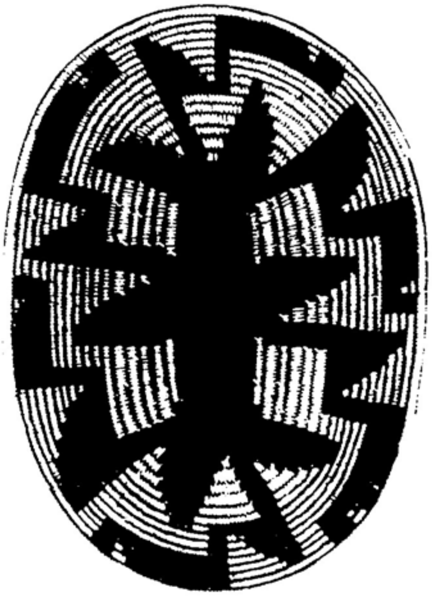

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LOST AND FOUND

The following sympathetic and remarkably balanced account of the events that embroiled the settlers and Native Americans living in the San Joaquin Valley in a series of armed confrontations in 1856 originally appeared in The Overland Monthly *in 1884 (Vol. 3, No. 1, pp. 46–53). Although the author, George W. Stewart, was not born until 1857, a year after the events that he describes, his long involvement in the community as editor of the Visalia newspaper furnished him with an opportunity to compile a great deal of factual information on the topic from a wide variety of local sources while simultaneously maintaining a certain degree of objectivity. As recent scholarship has demonstrated, the kinds of misunderstandings and cultural biases that Stewart describes here triggered actions that were tragically replicated in many other parts of the state. Stewart was clearly sympathetic toward the local Yokuts people, and wrote a number of papers on their beliefs and customs; he also had a deep interest in the natural resources of the region, and is perhaps best known today for his pivotal role in the creation of Sequoia National Park*

THE INDIAN WAR ON TULE RIVER

George W. Stewart

It is impossible at this late day to determine the real causes that led to the war on Tule River in the spring of 1856, since the events were not noted in detail at the time, and but few of the prominent actors are now living; and, after the lapse of years, it is the most important items concerning troubles of this kind—the causes that led to them—that are soonest forgotten, only the more vivid pictures remaining distinct on memory's page. The Indians, of course, were credited at the time with the full blame of forcing the conflict; but there is much to lead to the belief that the exercise of a little moderation on the part of the white settlers would have prevented any great amount of bloodshed. Before entering upon the account of this war it may be of interest to make brief allusion to former Indian troubles, and to say a word concerning affairs prior to the outbreak.

Large numbers of Indians were living at that time about the eastern shore of Tulare Lake, and along the several streams issuing from the Sierra Nevada mountains—Kings River, Kaweah River, Tule River, Deer Creek, White River, Posa Creek, Kern River, and smaller streams. It was estimated that among the several tribes, speaking the same language with only the variance of an occasional word, there were in the neighborhood of two thousand warriors. Game and fish, upon which they subsisted principally, acorns, and the plants and roots and other articles that varied their diet, were plentiful; and before becoming acquainted with the fatal vices of civilized man, they were a healthy and contented people. Petty jealousies existed among the different tribes, and occasional ruptures occurred; but they were never so warlike nor so blood-thirsty as the large tribes farther east, that have maintained the struggle against civilization since the advent of the first white man among them. The first hunters and trappers who entered the valley found the Indians hospitable and friendly. A few parties of white men, Fremont's exploring party among others, passed through the valley, but were not molested until they encountered the tribes farther north, who had had more intercourse with Americans.

The first blood was shed on the 13th of December, 1850, when a small party of settlers was cruelly massacred by the Kaweah Indians. This party, fifteen in number, was conducted by a Mr. Wood to a beautiful spot about six miles east of the present town of Visalia, on the bank of the Kaweah River, where they intended to form a settlement, and immediately began the construction of a house from the oak timber growing plentifully thereabouts. Shortly after their first dwelling was finished, the chief of the Kaweahs, an influential personage, known by the Spanish name "Francisco," visited these pioneer settlers accompanied by a number of armed followers, and gave them notice to depart within ten days, at the same time informing them that death would be the penalty for remaining longer. They consented to leave within the specified time, and secreted many of the articles they had brought with them, intending to return to the place at some future day. For some reason they were not prepared to leave until the eleventh day after receiving their warning; and while the men were separated in the morning, gathering up their horses and making other necessary preparations for the start, a large force of Indians armed with bows and arrows fell upon them suddenly, and in a very short time killed eleven of their number. Two succeeded in making their escape, one of them, however, seriously wounded. The Indians then surrounded the house, where they found Wood and one other. Wood's companion was given a mark to hold for the savages to shoot at, but at the first fire his body was filled full of arrows. The leader of the little colony finding himself alone, sought refuge in the house and fired upon the Indians from the inside, killing seven before his ammunition was expended. After making an ineffectual attempt to gain entrance through the roof, the Indians forced the door and were faced by Wood, who fought bravely until overpowered. Holding a brief consultation, they determined to skin their captive alive as a punishment for having killed so many of their braves; and tying him to a tree nearby, performed the fiendish deed.

The reason for notifying Wood and his party to leave is not known. Had there been any natural feeling of hostility toward the white men, they would not have been allowed to remain long enough to erect a dwelling, nor is it likely that they would have been given so many days' grace to prepare for their departure. It is probable that their action was influenced by northern Indians, who were in constant communication with them, and felt less friendly toward the whites; and it is not improbable that some member of the party was responsible for the estrangement.

Shortly after this, General Patten arrived from Fort Miller with a detachment of United States troops, and began to build a fort near Woodville, the site of the unfortunate and unsuccessful attempt to make a settlement, but did not remain to complete it.

Settlers continued to arrive in small bodies from time to time, but there was no further difficulty with the Indians until four years later. The whites were generally disposed to be overbearing in their intercourse with the tribes among whom they settled, and a few trivial quarrels resulted in threats of extermination being made by the Indians, who greatly outnumbered the settlers, and naturally looked upon them as intruders. Lieutenant Nugent was sent from Fort Miller with a small force of soldiers, and attacked the Indians near General Patten's unfinished fort, and brought them to terms. Only one Indian was killed in this skirmish, which lasted but a short time. Lieutenant Nugent remained in the vicinity several months, when he was recalled to Fort Miller.

A short time after the departure of the troops, threats were again heard from the Indians, and for several months affairs were in a very unsettled state. The Americans were prone to magnify the hostile actions of the Indians, but to forget their own. The Indians, also, were regarded as inferior beings, and treated as such; this they naturally resented, and became quite insolent. Private difficulties led to either side's espousing the cause of its friends, and affairs began to bear a most serious aspect.

The county of Tulare had been organized in the meantime, the town of Visalia established, and newly arrived settlers were scattered through the valley, engaged principally in the raising of cattle and hogs. The first penalty inflicted by law was the imposition of a fine of fifty deer-skins upon a young Indian, who had maliciously shot an arrow into an ox belonging to one of the settlers. The sentence was regarded as a just one by the Indians, who awaited with interest the judgment of the Court, and the fine was promptly paid. Shortly after, cattle running on the plains were found to have been shot with arrows, and three Indians supposed to be the offenders were taken by the whites (without legal process) and severely whipped, and warned that a repetition of the offense would result in the death of the guilty parties. It was not long before more cattle were shot, and the whites went to the chiefs of the tribe with their complaints. Two Indians were turned over to them; one of these in attempting to escape was shot, and the other feigned death and was afterward pardoned. These summary punishments did not have a tendency to pacify matters, but, on the contrary, had a diametrically opposite effect; and affairs continued in this effervescent state for a considerable time, gradually growing from bad to worse. A Mexican vaquero employed by an American cattle-owner was killed by Indians, and about the same time an Indian boy was shot a short distance east of Visalia. The demeanor of the Indians became more hostile, and several of the whites favored an immediate attack on the rancherias in the neighborhood, but others were strongly opposed to any such action. Both races becoming mutually suspicious, preparations were quietly made for the worst. In the spring of 1856 a collision was considered to be inevitable, and not a few, particularly among the young men, were anxious for hostilities to commence. At this time a party of Americans attacked one of the rancherias under cover of darkness, and, without losing any of their own number, killed or wounded several of the Indians. This cowardly and reprehensible act received, as it merited, the condemnation of the people in the settlement.

A Government sub-agent visited the Indians for the purpose of restoring harmony, but he was too late; they would listen to no conciliatory terms, probably believing that he represented the views of only a minority of the settlers. Warriors from all the tribes between the Kaweah River and Fort Tejon now began to concentrate in the mountains on Tule River, and the old men, women, and children moved away from the valley, except a few that remained in the vicinity of Visalia and refused to join the hostiles. It was thought that there were a few Indians from the valley tribes to the north, but they did not come in large numbers from any point beyond the present limit of Tulare County.

The "opportunity" long wished for soon arrived. A report reached Visalia that five hundred head of cattle had been stolen from what is now Frazier Valley, and driven to the mountains; another report placed the number at one hundred, with the additional information that they had been recovered from the Indians by the owners; and later it was stated that the Indians took only one calf from a band of cattle. At that time the first report was most willingly believed to be the true one, and it was resolved to punish the marauders immediately. The movements of the hostile band were made known to the whites by the friendly Indians in the settlement, and a company of some fifty or sixty men, hastily gathered from all parts of the Four Creeks country, as this section was known, under command of Captain Demastus, started in pursuit of the Indians. The same day a party of nine mounted men followed the trail of a band of sixty Tejon Indians, who, they had been informed, were traveling southwards in the direction of White River.

Captain Demastus' company. who were looking for the larger body of Indians, after reaching Tule River continued up the north fork several miles, where columns of smoke arising in the distance discovered to them the location of the camp. The command moved forward and found the Indians occupying a strong position, which, to their surprise, was well fortified. The location was admirably chosen, and the defenses would have done credit to an experienced military engineer. A line of breastworks from two to four feet high, composed of boulders and brush, extended a distance of eighty rods along the face of a hill at the head of a little cove or plain. Immediately in the front of the position the ground was rough and broken, but to reach it it was necessary to traverse the open plain mentioned, exposed to a fire from behind the fortification. At either end, and in the rear of the line of defenses, was a dense thicket of chaparral and scrub brush, extremely difficult to penetrate. This position was defended by a large force numbering in the neighborhood of seven hundred warriors, armed with bows and arrows. A few had pistols. Had they been well provided with firearms, all the white settlers in the valley could not have dislodged them. Demastus, confident of the superiority of his men, small as their numbers were, ordered an attack. A shower of arrows tipped with heads of flint and hard wood met his command as they neared the breastwork. The fire was returned, but with no appreciable effect, and realizing the strength of the Indian stronghold, and the inefficiency of his small force, Demastus retired about a mile and went into camp to await reinforcements.

The little party of nine men previously spoken of, on the trail of the Tejon Indians, kept in their saddles all day and night; and about daylight on the following morning, when near White River, a short distance above where the little village of Tailholt is now situated, heard the barking of a dog. This they rightly judged to come from the Tejon encampment, and, tying their horses, advanced cautiously on foot in the direction whence the sound proceeded. Discovering the camp, they succeeded in making their way to within fifty yards of it, when the dogs began barking and growling furiously. One of the Indians, painted and decked with feathers, stepped forward to a little knoll that commanded a view in all directions, to ascertain the cause of the alarm. There was no one in command of the whites, but John W. Williams, afterward city marshal of Visalia for several years, seemed to be the recognized leader, and directed the man nearest to him, who had a rifle, to shoot. He fired, and the Indian dropped dead. A charge was then made, and the

Americans rushed into the camp, firing rapidly at the Indians, who scattered precipitately, not knowing the number of their assailants. Five Indians were found dead, but none of the whites were injured. Not feeling strong enough to continue the pursuit in the wooded country they were in, or to remain where they were after daylight, they returned to their horses, and rode back to Tule River to join the larger party.

It was the supposition at the time that this party of Tejon Indians had been implicated in the cattle stealing in Frazier Valley, and had gone on a marauding expedition to White River to massacre the few Americans then living along the stream; but nothing was heard of them afterward, and as they had a few women with them, they were probably only returning home to their own tribe.

When the party of whites rejoined the command under Demastus, it was decided to dispatch Williams to Keysville, in the Kern River Valley, for assistance, it being impossible to accomplish anything against the strongly fortified position held by the Indians with the handful of men before it.

Williams set out immediately, going by way of Lynn's Valley, Posa Flat, and Greenhorn Mountain. At the first named place he changed horses, and William Lynn, after whom the valley was named, agreed to accompany him to where he had some men at work in the mountains, from which place the trail could be more rapidly followed. During their ride after dark, through a heavily timbered region where bears were plentiful, an incident occurred that is worthy of note. Both were on the lookout for bruin, and after riding a short distance into the forest heard a noise behind, and turning observed a large black animal following them. Lynn raised his gun to fire, but Williams, who was mounted on a fractious mustang, thought it was not advisable to shoot at the bear in such close quarters, in a narrow trail leading through a dense thicket, particularly at night, when it would have been impossible to make a sure aim. They hastened on, and the animal behind also quickened his steps, which they could hear indistinctly on the soft earth. William's horse became frightened and darted up the steep mountainside, but floundered back into the trail again. Soon they reached a small opening, and here they determined to try the effect of a shot at the brute, which followed them persistently. Lynn discharged a load of buckshot, and the bear fell at the first fire, greatly to their relief, and they proceeded on their way not caring to learn whether it was dead or not.

Williams reached Keysville the next day, the miners along Kern River assembled, and a party of about sixty men consented to assist the Americans before the Indian camp on Tule River. Hastily arming themselves, they immediately set out by the way of Lynn's Valley, where they were joined by Lynn and a few others.

On the return the bear killed by Lynn was found, and proved to be a large black mule belonging to a settler in the valley below. The owner also was found, and received from the two men the sum of ninety dollars, which amount he had recently paid for the animal. It was a long time before the young men heard the last of it; the mere mention of "bear's oil" was sufficient to cause either one of them to stand treat, and before the joke wore out it had cost them in the neighborhood of five hundred dollars.

When the Keysville party reached the scene of action, the number of whites there had already been increased by scattering settlers who had arrived from all parts of the surrounding country. W.G. Poindexter, sheriff of Tulare County, was chosen commander, and with a force of one hundred and forty men made a second advance upon the Indians. The breastwork was attacked from the front, the Americans shielding themselves as well as the nature of the ground permitted, and pouring a continuous fire into the interstices through which the Indians were discharging their arrows. The Indians fought bravely, but their arrows proved to be comparatively harmless missiles; and every one that exposed any portion of his body became a target for a number of excellent marksmen. It was an impossibility to drive the Indians from their position by attacking them from the front without a charge, which was not deemed advisable then, and Poindexter did not consider his force strong enough to spare an effective number for a flank movement; besides, it was thought the arrows of the Indians would have been more effectual at short range in the brush than at the long distance they were compelled to fire in front. By attacking from either flank it is quite probable that some of the whites might have been killed, but this was the most feasible plan of dispersing the Indians, and it was supposed the expedition was undertaken for that purpose. During this attack two young Americans, Danielson and St. John by name, were severely wounded.

The former crawled quite near the breastwork, but was discovered by the Indians and became the mark for scores of arrows. Three or four men rushed forward and carried him from his perilous position. He was dangerously hurt, and for a time it was thought fatally; but he eventually recovered. One other young man, Thomas Falbert, was shot in the thigh by an arrow, but coolly broke it off and continued loading and firing his piece as if nothing had happened. These are the only whites known to have been injured. Some of the Indians were quite reckless, a few standing fearlessly before their fortification heedless of the leaden rain from the guns of the assaulting party. One of these, struck down by a bullet, raised himself with difficulty and fired at the whites until his last arrow was gone. He and two others were killed in front of the line; what execution was done behind the breastwork was not ascertained, but it must have been considerable. Failing to accomplish anything of importance by this attack, Poindexter ordered his command to fall back. The Indians left their position and followed them, yelling like fiends, and keeping up a steady fire with their bows and arrows; but as soon as they got clear of the brush on to the open ground a volley of bullets sent them back to their stronghold.

Sentries were posted during the night to prevent a surprise by the Indians, should they feel emboldened to make the attempt. It would not have been difficult to have thrown the camp into disorder by a sudden and vigorous charge, as a false alarm proved in the night; but the Indians considered themselves safer behind their defenses. One of the men who had passed beyond the lines unobserved was seen when returning by a sentry, who, supposing him to be an Indian, opened fire. The man lay close to the ground and escaped unhurt. The whole camp, however, was immediately in an uproar, all supposing the Indians were about to fall upon them, and not knowing from what point the expected attack would be made. Men picked up the wrong guns, knew not which way to turn, and several minutes passed before anything like order was restored. This was the effect of a total lack of discipline, and served as a good lesson.

The Americans remained at their rendezvous several days without making any effort in force against the Indians. It was realized that a charge would be necessary to dislodge them, and William Lynn, before spoken of, invented a padded armor impervious to the arrows, to be worn by the van of the attacking party. This armor protected the vital parts, leaving only the face and limbs uncovered. About a dozen men were thus provided and were known as the "Petticoat" or "Cotton-bag brigade." They were amongst the most fearless and intrepid young men in the camp, but presented anything but a warlike appearance in their ridiculous habiliments. As the sequel will show, they never had an opportunity of trying their armor in the proposed grand charge.

For several days, while awaiting further reinforcements, nothing of importance was attempted. Frequent skirmishes took place, but little was known of the results except that an occasional Indian was seen to fall dead or wounded. Small parties of whites also sought and destroyed the caches of provisions made by the Indians at different points about the foothills, as was their custom. There was little trouble in finding them, as they were usually made among the branches of the oak trees. A portion of the command returned to Visalia for a few days, and, while there, insisted that the Indians who had remained among the whites, and who had been disarmed, should leave the settlement forthwith. They had taken no part in the hostilities, and several of the leading citizens protested against the unnecessary measure. But they were Indians, and that was considered sufficient cause for driving them away. They were assisted by a few of the whites to remove to Kings River, until quieter times. Most of the Americans who had engaged in this war were young men, and to them the excitement of the times was only a source of enjoyment; and owing to the inferior weapons of the Indians, they were in no imminent danger of losing their lives. They would gladly have seen a war of extermination inaugurated, and would have forced the peaceable Indians to assume a hostile attitude, that they might have had an excuse for attacking them. While in the settlement it was proposed by them to surround a rancheria of non-combatant Indians—men, women, and children—in the night, and exterminate the last one of them: before their scheme was consummated, however, the Indians were notified of their intentions and decamped. It was thought advisable that a place of refuge be prepared for the people in the valley to resort to in case an attack should be made by the Indians while the men were "off to the war," and the erection of a small fort was begun in the town of Visalia on the bank of Mill Creek; but it was never needed and never completed.

Small parties of men now began to arrive from the upper country; some of them coming from as far north as Merced and Mariposa. Companies arrived from Millerton and Coarse Gold Gulch, now included within the limits of Fresno County; those from the first-named place under command of Ira Stroud, those from the second commanded by John L. Hunt. There also arrived from Fort Miller a detachment of twenty-five soldiers under Captain Livingston, bringing with them a small howitzer for throwing shells into the Indian camp; and from Fort Tejon half as many mounted cavalry under the command of Alonzo Ridley, an Indian sub-agent. When all of these had congregated at the rendezvous on Tule River, the total strength of the force was about four hundred, and comprised nearly all of the able-bodied men in the valley. Captain Livingston assumed the chief command. The citizen volunteers were armed with every style of firearm known, each one providing his own accoutrements. They were not well organized or drilled, of course, but what they lacked in discipline was made up in marksmanship, all being familiar with the use of firearms.

After all had reached camp a consultation was held, and it was agreed to divide the command into four divisions, and attack the Indians at daybreak the following morning from the front, rear, and both flanks, and thus hem in and annihilate the entire force if possible. Parties were sent out to view the country, that the several divisions might be guided to their respective positions during the night without confusion or loss of time: and Captain Livingston with his soldiers and about sixty volunteers ascended an eminence commanding the Indian fortification from the side, to select the most advantageous position for mounting their howitzer, that all might be in readiness for the battle on the morrow. The Indians unexpectedly made a vigorous attack on this party, forcing them to a fight, and thus precipitating the engagement. Livingston ordered a charge, and with his officers led the men in. They forced their way through the brush, at the same time firing upon the Indians, who, not having their breastworks to shield them, fled from their strong position into the mountains among the pine forests, where they had left their women and children. The Americans continued the pursuit two or three days, but failing to discover another camp or any large body of Indians, retired to the valley. After the Indians had been driven from their position several dead braves were found inside the fortification, and there was evidence of many having been borne off through the brush. Nothing definite is known of the loss they sustained, but it was estimated that from the breaking out of hostilities up to this, the last real engagement, the total number of killed and wounded was not far from one hundred. No whites were killed during the charge, and none seriously injured.

The little army now broke up, and small detachments were posted at intervals along the edge of the foothills, to prevent the Indians from descending into the valley: the major portion returned to their homes. Notwithstanding the blockade, small parties of mounted Indians succeeded in reaching the plains at night, and did a considerable amount of damage. Most of the cattle had been driven in near the settlement, where they were closely herded and guarded; but the Indians succeeded in killing or driving off quite a number. They also burned a few houses in the foothills, and all but one along Tule River and Deer Creek—thirteen in number—their owners having deserted them for the time being. The only one on Tule River that escaped destruction was occupied by John Williams, and was constantly guarded. One night, while himself on guard, he observed two mounted Indians riding toward a cow that was feeding near the house. Wakening one of the three young men who were with him that night, that the Indians might be confronted by an equal number, he awaited their nearer approach. When the Indians were within range both advanced toward them and fired; and they scampered off without their expected booty, not stopping to return the fire until they had placed a quarter of a mile between them and the house, when a single pistol shot and a yell of defiance were sent back. The following morning one of their horses was found dead a short distance off, having been ridden apparently until it fell.

These night raids were continued for several weeks, until William Campbell, the sub-agent at Kings River, sought the Indians out in the mountains and found them willing to come to terms. The war had lasted six weeks, when the Indians returned to the valley, and they have remained friendly from that time to the present day; although, a little more than a decade later, a few murders committed on Tule River caused the government to send a company of troops from San Francisco, and force the Indians of that section on to a reservation set apart for them. There was no difficulty with them collectively, however, and their liberties are in no way more restricted than those of other tribes. Throughout the valley their numbers are rapidly decreasing, only a handful now remaining to preserve the language and traditions of a once numerous and happy people.

Thus ended the Tule River war of 1856; a war that might have been prevented had there been an honest desire on the part of the white settlers to do so, and one that brought little glory to those who participated therein. The responsibility cannot now be fixed where it properly belongs. Possibly the Indians were to blame. Certainly the whites were not blameless; and it is too seldom, indeed, that they have been, in the many struggles with the aboriginal inhabitants of this continent.

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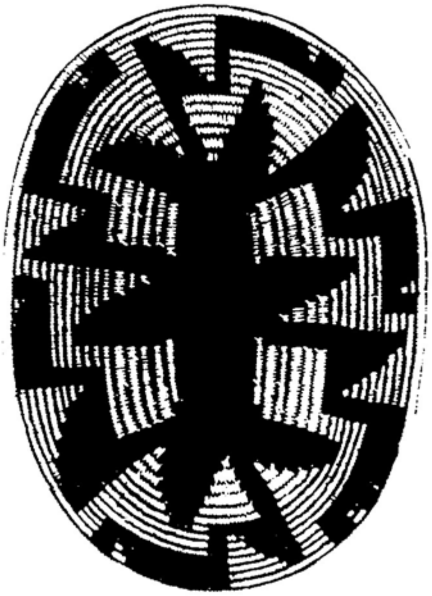

REVIEWS

Cultural Contact and Linguistic Relativity among the Indians of Northwestern California

Sean O'Neill
Norman: University of Oklahoma Press, 2008
xix + 354 pp., 24 illustrations, $50.00 (cloth)

Reviewed by Shannon Tushingham
Elk Valley Rancheria, 2332 Howland Hill Road,
Crescent City, CA 95531

The traditional culture of northwestern California has long been recognized as unique within native North America. Aboriginal groups were sedentary hunter-gatherers who shared a common material culture and way of life, with similar religious views and ceremonials. Despite these parallels, northwestern California is also one of the most linguistically diverse places on the planet, with only a handful of areas such as Papua New Guinea and the Caucasus Mountain region in Eurasia rivaling the cacophony of languages spoken here.

The great linguist Edward Sapir was among the first to highlight this apparent paradox in his book *Language* (1921), in which he pointed out that despite striking cultural similarities between the Hupa, Karuk, and Yurok, their languages were completely alien to one another and belonged to three major linguistic stocks widely distributed over the North American continent: Athabascan, Hokan, and Algonquian. Sapir's theoretical stand was revolutionary at a time when language was commonly viewed as an outgrowth of a society's "national character." Several decades later Harry Hoijer, a student of Sapir's, addressed "the principle of linguistic relativity" in his famous 1953 article entitled "The Sapir-Whorf Hypothesis." Simply put, the basic premise is that the structure of a particular language affects how its speakers see the world. Areas such as northwestern California were viewed as providing a prime testing ground for the principle, since culture could be held as the constant and language as the variable in the comparative analyses Hoijer promoted. Since then, the Sapir-Whorf hypothesis has been hotly debated by generations of scholars and studied by countless students of anthropology.

Despite scientific interest, surprisingly little scholarly research has addressed the question of linguistic relativity in northwestern California. Sean O'Neill addresses this gap in his book *Cultural Contact and Linguistic Relativity among the Indians of Northwestern California*, in which he explores theoretical issues of language contact (how languages change when groups come into contact) and linguistic relativity (how language affects human cognition). His data are drawn from a broad comparative analysis of traditional Hupa, Karuk, and Yurok language and culture, distilled from his 2001 UC Davis Ph.D. dissertation research, which focused on how space and time are expressed in these three speech communities.

The book includes eleven chapters divided into five parts. Part I, "Language, Culture, and the Principle of Linguistic Relativity," introduces the concept of linguistic relativity and the intellectual roots of the idea. The middle three parts are data-rich comparative treatments of a variety of conceptual linguistic and cultural categories.

Part II, "The Spatial World," addresses spatial concepts in language and culture. Here we learn that the Hupa, Karuk, and Yurok share a common cosmological vision of the universe and a geographical orientation to the world, based not on the cardinal directions but on the upriver/downriver direction of rivers and surrounding mountains. However, the specifics of how the universe is conceptualized (in folklore and mythology) and how geographical and directional categories are expressed (in everyday speech and grammatical systems) are often radically different between each speech community.

Part III, "The Realm of Time," demonstrates that while concepts of time (near and distant future, the concept of ancient time) are generally very similar, some temporal categories "are restricted to a particular tradition, such as the complex aspectual system of the Hupa language and the distal future of Yurok language. In the end, each language imposes a different system of categories onto the realm of time, encompassing both everyday activities and those distant historical events reported in narrative and preserved in storytelling" (p. 175).

Part IV, “Classification and Cultural Meaning,” considers taxonomy and vocabulary in everyday speech and narrative. O’Neill explains that specialized classificatory systems are especially elaborate in northwestern California, and while Hupa, Karuk, and Yurok all have similar categories for words based on their shape or animacy (e.g. round, long or straight and rope-like objects, filled containers), how these categories are divided is strikingly unique to each language. O’Neill adroitly weaves language and culture in the second chapter of this section (Chapter 9), which is a fascinating treatment of the deeper cultural meaning of words. The reader truly comes to understand what Sapir (1921) meant when he likened single Algonquian words to “tiny imagist poems,“ where even common nouns may evoke profound images from mythology and folklore.

In the final section, “From Language Contact to Linguistic Diversity,” O’Neill reexamines the data, concluding that—despite centuries of contact—the Hupa, Karuk, and Yurok people speak languages that remain structurally quite unique in terms of their vocabularies, grammars, and phonologies. As for the principle of linguistic relativity, the study suggests that it “is inherent to the human condition, emerging from ongoing intellectual differences among neighboring speech communities” (p. 307).

O’Neill posits that although many aspects of Hupa, Karuk, and Yurok culture became more similar after a thousand or so years of contact, their languages, in fact, grew increasingly distinct. This stands in stark contrast to the oft-cited case of Kupwar village in India, where contact and multilingualism has led to linguistic convergence (Gumperz and Wilson 1971). O’Neill’s explanation was succinctly described by Aram Yengoyan: “Propinquity breeds inversion” (p. 285). In other words, when groups come into close contact they will often, consciously and unconsciously, increasingly emphasize differences in certain aspects of their identity, including language.

Why convergence at Kupwar but inversion in northwestern California? This question is addressed in the second to last chapter, where O’Neill explores the evolutionary concepts of variation and drift as they apply to languages and their development through time. The discussion of linguistic ecology explores what social and environmental conditions might contribute to linguistic diversity when groups come into contact over long periods of time. In northwestern California, people often spoke several languages fluently. There were many multilingual speakers, but how did the languages remain distinct? Explanations remain complex but key factors appear to be resource abundance and the autonomous nature of socio-political groups, circumstances that certainly apply to northwestern California. I found this chapter to be the most provocative in the book, but found myself wanting more—I am an archaeologist after all, and we *do* tend to like explanations—but I was left with a lot to consider.

Here are a few general comments about the book. The nuances of linguistic categories and grammar are elegantly explained throughout the text so that the non-specialist may follow technical points with relative ease. O’Neill demonstrates his impressive understanding of northwestern California mythology and worldview, illustrating his points with copious examples, many garnered from creation stories and myths, so that the reader picks up many fascinating details about both language and culture.

The 24 figures include a map of northwestern California ethnographic groups and illustrations of the linguistic models and classificatory systems discussed in the text. The figures are helpful in that they boil concepts down to a visual level. However, a few well-chosen photographs and illustrations, perhaps of early ethnolinguists and consultants, major dances, village life, etc., would have enormously enhanced the text, particularly for readers not familiar with the area.

Although O’Neill’s points are well argued and explained in the text, a summary table or series of tables comparing major characteristics of each language would have been enormously helpful. Which group has the overwhelming focus on directional markers (Karuk)? Which group includes spherical objects as “round objects” (Hupa) and which includes disk-shaped objects (Yurok)? Tabulating the data would have provided a handy reference for readers as they returned to these points several times in the text, and (perhaps more importantly) would have succinctly illustrated one of the author’s major points—that these languages are, at their core, fundamentally different from one another.

Cultural Contact and Linguistic Relativity among the Indians of Northwestern California is an impressive work that takes on one of the most debated issues in linguistic theory and complements it with a nuanced view of local culture. This book will interest both Californianist anthropologists and scholars interested in linguistic relativity among world-wide languages. I would also encourage any archaeologist working in northwestern California to read this book. Historical linguistics has been enormously influential in terms of developmental models addressing the prehistory of the region, and though O'Neill does not address archaeology *per se*, his lucid explanations of how linguists have established the ancestry of Athabascan, Hokan, and Algonquian languages through comparative studies are extremely useful. If nothing else, the reader will be left with a deep appreciation for the complicated and unique nature of the Hupa, Karuk, and Yurok languages, "as profoundly different as any three unrelated tongues spoken on earth—say, Hebrew, Hindi, and Korean, for instance" (p. 26). I for one was left with even greater respect for native northwestern California speakers and scholars, many of whom were and are multilingual, and for the native communities that are working hard to revitalize their languages.

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Once & Future Giants: What Ice Age Extinctions Tell Us About the Fate of Earth's Largest Animals

Sharon Levy
New York: Oxford University Press, 2011. xvi, 255 p. : ill., map, 24.95 (paper)

Reviewed by G. James West
Farris, West & Schulz, P.O. Box 184, Davis, CA 95617
gjwest323@att.net

If one can imagine stepping into a prehistoric world occupied by giant animals (such as mammoths, mastodons, camels, Shasta ground sloths, giant short-faced bears, Brea lions, and saber-tooth cats, known collectively as megafauna), and then can further imagine the introduction of the relatives of some of these species into the modern day wilderness, this well-written book by Sharon Levy will be a joy to read. Levy, an excellent science writer, succinctly reviews two of the main hypotheses for the extinction of some of these beasts near or at the end of the last Ice Age (Late Pleistocene), and then addresses the issue of rewilding, which is the introduction of comparable taxa, when possible, into selected environments in order to re-establish ecosystems that are reinvigorated, have greater biodiversity, and more closely reflect the trophic levels prior to megafaunal extinctions.

Many forces, some external and others internal, that could trigger extinctions are evident in Earth's history. Proposed explanations for Late Pleistocene extinctions have included climate change and its effect on the environment, the ecological shock of human arrival, nutrient shortages, disease, and even the possibility of a meteor strike, among many others. Levy chooses to place the emphasis in her review of extinction causes on the two main hypotheses—climate change and anthropogenic causes—with the focus on the latter. Both causes have been argued for many decades; however, there is little reason to believe that only one of these hypotheses accounts for all of the species disappearances worldwide. As a result of Levy's anthropogenic focus, much of the discussion is on the extinction of megafauna in Australia and North America. The natural history of wooly and Columbian mammoths in North America and selected giant marsupials in Australia is far better known than that of many of the other extinct taxa such as shrub ox, Brea lion, or glyptodonts. The only detailed evidence of human predation involves mammoths, a fact that has provided empirical support for Paul S. Martin's "overkill hypothesis" (2005). Thus the arguments for extinction are circumscribed by the data selected.

From the isotopic and fossil record it is known that the transition from the Last Glacial Maximum (LGM), 18 to 21,000 years ago, to the Holocene, ca. 10,000 years ago, was marked by abrupt shifts in climate. The most significant climate reversal was a cold period, termed the Younger Dryas, which began about 12.9 ka. B.P. and lasted for about 800 to 1,000 years. However, the fossil evidence of the Younger Dryas reversal is not global, and its expression in the environment may be enhanced in some regions while diminished in others. With little exception, megafaunal extinctions in North America appear to have taken place prior to or about 12.9 ka. ago, after the fauna had survived hundreds of thousands of years of climatic variation. Was there something about the Younger Dryas climatic reversal that was different enough from earlier such shifts to have caused the extinctions?

Up until a few years ago, extinction was also thought to co-occur with the first arrival of humans in the New World, termed by some as the Clovis First or blitzkrieg hypothesis. We now know that part of that hypothesis is no longer supported, as findings—such as the detailed dating of the Manis mastodon and an associated mastodon rib with a mastodon bone projectile point impaled in it (Waters et al. 2011)—have demonstrated that humans were in North America at least 800 years prior to the period ascribed to the makers of Clovis projectile points. Did the Clovis projectile point makers provide the *coup de grace* to mammoths that were just hanging on?

After summarizing the ongoing debate over Pleistocene extinctions, in the second section of her book (termed "Wild Dreams") Levy covers the issues, many of them controversial, involved in rewilding in a very thoughtful manner. Here she discusses the planned introduction of extirpated species (such as the wolf into Yellowstone National Park, the condor into Arizona, and the unplanned reintroduction of the horse into North America), and summarizes the ideas of the proponents of Pleistocene rewilding. The reintroduction of species to their former ranges has in many cases had profound and unpredicted effects upon their ecosystems. One example she presents is the role of African elephants in the opening up of new grasslands by their browsing on the taller trees in woodlands from which they had been previously excluded. The effect, in many instances, has been dramatic, with a landscape of decimated woodlands being replaced by grasslands.

Did mammoths have a similar effect on the ecosystems and, in particular, on the vegetation of North America? It is here, in the arena of Pleistocene rewilding, that Levy connects to the extinct megafauna discussed in the earlier chapters of her book. Proposed by Paul S. Martin, the idea of "Pleistocene rewilding has generated enthusiasm, scorn, and a great deal of media hubbub over the idea of lions and elephants loose in the American West" (p.166). Martin has suggested introducing species similar to extant taxa to fill the ecological niches left open by Pleistocene extinctions. Others have even suggested (since researchers now have nearly complete mammoth and ground sloth genomes) that these extinct species be cloned and reintroduced into the wild when possible. But if it was climate or some other effect, and not anthropogenic factors, that originally led to the extinction of these beasts, would we be bringing back species that are no longer compatible with today's world? There is plenty of evidence to indicate that many Pleistocene environments have no modern analogs.

While we may never have answers to many of the issues addressed in Levy's book, they are of importance to archeologists who want to have an understanding of human interactions with the environment, as well as an appreciation of the complexities of ecosystems and the changes they can undergo. Finally, Levy's book should be read as an example of how to write clearly about such wide-ranging, complex issues.

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2011 Pre-Clovis Mastodon Hunting 13,800 Years Ago at the Manis Site, Washington. *Science* 334: 351–353.

Hunter-Gatherer Foraging: Five Simple Models

Robert L. Bettinger
Clinton Corners, New York: Eliot Werner Publications, Inc., 2009, 111 pp., 20 figures, 42 tables, 8 appendices, $29.50 (paper).

Reviewed by Mark E. Basgall
Archaeological Research Center
California State University, Sacramento
Sacramento, CA 95819-6106

Foraging models drawn from behavioral ecology have been directly applied to archaeological and ethnological problems for more than 25 years now. Any contemporary hunter-gatherer researcher or serious student is well aware of at least some of these models–e.g., diet breadth, patch choice, and linear programming, to name a few. Fewer people, however, are well acquainted with the math that underlies these applications and gives them much of their elegance. While we all employ many of the catch-phrases that have emerged from foraging theory—terms such as handling time, high (or low) cost resources, return rates and the like—many anthropologists have only an intuitive understanding of how these models work. It is just that problem that Bettinger hopes to remedy with this concise book. Writing in the Preface about his motivations for assembling the volume, he observes by analogy that "reading the recipe is not the same as cooking the dish," and goes on to say that one cannot truly understand how a foraging model works without engaging the math in relationship to a specific problem. And that is precisely what Bettinger does in this volume.

In keeping with the book's title, Bettinger tackles five "simple" foraging models, several of which he was originally involved in developing. Chapter 1 deals with the diet breadth model, by now familiar to nearly everyone, and lays it out via a straightforward consideration of three different resources and the question of which should be targeted by a prospective forager. He not only presents the mathematical solution clearly, but discusses some of the attendant issues, like the relative importance of energetic search and handling costs. Chapter 2 takes up linear programming and how to model foraging decisions with known constraints. As before, the examples used to illustrate the model are clear and precise, exploring solutions that are meant to both maximize and minimize different currency requirements.

Most readers will be less familiar with the models that follow. Chapter 3 deals with how to examine the differences between front- and back-loaded resources, those that require a heavy investment when collected and prepared for storage, versus those that accrue significant handling costs prior to consumption. These turn out to be important distinctions, and have implications for the emergence of caching and storing behaviors among foraging populations everywhere. In Chapter 4, Bettinger considers a model that measures the effects of technological investment; i.e., how the effort put into making a tool should be dependent upon its success in procuring resources. Such relationships help explain changes in extractive technologies generally, and offer insights into how some solutions can catch fire almost overnight. A derivative application shows how these same variables can be used to assess field transport, and when it makes sense to partially process a resource at the point of acquisition before transporting it home. In the last section, Chapter 5, Bettinger considers a separate field-processing model that makes fewer demands on known information. The utility of a processed load is higher, but it also requires more investment, and the trick is to determine the point at which travel costs (distance) predict such treatment. The math in these chapters is a bit more involved than in earlier sections, but Bettinger patiently walks the reader through the steps and provides plenty of examples of how the relationships operate.

There are two other issues that the book does not address–they are outside its intent–but which models of this kind invariably raise. The first has to do with how reliable the information that is plugged into these applications really is: how do we really know how long it took prehistoric hunter-gatherers to process a particular resource, or the time needed to reduce a cobble into a bifacial preform, or how to gauge the relative investments in different kinds of stone tools? Do we really believe that a weekend seed-gatherer or a once-a-year deer hunter is going to be as efficient at the task as someone who performed such activities on a regular, traditional basis? It probably does not matter in many cases, but where our estimates are way off or the models are especially sensitive to slight quantitative changes, it could well bias the outputs a great deal. Researchers are, of course, endeavoring to refine these baseline data through experimentation and by conducting robust ethnographic research on extant foraging populations.

The other issue is more problematic. How can we most effectively apply these elegant models to actual archaeological contexts, where the record is heavily compromised and the linkage between behavioral predications and material consequences is often far from clear? Just what does it take to corroborate a model's predictions involving empirical zooarchaeological data or the technomorphological attributes of a stone tool sample? Far too often, it seems, the fit between our models and the real-world data is weak at best, but researchers still assume a reasonable concurrence and claim to have explained the phenomenon under scrutiny. Just because a mathematical model tells us that something should or could work in a certain way does not mean that it did. Otherwise, why do archaeology at all? Models of this sort provide an important guide to problems but are not ends in themselves.

But having said that, this is a fine volume that does just what it aims to do. The style is informal, often humorous, and it will clearly work well in a classroom with advanced undergraduate or graduate students. The flow and clarity of the discussions almost makes one forget that this is math that one is trying to master. Bettinger provides numerous additional exercises at the close of each chapter (with the correct answers), and includes eight appendices that further explicate the mathematics of particular model formulations. The volume is comparatively inexpensive for an academic book, and anyone with a serious interest in hunter-gatherers, prehistoric subsistence, and resource provisioning will want to own a copy. I, for one, look forward to the day when someone with Bettinger's theoretical insights will write a similar treatment on how to better link these simple models to an intransigent archaeological record.

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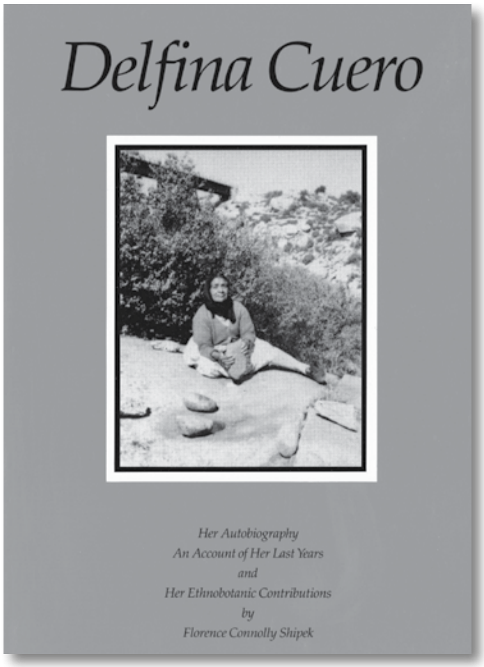

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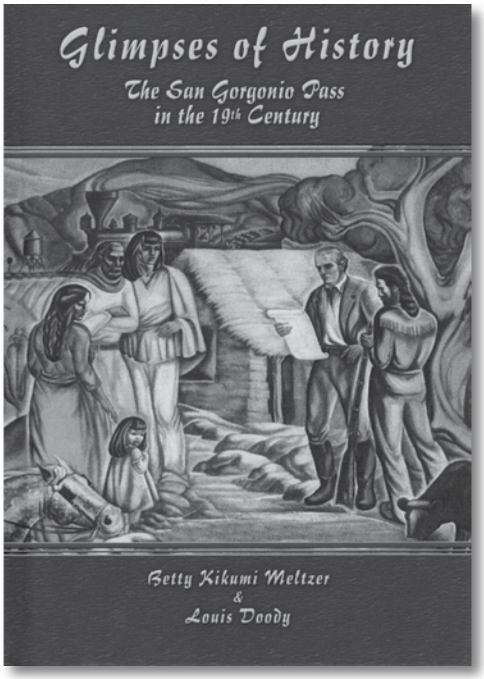

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The San Gorgonio Pass in the 19th Century
by Betty Kikumi Meltzer and Louis Doody

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This work sheds light on three periods that profoundly affected the fate of the Cahuilla people: the short period of Spanish rule from 1819 to 1821, the Mexican period from 1821 to 1848—an era of grand ranchos; and the American period from 1848 to 1892.

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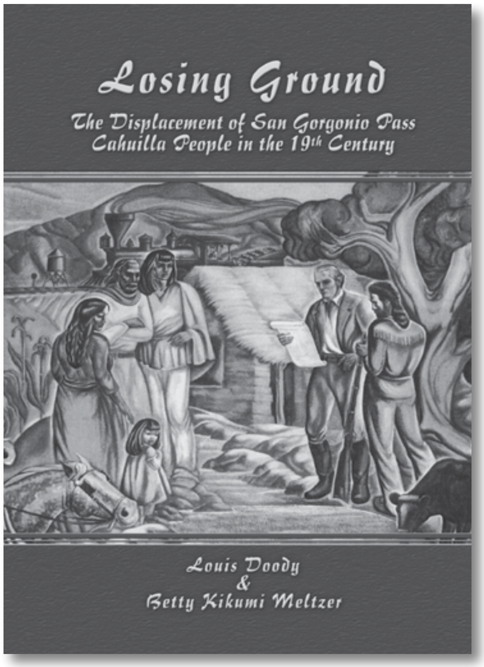

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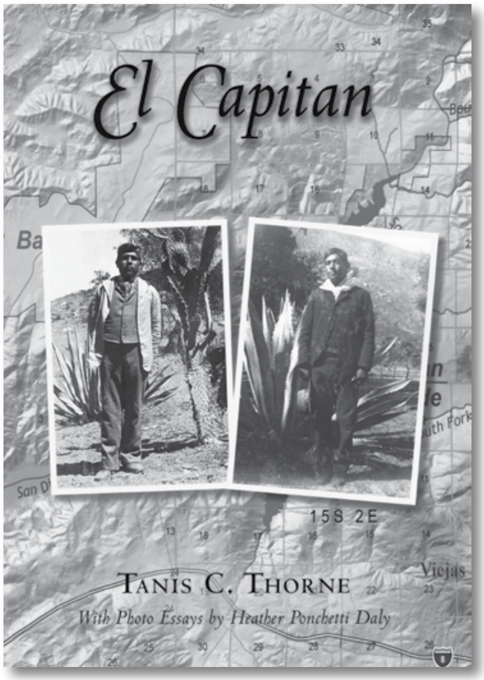

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