Evidence of the Chumash plank canoe at Ca-Sba52, Santa Barbara County, California

Suzan Faye Rose
University of Nevada, Las Vegas

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EVIDENCE OF THE CHUMASH PLANK CANOE
AT CA-SBA-52. SANTA BARBARA
COUNTY, CALIFORNIA

by

Suzan Rose

Bachelor of Arts
University of Nevada, Las Vegas
1983

A thesis submitted in partial fulfillment of the requirements for the

Master of Arts Degree
Department of Anthropology
College of Liberal Arts

Graduate College
University of Nevada Las Vegas
May 2000
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is approved in partial fulfillment of the requirements for the degree of  

Master of Arts in Anthropology  

Examination Committee Chair  

Dean of the Graduate College  

Examination Committee Member  

Graduate College Faculty Representative  

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ABSTRACT

Evidence of the Chumash Plank Canoe at CA-SBA-52, Santa Barbara County, California

By

Suzan Rose

Dr. Alan Simmons, Examination Committee Chair
Professor of Anthropology
University of Nevada, Las Vegas

The Chumash plank canoe or *tomol*, was an important part of the maritime subsistence pattern of the Chumash as well as an important element in the maintenance of a complex hierarchical socio-political structure. The placement in time of the origin of the *tomol* is critical to many models of culture change and cultural ecology in the Santa Barbara Channel area. The assemblage of artifacts and features at CA-SBa-52 on the Goleta Slough adds to the body of data regarding the development of the *tomol* and indicates that it may have had a longer history in the area than previously suspected.
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CHAPTER 1

INTRODUCTION

Statement of the Problem

When Spanish explorers made contact with the Chumash Indians of the Santa Barbara Channel area (Figure 1), the elaborate, sea-worthy plank canoes (tomol) used by the native population intrigued them. The Chumash plank canoe was a relatively large sea-worthy craft constructed from planks cut from redwood driftwood logs. The planks were affixed in rounds to a slightly hollowed out keel board. Holes were drilled into the planks, which were lashed together with twine or sinew. The boat was caulked with a substance made from pine pitch and asphaltum (yop).

This unique watercraft was not only an integral part of the maritime economic adaptation of the Chumash; it played a central role in the complex socio-political organization. The Chumash plank canoe and the timing of its development is a critical element in many models of the development of socio-cultural complexity in the Santa Barbara Channel region.

Jeanne Arnold (1991) and Chester D. King (1990) agree that the tomol was invented about AD 500-800 based on a set of artifacts generally regarded to be associated with tomol construction. Harrison and Harrison (1966) and Carter (1941) believe the tomol was in use much earlier on inferential grounds. The presence of Hunting People sites on the Channel Islands and high frequencies of marine mammals

1

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Figure 1: Map of the Santa Barbara Channel Area
and large fish in the faunal assemblages of Hunting People sites indicate to Harrison and Harrison that a seaworthy watercraft was in use at the time. They proposed that "the Hunting People arrived in, or developed, the prototype of the frameless plank canoe" (1966:74). Jon Erlandson agrees that the colonization of the islands, between 10,000 and 11,000 RYBP on San Miguel Island and Santa Rosa Island, would have required the use of relatively seaworthy boats (1997:5).

Some researchers (J. Arnold 1991, 1993, Linda King 1982) believed that the tomol was an important factor in the development of elite classes in the Late period (A.D. 1200-1300). Canoe owners had control of cross channel trade and presumably a monopoly on exploitation of pelagic fish species and cetaceans such as dolphins and porpoises (Arnold 1991, 1993). While C.D. King agrees that the tomol dates to Middle period times, he believes that the development of socio-cultural complexity pre-dates the development of the tomol by about 2000 years (King 1990). If this is correct, the tomol could obviously not be a causal agent in the development of cultural complexity. Was the tomol a cause or consequence of cultural complexity? Answering this question depends on accurate chronological placement of both features in the Santa Barbara sequence.

Another important issue in California coastal archaeology is the evolution of coastal subsistence adaptations. Many of the early coastal populations depended greatly on shellfish and plant food collection. Late period economies in Santa Barbara appear to be fully developed maritime subsistence economies relying on sea mammal hunting and fishing (Erlandson 1997; Moratto 1984). Throughout the Middle and Late Periods (3400 BP to present in C. King’s Chronology), there seems to be a general trend toward intensification of marine fishing and hunting. According to Erlandson (1997:10), the
middle Holocene brackets a transition from the littoral economy of the early Holocene and the fully developed maritime economy seen in the late Holocene. A reconstruction of Middle Holocene diets is essential to understanding the early stages of the development of maritime adaptations along the California coast. Since changes in subsistence are closely linked to technology and artifact form, an analysis of subsistence-related artifacts in middle Holocene sites will shed light on the development of maritime economies in the Santa Barbara Channel area (Erlandson 1997;10).

CA-SBa-52 is uniquely situated in time and space to address these issues. An initial impression of the site is that it contains many elements associated with tomol construction at an earlier date than some estimates for its invention. The site can be placed in Middle Holocene by radiocarbon dates and cross dating of artifacts in the assemblage. Two radiocarbon dates place the site in King's Eyb period. The suite of artifacts is consistent with Campbell cultural tradition (Warren 1968).

To support a hypothesis that plank canoes were being constructed on the site, several lines of investigation should be followed. Because of the relative age of the site in comparison to many estimates for the invention of the tomol, strong evidence is demanded to support tomol construction at SBa-52. While a complete faunal analysis will be crucial to support the hypothesis, my emphasis will be on artifactual evidence. A suite of artifacts and materials related to the manufacture of the tomol have been identified from ethnographic and historic accounts as well as archaeological contexts. An analysis of these items at SBa-52 should support the hypothesis.

A determination of tomol building at CA-SBa-52 will have implications for models of the development of a maritime economy, sociopolitical development and craft specialization in the Santa Barbara Channel area. If it can be shown that this site
was an early *tomol*-making site it would help to place the *tomol* in relation to the emergence socio-political complexity. As an important feature of the maritime economic adaptation of later periods, establishing an early date for the invention of the *tomol* at SBa-52 will also have implications for questions about the development of the maritime economy.

**Chronology**

Establishing chronological sequences is fundamental to most research problems in archaeology. A plethora of chronologies have been contrived for the southern California coast and the Santa Barbara Channel area. Table 1 presents some of the major chronologies developed for the Southern California coast.

The earliest scientifically oriented archaeological research in the Santa Barbara Channel area began around 1919-1920 with the work of J P. Harrington at Burton Mound (Moratto 1984). Since that time, there have been numerous attempts to define regional and local sequences for southern California coastal prehistory.

Most local chronologies build on the early work of David Banks Rogers in the Santa Barbara area in 1929. Rogers was introduced to the archaeology of the region in the early 1920s, when he worked with Harrington at Burton Mound. Based on over a hundred sites, review of historical data and excavations he conducted on the southern California coast between Carpinteria and Gaviota, Rogers defined three cultural periods (Oak Grove, Hunting People, Canaliño), proposing separate migrations to account for each phase (Grant 1978:519; Moratto 1984:124; Rogers 1929). The earliest period identified by Rogers is called the Oak Grove People because of the location of sites near...
Table 1: Chronological Sequences for the California Coast  
(Adapted from Erlandson 1997)

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<tbody>
<tr>
<td>Historic Chumash</td>
<td>Historic Cultures</td>
<td>Historic Cultures</td>
<td>Late Period Phase 3 (L3) AD 1782</td>
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<td>Late Period</td>
<td>Chumash</td>
<td>Late Period Phase 2 (L2) AD 1500</td>
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<td>Late Period Phase 1 (L1) AD 1150</td>
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<tr>
<td>Canalino</td>
<td>Horizon IV</td>
<td>Late Prehistoric</td>
<td>Late Period</td>
<td>Middle Period Phase 5 (M5) AD 900</td>
<td>LATE HOLOCENE</td>
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<tr>
<td>600 BC</td>
<td>Middle Period</td>
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<td>Middle Period Phase 4 (M4) AD 700</td>
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<tr>
<td>Hunting People</td>
<td>Early Period</td>
<td>Horizon III Intermediate</td>
<td>Campbell Tradition</td>
<td>Middle Period Phase 3 (M3) AD 300</td>
<td>MIDDLE HOLOCENE</td>
</tr>
<tr>
<td>Hunting People</td>
<td>Early Period</td>
<td>Horizon III Intermediate</td>
<td>Early Period Phase 1 (M1) 1400 BC</td>
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<td>Early Period Phase 2 (M2) 0 BC (2800 B)</td>
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<td>Early Period Phase 3 (M3) 1400 BC</td>
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<td>Early Period Phase 4 (M4) 2400 BC</td>
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<td>Early Period Phase 5 (M5) 4500 BC</td>
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<td></td>
<td>Early Period Phase 6 (M6) 8600 BC</td>
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<tr>
<td>Oak Grove</td>
<td>Horizon II Millingstone</td>
<td>Encinitas Tradition</td>
<td>Early Period Phase X (Ex) 6000 BC</td>
<td></td>
<td>EARLY HOLOCENE</td>
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<tr>
<td>?</td>
<td>Horizon I Early Man</td>
<td>San Dieguito Tradition</td>
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</table>

oak forests. The period is characterized by a settlement pattern of sites located on high ground some distance from the sea, semi subterranean huts, large elliptical metates, oval
manos and crude points (Moratto 1984; Orr 1952; Rogers 1929). Rogers was convinced that the appearance of the Oak Grove People coincided with the earliest appearance of man in America (Rogers 1929:353). This phase has been subsequently radiocarbon dated to the Early and Middle Holocene (Glassow 1997).

Rogers identified a subsequent culture he called the Hunting People. He believed a gap of several centuries existed between the disappearance of the Oak Grove Culture and the appearance of the Hunting People. The period was characterized by a shift in relative frequencies of manos and metates to mortar/pestle combinations. Manos and metates were not replaced entirely but became less abundant in comparison to mortars and pestles. Large, well-formed side notched projectile points replaced the crude points found in Oak Grove assemblages and occur in greater quantities. Burials were most often flexed (embryonic) and villages were located near the ocean on the headlands near the mouths of canyons or bordering estuaries (Moratto 1984; Rogers 1929). The settlements of the Hunting People are few but larger in comparison to Oak Grove sites, up to nearly a mile in length. In contrast to Oak Grove, the Hunting People left a uniform distribution of refuse with no evidence of kitchen middens. The use of asphaltum made its first appearance in the sequence during this period (Orr 1952) According to Rogers, asphaltum was encountered at almost every step of investigation and seems to have been in continuous use from the beginning of the period (Rogers 1929).

Another hallmark of the Hunting Period is the unusual basket-hopper mortar, which consisted of a flat stone with circular groove that held the lower rim of a bottomless funnel shaped basket. The basket was attached to the stone with hot
asphaltum. Rogers thought the complex basket-hopper mortar was an indication that the Hunting People immigrated into the region as a fully developed culture. He reaches this conclusion by the following logic:

I have previously stated my belief that the metate mill of the Oak Grove People was indigenous to this region, being a perfectly natural result from the needs of the moment. Not so the basket mortar. It bears every imprint of being the result of careful forethought and probably also of a long period of evolutionary experimental stages, from which finally emerged the simple form which we find upon the first appearance of the Hunting people in our valley, and which endures without change to the end of their culture. Any occurrence of this or of similar forms of the basket-mortar, contemporaneously with or antedating their appearance in the Santa Barbara Valley, we should look upon as extremely important clews which might lead us to a solution of the mystery that now surrounds the origin of this second culture (Rogers 1929:364).

Rogers' final cultural phase was called Canaliño and has been identified as ancestral to the Chumash (Grant 1978:519). The Canaliño period is characterized by domed thatched houses, plank canoes, flexed burials, elaborate shell and steatite industries (Moratto 84:124). Like the Hunting people, they settled on the silted-in floors at the mouths of canyons or on rocky surface of the adjacent headland. Canaliño sites were generally located where Hunting people had been established in the past (Rogers 1929:369). Projectile points were more finely made and no Canaliño points were side-notched. According to Rogers, the only Hunting people artifact adopted by the Canaliño was the basket-hopper mortar.

Rogers thought the Hunting People entered the region some centuries after the disappearance of the Oak Grove group and remained in the area after the arrival of the Canaliño. He stated that the Canaliño came during a period of aridity, presumably during the Late Holocene. After several centuries, the two peoples merged and became one (Rogers 1929:366).
R.L. Olson in 1930 and Phil C. Orr in 1941 further refined Rogers' three phases. Based on data from excavations near Santa Barbara and on Santa Cruz Island, Olson developed a sequence of five cultural periods, three Mainland periods and two Island periods. His sequence begins with a hypothetical Archaic stage which coincides chronologically with Rogers' Oak Grove culture. Early and Middle Mainland phases temporally encompass the Hunting Peoples culture and the Late Mainland corresponds with the Canalino phase. Olson did not correlate his periods with those of Rogers. He saw cultural changes in the sequence happening gradually with no indication of sudden shifts in cultural patterns. In contrast to Rogers, Olson implied that Santa Barbara cultures had developed in place. He stated "The changes in culture which the materials indicate are rather minor in nature and for the most part gradual. There are no indications of sudden or major shifts in pattern of culture" (Olson 1930:20). Olson did not discount the possibility of tribal or linguistic replacement over the course of the sequence, but asserted that any newcomers to the area must have completely adopted the patterns of their predecessors (Olson 1930:20).

P.C. Orr elaborated on Rogers' Canalino period based on excavations of six cemeteries on Mescalitan Island near Goleta in 1941. He divided the Canalino period into three sub-phases: Early, Middle and Late, based on burial styles. Orr believed that neither the Oak Grove nor Hunting People had reached the islands with their mainland culture (Orr 1952). He used radiocarbon dating to build a chronology of human settlement of Santa Rosa Island showing that the Channel Islands had been occupied continuously for the last 10,000 year (Orr 1962, 64-68).

William J. Wallace (1955) synthesized southern California prehistory into four broadly defined horizons. The purpose of his chronology was to provide a framework
in which to discuss the available data and to provide structure for future data collection. Wallace's horizons were not well dated and he expected further data gathering would be necessary in order to describe them in more detail. His primary concern was with establishing a sequence with chronological placements of sites being arrived at by broad typological comparisons.

Horizon I represented Early Man in California which is not well represented in the archaeological record and is largely hypothetical (Wallace 1955:215). Horizon II includes the Millingstone assemblages of California including the Oak Grove period (Rogers 1929) and the Encinitas tradition (Warren 1968). Wallace estimated that Horizon II began about 4500-5000 years ago and spanned 2,000- to 3,000 years (5,000 BP to 2000 B.P).

Horizon III represents Intermediate Cultures. Wallace described this horizon as a gap between Millingstone cultures and the more elaborate cultures of the late prehistoric period. He recognized that this gap was due to a lack of data rather than to a period of abandonment. The Hunting People and Campbell tradition fall temporally into this Horizon (Wallace 1955:222).

While the intermediate cultures of California could not be organized chronologically at the time, Wallace felt that some assemblages appeared to be more recent others. He estimated that Horizon III probably dated between 1,000 BC- AD 1,000 (Wallace 1955: 223). Wallace felt that the Intermediate cultures showed little specific relation to either preceding or subsequent cultures.

Horizon IV (AD 1000-contact) represents the Late Prehistoric Cultures and includes the distinctive local complexes extant at the time of European contact. The
Canaliño or Chumash, which was the most elaborate of the late prehistoric cultures, is the Santa Barbara area manifestation of this Horizon (Wallace 1955).

In 1964 William Harrison elaborated on Rogers’ sequence based on six sites located on the Santa Barbara coast. He proposed four phases, the Goleta Phase, El Capitan Phase, Extraños Phase and the Rincon Phase. The Goleta and El Capitan phases were subdivisions of Rogers’ Oak Grove. The Goleta Phase (5100-4500 BC) was marked by the initial appearance of the Oak Grove culture. During this phase manos and metates were used exclusively as grinding implements, and mussel shell dominated sea food remains (Harrison 1964:352). The El Capitan Phase (3350-1950 BC) economies were still land oriented, focusing on vegetal foods with minor use of small mammals and coastal resources. The mortar and pestle were introduced and clam shell dominated seafood remains (Harrison 1964; Harrison and Harrison 1966:67).

Harrison believed the Oak Grove People were immigrants from the East. The presence of millingstones and the patterns of subsistence suggested to Harrison that the Oak Grove People had migrated from the inland deserts (Harrison 1964; Moratto 84:133).

During the Extraños Phase (2900-2,000 BC), Rogers’ Hunting People appeared. Harrison thought they co-existed with the El Capitan phase of the Oak Grove People for about 1,000 years He based this contention on radiocarbon dates that apparently show contemporaneous occupation of the two cultural manifestation at SBa-53 and SBa-78 which are located only a few kilometers apart. An Oak Grove component was found at SBa-78 dating to 4000 RYBP while a Hunting people occupation was dated at SBa-53 to 5000 RYBP (Glassow 1997).
Because the interior desert cultures had no maritime adaptation, Harrison believed that it was impossible for the Hunting culture to have originated in the California interior. He claimed instead that the Hunting People originated in Alaska, possibly migrating to southern California in plank canoes (Harrison and Harrison 1966:68-9).

The Rincon Phase (2000-Contact) saw the appearance of the Canaliño or Chumash. Harrison believed this phase was the result of a merging of the Oak Grove People and the Hunting People after centuries of co-existence (Harrison 1964; Moratto 1984:137).

Claude N. Warren's synthesis of southern California coastal prehistory introduced the concept of 'cultural tradition'. A cultural tradition is defined as "...a generic unit comprising historically related phases" (Warren 1968:1). A cultural tradition is identified by a suite of technologies, artifacts and cultural features. Descriptions and definitions of cultural traditions are independent of environmental settings or ecological considerations. Warren defined four cultural traditions for the southern California coast: the San Dieguito Tradition, the Encinitas Tradition, the Campbell Tradition, and in the Santa Barbara Channel area, the Chumash tradition (Warren 1968).

The San Dieguito Tradition dates from before 7080 B.C. and lasted until between 6540 B.C. +/- 400 and 5670 B.C. +/- 380. This tradition was identified mainly in one site located in San Diego County and was not known in the Santa Barbara archaeological record (Warren 1968:2).

The Encinitas Tradition subsumes the Oak Grove and related millingstone complexes, including Wallace's Horizon II (Moratto 1984:160). It appeared about 5500
B.C. in both San Diego and Santa Barbara counties and lasted until sometime between 3,000-1,500 BC in Santa Barbara county but persisted until about A.D.1 in San Diego (Warren 1968). Subsequent radiocarbon dates indicate that the first appearance of this tradition may have occurred somewhat earlier (Moratto 1984:160). The defining features of the tradition include crude flaked stone tools and abundant manos and metates. Projectile points are uncommon and are generally large and crudely made (Warren 1968).

The Encinitas tradition represented a collecting economy in which pinyon nuts, seeds, and shellfish were utilized. There is very little evidence of fishing or hunting. This adaptation persisted along the coast of Santa Barbara County for about 2500 years with very little variation (Warren 1968).

The Campbell Tradition, which is equated with the artifact assemblages and sites of D.B. Rogers' Hunting People, dates as early as 3030 B.C. in Santa Barbara County (SBa-53). Defining features of the tradition include side-notched, stemmed and lanceolate projectile points, large knives and flaked scrapers. Hopper mortars and stone bowls or mortars and pestles appear for the first time. The economy of Campbell tradition relied on terrestrial and marine mammals, fish and shellfish. Collecting and processing seeds and nuts continued to be an important subsistence activity (Warren 1968).

Like Harrison, Warren believes the Campbell tradition is intrusive to the area but believes that the immigrants were hunting people from the interior regions. This is based on the similarity between Campbell tradition assemblages and Pinto assemblages found further east in California and Nevada. No local precursors to the Campbell tradition are known in the Santa Barbara area and there is some evidence for co-
existence and, perhaps, merging with the Encinitas tradition (Moratto 1984:161; Warren 1968).

The Chumash Tradition is the late proto-historic cultural expression in the Santa Barbara area. Defining features of the Chumash tradition include elaboration of ornamentation and artistic items, pecked and ground stone items such as bowls, mortars, stone balls and beads. Projectile points are usually non-stemmed with convex or concave bases. The Chumash represent a maritime adaptation with emphasis on fishing and sea mammal hunting as well as use of inland resources. Broad-spectrum use of available resources in the environment and increased efficiency of hunting, fishing and collecting equipment facilitated population increase and cultural elaboration. Warren suggested that the Chumash tradition was more likely the result of continued elaboration of the Campbell tradition than developing from outside influences (Warren 1968:9).

Warren's system provides flexibility by defining cultural traditions independently of environmental factors. This system provides a conceptually fluid framework in which a tradition can be considered in a variety of environments and conversely, more than one cultural tradition can be considered in the same environment.

A more recent and finely tuned chronology, developed by Chester King, has been used extensively by researchers in the Santa Barbara region since 1981 (Table 2). His work was based on analysis of museum collection burial lots. King describes a burial lot as “a set of artifacts used at the same time or as a subset of all the types of artifacts used by a society at the time of its burial” (King 1990:18). His chronology relies heavily on seriation of shell beads and other ornaments from mainland and island collections. The artifacts were correlated with specific cultural phases from Santa
Barbara that were linked to the central California chronology of bead types developed by Bennyhoff (Moratto 1984).

Table 2: Chester King’s Chronology (1990)

<table>
<thead>
<tr>
<th>Period Phase</th>
<th>Estimated Date</th>
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<td>AD 1782-1804</td>
<td>Late</td>
<td>Late</td>
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<tr>
<td>L2</td>
<td>AD 1500-1782</td>
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<td>L1</td>
<td>AD 1150-1500</td>
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<td>M5</td>
<td>AD 900-1150</td>
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<td>M4</td>
<td>AD 700-900</td>
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<td>3000-1000 BC</td>
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<td>Eya</td>
<td>4000-3000 BC</td>
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<tr>
<td>Ex</td>
<td>5500-4000 BC</td>
<td>Early</td>
<td></td>
</tr>
<tr>
<td>?</td>
<td>8000-6000 BC</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

King applied the Early, Middle and Late periods, recognized in central California, to the southern California sequence, dividing them into phases based on grave lot seriation. His chronology includes the mainland and islands in a single sequence (King 1990:27).

The Early Period (6000-600 BC: 8000-2600 B.P.) is divided into four phases. The Ey phase was further subdivided. The Early Period spans about 5400 years and includes Rogers’ Oak Grove and most of the Hunting period. Olson’s (1930) Early periods, Wallace’s Millingstone and Intermediate Horizons and Warren’s (1968) Encinitas and early Campbell Traditions. According to King, non-egalitarian society occurred near the end of the Early Period.
The Middle Period (600 B.C.- A.D. 1150: 2600-840 B.P.) is divided into five phases some of which have been further subdivided. During M3 (A.D 400-700), there is evidence of plank canoe use in Santa Barbara channel (King 1990:85-86). The Late Period (A.D. 1150-A.D. 1804 850-180 B.P) is divided into six phases. This period includes all historic and late prehistoric cultures.

King uses grave lots to create a dateable sequence of beads and ornaments. He does not associate these items with a suite of artifacts or features in order to affiliate them with a cultural horizon or ethnic group. King identifies two periods of significant change in the sequence: a transformation to chiefdoms around 3000 B.P., and a conversion to a market economy around 1200 B.P.

In response to the confusion of the chronologies described above, Jon Erlandson (1997) has attempted to simplify regional chronologies by dividing the Holocene into three equal parts and describing cultural developments within these periods. While this division is arbitrary, he finds that these epoch correspond to some general developments in California coastal prehistory.

The Terminal Pleistocene (ca. 12,000-10,000 RYBP) is marked by the Paleo-Indian Horizon which is represented by a limited number of fluted points found on the California coast. These have not been radiometrically dated, however, appear to be related to the North American fluted point tradition which dates to about 11,000-12,000 B.P. Another Paleo-Indian complex beginning in the Terminal Pleistocene is the San Dieguito Complex, which is commonly believed to date from 11000 to 8000 BP (Erlandson 1994:44).

The Early Holocene (10,000 to 6650 RYBP) is marked by an increase in the number of coastal sites between 9000 and 8000 RYBP. These sites are representative...
of early Millingstone occupations. This period includes the onset of Warren's Encinitas tradition as well as Rogers' Oak Grove and Wallace's Millingstone Horizon.

The Middle Holocene (6650 to 3350 RYBP) is characterized by the changes described by Rogers, Wallace and Warren in the Oak Grove (Millingstone) to Hunting People (Campbell) transition. A shift from manos and metates to mortars and pestles, increased numbers of large side notched projectile points, and a trend toward diversification of hunting and fishing technologies occur during this time (Erlandson 1997:7). The Late Holocene (3350 to 0 RYBP) is marked by the appearance of California's complex maritime societies (e.g. Chumash, Gabrieleno).

Erlandson supports the use of King's chronology because of its good temporal resolution (the sequence is explicitly tied to radiocarbon dates), use of non-functional terms and its usefulness as a framework for understanding regional variation. Kings sequence begins at about 7,500 RYBP and so does not deal with the earliest portions of the Holocene. Like King, Erlandson asserts that recent research suggests that stages represent the evolution of a single culture over 7,000 to 9,000 years (Erlandson 1997).

Michael Glassow has subdivided the Middle Holocene into three stages of cultural development. The first, beginning in the Early Holocene and lasting until about 5500-5000 RYBP, relies mainly on terrestrial resources and easily acquired marine resources such as shellfish. During the second stage, which lasts until about 4000 RYBP, there is an increased emphasis on marine resources in addition to shellfish. Hunting is expanded to include marine mammals and the variety of exploited plant foods is increased. The third stage introduces the basket hopper mortar that may indicate the advent of acorn exploitation. Glassow suggests that these three stages occurred during time intervals when sea surface temperatures were relatively low.
These are periods when subsistence systems would have remained relatively stable and population densities would have increased (Glassow 1997:88).

In general, Rogers' three periods have held up with some modifications and refinements. Controversy remains regarding whether the various phases and periods represent temporal periods in the development of a single culture or represent cultural replacements in a variety of configurations.

Rogers believed his three groups represent three distinct groups of people (Rogers 1929). Others (Harrington 1930; Harrison and Harrison 1966; Warren 1968) believe the Hunting People (Campbell Tradition) were intrusive into the area but may have developed into the Canalino. C. King and others (Erlandson 1997; Glassow 1997) have concluded that Chumash society developed in place over a period of more than 7,000 years.

In addition to chronological studies, researchers in the Santa Barbara Channel region are concerned with issues relating to the development of cultural complexity and the maritime economy that was extant at the time of contact. When was the area first settled and from where, do the sequences represent an in situ development or are the changes indicative of the incursion of different groups into the area?

Models of Cultural Complexity

Jeanne Arnold (1987,1991,1993,1995) has focused a great deal of her research on the development of cultural complexity and craft specialization. She wants to shed light on the initial appearance of complex culture. When and why did chiefly authority and social differentiation first emerge? Arnold contends that the mechanism of change
from egalitarian to non-egalitarian societies is the changing organization of labor (Arnold 1993:83).

She conservatively traces the antiquity of sociopolitical complexity to AD 1200-1300. She acknowledges that trade and craft specialization existed prior to this time but that there is no evidence of chiefdoms in the archaeological record prior to this time. Arnold sees this development largely as a response to environmental stress. There is some evidence (Pisias 1978) of elevated sea surface temperatures (SST’s) between A.D. 1150 and 1250. Such elevated SST’s are known to reduce the productivity of the maritime environment. Arnold believes that this stress created opportunities for certain individuals to gain control of labor needed to organize transportation across the channel.

Canoe owners are assumed to have already established an ability to organize labor for the manufacture and maintenance of the boats. They were also in a position to manipulate goods and services, amass surpluses and move cargo over great distances. With environmental stress, cross-channel trade and exploitation of off shore resources became more important. As a result, individuals who owned *tomolo* were established as wealthy and powerful individuals.

Arnold assigns a Middle Period date of about AD 500-800 for the invention of the *tomol* with it attaining its final form by about AD 1100-1150 just in time for the environmental disruptions caused by elevated sea surface temperatures (Arnold 1987:7; 1995:736). The prior development of the plank canoe was a crucial innovation, which allowed the intensification of trade and the increasing power of canoe owners (Arnold 1987:11).

Chester King claims the archaeological record reflects the gradual growth of social systems over time in contrast to Arnold’s view of the development as responses
to catastrophic environmental changes (King 1990: xviii). He says hierarchical social differences arose late in the Early period, about 2700 years earlier than Arnold’s contention (3400 B.P. or 1400 B.C.). While environmental disruptions are seen as causal factors to Arnold, King claims that climatic change is not necessary to explain the changes in subsistence technology (King 1990:79).

Erlandson believes that the socioeconomic and technological complexity seen in California coastal prehistory, was fueled by population growth, the effects of environmental perturbations on populations approaching the carrying capacity of the environment, and resource stress. However, he does not rule out the possibility that population movements may have played a role in initiating culture change (Erlandson 1997:8). While environmental changes in early and middle Holocene may have affected the timing of subsistence shifts, alone, they do not account for the major cultural changes observed (Erlandson 1994).

A number of research issues are very much unresolved regarding Middle Holocene developments on the southern California coast. Among these issues are shifts in settlement and subsistence patterns, causes of technological change, and the evolution of coastal adaptations. A general pattern of increasing reliance on marine fishing and sea and land mammal hunting is seen on the southern California coast during the late and Middle Holocene. Within this trend, however, there is a great deal of regional variation and a great many details left to be discovered.

The development of the *tomol* is a technological change that is interwoven with changes in subsistence, the evolution of coastal adaptation and the development of sociocultural complexity. Because the *tomol* was such an integral part of coastal adaptation, placing its development in the coastal chronology becomes an important step in
addressing how, when and why, local subsistence economies based on terrestrial and littoral resources, were replaced by a fully maritime economy relying on deep water fishing and sea mammal hunting. This placement is also vital to an understanding of the evolution of socio-cultural complexity and sedentism in hunting/gathering societies. Because of the position of CA-SBa-52 on the southern California coast during this important transitional time, it has great potential to address many of these research issues.
CHAPTER 2

THE CHUMASH PLANK CANOE (TOMOL)

Description of the Tomol

The seaworthy Chumash plank canoe, or tomol, is unlike any other watercraft developed by aboriginal North Americans. In fact, similar frameless plank canoes were only developed in parts of Oceania, Egypt, and Chile (Heizer 1940; Kohler 1977; Rogers 1929). The tomol was constructed of wooden planks, sewn together and caulked with asphaltum. These canoes were lightweight and flexible being based on a bottom plank with planks attached to a bow post and a stern post (Heizer 1940:84).

Although no specimen of the Chumash tomol has been preserved, its technology, use and related social organizations survived into the mission period (Hudson 1976) and, according to Harrington (Hudson et al 1978), early missions had possession of one or more plank canoes. Early accounts by Cabrillo and other explorers provide descriptions of the boats. The following description is from D. B. Rogers: “This native tomolo was formed of pieces of plank, lashed together with thongs run through eyelets near the edge of each piece, the seams of which were later caulked with hot asphaltum. It is known to have measured somewhat over 20 ft. in length with approximately a four-foot beam at the center, narrowing rapidly toward each end. The depth is conjectural, but was probably not less than two feet, as the craft was eminently sea-worthy “ (Rogers 1929:6).
According to historic and ethnographic accounts, *tomolo* seem to have been of two sizes. The smaller craft was estimated to have been between 12-18 feet in length and four feet wide. Two to six men could be accommodated in the smaller *tomol*, which was used primarily for fishing. The larger *tomol*, which measured between 19-22 feet long and five feet wide, was probably used for trade between the mainland and islands (Kohler 1977:62).

By historic times the canoe had developed into a craft that could carry a crew of three to four men plus two tons of cargo. At contact, the canoe was used for deep-sea mid-channel fishing as well as trade and transportation across the channel (Arnold 1992; 1995).

**Construction of Tomol**

Relatively detailed descriptions of the boat and its construction are available largely due to the extensive notes kept by J.P. Harrington. Around 1913 Harrington interviewed consultant Fernando Librado, a Chumash Indian who was in his 70’s at the time. Fernando was able to describe *tomolo* in use and under construction as far back as the 1840’s (Hudson et al 1978:15).

The ultimate purpose of the interviews was to reconstruct a functioning *tomol*. This boat, named the *Helek*, was built according to Librado’s specifications for the Santa Barbara Museum of Natural History. Figure 2 shows a schematic drawing for the construction of the *Helek*. In order to recreate the *tomol*, detailed descriptions of construction techniques, tools, and materials were recorded. According to Librado, construction of the *tomol* was an extremely costly undertaking requiring up to 540
Figure 2: Schematic Drawing of the Helek (From Hudson et al. 1978)
person days of skilled labor over approximately a six-month period (Hudson 1976; Hudson & Blackburn 1987). In addition to labor costs, raw materials were rare and costly. Because the locally available trees were inadequate, the canoes were constructed from driftwood logs that came ashore from the northern California coast (Arnold 1992).

Construction was carried out under the direction of a master boat builder (altomolich), who was respected for his knowledge and skills as well as his wealth. This man directed six to twelve men in a variety of tasks such as board making, fitting planks, drilling holes, tarring, sewing, caulking, and decorating. Each craftsman belonged to a craft guild called the 'Brotherhood of the Canoe'. Substantial engineering knowledge was required. Each plank was planed, measured, drilled, lashed and caulked with asphaltum (Hudson et al. 1978).

The canoes were constructed from planks that were split out of driftwood logs. Redwood was preferred due to its resistance to rot but other woods were used on occasion (Hudson et al., 1978). Arnold notes that the northern islands were probably optimal places to obtain driftwood because they intercept the south-flowing California Current (Arnold 1995:738). Logs were split with a wooden or whalebone wedge and only a few planks could be obtained from most logs. The planks were then smoothed and shaped using bone, shell, and stone tools. The bottom of the canoe consisted of one long heavy plank to which the hull boards were attached. The first round of boards were twisted and bent to conform to the bottom. The boards rested edge to edge and were beveled to overlap end to end.

Then the tarrers applied a hot adhesive (yop) to all joining edges. This caulking material was made of a mixture of tar and pine pitch, which was heated to refine it by evaporation. Additional stability was given to the hull by sewing the boards together.
First, a pair of holes was drilled into the plank. Several layers of twine bound the boards through the holes end to end and side to side. *Yop* was again applied to seal the holes and twine. Between the fifth and sixth rounds of hull boards a crossbeam or thwart was installed across the middle of the canoe. This crossbeam was the only structural bracing. The sixth round was the gunwale and did not meet at the prow or stern allowing for the egress of fishing and harpoon lines (Hudson 1976). This description from Harrington's notes is mirrored in that given by the Spanish explorer Constanso in 1769:

> The expertness and skill of these Indians is unsurpassed in the construction of their canoes of pine boards. They are from eight to ten yards in length, from stem to stern post, and one yard and a half in breadth. No iron whatever enters into their construction, and they know little of its use. But they fasten the boards firmly together, making holes at equal distances apart, one inch from the edge, matching each other in the upper and lower boards, and through these holes they pass stout thongs of deer sinews. They pitch and calk the seams, and paint the whole with bright colors. They handle them with equal skill, and three or four men go out to sea to fish in them, and they will hold 8 or 10 (Men) (In Rogers 1929:6-7).

A variety of tools and materials was required for the construction of the *tomol*. Ethnographic accounts describe the use of tools such as drills, asphaltum applicators, crucibles or stone bowls, and wedges. Materials required included driftwood logs, asphaltum and pine pitch. *Yop* was a critical element in *tomol* construction. This substance consisted of two components, hard tar and pine pitch. The tar was mined by the Chumash because the abundant beach tar was too soft to be used. Harrington's consultant reported that the Indians would dig or mine hard tar at, among other places, Goleta Point near La Patera (Hudson and Blackburn 1987:163). *Yop* was applied at each joint and lashing-hole to make the vessel watertight. Heizer believed that this type
of plank canoe would have been impossible to construct without the availability of asphalt as a caulking material (Heizer 1940:83).

Hypotheses Regarding Tomol Development

The tomol undoubtedly played an important role in Chumash society as it was at the time of European contact. A reliable ocean-going vessel allowed the Chumash to exploit open water marine resources and carry on trade between the islands and the mainland. Its place in the direction of development of socio-political complexity is an open question. Did it allow for the development of elite classes or were powerful men a necessary prerequisite for the development of this very costly tool? The establishment of the chronology the development of the tomol becomes an important factor in addressing this question.

Some researchers (Hudson et al. 1978) believe that if the tomol was a local invention, its predecessor was the dugout canoe that was also used in the region. The dugout was not used for cross channel travel and was restricted to use in estuaries and lagoons. They assert that because the bottom board of the tomol resembles the dugout, it may be a vestigial feature. They thought that the earliest tomolo were dugouts modified with a few rounds of boards to increase the stability of the craft (Hudson et al. 1978).

Heizer disagreed, denying that either the dugout or the tule balsa were precursors of the tomol. Neither does he believe that the balsa is an older element in California than the plank canoe. He asserts “We find that there is no single pre-existent boat form from which the Chumash canoe can be shown to have evolved. The multiple foundation (bow-post, bottom plank, and stern-post) cannot be considered a vestigial
dugout hull...There is good reason to believe that the plank canoe was autochthonous to the Santa Barbara channel region, since it was eminently suited to the environmental conditions and seacoast economy” (Heizer 1940:86).

Harrison and Harrison (1966) do not subscribe to the local invention scenario but believe that the Hunting People may have arrived in a prototype of the *tomol*. While there is no direct evidence for canoes or boats at Hunting People (Campbell Tradition) sites, the presence of ocean-going watercraft is indicated on purely inferential grounds. The Harrisons contention is based on the maritime subsistence orientation at the early Hunting People site, SBA-53 (Aerophysics Site).

There are varying opinions on the date of origin of development of the *tomol*. Many researchers (Arnold 1995, King 1990, Hudson et al. 1978), date the first appearance of the *tomol* to about A.D. 500 based on appearance of caulking, canoe drills and a strong maritime economy.

According to Jeanne Arnold (1995), the invention of the *tomol* is estimated to have occurred between AD 500-800 and had reached is fully modified form by AD 1100-1150 (Arnold 1995:736). This timeframe is based on artifactual evidence as well as on her assertion that goods seem to have moved across the Santa Barbara Channel with increasing ease during the later middle period (AD 800-1150).

This timing is significant in light of Arnold's hypothesis that chiefdoms and sociopolitical complexity began to emerge in the Channel area at about A.D. 1200-1300 (Arnold 1991). Arnold has proposed that emerging elites were tied to canoe ownership and operation. (Arnold 1987). According to Arnold (1991, 1992, 1995) the development of the ocean-going canoe facilitated sociopolitical activities and was probably vital to the development of complex economic and political features. They
facilitated information exchange, manipulation of goods by elites, and controlling social contacts (Arnold 1995:736). The tomol allowed canoe owners to control trade and accumulate wealth. She contends the emergence of elite classes during A.D. 1150-1300 may have been based on a combination of environmental disruptions that took a heavier toll on the islands than on the mainland, and the advantage given to canoe owners who then had control of cross-channel trade as well as access to mid-Channel subsistence resources (Arnold 1995:738). Arnold’s hypothesis regarding the emergence of socio-cultural complexity and craft specialization relies on accurate chronologies of cultural complexity, environmental stress precipitated by elevated sea surface temperatures, and the invention of the tomol.

Chester King (1990) places the beginning of the tomol only slightly earlier than Arnold, contending that evidence exists for the plank canoe in the Santa Barbara area during his M3 period (AD 300-700). He claims that evidence for an increase in fishing technology during M3 and M4 probably reflects an increase in the numbers of large boats (1990:85). He also cites artifactual evidence including the rare piece of planks, asphaltum caulking with appears as early as M4 (A.D. 700-900), and large chert drills tentatively placed near the end of M3 (A.D. 400-700) (King 1990:85). King disagrees with Arnold’s timing of the onset of the development of cultural complexity claiming that evidence for non egalitarian society begins near the end of the Early period (2400-1400 BC). This places tomol development nearly 2000 years after the emergence of cultural complexity.
Archaeological Indicators of *Tomol* Manufacture

A number of archaeological indicators can be used as evidence for the manufacture of plank canoes. Direct evidence in the archaeological record is sparse, consisting of pieces the *tomol* or its component parts such as wooden planks or asphaltum plugs (Arnold 1995; Kohler 1977). Rarely, planks have been found in archaeological contexts but these date to L2 or later (A.D 1500) (King 1990:85). Due to the highly perishable nature of wood, it is necessary to rely on indirect evidence of boat manufacture and use such as the tools and raw materials associated with *tomol* manufacture.

The presence of asphaltum in archaeological contexts is an indicator of possible *tomol* construction. Rogers (1929) and Olson (1930) agree that the first use of asphaltum occurred at beginning of Rogers' Hunting Period. While asphaltum was also used to coat baskets and for hafting, an abundance of asphaltum and evidence of its liberal application coincides with the use and manufacture of plank canoes (King 1990, Kohler 1977).

The different uses of asphaltum required different means of application. Tarring pebbles were used to apply asphalt to the interiors of basketry water jars. These are small, unmodified stones about the size of a walnut or about 2 inches (5.08 cm) in diameter. In 1853, Nidever (Hudson and Blackburn Volume 5: 174) observed a San Nicolas Island woman lining a basket for holding water. She heated small stones, about the size of a walnut, in a fire. The hot stones were dropped on top of pieces of asphaltum in the vessel. When the asphaltum had melted, the vessel was swirled in order to coat the interior.
Harrington's consultants described the same process. Tarring stones, measuring about two inches in diameter, were carefully selected. The stones were heated and dropped into a water jar with asphaltum and rolled around inside the basket (Hudson and Blackburn 1982 vol. 5:174). Asphaltum applicators are stones used in applying asphaltum to external surfaces. Applicators were probably used in conjunction with stone crucibles or abalone shell mixing dishes which are known ethnographically to have been used to thin yop to coat sewing string for the tying together of canoe planks (Hudson and Blackburn vol. 5 1987). Applicators are differentiated from tarring pebbles by size and shape. Applicators are flat, elongated cobbles with asphaltum smeared on one or both ends (Kohler 1977). Asphaltum applicators are another indicator of tomol construction. Their presence is important in order to tie the presence of asphaltum to tomol construction rather than to the tarring of baskets or hafting of stone tools.

Large chert drills and reamers were employed for boring lashing-holes in planking (King 1990; Kohler 1977). Harrington's consultants reported using stone pointed drills hafted to a wooden shaft or bone points to drill holes in planks. They also reported that the old people used to bore holes in planks using flint knives (Hudson and Blackburn 1987:95).

Wedges were used ethnographically in tomol construction. According to Harrington's consultants, wedges used in boat construction were made of either wood or deer horn. Whalebone wedges have been recovered from archaeological contexts on the northern Channel Islands (Hudson and Blackburn 1987).

Caulking tools are wooden or bone implements used to force caulking materials between planks of canoes (Hudson and Blackburn 1987).
Crucibles: Stone containers (usually made of steatite ethnographically), in which asphalt is heated and processed (Hudson et al. 1978).

Twine used to sew planks together was made from fiber of the California Maguey (Agave sp.), red milkweed, and occasionally sinew. Apparently vegetable fiber was preferred over sinew because it was less susceptible to rot (Hudson et al. 1978; Kohler 1977:63).

It cannot be expected that all tools and materials used in tomol construction will be preserved over long periods of time. Stone tools drills, applicators, crucibles, and asphaltum can be expected to last. Wooden tools such as wedges, planks, caulking chisels, and either form of bindings, are not expected in sites of any significant antiquity. Other forms of indirect evidence include faunal remains, trade items, and deep sea fishing gear, which indicate the use of deep-sea resources or long distance trade to the islands. A high percentage of sea mammal and deep-sea fish bones in middens is also an indicator (Kohler 1977).

Researchers have reached their conclusion regarding the inception of the tomol based on two methods. One is artifactual evidence consisting of tools and material associated with the use or construction of the tomol. Chester King states archaeological evidence of the tomol consists of asphaltum caulking and large chert drills which appear during his M3 period (1990:85). The other approach is inferential. Arnold sees the increase in trade goods across the channel as indicative of early tomol use. The Harrisons infer the existence of the tomol based on the maritime adaptation of Hunting People. Jon Erlandson believes the occupation of the Channel Islands between 10,000 and 11,000 RYBP, required the use of relatively sea-worthy boats (Erlandson 1997:5).
Both lines of evidence are applicable to CA-SBa-52, however, I will focus on the artifactual evidence to support the hypothesis that people at this site were constructing *tomolo* or an early prototype of that craft. Of the archaeological indicators listed above, this study will focus on the correlation of boat drills with the presence of asphaltum as well as with asphaltum applicators and asphaltum stained pestles.

A variety of drilling and perforating tools are found on the site, many of these are not of the appropriate size or strength required to drill or enlarge holes in wooden planks. In order to identify those drilling and perforating tools that can be classified as boat drills, I use a functional hypothesis proposed by Michael Glassow (1986) described below:

Carefully shaped chipped stone drills with a triangular or quadrilateral cross-section and between 5-10 cm. in length were used to drill holes in wood planks in the process of making plank canoes. Alternatively, they were used to make serpentine tubes or shell fishhooks. Test Implications: A correlation between the abundance of drills and other evidence of canoe manufacture such as (possibly) asphaltum applicators; alternatively correlation between the abundance of serpentine tubes, and shell fishhooks; presence on drills of this type of wood, stone or shell microwear (Glassow 1986).

After identification of drills on the site matching the above description, a correlation between these drills and applicators and asphaltum on the site would indicate that *tomolo* were being constructed on the site. Following C. King's method of showing the presence of the *tomol* through artifactual indicators of its construction, if these or similar artifacts are found at SBa-52, it would support the contention that they were constructing *tomolo* on the site.
CHAPTER 3

CA-SBA-52 SITE DESCRIPTION

Geography

CA-SBa-52 is located on the Pacific coast of southern California in Santa Barbara County. The Santa Barbara coast is the western extension of the Transverse Ranges of mountains, which are the only east/west trending mountains in California. The major Transverse Ranges include the Santa Ynez, San Miguel, Santa Monica, San Gabriel, San Bernardino, Eagle and Orocopia Ranges. They extend approximately 500 kilometers from the Mojave Desert in the east to San Miguel Island in the Pacific Ocean. The islands of San Miguel, Santa Cruz and Santa Rosa are, in fact, semi-submerged peaks of the Santa Monica Mountains (Jones 1991; Moratto 1984:16; Morris and Webb 1990:301).

The unique south-facing orientation of the Santa Barbara Channel and the presence of the Channel Islands protects the coast from prevailing winds and heavy surf typical of the rest of California's coastline (Glassow et al. 1988). This area is defined as the Southern California Archaeological region (Moratto 1984). The region extends south from Morro Bay along the Pacific coast. The Santa Barbara sub-region of the Southern California Archaeological region that lies between Morro Bay and Santa Monica in the south, is characterized by varied coastal and mountainous zones. Massive erosion has cut deep canyons into the sediments that make up the Transverse
Ranges. The area is warmer and dryer than the central coast region but with sufficient rainfall to support a rich environment. The mainland coast is protected by the islands of San Miguel, Santa Cruz, Santa Rosa and Anacapa (Moratto 1984:116).

The southern coast of California is less rugged than that to the north. The coastline consists of stretches of rocky, sandy, and protected coast with estuaries and lagoons. Between 8000-5000 B.P. coastal California experienced a "heyday of estuary and lagoon development" as sea levels rose (Carbone 1991:13). This Early Holocene transition of the coast from rocky shorelines to estuarine and lagoon environments provided habitat for increased marine, avian, and small terrestrial populations (Carbone 1991:12).

CA-SBa-52 is located on the edge of one such system, the Goleta Slough. The Slough is located approximately 13 kilometers west of Santa Barbara on a sheltered coastal plain crossed by several streams. The slough is a major topographic feature of the Goleta Basin which is eight miles long east/west, three miles wide north/south. The basin has been filled with sediments deposited by the streams that flow into it from the mountains (Harrison and Harrison 1966). It is the remnant of the ancient Goleta Lagoon, which reached a maximum area of approximately eighteen square miles. (Figure 3) The condition of the slough, prior to modern development, was the result of sedimentary infilling of the embayment due to sea level rises. Today the slough has been reduced to a remnant due to alluviation and airport construction (Lohmer et al. 1980:232 in Colton 1989:203).

Climate, Flora and Fauna

Throughout the Holocene (10,000 B.P. to present), California generally
Figure 3: Map of the Santa Barbara Channel and the Goleta Lagoon from Harrison 1965

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experienced a sub-humid or semiarid Mediterranean climate with the cool/moist and warm/dry seasons that are seen today. The Santa Barbara sub-region is warmer and less foggy than the central California coast. The coast from Santa Barbara south to the Mexican border has an average rainfall of about 45 centimeters per year (Baumhoff 1978; Moratto 1984).

The native vegetation of coastal southern California is typical of warm Mediterranean type climates. Coniferous communities are limited to small stands of closed-cone forest (Jones 1991:427). The wooded areas of the Santa Barbara region are Southern Oak Woodland type dominated by coast live oak and Englemann oak (Baumhoff 1978:22). Grasslands are rare, primarily being confined to the Channel Islands and some portions of San Luis Obispo and Santa Barbara counties. Vegetation is dominated by sclerophyllous communities such as Coastal Sagebrush, Chaparral and Southern Oak Forest (Kuchler 1977 in Jones 1991:427).

Large herd animals were rare in most of southern California, although there were some populations of elk, deer, and pronghorn antelope (Baumhoff 1978:16). The marine environment, in contrast, was rich and diverse. The offshore and littoral environments supported fish, shellfish, and marine mammals such as sea lion (Eumetopias jubata), sea otter (Enhydra lutris) and harbor seal (Phoca vitulina richardii) (Koerper 1981:562-567 in Jones 1991:428; Baumhoff 1978).

Paleoclimates

California climates have changed significantly during the last 10,000 years (Erlandson 1985:107). The Holocene is marked by six relatively cool/moist periods of 400 to 1500 years in duration separated by five warm/dry intervals. The Altithermal
was a time of abnormally warm/dry climate which began somewhere between 8,000-7500 RYBP ending ca 2900 BP (Carbone 1991:11). According to Pisias, after 5400 B.P., the vegetation changed from a pine and oak woodland associated with a humid environment to an open and non-arboreal indicating a shift to a warm/dry period that lasted until about 2000 B.P. (Pisias 1978:376-380). This period includes the California Xerothermic period that persisted between 8500-3000 B.P. (Glassow et al., 1988). Between 2900 and 1500 B.P. cool/moist conditions returned followed by a warm/dry episode from 1500-600 BP. Between about 600 and 100 B.P. California's climates were essentially like those of the early historic period. Available data suggest that the most recent cool/moist trend, which began ca. 600 B.P. and reached its maximum ca. 200 B.P. returned to generally warmer/dryer conditions beginning ca. AD 1860 (Moratto et al. 1978).

The environmental changes that have occurred in the Santa Barbara sub-region over the course of the Holocene may be largely attributable to the process of sea-level fluctuations (Erlandson 1985). Between 16,000 B.P. and 6,000 B.P. a relatively rapid rise in sea levels of a meter per century or more occurred (Pisias 1978). One of the effects of rising sea levels is the creation of estuaries in canyon mouths. After about 6,000 B.P. sea levels stabilized near their present level (Colten 1989). This is the end of King's Phase Ex and the transition from the Encinitas to the Campbell tradition. This was a period of significant cultural change in the Santa Barbara sub-region (Colton 1989:209).

**Site Description**

Over twenty archaeological sites line the shoreline of the ancient Goleta Lagoon
and its tributaries. These sites represent occupation of the slough from 7,000 to 200 years ago (Colton 1989:203). The site, which he called Campbell 2, was described by D. B. Rogers in 1929; "At the western end of this series of bluffs is a rounded knob almost directly south of the site described as Campbell No. 2. Over the crest of this mound is scattered sparsely the characteristic camp refuse of the Hunting People. No excavating was done here, but it appears to have been an unsuitable site for the Oak Grove People" (Rogers 1929:140).

CA-SBa-52, approximately 154,065 square meters in area, is located on a ridge that projects into the ancient Goleta Lagoon from its western edge. The site is approximately three meters above sea level (Archaeological Systems Management, Inc. 1982:72). The kitchen midden, which followed the original clay ridge along the northern edge of the spit and extended onto the 'mainland', measured 1600 feet in length and had a maximum width of 500 feet. Rogers described two smaller outliers of the site. One was located several rods north and west of SBa-52 on the mainland. The smaller outlier was located at the eastern edge of the spit that would have bordered the lagoon. Because the small eastern site did not contain the black, greasy soils associated with Hunting People kitchen debris, Rogers suggested the following function of this outlier: "I think it probable that this small site was never used as a residential plot, but served as a favorite boat landing, or port of entry for the cargoes of sea food that formed such an important part of the Indians' daily food supply" (Rogers 929:142).

When Rogers recorded the site in 1925 it had just been plowed for cultivation and was clear of all vegetation. Figure 4 is Rogers map of Campbell 2. He noted accumulations of shellfish and bone. Much of the bone was of marine mammals such as whales and pinnepeds. Bones of large land mammals were also abundant including
Figure 4: D.B. Roger's (1929) Site Map of SBa-52.
elk, deer, bear, and mountain lion. Rogers also noted large quantities of asphaltum in cakes and nodules and made the following observation: “This commodity appeared to be restricted to certain areas, as though its use had been less a household function than a centralized act of manufacturing or repairing” (Rogers 1929:145).

Rogers described an abundance of debitage representing all stages of reduction and was impressed by the quantity and variety of finished chipped stone tool forms including knives, planers, drills, and projectile points. He noted a lack of the refinement of finish that was typical of other sites in the area. Rogers also took note of the relative lack of vessels among the surface assemblage which were limited to small stone bowls and shallow mortars rimmed with asphaltum (Rogers 1929:151-152).

CA-SBa-52 was revisited by archaeologists in the late 1960's. In the course of two field seasons in 1968 and 1969, 317 five by five-foot units were excavated. Most units were taken down to sterile soil, generally no deeper than 36 inches. No site boundaries were delineated but the extent of the excavations measured approximately 650 feet east/west by 500 feet north/south.

For purposes of analysis, I have divided the site into 6 discrete areas (Figure 5). Area 1 includes units excavated west of the north/south trending datum line, units to 10 units to the east, and Trench 1 which roughly parallels the north/south datum line. The area is comprised of a total of 12 units and 1 trench. Area 1 is located on the extreme western edge of the site. Area 2 includes a total of 151 units and Trench 3. This is the largest block of excavation units on the site and includes all units from 23 north-10 east to 59 north-49 east. Area 4 consists of 56 units in the north-central portion of the site from 61n80e to 68n85e. Area 5 is located at the eastern edge of the site north of the east/west trending datum line. This area consists of 57 units. Area 6 includes all units
Figure 5: Site Map Showing Areas
located south of the east/west trending datum line. This is the southernmost extent of the site where it slopes toward the beach. It consists of 17 units and Trench 2.

Artifact Descriptions

Over 7,500 artifacts were recovered and cataloged during the 1968 and 1969 field seasons. These include a wide range of artifact types groundstone, chipped stone implements, beads and ornaments, bone awls, bowls. For the purposes of the current study, I am addressing only the tools described in Chapter 2 as related to *tomo*l manufacture. Additionally, projectile points are analyzed for cross-dating purposes only. Projectile points

A total of 1016 projectile points and point fragments have been identified at SBa-52. Of these, 258 are complete enough to be classified. To facilitate comparison to nearby SBa-53, I have classified the projectile points following Harrison and Harrison's (1966) analysis of that site. This simple classification is based on gross morphological characteristics, specifically the form of the base.

Type I: Stemmed points. (109 specimens) These points have straight to contracting stems. Shoulders vary from well defined to gently curved.

Type II: Side Notched Points. (44 specimens) A certain degree of variation in notch placement occurs within this category ranging from true side notched to corner notched points.

Type III: Points lacking stems or notches. (105 specimens) These can be subdivided according to base morphology into leaf shaped ( convex based), triangular ( straight base) or concave based. 82 specimens are leaf shaped, eight are triangular and 15 have convex bases.
The projectile point assemblage at SBa-52 is dominated by the large points representative of the Campbell tradition. New types of large dart points, similar to Elko series points, appeared for the first time during the Middle Holocene around 5500-4500 RYBP. Coastal side notched points include the corner notched variety and the two grade into one another somewhat (Glassow 1997). Glassow believes that the side notched points may have endured for less than 1,000 years and notes, “If they truly date to a narrow bracket of time they may serve as a useful marker. The problem is, they are rare in most sites where they occur and small-scale testing programs are not likely to encounter them. As a result, their utility as a time marker seems restricted to fortuitous encounters or to relatively large-scale excavations (Glassow 1997b:153).

This replacement of side notched points contracting stemmed points of similar size and workmanship, is one of several noticeable changes in artifact form observed after 4600 RYBP and closer to 4000 RYBP (Glassow 1997:81). The point assemblage from SBa-53 (Aerophysics Site), analyzed by the Harrisons in 1966, is heavily weighted toward side notched points (95%) with only one example of the contracting stemmed point. In contrast, the projectile points at SBa-52 are 42% stemmed and 17.1% side notched. This is consistent with the c14 dates of these sites which dates SBa-53 to between 5000 and 4600 RYBP (Glassow 1997) and SBa-52 which dates to 4040 +/- 80 RYBP, about 1000 to 600 years later. Table 3 and Table 4 show a breakdown of relative frequencies of projectile point types at SBa-52 and SBa-53 respectively.
Table 3: Projectile Points at SBA-52

<table>
<thead>
<tr>
<th>Point Type</th>
<th>Count</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stemmed</td>
<td>109</td>
<td>42.25</td>
</tr>
<tr>
<td>Side Notched</td>
<td>44</td>
<td>17.1</td>
</tr>
<tr>
<td>Leaf Shaped</td>
<td>82</td>
<td>31.8</td>
</tr>
<tr>
<td>Triangular</td>
<td>8</td>
<td>3.1</td>
</tr>
<tr>
<td>Concave Base</td>
<td>15</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>258</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4: Projectile Points at SBA-53

<table>
<thead>
<tr>
<th>Point Type</th>
<th>Count</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stemmed</td>
<td>1</td>
<td>1.05</td>
</tr>
<tr>
<td>Side Notched</td>
<td>88</td>
<td>92.63</td>
</tr>
<tr>
<td>Corner Notched</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Leaf Shaped</td>
<td>3</td>
<td>3.15</td>
</tr>
<tr>
<td>Triangular</td>
<td>3</td>
<td>3.15</td>
</tr>
<tr>
<td>Concave Base</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>99.98</td>
</tr>
</tbody>
</table>

Drilling and Perforating tools (550 specimens)

The assemblage of drilling and perforating tools at SBA-52 consists of 550 provenienced tools. Of the 550 drilling tools analyzed, 457 specimens are complete enough to be typed. The remaining 93 fragments are excluded from the discussion. Each artifact previously classified as a drill or graver was re-evaluated and classified according to the system described below. The entire artifact assemblage was examined in order to identify other drilling and perforating tools which may not have been originally identified as such.

The drilling and perforating tools have been divided into seven major categories based on gross morphological characteristics. Some of these divisions are further...
broken down into sub types. Attributes used in this analysis are maximum length, width and thickness, width/thickness ratio, bit diameter and bit length. Other attributes noted include cross section and blank type. No single classification system satisfactorily described all types found in this assemblage so categories from several sources were utilized.

Type A: Reamers (80 specimens)

The description of this type of tool was derived from Kowta's analysis of reamers at SBa-60, "These are implements believed to have been used to enlarge perforations by means of a rotary scraping action against their angular sides. They are short, thick and bluntly pointed with squarish or rarely triangular cross section. A few retain traces of an initial shaping by means of longitudinal flaking but steep transverse flaking characterizes the group Kowta" (1961:369).

The major difference between reamers and macro drills is reamers lack an observable drilling tip or bit. Because of the rough, unfinished nature of reamers, evidence of rotary-type use on the edges is considered a necessary attribute of the reamer. Tools that would have been classified as reamers but which lack evidence of use have been classified as blanks or preforms and eliminated from the category. Following Kowta, reamers are sub-divided into bi-pointed and uni-pointed reamers. Type A1, Bi-pointed reamers (10 specimens), Type A2, Uni-pointed reamers (52 specimens), and Type A, Fragments that could not be identified as bi or uni pointed (18 specimens).

A total of 80 reamers was recovered from the excavations. There is a great deal of variation within the group in terms of size. In cross section most are triangular (45%), or rectangular (42%), and the remaining 13% were either lenticular or plano-
convex in cross-section. 84% were manufactured on thick, longitudinally split preforms, 8.75% on unknown blanks, and the remaining 7.25% were pebble or flake based. Table 5 shows the dimensions of reamers at SBa-52.

Table 5: Reamers at SBa-52

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Thickness (cm)</th>
<th>Average W/T</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Average</td>
<td>Range</td>
<td>Average</td>
</tr>
<tr>
<td>A1</td>
<td>2.7-4.3</td>
<td>3.5</td>
<td>1.0-1.7</td>
<td>1.4</td>
</tr>
<tr>
<td>A2</td>
<td>1.9-5.6</td>
<td>3.5</td>
<td>.94-2.5</td>
<td>1.7</td>
</tr>
<tr>
<td>A</td>
<td>1.8-3.4</td>
<td>2.6</td>
<td>1.1-2.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>1.8-5.6</td>
<td>3.2</td>
<td>1.0-2.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Type B. Shouldered Drills: (42 specimens)

In Shouldered Drills, the base of the bit expands to form concave shoulders at the widest point. The edges then converge to a rounded base. These drills are generally made on flakes and are broader and thinner than macrodrills with an average width/thickness ratio of 2.6 as opposed to 1.7 cm for macro-drills. Shouldered drills are subdivided into long and short bit sub types.

Type B1: Long bit drills. (23 specimens) The bit lengths range from 7-14 mm with a bit length to maximum length ratio averaging 3.05 mm.

Type B2: Short bit drills. (19 specimens) The bit lengths range from 3.5-7 mm with a bit length to maximum/length ratio averaging of 5.76 mm.

Type C: Elongated Slender Drills (33 specimens).

The definitions of Elongated Slender Drills and Gravers are taken from Greenwood and Brown 1969. Greenwood and Brown (1969:18) describe drills in general as follows: "In most cases, they are flaked all over but the greatest care and
amount of chipping is found at the tip. The working end is always thinner and narrower than the butt except in the few specimens which are bi-pointed. Drills are thicker in relation to their width than are projectile points or blades and much less symmetrical" (Greenwood and Brown 1969:18).

These drills are flaked all over, and are more carefully flaked than macrodrills (See Type E below). They are longer in comparison to width than macrodrills. They have been further divided into two size categories. Type C1 consists of extremely small delicate drills (3 specimens), and Type C2 are larger, sturdier drill (30 specimens).

Table 6: Elongated Slender Drills

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Thickness (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Average</td>
<td>Range</td>
</tr>
<tr>
<td>C1</td>
<td>1.9-2.4</td>
<td>2.3</td>
<td>.7-1.0</td>
</tr>
<tr>
<td>C2</td>
<td>2.1-5.3</td>
<td>3.4</td>
<td>.8-1.9</td>
</tr>
<tr>
<td>Total</td>
<td>1.9-5.3</td>
<td>3.2</td>
<td>.7-1.9</td>
</tr>
</tbody>
</table>

Type D: Gravers (92 specimens)

These have a fine, short, slightly undercut point formed by the removal of tiny flakes on both sides of the projection. They are keeled at the tip. Most are unifacially flaked. (Greenwood and Brown 1969:19).

Table 7: Gravers

<table>
<thead>
<tr>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Thickness (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Average</td>
<td>Range</td>
</tr>
<tr>
<td>1.8-4.6</td>
<td>2.8</td>
<td>.8-2.6</td>
</tr>
</tbody>
</table>
The 92 specimens of gravers show a great deal of variation in body size, blank type and cross-section. The majority of gravers are plano-convex (44.5%) or triangular (33%) in cross section with 16% being roughly square and 6.5% are lenticular. Most gravers were manufactured on flakes (53.26%) or longitudinally split preforms (40.2%) with the remaining 6.54% either unidentifiable or pebble bases.

Type P (7 specimens):

Drills made on projectile points. Morphologically these could be classified as shouldered drills, however they are manufactured on projectile point blanks.

Type E: Macro-drills (203 specimens)

The definition of macrodrills is derived from Jeanne Arnold's analysis of macrodrills (1992). These are relatively thick, broad and sturdy drills. Like reamers, they are characterized by steep transverse flaking and differ from reamers only in having a retouched bit. They are generally made on thick preforms and have a triangular to squarish cross section. Macrodrills are subdivided into three divisions based on size and further subdivided into broad bitted and slender (narrow) bitted subtypes. Bit diameters defining these subdivisions vary according to the overall size of the artifact. Obviously, bit diameters for the largest tool type will be larger than for the smaller category. Broad bitted drills average bit diameters are around 10 millimeters while the narrow bitted bit diameters average between 5 and 6 millimeters.

Type E-fragments (16 specimens) These are broken drills and their lengths could not be ascertained. Of the 16 total specimens, 12 are Type E-b (broad bitted) and 4 are type E-s (slender bitted).

Type E1: Small Macrodrills (25 specimens) These are chunky with the width nearly 1/2 of the length. Thirty-nine macrodrills fall into this category with 14 being
broad bitted drills and 25 being slender bitted drills.

Type E2: (125 specimens) Medium macro-drills are larger and slightly slimmer than the small drills. 125 macrodrills fall into this category with 54 being small bit and 71 being broad bit drills.

Type E3: (23 specimens) Large macro-drills. These are the slimmest of the macro drills. Twenty-three macrodrills fall into this category with 14 being small bit and 9 being broad bit drills. Table 8 shows the dimensions of the macrodrills.

Table 8: Macrodrills

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Thickness (cm)</th>
<th>W/T Ratio</th>
<th>Bit Diam.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Average</td>
<td>Range</td>
<td>Average</td>
<td>Range</td>
</tr>
<tr>
<td>E-b</td>
<td>unk</td>
<td>unk</td>
<td>0.8-2.1</td>
<td>1.6</td>
<td>0.5-1.9</td>
</tr>
<tr>
<td>E-s</td>
<td>unk</td>
<td>1.6-2.4</td>
<td>1.8</td>
<td>0.8-1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>E1-b</td>
<td>2.0-2.6</td>
<td>2.4</td>
<td>1.0-2.1</td>
<td>1.5</td>
<td>0.6-1.2</td>
</tr>
<tr>
<td>E1-s</td>
<td>2.1-2.9</td>
<td>2.4</td>
<td>0.9-2.3</td>
<td>1.5</td>
<td>0.5-1.1</td>
</tr>
<tr>
<td>E2-b</td>
<td>2.4-3.9</td>
<td>3.2</td>
<td>1.2-2.9</td>
<td>1.8</td>
<td>0.6-1.1</td>
</tr>
<tr>
<td>E2-s</td>
<td>2.2-3.8</td>
<td>3.1</td>
<td>1.1-2.6</td>
<td>1.7</td>
<td>0.7-1.2</td>
</tr>
<tr>
<td>E3-b</td>
<td>4.1-5.5</td>
<td>4.5</td>
<td>1.5-2.6</td>
<td>1.9</td>
<td>0.9-1.7</td>
</tr>
<tr>
<td>E3-s</td>
<td>2.8-5</td>
<td>4.1</td>
<td>0.9-2.3</td>
<td>2</td>
<td>0.4-1.2</td>
</tr>
</tbody>
</table>

Application Stones

Asphaltum was used for several purposes each requiring a different means of application. Ethnographically, asphaltum was applied with wooden tools, bundles of vegetation or stones of various sizes and shapes. Stone tools are the only class of applicators that are expected to survive in the archaeological record. These are tarring pebbles, applicators and pestles.

Tarring pebbles were used to apply asphalt to the interiors of basketry water jars. These are small unmodified stones about the size of a walnut or about 2 inches (5.08 cm) in diameter. Asphaltum applicators are stones used in applying asphaltum to external surfaces. Applicators are differentiated from tarring pebbles by size and shape.
Applicators are flat, elongated cobbles with asphaltum smeared on one or both ends (Kohler 1977).

Approximately 178 asphaltum-stained stones were found at SBa-52. Of these, 18 can be identified as applicators based on the above description. Six of the applicators are identified as tar stained pestles which were used to crush asphaltum in a crucible to facilitate the yop making process. The remaining tar stained stones can be classified as tarring pebbles or unidentifiable fragments.

<table>
<thead>
<tr>
<th>Area</th>
<th>Applicators</th>
<th>Tar Stained Pestles</th>
<th>Tarring Pebbles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3</td>
<td>79</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>6</td>
<td>161</td>
</tr>
</tbody>
</table>

Asphaltum occurs throughout the site in small nodules. A total of 2885.3 grams was recovered. Table 10 shows the distribution of asphaltum collected on the site.

<table>
<thead>
<tr>
<th>Area</th>
<th>Weight (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.10</td>
</tr>
<tr>
<td>2</td>
<td>1162.50</td>
</tr>
<tr>
<td>3</td>
<td>297.90</td>
</tr>
<tr>
<td>4</td>
<td>508.30</td>
</tr>
<tr>
<td>5</td>
<td>912.50</td>
</tr>
<tr>
<td>6</td>
<td>3.00</td>
</tr>
<tr>
<td>Total</td>
<td>2885.30</td>
</tr>
</tbody>
</table>
Crucibles are defined as stone containers in which asphaltum is heated and processed. Ethnographically, most crucibles were made of steatite (Hudson and Blackburn 1987: 203). At SBa-52 two nearly complete stone vessels and 68 fragments were recovered. Both of the vessels were located in Area 2. One of these, a crude, thick walled basalt vessel, can be positively identified as a crucible as it was filled with a black tarry substance.

Rogers (1929) originally classified SBa-52 as a Hunting People site. He based this assessment on a suite of artifacts and features that define this tradition. These characteristic traits include site locations, black ‘greasy’ soils, large well-formed side notched and stemmed points, the use of asphaltum. These characteristics are also definitive of Warrens (1968) Campbell Tradition which dates to between 5000 BP and 1200 BP in Santa Barbara County.

Two radiocarbon dates for the site: 4040 =/-80 (Glassow 1997:76) and 4170 =/-70 (Beta Analytic #103571), place the site within the Middle Holocene during the time period of the Campbell Tradition (Warren 1968), and Period Eyb (King 1990). These dates support the artifactual evidence that SBa-52 is a Campbell Tradition site.
CHAPTER 4

TOMOL MANUFACTURE AT CA-SBA-52

Evidence of Tomol Manufacture at Ca-SBa-52

The archaeological record is made up of material things and arrangements of matter (Binford 1983). These things do not speak for themselves, but must be interpreted. How do we get from the assemblage of artifacts at CA-SBa-52 and their arrangement on the site to the conclusion that tomolo were being manufactured at the site. As outlined in Chapter 1, two lines of evidence have been used by archaeologists to infer such activity. First, the presence of tools and materials that have been shown to be used for the manufacture of plank canoes are used as indirect evidence. Jeanne Arnold states that indicators of canoe making include discarded redwood planks, cakes of asphaltum, large drills, and related gear (Arnold 95:738).

The second method involves the inference of the use of tomolo based on faunal remains, hypotheses of migration (Harrison 1966), and the early presence of humans on the Channel Islands. Pelagic fishes such as yellowtail, yellowfin and marlin, that must be taken in deep water, could have been more successfully exploited using plank canoes (Arnold 1991). The remains of such fishes in archaeological contexts can be used to infer the use of ocean going plank canoes. Arnold also inferred an increase in the use of the tomol based on the appearance that trade goods from both sides of the channel moved with increasing ease between AD 800-1150. Based on this apparent increase in
trade, she asserts that the *tomol* reached its fully modified form by AD 1100-1150 (Arnold 1995). Harrison (1966) surmised that the ancestors of the Chumash migrated to the area from the northwest coast in an early prototype of the *tomol*. Erlandson cites the early presence of humans on the islands of the early use of ocean going craft (Erlandson 1997). While such inferences can probably be made regarding Ca-SBa-52, as I have indicated earlier, this study relies on artifactual indicators alone.

Because direct evidence for the *tomol* is rare and restricted to recent sites, the presence of the Chumash plank canoe has been inferred by the presence of imperishable tools and materials associated with its construction (Arnold 1993, King 1990, Glassow 1986). These items include drills, applicators, asphaltum and crucibles. These indicators have been used by J. Arnold to infer the presence of the *tomol* at sites dating to Kings L2 period (AD 1500-1782) (King 1990). The presence of large chert drills was used by C. King to suggest that *tomol* were in use by the end of Phase M3 (AD 400-700) (King 1990:86-90). Since these artifact classes and materials are found at SBa-52, it is reasonable to interpret them in the same manner.

As discussed in Chapter 3, large chert drills, asphaltum, asphaltum applicators and crucibles all occur at SBa-52. There are a number of drilling and perforating tools on the site which are obviously not suitable for use in the manufacture of *tomolo*. How can we confidently assert which drills can be classified as boat drills? Of the 457 drills recovered at SBa-52, 273 (80 reamers, 193 macrodrills) conform to Arnold's characterization of boat drills. In her study of Vandenberg drills, Arnold defined macrodrills as "finished tools that appear to have been used to drill holes about 5-20 mm in diameter" (Arnold 1992:102). Table 11 compares the characteristics of Arnold's Vandenberg macrodrills with those at SBa-52. Use wear analysis on the Vandenberg
Macrodrills indicates that many of them were used in drilling holes in shell fish hooks (Gamble 1983 in Arnold 1992) or in the planks of the Chumash tomol. While no use wear analysis was done on the macro-drills found at SBa-52, it is assumed that similar use patterns will be observed on these drill types throughout the existence of the Campbell Tradition.

Table 11: Comparison of SBa-52 Macrodrills With J. Arnold's Vandenberg Data

<table>
<thead>
<tr>
<th>Characteristics of Macrodrills</th>
<th>Arnolds Vandenberg Data</th>
<th>SBa-52 Macrodrills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Wear</td>
<td>Used on shell or wood</td>
<td>NA</td>
</tr>
<tr>
<td>Mean Slender Bit Diameter</td>
<td>5 mm</td>
<td>5.6 mm</td>
</tr>
<tr>
<td>Mean Broad Bit Diameter</td>
<td>11 mm</td>
<td>9.9 mm</td>
</tr>
<tr>
<td>Mean Width/Thickness Ratio</td>
<td>1.87</td>
<td>1.73</td>
</tr>
<tr>
<td>Range Width/Thickness Ratio</td>
<td>1-3.7</td>
<td>1-3.1</td>
</tr>
<tr>
<td>Mean Width</td>
<td>18 mm</td>
<td>17.2 mm</td>
</tr>
<tr>
<td>Mean Thickness</td>
<td>10 mm</td>
<td>10.4 mm</td>
</tr>
</tbody>
</table>

Macrodrills at SBa-52 are also consistent with Glassow's (1986) description, discussed in Chapter 2. His functional hypothesis states that if drills with a triangular or quadrilateral cross-section and measuring between 5-10 centimeters in length, are associated with other evidence of tomol manufacture, these tools were probably used to drill holes in wood planks in the process of making plank canoes. Eighty-seven percent of the reamers and macrodrills at SBa-52 are triangular or quadrilateral in cross section. They are considerably shorter than the 5-10 centimeters proposed by Glassow, with a maximum length of 5.63 centimeters. However, widths of 2 centimeters are not unusual with the average for reamers being 1.7 centimeters and 2 centimeters for large macrodrills. These drills could have been used to drill holes between .5 and 2 centimeters in diameter proposed by Arnold (1992a).
Arnold's alternate hypothesis that macrodrills were used in manufacture of shell fishhooks, and Glassow's alternate hypothesis that they were used to drill holes in serpentine tubes, are rejected at SBa-52 simply because these items do not exist on the site. The drilling of holes in planks for canoes is the only alternative use proposed.

While the characteristics of the macrodrills at SBa-52 are generally consistent with the gross morphological characteristics described by Arnold (1992a), they are generally rougher and less symmetrical than those described and illustrated by Arnold (1992a) and King (1990). Considering that we see a refinement in projectile point manufacture through time, it is conceivable that these rougher drills could be early prototypes of the more finely flaked drills of Kings (1990) M3 Period.

Over 2,800 grams of asphaltum have been collected from the site. Asphaltum was used for a variety of purposes by the prehistoric people of the Santa Barbara Channel region (See Chapter 3), and this was probably the case at SBa-52. However, the large amount of asphaltum collected, along with the presence of other tomol related tools on the site strengthens the argument that asphaltum was used here to caulk the exterior surfaces of tomol.

Twelve applicators and six tar-stained pestles were recovered from the site. The tar-stained pestles were probably used in conjunction with crucibles to crush asphaltum in processing. The remaining applicators are elongated and spatulate in shape and must have been used for applying asphaltum to the exterior surface of a large object. They could not have been used for tarring the interiors of baskets and were probably not used for the hafting of points.

Two nearly complete stone bowls and 68 bowl fragments were recovered at SBa-52. One of the nearly complete bowls was filled with asphaltum leaving no doubt
of its use as a crucible. This crucible was found in unit 33n40e located in Area 2b, roughly in the central part of the site. The assemblage recovered from this unit was relatively sterile of other tomol-associated artifacts and asphaltum consisting of randomly scattered rocks and one fragment of another bowl and 5.2 grams of asphaltum. Area 2b contains less than the mean amounts of applicators and asphaltum with slightly higher numbers of drills and reamers.

The artifactual indicators used by Arnold (1992, 1995) and King (1990) to identify tomolo in archaeological contexts are present in significant quantities at SBa-52. The presence of large chert drills alone has been used by King and Arnold to indicate the presence of tomolo in archaeological contexts. Following Glassow's (1986) hypothesis, the presence of these large chert drills at SBa-52 associated with other tomolo related artifacts such as large amounts of asphaltum, applicators and crucibles, strongly supports the hypothesis that these drills were used in the manufacture of tomolo. Table 12 shows the distribution of tomol related artifacts across the site.

The hypothesis that tomol manufacture was being carried out at SBa-52 would be further supported if an association between asphaltum applicators and high concentrations of asphaltum could be demonstrated. Table 13 below shows the amount of asphaltum in excavation units that also contain applicators. In three of the eight areas containing applicators, the average amount of asphaltum per unit is lower than the average for the site as a whole (9.16 grams). In the remaining five areas, the amount of asphaltum per unit is greater than the site average. Based on this, an association of asphaltum applicators with higher concentrations of asphaltum is demonstrated supporting the hypothesis that asphaltum at SBa-52 was used in conjunction with stone
applicators and thus likely to have been used to caulk the exterior of large objects rather than for hafting or lining baskets.

Table 12: Concentrations of Tomol Related Artifacts by Area

<table>
<thead>
<tr>
<th>Area</th>
<th># of Units</th>
<th>Drills and Reamers</th>
<th>Applicators</th>
<th>Asphaltum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Per Unit</td>
<td>Total Per Unit</td>
<td>Total Per Unit</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>8</td>
<td>0.62</td>
<td>0</td>
</tr>
<tr>
<td>2a</td>
<td>61</td>
<td>70</td>
<td>1.15</td>
<td>6</td>
</tr>
<tr>
<td>2b</td>
<td>88</td>
<td>85</td>
<td>0.97</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>17</td>
<td>0.74</td>
<td>2</td>
</tr>
<tr>
<td>4a</td>
<td>11</td>
<td>15</td>
<td>1.36</td>
<td>2</td>
</tr>
<tr>
<td>4b</td>
<td>44</td>
<td>40</td>
<td>0.91</td>
<td>2</td>
</tr>
<tr>
<td>5a</td>
<td>18</td>
<td>17</td>
<td>0.94</td>
<td>1</td>
</tr>
<tr>
<td>5b</td>
<td>39</td>
<td>13</td>
<td>0.33</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>7</td>
<td>0.39</td>
<td>1</td>
</tr>
<tr>
<td>Site Total</td>
<td>315</td>
<td>272</td>
<td>0.86</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 13: Distribution of Asphaltum in Units With Applicators

<table>
<thead>
<tr>
<th>Area</th>
<th># of Units</th>
<th>Applicators</th>
<th>Asphaltum in units with applicators</th>
<th>Asphaltum per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>6</td>
<td>6</td>
<td>74.3</td>
<td>12.4</td>
</tr>
<tr>
<td>2b</td>
<td>1</td>
<td>1</td>
<td>32.2</td>
<td>32.2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>24.4</td>
<td>12.2</td>
</tr>
<tr>
<td>4a</td>
<td>1</td>
<td>2</td>
<td>25.3</td>
<td>25.3</td>
</tr>
<tr>
<td>4b</td>
<td>2</td>
<td>2</td>
<td>17.8</td>
<td>8.9</td>
</tr>
<tr>
<td>5a</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5b</td>
<td>3</td>
<td>3</td>
<td>84.4</td>
<td>28.1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>18</td>
<td>258.4</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Location of Work Areas at SBA-52

Another question that can be addressed at SBA-52 is the possibility of locating work areas within the site. In order to show associations between the various tomol related tools and material, these items have been plotted on a site map. The site has...
been subdivided into six 'areas' to facilitate analysis and identify areas where *tomol* manufacture may have been carried out. Figure 5 shows the location of these areas. Areas 1 and 6 are located on the western and southern edges of the site respectively, and consist of a few widely dispersed units. The excavation units in these areas contain smaller amounts of cultural materials in general than those located in the central part of the site. Area 2 is located in the west-central part of the site and includes the largest block of excavation units (151). This area was sub-divided into Area 2a and Area 2b because, intuitively, Area 2a appeared to have higher concentrations of *tomol* related artifacts. Area 3 is located near the center of the site. While Area 3 has the second highest concentration of asphaltum per unit, drills per unit are slightly below the site average. Area 4, located at the north edge of the site was subsequently divided into 4a and 4b, also because of a perceived concentration in Area 4a. Area 5 is located in the central part of the site and extends to the eastern edge.

I have focused on concentrations of asphaltum to identify areas where caulking was most likely carried out. The asphaltum recovered may include stray pieces of raw material scattered at a work area. It seems likely that caulking would be carried out near a launch point since the *tomol* would be near the end of the construction process and would be quite heavy at that stage. This suggests that such work areas will be located near the water’s edge. Area 4 is hypothesized to be such a work area based on its location at the northern edge of the site near the former beach, and at the steepest incline. Significantly higher concentrations of asphaltum in Area 4a or 4b, would support this hypothesis.

Drills and applicators, on the other hand, may not be expected to concentrate at the location in which they were utilized. Both of these items are portable and reusable
tools and were probably personal property. As such they may have been carried away from the work area, curated by the owner when the work was completed and possibly included as grave goods when the owner died.

In order to locate concentrations, the distribution of asphaltum was plotted on a site map. Because each area consists of different numbers of excavation units, averages per unit are used instead of raw numbers in order to compare relative concentrations of asphaltum between different areas of the site. In addition, each area can be compared to the total site average concentration of asphaltum (See Table 13). Table 13 shows that the average amount of asphaltum for the site as a whole is 9.16 grams per unit. Average asphaltum per unit varies widely among the different areas of the site ranging from .08 to a maximum of 27.52 grams per unit. Areas 2a, 3, 4a, and 5 contain higher concentrations of asphaltum than the average for the entire site. Area 4a in particular, with 27.52 grams of asphaltum per unit, contains significantly higher concentrations than the site average. Figure 6 gives graphic representation of asphaltum and drill frequencies in each area. The last bar gives the average per unit for the site as a whole.

Based on averages per unit of each artifact class, an association between the distribution of drills, applicators, and asphaltum is not apparent. This may be function of the large difference in the numbers per unit of each class. In order compare these averages, they have been equalized by calculating the distance from the mean for each observation. Table 14 below shows the distance from the mean for each observation for three categories of artifacts.
Table 14: Adjusted Numbers: Distance From Mean

<table>
<thead>
<tr>
<th>Areas</th>
<th>Drills And Reamers</th>
<th>Applicators</th>
<th>Asphaltum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 4a</td>
<td>5.3</td>
<td>18.32</td>
<td>18.37</td>
</tr>
<tr>
<td>Area 5b</td>
<td>-5.6</td>
<td>3.05</td>
<td>8.4</td>
</tr>
<tr>
<td>Area 3</td>
<td>-1.27</td>
<td>4.6</td>
<td>3.79</td>
</tr>
<tr>
<td>Area 5a</td>
<td>0.85</td>
<td>0</td>
<td>3.49</td>
</tr>
<tr>
<td>Area 2a</td>
<td>3.07</td>
<td>6.1</td>
<td>0.37</td>
</tr>
<tr>
<td>Area 2b</td>
<td>1.17</td>
<td>-7.5</td>
<td>-2.56</td>
</tr>
<tr>
<td>Area 4b</td>
<td>0.53</td>
<td>-1.53</td>
<td>-4.49</td>
</tr>
<tr>
<td>Area 6</td>
<td>-4.98</td>
<td>0</td>
<td>-8.9</td>
</tr>
<tr>
<td>Area 1</td>
<td>-2.54</td>
<td>0</td>
<td>-9.08</td>
</tr>
</tbody>
</table>

Figure 7 is a graphic representation of the corrected distances from the mean for drills, applicators and asphaltum. This graph shows a steady upward trajectory in amounts of asphaltum with the maximum in Area 4a. This trajectory is not mirrored by drills and reamers or by applicators.

When these adjusted numbers are graphed, (Figure 8) associations between artifact classes become clear. The most obvious association of tomol related artifacts is
Figure 7: Distributions of Tomol Related Artifacts (Adjusted Averages)
Figure 8: Distance From Mean: Adjusted Numbers
clearly in Area 4a which contains significantly higher numbers of all three artifact classes. This supports the hypothesis that Area 4a was used as a location for assembly and caulking of tomolo at SBa-52. Area 5b and Area 3 also show higher numbers of asphaltum and applicators than the site average although at lower concentrations than Area 4a. These areas also exhibit lower than average amounts of drills and reamers. This lack of association is understandable. Because both applicators and asphaltum are used for the caulking process, they would be more likely to co-exist in the same locations on the site. Drills and reamers represent a different type of activity, one that does not require the use of asphaltum. Planks could be drilled at any location on the site or indeed, at a different location altogether, and then transported from the location where they were planed and drilled to the area where the tomol was assembled. Applicators and asphaltum on the other hand, were used together, probably at the location of tomol assembly. Figure 8 demonstrates that this association of artifacts is born out in most areas. Those areas containing higher numbers of asphaltum also contain higher numbers of applicators and those showing less asphaltum also contain lesser numbers of applicators. The distribution of drills and reamers, on the other hand, does not appear to be tied to applicators or asphaltum.

The distribution of drills does not appear to show significant differences among the areas of the site, which would indicate that they have been discarded at specific work locations. The site average is .87 drills per unit. The range among the areas of the site is from .33 to a maximum of 1.36 drills per unit. Asphaltum averages on the other hand, range from a minimum of .08 grams per unit to a maximum of 27.52 grams per unit. Asphaltum appears to have accumulated in more dense concentrations in areas 3, 4a, and 5. Concentrations in Area 3 at 12.95 grams, do not appear to be
significantly higher. Area 4a alone contains higher concentrations of drills, and applicators in addition to higher concentrations of asphaltum. In addition to containing higher concentrations of *tomol* related artifacts than any other area of the site and the site as a whole, Area 4a is located near the ancient beach. (See Figure 9) This pattern of artifacts and their location near the beach indicates a likelihood that *tomol* construction may have been carried out at Area 4a.

The presence of artifacts commonly used by archaeologists for the identification of *tomolo* in the archaeological record in large quantities at Ca-SBa-52 suggests that the site may have been the location of early use of the *tomol* or an early prototype of that craft. This pattern alone is not enough to state unequivocally that the inhabitants of the site were constructing and using plank canoes. This evidence must be supported by additional work.

A use wear study on the large chert drills and reamers could verify that the tools were used to drill holes in wood. A faunal analysis showing a large number of pelagic fishes and marine mammals, would also support the hypothesis. Despite these reservations, the large numbers of artifacts and materials related to *tomol* construction on the site offer tantalizing evidence of early use of the *tomol* and provides direction point for further research at SBa-52.

If the site dated to a later period more consistent with current ideas about the genesis of the Chumash plank canoe, the presence of the *tomol* at SBa-52 would be easily accepted. However, because SBa-52 dates to approximately 3000 years earlier than accepted estimates of *tomol* use, it might be questioned merely because of its date. The existence of the *tomol* at SBa-52 should no be discounted merely because of the age of the site. If artifactual evidence can be used to infer the existence of *tomolo* at
later sites, the same standard applies to any occurrence of these artifacts regardless of their relative antiquity.
Figure 9: Contour Map of SBa-52 Showing Location of Area 4a
CHAPTER 5

DISCUSSION AND CONCLUSIONS, SUGGESTIONS FOR FUTURE WORK

Glassow (1997) has identified three categories of issues of interest to Middle Holocene archaeology on the California Coast. These are chronology building, middle range theory and determinants of cultural variation. CA-SBa-52 has the potential to contribute significantly to the Santa Barbara archaeological record in all three categories.

The radiocarbon dates for the site along with cross dating of artifacts, supports the chronological placement of the Campbell tradition. CA-SBa-52 can help the continuing definition and refinement of the Campbell Tradition.

The site contributes data that can be used to explain the nature and causes of culture change. The assemblage at SBa-52 strongly supports the hypothesis that the *tomol* was being manufactured at that location at a far earlier date than previous estimates of its development. There is an apparent gap of approximately 2800 years between SBa-52 and other sites with *tomol* related assemblages. This has ramifications for many models of culture change in the Santa Barbara Channel.

If the hypothesis is supported, what effect does this have on Jeanne Arnold's model of emerging complexity in the Santa Barbara Channel, her hypothesis that the *tomol* made emerging elites possible. Arnold has tried to explain the initial appearance
of complex culture in the Santa Barbara region, when chiefly authority and social
differentiation first emerged, what stimulated these developments, and what
mechanisms maintained the dynamics of the more complex organization once it had
appeared (Arnold 1991:954). Her interpretation of the appearance of features known to
indicate sociopolitical complexity lead her to conclude that it dates to AD 1200-1300.
Her model of emerging elite classes relies on environmental disruption and prior canoe
ownership or control. The El Nino event of 1150-1250 AD caused elevated sea surface
temperature's which are known to reduce the productivity of the marine environment
(Pisias 1978). According to Arnold, this event spurred political and economic power
for canoe owners when cross channel transportation provided an opportunity for them to
broker goods by controlling trade (Arnold 1991:960). Canoe owners could build wealth
through directly controlling subsistence activities such as mid-channel fishing and
hunting, as well as controlling the distribution of goods (Arnold 1991:960).

The plank canoe is so important to her model that she claims that complex
maritime cultures could not have developed many of their economic and political
characteristics such as information exchange, elite manipulation of goods, and
controlling direction and intensity of social contacts, without the oceangoing canoe

In Arnold's model, complex sociopolitical organization arises between 1200-
1300 AD (700 BP) and the tomol was invented at about 500-800 AD reaching its full
form at about 1100-1150 AD (Arnold 1995:736). In this time frame, the gap between
the invention of the tomol and increased socio cultural complexity is between a
minimum of 50 and a maximum of 800 years. If the invention of the tomol is pushed
back to about 4,000 BP, the time span between its early use at SBa-52 and emerging
socio political complexity is expanded to over 3,000 years effectively removing the *tomol* as a direct stimulus for the emergence of elite classes.

Arnold’s model does not explain how the *tomol* appeared prior to cultural complexity when it is clear that the construction of the *tomol* required organization of labor. Some hierarchical social structure was probably necessary even at the early stages of development. Was it a cultural feature that increased in complexity along with the increasing complexity of the canoe?

At the time of Spanish contact with the Chumash, the *tomol* was not only an important tool for subsistence and trade, it was a vital part of a complex social system. The relationship between the *tomol* and socio-political complexity is one of an interconnected feedback system; each feature seems to require the existence of the other for its maintenance and survival.

Another question arising from the problem of stimulus of culture change is the question of how the *tomol* developed. In its final form it was a highly complex and costly tool. It was the result of complex engineering and construction techniques. The *tomol* was remarkably stable, swift and well suited to the climate and geographic conditions in Santa Barbara. It seems probable that the *tomol* was developed in the Santa Barbara channel rather than being a result of outside influence (Heizer 1941; Hudson et al 1978). If this is the case, the *tomol* must be the result of many years of development, modification, and trial and error. Hudson et al (1978) have suggested that the early prototypes of the *tomol* was perhaps a dugout with a round of planks attached to the top for additional stability. Over time, more and more rounds of planks were added, while the dugout was reduced until all that was left was the hull board of the Chumash *tomol*. 

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This process, along with the accompanying socio-cultural changes, would have taken many years. Chester King implied such development when in discussing the replacement of barbed fishhooks with shell fishhooks he stated "Possibly curved fishhooks were being used more frequently in deeper water as the number and size of plank canoes increased over time" (C. King 1990:86).

Another open question in the Santa Barbara sequence is that of the origin of the Campbell Tradition. Warren (1968) believes that Campbell Tradition came from the inland deserts. How would a fully developed hunting tradition transplanted to a marine environment be able to apply their adaptation (cultural tradition) to a new environment? When a people is faced with increasing difficulty in sustaining itself due to environmental change or other stress, adaptive changes will first be seen within the focus of the culture. Modification and elaboration is most likely to occur in the least conservative aspects of a culture, those that are consciously used regularly on a daily basis. A hunting culture moving to a marine environment will not suddenly become a littoral gathering economy or learn immediately to fish using hooks, lines and weirs. They will attempt to use their familiar techniques for procuring resources and will elaborate those techniques over time as necessary. It is not impossible to imagine that a desert hunting tradition would be capable of developing complex water craft as a hunting tool in response to an unfamiliar environment.

Suggestions for Future Work

Because the inception of the tomol and its use are vital to many models of culture change the apparent time anomaly between SBa-52 and other evidence for the tomol must be explained. What is the nature of this apparent gap? Is this due to a lack
of excavated sites dating to this period, or is SBa-52 a unique occurrence or the beginning of a trend that is extensively played out only in later periods? Further analysis of Middle Holocene sites in the Santa Barbara Channel area will help clarify this issue.

In addition, the hypothesis that SBa-52 is an early *tomol* building site should be strengthened by a use wear analysis on the drills and reamers, and a faunal analysis the site. If marine mammals and pelagic fishes are represented in the faunal assemblage it would support the use of the *tomol* for mid channel hunting and fishing. If these species are represented in small numbers or are absent, another explanation for the *tomol* related tool assemblage must be sought.
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Jones, Terry L.

King, Linda

King, Chester

Koerper, Henry C.

Kohler, Lisbeth

Kowta, M.

Kuchler, A.W

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Wallace, William J.

Warren, Claude N.
VITA

Graduate College
University of Nevada, Las Vegas

Suzan Rose

Local Address:
1208 Nelson Court
Boulder City, Nevada 89005

Degrees:
Bachelor of Arts, Anthropology, 1983
University of Nevada, Las Vegas

Thesis Title: Evidence of the Chumash Plank Canoe at CA-SBA-52, Santa Barbara County, California

Thesis Examination Committee:
Chairperson, Dr. Alan Simmons, Ph.D.
Committee Member, Dr. Claude N. Warren, Ph.D.
Committee Member, Dr. George Urioste, Ph.D.
Graduate Faculty Representative, Dr. Fred Bachuber, Ph.D.