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WEST BERKELEY (CA-Ala-307): A CULTURALLY STRATIFIED SHELLMOUND ON THE EAST SHORE OF SAN FRANCISCO BAY

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and

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PREFACE

This report describes the excavation of the last intact portion of the West Berkeley shellmound, situated on the east shore of San Francisco Bay. The investigation was carried out by the University of California Archaeological Survey under the general supervision of its Director, Robert F. Heizer. Work began May 22, 1950, under Arnold Pilling, who remained in charge until the end of May, when Robert Greengo became field supervisor. Greengo was succeeded on June 18 by Donald W. Lathrap who directed the work for the rest of that month. During July, August and early September, William J. Wallace headed the field party. The other personnel consisted mainly of students, graduate and undergraduate, from the Department of Anthropology on the Berkeley Campus. Donald and Douglas McGeein, William Mueller, and Edith S. Taylor provided welcome volunteer service.

Permission to excavate was granted by Mrs. Lincoln Maclise, owner of the property, to whom grateful acknowledgement is made. A.E. Troiel, of Troiel Companies, Inc., occupant, cooperated with the field crew throughout. The success of the project owes much to him and to the workers in his factory, who were subjected to various inconveniences as a result of the digging.

The following pages present a revised and up-dated version of a detailed report on the shellmound excavation, completed in 1951. The descriptive parts of the original account remain largely unchanged. Only the introductory and concluding sections have been extensively rewritten.

The Site

The West Berkeley Site (CA-Ala-307), located at the junction of Second Street and Hearst Avenue in the City of Berkeley, California, was one of the last of the great shellmounds which up to a relatively few years ago lined the eastern shore of San Francisco Bay. It had survived only because part of it was wedged tightly between two old factory buildings (Pl. 1). The midden lay only a few yards from the north bank of Strawberry Creek, near the stream's entrance into San Francisco Bay. Just to the west stretched the broad tidal marsh which separated the bay shore from the wide expanse of water beyond. Much of the tidal land has long since been filled in.

The original dimensions and exact limits of the shellmound could not be determined because most of it had been removed. Land formerly overspread with the accumulated aboriginal refuse now lies under paved streets, railroad tracks, factory buildings, and storage yards. The mound seems to have covered an elliptical area, conservatively estimated at 350 X 600 feet, with its long axis paralleling Strawberry Creek. The portion remaining measured 45 X 100 feet. Approximately one half of the northern part of this had been scraped off and crushed limestone dumped on its surface. Over the years, the limestone had become consolidated into a hard stratum, three to four feet thick. At its highest point the shellheap rose 15 feet above ground level and extended three feet below. Once it had been higher for the peak had been cut down and leveled to serve as the base for a water tank.

In 1950, when the West Berkeley site was threatened with total destruction to make way for industrial expansion, the University of California Archaeological Survey undertook a large-scale excavation. Work began on May 22 and continued without interruption until September 6. During December of the same year the northern part of the mound was leveled and the midden material carried away. While this earthmoving operation was in progress a quantity of artifacts and several burials were salvaged. Finally, in the spring of 1954, the old building covering the site's northwest corner was razed and digging was done beneath the floor (Appendix V).

The Geographical Setting

Even though the land in the immediate vicinity has been drastically altered, it is possible to describe the natural surroundings as they must have been when the West Berkeley midden was occupied for there is nothing to indicate a marked change in the physiographic and climate conditions. The eastern shore of San Francisco Bay is bordered by a broad sloping plain, broken here and there by isolated

hills or ridges. Widely separated valleys, containing small streams which normally flow at all seasons, cut across the flattish terrain in an east-west direction. The plain extends gently upward to the Berkeley Hills, a prominent range, 15 miles long and 10 miles wide, with an even crest and a steep, dissected western slope. This rather rugged hilly block, aligned northwest to southeast, is not lofty. The highest points on the main ridges are Bald Peak (1930 feet), Grizzly Peak (1769 feet), Round Top (1750 feet) and Redwood Peak (1608 feet). Streams have etched deep, narrow valleys between the hills.

The climate is mild, with long dry summers and relatively warm winters. For January the average temperature falls near 49°F; for September, the warmest month, it is slightly above 63 (Hambridge 1941: 783; Dale 1959:13). Most of the 23-inch annual precipitation falls during the winter, with the greatest amount for any month usually coming in January. Snow and hail are rare and unimportant in the bay region. Two extremely significant weather factors are fog, more frequent in the summer than in the winter, and cloud cover. Since they act as a screen to reduce the amount of sunshine, the fog and clouds strongly affect the temperature, rate of evaporation, and relative humidity. The mean annual cloudiness falls between 50 and 60 percent. Climate alone might indicate just two seasons - wet and dry - but there are enough variations in the weather and changes in the plant cover and so on to give abundant evidence of four (Smith 1959:11-13; Gilliam 1962:12-61).

The bay area was never heavily wooded. Much of the plain had a covering of grass, interrupted by occasional groves of Coast Live Oaks and patches of brush. Vegetation became dense only along watercourses, which are fringed with Yellow Willow, California Laurel, California Buckeye and Coast Live Oaks: Hills remained almost bare of trees except in protected canyons, but a few miles to the southeast, the Oakland Hills had extensive redwood forests, of which vestiges remain. Oaks were the outstanding trees and provided the aboriginal peoples with acorns, an important foodstuff.

At the time West Berkeley was inhabited the native fauna was abundant and diversified. Of the more than two hundred different species of mammals found in California, seventy-five lived in the bay region (Berry and Berry 1959:5). Deer and Tule Elk roamed the plain and foothills and the California Grizzly was fairly common. Among the lesser species were three kinds of rabbits and a variety of squirrels, rats and mice. There was a wide range of carnivores including coyotes, bobcats, mountain lions as well as weasels, badgers, raccoons and skunks. Into the bay came several sea mammals, the once abundant Sea Otter, seals, sea lions, dolphins, and porpoises. Low marshy areas attracted a great abundance of waterfowl, both year-round dwellers and seasonal visitors. Clams, oysters, mussels and many other kinds of shellfish lived in the sand-mud flat intertidal zone and the offshore waters teemed with fish, both large and small.

Obviously West Berkeley was an excellent location for aboriginal settlement. The immediate neighborhood provided a plentiful and diversified supply of natural foods and the exploitation of these was fairly easy. Strawberry Creek furnished a steady, though during the summer and fall months, a meager supply of fresh water. Essential raw materials - wood, plant fiber and stone - lay near at hand. The generally mild climate contributed to the favorable situation.

Previous Archaeological Investigations in the San Francisco Bay Region.

The numerous shellmounds, the only conspicuous remains left by the local Indians, attracted the attention and excited the curiousity of early settlers in the bay region. As long ago as the 1850's, collections were being made of stone mortars, arrowheads, bone awls, shell beads and other objects found on their surfaces, turned up by the plow, or unearthed during roadbuilding or other construction activities. Systematic investigation of the middens did not begin, however, until the early years of the present century. The formative period saw the introduction of controlled excavation and site survey, the two essential fieldwork procedures.

West Berkeley was one of the first bay shellmounds to receive scientific attention. During 1902, E.L. Furlong, working under the direction of John C. Merriam, conducted limited excavations at the site for the University of California. The 265 artifacts acquired as a result of this digging were deposited in the Museum of Anthropology but Furlong's field notes apparently did not accompany the collection. Two years later, Joseph Peterson resumed the exploration, excavating at the site's northeast corner.[1] A report was prepared and filed in the Museum of Anthropology (Peterson 1904). Representatives of the Department of Anthropology continued to dig sporadically at the site. Local collectors also cut into the mound and a few of their artifacts eventually found their way into the Museum's collections. Other cultural and skeletal remains were uncovered and turned in by construction workers.

The Emeryville site (CA-Ala-309), perhaps the deepest (more than 32 ft.) and certainly the most famous of the Bay middens, was also first examined at this time. Work at the mound, located about two miles south of West Berkeley, was begun in 1902 by Max Uhle. Uhle's investigations were limited in scope and the number of specimens recovered was small, but he nonetheless proposed 10 distinct strata and suggested certain cultural changes (Uhle 1907). While the Emeryville shellmound was being scraped away in 1924 to convert the area into a factory site, a considerable quantity of artifacts and

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[1] The exact location of these excavations could not be determined. They were probably carried on in an area now [1951] under a brick building.

human skeletal material was salvaged. After the removal of the upper portion of the deposit by steam shovel, controlled excavations were made by W. Egbert Schenck and L.L. Loud in the undisturbed lower levels. A final report appeared in 1926 (Schenck 1926). Schenck concluded that different groups of people from nearby interior regions lived on the mound seasonally to gather shellfish and hunt sea otter and that not all of them were identical in culture. The data, however, were regarded as too sketchy to permit an extensive reconstruction of the site's cultural history.

In 1906, N.C. Nelson carried on limited excavations at the Ellis Landing shellmound (CA-CCo-295), four and one-half miles north of West Berkeley in Richmond, Contra Costa County. This site covered a greater area than Emeryville but was shallower, attaining a maximum depth of 30 ft. During the removal of the deposit in the following year, Nelson collected artifacts and skeletal remains. Finally, early in 1908, he sank a shaft to the bottom in search of clues to the culture represented in the lower strata which lay below sea level. Nelson published a description of the site and its contents in 1910. Aside from certain additions to, and some changes in, artifact forms, he observed that essentially the same type of culture prevailed from the bottom of the refuse heap to the top (Nelson 1910:-402).

Of considerable importance was N.C. Nelson's detailed archaeological survey, completed in 1908. Four hundred and twenty-five shellmounds, located with few exceptions, near the open bay were recorded and mapped (Nelson 1909). Probably many middens had already disappeared without a trace; a few escaped Nelson's notice. The final investigation of this early phase of shellmound exploration came in 1915 when L.L. Loud recovered material from two shellmounds (CA-CCo-298 and CA-CCo-300) at Stege, in the city of Richmond, while they were being destroyed. In a short report, which appeared some years later (Loud 1924), a few differences between the two shell heaps were noted. The smaller abounded in bird bones, bone implements, ash layers, and calcined shells -- materials which were almost entirely absent in the larger midden. There seems to have been a difference in stone implements as well with a higher percentage of mortars and pestles in the small site, and a greater proportion of stone net-sinkers in the larger. The variations were interpreted as being due to relative age as well as environment. Following this work there was a long interval during which other bay middens were partially excavated or materials were collected from them during the earth-moving operations but, except for brief notes on a site at San Bruno in San Mateo County (Drake 1948), no descriptions were published. It should be noted that, aside from San Bruno which lies on the west side of the bay, all sites reported upon were situated on the east shore and only a few miles apart.

The search for adequate means of dating the San Francisco Bay shellmounds consumed much thought and energy during this early exploratory phase. In order to determine their approximate antiquity archaeologists consistently sought a reliable basis for calculating

the rate at which the refuse heaps accumulated. N.C. Nelson roughly estimated the age of the Ellis Landing midden on the basis of probable daily deposition, primarily the day-to-day accretion of shellfish remains, as 3000 to 4000 years (Nelson 1909:345-346). Final occupation was assumed to have preceded by only a short time the discovery and occupation of the country by whites (Nelson 1910: 401). E.W. Gifford later applied a more refined quantitative technique to the study of the composition of twelve Bay mounds, including West Berkeley, Emeryville and Ellis Landing, and of three middens elsewhere in California. Age estimates were made for only the last two -- Ellis Landing (3500 years) and Emeryville (3300-3700 years) (Gifford 1916:13). Schenck calculated that the accumulation at Emeryville had taken place in a relatively short period, perhaps 1000 years or less (Schenck 1926:298). These analyses were directed toward ascertaining the time elapsed between first occupation of the shellheaps and the time of their abandonment. They were not essentially concerned with relative chronology.

The pioneer investigators applied themselves primarily to the task of building up a body of data, rather than to the interpretation of the bay region's cultural history. Beyond the observation of slight differences between sites and minor changes of content within shellmounds, the problem of sequence or developmental change was not seriously considered. Actually the notion seems to have gradually emerged that the local prehistoric cultures remained static, or at best, changed slowly. This was due in part to the earlier explorations having been conducted without a sense of genuine scientific problem but even more to the great size of the middens and their simple and limited artifact inventory (Kroeber 1936:108). Contributing to the difficulty of reconstructing history was the small amount of carefully conducted research. The first comprehensive effort to piece together the regions' aboriginal past and to provide a chronological framework came in 1948 when R.K. Beardsley proposed a cultural sequence for the San Francisco Bay area and the Marin County coast to the north (Beardsley 1948, 1954a, 1954b). This interpretation was based on an examination of artifacts accompanying burials from the published sites and of others not yet described in print. The technique of burial analysis had earlier been applied in the lower and middle Sacramento River Valley, where a threefold sequence of prehistoric horizons -- Early, Middle (formerly termed Transitional) and Late -- had been worked out (Lillard, Heizer and Fenenga 1939). Beardsley fitted the San Francisco Bay and Marin coast sites into the classification developed for the interior. Local variations of manifestations of Middle and Late horizons were recognized. The lower levels of Emeryville were assigned to the Middle period; the remainder to the Late (Phase I). Ellis Landing, Stege, and West Berkeley were ascribed to the Middle horizon. No sites of the distinctive Early culture were recognized, though the occurrence of a few specific Early cultural items was noted. It was assumed that the bay and coastal cultures equated typologically with those of the interior and placed within the same horizon were contemporary.

This chronological scheme is probably correct in broad outline for it seems logical to expect that something corresponding to cultural development in the interior must have taken place on the bay and coast in view of the geographical proximity and established trade relations of the two regions. It is essential, however, to realize how sketchy, from the point of view of real evidence, the associations and tie-ups and, therefore, inferences are, because classification schemes, once published, are often followed without question by other investigators or with a forcing or straining of the data. As indicated, the bay sites were assigned to the various horizons on the basis of burial associations alone. In the Emeryville shellmound, of the 700 interments recorded, 83 had grave goods and of these only 48, roughly 7 percent of the total, were utilized because the remainder lacked depth data or diagnostic artifacts. The number of burials from other shellmounds was even smaller. The assignment of sites to horizons on the basis of burial accompaniments alone probably has more validity for the interior, where 70 percent of the graves contain artifacts.

The twenty years which have elapsed since the publication of Beardsley's cultural sequence have witnessed the excavation of a number of San Francisco Bay shellmounds and their placement within the suggested chronological framework. The most prolonged digging has gone on at the Patterson midden (CA-Ala-328), located about three miles south of Alvarado in Southern Alameda County (Davis and Treganza 1959). This big, productive shellheap contains materials ascribable to both the Middle and Late periods. The earliest component (Patterson facies) antedates the Middle horizon manifestation at Ellis Landing and Emeryville. The results of several field sessions, conducted for the most part between 1935 and 1959, at the Fernandez mound (CA-CCo-259) in Rodeo Valley, Contra Costa County, have been summarized (Davis 1960). Three main archaeological components, ranging from Middle through the final phase of Late horizon, were distinguished on the basis of burials and their accompaniments. Two Marin County sites have been partially explored and their contents described. Test excavations at the first, the Thomas shellmound (CA-Mrn-115) situated on the bay shore north of San Rafael, revealed that the upper portion of the refuse deposit contained artifact types diagnostic of Late times whereas the group of objects from deeper down could be fitted into the Middle period (Meighan 1953:4-5). A smaller shellheap (CA-Mrn-20) at Strawberry Point on Richardson Bay, an arm of San Francisco Bay, produced an artifact assemblage which demonstrates that the site's major occupation came in a time of transition between the Middle and Late horizons (McGeein and Mueller 1955).

Of extreme importance were investigations at two localities which yielded cultural materials of greater antiquity than any previously reported for the bay region. A salvage operation carried on at University Village (CA-SMa-77), near Palo Alto in San Mateo County, resulted in the discovery of a unique series of artifacts which were assigned to an early San Francisco Bay period (Gerow 1968).

A second rescue effort at three sites in the interior drainage area of Contra Costa County led to the recognition of five temporal components (Frederickson 1965). The deepest habitational stratum at one of the three sites, Stone Valley (CA-CCo-308) in Alamo, yielded 93 artifacts, all compatible with the Early horizon though the burial posture differed.

Archaeological work has gone on at additional shellmounds, most often while they were being leveled and their sites given up to residential or industrial developments. But aside from the description of a deeply-buried midden near Walnut Creek (Heizer 1950) and two sites south of Alvarado (Rackerby 1967), no reports on any of these has yet appeared in print. Many more shellheaps have vanished without any record of their contents having been obtained.

There have been other recent developments. Quantitative studies of the constituents of aboriginal middens have been refined (Cook 1946; Cook and Treganza 1947; Gifford 1949; Greengo 1951; Follett 1957). Quite apart from considerations of the shellmounds' antiquity, these careful analyses have furnished useful facts on the diet and eating habits of the bay region's prehistoric inhabitants. Radiocarbon determinations have provided absolute dates for several of the mounds, including Emeryville, West Berkeley, Patterson and University Village (Heizer 1959). And interpretation has not been wholly neglected. A treatise on native California settlement patterns contains a brief examination of conditions in the San Francisco Bay area (Heizer and Baumhoff 1956:37-38). Exploitative economics and culture change in Central California, including the bay region, have been scrutinized (Gould 1964) and the use of rocks and minerals by the local Indians detailed (Heizer 1951). Finally, the entire archaeological story has been popularly recounted in an imaginative manner (Suggs 1965).

Such briefly, is the history of prehistoric research around the shores of San Francisco Bay. That progress has been slow and spotty is obvious. There never has been a sustained, planned program of shellmound exploration and, even though a considerable body of knowledge has gradually accumulated, no adequate conception of the region's past has been gained. The 1950 West Berkeley excavation, the results of which are described in the following pages, add concrete data and fill in at least one important gap in the archaeological record.

Excavation

Although the mound had already been greatly reduced in size when digging began, enough remained to give a fair sample. When the growth of weeds and litter of factory debris covering the surface had been removed, an area at the south end was staked out in five-foot squares. A cut 20-25 feet wide was then carried in along the site's major north-south axis. The material was removed with shovels in

arbitrary 12-inch layers until the underlying sterile stratum was reached. The excavation then was carried an additional foot down to make certain nothing was overlooked. When a trench was completed, the next five-foot section was cut down, the open trench being used as a place to deposit back dirt. The over-all plan had to be altered occasionally to avoid undermining factory walls or railroad tracks, to follow out special features, or for other reasons. In order to obtain as full information as possible, four trenches were excavated entirely with trowels instead of by the shovel method.

The area excavated comprised approximately 1,175 square feet, worked down to depths of 9 to 18 feet according to the thickness of the deposit. Roughly, about 14,000 cubic feet of midden received examination. In addition to the main trench, a 10-foot square pit was cut through the overburden of limestone at the north end and carried down through the midden deposit to sterile soil. This was the section later leveled to ground surface by earth-moving equipment. Deep auger borings were made in the base of the midden at several points. These probings showed that a heavy but well-drained yellow clay extended down about 3 feet, where it merged with a damp layer consisting of clay mixed with rounded pebbles and angular fragments of sandstone.

Profiles taken across the excavations at five-foot intervals showed a marked soil difference, which divided the deposit into two layers. The bottom of the mound rested upon an underlying clayey material free of artifacts and shell, a compact yellow alluvium doubtless derived by wash from the nearby hills. The undisturbed yellow soil graded upward into a darker zone, different in texture and appearance, still compacted but containing shell, charcoal, artifacts, and human and animal bones. This layer extended from the sterile base to a maximum height of about 12 feet and shaded gradually into a dark gray softer mass of shell, soil, ash, and organic matter, the more typical midden deposit, which reached to the surface. The uncompacted portion of the shellheap attained a maximum thickness of about six feet. Pockets of shell and ash were irregularly dispersed throughout but widely spread lenses were not found. The upper one to two feet consisted of a disturbed powdery layer of low artifact content. A typical section of the deposit where the layers were most clearly marked is shown in Plate 2. West Berkeley's internal structure proved to be strikingly similar to that described for the Ellis Landing shellmound (Nelson 1910:374-375).

Artifacts

San Francisco Bay middens characteristically yield a small quantity of artifacts, tending to furnish only about one item, whole or broken, per cubic yard dug (Kroeber 1925:25). West Berkeley proved no exception; only 3,412 man-made objects were collected,

including those found by Furlong, Peterson, and others.[1] Besides prehistoric implements, the excavation yielded broken china, bottle glass, nails, and various other evidences of white occupation. Surface disturbances resulting from recent digging of supports for the water tank and from other activities displaced some of the latter to depths of 1 to 2 feet. This represents entirely a post-Indian accumulation; none appears to be "contact material" in the sense of having been obtained by the Indians from Europeans.

The artifacts, while not abundant or spectacular, are fairly diverse. Their frequency is given below. Fragments are included along with whole objects.

List of Artifacts from West Berkeley

Stone

Chipped stone			
Projectile points	56	Core scrapers	58
Knife blades	18	Choppers	20
Flake scrapers	136		
Pecked and ground stone			
Mortars	78*	Charmstones	46
Pestles	69	Pendants	3
Net-sinkers	360	Ring	1
Anchor (?)	2	Plugs	2
Chisel	1	Bars	2
Unworked stone			
Hammerstones	52		
Abrading stones	3		
Anvil	1		
Slingstones (?)	46		
Prismatic flakes	3		
Quartz crystals	16		

Bone

Awls	98	Whale vertebrae containers	3
Flakers	48	Bone pins	7
Spatulas	11	Bone needles (?)	3
Spatula-like implements	6	Bone pendants	4
Daggers	2	Mammal bone bead	1
Notched scapulae	15	Bird bone beads	3
Notched ribs	2	Bird bone tubes	3
Fishhook	1	Bird bone whistles	8
Split mammal bone tools	60	Fish vertebrae beads	15
Mammal rib tools	11	Misc. bone objects	10

[1] The uncertain extent of the areas excavated by earlier investigators makes compilation of average artifact yield per cubic yard of midden removed unreliable, so none is attempted.

* Including fragments (see descriptive section).

Antler	
Wedges	52
Flakers	35
Punches	7
Curved blades	7
Animal Tooth	
Sea lion tooth pendant	1
Canid tooth beads or pendants	20
Shell	
Mussel shell scrapers (?)	4
Limpet shell bead or pendant(?)	1
Olivella shell beads	1,547
Abalone shell beads	413
Abalone shell pendants	36
Baked Clay	
Baked clay ball	1
Textiles	
Basketry	1
Matting	2
Cordage	Impressions Only

The artifact content was extremely sparse in the upper two to three feet of the deposit. This can be attributed, in the main, to recent disturbance, though the possibility of a more rapid build-up of the refuse cannot be overlooked. A decided decrease in numbers of articles also occurred as the bottom of the shellmound was approached.

Stone

Lithic artifacts form a high percentage of the West Berkeley specimens. They can be grouped initially into two main categories: objects manufactured by a chipping technique and those produced by pecking or grinding. A third minor group is made up of unworked stones and minerals presumably used by the aboriginal inhabitants or collected as curiosities.

Chipped stone

Except for a fair quantity of rather amorphous scrapers, chipped stone specimens were not particularly plentiful. In general, the workmanship is good though a great deal of percussion flaking is observable. The materials consist of various cherts, obsidian, basalt, slate, and a quartz-like stone. There are nearby sources for all of these (Bowen 1962) except obsidian, the closest known outcroppings of which lie in Napa, Sonoma and Lake Counties, some miles north of San Francisco Bay (Heizer and Treganza 1944:304-305).

Projectile points -- Fifty-six flaked stone objects which may be termed projectile points were found. They are too large and heavy to have been used on arrows and the majority would have been most serviceable as dart tips. Four classes of points can be recognized.

a. Stemmed: leaf-shaped, contracting stem -- (20 specimens, 9 obsidian, 8 chert, 3 slate). In general this is a heavy point with defined shoulders, ranging from square to sloping, formed by lateral notching (Pl. 3, a-c). One has only a single shoulder but this seems to be a roughly reworked broken specimen rather than a special form. Regularly, the stems contract to a rounded tip, though in a few instances they vary toward parallel-sided. None is barbed; the edges are somewhat beveled. The points differ in size, the range being from 5 to 8.6 cm. in length, 1.8-3.3 cm. in maximum width, and 5-12 mm. in thickness. Average dimensions are: length 6.9 cm.; width 2.45 cm.; thickness 7.4 mm. Stems are relatively short, measuring 1.0-2.3 cm. with an average of 1.6 cm. The stems of two specimens retain traces of adhesive.

b. Stemmed: leaf-shaped, expanding stem -- (8 specimens, 5 obsidian, 2 chert, 1 quartz-like). These weapon tips have broad U-shaped side notches and rounded bases (Pl. 3 d-f). One aberrant piece has a rudimentary basal notch. The eight points are somewhat smaller than the preceding. The length range is 4.1-7 cm., average 5.4; widths very between 1.9 and 2.6 cm., with an average of 2.3 cm.; thicknesses are from 6 to 10 mm., average 8 mm.

c. Stemless: leaf-shaped, convex base (8 specimens, 5 obsidian, 2 chert, 1 basalt). The greatest width of specimens of this class comes about one-fourth up from the base (Pl. 3 h,g). Thence the blade tapers to a long sharp point at one end and to a blunt-pointed, sometimes almost rounded, butt at the other. Dimensions are: length 4.2-8 cm., average 5.8 cm.; width 1.8-2.3 cm., average 2.2 cm.; thickness 5-10 mm., average 8 mm.

d. Stemless: leaf-shaped, concave base -- (1 specimen, obsidian). A squat missile tip has a broad and shallow basal notch (Pl. 3 i). This specimen, manufactured almost entirely by the percussion method, has a deep indentation on either edge about half-way down the blade. It measures 5.3 cm. in length, 3.6 cm. in width, and is 9 mm. thick. It appears to be a retouched fragment of a large blade.

e. Unclassifiable tips and median fragments. Twenty-one unclassifiable fragments were unearthed. Twenty are of obsidian and one of gray chert.

Except a single specimen, unearthed at a depth of 20 inches in disturbed slough at the midden's southern border, all the projectile points were recovered below the 6 foot level. No clean-cut stratigraphic differences in classes is noticeable, though three of the four leaf-shaped, convex-based specimens for which there is depth provenience came from above the 8-foot level (Table 1). Aside from this form, which occurred at Emeryville and Ellis Landing, the West

Berkeley points are not duplicated in nearby shellmounds. The only examples analogous to the large-stemmed variety are two obsidian points from the deeper portion of Ellis Landing (Nelson 1910: Pl. 44, Figs. 1,4). A vaguely similar but smaller specimen was obtained at Emeryville (Schenck 1926: Pl. 486); its depth is unknown. In size and outline, the West Berkeley specimens show more resemblances to interior Early horizon points than to those recovered from Bay sites (Heizer 1949:20-23, Figs. 11-14). The Valley toolmakers also exhibited a preference for obsidian, the most frequently used material at West Berkeley, but often resorted to the use of stones less amenable to fine chipping. Weapon tips are more numerous in the interior settlements where they frequently accompany burials.

Table 1

Projectile Points

Form	No.	Length (cm.) Max.	Min.	Aver.	Width (cm.) Max.	Min.	Aver.	Depth (in.)
Stemmed, leaf-shaped contracting stem	18	8.6	5	6.9	3.3	1.8	2.4	96-192
Stemmed, leaf-shaped, expanding stem	8	7	4.1	5.4	2.6	1.9	2.3	168-192*
Stemless, leaf-shaped pointed base	8	8	4.2	5.8	2.8	1.8	2.3	72-192
Stemless, leaf-shaped, concave base	1	5.3	--	--	3.6	--	--	--
Unclassifiable fragments	21	--	--	--	--	--	---	72-202
Total	56							

* 1 specimen from disturbed slough at depth of 20 inches.

Knife blades -- Twelve long, heavy blades and six fragmentary specimens, probably used as knives were recovered. They are all leaf-shaped and chipped over both faces.

a. Leaf-shaped, pointed base -- (6 specimens, obsidian). These large bipointed specimens are characterized by fine, often diagonal flaking over both surfaces (Pl. 3 j,k,l). Their edges have been delicately retouched, giving a neatly chipped border with shallow serrations. A lenticular cross section is basic. In size, range is from 10.1 to 14 cm. long, from 2.7 to 3.8 cm. wide, and 7 to 9 mm. thick. Average dimentions are 11.5 cm. long, 3 cm. wide, and 8.5 mm. thick. Two of the five whole specimens were associated with burial 32; another pair, located in adjoining pits at the same level, may have been with this interment. An incomplete example was collected during filling-in operations in the same general area. Large, symmetrical implements of this kind may well have served as ceremonial objects or treasures, prized works of skilled craftsmen.

b. Leaf-shaped, squared base -- (7 specimens, obsidian). These long and narrow specimens have squared bases, thinned by removing several longitudinal flakes and by grinding or polishing from each side (Pl. 3 m,n). The two whole specimens measure 9.7 cm. and 13.5 cm. in length and have maximum widths of 3.1 cm. and 3.0 cm. Each is about 10 mm. thick. The flaking is somewhat less skillfully executed than in the group described in the preceding paragraph, with numerous percussion scars visible on the surfaces. The borders are not serrated.

c. Leaf-shaped, concave base -- (1 specimen, obsidian). This knife blade has a deep, rounded concavity at the base (Pl. 3 o). This is more or less straight-sided, though slightly asymmetrical. Flaking is rather coarse on both surfaces. The specimen is 8.6 cm. long, 2.3 wide, and 1 cm. thick.

d. Leaf-shaped, stemmed -- (2 specimens, obsidian). Somewhat similar in form to the contracting stemmed projectile points though larger, are two obsidian blades. One has sloping, ill-defined shoulders (Pl. 3 p); on the other the shoulders are essentially square. Their stems narrow toward a round base. The largest of the pair measures 2.7 cm. X 10.5 cm. and is 9 mm. thick; the second is about 1 cm. shorter. Their provenience is unknown.

e. Leaf-shaped, notched and stemmed -- (2 specimens, chert). Two exceptional specimens made of a white chertlike material were taken from the same grave that yielded the pair of bipointed specimens (burial 32). Both have corner notches, though they are not deep on one of the examples (Pl. 3 q,r). Well-defined side notches occur on the more complete blade. Originally, both appear to have had narrow stems, probably contracting, though on one it has been broken away. The blades are broad and flat with toothed borders. The largest has an over-all length of 15 cm., is 45 cm. wide and 7 mm. thick; the other measures 4.8 X 12 cm. and is 6 mm. thick.

The small number of knife blades makes statements concerning their vertical distribution somewhat unreliable, but certain depth differences can be noted (Table 2). The bipointed form remained limited to the upper 44 inches of the deposit; the pair of white blades was also obtained from this level. The squared and thin-based variety occurred between 96 and 126 inches, and the single concave-based specimen for which there is depth information came from 157 inches. Two large doublepointed blades accompanied a burial at Ellis Landing (Nelson 1910:389). This is a form usually attributed to the Middle horizon (Beardsley 1948:11). The hollow-based knife found at some depth in the West Berkeley midden, is also considered a typical Middle form of the interior and coast (Heizer and Fenenga 1937:386; Lillard, Heizer, Fenenga 1939:Pl. 24, Figs. 1 and 2; Beardsley 1948:11). The only specimen analogous to the white, side-notched blades, comes from a site in the Lodi region of the northern San Joaquin Valley (Schenck and Dawson 1929: Pl. 91, c). However, some bearing a general resemblance have been recovered from Middle and even Late period Valley sites (Lillard, Heizer, and Fenenga 1939: Pl. 24, Figs. 3,4,24,25). Chipped blades with a squared and ground base are characteristic of the interior Early horizon settlements (Heizer 1949:Fig. 11, g-t).

Table 2

Knife Blades

Form	No.	Length (cm.) Max.	Min.	Aver.	Width (cm.) Max.	Min.	Aver.	Depth (in.)
Pointed base	6	14	10.1	11.5	3.8	2.7	3	44
Squared base	7	13.5	9.7	11.6	3.1	3	3	96-126
Concave base	1	8.6	--	--	2.3	--	--	157
Stemmed	2	10.5	9.5	10	2.8	2.7	2.7+	--
Notched and stemmed	2	15	12	13.5	4.8	4.5	4.6+	44
Total	18							

Scrapers -- Flaked objects which could have functioned well for scraping were abundant. Although a few are well-formed and carefully chipped, most of them consist of flakes or cores with little or no modification beyond the sharpening of one edge. The edging was usually done from one face by the percussion method. Chert was the most frequently used raw material, with quartzite and other stones being utilized only rarely. Scrapes of obsidian or sections broken off from obsidian points or blades were occasionally made into scrapers but this material appears to have been far too precious for regular use in manufacturing these simple service tools.

a. Flake (136 specimens). These comprise irregular flakes, usually fairly thick, struck off so as to give a sharp edge, which was then retouched. The tools are very diverse in form and size and could have been divided in a number of descriptive classes, with the vast majority falling into the category of "side-scrapers." But that these differences have any far-reaching significance is doubtful, since the form seems to be due to the chance shape of the flake struck off. The flake scrapers vary in length from 2.1 to 7.2 cm., averaging about 4.3 cm. Widths are from 1.4 to 6.1 cm. with an average of 2.9 cm. In thickness there is a range from an exceedingly thin specimen, only 3 mm. thick, to one 2.5 cm. The average thickness is about 1.3 cm.

b. Core (58 specimens). Both thin and somewhat heavy cores were utilized in fabricating these tools. Large primary flake scars are visible on their surfaces with secondary finishing normally limited to one edge, usually about one-third of the core's periphery. On 54 examples the working edge has been produced by the intersection of somewhat irregular flutings with a flat plane surface resulting from removal of a large flake below; the remaining four lack the flat undersurface. The smallest specimen measures 2.2 X 1.5 cm. and is 1.1 cm. thick; the largest is 5.3 X 7.5 cm. with a thickness of 1.6 cm. Average dimensions are: length 5.5 cm.; width 3.8 cm.; thickness 2.0 cm.

The vertical distribution of scrapers (Table 3) indicates a somewhat higher incidence in the middle and lower levels. The apparent lack of a specific standardized form makes comparison with other sites difficult and, furthermore, the data on scrapers from San Francisco Bay sites is sketchy. Uhle regarded a number of irregularly shaped tools from deeper levels at Emeryville as scrapers or choppers (Uhle 1907:65). Schenck, however, reported only two such articles but plentiful chips of chert bearing no evidence of retouching (Schenck 1926:243). No scrapers are mentioned for either the Ellis Landing or Stege sites. The seeming scarcity or, in some sites, the absence of scrapers is perhaps due to a search for a defined shape and an unwillingness to accept crude, partially chipped objects as man-made tools.

Table 3

Vertical Distribution of Scrapers

Depth (ft.)	Flake Scrapers	Core Scrapers
0-1	0	1
1-2	1	1
2-3	2	0
3-4	6	1
4-5	2	0
5-6	7	0
6-7	6	5
7-8	6	5
8-9	3	9
9-10	3	8
10-11	8	5
11-12	6	5
12-13	6	6
13-14	9	6
14-15	6	5
15-16	6	0
16-17	2	0
17-18	0	0
18-	0	0
Total	79	57

Choppers -- (20 specimens, quartzite). These implements cannot easily be distinguished from core scrapers, except that they are larger and heavier. There is no reason to doubt that, although their main function was hacking or chopping, they served also for cutting and scraping. Their shape is that of good-sized, untrimmed cores with a sharp edge formed by striking off large flakes from one side only. The tools' borders regularly show signs of battering or wear. They range in size from 15.2 cm. X 8.2 cm. to 8.3 cm. X 5.7 cm. Choppers were evenly distributed throughout the debris, occurring from the surface to a depth of 17 feet.

Pecked and Ground Stone

There was no dearth of articles manufactured by pecking and grinding but apart from a few ceremonial and ornamental forms, the objects are simple in nature and little care was lavished on their production. The region supplied the prehistoric inhabitants with an abundance of suitable raw materials.

Mortars -- Stone mortars were among the more common household implements. Materials used most frequently in their manufacture were basalt and hard sandstone; a few specimens were fashioned of metamorphosed stones. Mortars are difficult to classify because the forms vary a great deal and many of the specimens either retain the natural shape of the rock or seem to have received their shape through being used. They can be divided into five descriptive groups.

a. Semispherical (19 specimens). These fairly symmetrical mortars have convex, thick side walls. The entire outer surface is normally smoothed, though not really shaped, by pecking. The vessel lip is thin and rounded, occasionally grooved or scalloped and the inner cavity is broad, round, and fairly deep. A rounded bottom is characteristic. None is entire but it is possible to estimate the diameter of several of the 19 specimens. They show a range from 19 to 30 cm.; average cavity depth is about 13 cm.

b. Oval (8 specimens). Similar to the above but made from flatter stream or beach cobbles are eight fragments of rather irregular, convex-sided mortars. Their surfaces have been only slightly modified, pecked here and there to remove irregularities. The interior consists of a shallow oval depression. Their rims are broad and rounded; their unshaped bases tend toward flatness. Three fragments were fitted together to form a vessel with a diameter of 22.6 cm. and a height of 17.6 cm. The cavity has a depth of 14.3 cm.

c. Unshaped (7 specimens). Made from rounded boulders, these mortars have rough natural surfaces. The two largest specimens, found inverted over the pelves of burials, are included in this group. Each weighs well over 100 lbs. One has a diameter of 37.1 cm. and a height of 25.5 cm.; the cavity is 20.5 cm. deep. The other specimen has a diameter of 45 cm., a height of 32 cm., and a cavity 19 cm. in depth. Their grinding depressions are broad and bowl-shaped; bases are irregular; rims are modified only by use. Fragments of five smaller specimens possess estimated diameters of 15-22 cm.

d. Cylindrical (4 specimens). Four sections of what appear to be deep, nearly straight-sided mortars were found. The exterior surface of each has been carefully finished. Rims are thin and well rounded. Exact dimensions could not be determined.

e. Unclassifiable fragments. Twenty-six recognizable but unclassifiable mortar fragments were obtained. Several show smoke-blackening, presumably from use as firestones.

"Paint" mortars -- A special group, often referred to as "paint" or "medicine" mortars because of their small size, is represented by eight specimens. Two distinct varieties can be recognized.

a. Cylindrical (5 specimens). This first group appears to have been made from broken ends of cylindrical pestles. Their sides slope slightly inward to a rounded base. The lip is rounded and thin;

the grinding concavity is relatively shallow. The mortars have diameters of 6.7-7.9 cm., stand 4.6-6.0 cm. high, and have cavities 2.3-2.4 cm. deep.

b. Semispherical or oval (3 specimens). Three mortars have been fashioned from smooth pebbles. Their edges tend to be somewhat square; their bases have been flattened by pecking. In overall dimensions they exceed the other group, ranging from 9.2 to 11.2 cm. in diameter, from 6.7 to 7.1 in height. Cavities measure from 2.8 to 2.9 cm.

Depth information on mortars, owing to omissions and errors in field recording and in museum cataloging, is too spotty to permit precise statements concerning stratigraphic differences, though a few suggestive distributions can be mentioned. The semispherical form, by far the most abundant, occurred quite generally from near the surface to the lowest level, with about the same frequency at all depths (Table 5). The cylindrical mortar fragments were all secured from below 7 feet, with two lying near the bottom of the deposit. Three "paint" mortars, for which there is depth provenience, came from between 5 and 8 feet.

Table 4

Mortars

Form	No.	Diameter (cm.) Max.	Min.	Aver.	Depth (in.)
Semispherical	19	30	19	23	36-204
Oval	8	--	--	22.6	192*
Unshaped	7	45	15	32	120-156+
Cylindrical	4	--	--	--	84-204
"Paint" Cylindrical	5	7.9	6.7	7.3	--
Semispherical+	3	11.2	9.2	10.4	60-96

* Depth data for 1 specimen only.

+ Depth data for 2 specimens only.

Counterparts of the West Berkeley mortars, with the possible exception of the large cylindrical form, have been recovered from other Bay shellmounds. The semispherical variety was present at Emeryville, though not numerically dominant; the oval and large unmodified forms also occurred (Schenck 1926:245-247). The common Emeryville mortar, a large well-finished container with a flat bottom, flared sides, and beveled rim, generally considered to be a late type, was lacking at West Berkeley. Semispherical mortars were obtained at Ellis Landing (Nelson 1910:385). Miniatures were unearthed at Emeryville, Ellis Landing, and Stege (Uhle 1907:Fig. 4, 44; Nelson 1910:Pl. 42, Fig. 2; Loud 1924:364). Small mortars are regarded as a feature of the Middle horizon culture in the Delta region (Lillard, Heizer, Fenenga 1939:78). Around San Francisco Bay, mortars and pestles appear to have considerable antiquity, with some forms continuing in use over a long period. No convincing proof of the precedence of the milling stone over the mortar, has been found, a shift noted elsewhere in California. Except for the mention by Uhle (1907:46) of three doubtful milling stone fragments from Emeryville, and a statement that flat grinding slabs are known from Middle horizon sites around San Francisco Bay (Beardsley 1948:10), no implements of this type have been reported.

Pestles -- Pestles are made from a variety of stones, all apparently of local origin. Most are of compact, fine-grained sandstone, but igneous rocks were also used. All degrees of finish from roughly pecked or even natural surfaces to smooth and highly polished faces are evident. Ornamental specimens, decorated with rings, knobs, or flanges, are absent, however. The pestles fall into four classes.

a. Cylindrical (44 specimens). Characteristically round in cross section, though at times elliptical, these pestles are carefully worked and highly polished. All are short, 10.6-12.6 cm., averaging 11.4 cm., and stout, with diameters 5.3-7.6 cm., averaging 6.07 cm. Their ends, originally flat, have become rounded through use. This was by far the most numerous type.

b. Conical (13 specimens). This somewhat longer variety tapers from a broad base to a blunt point at the grasping end. The striking base is rounded and battered from wear. Like the preceding, these implements are regularly circular, or nearly so, in cross section, but less care was used in their fashioning. The longest is 16.6 cm., the shortest 13.3 cm.; diameters ranged from 6.2 to 9.1 cm. The scarcity of whole pestles makes the averages of 16.0 cm. in length and 7.5 cm. in diameter somewhat untrustworthy.

c. Conical, small (9 specimens). Because of their small size and careful construction the pestles in this group are considered to have had a specialized function, such as grinding pigment. Like the conical pestles they taper to a blunt point. Both ends generally show the effect of pounding and one pestle has hematite adhering to its base. The specimens measure 11.3-12.5 cm. in length with an average of 11.9 cm.; diameters are 4.0-4.7 cm., averaging 4.2 cm.

d. Unmodified cobble (3 specimens). Conveniently shaped beach or stream cobbles were not regularly employed as pestles. A single complete specimen and two broken ones make up this category. Both ends of the first, entire pestle, which measures 13.6 cm. in length and has a diameter of 8.4, appear to have been functional.

Table 5 shows the stratigraphic position of pestles.

Table 5

Depth Distribution of Pestles

Depth (ft.)	Cylindrical	Conical	Conical, small	Cobble
0-1				
1-2	1			
2-3	2			
3-4	1			
4-5	2		1	
5-6	2			
6-7	1		2	
7-8	2			
8-9	1			
9-10	2			
10-11	2			
11-12	1			1
12-13	3	1		
13-14	2	4		
14-15	1		1	
15-16	1			1
16-17				
17-18		2		
18-19	2			

It can be seen from the table that the cylindrical type was evenly distributed throughout the deposit. The less numerous conical pestles had a scattered occurrence with none found about 6 feet. The others are too few to have any real significance. Apparently several forms saw contemporaneous use.

The short cylinder, the prevailing West Berkeley pestle, was the most abundant form at Stege and was also well represented at Emeryville (Loud 1924:363-364; Schenck 1926:248). The conical or tapering variety, numerically the most important at Emeryville, occurred with less frequency at Stege. Crude cobbles were utilized at both sites and paint pestles are reported for Stege. Few details on the Ellis Landing specimens are given (Nelson 1910).

Net sinkers -- The most numerous objects from West Berkeley consist of notched or grooved stones, 360 of which were obtained. They comprise ordinary beach or stream pebbles, unworked except for notches or grooves pecked into them at or near their centers. Presumably the stones were tied to fishing nets to weight them down. Smooth and rounded sandstone pebbles were generally selected, though the shellmound people occasionally used irregular stones. Two types, notched and grooved, can be distinguished. The two varieties intergrade and apparently were used simultaneously, since they were found at the same levels and occurred together in caches. Four caches of 42, 9, 7 and 3 sinkers were uncovered. The largest of the caches also contained a pestle and several mortar fragments.

a. Notched (211 specimens). These are flattish stones, more or less oval in outline, notched at opposite corners to keep an encircling line from slipping. In weight they range from 2 to 15 oz., averaging about 7 to 8 oz. This was the most abundant form.

b. Grooved (149 specimens). More rounded or spherical stones were selected for this group of sinkers, each of which was slightly grooved transversely. Rarely, a small pestle was girdled. Their weight varies from 5 to 16 oz. with an average slightly above 8 oz.

A tabulation of the vertical distribution of 253 of these objects indicates their absence or extreme rarity in the upper nine feet of the refuse with greatest relative frequency between 10 and 15 feet. There was a gradual decline in numbers toward the bottom of the deposit.

Net Distribution of Net Sinkers

Depth (ft.)	Number
0-1	0
1-2	0
2-3	0
3-4	0
4-5	0
5-6	0
6-7	2
7-8	0
8-9	2
9-10	9
10-11	32*
11-12	24
12-13	48
13-14	81+
14-15	36
15-16	13
16-17	4
17-18	2
Total	253

*Includes cache of 9
+Includes cache of 42

The major concentration of net sinkers in the midden (9-16 feet) corresponds with the most abundant occurrence of bones of the white sturgeon and green sturgeon (Appendix B). This suggests that these large food fishes were the ones taken in nets weighted down by notched and grooved stones. Bony elements attributable to the two species gradually diminish, like the net sinkers, in the upper levels of the midden.

Stone sinkers have been reported for several San Francisco Bay mounds. The larger Stege shellheap yielded many specimens; the smaller one, fewer (Loud 1924:362). At Ellis Landing a fair number were recovered from the upper 4-5 feet of the deposit, but sinkers were absent in the middle levels. When excavation was carried below the waterline, they appeared again and continued to the bottom (Nelson 1910:387). Only one specimen, a grooved sandstone pebble, was recovered at Emeryville (Schenck 1926:264), but this object may well have been picked up elsewhere.

The variation in relative frequency of this type of artifact in Bay mounds has been noted several times. Sites where sinkers occurred in abundance were regarded as unusually favorable spots for fishing. Loud, however, suggested the possibility of cultural and, presumably, temporal variation in the sinkers' presence (Loud 1924:363), an assumption which seems to be correct.

On the Marin seacoast notched and grooved stones are common in sites attributed to the Middle horizon (Beardsley 1948:12), but it is reported that they were used little, if at all, in the later times. Sacramento Valley sites generally lack stone sinkers but they seem to occur in Late horizon (Phase I) times.

Anchors (?) -- Two grooved stones, weighing 2 lbs., 9 oz. and 6 lbs., 3 oz., are seemingly too large to have served as net sinkers and can probably be considered boat anchors. The first has a longitudinal groove; on the second, the rough groove is transverse to the stone's long axis. A large girdled stone also came from one of the Stege mounds (Loud 1924:363).

Chisel -- A chisel or wedge-shaped object of sandstone shows a working which was beveled by pecking and grinding from both sides. The tool's butt end is flat and scarred. Its dimensions are 3.1 by 11.5 cm.

Ornaments -- Stone objects for personal adornment were uncommon at West Berkeley. There are several distinct types.

a. Pendants. Three thin, oval pendants, made from grayish-green steatite, were found at the neck of Burial 71, 112 inches from the surface. The pendants' upper and lower borders are deeply, and apparently ornamentally, notched. Each specimen bears a single perforation, drilled, from both faces, near one end. The pieces range in size from 1.5 to 1.8 cm. and are 2 mm. thick. A similar, though

incomplete, specimen was found at Ellis Landing (Nelson 1910:399, Pl. 45, Fig. 4). From the West Berkeley site also came a flat, rectangular pendant of darker steatite, drilled close to one end. The base of this specimen is missing so its complete length cannot be determined. Somewhat similar but tapering toward the base is another fragmentary pendant of hard white stone. This is elliptical and thin near the upper drilled end and rounded toward the base.

b. Ring -- A ring-shaped ornament of grayish-green steatite, 3.1 cm. in diameter, came from the ear region of burial 70, 85 inches beneath the surface of the mound. A spot of asphalt on the rim retains an impression of a thin, 2-ply cord. The article is too small for a bracelet and too large for a finger ring. It had been placed with the burial in such a way as to suggest that it hung suspended from the ear lobe by a string. Ring-shaped ornaments are common in Middle horizon sites in the Delta region.

c. Ear Plugs -- Two smoothly-worked objects of fine-grained sandstone were recovered, one on the surface, the other 35 inches below. They are almost cylindrical in form, having only slightly different diameters at opposite ends. Their bases are squarely cut and one is pitted in the middle. This latter specimen also has a shallow encircling groove near its center. The largest of the two measures 2.2 cm. in length and one end has a diameter of 2.5-2.7 cm., the other end a diameter of 2.7-2.8 cm. The dimensions of the second are: length, 1.7 cm., diameters 1.8-2.0 and 2.1-2.3 cm.

The purpose of the objects is not clear though it has been suggested that they were worn as labrets or as earplugs (Uhle 1907: 59-60). Similar objects were found at Ellis Landing (Nelson 1910:390), and three were recovered at Emeryville (Schenck 1926:253-254). They are generally made of local sandstone. A special feature of the Sacramento Middle horizon culture, south of Carquinez Strait, is the occurrence of steatite labrets and earplugs like the sandstone specimens from San Francisco Bay sites (Lillard, Heizer, and Fenenga 1939:78).

Bars. This designation covers a miscellaneous group of elongated ground stone objects, none of which is perforated. Two long, narrow rectangles of green serpentine, well smoothed and polished, were found at depths of 88 and 100 inches. The largest is 11.3 cm. long, 1.5 cm. wide, and 6 mm. thick; the smaller measures 8.7 by 0.6 cm., with a thickness of about 1.3 cm. A short bipointed rod of brown serpentine is elliptical in cross section with one end highly polished and the other scarred with a series of longitudinal grooves. This object is 5.1 cm. long, 8 cm. wide, and 5 mm. thick. The specimens may be related to the cylindrical "pencils" or rods of the lower Sacramento region.

Charmstones. The "charmstones" of California archaeology are well represented. These problematic objects, made by pecking and grinding, range from simple flattish ovals to elaborate "phallic" forms. Most of them are highly polished and symmetrical but a few are rudely shaped. A wide variety of materials, from relatively soft steatite to hard igneous rock, were utilized in their manufacture.

All of the materials seem to be of local origin, obtainable within a radius of a few miles from the settlement.

Thirty-eight charmstones have a biconically drilled hole near one end. Often the pierced end is also notched or roughened by pecking, presumably to allow for a firmer attachment of a suspension cord.

a. Oval (28 specimens). The most abundant group is essentially alike in their general oval outline but differ in details (Pl. 4, a-d). In cross section the 16 completed specimens range from flattened lenticular to almost circular. There is some variation in size, though this is not great. The longest specimen is 12.1 cm. long; the shortest 6.0 cm.; the average length for the group is 8.6 cm. Diameters vary from 3.1 to 4.6 cm., the average falling near 3.8 cm. The perforation is drilled 1.5-2 cm. from one end. The majority have been made from blue amphibolite schist. One unique green micaceous schist specimen has incised grooves or scratches running diagonally around its body. Twelve unfinished charmstones have rougher surfaces with beginnings of perforations visible as small pits on one or both sides. Why these objects were not completed remains conjectural; only one seems to have been broken in process of manufacture.

b. Biconical (3 specimens). The three charmstones making up this group are round in cross section, tapering toward each end (Pl. 4, i,n). A large hole is drilled biconically 2.3-3.2 cm. from one tip. The largest complete example is 13.8 cm. long and has a diameter of 2.9 cm.; the other whole one measures 13.3 cm. by 3.2 cm. Two, including the fragmentary specimen, are fine-grained sandstone; the third is a greenish granular schist.

c. Biconical miniature (2 specimens). Like the preceding, these two objects have their greatest diameter at about the center and taper toward each end (Pl. 4, j,k). They are, however, much smaller and squatter, measuring 4.1 and 3.9 cm. in length; diameters are 1.6 and 2.1 cm. Soft yellow-gray steatite and green schist were used in their manufacture.

d. Trianguloid (1 specimen). A pendantlike charmstone of gray steatite has a flat broad base which tapers to a squared tip (Pl. 4, m). It is drilled 1.3 from the smaller end and a groove runs across the top. Square olivella beads have been affixed with asphaltum to one face. The article has a length of 6 cm.; its greatest width is 1.9 cm.

e. Phallic (4 specimens). Four charmstones are easily recognizable as pahlli, though differing in size and details of construction. A double-ended green, micaceous schist specimen, 7.1 cm. long and 3.9 wide, has a large perforation in the expanded central portion (Pl. 4, g). A second, of hard green stone, is cylindrical, with a perforation and groove near one end (Pl. 4, h). The other two are incomplete (Pl. 4, f,l). One is a highly polished portion of

a rather small charmstone, broken at the perforation; the other consists only of the sculptured tip.

A small, heterogeneous group of eight unperforated charmstones was recovered. A considerable proportion of them reveal traces of asphalt at the upper end and a few still show marks of twisted cord, which was wound about the stone and held fast by the sticky adhesive.

a. Spheroid, flat base (1 specimen). A globular specimen of hard igneous material has a flattened base and a narrow ungrooved stem which flares slightly toward a squared tip (Pl. 4, r). The entire stem is coated with asphalt, though no cord impressions remain visible. Its length is 8 cm., its diameter 3.9 cm. The tip is 1.5 cm. long.

b. Spheroid, rounded base (1 specimen). This rather crude charmstone has an elongated and rounded stem smeared with asphalt (Pl. 4, q). The stem is not grooved but cord markings are present in the adhesive. Made from a green granular schist, it is 4.6 cm. long and has a diameter of 3.4 cm. The stem measures 2 cm.

c. Plummet (2 specimens). Manufactured from a heavy green stone, the first of two plummet-shaped specimens is the most symmetrical of all the charmstones (Pl. 4, o). Its greatest diameter, 3.5 cm., occurs below the center; thence it tapers to a pointed base. The upper portion narrows to a flattened tip, which has an encircling groove 1.2 cm. from the end. Asphalt, extending from the groove to the top, is impressed with 20 rows of fine cord and a few grains of hematite adhere to the adhesive. The second specimen has a similar outline but is less symmetrical (Pl. 4, p). It has two grooves near the apex; a deep notch over the tip is filled with a mixture of asphalt and cordage. Soft gray steatite was the material selected for the fabrication of this specimen. It has a length of 7.8 cm. and a diameter of 3 cm.

d. Miscellaneous fragments: Four tapering tips are round in cross section. One is grooved.

The vertical distribution of charmstones in the midden indicates a clear-cut stratigraphic difference. The undrilled specimens ran from near the surface to a depth of seven feet whereas perforated examples, except for one recovered at four feet in disturbed slough, remained restricted to the lower levels, 7 to 16 feet below the surface. This distribution, demonstrating the temporal priority of perforated charmstones, agrees with the evidence obtained from other Central California sites.

These distinctive prehistoric artifacts were present in other San Francisco Bay shellmounds. More than 70, all apparently from the upper layer, were obtained at Ellis Landing; 42 from the larger Stege mound, and 40 at Emeryville (Nelson 1910:388; Loud 1924:365-366; Schenck 1926:254-264). Four oval specimens from Emeryville's deepest levels were drilled and notched. Perforated stones also

occurred at Ellis Landing and Stege but their depth is not reported. Charmstones are numerous in lower Sacramento Valley sites where they remained important ceremonial objects from Early to Late horizon times. Early charmstones, often of phallus form, almost invariably have been bored through near one end, whereas most examples from the later cultures are not drilled (Heizer and Fenenga 1939:385-386). Certain of the West Berkeley perforated stones are identical or very similar to those obtained from Early horizon settlements. The undrilled Bay specimens resemble Middle horizon forms (Heizer 1949: Fig. 7-10; Lillard, Heizer, and Fenenga 1939:Pl. 14, Figs. d-f). Charmstones often come from graves into the interior, while around San Francisco Bay they generally turn up in the refuse without association.

Unworked or Slightly Modified Stone

Many additional stone items were recovered, all of them natural forms modified only by use, if at all.

Hammerstones (52 specimens). Twenty-nine of the hammers consist of smooth unworked beach or stream pebbles with one or more battered edges. Hard sandstone and basalt pebbles, which do not fracture easily, were principally used. Twenty-three angular specimens of chert or similar materials have been scarred on all surfaces. A more modified series of 32 oval and discoidal stones, all of compact sandstone, were employed for striking. Some have the shape of a short, flattened pestle. A few show slight workmanship in the form of deliberate pecking along one or two edges, presumably to give a more rounded or symmetrical outline. Marks of use as a percussion instrument are visible on one or two edges. Hammerstones were evenly distributed in the mound from near the surface to 18 feet.

Abrading stones -- Pieces of stone used to fashion, sharpen, or polish other objects, were not numerous. A single "awl-sharpener" has several long shallow grooves on both surfaces. Presumably abraders of whetstones are a soft fine-grained section of sandstone, scratched on one side, and a micaceous schist pebble with an extremely smooth and slightly concave surface. Several irregular fragments of sandstone with worn and flattened faces appear to be portions of polishing or grinding instruments.

Anvil -- A flat slab of sandstone, 18.8 cm. long, 17.7 cm. wide, and 3.3 cm. thick may have functioned as an anvil. It has a small pit near the center of one surface but is otherwise unmodified.

Slingstones (?) -- Four caches of semispherical or oval pebbles contained 17, 15, 8 and 3 specimens. Three isolated pebbles were also collected. All are of the same material, a grayish, hard sandstone, and of approximately the same size and weight. The size range is from 4.6 to 6.7 cm. with diameters of 3.7 to 4.2 cm. In weight they vary from 1-3/4 to 4-1/4 oz. with an average of a little over 3 oz. Most were quite clean, only a few showing traces of

fire-blackening. They are not too heavy to have served as slingstones and their general form suggests such usage. A few are battered on one or both ends, perhaps indicating secondary employment as pecking tools.

Quartz crystals -- Among the most interesting unworked stone objects are quartz crystals, 16 complete specimens of which were found. All are small, the largest being 6.7 cm. long, and none reveals any modification, though one has been burned and melted. It is well known that the quartz crystal played a prominent part in the magico-religious life of the recent California Indians and their presence here suggests that it occupied an analogous position in the prehistoric period. Small quartz crystals were obtainable in Alameda County, south of the present city of Livermore, and elsewhere in the Bay region (Bowen 1962:13).

Prismatic obsidian splinters -- Three slender, obsidian prisms of natural origin were found in a cache at a depth of 150 inches along with 2 stemmed points and 11 quartz crystals, an agate pebble, and a mass of powdered hematite. This association suggests a medicine bag or fetish bundle. One prism has been retouched so that it is leaf-shaped and bipointed, with a diamond cross section. The other two exhibit dull surfaces, produced by burning. Two including the reworked specimen, are 7.2 cm. long, the third measures one cm. shorter. Prismatic obsidian splinters, sometimes referred to as "tinklers" or "bangles," are regarded as typical of the Coastal Province in Middle horizon times, where they are sometimes found in large numbers near the skulls of burials (Beardsley 1948:13). Triangular pieces of obsidian, the facets of several of which appeared to be ground smooth, where reported from Ellis Landing (Nelson 1910:289). They are absent from the Interior Province during the Middle horizon times, although they occur in both the Early and Late periods. The recent California Indians attached obsidian prisms to dance skirts.

Miscellaneous minerals -- The West Berkeley collection contains a number of rock and mineral specimens, presumably picked up because of their attractive color or peculiar form. Included are several iris agate nodules, which could have been secured from rock outcrops in the Berkeley Hills, irregular pieces of quartz, an opal geode and a quartz geode broken open to get at the quartz crystals contained in it, and a small stony meteorite. Unworked brightly-colored stream pebbles were commonly met with in the refuse. All of these items were picked up and carried to the site by the Indians and perhaps retained merely as curiosities though their employment in some magical or religious rite cannot be entirely ruled out.

Pigments -- Three kinds of pigment -- hematite, limonite, and a peculiar white substance, possibly diatomaceous earth -- are represented. In color, the former ranges from a brownish-red to a rich, dark red hue. Powdered hematite was found sprinkled over burials and isolated patches of it also occurred. Four lumps or balls, probably remains of prepared cakes of paint material, were found.

The closest source of hematite lies in the Oakland hills, only a few miles away (Wallace 1947:272). Yellow-brown limonite is less abundant with four irregular lumps and a scattering over one burial. Several chunks of raw ore containing hematite and/or limonite were noted. There is one large (4 X 6 cm.) piece of a chalky substance that may have been the source of white paint. Apparently it was molded into a lump while damp, for finger marks are still visible on its surface.

Bone

The West Berkeley site was well supplied with bone artifacts. This material was used generously in the production of utilitarian objects, less frequently, for ornamental and ceremonial items.

Awls -- A rather general category of single-pointed implements, are clearly predominant among the bone articles. Not a particularly well-made lot, they generally show high polish from use and some give evidence of constant resharpening of their points. Fragmentary specimens have become frequently calcined or otherwise damaged by fire and many were recovered from ash deposits. Awls can be separated into five groups.

a. Deer or elk cannon bone, split head (26 specimens). These flat, rather heavy bone awls were by far the most common. The proximal or distal end of the bone was split at the division of the articular surface and in some the end was partly worked down or ground almost flat. The shaft, which often shows the characteristic cannon bone channel, was tapered to a sharp point. The awls range in size from 10.6 to 18.4 cm.

b. Deer or elk tibia, split head (4 specimens). Though the tibia bone is well adapted for making awls, it seems to have been rarely used. The four tibia awls are slightly bowed owing to the natural curvature of the bone. They possess long and rounded tips and their butt ends remain unmodified except for the original cutting. The specimens vary in length from 13.1 to 17.2 cm.

c. Carnivore ulna, head intact (6 specimens). Awls made from carnivore bones all seem to be fashioned from coyote ulnae. Practically all that was done to make serviceable implements was to sharpen one end of the bone. The length range is 10.8 to 15.5 cm.

d. Mammal leg, bone splinters (14 specimens). This group includes a miscellaneous assortment of pointed tools with a rough angular appearance. They show little modification save for their smooth tapering points, and part of this may have resulted from wear. The butt ends are irregular. It is impossible to identify the bones utilized in making these tools as all distinguishing marks have been broken or cut away. Most appear to be fragments of deer or elk long bones, with an occasional piece made from a rib. The specimens very greatly in size, the shortest being 3.8 cm. long and the largest, 10.4 cm.

e. Bird bone, midshafts (6 specimens). These awls were made by removing the end of a bird bone and splitting the shaft obliquely, then grinding the tapering end to a point. Apparently both wing and leg bones of large marine species were utilized, though this is not certain since all identifying characters have been removed. The bird bones are rather small, 5.4 to 9.5 cm. long, and fragile. They may have served as clothing or hair pins rather than as piercing tools.

f. Unclassifiable tips and medial fragments. Forty-two remnants of mammal-bone awls were recovered. All show smoothed and polished surfaces.

In addition to purposefully shaped implements a number of naturally pointed bones could have been employed as awls or perforators. Ten deer splints (vestigial outer metatarsals) show signs of use and/or sharpening. Four have perforations at the distal end; four are not drilled; two are too fragmentary for determining their original condition. Sting ray spines with the barbs worn or ground off probably saw service as piercing tools. A number of unmodified barbs were also found.

The distribution of awls through the midden was quite uniform (Table 6) and the forms recovered are well represented in nearby shellmounds (Gifford 1940:161). Split-headed cannon bone awls proved the most numerous at Emeryville and Ellis Landing; tibia and splinter tools were also present in fair numbers (Schenck 1926:214-217; Nelson 1910:392). Awls are rare in Early horizon settlements of the Sacramento Valley with fortuitous splinters, split tibiae, and specimens fashioned from coyote ulnae reported (Heizer 1949a:26). In the later Valley cultures bone awls become abundant and diversified.

Table 6

Bone Awls

Form	Number	Length (range) (cm.)	Depth (in.)
Cannon bone, split head	26	10.6 - 18.4	48-169
Tibia, split head	4	13.1 - 17.2	60-170
Ulna, head intact	6	10.8 - 15.5	52-173
Splinter	14	3.8 - 10	52-194
Bird Bone	6	5.4 - 9.8	120-178
Unclassifiable fragments	42	---	12-174
Total	98		

Flakers -- Next in numerical importance among the bone artifacts are flaking implements with their working ends rounded and irregularly scarred. Some may have functioned as gouges or punches rather than as flakers and many originally seem to have been awls put to secondary use after their points had become dulled or broken. Both land mammal and sea mammal bones were used in the fabrication of these tools.

a. Deer or elk cannon bone, head intact (5 specimens). The complete distal or proximal end of the cannon bone was retained to serve as a handle on each of the five implements. All are relatively rough with little surface finish. They range in length from a short, stubby 6.5 cm. specimen to a long-bladed one, measuring 14.2 cm.

b. Deer or elk cannon bone, split head (5 specimens). These are identical in form to awls made from the same bone except for the tip, which is blunt rather than pointed. Their shafts are not so well shaped or polished as those of the awls, however, which gives them a cruder appearance. The shortest is 10.8 cm., the longest 14.0 cm.

c. Deer or elk ulnae, head intact (4 specimens). Ulna flakers, found so frequently in archaeological deposits throughout California, are represented by four examples. The head of the deer or elk bone remains entire, apparently to function as a handle. A single carnivore ulna was similarly fabricated. The tools are short, 9.2 to 12 cm., sturdy, and the tip, as is common in implements of this type, is well worn.

d. Sea mammal tibiae, head intact (2 specimens). The distal ends of two sea otter tibiae have been fashioned into flakers. The bones were employed without splitting the head; only the shaft was cut or broken to form the working end. The flakers are relatively short, measuring 8.4 to 9.3 cm.

e. Sea mammal penis bones (3 specimens). To judge from their scarred tips, three sea otter penis bones saw use as flaking tools. The bones are otherwise unmodified. They measure from 1.1 to 13.4 cm. in length. One has a coating of asphaltum on the proximal half.

f. Mammal leg bone splinters (26 specimens). Split fragments of mammal leg bones were fashioned into short (5.7 to 9.3 cm.), relatively sturdy flakers. All appear crude with the butt end rough and unfinished. A few of the 26 specimens may be tips of larger specimens rather than complete tools.

g. Mammal rib sections (3 specimens). On each of these tools, the rib was cut obliquely to make a beveled working edge. The butt is broken away. All may have been made from sea mammal ribs. Complete lengths could not be determined.

Flaking tools were present in the deposit from the surface to a depth of 14 feet 1 inch (Table 7). No obvious stratigraphic separation between the various classes can be detected. Specimens fabricated from sea mammal tibiae were limited to the upper 7 feet but there were only two of them, far too few for their occurrence to be really important. Mammal leg bone splinters with rounded scarred tips all came from near the surface. Rib flakers were represented in the three to eight and a half-foot section of the deposit, but again there are not many. Ulna tools with heads intact, two of which have specific depth data, are reported from 11 feet and 13 feet 8 inches.

Table 7

Bone Flakers

Form	No.	Length Range (cm.)	Depth (in.)
Deer or elk, cannon bone, head intact	5	6.5 - 14.2	59-169
Deer or elk, cannon bone, split head	5	10.8 - 14.0	24-186
Deer or elk ulna, head intact	5*	9.2 - 12	132-164
Sea mammal tibia, head intact	2	8.4 - 9.3	33-84
Sea mammal penis bone	3	9.8 - 10.1	48**
Mammal leg bone splinters	26	5.7 - 9.3	0-15
Mammal rib section	3	---	36-84
Total	48		

* Includes 1 specimen fabricated from carnivore ulna.

** Depth information for 1 specimen only.

The cannon bone flaker with the head left intact is the form most frequently found in San Francisco Bay shellmounds; ulna flakers are also fairly common (Gifford 1940:170-171). Implements fashioned from sea mammal tibiae are less abundant but have been reported for Emeryville and one of the Stege mounds. Utilized penis bones were obtained at Ellis Landing and Sausalito (CA-Mrn-3) in Marin County. A single specimen manufactured from a rib is reported for the Sausalito mound. These tools appear to be rare in the delta region.

Spatulas (17 specimens). Formed by splitting large bones of deer or other large mammals and grinding them flat, these broad objects have rounded ends (Pl. 5, n,p). Their edges are somewhat beveled and their butt ends squared. Carefully shaped and highly polished, the articles show no signs of rough usage and to what purpose they may have been put remains unknown. They have been referred to as strigils or sweat-scrapers. Eleven were recovered from the lower levels of the mound at depths varying from 10 feet 5 inches to 15 feet 8 inches. The largest is 2.1 cm. wide and 16.9 cm. long; the smallest measures 1.9 by 11.8 cm.

Six other spatula-like implements differ only slightly from flakers in having broad, rounded points. Split cannon bones were used in their manufacture. Two retain half of the distal head; the other four represent shaft fragments. The tools have not been carefully shaped, and polishing is visible only near the rounded tips. Their appearance suggests that they represent service implements. Lengths vary from 9.2 to 11.4 cm. Three of the artifacts were unearthed in the disturbed material at the south end of the midden; the remaining ones were found at depths of 9 feet to 13 feet 4 inches.

Daggers (?). Allied in form and manufacture to the nicely-worked spatulas are two highly polished triangular objects made from leg bones of large mammals (Pl. 5, m,o). The blade of each has been carefully worked down to terminate in a sharp point. The base, from which have been ground off all the protuberances of the condyles, is squared. The objects could have functioned as efficient daggers. The first, found at a depth of 2 feet 6 inches is 13.8 cm. long and 2.0 cm. wide; the length of the second, part of the butt end of which is missing, is estimated as 20 cm.; the width is 3 cm. at its widest point. This specimen was obtained 5 feet 10 inches below the surface.

Notched scapulae (15 specimens). A characteristic, though problematical, implement is made from the thick portion of the shoulder blade of a deer or elk. One side is notched every 3-4 cm. to present a toothed and sawlike edge (Pl. 5, a,b). The teeth are generally rounded rather than pointed. One unique specimen has two indented edges. The unmodified proximal end apparently served as a handle. Most of the scapulae tools are carefully fashioned and the high polish on their serrated blades indicates long use. On several, the teeth are almost completely worn down; two specimens appear to have been renotched after extended wear or when the teeth were broken out. Eight of the 15 were fabricated from right scapulae;

the remaining 7 are from the left. Exact dimensions are difficult to ascertain because none survives. They seem to have averaged between 20 and 22 cm. in length and 3 to 5 cm. in width.

Although implements of this kind have often been referred to as "scapula saws," it is generally agreed that they are much too fragile to have been used in sawing through wood or bone. No satisfactory explanation of their function has been arrived at, though they have been variously described as weaving tools, fleshers, bark-shredders, wood-scrapers and musical rasps (Gifford 1940:172). Conceivably, they performed several tasks, including the scaling of fish or even as sickles in harvesting wild grasses. Either of the last operations could have produced the characteristic high polish on the blade.

Notched scapulae were spread in the mound from near the surface to 15 feet 5 inches below. These distinctive tools seem to be especially characteristic of the San Francisco Bay region. Forty-five were taken from Emeryville; a fair number were recovered in the Ellis Landing midden, from two sites near Newark (CA-Ala-328, CA-Ala-329), and at the Ponce (CA-SCl-1) shellmound (Gifford 1940:178). Only a few notched scapulae have been reported from the delta region.

Notched ribs -- Two large rib fragments, probably elk, are notched (Pl. 5, c). One has large circular cuts giving a scalloped edge; the second has almost square indentations. Their original lengths could not be ascertained; their widths are 2.6 cm. and 2.8 cm. Both form and function remain uncertain, though presumably they could have served the same purpose as the serrate scapulae. Such implements are rare in Central California. A lone specimen were obtained at Emeryville, another at Newark (CA-Ala-329) and a third from Ponce (Gifford 1940:172).

Single-piece curved fishhook -- A bone fishhook was found at a depth of 16 feet. It is subrectangular and has a small knob worked on the end to serve as an aid in attaching it to a line. The point is thin and delicate. The hook is quite small, measuring 2.1 cm. long and 1.1 cm. wide. Another almost identical specimen was recovered from Blossom (CA-SJo-68), an Early horizon settlement, in the lower Sacramento Valley (Heizer 1949b:192). None has previously been reported for a San Francisco Bay shellmound.

Split-mammal-bone tools -- Included here is a heterogeneous lot of rough bone implements. They consist of scraps of split long bones of large mammals, most of them pressure-flaked along one or more edges. Varied forms such as would result from the chance splitting of large bones are included. Thirty-two pieces are roughly flaked along one edge to give a sharp, though irregular, cutting blade. A single specimen has flake scars on two borders. The tools' lengths vary from 6 to 16 cm. A second group of 12 bones have broad, rounded tips, some of which have been flaked. Several are highly polished, evidently through use. They are 5 to 15 cm. long and 2.4 cm. wide.

Sixteen additional specimens, 10 to 21 cm. long, have blunt, flaked points. Four retain the head of the bone or part of it.

It is doubtful that these constitute standardized implements. Rather, they seem to be hastily improvised tools. Their relative abundance is of some interest, and they appear to have been used throughout the period of occupation. Similar rough bone objects were recovered from the lower strata of the Emeryville shellheap (Uhle 1907: 71-72). No great number of them has been reported for other bay sites. It seems probable that crude pieces like these often go unnoticed or unrecorded.

Mammal rib tools -- Eleven bone pieces, all fragmentary, are somewhat curved, and appear to have been formed from mammal ribs. They are rounded, smooth points and are unusually well-polished. Their bases are missing. In the mound they occurred from 2 inches to 13-14 feet. Items of quite similar form have been noted at Emeryville and in Early horizon Valley settlements (Schenck 1926: 216; Heizer 1949a:27).

Whalebone containers -- Three bowls have been hollowed from whale vertebrae. The largest (24 cm. in diameter) and most elaborate exhibits an elliptical hole (12 cm. in diameter) worked into its upper surface (figured as type BB1 in Gifford 1940:225). The cavity, which tapers toward the bottom, is lined with a thin coating of a black material, presumably asphaltum. The projections of the vertebra have been removed, broken or cut off. A second container, 22 cm. in diameter, has a shallow (1 cm. deep) depression worked into one surface. The rim is ground flat. A third whale vertebra, slightly pecked on one surface, probably represents an unfinished bowl. The three West Berkeley whale bone bowl specimens are the only ones reported from Central California.

Bone pins -- Seven long, nicely finished bone objects, flattened oval in cross section, may have served as hair or nose ornaments or perhaps for holding garments together. They are broken, so their exact form could not be ascertained, but all seem to be fragments of slender bipointed pins, tapering gradually and evenly to either end. Two have slightly curved or upturned points. Estimated lengths are 20 to 25 cm.; each is about 8 mm. in diameter. Four other pins were recovered from graves, two with burial 20, 5 feet 3 inches below ground level, and another pair from the grave of burial 56 at the depth of 7 feet 6 inches. The only other specimen for which provenience is recorded was found 6 feet down. Though the incomplete nature of the specimens makes comparison uncertain, it is probable that their original form was like that of the bipointed pins found in other Central California sites (Gifford 1940:176-177).

Bone needles (?) -- Three small, thin, well polished splinters of mammal bone are ground sharp at one end and to a blunt point at the other. The term "needle" is applied with some doubt, since none is perforated. They all may be pins. The specimens are 9.4 to 12 cm. long.

Bone pendants -- Four bone pendants are thin and flat, with rounded sides that taper to square-cut bases. (A West Berkeley specimen is illustrated as type Q1 by Gifford 1940:218.) Each has a biconically drilled suspension hole near one end. Three of the four were taken from a grave at a depth of 10 feet; for the remaining specimen, the vertical position is unknown. The specimens are 1.1 to 12. cm. long, 7-8 mm. wide, and 1-2 mm. thick. Bone pendants are not numerous in Central California, perhaps because of the great emphasis upon the wearing of shell ornaments.

Mammal bone bead -- A tubular bead, with roughly squared and ground ends, is cut from a small mammal bone. Owing to the bone's natural curvature, the object is somewhat bowed. A slight polish is visible on all surfaces. The bead has a length of 4 cm. and a diameter of 6 mm.

Bird bone beads and tubes -- Three polished tubular objects are made from shafts of bird long bones. The process of their manufacture has removed all means of identification of the kind of bird from which they were taken. The smaller samples undoubtedly represent bone beads. They were made from small leg bones, 6 to 7 mm. in diameter, cut into lengths of 1.7 to 2.2 cm. On most examples the cut edges of the bone have been rounded and smoothed off. None is engraved or otherwise decorated. The three specimens were found at depths of 93, 95 and 132 inches.

Longer tubes, fashioned in a similar manner, are highly polished, as if much handled. It seems quite possible that they functioned as drinking tubes at various life crises. One complete specimen, 10.5 cm. long and 7 mm. in diameter, and two broken ones were recovered at depths ranging from 62 to 72 inches. A cruder, less finished tube may be an unfinished product. A cache of about 20 large bird bones with their ends removed was uncovered 59 inches down in the refuse. These probably constitute "blanks" designed to be made into beads, tubes, or whistles.

Undecorated bird bone beads or tubes were more abundant in other San Francisco Bay sites than at West Berkeley. Emeryville produced 87 and Ellis Landing 33. Articles of this sort are found in both coast and interior sites throughout the entire span of prehistoric time. Though rare in the Valley Early horizon sites, they occur in respectable numbers in later settlements (Gifford 1940: 179; Heizer 1949a:26).

Bird bone whistles -- Slender long bones of birds were sometimes made into whistles. The interior of the shaft was cleaned out and a roughly rectangular or eliptical hole was cut about midway in the upper surface. The bone's exterior was somewhat smoothed and polished. One complete whistle, 10.2 cm. long with a diameter of 7 mm., and fragments from seven broken ones were obtained. Three retain traces of asphalt stops, built up near their holes. No specimen gives evidence of having been bound to another. The bone whistles all lay in the upper portion of the refuse deposit from 10 inches below the

surface to a depth of 6 feet. Tubular whistles are frequent in Bay and Valley middens (Gifford 1940:183). They are attributed to both the Middle and Late horizons (Beardsley 1948:13, 16).

Fish vertebrae beads -- Fifteen centrally perforated fish vertebrae have their edges carefully worked down. Eight were found together; 2 additional vertebrae were associated; the remaining 5 occurred as isolated specimens. All were obtained in the upper three to eight feet of the deposit. The pierced vertebrae, presumably beads, are small, averaging about 1.5 cm. in diameter. The fish species represented is the thresher shark (see Appendix B).

Miscellaneous bone objects -- A heterogeneous lot of bone articles includes a bipointed mammal bone splinter 13.6 cm. long, with one tip polished from use, perhaps as an awl or perforator. Two distal ends of deer cannon bones have been extensively ground on both sides of the articulation. One has shallow pits on both surfaces, as if a perforation had been started. Their purpose is unclear. An elk ulna, unmodified except for extensive battering on the edge opposite the proximal epiphysis, perhaps saw employment as a hammer or club. A heavy split section of elk long bone (tibia?) and a splinter of sea mammal bone (whale?) also exhibit scarred edges, indicating utilization as pounders. Three pieces of split mammal bone, 7.1 to 8.3 cm. long and 1.3 to 1.4 cm. wide, are cut obliquely at one end, resulting in a blunt point. The opposite end is square-cut. All show some smoothing. A highly polished bit of bone has a narrow, parallel-sided neck, which expands to a blunt point. This object, 1.7 cm. long and 6 mm. wide, is presumably part of a larger implement. Eight scraps of worked bone are too fragmentary to be identified as artifacts.

Antler

The shellmound people utilized both deer and elk horn in making tools, but neither very extensively. The antler objects are not well preserved and some have become so badly decomposed that it is difficult to determine their original form and dimensions. The porous material apparently decayed rapidly because its large cells and open structure permitted free access of oxygen and dampness. The range of implement types is small, wedges, flakers, punches, and spatulas comprising the total.

Wedges -- Antler wedges vary considerably in size, from small ones, apparently designed for fine work, to large, heavy implements suitable for splitting thick branches or even logs. The tools were made by tapering a section of antler to a rounded and beveled tip. The butt end usually shows scars from the effects of pounding. Longer specimens tend to show the natural of the antler. Two classes are represented, the main differences between them being size and method of beveling the blade.

a. Short, broad, blade beveled from side (22 specimens). Made from short lengths or split sections of antler, the blades on

these wedges have been tapered by cutting and grinding from one surface only (Pl. 5, h,i). The butts of the tools have been cut off square. Their length varies from 10 to 15 cm.; the width of the blade ranges from 3 to 3.5 cm.

b. Long, narrow, beveled from both sides (30 specimens). Wedges included here are made from sections near the tip of the antler (Pl. 5, f,g). Their blades have been ground from both surfaces to give a relatively narrow, rounded tip. Like the preceding group, they have square-cut bases. On the whole, these wedges are more carefully made than those of the first class. In length they vary from 12 to 22.5 cm. and in width from 2 to 3 cm.

Antler wedges were found throughout the mound from a depth of three to four to more than 16 feet beneath the surface, with most of them found below the eight to nine foot level. Both classes showed about the same vertical occurrence. Only one specimen was taken from a grave (Burial No. 32). If these objects were used exclusively for woodworking, their presence in some numbers points to a well-developed wood industry. No specialized mauls were unearthed, but any of the hammerstones could have been used to pound in the wedges. Antler wedges have been reported from other Bay middens, but Emeryville is the only site where they were met with in comparable quantity. Here, as at West Berkeley, the wedge was the most common antler artifact, with some indication of a more frequent occurrence in the lower levels of the deposit (Schenck 1926:229-230). The Ponce mound also yielded a fair quantity, even though excavations were extremely limited (Gifford 1940:182). Antler wedges are rare items in the delta region with only one reported from Early horizon settlements and a few more from later sites (Heizer 1949a:28; Gifford 1940:182).

Flakers -- Antler tines with cut bases were present at all levels. The tines had received no intentional shaping, but their tips exhibit wear, presumably from flaking stone by the pressure technique. Both straight and slightly curved specimens are included, with a unique piece consisting of a branched tine. Nineteen complete flakers, 5.7 to 13.7 cm. long, and 16 fragments were recovered from depths ranging from four feet from the surface to 14 feet.

Curved blades -- Two whole and five fragmentary objects comprise split sections of antler, evidently elk, ground into flat, blunt-pointed blades. They still show the natural curvature of the horn (Pl. 5, k,l). The largest specimen has a length of 46.2 cm. and a concave base; the second, quite similar, measures 15 cm. less and has a straight rather than concave base. The original form and size of the incomplete blades could not be determined. The objects could have functioned as sweat-scrapers or strigils or even as sickles.

Animal Teeth

Twenty-one modified animal teeth must have served as pendants or beads. A sea lion canine is cut off square at the root end and

has three small grooves around its circumference. Traces of asphalt and cord wrappings are visible near the squared end, indicating its suspension as a pendant by wrapping the root end with a thin, two-ply cord, held fast with asphaltum. From two graves at the north end of the mound (Burials 84 and 85) came 20 coyote teeth, 18 in one grave and 2 in the other. The teeth are undrilled, but bear asphalt and cord impressions. Beads and pendants made from animal teeth are not common in Central California sites. Unperforated canid (coyote) teeth occasionally unearthed have been with Early horizon burials in the delta region (Heizer 1949:48). Drilled coyote teeth have also been found.

Shell

At West Berkeley shell was used almost exclusively for the making of beads and pendants. Only three kinds, Red Abalone (*Haliotis rufescens*), Black Abalone (*Haliotis cracherodii*), and Olive (*Olivella biplicata*) were regularly utilized. The making of shell ornaments does not seem to have taken place at the site for the refuse failed to yield discarded waste fragments, incomplete articles, or pieces broken during manufacture. Drills suitable for piercing shells were lacking. Thus, it can be concluded that finished products were brought in from elsewhere. Either the West Berkeley people journeyed to the seacoast to gather shells and there made ornaments from them, or more likely, they procured the finished products in trade from shore-dwelling populations.

Beads -- Beads usually lay near the neck or thoracic region of skeletons. All are well-made but shaped rather simply. Six types are represented.

a. *Olivella* with spires removed (1,195 specimens). Beads consisting of whole Olive shells with the tip or spire ground off down to the main whorl (Pl. 6, l,f), found in 10 lots, show a complete intergradation in size from tiny specimens measuring only 6.9 mm. in length to large ones of 13.2 mm. The beads recovered together were not carefully graded according to size.

b. Rectangular *Olivella* (350 specimens). These thin and slightly concave beads have straight edges and square corners (Pl. 6, k,l). The central perforation is drilled from one side only. Four lots of 168, 152, 25, and 5 were secured. There is some size variation from 4.1 by 5.3 mm. to 6.6 by 8.6 mm.; perforations range from 12. to 1.7 mm., with the average falling near 1.5 mm.

c. Circular *Olivella* (2 specimens). Two circular, slightly cupped Olivella beads were found together (Pl. 6, g,h). Each has a biconically drilled hole in the center. Their diameters measure about 8.7 mm.

d. Rectangular *Haliotis* (412 specimens). Rectangular or, in a few instances, almost square, beads cut from abalone shell were

recovered in four lots, numbering 243, 87, 64 and 13. Each bead has a single central or slightly off-center preforation, drilled from both sides (Pl. 6, i,j). The beads' edges are unmodified except for the original cutting; the angles of the corners are sharp. The shell's coarse back was cut away so as to exhibit the inner irridescence. The size range is from 5 X 6 mm. to 6 X 17 mm.; perforations average about 2.5 mm.

e. Circular *Haliotis* (1 specimen) -- A single, centrally perforated abalone shell bead, 14 mm. in diameter, was found. It is slightly cupped due to the utilization of a curved fragment for its manufacture. The back of the shell has been ground away.

f. Limpet (1 specimen). The aperture of a small limpet (*Acmaea* sp.) shell beads, appears to have been enlarged by grinding; the shell may represent a completed bead or even a pendant. Its natural opening certainly made it suitable for suspension.

It was possible to detect a stratigraphic difference in the occurrence of shell bead types (Table 8). Circular forms remained limited to the higher part of the deposit, whereas rectangular beads were distributed in the deeper levels. The pair of disk-shaped *Olivella* beads were obtained at a depth of 42 inches; the circular abalone at 60. These may be too few to be made the basis for statements concerning stratigraphy, though their complete absence from the lower 13 feet of the midden seems significant. Except for a specimen in a necklace of spire-lopped shells associated with an infant, buried 85 inches down, rectangular *Olivella* beads were all recovered at depths from 146 to 171 inches. The rectangular *Haliotis* forms run from 101 to 172 inches. Olive shells with their spires removed had the greatest depth range, from 72 to 172 inches. Beads of the last three forms were sometimes strung together in a single necklace.

Shell bead types have been recognized as reliable indicators of culture periods in Central California since the people of each prehistoric phase tended to use distinctive forms. Of the West Berkeley types, the spire-lopped *Olivella* is the least useful as a horizon marker because of its wide geographical and temporal range. In the delta region whole shells occur in all periods, with the Early beads being typically small (Gifford 1947:10). For the Bay area, this type was abundant at Emeryville but almost absent at Ellis Landing and Stege, only one specimen having been recovered from the last two sites. The other West Berkeley forms have more diagnostic value. Circular *Olivella biplicata* beads with a central hole are characteristic of the Middle horizon in the Valley (Lillard, Heizer and Fenenga 1939:391-392). Two beads of this type were found at Emeryville and Ellis Landing (Schenck 1926:233-234; Nelson 1910:398). Round and flat abalone shell beads are diagnostic of Middle horizon sites. Rectangular *Olivella* shell beads of the variety recovered at West Berkeley occur only in Early horizon sites with a smaller, thinner bead with a tiny perforation found in Late horizon deposits (Heizer 1949a:17). The latter seems to be the form reported for Emeryville (Schenck 1926:233). Rectangular to square *Haliotis* pieces

are standard in Early horizon settlements (Heizer 1949a:17). The *Haliotis* beads from Emeryville, which vary from circular to rectangular, are not of this type (Schenck 1926:233). To sum up, the shell beads found exclusively in the upper levels at West Berkeley represent types generally ascribed to the Middle horizon; those from the deeper stratum are Early horizon forms. The spire-lopped Olives cannot be assigned to a specific chronological period though their apparent absence in the upper 72 inches of the midden may have temporal significance in the San Francisco Bay region, particularly in view of their almost complete absence in two nearby shell middens.

Pendants -- Pendants are all made from abalone shell. The species could not always be identified because of alteration but when recognizable it was either *Haliotis rufescens* or *cracherodii*. The shell pendants, thin, concave objects, and drilled for suspension, undoubtedly served as articles of personal adornment, either attached to clothing or as ornaments worn about the neck. Some were associated with beads, indicating their use as parts of necklaces. The pendants assume a number of distinct shapes.

a. Circular, two central perforations, plain or incised edges (11 specimens). Eight of these pendants exhibit incised borders while three have unmodified margins (Pl. 6, n,p,q). Four show traces of asphalt or other adhesive on the backside and may represent earplug or labret facings. Their diameter are from 18 to 51 mm.; perforations vary from 2.3 to 3 mm.

b. Circular, two central perforations, serrated edges (13 specimens). These specimens consist of disks with scalloped or serrated borders (Pl. 6, a,b). They are much like the above but with smaller diameters and larger perforations. The size range is from 14.4 to 20 mm.; perforations vary from 2.5 to 3.3 mm.

c. Circular, single central perforation, incised edges (1 specimen). This single-holed pendant, 18 mm. in diameter has incised borders (Pl. 6, o).

d. Rectangular with concave sides, two perforations at narrow end, plain edge (3 specimens). The general form of these pendants is rectangular with the sides curving inward (Pl. 6, r,s). The most finely finished example measures 18 by 35 mm.; a second larger and cruder one has dimensions of 25 by 42 mm. The third is incomplete. The method of finishing their margins varies: one has plain edges; a second, incised; and the third, a partially serrated border.

e. Rectangular, one peripheral perforation, plain edge (3 specimens). The three specimens of this class are long and narrow (Pl. 6, t,u) with curvature of the shell making them somewhat asymmetrical. Dimensions of two of the pieces are 18 by 50 mm. and 10 by 54 mm. The third is incomplete.

f. Triangular, single peripheral perforation, plain edge (4 specimens). Three small, roughly triangular pendants are made

from rim sections of a *Haliotis rufescens* shell. The shell's curvature adds to their asymmetry. All are crudely finished. They measure 6 by 23 mm., 11 by 20 mm., and 11 by 20 mm. A fourth specimen, similar in outline, has a second perforation drilled near its lower border.

g. Indeterminate. A fragmentary pendant has two peripheral perforations and a third drilled slightly below. Its original shape and dimensions could not be ascertained.

Little can be said about the stratigraphy of pendant types because their number is small and depth information is inadequate because of errors and omissions in field recording and in cataloguing. Further, the majority of the pieces were taken from two graves. Six circular pendants with two central holes, the disk with a single perforation, and two of the three rectangular specimens with concave sides were found with Burial 45 at a depth of 172 inches. Nine of the disks with scalloped edges came with Burial 66, 166 inches below the surface.

As a group, the West Berkeley shell pendants are distinct from those recovered at other shellmounds on the shores of San Francisco Bay, but several forms are very similar or identical to those from lower Sacramento Valley early horizon cemeteries. The most frequent Early pendant, as at West Berkeley, is circular with two central perforations (Heizer 1949a:17). Like some of the West Berkeley specimens, the reverse surface often has been smeared with asphaltum. The distinctive rectangular pendant with concave sides is also found in Early horizon graves. Circular disks with deeply serrated or scalloped edges generally are regarded as belonging to the Middle horizon (Heizer and Fenenga 1939:392). No such quantity and variety of shell ornament was present at West Berkeley as in the delta region. The relative scarcity of shellwork is also characteristic of other Bay mounds. Evidently, the Bay area people failed to develop a distinctive art in shell (Gifford 1947:50). The suggestion that this reflects their economic status may be correct (Schenck 1926:232). The bayshore dwellers probably did not have desirable trade items to exchange with the coast tribes for shell articles. Apparently the inland peoples did.

Table 8

Shell Artifacts

Artifacts	Number	Size Range (mm.)	Depth (in.)
Beads			
Spire-lopped *Olivella*	1195	7 - 13	72 - 172
Rectangular *Olivella*	350	6 X 16 - 5 X 7	146 - 175
Circular *Olivella*	2	8	42
Rectangular *Haliotis*	412	6 X 17 - 5 X 6	101 - 172
Circular *Haliotis*	1	---	60
Total	1960		
Pendants			
Circular, 2 perforations, plain or incised edges	11	18 - 51	172
Circular, 2 perforations, serrated edges	14	14.4 - 20	129 - 162
Circular, single perforation, plain or incised edges	1	18	172
Rectangular, concave sides, 2 perforations	3	18 X 35-25 X 42	172
Rectangular, single perforation	3	18 X 50-10 X 54	---
Triangular, single perforation	3*	6 X 23-11 X 20	85
Indeterminate, 3 perforations	1	---	136
Total	36		

* Plus 1 specimen with second perforation.

Shell rarely served utilitarian purposes. Occasionally empty mollusk valves were utilized in their natural state as containers. An unmodified Bay Mussel (*Mytilus edulis*) shell was found filled with red ocher; a few others showed traces of pigment. Some employment of shells as scrapers or knives is demonstrated by the presence of three roughly rectangular sections, cut from the borders of valves of the larger Sea Mussel (*Mytilus californianus*). Each of the pieces shows wear on one edge. A section of mussel shell with a cut and rounded border may have been similarly used or may have operated as an artificial thumbnail in extracting fibers from leaves and stalks. Ten additional severed pieces are too fragmentary for their original shape and possible function to be ascertained. Several small masses of

powdered (clam?) shell were discovered. Their compact shape suggests that they had been in containers of perishable material.

Baked Clay

A hand-molded chunk of fired clay, 2 cm. long and 6 cm. in diameter, was obtained at a depth of 150 inches. Made from reddish clay, blackened on one side by fire, it is roughly oval in form, with a plain, irregular surface. Baked clay objects, so numerous in interior sites of Central California, are generally lacking in San Francisco Bay shellmounds, though a few have been found. A baked-clay ball and a "biscuit-shaped" fragment were excavated at Emeryville (Schenck 1926: 225). This rudimentary fired-clay industry is represented in all of the three lower Sacramento Valley horizons, though rather weakly in Early settlements (Heizer 1949:25). The West Berkeley specimen is too generalized in form to be definitely linked with any of the Valley types though it does bear a vague resemblance to the ungrooved biconical clay balls of the Early horizon. That the West Berkeley specimen was locally made seems doubtful.

Perishable Materials

Soil conditions were not favorable for the preservation of perishable materials, so little has survived. There is one piece of basketry, saved from destruction by charring and a protective coating of pitch and hematite. The fragment, found at 127 inches, is small and crumbly, making recognition of its structure exceedingly difficult and identification of fibers impossible. The weaving technique appears to be lattice-twining, weft elements passing around both vertical and horizontal warps. It is closely wove, with 14 warps and 25 wefts per 10 cm. The pitch of the stitch is down to the left. If the identification is correct, this is an early indication of a rather rare basketry technique.

A mass of carbonized fibers was uncovered at 127 inches. The strands are long and rows of them seem to cross at right angles, suggesting a remnant of a checker-weave mat of shredded bark or tule. A second bunch of fibers is too poorly preserved for ascertaining whether they were woven. Though no actual cordage was found, the presence of a fine two-ply string is attested by impressions in asphalt on the ends of charmstones and canid teeth.

House Remains and Other Features

Architectural evidence was meager at West Berkeley but fireplaces and concentrations of burned and cracked stones were plentiful. A single storage pit was also exposed.

Houses -- When excavation began, no pits or other surface indications of houses were visible. This is not surprising, considering

the disturbed condition of the midden and its antiquity. Little subsequent evidence concerning habitations was obtained. Three compacted areas were noted, one with a fire pit near its center. These may well have been remnants of house floors but the absence of defined postholes makes this uncertain.

The only indubitable structural remains, uncovered at a depth of 123 inches, consisted of a section of the floor of a large, presumably ceremonial, house. The floor, a two-three inch layer of clean, hardpacked, yellow clay spread over 5 by 12 foot area, sloped inward toward the center, forming a broad shallow depression, 4 to 6 inches deep. Its edge was marked by a curving line of 9 post molds, spaced 8 - 12 inches apart. Seven additional postholes lay inside the circle. Two of the latter had raised clay rims on their outer edges, apparently added for greater support. A single large posthole was observed outside the house outline. Profiling the postholes showed that they were pointed or slightly rounded at the base. Their diameters varied between two and five inches and their depths from four to six inches. All tended to slope inward at the top, suggesting a conical or domed framework once covered the floor area.

The house floor could not be completely exposed, for it lay on the edge of the excavated area next to the factory building. As a consequence the exterior form of the structure could not be determined with any exactness but it seemed to be an oval, perhaps 40 feet long and 20-25 feet wide. No definite entranceway could be observed and there was no fireplace. An intrusive pit from a level two to three feet higher cut through one corner of the floor. Four inches below, the house floor, separated from it by a thin deposit of charcoal and calcined shell, lay another thinner clay band, perhaps remains of an earlier house.

Fireplaces -- Small areas of charcoal and ash, 15 to 16 inches across, were frequently met with. They were not contained in defined pits nor regularly surrounded by stones. Of 21 recorded, only six had fire-blackened rocks irregularly arranged around them. Several charred twigs and a handful of burned acorns were taken from one of the hearths.

Concentrations of stone -- Sixteen masses of cracked and irregularly broken stones, often fire-stained, were exposed. In size the individual stones ranged from 8 to 30 cm. Fragmentary and, occasionally, complete lithic artifacts were intermingled. The largest concentration covered a 5 X 10 foot area; the smallest 2 by 3 feet. Their vertical distribution was from 5 to 14 feet.

Storage pit -- An oval, sand-lined pit, 19 by 24 inches in diameter and 12 inches deep, was encountered 180 inches down. Over it lay several red sandstone slabs. The pit contained whole and broken mussel and oyster shells but no artifacts.

Mortuary Practices

During the excavation of the West Berkeley shellmound, 95 more or less complete skeletons and a number of disassociated human bones were exhumed.[1] Most of the skeletal material was in poor condition; many of the bones had become badly decayed and crumbly, making exposure and removal difficult. The poor preservation can be explained by several factors. Many skeletons had been badly broken up as a result of lying in shallow graves and being subjected to pressure from human activity above; others had been disturbed by later aboriginal digging of graves or other pits. The cutting away of the east section of the mound close to a cemetery in order to make way for a railroad spur track exposed many skeletons to the forces of disintegration.

The prehistoric people habitually interred their dead directly in the village debris. It appears that burials were made in the midden during all stages of its formation for skeletons were encountered at all levels, from about 2 feet 4 inches below the surface to the subsoil. Relatively few clearly defined burial pits or grave walls could be discerned. All were shallow (2-1/2 to 3 feet deep), oval hollows, averaging about 24 by 36 inches in dimensions. Burials occurred in all parts of the mound but there were two areas, apparently cemeteries, in which they were concentrated. Unfortunately neither could be satisfactorily explored. The first lay on the midden's eastern fringe where operations had to be limited because of the danger of undermining a heavy wire fence and a railroad track. This cemetery yielded 7 skeletons, several badly disarranged, and deteriorated. Five others were observed in the trench walls but could not be exposed. During bulldozing of the northern section, 20 skeletons or more were noted in a small space. It was possible to remove only 12, all severely damaged by the earth-moving operation.

The West Berkeley mound-dwellers placed corpses in the ground in a loosely flexed position with the arms bent so that the hands lay near the face (Pl. 7). No customary direction of orientation could be detected. In 19 graves the skull was oriented to the west and in 23 to the east. Twenty-two showed the head placed in a northerly direction, 9 roughly toward the south. For 22 burials, orientation could not be determined or went unrecorded. A similar variation in the body's position was noted. The skeleton lay on the right side in 33 instances, on the left in 23. Eight skeletons appeared to be on the back, six on the face; it is possible that some of the latter originally lay on the side but were shifted in the settling and movement consequent to decomposition. One interment was doubtfully reported in a sitting position. Placing more than one body in a grave does not seem to have been a common practice as only three occurrences were observed.

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[1] Ten skeletons uncovered by Peterson in 1904 were included. The later section on human skeletal remains describes some material omitted here for which there are no burial data.

Depositing articles with the dead either was not a well-developed custom, or it was reserved for special individuals. Only 32 of the 95 burials had accompanying mortuary goods and of these at least five represent doubtful associations. In 11 graves, offerings remained limited to beads or ornaments. Objects of daily use were not regularly placed with the dead and the apparent intentional inclusion of animal remains was noted only three times. The "killing", or purposeful damaging, of burial objects was reported once -- a mortar accompanying Burial 2 had a hole knocked through its base. Forty-three bodies showed signs of powdered pigment. For 42 burials, this consisted of red ocher or hematite; one (Burial 10) had traces of yellow-brown limonite. In only 13 graves was the red ocher profuse. There is no need to describe the burials in detail since the data for each are presented in Table 9, but Burial 32, a young adult male, probably merits special attention. It was the only one which accompanied a fair number of burial gifts. Two large obsidian blades and a pair made from a white chertlike material, as well as an antler wedge and a grooved net sinker, were found in the grave. Red ocher colored most of the bones and the bases of the two obsidian blades.

The practice of laying burials in a flexed position in refuse mounds was common procedure in prehistoric California. All San Francisco Bay sites thus far reported upon have yielded flexed burials. At Emeryville this seems to have been the universal rule and, as at West Berkeley, little attention was given to orientation or position of the torso (Schenck 1926:197). For Ellis Landing, flexure was the prevailing method, again with no observance of cardinal direction (Nelson 1910: 382). Several skeletons at this site lay stretched out instead of contracted. The occurrence of human remains is reported for the Stege mounds but no information on body posture is given (Loud 1924: 360). At San Bruno both flexed burials and cremation were noted (Drake 1948:319). In the Bay shellmounds only a small percentage of graves contained artifacts and these when found were frequently restricted to shell beads and ornaments. The use of red ocher was general.

A sequence of burial techniques has been worked out for interior Central California. Burials fully extended on the ventral side and oriented west characterize the Early horizon; flexed burials, usually tightly contracted, appear in the Middle horizon with some cremations; both cremation and flexed interment were practiced by the Late people with cremation becoming more frequent with the passage of time (Heizer and Fenenga 1939:385). A sequence has been suggested for the Bay and coast dwellers, with loose flexure, variable orientation and disposition, and scanty mortuary offerings characterizing Middle sites and these practices carrying over without marked change into the Late horizon, Phase I. Cremation appears to have been introduced in Late, Phase II times, just before European contact. The significance of sporadic extended burials in Bay shellmounds is not known.

Table 9

Burials

Burial No.	Depth (in.)	Age	Sex	Position	Orientation	Red Ocher	Associated Objects
1*	78	Infant		Back	East	Absent	None
2	120	Adult	M	Back	East	Abundant	Killed mortar, net sinker, rectangular beads
3	114	Infant		?	West	Absent	None
4	132	Infant		?	North	Absent	2 bone needles, 82 quartzite fragments, rectangular beads
5	114	Infant		?	North	Absent	None
6	120	Infant		?	?	Absent	None
7	114	Infant		?	?	Absent	None
8	72			?	South	Absent	Quartzite pebble
9	96	Subadult	M	L. side	East	Present	4 obsidian blades, quartzite pebble
10	17	Infant		L. side	East	Present**	None
11	28	Infant		Back	North	Absent	None
12	37	Subadult	M	R. side	East	Absent	None
13	38	Infant		R. side	North	Absent	None
14	37	Adult	F	R. side	South	Absent	None
15	72	Adult	F	L. side	North	Absent	None
16	35	Infant		Face	East	Absent	None
17	70	Infant		R. side	West	Present	None
18	64	Adult	F	Back	West	Abundant	Net sinker (?)
19	98	Infant		L. side	East	Present	None
20	84	Infant		L. side	East	Abundant	3 worked animal bones, bone awl, chert scraper, 3 chipped chert flakes
21	60	Infant		R. side	North	Absent	None
22	123	Infant		R. side	North	Present	Antler spatula, steatite charmstone, chert core tool
23	124	Infant		R. side	East	Abundant	Antler wedge, *Haliotis* pendant, carnivore mandible, flaked chert fragment
24	99	Adult	M	L. side	East	Abundant	2 obsidian flakes, 1 bone tool (?)

* Burials 1-10 were excavated by Peterson (1904) and are described in detail in his field notes. Depth graves (1-9) are approximate.

** Limonite.

Table 9: Burials (cont'd.)

Burial No.	Depth (in.)	Age	Sex	Position	Orientation	Red Ocher	Associated Objects
25	92	Infant		---	---	Present	None
26	92	Infant		---	---	Present	None
27	131	Infant		R. side	North	Present	None
28	127	Infant		---	---	Abundant	None
29	127	Infant		---	---	Abundant	None
30	172	Infant		Back	North	Absent	None
31	134	Adult	F	L. side	West	Absent	None
32	44	Adult	M	L. side	East	Present	2 obsidian blades, 2 white blades, antler wedge, net sinker
33	106	Adult	M	L. side	South	Present	Chert scraper
34	113	Infant		?	----	Present	None
35	135	Adult	F	L. side	East	Absent	2 net sinkers, 1 chert scraper, 1 obsidian scraper fragment, chert core, 1 tool, split deer bone
36	166	Infant		Face	North	Present	None
37	158	Child		L. side	West(?)	Abundant	None
38	170	Adult	M	L. side	South	Present	Spire-lopped *Olivella* beads
39	110	Infant		R. side	South	Abundant	Spire-lopped *Olivella* beads
40	194	Subadult	F	R. side	East	Absent	None
41	112	Infant		L. side	---	Absent	None
42	175	Infant		L. side	North	Abundant	Rectangular *Olivella* beads
43	156	Child		---	---	Absent	None
44	166	Infant		L. side	North	Absent	None
45	172	Child		L. side	West	Absent	Circular *Haliotis* pendant, rectangular *Haliotis* beads, spire-lopped *Olivella* beads, elk vertebrae
46	172	Infant		?		Absent	None
47	192	Infant		L. side		Absent	Pecked white pebble
48	192	Infnat		R. side		Absent	
49	143	Subadult		Face	West	Absent	Circular *Haliotis* pendant, rectangular *Olivella* and *Haliotis* beads
50	144	Adult	F	R. side	East	Absent	Rectangular *Olivella* beads, awl fragment, polished bone object

Table 9: Burials (cont'd.)

Burial No.	Depth (in.)	Age	Sex	Position	Orientation	Red Ocher	Associated Objects
51	154	Child		R. side	East	Present	Bone flaker, bone awl fragment, rectangular *Olivella* and *Haliotis* beads, sting ray dental plates
52	86	Infant		?		Present	Worked bone
53	98	Subadult		?		Present	None
54	136	Infant		?		Absent	Circular *Haliotis* pendant, bone awl, 2 bone awl fragments
55	158	Infant		?	South	Present	
56	85	Infant			North	Absent	Mammal jaw (sea otter?)
57	111	Infant		L. side	West	Absent	None
58	138	Adult	F	L. side	East	Absent	None
59	180	Infant		Face(?)	North	Absent	None
60	206	Adult	M	R. side	East	Absent	None
61	156	Adult	M	R. side	East	Absent	None
62	173	Adult	M	Face	West	Abundant	Rectangular *Olivella* beads
63	82	Subadult	F	R. side	West(?)	Absent	None
64	101	Adult	F[1]	R. side	East	Abundant	Rectangular *Haliotis* beads
65	150	Adult	M	R. side	North	Present	2 chert chips (scrapers?) 1 quartzite scraper
66	162	Adult	M	R. side	North	Present	Circular *Haliotis* pendants, rectangular *Haliotis* beads
67	155	Infant		?	North	Present	None
68	155	Adult	F	R. side	North	Absent	None
69	107	Infant		R. side	East	Present	*Olivella* beads
70	85	Child		L. side	South	Abundant	Steatite ring, rectangular *Olivella* and *Haliotis* beads, Limpet shell
71	112	Infant		R. side	North	Present	Steatite pendants
72	99	Infant		?	?	Present	
73	104	Adult		Sitting(?)	West	Absent	Hammerstone, net sinker, 2 worked bones

[1] Included were remains of subadult male, about 13 years of age.

Table 9: Burials (cont'd.)

Burial No.	Depth (in.)	Age	Sex	Position	Orientation	Red Ocher	Associated Objects
74	140	Child		R. side	East	Present	None
75	145	Subadult	F	R. side	West	Absent	Chert scraper
76	162	Adult	M	L. side	North	Present	Large mortar over pelvis
77	169	Infant		R. side	East	Abundant	None
78	185	Adult	F	L. side	North	Absent	None
79	184	Infant		L. side	North	Absent	None
80	165	Adult	F	Back	West	Absent	None
81	162	Child		Face	West	Absent	None
82	183	Adult	F	R. side	West	Absent	None
83	183	Child		R. side	West	Absent	None
84	132	Adult		R. side	---	Abundant	Coyote teeth, bone needle on skull
85	132	Adult	F	R. side	---	Abundant	Coyote teeth
86		Adult	M[1]	---	---	Absent	None
87	144	Adult	M	R. side	West	Absent	None
88	144	Infant		---	---	Present	None
89	144	Adult	M	R. side	South	Absent	Net sinker (?)
90	144	Adult		R. side	East	Absent	None
91	158	Adult	F(?)	Back	South		None
92	158	Adult	F	Back	West	Present	None
93	144	Infant		?	?	Present	
94	144	Adult	M(?)	R. side	East		None
95	120	Adult	M	?	?	Present	None

[1] Includes 7-8 year old child.

Animal and Bird Burials

Near the base of the mound, at a depth of 182 inches, lay half of a coyote skeleton. The animal had been placed in a shallow depression and purposefully covered over. Its remains lay in anatomical articulation, suggesting that the coyote was buried after having been halved longitudinally. This may represent an interment of an animal, ceremonially raised and killed. Thirteen coyote burials, some with offerings, have been reported from Late and Middle horizon sites in the Valley (Heizer and Hewes 1940: 589-590). The hindquarters of four were missing. Special post-mortem disposal of other mammal species has also been noted in the interior region.

An almost completely articulated skeleton, consisting of the entire skull and mandible and most of the postcranial bones of a large raptorial bird, was uncovered 123 inches down in the refuse. The remains were identified as those of a California Condor, the state's largest living bird. The completeness of the skeleton again implies special or ritual sepulture, perhaps mortuary treatment similar to that accorded humans (Wallace and Lathrap 1959). The bones of large carnivorous birds, eagles, hawks, and condors, have been unearthed elsewhere in California under conditions suggesting careful postmortem treatment. Ethnographic data indicate ritual disposal of birds killed during ceremonies by recent California Indians (Heizer and Hewes 1940:391). A fairly large number of condor bones were encountered at Emeryville (Howard 1929:314), all of the elements except one collected within the same small area and apparently representing a single individual. This may also have been an interment.

A second bird skeleton proved to be a member of the Anatidae Family (ducks, geese). The skull had been badly crushed and was lying on the vertebrae. This probably does not represent an intentional burial but is merely a fowl which for some reason was not eaten after its capture.

Subsistence Remains

The enormous mass of molluscan valves contained in the West Berkeley midden shows that shellfish collecting remained the constant and principal means of gaining a livelihood throughout the period of occupation. The earliest inhabitants gathered vast quantities of mussels and oysters, both obtainable with relatively little effort and without special tools. Mussels were to be had merely by pulling them off rocks; oysters needed only to be scooped up at low tide from gravel bars. Later, clams replaced oysters as an important food item though an emphasis upon mussels continued (Appendix A). Procuring clams proved more arduous, for they had to be dug from mud and sand.

Fish must have been another mainstay of the aboriginal fare. The prominence of fishing is attested to not only by plentiful fish bones (Appendix B), but also by numerous net sinkers. From a time soon after their arrival, almost to the end of their residence, the shellmound people caught quantities of large fish in shallow offshore waters in nets weighted down with notched and grooved stones. A subsidiary device probably for supplying daily needs, consisted of a single-piece, curved bone hook.

Hunting appears to have been a less significant method of procuring food than either shellfish collecting or fishing, though mammal bones were present in sufficient numbers to demonstrate that meat was a fairly regular dietary item. The favorite was venison, with sea otter meat becoming more popular in later times but never superseding deer flesh (Appendix C). Presumably, deer were killed with stone-tipped darts, hurled from a throwing board. How sea otter were captured remains unknown. Judging from the scarcity of their remains, small game animals were not hunted on any considerable scale. Bird flesh was also consumed in fair quantity for skeletal parts of various avian species were liberally sprinkled through the refuse. Most of the bones are those of migratory waterfowl, especially ducks and geese (Appendix D). Evidence as to how they were taken is lacking.

It is difficult to estimate the extent to which vegetable foods were gathered and eaten for vestiges of them were rarely met with during the excavation. Identifiable specimens, all charred, consisted entirely of acorns. Despite this near absence of direct evidence, it can be safely assumed that vegetal products formed staple articles of subsistence. Proof of the utilization of wild plant foods comes from the finding of a substantial number of mortars and pestles, implements essential for their preparation.

Conclusions and Interpretations

The West Berkeley shellmound culture, as illustrated by the archaeological findings, represents a meager mode of existence, preoccupied with food-getting and showing few outstanding technical achievements. That its fundamental pattern, once established, never radically altered is demonstrated by the stability of a sizable number of customs and classes of objects. Subsistence activities, heavily emphasizing shellfish collecting, remained constant. General utility implements and tools -- mortars, pestles, hammerstones, wedges, bone awls and the like -- continued in use with minimal, if any, shifts in form or relative abundance. Mortuary practices persisted and no change took place in the racial characteristics of the human population. Evidently, the last people to live on the midden were the cultural and physical descendants of its earliest residents.

Although the same manner of living carried over in essence, new practices and items came into vogue from time to time. Most of

the additions and substitutions seem trivial, such as the introduction of a new form of shell bead or the dropping of the habit of perforating charmstones. The only fundamental change was the abandonment of the use of net-sinkers, presupposing the giving up of an important fishing technique. Innovations did not appear suddenly and all together in a group, but in vertical distribution within the refuse deposit, and therefore, in time of introduction, they tend to cluster around the six-foot (below surface) level. This clustering of new traits allows for the recognition of two cultural components, one characteristic of the upper six feet of the shellmound and the other of the lower 12 feet (Table 10).

Table 10

Stratigraphic Distribution of Traits at West Berkeley

Lower 12 feet

Stemmed projectile points, contracting base
Stemmed projectile points, expanding base
Stemless projectile points, pointed base (?)
Knife blades, squared base
Unshaped mortars
Cylindrical mortars
Conical pestles (?)
Cobble pestles (?)
Net sinkers, notched and grooves
Perforated charmstones
Stone bars or pencils
Bird bone awls
Bone spatulas
Bone punches (?)
Ulna flaker, head intact
Bone pendants (?)
Spire-lopped *Olivella* beads
Rectangular *Olivella* beads
Rectangular abalone beads
Abalone pendants (all types)
Bird bone beads (?)
Canine teeth beads or pendants
Animal and bird interments
Oysters as important food

Upper 6 feet

Knife blades, pointed base
Knife blades, side-notched
"Paint" mortars
Nonperforated charmstones
Flakers, mammal rib bone
Bone daggers (?)
Bone pins (?)
Bird bone tubes (?)

Table 10: Stratigraphic Distribution of Traits at West Berkeley (cont'd.)

Upper 6 feet

Stone ear plugs	Bird bone whistles
Flakers, sea mammal tibia, head intact	Fish vertebrae beads
Flakers, mammal leg bone splinters	Circular *Olivella* beads
Flakers, sea mammal penis bone	Circular abalone beads
	Clams as important food
	Sea otter as important food

Throughout deposit

Flake and core scrapers	Antler flakers
Choppers	Antler wedges (?)
Semispherical mortars	Interment in village area
Cylindrical pestles	Flexed burial, no special orientation
Hammerstones	Rare grave offerings
Mammal bone awls (all classes)	Red ocher on burials
Flaker, deer or elk common bone, split head	Concentrations of stone
Notched scapulae	Undifferentiated hearths
Mammal rib tools	Mussels as important food
Split mammal bone tools	Deer as important food

The West Berkeley cultural remains rather closely resemble those left behind by other prehistoric bayshore dwellers. A comparison of the more significant classes of West Berkeley artifacts with those from Emeryville and Ellis Landing reveals that certain basic traits are common to all three shellmounds. Mortars and pestles represent the characteristic grinding implements; a developed bone industry is found; shell beads and pendants comprise the typical articles of personal adornment. Food habits and methods of disposing of the dead are alike.

Although essential cultural unity is evident, differences can be discerned. Some Emeryville and/or Ellis Landing items, including stone pipes, small projectile points, mica ornaments, charmstones with basal projections, fork-like bone or antler objects ("head scratchers"), eyed needles and entire abalone shells are absent at West Berkeley.

Others, for example, bone tubes, beads and whistles, are shared, but are present at West Berkeley in reduced numbers. A few groups of objects found in the three shellmounds differ in their stratigraphic distribution. Perforated charmstones came from the lowest Emeryville stratum; at West Berkeley they showed a wider occurrence, being absent only in the top-most six feet; their depth provenience for Ellis Landing is not stated. Nonperforated charmstones, confined to West Berkeley's higher cultural layer, were found scattered more or less throughout the other two middens.[1] Notched and girdled net-sinkers, unearthed in profusion below eight feet in the West Berkeley deposit, were virtually unknown at Emeryville. For Ellis Landing, stone weights were collected from the top and bottom of the refuse, being nonexistent in the middle part. Large, stemmed projectile points, the characteristic West Berkeley lower-stratum form, are not reported for Emeryville. One of four weapon tips from the shaft dug below water level at Ellis Landing is of this type; a second, smaller specimen, might be added. Finally, the West Berkeley assemblage includes a series of articles, all from deep down, which were absent in the other two shellheaps. Among them are chipped stone blades with squared bases, rectangular *Olivella* and *Haliotis* beads, circular abalone and other ornament forms.

These differences in content and stratigraphy permit an ordering of the cultural layers of the three shellmounds. On the basis of shared traits, the upper six feet of West Berkeley can be equated with the lower 10-14 feet of Emeryville and the bulk of Ellis Landing. The bottom 12 feet of West Berkeley, which produced items absent at the other two sites, has no direct counterpart though there is a possibility, based on the scanty evidence of a plentiful supply of net-sinkers and two stemmed projectiles, that the Ellis Landing's deepest stratum overlaps somewhat. Conversely, the higher portions of Emeryville and Ellis Landing contained materials not represented at West Berkeley. Thus, it appears West Berkeley appears to have been the first of the three localities to have seen human occupation with Ellis Landing inhabited next and Emeryville last. There may have been a brief period when all three were inhabited simultaneously. West Berkeley became deserted first while people continued to live at both Emeryville and Ellis Landing for a lengthy span of time.

At least nine additional San Francisco Bay shellmounds have produced materials analogous to these from the upper six feet of the West Berkeley midden (Beardsley 1954b: 100-102). The type of culture represented by the archaeological remains seems to have been widely distributed along the bay's shoreline. By contrast, only one local site, the University Village, near Palo Alto in San Mateo County, has yielded an assemblage comparable to that from West Berkeley's lower level (Gerow 1968). The projectile point traditions are equivalent and the mortar and pestle forms are much alike. Other duplications in stone objects include perforated charmstones, notched

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[1] No charmstones were recovered in the bottommost Ellis Landing layer. Their absence may be due to accident as the chance is slight that items of such comparative rarity would have been contained in the small sample.

sinkers, and chrysotile asbestos rods. The San Mateo County site's bone industry appears less developed because, although awls, flakers, notched scapulae, split and polished elk ribs, and wedges are present, they appear in greatly reduced numbers. Essential uniformity can be seen in the shell beads and ornaments from the two middens. As at West Berkeley, the University Village people interred their dead in a flexed posture, with few grave goods and a sprinkling of red ocher. Little doubt exists that the two assemblages are closely related and overlap in time. Back from the bayshore, the lowest occupational level of the Stone Valley settlement, at Alamo in Contra Costa County, contained a preponderance of stemmed projectiles and other articles compatible with those of West Berkeley (Fredrickson 1965:20). The Stone Valley burial position was exclusively flexed. Unfortunately, there was a virtual absence of shell beads and only a limited repertory of bone articles.

Cultural items from the deeper portion of West Berkeley show many correspondences to those obtained from Early horizon settlements in the lower Sacramento Valley (Heizer 1949a; Olsen and Wilson 1964). Besides shared specific forms, such as rectangular *Olivella* and *Haliotis* beads and circular shell ornaments, the West Berkeley weapon tips and knives, as a group, are like Early Sacramento specimens. Drilled charmstones, often phallic representations, are also held in common. These three groups of artifacts - shell beads and ornaments, projectile points and blades, and charmstones are regarded as important Early period diagnostics. Certain rare items, significant because of their uniqueness, such as bone fishhooks, asbestos-splinters, and bipointed bone objects, match Early forms. Other fundamentally similar, but less precise agreements, can be observed in bone spatulae, bird-bone awls, antler tines with cut bases, undrilled canid teeth ornaments, unmodified animal bones in graves, and the use of asphalt as an adhesive. Naturally, diversity in detail occurs, for culture identity hardly can be expected, even in localities so close geographically. The Sacramento Valley assemblage is much richer and some of its distinctive traits, like extended burials accompanied by quantities of grave goods and the employment of milling stones are wanting at West Berkeley. Conversely, bay net sinkers have no inland counterparts, though fishing must have been a major economic activity in the lower Sacramento Valley, and the abundance of mortars, pestles, and bone artifacts is not repeated. The two populations differ in physical features, with the Early Valley people exhibiting greater size and ruggedness than the bayshore dwellers.

The two West Berkeley components can be fitted into the temporal-cultural classification proposed for Central California (Beardsley 1948a:Table 1; 1954a:Table 1; Kroeber 1948:812; Heizer 1949a:33). The basic unit of this taxonomic scheme is the "component," the archaeological record of human habitation at a single locality at a specific time. Components which demonstrate strong cultural ties are grouped into a "facies." Related facies, in turn, are combined in a "phase" of a "horizon," the largest unit. Three of the latter, designated as Early, Middle, and Late, have been recognized.

Phases have been established for only the last of the three. The older West Berkeley materials can be considered as a component of a West Berkeley facies of the Early horizon (Table 11), not previously known for the San Francisco Bay area. It is somewhat differently conceived than the corresponding interior Windmiller facies. The University Village and Stone Valley assemblages also can be assigned to the West Berkeley grouping. A fourth component may have been present in the bottommost portion of the Ellis Landing shellmound.

The upper level or latest West Berkeley component falls in the Middle horizon but its assignment to a facies is not easy. It does not correlate too closely with either of the two facies, Ellis Landing and Patterson, established for the San Francisco Bay area. The Middle period, as now conceived, covers a long time span (ca. 2000 years) and represents a loose grouping of components scattered over practically the entire bay region. There are probably significant temporal subdivisions, or phases, which need to be worked out. Judging from the relatively minor amount of artifactual material attributable to the Middle horizon, the occupation at West Berkeley came early and lasted for only a few centuries. After its abandonment in early Middle times, it never again experienced aboriginal habitation. No typical Late period objects such as lightweight arrowpoints or clamshell disk beads turned up.[1] Why the prehistoric West Berkeleyans departed remains a mystery. Perhaps their shellfish supplies, the primary attraction for settlement, became depleted and they shifted to a more favorable spot.

Table 11

Cultural and Temporal Relationships

Horizon	Phase	Facies	Suggested Beginning Date
Late	II	Fernandez	A.D. 500
	I		
Middle		Emeryville	2500 B.C.
		Ellis Landing	
		Patterson	
Early		West Berkeley	?

[1] The clamshell bead attributed to West Berkeley by Beardsley (1948:17) came from another locality.

Absolute dates for the two West Berkeley components support their chronological placement. Eight wood charcoal samples and one of oyster shell were collected for radiocarbon analysis. Because no concentrations or large chunks of charcoal were encountered, scattered bits were gathered from each 12-inch level and combined to make a sample. The shell came from a lens. The material was sent to the University of Michigan Memorial-Phoenix Project Radiocarbon Laboratory. As it was not possible to run all of the samples, when submitted, two, both charcoal, from culturally significant layers were selected, one from near the deposit's base, and the other from just below the presumed cultural break. Age determinations by the carbon dioxide gas method were:

Sample No.	Depth in inches	C14 Date
M-121	96-108	2200 ± 400 B.P.
M-127	192-204	2700 ± 400 B.P.

Although in proper depth relationship, the dates did not accord with the expected age.

Later, the Michigan Laboratory re-ran more of the same two charcoal samples along with six additional ones. These analyses provided a series of dates which make sense. They are as follows (Crane 1956):

Sample No.	Depth in inches	C14 Date	
M-121	96-108	2700 ± 300 B.P.	745 B.C. ± 300
M-122	132-144	3210 ± 300 B.P.	1255 B.C. ± 300
M-123	144-156	2880 ± 300 B.P.	925 B.C. ± 300
M-124	156-168	3500 ± 300 B.P.	1545 B.C. ± 300
M-125	156-168	3700 ± 350 B.P.	1745 B.C. ± 350
	156-168	3860 ± 450 B.P.	1905 B.C. ± 450
M-126	180-192	3140 ± 450 B.P.	1485 B.C. ± 300
M-127	192-204	3700 ± 300 B.P.	1745 B.C. ± 300

Six of the series fall into a more or less consistent and orderly sequence; two (M-122 and M-126) do not. The anomalous dates can be regarded as "archaeologically unacceptable" and disregarded. Most securely fixed in time is the 156-168 inch level for which there are three C14 determinations, all falling within a reasonable range.

The radiocarbon dates suggest that West Berkeley's occupation began prior to 2000 B.C. Three of the lower level determinations fall near 1800 B.C. Several hundred years must be added to this figure to allow for the accumulation of the basal 12-inch level, which contained

only a minute amount of charcoal, insufficient for dating purposes. The habitation period covered by the series of C14 dates is approximately 1000 years. More centuries need to be granted for the buildup of the upper eight feet of the refuse, giving a total time span of perhaps 1300-1500 years.

West Berkeley radiocarbon dates correspond reasonably well with those obtained for sites of comparable cultural content. The earliest determinations fall close to those of Blossom (CA-SJo-68), an Early horizon site in the lower Sacramento Valley (Heizer 1958). University Village has two younger dates, 2700 ± 350 and 3150 ± 300 years, and Stone Valley one, 4450 ± 400 years (Fredrickson 1965:20). The West Berkeley 2700 ± 300 determination for the 96-108 inch level is also of a degree of magnitude expectable on the basis of cultural comparison. It comes from below the line of assumed stratigraphic separation, with materials above ascribed to the Middle horizon. This is in general agreement with two C14 dates available for Middle occupation zones at bayshore sites. Charcoal from a component of the Patterson Mound, assigned to the Ellis Landing facies, yielded an age of 2588 ± 200 and 2090 ± 220. A sample of charcoal and oyster shell from near the base of Emeryville has been dated at 2310 ± 120 years ago (Hubbs, Bien and Suess 1962:208).

As a concluding statement, it can be said that the West Berkeley shellmound proved to be of unusual significance to the understanding of San Francisco Bay's prehistoric past. Not only has the midden's excavation enriched the archaeological record with a considerable body of substantive data, but, more importantly, it extends knowledge of man's presence in the bay region farther back in time by providing the first clear-cut evidences of Early Horizon occupation, hitherto recognized only at inland localities. Major and minor differences in detail distinguish the bayshore Early manifestation from its interior counterpart, though there can be little doubt of their generic affinities. The shellmound exploration also demonstrated cultural dynamics for the San Francisco Bay area in a firmer way than previously, proof being based on cultural stratigraphy in a refuse deposit of relatively great depth. The archaeological findings make it clear that change came slowly and was unspectacular. No vital alteration in the mode of existence was accomplished during the lengthy habitation period and the last West Berkeleyans lived in much the same fashion as the site's earliest settlers.

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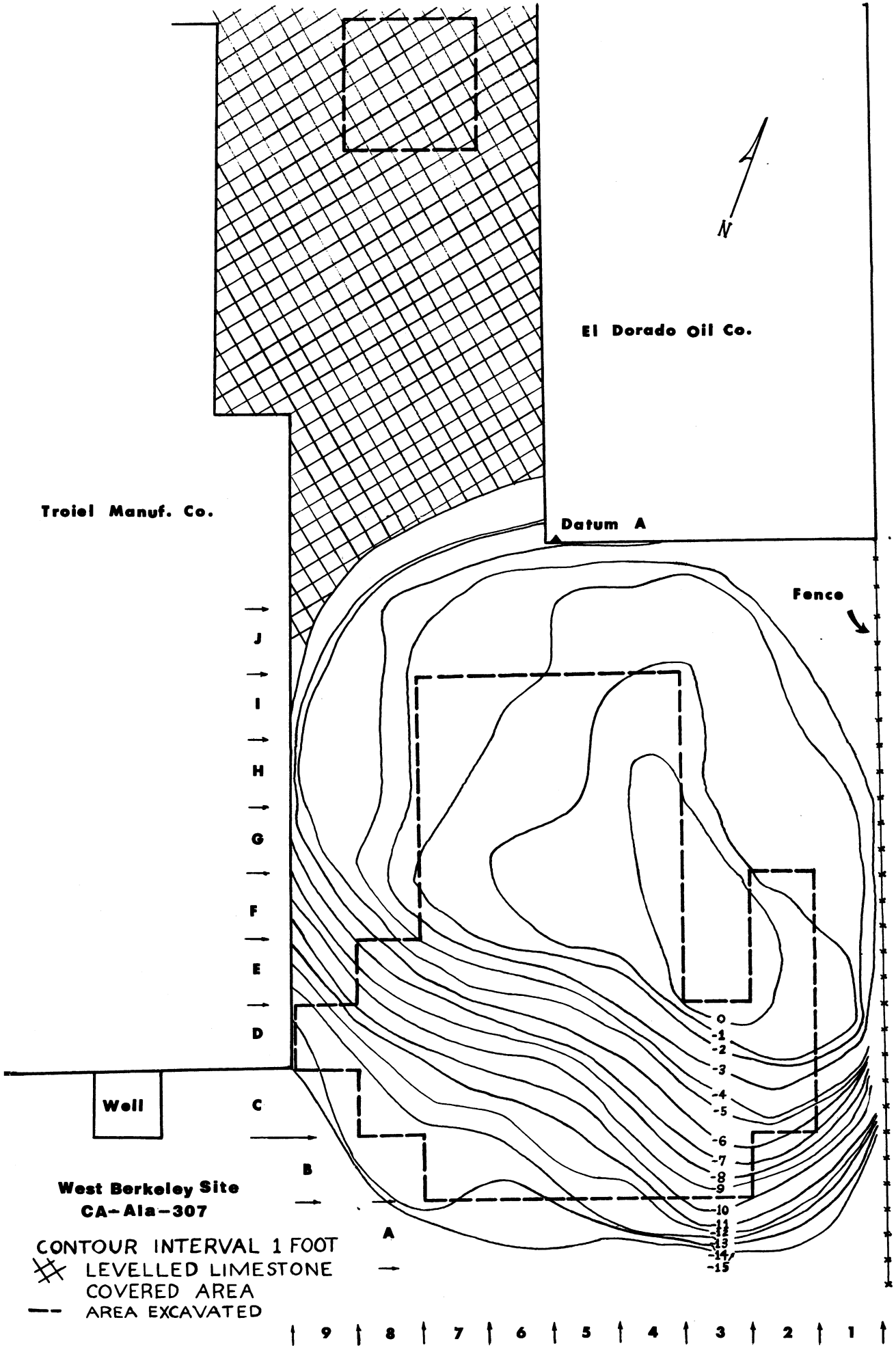
ILLUSTRATIONS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West Berkeley Site
CA-Ala-307
CONTOUR INTERVAL 1 FOOT
LEVELLED LIMESTONE COVERED AREA
AREA EXCAVATED
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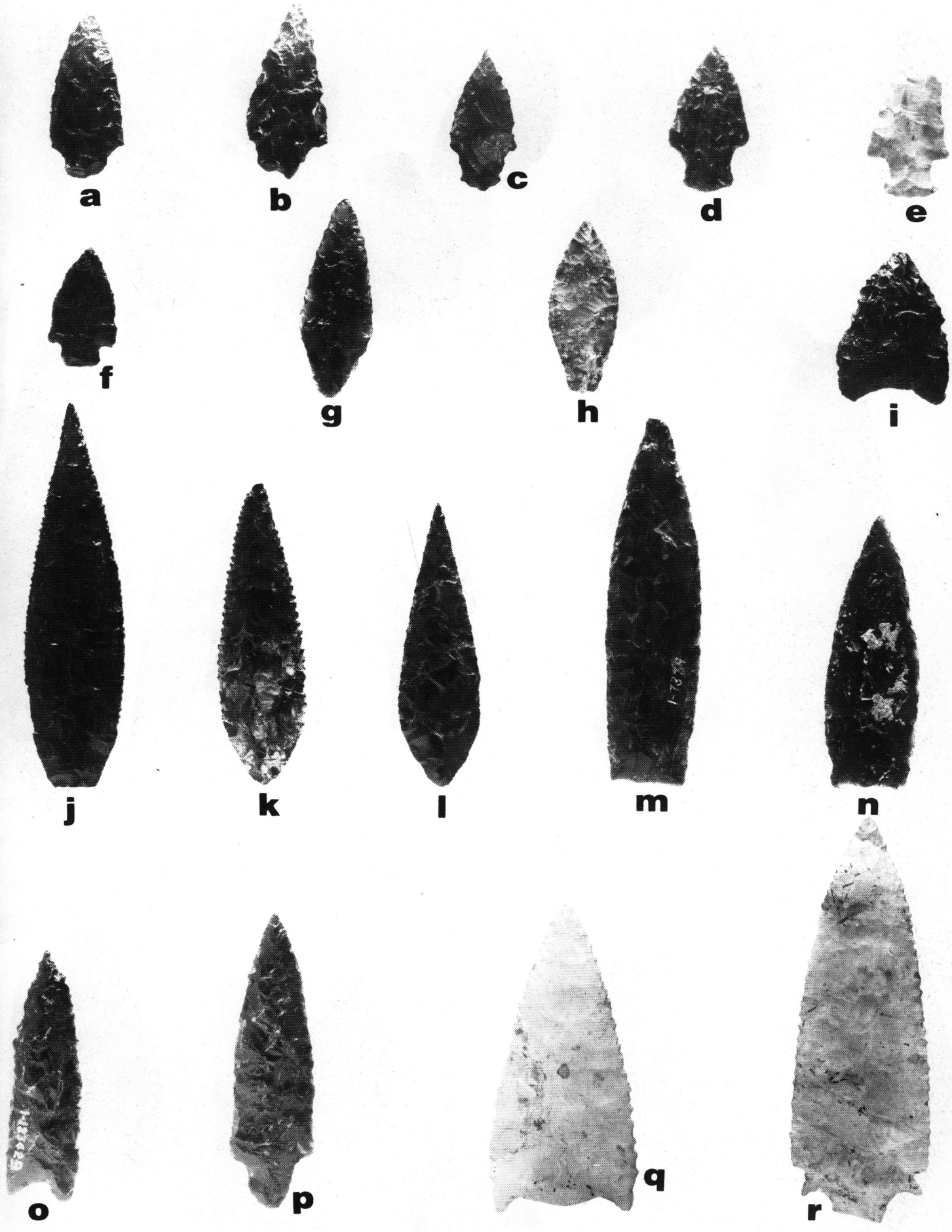
PLATE 1

PLATE 2



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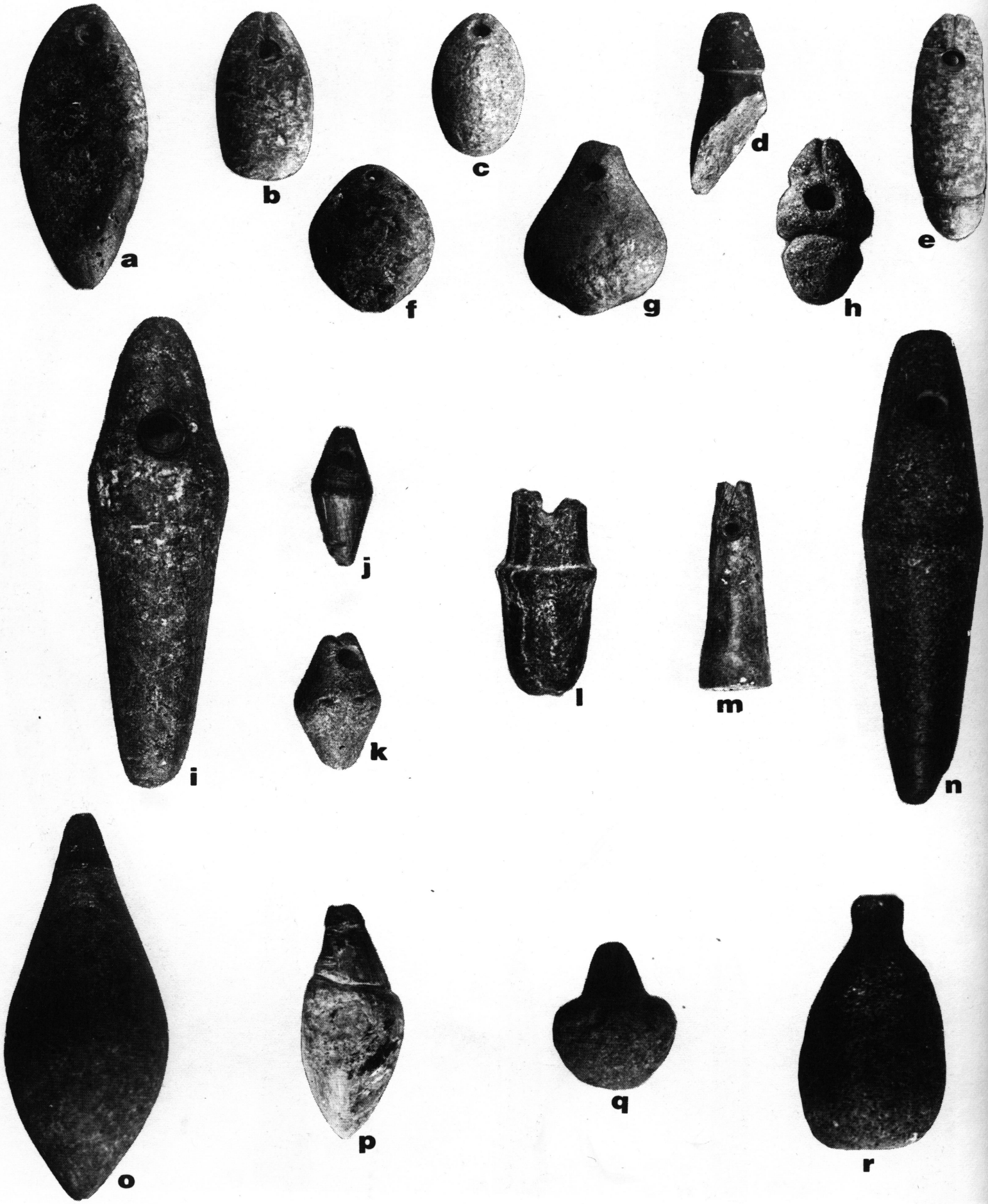

PLATE 4

PLATE 5

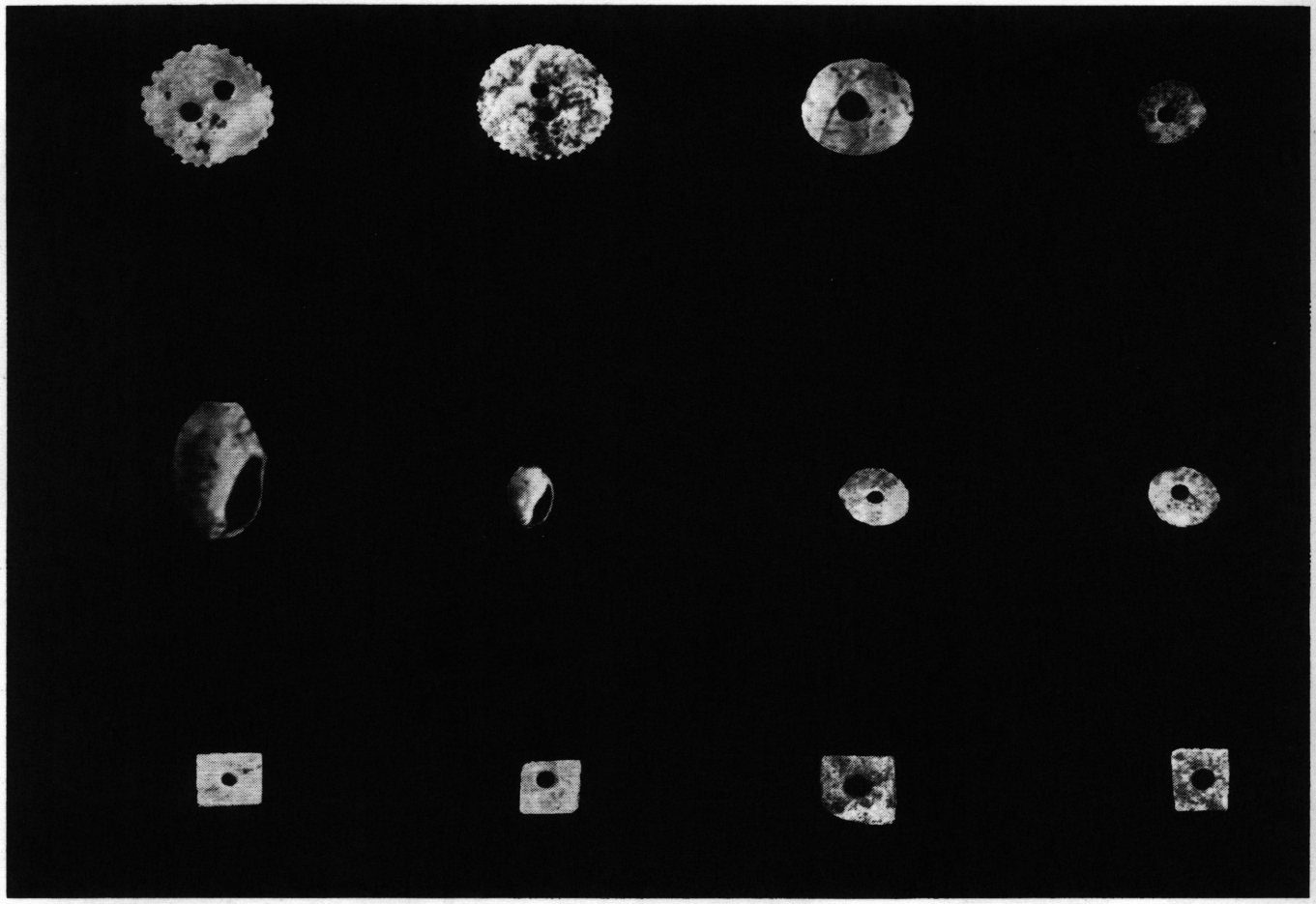

PLATE 6

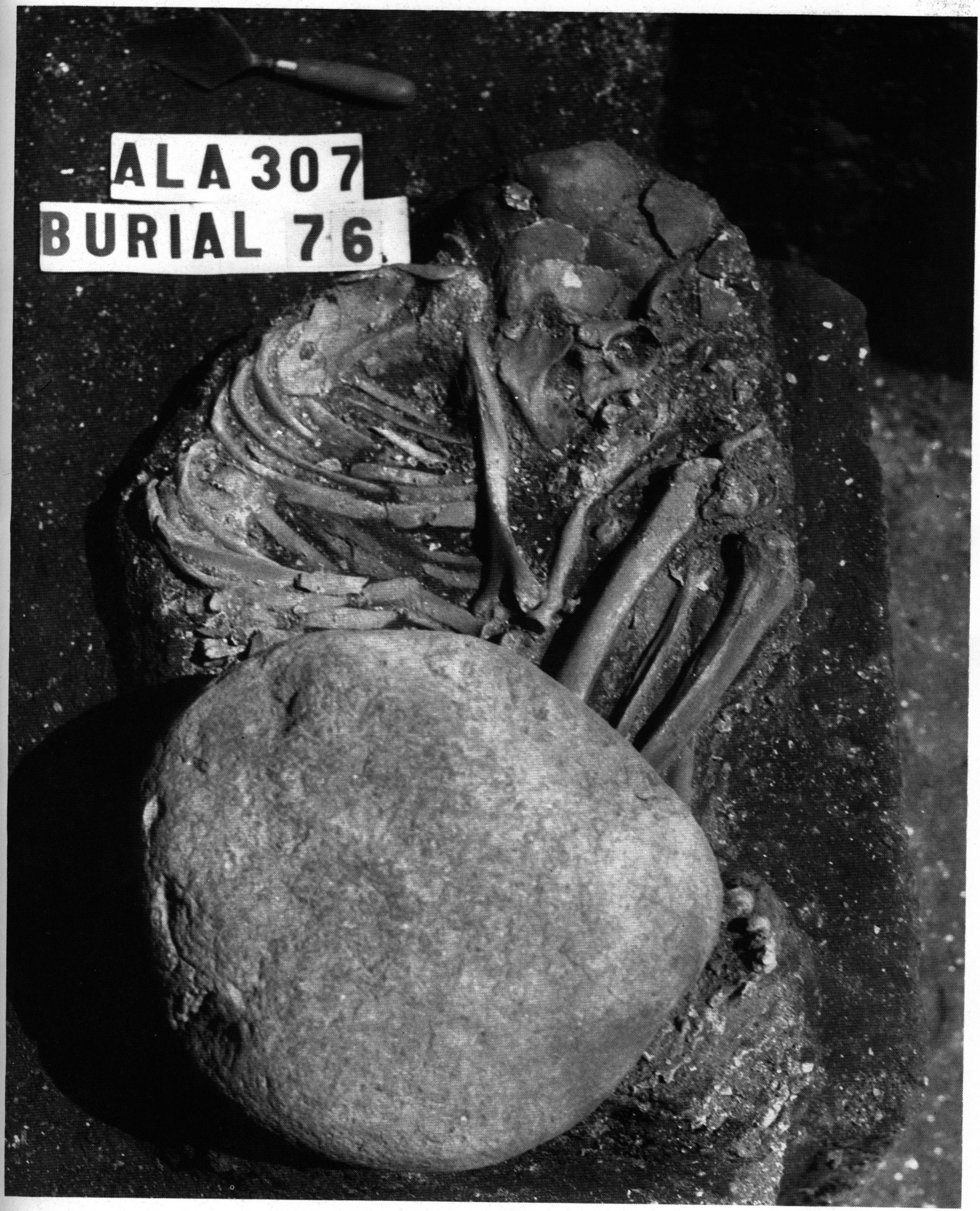

PLATE 7

Appendix A

SHELLFISH

Robert E. Greengo

Molluscan remains were an important constituent of all levels of the refuse deposit, though there was a noticeable decline in the proportion of shell as the bottom of the mound was approached. No attempt was made, of course, to collect all shell, but while the excavation was in progress two one foot column samples were obtained. One of these has been analyzed. In addition, all examples of rare or unusual shells were kept. The following species were represented:

Clams

Clinocardium nuttalli (Basket or Heart Cockle)
Macoma nasuta (Bent-nosed Clam)
Pholas pacifica (Pacific Piddock)
Protothaca staminea (Rock Clam)

Mussels

Mytilus edulis (Bay Mussel)
Mytilus californianus (Sea or California Mussel)

Oysters

Ostrea lurida (West Coast Oyster)

Snails

Littorina scutulata (Checkered Periwinkle)
Odostomia sp.
Cerithidea californica (California Horn Shell)
Olivella biplicata (Purple Olive)
Thais lamellosa (Wrinkled Thais)

Abalone

Haliotis rufescens (Red Abalone)
Haliotis cracherodii (Black Abalone)

Limpets

Acmaea sp.

Miscellaneous

Balanus sp. (Barnacle sp.)
Crab
Land snail

The column sample was analyzed primarily to determine the percentage of shell to other midden components. Interest in the significance of proportions of constituents in Californian shellmounds, especially mollusks, was first shown by E.W. Gifford, over 45 years ago (Gifford 1916). Among the soil samples analyzed at that time, eight came from West Berkeley. These had been collected years earlier by Furlong and Peterson.

Results of the 1916 analysis differ from those presented here, and an exposition of the sampling and analytical procedures will, in a large measure, explain the differences. The locality of the samples used by Gifford is not known; he states that they were not taken in the same vertical plane and that the depths ranged unevenly down to 12 feet from the surface. Those obtained in 1950 were all in the same vertical plane, and in successive one foot depths down to the bottom of the mound, 17 feet from the surface. In each case the sampling areas selected contained no unusual features and were regarded as "typical" of their respective sections of the midden. Wide variation in size of the 1916 samples must be noted, from 31.5 to 832.9 gm., with an average of 119.1 gm. For the present analysis, 500 gm. from each one foot level was sorted. The analysis techniques were essentially similar.1

The 500 gm. sample from each level was washed through a 1/8 inch (2 mm.) screen and then air dried. Material held by the screen was next sorted into bone, stone, and shell, the last being subdivided according to species. Mostly it was soil that went through the sieve, together with very small bones and shell fragments, and this was considered residue. After each component and species had been segregated and dried, it was weighed. The total weight of components and species from each level (exclusive of residue) was subtracted from 500 gm. thus giving a figure for the residue. Five hundred grams was taken as 100 percent of each level sample and the weights of the components and species were converted into percentage proportions of that figure.

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[1] Greengo (1951) presents a detailed discussion of the quantitative analyses of midden constituents and related problems.

Gifford found that his samples averaged 52.53 percent shell, 23.76 percent ash, 4.9 percent stone, and 18.51 percent residue (Gifford 1916:15). In the 1950 analysis, ash--what there was of it--was lumped with residue, and the following percentages were obtained: 23.1 percent shell, 7.8 percent stone, and 69.0 percent residue. (See Table 2). Due to the variables involved and lack of information on the earlier samples, it cannot be certain that the differences in proportions represent variability in mound composition or merely differences in sampling techniques. At any rate, the trends reflected by Gifford's analysis are of the same order as those presented here, a fact which serves to corroborate the results of the independent findings.

Of the 23.1 percent shell contents analyzed, only three species out of ten in the sample were represented in proportions large enough to be significant, the bay mussel (*Mytilus edulis*), the West Coast oyster (*Ostrea lurida*), and a mud clam (*Macoma nasuta*). Of the rest, a small species of barnacle (*Balanus sp.*) was the only kind exceeding one percent.

The California shellmound dwellers apparently exploited the shores near their village sites to the fullest possible extent, ignoring no species occurring in sufficient size and quantity. The middens, then, fairly accurately reflect the molluscan population of adjacent waters. This does not necessarily mean that all species represented in the sites were eaten. For example, the small barnacle, constituting 4 percent of the 1950 samples and 2 percent of Gifford's samples, was probably carried in fortuitously with larger shellfish. It was almost certainly not economically feasible to pick out the small crustaceans when other forms of food were available.

Both the present data and Gifford's indicate that a shift took place in species content from bottom to top in the West Berkeley mound. Involved were two species, *Macoma nasuta*, a mud-flat inhabitant, and *Ostrea lurida*, an oyster favoring a gravel bottom or a bed of its own shells. The environmental niches of these two invertebrates are all but mutually exclusive. That is not to say, however, that an oyster bar and a mud flat cannot be found in close proximity to one another.

In the lower portion of the midden *Ostrea* constituted almost one-half of the shell content, to the virtual exclusion of *Macoma*. At the top, however, the latter exceeded *Ostrea* by over 26 percent. This is interpreted to mean that ecological conditions of the nearby shore were seriously modified during the shellmound's occupation. While the first 11 feet of midden was accumulating, gravelly bottom conditions are indicated, and this agrees with the fact that the site rests on alluvial outwash from the Berkeley Hills. On the other hand, from the top to a depth of six feet the predominance of *Macoma* over the oyster points to mud flats. Again, this is in line with observable conditions in the vicinity of the mouth of Strawberry Creek (Louderback 1939:788).

One additional fact should be brought out. *Mytilus* varies relatively less than the other two species, and maintains a constantly high proportion. It is well known that this mussel requires a gravel or rock bottom, a fact which would seem to conflict with the muddy condition indicated by the predominance of *Macoma* in the upper six feet. It can be deduced that, although *Mytilus* was undoubtedly covered by the apparently sudden sedimentation of silt which drastically reduced the oyster beds, mussels were sufficiently vigorous to recover, whereas the more delicately adjusted oysters were destroyed. The sedimentary history of the bay apparently fluctuated between relatively greater accumulations of silt brought down from the Interior Valley drainage system and the heavier gravel alluvium from the slopes bordering the bay (Louderback 1939; Sumner et al. 1914). At West Berkeley the supply of gravel supposedly remained constant enough and the reproductive capacity of mussels great enough for them to maintain a dominant position during the entire period of occupation. The mussels may have been attached to rocks or rock ledges, not covered by sediment.

A comparison with two other sites, Emeryville and Ellis Landing, is pertinent here. Gifford's analysis of the constituents of the Emeryville shellmound shows that shell represented almost 60 percent of the samples obtained. This figure may be somewhat high, for it is very similar to his shell proportion for West Berkeley (52.53 percent) as against the mere 23.1 percent found in later samples. The Emeryville findings also point to a shift in the molluscan complex, similar to that at West Berkeley. Again this variation occurs between oysters and clams, this time at a depth of 19.5 feet. Mussels remain relatively constant. Thus on the basis of analysis of shell remains it is possible to postulate contemporaneity of the upper six feet of the West Berkeley mound with the topmost 19.5 feet at Emeryville.

For Ellis Landing, Gifford found the shell content to be 69.43 percent. Of this, *Mytilus edulis* averaged 35 percent and *Macoma nasuta* 36 percent. However, concentrations of these two species varied considerably with depth. The site was 29 feet deep, but soil samples were obtained from the upper 17 feet only. Gifford's data show that below 10 feet *Macoma* occurred in minor proportions, whereas above that mark it attained a much higher percentage, exceeding that of *Mytilus* in three samples. Here, *Ostrea lurida* did not occur in significant quantities and the variability is expressed between mussels and clams. Although no exact figures exist for the lowermost levels of the midden, a good bit of which lay below the high tide line, Nelson states that it was composed almost exclusively of mussel shells, "and it is only in the upper eight feet that the clam shells become at all plentiful" (Nelson 1910:376). This agrees substantially with Gifford's findings.

At all three middens, variations of the molluscan fauna seem to reflect a shift from a gravel-bottom species to a mud clam during the accumulation of the refuse. Certainly these data indicate silting in of the bay, but they need not necessarily mean that this impact

was felt everywhere at the same time. Fluctuations in the rate of sedimentation are known to exist.

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Appendix B

FISH REMAINS FROM THE WEST BERKELEY SHELLMOUND (CA-Ala-307), ALAMEDA COUNTY, CALIFORNIA

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Introduction

This is a report on a collection of fish remains recovered from the West Berkeley Shellmound (CA-Ala-307) by William J. Wallace and his associates of the University of California Archaeological Survey, under the general supervision of Robert F. Heizer, Director. The collection was obtained during 1950 from the two deepest trenches excavated in the last intact portions of the shellmound.

The West Berkeley site was a habitation shellmound at what is now the junction of Second Street and Hearst Avenue in the city of Berkeley, Alameda County, California. The site is a few meters from the north bank of Strawberry Creek near its mouth at San Francisco Bay.

The mound was excavated in 18 twelve-inch levels, the deepest level extending from 204 to 216 inches (see Table 1). Seven radiocarbon determinations based on charcoal recovered from the 96"-108" level downward to the 192"-204" level of the West Berkeley shellmound indicated a minimum age of 2200 $\pm$ 400 years and a maximum age of 3860 $\pm$ 450 years before the present (see Crane 1956:669). (To conform to a radiocarbon half-life of 5730 $\pm$ 40 years--accepted as most probable at the Fifth Radiocarbon Dating Conference, Cambridge, England, 1962--these dates should be multiplied by a factor of 1.03 (see Ralph and Michael 1974:554) and would then stand as 2260 and 3970 years, respectively.)

When first observed by the white man, the western edge of the shellmound was probably only a few meters from the high-tide line of San Francisco Bay. According to a handwritten note, presumably added by N.C. Nelson to a map of the West Berkeley shellmound (Peterson 1904), the mound was "3-4 ft. above high tide except SW. close to creek. e.g. on S. of creek shell appears to go below tide level. N.C. N., 1910." However, a rise of sea level relative to land, amounting to 1.5 $\pm$ 0.5 mm. per year in San Francisco Bay since about 6000 years before the present, which resulted in part from the melting of glacial ice, suggests that 3000 years ago sea level off West Berkeley may have been at least 3 m. lower than at present and that therefore the reach

of the highest tides may have been at a considerable distance--perhaps several hundred meters--from the shellmound (Brian F. Atwater 1975 personal communication). Perhaps the site was originally established at such a distance from the bay because an adjacent part of Strawberry Creek provided permanent water during periods of drought.

Among nearby archaeological sites were the Ellis Landing shellmound (CA-CCo-295), about 7.2 km. (4.5 mi.) northward (see Nelson 1910); the Stege mounds at Richmond (including CA-CCo-300), about 5.6 km. (3.5 mi.) northward (see Loud 1924); and the Emeryville shellmound (CA-Ala-309), about 3.2 km. (2 mi.) southward (see Uhle 1907; Schenck 1926).

The present report is a revision of the unpublished manuscript cited by Follett (1957:70; 1963a:309; 1964:35) as "Follett, W.I. 1954. Fishes. In 'The Archaeology of West Berkeley Shellmound.' MS. California Academy of Sciences, San Francisco."

The geographical setting, ecology, excavation, and archaeology of the West Berkeley site are described by Wallace and Lathrap (this volume).

Osteological terminology follows that adopted by Tatarko (1936) and by Weitzman (1962).

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Fishes represented

The collection comprises 338 fish remains (many incomplete or fragmentary). Of these, 186 are identified to species (some doubtfully),

124 only to genus, and 28 only to family. Eleven species, referable to 9 genera and 8 families, are represented:

Thresher Sharks--Alopiidae

Thresher shark, *Alopias vulpinus* (Bonnaterre)

Smoothhound Sharks--Triakidae

Leopard shark, *Triakis semifasciata* Girard

Eagle Rays--Myliobatidae

Bat ray, *Myliobatis californica* Gill

Sturgeons--Acipenseridae

White sturgeon, *Acipenser transmontanus* Richardson
Green Sturgeon, *Acipenser medirostris* Ayres

Salmons--Salmonidae

King (chinook) salmon, *Oncorhynchus tshawytscha* (Walbaum)
Silver (coho) salmon, *Oncorhynchus kisutch* (Walbaum)

Silversides--Atherinidae

Jacksmelt, *Atherinopsis californiensis* Girard

Surfperches--Embiotocidae

Redtail surfperch, *Amphistichus rhodoterus* (Agassiz)
Black perch, *Embiotoca jacksoni* Agassiz

Toadfishes--Batrachoididae

Plainfin midshipman, *Porichthys notatus* Girard

Thresher shark

The thresher shark (see Bigelow and Schroeder 1948:Figs. 27-28) is considered an excellent food fish (Cannon 1964:176). Most of those seen in California waters are from 2.1 to 2.4 m. (7 to 8 ft.) in total length (Roedel and Ripley 1950:47), but one netted off Newport Beach, Orange Co., was about 5.5 m. (18 ft.) in total length and 272 kg. (600 lb.) in estimated weight (Joseph 1954).

Material: 3 vertebral centra, 5.8 to 6.2 mm. in length and 16.2 to 16.6 mm. in diameter (one shown in Pl. 2a), presumably from the same individual, a shark about 160 cm. (63 in.) in total length and perhaps 9 kg. (20 lb.) in weight. The center of each had been reamed out to a diameter of approximately 3.5 mm. They appear to be 3 of the 15 regarded by Wallace and Lathrap (this volume) as probably fish-vertebrae beads; the remaining 12 have not been available for

examination. There may have been more of these beads than were recovered: this exceedingly long-tailed shark has approximately 120 precaudal vertebrae of more or less uniform size, as well as 240 or more caudal vertebrae diminishing in size posteriorly to small granules (see Springer and Garrick 1964:84).

I have found no record of this species from other archaeological sites.

Leopard shark

The leopard shark (see Schott 1964:Figs. 1-6) is considered an exceptionally fine food fish (Cannon 1964:180). It may attain a total length of about 200 cm. (6.5 ft.) and a weight of about 32 kg. (70 lb.) (Fitch 1972:105). It is abundant in San Francisco Bay (Herald and Ripley 1951:317).

Material: 7 vertebral centra, the largest, 18.8 mm. long, representing a leopard shark perhaps about 175 cm. (5.75 ft.) in total length. (These centra are identified from radiographs.)

For a photograph of a vertebral centrum of a leopard shark, see Follett 1957:Fig.1a.

Records from other archaeological sites: Arroyo Sequit, Los Angeles Co. (Follett 1963b:114); Century Ranch, Los Angeles Co. (Follett 1963a:300; 1968b:133); Chumash village site CA-Ven-87, Ventura Co. (Fitch 1975); Conejo Rock Shelter, Ventura Co. (Follett 1965b:82); Corona del Mar, Orange Co. (Fitch 1967:187); Diablo Cove, San Luis Obispo Co. (Fitch 1972:105, 120); Estero de Limantour, Marin Co. (Follett 1964:32); Irvine, Orange Co. (Follett 1966:190); Kodani site, Monterey Co. (Follett 1972:3); Shelter Hill, Marin Co. (Follett 1974:146); Shisholop, Ventura Co. (Fitch 1969:61; Greenwood and Browne 1969:47); Stege mounds, Contra Costa Co. (Loud 1924:359; Follett Appendix G this volume); Strawberry Point, Marin Co. (Follett 1957:68).

Bat ray

The bat ray (see Walford 1935:Fig. 56, as *Aetobatus californicus*) is edible, although its flesh emits an odor similar to that of iodoform, presumably acquired from the mud in which this ray forages for mollusks (Cf. Springer 1957:430-431, iodoform taste in certain shrimps). It may attain a width of 122 cm. (4 ft.) (Miller and Lea 1972:50) and a weight of 95 kg. (209 lb.) (Fitch 1972:109). Bat rays have been recorded from San Francisco Bay at all seasons of the year (Aplin 1967), but few, if any, are usually found there during the winter.

Material: 6 median dental-plate segments (one shown in Pl. 2b), 29 vertebral centra (one is partly charred; Univ. Calif. Lowie Mus. Anthro. No. 1-124405), and 2 caudal spines (one shown in Pl. 2c), representing bat rays to perhaps 45 kg. (100 lb.) in weight. On one of the caudal spines, the marginal teeth have been abraded (Pl. 2c), as if the spine had been used as an implement, perhaps as a punch for perforating mammal skins preparatory to lacing them together. (A "stingray spine . . . with barbs ground off," from the Emeryville shellmound, was noted by Gifford 1940:170.)

For a photograph of another aspect of a median dental-plate segment of a bat ray, see Follett (1957:Fig. 1b). The complete dentition has been figured by Garman (1913:Pl. 49, Figs. 4-6). For a detailed description of the caudal spine, or "sting," of the bat ray, see Halstead and Modglin (1950, as *Holorhinus californicus*).

Records from other archaeological sites: Arroyo Sequit, Los Angeles Co. (Follett 1963b:115); Belvedere, Marin Co. (Nelson 1909: Map 1; see Follett 1964:34); Burton Mound, Santa Barbara Co. (Harrington 1928:135); Century Ranch, Los Angeles Co. (Follett 1968b:134); Conejo Rock Shelter, Ventura Co. (Follett 1965b:83); Diablo Cove, San Luis Obispo Co. (Fitch 1972:109, 120); Ellis Landing, Contra Costa Co. (Nelson 1910:378); Emeryville, Alameda Co. (Schenck 1926:179; Gifford 1940:170); Irvine, Orange Co. (Follett 1966:190); Little Harbor site, Santa Catalina Island (Meighan 1959:402; see Fitch 1969:63); McClure site, Marin Co. (Beardsley 1954a:iii, 23-24; bat ray material identified by W.I. Follett); San Miguel Island (Heye 1921:110); Shelter Hill, Marin Co. (Follett 1974:146); Shisholop, Ventura Co. (Fitch 1969:63; Greenwood and Browne 1969:47); Strawberry Point, Marin Co. (Follett 1957:69); White Gulch, Marin Co. (Follett 1968a:3).

Sturgeons

Young individuals of the white sturgeon (see Pl. 1a) are among the finest of food fishes. In California, this species has been known to attain a total length of 3.8 m. (12.5 ft.) and a weight of 629 kg. (1,387 lb.) (not the same fish) (Fry 1973:34). It was formerly abundant in San Francisco Bay, and especially in San Pablo Bay (see Collins 1892:126, Pl. 6), whence it ascended the Sacramento and San Joaquin rivers.

Young individuals of the green sturgeon (see Pl. 1b) are fine food fish. This species has been said by Hart (1973:82) to attain a total length of 213 cm. (7 ft.) and a weight of 136 kg. (300 lb.). A specimen was taken off West Berkeley in about 3.7 m. (12 ft.) of water (Calif. Acad. Sci. No. 25737). Green sturgeon were less numerous than white sturgeon in the Berkeley area even before the turn of the century (Frank Spenger, Sr., 1964, personal communication).

The sturgeon remains do not appear sufficiently distinctive for

differentiating white sturgeon from green sturgeon. This uncertainty arises in part from the incomplete or fragmentary condition of many of the sturgeon remains, and in part from ontogenetic variation (the changes occurring with age and growth of the fish), as well as from the somewhat remarkable individual variation in a number of the skeletal elements of each of these species.

Material: 6 ceratobranchials, 4 ceratohyals, 10 clavicles (one shown in Pl. 3c), 11 cleithra, 5 dentaries, 11 frontals, 6 hyomandibulars, 1 maxillary, 4 palatines, 19 parasphenoid fragments, 7 parietals, 7 pectoral rays (one shown in Pl. 4c), 3 posttemporals (one shown in Pls. 5a and 5b), 3 pterotics, 8 pterygoids, 14 scutes (one shown in Pl. 4a, one in 4b), 8 subopercles, 5 supracleithra, 1 supraoccipital, 1 ventral opercle, first (Pl. 3a), and 2 ventral opercles, second (one shown in Pl. 3b), representing either white sturgeon or green sturgeon, the largest perhaps 214 cm. (84 in.) in total length and perhaps 85 kg. (187 lb.) in weight.

Records from other archaeological sites: Blodgett site, Sacramento Co. (Schulz, in press); Brazil site CA-Sac-43, Sacramento Co. (Casteel 1975:284); Deterding site, Sacramento Co. (Schulz, Wagner, and Simons 1974); Miller Mound, Colusa Co. (Schulz and Essig 1973); Point St. George site, Del Norte Co. (Gould 1966:85; material identified February 1965 by W.I. Follett); Shelter Hill, Marin Co. (Follett 1974: 146); Stege mounds, Contra Costa Co. (Follett Appendix G, this volume); Stone Lake, Sacramento Co. (Schulz and Simons 1973:110); Strawberry Point, Marin Co. (Follett 1957:69).

King (chinook) salmon

The king (chinook, quinnat) salmon (see Hudson 1917:color Pl. facing p. 97) is an excellent food fish. It is known to attain a weight of 38.6 kg. (85 lb.) in California waters, but the average weight at spawning time is about 9 kg. (20 lb.) (Fry 1973:75).

Myriads of king salmon formerly passed through San Francisco Bay on their migration up the Sacramento or San Joaquin River, where the entire adult population died after spawning. The principal migration, known as the fall run, entered those rivers during August, September, and October; the spring run, during April, May, and June; but some king salmon probably occurred in San Francisco Bay at almost any time of the year (see Rutter 1903:121, 123).

Material: 1 articular and 1 angular (Pl. 5c), 1 cleithrum, 1 dentary, 1 haemal spine, and 50 vertebrae (the largest shown in Pl. 5d), representing king salmon up to about 15 kg. (33 lb.) in weight (estimated mean value, computed from vertebrae as by Casteel 1972) and therefore about 106 cm. (42 in.) in length (see Snyder 1931:Table 3).

All elements except the vertebrae are identified on the basis

of their sculpturing; the vertebrae, on the basis of the enlarged apertures adjoining the anterior and posterior rims.

Records from other archaeological sites: Alamo Creek site CA-Sol-35, Solano Co. (Casteel 1972:85); Bamert Cave, Amador Co. (Follett 1973:55); Blodgett site, Sacramento Co. (Schulz in press); Brazil site CA-Sac-43, Sacramento Co. (Casteel 1975:284); Clark Flat site CA-Cal-276, Calaveras Co. (Casteel 1972:99); Deer Creek Cave, Elko Co., Nevada (Follett 1965a); Deterding site, Sacramento Co. (Schulz, Wagner, and Simons 1974); Kawumkan Springs midden, Klamath Co., Oregon (Cressman 1956:481; material identified July 1950 by Carl L. Hubbs); Miller mound, Colusa Co. (Schulz and Essig 1973); Oroville Dam site CA-But-84, Butte Co. (Erskian 1968; material identified March 1968 by W.I. Follett); Point St. George site, Del Norte Co. (Gould 1966:85; material identified February 1965 by W.I. Follett); Sheep Island site, Benton Co., Washington (Osborne, Bryan, and Crabtree 1961:293); Shelter Hill, Marin Co. (Follett 1974:146); Stone Lake site, Sacramento Co. (Schulz and Simons 1973:110).

Silver (coho) salmon

The silver (coho) salmon (see Fry 1973:Fig., p. 70) is an excellent food fish. It is known to attain a weight of 10 kg. (22 lb.) in California waters, but the average weight at spawning time is 3.2 to 5.4 kg. (7 to 12 lb.) and individuals over 6.8 kg. (15 lb.) are uncommon (Fry 1973:70).

This salmon spawns in the smaller coastal streams from the northern part of Monterey Bay northward; in general, the period from October into February covers its time of migration and spawning in most California streams (Fry 1973:71-72).

Material: 6 vertebrae, tentatively identified as those of silver salmon from about 2.9 to 5.4 kg. (6.4 to 12 lb.) in weight (estimated mean value, computed as by Casteel 1972).

Records from other archaeological sites: Point St. George site, Del Norte Co. (Gould 1966:85; material identified February 1965 by W.I. Follett).

Salmon (presumably king or silver)

Material: 1 basipterygium (pelvic fin base), 11 fin rays, 2 hypurals, 6 neural (or haemal) spines, 1 rib, 7 vertebrae.

Records from other archaeological sites: Alamo Creek site CA-Sol-35, Solano Co. (Casteel 1972:85, *Oncorhynchus* sp.); Clark Flat site CA-Cal-276, Calaveras Co. (Casteel 1972:99, *Oncorhynchus* sp.).

Jacksmelt

The jacksmelt (see Walford 1931:Fig. 45) is good eating. It is known to attain a total length of 44.5 cm. (17.5 in.) (Miller and Lea 1972:82). It occurs throughout the year in San Francisco Bay (Aplin 1967).

Material: 50 vertebrae (many nearly complete), presumably representing 1 individual, a fish about 35.5 cm. (14 in.) in total length.

The count of 50 (the hypural is lacking) is strongly suggestive of *Atherinopsis* rather than of *Atherinops* (see Clothier 1950:49). In 10 specimens of *Atherinops affinis* from San Francisco Bay (Calif. Acad. Sci. No. 25367), the vertebrae, including the hypural, number 45 to 49.

Records from other archaeological sites: Shelter Hill, Marin Co. (Follett 1974:146); Shisholop, Ventura Co. (Fitch 1969:64).

Redtail surfperch

The redtail surfperch (see Haw and Buckley 1972:Fig. 16, bottom) is a fair food fish. It is known to attain a total length of about 40.5 cm. (16 in.) (Miller and Lea 1972:160). It is abundant in San Francisco Bay during late winter.

Material: 14 vertebrae, presumably representing 1 individual, a fish about 30.5 cm. (12 in.) in total length.

Records from other archaeological sites: Point St. George site, Del Norte Co. (Gould 1966:85; material identified February 1965 by W.I. Follett); Shelter Hill, Marin Co. (Follett 1974:147); Strawberry Point, Marin Co. (Follett 1957:68).

Black perch

The black perch (see Tarp 1952:Fig. 24) is a fair food fish. It is abundant throughout the year in San Francisco Bay, especially near rocky areas.

Material: 1 precaudal vertebra (doubtfully referred to this species), representing a fish about 28 cm. (11 in.) in total length.

Records from other archaeological sites: Chumash village site CA-Ven-87, Ventura Co. (Fitch 1975); Estero de Limantour, Marin Co. (Follett 1964:33); Limantour Spit site CA-Mrn-16 (Henn 1970:203); Shelter Hill, Marin Co. (Follett 1974:147); Shisholop, Ventura Co.

(Fitch 1969:66); Strawberry Point, Marin Co. (Follett 1957:68).

Surfperch (identified only to family)

Material: 1 postcleithrum.

Plainfin midshipman

The plainfin midshipman (see Arora 1948:Pl. 1, Fig. 1) is not generally used as food, but Ricketts and Calvin (1968:273-274) and Cannon (1964:312) note its edibility.

This fish, usually found in moderately deep water during most of the year, enters the intertidal zone to breed during late spring and early summer (Arora 1948:90). It is abundant in certain shallow rocky areas of San Francisco Bay during June.

Material: 1 precaudal vertebra, representing a fish about 23 cm. (9 in.) in total length.

Records from other archaeological sites: Diablo Cove, San Luis Obispo Co. (Fitch 1972:103, 120); Shisholop, Ventura Co. (Fitch 1969:68).

Discussion

Some of the material that appears referable to silver salmon may represent fish that were taken either in San Francisco Bay or in Strawberry Creek on their spawning migration from the sea. The occurrence of salmon in Strawberry Creek under primitive conditions is suggested by historic reports of salmon in nearby Temescal Creek, a similar stream (see Louderback 1940:788). Schenck (1926:156) noted that "within the memory of men living nearby, it [Temescal Creek] has had salmon runs. And Mr. P.E. Bowles informs me that in the early 1800's it was a favorite resort for amateur fishermen." (Since the term "salmon" was formerly applied somewhat indiscriminately to the larger migratory salmonids of central California, these fish may have been either silver salmon or steelhead trout, *Salmo gairdneri* Richardson.) Runs of silver salmon and steelhead trout in San Leandro Creek, another Alameda County tributary of San Francisco Bay, "in the early days" were reported by Fish and Game Warden George Smalley, who had spent about 30 years in the region of that creek (Willis A. Evans 1957, personal communication). The occurrence of silver salmon in San Anselmo Creek, a Marin County tributary of San Francisco Bay, was noted by Fry (1936:68). Presumably,

therefore, both silver salmon and steelhead trout occurred in Strawberry Creek as well as in Temescal Creek in aboriginal times.

That so few silver salmon are represented in this collection may result from a shift from salmon to suddenly plentiful winter-visitant ducks as a source of food. As noted by Richard H. Brooks (Appendix D, this volume), most of the bird remains in this collection were those of migratory ducks and geese. Howard (1929:341) observed that at Emeryville shellmound, "the anserines represent nearly two-thirds of all the bird bones identified in the mound" and that "over two-thirds of the anserine bones are of ducks." Even within historic time, myriads of migratory ducks--canvasbacks, scaups, scoters--visited San Francisco Bay from October to about April (see Grinnell and Miller 1944:81, 83-84, 89). The silver salmon, spawning from October into February (Fry 1973:72), could presumably have been caught in Strawberry Creek by the West Berkeley people had not the ducks provided a welcome change of fare. The same shift of interest to ducks might also explain the absence of any remains of steelhead trout in the West Berkeley material, since this trout may be expected in most California steelhead streams between December 3 and May 5 (Shapovalov and Taft 1954:117).

Fishing methods

There are significant indications that the West Berkeley people used watercraft: among the archaeological materials of this collection 2 grooved stones, weighing 1.2 kg. (2 lb. 9 oz.) and 2.8 kg. (6 lb. 3 oz.) are seemingly too large to have been sinkers and can probably be considered boat anchors (Wallace and Lathrap this volume). Numerous grooved or notched stones interpreted as sinkers suggest extensive use of nets--either gill nets or seines. Neither fishhooks nor spears appear to have been of importance.

Tule balsas

The watercraft of the West Berkeley people was presumably a tule balsa.

At San Francisco, the explorer Vancouver (1798:4-5) observed 3 Indians in a "canoe of the country...length...about ten feet, the breadth three or four...constructed of rushes and dried grass of a long broad leaf, made up into rolls the length of the canoe, the thickest in the middle, and regularly tapering to a point at each end. These are so disposed, that on their ends being secured and lashed together the vessel is formed, which being broadest in the middle, and coming to a point at each extremity, goes with either end foremost. These rolls are laid and fastened so close to each other, that in calm weather and smooth water I believe them to be tolerably dry, but they appeared to be very ill calculated to contend with wind and waves.

The wind now blew strong with heavy squalls from the s.w. and in the middle of this spacious inlet the sea broke with much force; notwithstanding which,...they crossed the inlet [Golden Gate?] for the purpose of catching fish, without seeming to entertain the least apprehension for their safety. They conducted their canoe or vessel by long double-bladed paddles, like those used by the Esquimaux."

Perhaps this observation by Vancouver had been overlooked by Hewes (1947:68), who reasoned, quite logically, that "the Costanoans had rather unseaworthy balsas, which would become unmanageable [in San Francisco Bay] in the often choppy waters exposed to the breezes coming through the Golden Gate."

A boat known as "wah lee" to the Costanos, "the tribes of Indians upon the Bay of San Francisco," was "a sort of raft made of 'tule,' or rush; the only boats used by these Indians" (Schoolcraft 1853:496, 506). Other writers who concurred in regarding the tule balsa as the only aboriginal watercraft of the San Francisco Bay region are Howard (1929:379), Beardsley (1948:6), and Heizer and Massey (1953:291).

Referring to the fishermen of the Stege mounds, Loud (1924: 363) concluded from their use of relatively heavy stone sinkers that they went well out into San Francisco Bay even where the current was strong. He wrote that those fishermen ventured out "with craft no more substantial than bundles of bulrushes." This may have referred to a simple type of tule balsa, perhaps similar to the craft figured by Choris (1822:Pl. 9; reproduced by Heizer and Massey 1953:Pl. 23; also as Pl. 6, below).

More elaborate aboriginal balsas (which may or may not have been in use during West Berkeley time) were observed by the Spaniard José de Cañizares during late August or early September 1775 near the western entrance to Carquinez Strait, about 38 km. (24 mi.), by water, from West Berkeley: "This camp has some rafts, or better let us say canoes, of tule so carefully wrought and woven that it aroused my admiration to examine their handiwork. In these, four men embark to go fishing, rowing with such agility that, as I observed, they moved faster than the [Spaniards'] launch" (cf. Cook 1957:136, 137). The same tule balsas mentioned by Cañizares may have been observed on 3 April 1776 and described in more detail by Pedro Font (who, according to Cook 1957:134), had an excellent opportunity to observe aboriginal methods of navigation and fishing): "[The Indians] had many [launches] very well made of tule, with railings, and with poop and prow ending in an elevated point, and all the rails equipped with arched poles as if they served as a balustrade or as a back, and with some small oars they rowed with great facility and lightness of touch..." (Bolton 1933:384).

Stone sinkers

At least 360 grooved or notched stones interpreted as net sinkers are recorded by Wallace and Lathrap (this volume) from the West Berkeley shellmound. (Some duplication may be involved among the 12 such stones recorded from West Berkeley by Peterson (1904; see below), the 3 by Beardsley (1954b:90), and the 360 by Wallace and Lathrap.) These stone sinkers were presumably attached to the lower edge of a net, which may have been either a gill net or a seine.

There is a stratigraphic difference in the abundance of the stone sinkers. Only 5% were recovered between the surface and 120" (and none from above 96"), but 94% were recovered between 120" and 204". (Two stone sinkers were recovered from the 204"-216" level, where no fish remains were found.) Similarly, there is a difference in the abundance of the sturgeon remains: only 35% were recovered from the 10 levels between the surface and 120", whereas 65% were recovered from the 7 levels between 120" and 204" (Table 1). But this collection was recovered only from the 2 deepest trenches excavated in the relatively small part of the shellmound that remained in 1950. Had there been more extensive archaeological work before the mound was so nearly destroyed, stone sinkers and numerous sturgeon remains might have been recovered from higher levels.

During 1904, 12 stone sinkers were recovered from near the northeast corner of the West Berkeley shellmound, which then covered an area of about 15x37 m. (50x120 ft.), at about the following depths: 36"-48" (2), 48"-66" (2), 66"-84" (1), 84"-108" (4), 108"-132" (3); the only fish material mentioned was "two very small bone needles... [which] crumbled on being handled and may have been fish bones" (see Peterson 1904).

In the Ellis Landing shellmound, which was about 30 feet deep, 50 grooved sinkers were found in the upper 4 or 5 feet of the deposit, and 12 others below the waterline (Nelson 1910:387-401). (The fish remains from that site have not been available for examination.)

In the larger of the Stege mounds, which was 9 feet deep, 527 stone sinkers were recovered (depths not stated) (Loud 1924:357). Beardsley (1954b:91) noted 601 grooved and notched stone sinkers from this site. The fish remains mentioned by Loud (1924:359) are discussed by Follett (Appendix G this volume).

In the Emeryville shellmound, which was 32 feet deep, only 4 net sinkers were found: a grooved stone at a depth of 5 feet and another in Stratum I, and 2 notched stones in the upper strata (Uhle 1907:10, 50-51, Figs. 20-22). Yet the fish remains, which I have examined, included abundant remains of sturgeons.

As stated by Beardsley (1954a:39), "The absence [of grooved or notched stone sinkers] postulated for Late levels has little or no bearing on the question of use of seine nets or set nets, since unworked stones can be--and in ethnographic times are stated to be--bound into nets as sinkers."

Gill nets

The West Berkeley people may have caught sturgeon with a gill net. Indians whom Font observed at Carquinez Strait in 1776 appeared to be using a gill net. Of this observation, Bolton (1933:371-372) wrote: "[The aboriginal launches] had been anchored near the shore with some stones for anchors, and in the middle of the water some Indians were fishing in one...I saw that they were fishing with nets and that they anchored the launch with some very long slim poles... I measured one and found it to be eleven and a half varas long [presumably "varas" refers to the Spanish vara--about 2.8 ft.], and by subtracting a good piece which remained out of water and above the launch in which the Indian fishermen were seated, I estimated that the water would be some nine or ten varas deep....Among other fish which they caught the Indians who were fishing pulled out two very large ones, about two varas long, and their method of catching them was this: as soon as they felt from the pull made by the fish that it was in the net, which was tied to the two poles, they began gradually to raise one of the poles, and as soon as the fish and the net came into sight, without taking it from the water they gave the fish many blows on the head...Now that it was dead and had lost its strength they took it from the net and put it inside the launch...I was not able to determine whether or not they were those called tollos [possibly sollos, a Spanish word for sturgeon; see Lozano Rey 1947:7], although from their form they appeared to be those, for they had a very large head, little eyes, small mouth like a tube which they puffed out and sucked in, the body having no scales, thick skin, and some spots like little stars and other figures, caused by some little bones which they had between the skin and the flesh. The flesh was very white, savory, and without spines and the bones were soft and spongy like tendons." From this description, the fish can be identified confidently as a species of sturgeon.

Font made no mention of the length or width of the net, nor of the size of its mesh, but his description of the manner in which it was used suggests that it was a gill net.

The West Berkeley people may also have caught king salmon with a gill net. A favorable area for this fishery would have been in San Francisco Bay 2.4 km. (1.5 mi.) or more offshore, westward of the shellmound. During 1889, salmon were taken by drift gill nets, principally during April and May, in San Francisco Bay, in an area extending more than 4 miles off West Berkeley from about Point Richmond nearly to Yerba Buena Island (see Collins 1892:126, Pl. 6). As recently as 1914, according to Frank Spenger, Sr. (1964, personal communication), "The salmon came into the Berkeley flats and off Ellis Landing. We would catch 2 or 3 on the average, up to 25 or 30 pounds. On high water there would be 5 or 6 feet of water on the flats. We driftnetted them in fall and spring off Berkeley dock in 12 feet at high water, 1 to 1½ miles out."

The thresher shark also may have been taken by gill net. There

is a record of 2 that were taken in salmon gill nets off McNears Point, San Pablo Bay (Roedel and Ripley 1950:47).

Seines

Some of the numerous stone sinkers may have been used on a seine. With a proper seine, the West Berkeley people could have caught the sturgeons, bat rays, leopard sharks, surfperches, jacksmelt, and midshipman. But whether in aboriginal time the bay bottom near West Berkeley was sufficiently firm to permit men on foot to pull a seine is a question that cannot well be answered without core sampling. A former area of hard bottom in San Francisco Bay off Fleming Point, some 2.1 km. (1.3 mi.) northward from West Berkeley, is indicated by Alden (1855). Furthermore, the following quotation, containing a suggestion of hard bottom near the Emeryville shellmound, may have applied as well, under primitive conditions, to the vicinity of the West Berkeley shellmound and Strawberry Creek mouth: "Low tide left a quarter of a mile of beach exposed. This was true even at the [Temescal] creek mouth. Hence boats or rafts could have been beached or brought into the safe port of the creek only at high water. Beyond the low tide line it was another mile before a man was over his head at low tide. Within the memory of nearby residents this was a fine clean beach of white sand containing shellfish" (Schenck 1926:157). Such a hard-bottom area may have permitted seining on foot during West Berkeley times if that area extended a sufficient distance offshore to be covered by 1 or 2 meters of water when relative sea level was lower. However, in an extensive area of the Berkeley flats, the soft bay bottom of recent decades would have rendered seining on foot impracticable. A man attempting to pull a seine in that area would soon become exhausted, since at each step his foot would sink deep into the substrate.

But in the shallow waters of the Berkeley flats, the fishermen may have hauled a seine from a pair of balsas, whether over hard or soft bottom. In shallow Lake Earl, Del Norte County, "long, narrow nets were employed, being hauled, usually by a pair of canoes, in such a manner as to encircle and impound the fish in a small area" (Kroeber and Barrett 1960:49). The River Patwin used a somewhat similar method: "What was perhaps a gill net was fastened at the ends to sticks and held vertically from two tule rafts. When a fish was felt, the poles were released and lifted, so that they came together" (Kroeber 1932: 277).

The existence of the seine in pre-Columbian America was questioned by de Laguna (1934:170), who believed that "the evidence, though somehwat uncertain, tends to prove that only the small dip net was used in America in pre-Columbian times, and that the seine was introduced by the white men." But Loud and Harrington (1929:89) recorded from Lovelock Cave, Nevada, 4 fish nets 9.1 m. (30 ft.) or more in length, the largest more than 12.8 m. (42 ft.) long and more than 170.2 cm. (67 in.) wide. Furthermore, Rostlund (1952:83) commented that "the evidence tends to show that the Indians, or some of them, did

use seines or other long and large fish nets before the coming of the whites. Whether or not these nets should be labeled 'seines' and 'gill nets' is immaterial; what matters is that they could have been used only as seines or gill nets and could not have been employed as hand nets or dip nets in any form or fashion."

Single-piece curved bone fishhook

A single-piece curved bone fishhook such as that recovered from a depth of 16 feet (Wallace and Lathrap this volume) may not have been extensively used. It would seem too delicate to have landed the large leopard shark or any of the fair-sized sturgeon represented at the 16-foot level. It may have caught the midshipman, although that fish is infrequently taken by hook and line. (A midshipman can occasionally be picked up by hand within the intertidal zone during the extremely low tides of late spring.) This hook could have caught the surfperches and the smallest leopard sharks, bat rays, and sturgeons; perhaps attached to a relatively short line tied to a piece of dried wood used as a float, it could have caught at least the smaller salmon. But those species were represented only at depths remote from that at which the hook was found. The manufacture of such hooks may not have been long continued. On 1 April 1776, Font wrote, "...we made signs to them [some Indians west of Carquinez Strait] that they should go and get us some fish with two hooks which I gave them. They apparently understood us clearly, but they brought us nothing and showed very little appreciation for the hooks, because their method of fishing is with nets" (Bolton 1933:365).

Double-pointed gorge hooks

No double-pointed gorge hooks of bone or horn are noted by Wallace and Lathrap (this volume). But such hooks, perhaps resembling those found at the Emeryville shellmound (see Schenck 1926:227, Pl. 43s-v), might have been buried in the part of the West Berkeley mound that was destroyed before the present collection was made. Such hooks, baited with mollusks or fish and tied to a stout handline, may have been used by the West Berkeley people to catch sturgeons, leopard sharks, and bat rays. Or, baited with a small fish and tied to about 2 m. (6 ft.) of line trailing from a float, double-pointed gorge hooks may have been used to catch salmon. A composite fishhook such as that described and figured by Schenck (1926:226, Fig. 4) may have caught the largest of the West Berkeley sturgeons.

Fish spears

No fish spears specifically identified as such are recorded

by Wallace and Lathrap (this volume). But spears similar to those recovered from the Emeryville shellmound (Bennyhoff 1950:296, 297, 329, Figs. 1d, 1e, 1s) might have been used by the West Berkeley people to take sturgeons. During the early 1880's, sturgeons were speared by white men from a rowboat at the mouth of Redwood Creek, San Mateo County (Littlejohn 1932).

Conclusions

The following conclusions may be drawn from the fish remains and stone sinkers included in the present collection of archaeological materials:

Fishing was principally by nets--probably by both gill nets and seines--manipulated from tule balsas.

The fishery of the West Berkeley shellmound people was based primarily on sturgeons (presumably both white sturgeon and green sturgeon) and secondarily on salmons (king salmon and, probably, some silver salmon). Third in importance was the bat ray. A thresher shark, a jacksmelt, a plainfin midshipman, and a few leopard sharks and surfperches (redtail surfperch and possibly blackperch) were also represented.

All fishes represented in this collection could have been caught in San Francisco Bay within a distance of 6.4 km. (4 mi.) offshore from the West Berkeley shellmound--even at a time when sea level was considerably lower than at present.

The paucity of remains of silver salmon and the absence of remains of steelhead trout, both of which presumably spawned in Strawberry Creek during aboriginal times, may have resulted from a change of fare on the part of the West Berkeley people, occasioned by the sudden abundance of winter-visitant ducks at the time when adult silver salmon and steelhead trout would have been present in Strawberry Creek.

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Table 1

Vertical Distribution of Fish Remains and Stone Sinkers from West Berkeley Shellmound

Depth (ft.)	Thresher shark	Leopard shark	Bat Ray	Sturgeons	Salmons	Jacksmelt	Surf-perches	Midship-man	Stone sinkers*
0- 1	-	-	4	4	3	-	-	-	-
1- 2	-	-	-	2	-	-	-	-	-
2- 3	-	-	4	6	3	-	1	-	-
3- 4	-	4	5	4	8	-	-	-	-
4- 5	3	-	-	3	3	-	-	-	-
5- 6	-	-	1	6	5	-	-	-	-
6- 7	-	1	5	3	12	-	-	-	2
7- 8	-	1	1	6	11	-	-	-	-
8- 9	-	-	5	6	9	-	-	-	2
9-10	-	-	2	7	14	-	-	-	9
10-11	-	-	-	16	3	-	-	-	32
11-12	-	-	3	15	10	-	1	-	24
12-13	-	-	2	11	4	-	-	-	48
13-14	-	-	4	11	6	50**	14**	-	81
14-15	-	-	1	22	-	-	-	-	36
15-16	-	-	-	13	-	-	-	1	13
16-17	-	1	-	1	-	-	-	-	4
17-18	-	-	-	-	-	-	-	-	2
Totals	3	7	37	136	91	50	16	1	253

* From Wallace and Lathrap (this volume).

** Presumably representing 1 individual.

Explanation of Plates

Except where otherwise indicated, catalog numbers are those of the University of California Lowie Museum of Anthropology, Berkeley.

Plate 1a — White sturgeon (*Acipenser transmontanus*), total length 50.4 cm. (19 7/8 in.), from Suisun Bay, Solano County, California; Calif. Acad. Sci. No. 26875.

Plate 1b — Green sturgeon (*Acipenser medirostris*), total length 92.6 cm. (36 7/16 in.), weight 3.3 kg. (7 1/4 lb.) from Sacramento River 3 mi. above Collinsville, Solano County, California; Calif. Acad. Sci. No. 26913.

Plate 2a — Vertebral centrum, diameter 16.3 mm., length 5.8 mm., representing a thresher shark (*Alopias vulpinus*) about 160 cm. (63 in.) in total length and perhaps 9 kg. (20 lb.) in weight; No. 1-123851.

Plate 2b — Dental-plate median segment (inner aspect), length 25.4 mm., representing a bat ray (*Myliobatis californica*) perhaps 32 kg. (70 lb.) in weight; No. 1-124399.

Plate 2c — Caudal spines of bat rays (*Myliobatis californica*). Upper (incomplete and with marginal teeth abraded): length 58.5 mm.; No. 1-124207. Lower: length 73 mm., from a bat ray 45 kg. (99 lb.) in weight, from Tomales Bay, Marin County, California; Calif. Acad. Sci. No. 26208.

Plate 3a — First ventral opercle (left), height 47 mm., representing a sturgeon (*Acipenser* sp.) perhaps 160 cm. (63 in.) in total length; No. 1-124285.

Plate 3b — Second ventral opercle (right), length 40 mm., representing a sturgeon (*Acipenser* sp.) perhaps 152 cm. (60 in.) in total length; No. 1-124333.

Plate 3c — Clavicle (right), length 68 mm., representing a sturgeon (*Acipenser* sp.) perhaps 152 cm. (60 in.) in total length; No. 1-124222.

Plate 4a — Scute (dorsal), length 53 mm., representing a sturgeon (*Acipenser* sp.) perhaps 152 cm. (60 in.) in total length; No. 1-124408.

Plate 4b — Scute (preanal), length 16 mm., representing a sturgeon (*Acipenser* sp.) perhaps 84 cm. (33 in.) in total length; No. 1-124005.

Plate 4c — Pectoral ray (first, right), length 47 mm., representing a sturgeon (*Acipenser* sp.) perhaps 120 cm. (47 in.) in total length; No. 1-124204.

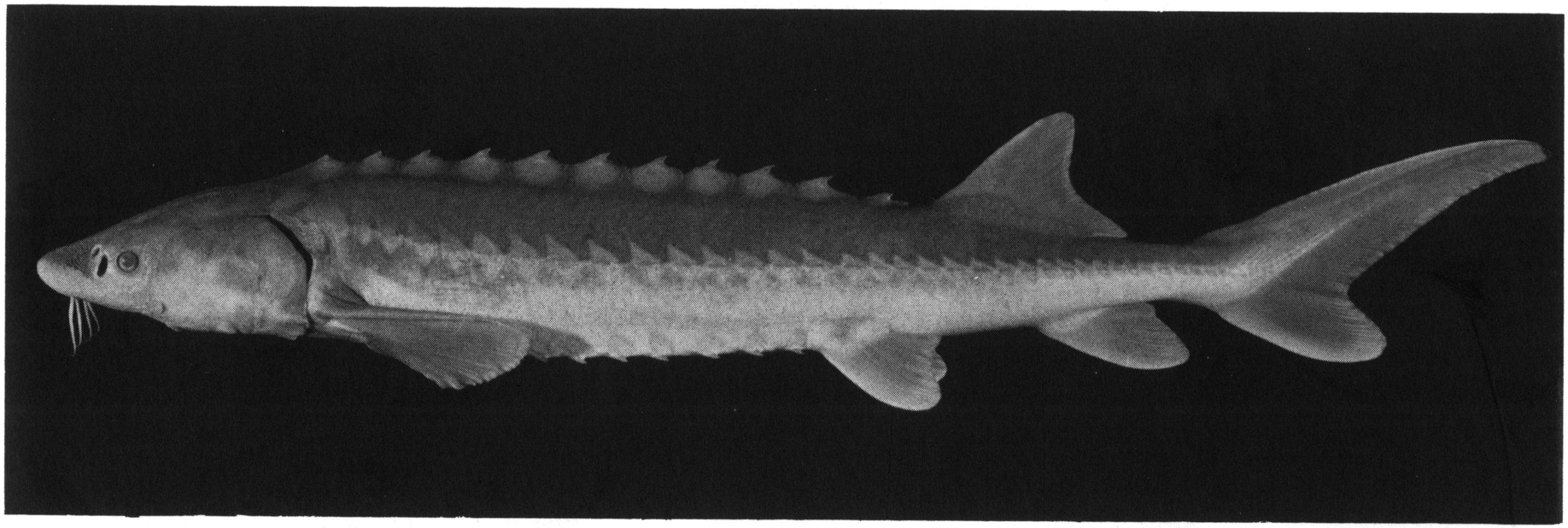
Plate 5a — Posttemporal (left, outer aspect), length 70 mm., representing a sturgeon (*Acipenser* sp.) perhaps 152 cm. (60 in.) in total length; No. 1-124275.

Plate 5b — Posttemporal (left, inner aspect, of specimen shown in Pl. 5a); No. 1-124275.

Plate 5c — Articular and angular (right), length 35 mm., representing a king salmon (*Oncorhynchus tshawytscha*) about 66 cm. (26 in.) in total length and perhaps 3.2 kg. (7 lb.) in weight; No. 1-124308.

Plate 5d — Vertebra (caudal), horizontal diameter 16.9 mm., representing a king salmon (*Oncorhynchus tshawytscha*) about 106 cm. (42 in.) in length and about 15 kg. (33 lb.) in weight; No. 1-124271.

Plate 6 — Tule balsa observed during 1816 on San Francisco Bay, California. (From Choris 1822:Pl. 9).



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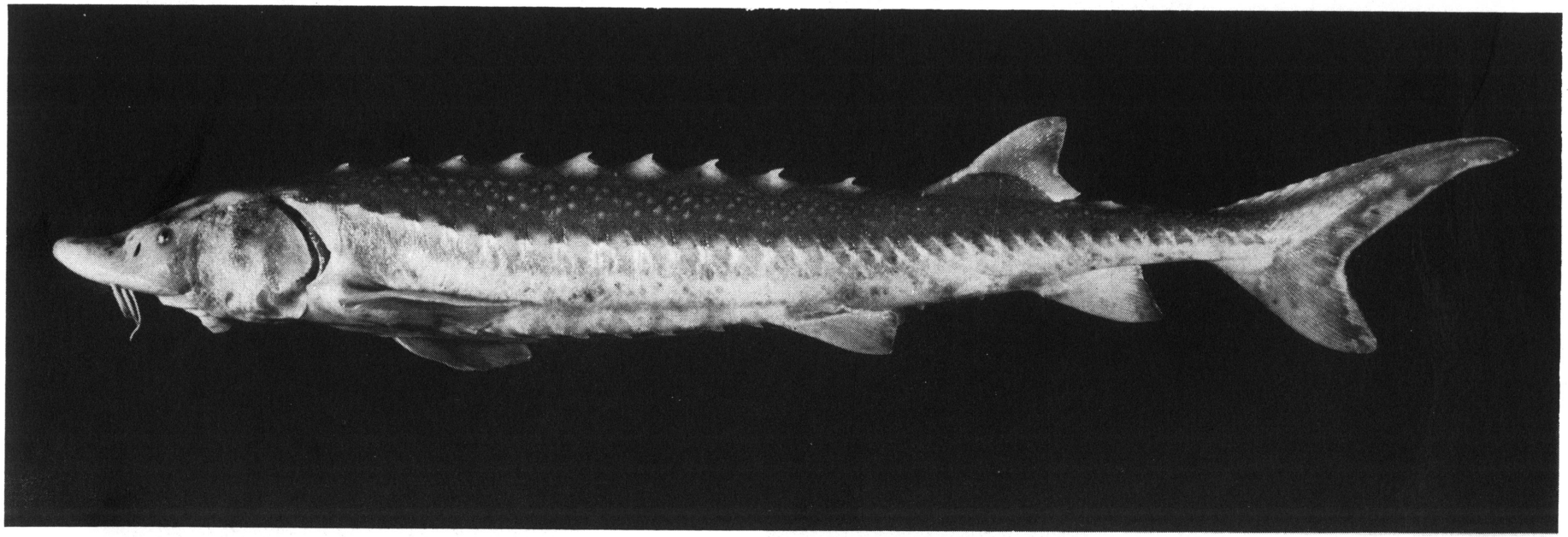

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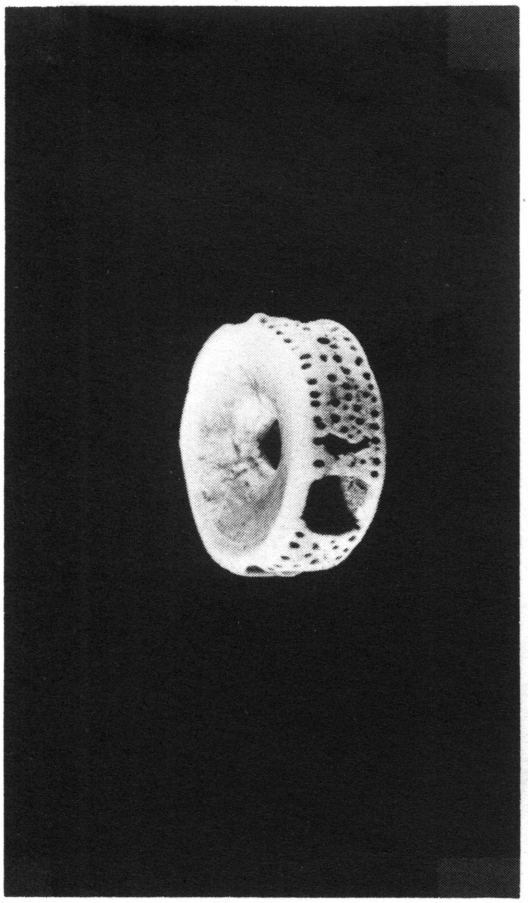
Plate 2



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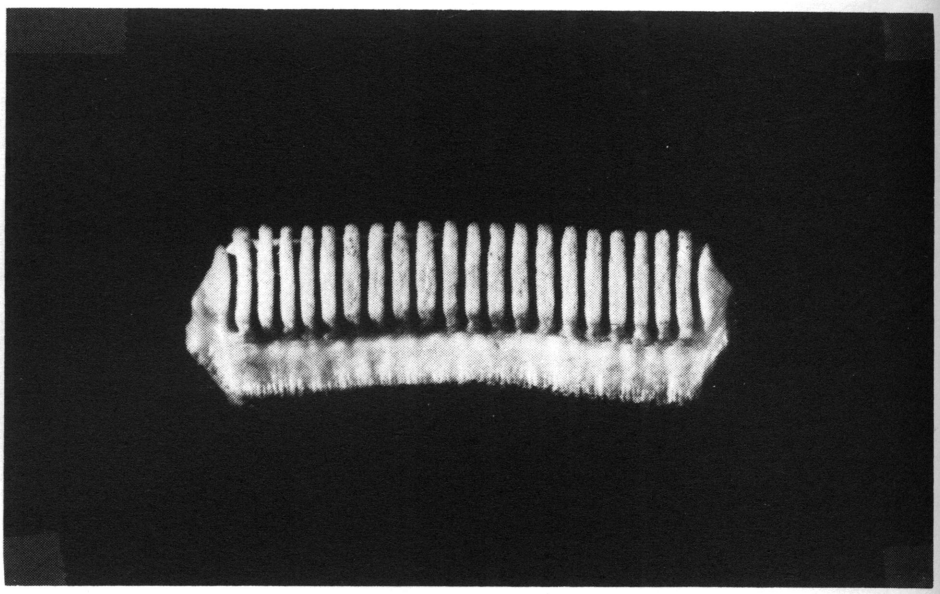

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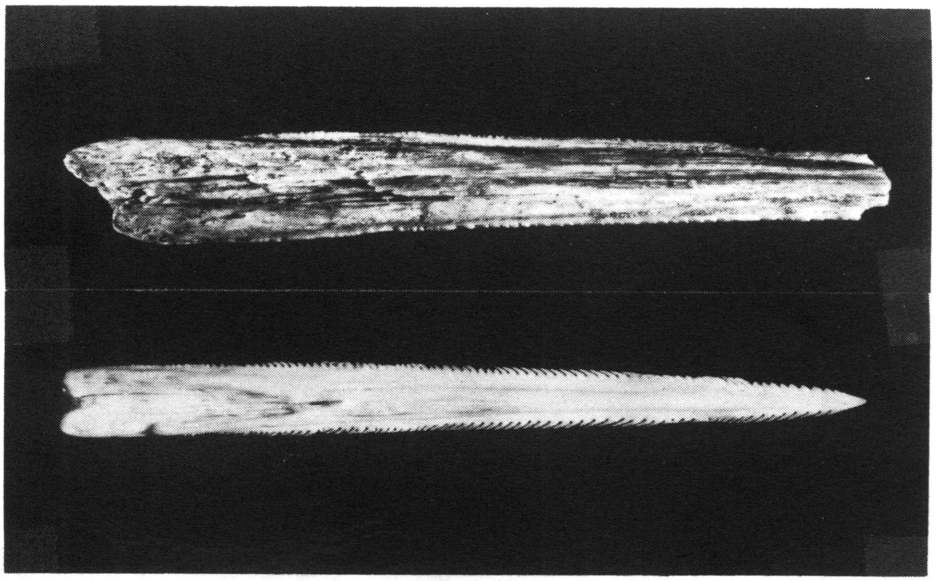
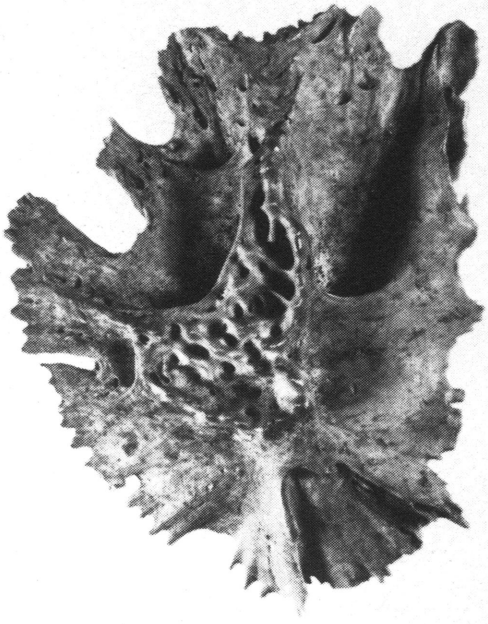


c

Plate 3

a



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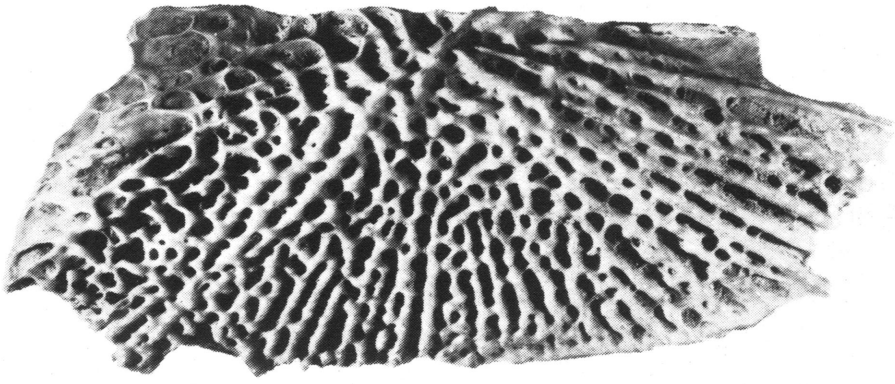

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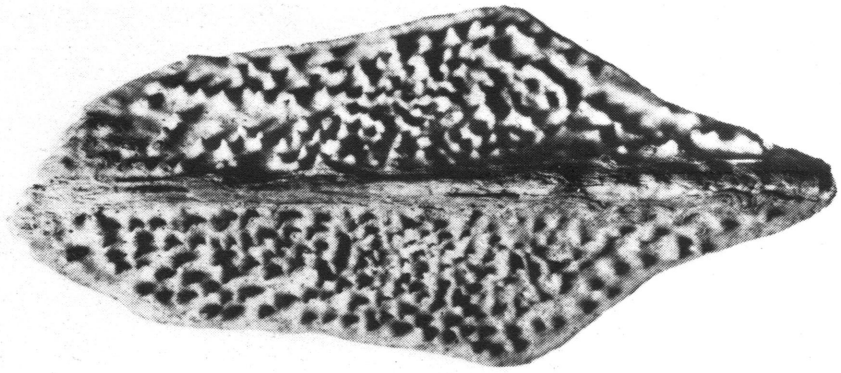
Plate 4



a

b

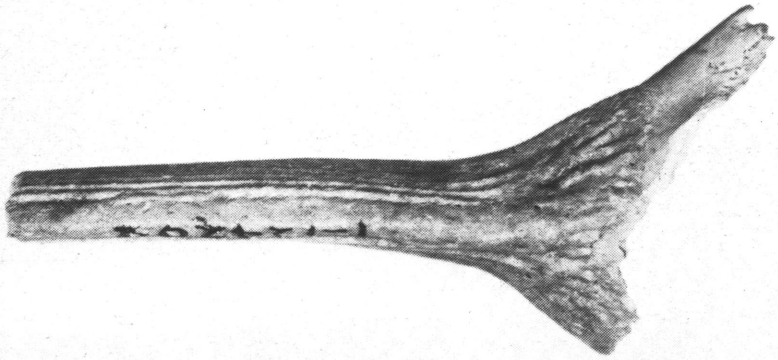


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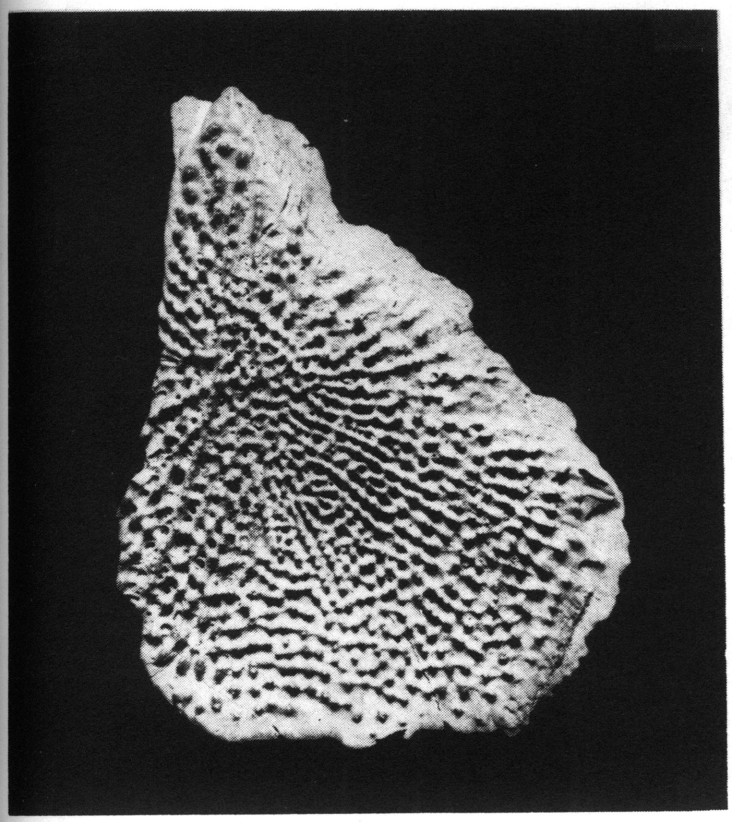
Plate 5



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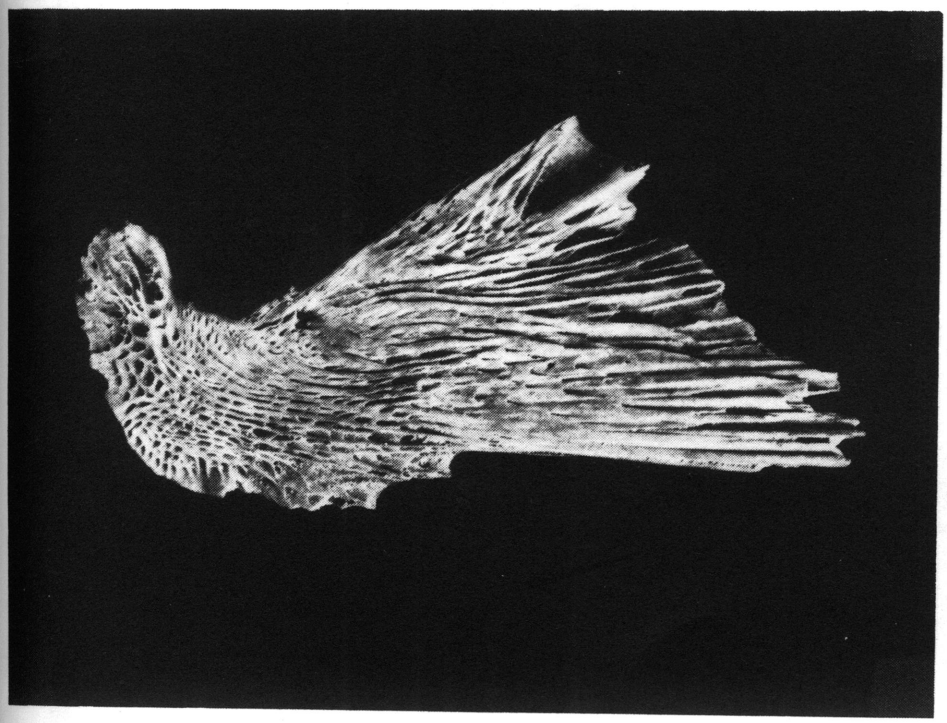

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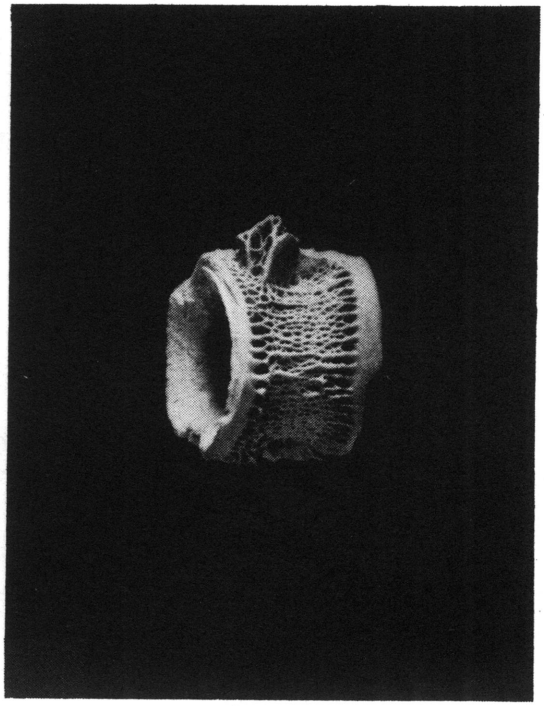
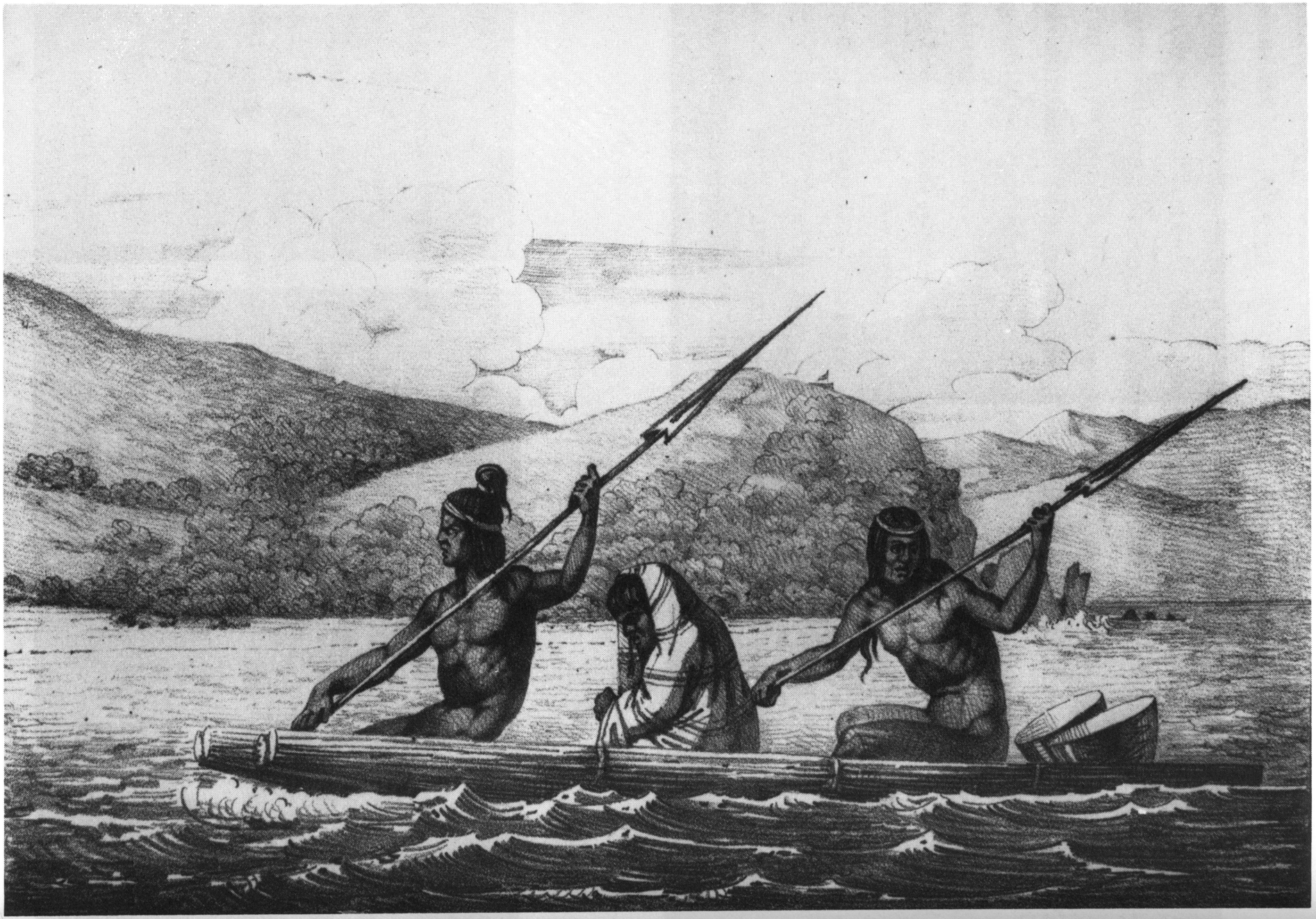


d

Plate 6



Appendix C

A MAMMALIAN FAUNAL ANALYSIS OF CA-Ala-307*

Colin Busby

Introduction

The faunal assemblage described in this report was obtained from various different excavations of site 4-Ala-307, commonly known as the West Berkeley Shellmound, and is a more complete (in terms of presented data) analysis than a previous attempt by J.A. Freed (n.d.). Excavations were conducted at various times during the years 1950-1954 by several University of California, Berkeley archaeological field classes in the course of salvage operations at the site. Much of the unmodified faunal material obtained during the course of the excavations has served as practical teaching material for several graduate seminars on the mechanics of faunal analysis given jointly by the Departments of Anthropology and Paleontology at the University of California, Berkeley at various times. This brief paper represents the results of one such seminar.

Due to these and other factors, much of the excavated material has become scattered and only partially analyzed over time. This has resulted in the loss of much valuable data on CA-Ala-307 in terms of subsistence, determination of butchery practices and patterning, activity areas, ecology and so on. This report should therefore be viewed as a partial, qualitative salvage attempt in understanding the faunal remains present at the West Berkeley Shellmound. As such, no attempt has been made to go into minimum and maximum numbers of species present, stratigraphic and areal analysis of units and other information currently considered essential in a report on a modern faunal assemblage. (See Daly 1969, Payne 1972, Ziegler 1965, for discussions on various aspects of faunal analysis.)

Methodology

From the excavated material stored in the collections of the Robert H. Lowie Museum of Anthropology, a selection was made of a series of related and non-related units for the analysis. Care was taken to see that the units selected would (1) cover a fairly large portion of the site (2) that they would present a viable and reliable overview of the site by representing a broad enough sample and (3) that several of the selected units would have a reasonable depth.

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* Submitted December, 1974.

Units K-1 and including K-8, L-1 to L-3, F-7, G-4 and C-2 were selected from the material available for study. (See Map I). The K and L units had been excavated in 1954, the F-7 and G-4 units had come from earlier excavations in 1951 and unit C-2 was from the summer excavations of 1950. These 14 units yielded a total of 415 mammal specimens weighing a total of 2465.2 grams for analysis.

Identification of the material was made possible by the use of the Department of Paleontology Element Collection, University of California, Berkeley and by the collections housed in the University of California Museum of Vertebrate Zoology. All bones were identified, where possible, to genus/species. Of the 415 mammal specimens, 204 (49.2%) could be identified to this level. Identification was hindered by the fact that much of the material was badly broken or fragmented and complete specimens of any element were relatively rare in the assemblage. This factor accounts in part for the large number of unidentified medium to large mammal long bone fragments. (See Table A for Distribution Frequencies of Mammals.)

The mammalian skeletal remains were identified as belonging to five orders: Carnivora, Rodentia, Lagomorpha, Artiodactyla and Cetacea. All species identified were found to be within their present range and habitat. (See Ingles 1947 for a discussion of distribution, habitats and so forth.) The remains of the following 18 species were recovered.

Identified Mammal Species Present at West Berkeley

Large Mammals

Antilocapra americana (Pronghorn Antelope)
Cervus sp. (Elk)
Odocoileus hemonius (Mule Deer)
Phoca sp. cf. *vitulina* (Harbor Seal)
Tursiops gilli (Bottle-nosed Dolphin)
Zalophus or *Eumatopias* sp. (Sea Lion)
Delphinus bairdi (Common Dolphin)**
Phocaena vomerina (Bay Porpoise)**

Medium Mammals

Canis sp. cf. *latrans?* (Coyote)
Enhydra lutra (Sea Otter)
Lepus sp. cf. *californicus* (Blacktailed Jackrabbit)
Procyon lotor (Raccoon)
Taxidea taxus (Badger)

Small Mammals

citellus beecheyi (Ground Squirrel)**
Mephitis mephitis (Striped Skunk)**
Neotoma sp. (Wood Rat)

Sylvilagus sp. (Rabbit)
Thomomys bottae (Pocket Gopher)

** Not found in present analyzed material but have been noted and identified in previous analyses, (Crader n.d.; Kreed n.d.; Harris and Kurashima n.d.; and Karoma and Gifford n.d.).

Results

The dominant identified species present at West Berkeley is *Odocoileus hemonius* (35.8%) with *Canis* sp. (19.6%) and *Enhydra lutra* (14.2%) coming in as poor seconds. *Thomomys bottae* (12.2%), *Phoca* sp. (6.3%) and *Zalophus* or *Eumatopias* sp. (4.9%) also are present to some degree. *Antilocapra americana* (0.9%), *Cervus* sp. (1.9%), *Lepus* sp. (0.9%), *Procyon lotor* (0.9%), *Neotoma* sp. (0.5%), *Sylvilagus* sp. (0.5%) and *Tursiops gilli* (0.5%) are all present in small quantities. It should be noted that these percentages are based on raw counts of the material and therefore may not represent the actual importance of each species at West Berkeley. They do, however, give us a rough quantitative indication of the relative abundance of each species.

Individual elements of the total mammalian fauna (Genus/Species/Category) are represented in Table A. The most commonly recurring bone elements of the total assemblage are long bone fragments (26.7%) followed by long bone elements (18.3% - excluding astragali, calcanei and phalanges), rib elements (11.3%) and vertebrae (8.0%). It should be noted that 45.0% of the total faunal assemblage is comprised of long bone elements/fragments and that of the specimens identified to the genus/species level, identifiable long bones (femur, radius, tibia, etc.) comprised 31.9% of the total. While the percentages appear to be slightly skewed by the large numbers of long bone elements and fragments present, one should expect such a large representation in the sample since these are among several of the more resistant and durable body parts that would be preserved in the archaeological record.

Out of the total mammalian remains, 23 (5.5%) were noted as belonging to immature individuals on the basis of standard characteristics (eg. unfused epiphyses, deciduous molars and so on). Of these, *Odocoileus hemonius* (2.4%) and *Enhydra lutra* (2.0%) had the largest number of juvenile specimens present of the identified species.

Twenty specimens, 4.8% of the total assemblage, were either completely carbonized or showed traces of charring. Of these, 1.4% were identified as to the genus/species level.

Conclusions/Observations

Due to the fragmented nature and incompleteness of the analyzed sample, no firm inferences can be derived from the faunal analysis of West Berkeley. However, several observations can be pointed out and from these several tenuous inferences can be drawn.

From the analysis it appears that the ecology of West Berkeley, as it pertains to the mammal distribution and their habitats, has not changed drastically over the time span of the occupation of the site. The subsistence of the aboriginal inhabitants, in regards to the exploitation of mammals and as determined from the relative frequencies of the faunal remains, appears to have been orientated primarily toward the exploitation of one land mammal, *Odocoileus hemonius*, and one marine mammal, *Enhydra lutra*. While other land and marine mammals also appear in the faunal record, these two are the dominants.

The large number of long bone fragments could perhaps be indicative of butchery practices or an alternate explanation could be that they were broken in order to obtain the marrow as a food. Still another reason could be that they were used as raw material in the manufacture of artifacts (see Wallace and Lathrap n.d.). The high percentage of both identifiable long bone elements and unidentifiable fragments could be due to either one or a combination of these suppositions. Lastly, as a final observation, it appears that the percentage of *Odocoileus hemonius* steadily increases from the lower levels to the upper levels of the site, while the frequency of *Enhydra lutra* shows a drastic increase at the 60-72" level. This might be explained either as a change in food preference or in methods of hunting (both in regards to *Enhydra lutra*) or it may be attributed in part to differential preservation due to depth and other edaphic factors, (see Table B).

As a concluding remark, this report should be viewed as only a brief, qualitative and incomplete summary of the mammalian fauna represented at CA-Ala-307, and as such any conclusions drawn from the data are at the best only tenuous inferences. It is unfortunate that one cannot use this existent data base more informatively.

Acknowledgments

The author gratefully acknowledges the assistance provided by the faculty members of Interdepartmental Studies 215, Faunal Analysis in Archaeology, Drs. Clemens, Isaac, Rodden and Savage, in completing this analysis. I am also indebted to my fellow students and especially to Larry S. Kobori and Eric Blinman for their comments and discussion on various aspects of the material and of this report. I should also like to thank Dr. William Z. Lidicker, Jr., Curator of Mammals, who gave me permission to use the comparative specimens in the University of California Museum of Vertebrate Zoology and Dr. R.F. Heizer, Department of Anthropology, for his advice and assistance.

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ADDENDUM

Explanation of Categories - Reference mammal sizes used as a basis for Table A categories.

Large Mammal - Wolf through Deer size.

Medium Mammal - Jackrabbit through Coyote size.

Small Mammal - Through cottontail size.

(After Ziegler 1965).

Distribution Frequencies of Mammals - CA-Ala-307

Bone elements		Neotoma sp.	Sylvilagus sp	Thomomys bottae	Canis sp.	Enhydra lutra	Lepus sp.	Procyon lotor	Taxidea taxus	Antilocapra americana	Cervus sp.	Odocoileus hemonius	Phoca sp.	Tursiops gilli	Zalophus or Eumatopias sp.	Unidentified Small Mammal	Unidentified Medium Mammal	Unidentified Large Mammal	Total	% of Total
Total number		1	1	25	40	29	2	2	1	2	4	73	13	1	10	1	62	148	415	
Total weight		0.5	0.5	4.4	153.3	223.7	4.3	10.8	6.6	4.2	194.3	741.1	105.8	25.3	116.6	0.1	97.0	776.7	32465.2	
Adult		1	1	25	38	25	2	2	1	2	2	68	11	1	9	1	60	143	392	
Juvenile					2	4					2	5	2		1		2	5	23	5.6
Burnt									1		1	3	1				1	13	20	4.8
Complete bone		1	1	13	19	13					1	14	5	1	4		3	2	77	18.6
Bone fragment				12	21	16	2	2	1	2	3	59	8		6	1	59	146	338	81.4
Antler											1	2						5	8	1.9
Astragalus																				
Right					1							2							3	0.8
Left												2			1				3	0.8
Calcaneum																				
Right			1		2							1	1						5	1.2
Left												1							1	0.2
Femur						1					1		2					1	5	1.2
Right				1		1													2	0.5
Left						2						1	2						5	1.2
Fibula																				
Right												2							2	0.5
Left																				
Humerus						1						2					1		4	1.0
Right					1	1													2	0.5
Left				2	1				1										4	1.0
Mandible				1	1	1									1				4	1.0
Right						2													2	0.5
Left						1						2							3	0.8
Maxillae				4	1														5	1.2
Metacarpals					4							2						3	9	2.2
Metatarsals					1							2	2				1		6	1.5
Metapodials					1							5						5	11	2.6
Pelvis & Sacrum		1		2		1					1	10	2						17	4.1
Phalanges					8	2						10	2		5			1	28	6.7
Radius						3						2					1	2	8	1.9
Right						3						1							4	1.0
Left												2							2	0.5
Ribs																	20	27	47	11.3
Scapulae								1		2		4							7	1.7
Right								1											1	0.2
Left					1												1		2	0.5
Skull				2	12	1						5	2		1	1	3	6	33	8.0
Teeth																				
I				11														1	12	2.9
M					1	3													4	1.0
C					2	1									2				5	1.2
Tibia												1					1	2	4	1.0
Right				1		1						2							4	1.0
Left				1		3	1					1							6	1.4
Ulna												1							1	0.2
Right					2														2	0.5
Left																				
Vertebrae												1					3	10	14	3.4
Caudal					1									1			2		4	1.0
Cervical												2					1		3	0.8
Lumbar																		1	1	0.2
Thorasic											1	7					1	2	11	2.6
Long bone frags						1	1										27	82	111	26.7

Table B

OCCURRENCE OF MAMMAL BONE BY DEPTH

	0-12	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	120-132	132-144	144-156	156-168	168-180
Neotoma sp.											1				
Sylvilagus sp.	1														
Thomomys bottae	8	1		1		13		1							
Canis sp.	3	2	4	12	4	1	3		2			1			1
Enhydra lutra	4	6	6		1	4	1				1	1			
Lepus sp.		1		1											
Procyon lotor	1		1												
Taxidea taxus				1											
Antilocapra americana	2														
Cervus sp.			2	1											
Odocoileus hemonius	12	10	15	7	1	1	4	2	6		1	4	5		
Phoca sp.		3	2			1		2	1		1	2		1	1
Tursiops gilli						1									
Zalophus or Eumatopias	1		3	1		1	1			1	1				
Small Mammal	9	2		2		13		1			1				
Medium Mammal	18	17	27	25	8	9	6	3	9		2	9	3		1
Large Mammal	46	40	35	31	7	12	11	8	10	2	12	20	14	1	1

Appendix D

BIRDS

Richard H. Brooks

The identification of bird bones from archaeological deposits has often been neglected and the avifauna generally has a minor place, if any, in descriptions of subsistence patterns of prehistoric populations. For the San Francisco Bay region Hildegarde Howard has published the only complete report (1929), a monograph describing a large series of bird bone (4,155 specimens) from Emeryville. The use of Howard's collection for comparative purposes has made possible the identification of species commonly used by the West Berkeley people.

The bay shore was apparently favorable for the support of an abundant and diversified bird life. This is indicated by the high percentage of bird bones in the local archaeological sites as well as by descriptions of precontact geographical conditions. Schenck (1926:157) reported extensive marshes to the south of Emeryville and to the north of West Berkeley. Four miles further north, Loud noted (1924:359) that in one of the Stege mounds bird bones were so plentiful that only a small percentage was saved. The marshes and adjacent bay determined the predominance of waterfowl over land species.

The skeletal remains of various bird species were, as in other nearby shellmounds, abundant in the West Berkeley archaeological deposit. The osseous material was generally in good condition though practically all of the large specimens were broken and some were charred. The bone selected for identification came from Trench F (pits 4-7). From a total of 482 identifiable specimens, the major elements present were radii 91, coracoids 73, tibiotarsi 68, humeri 65, and ulnae 67. These were also essentially the recognizable elements in the Emeryville collection.

Of the 18 orders of bird present in the San Francisco Bay area, the following nine were represented in the West Berkeley sample (Table 1): Gaviiformes (Loons), Colymbiforms (Greges), Pelecaniformes (Pelicans, Cormorants, etc.), Anseriformes (Ducks and Geese), Falconiformes (Vultures, Hawks, Falcons, etc.), Gruiformes (Cranes, Rails, Coots, etc.), Charadiiformes (Gulls, Auks, etc.), Strigiformes (Owls), and Passeriformes (Perching Birds). All, as well as Ciconiiformes (Herons, Egrets, Bitterns), Galliformes (Quail), Procellareformes (Albatrosses, Petrels, etc.), were also present at Emeryville. The smaller sample from West Berkeley probably explains the absence of the latter three orders.

The preponderance of West Berkeley bone was from the Anseriformes of the family Anatidae or Migratory Ducks and geese (385 of the 482 specimens). This group, due to the large number of

genera and species in the family and the lack of comparative material, could not be segregated into smaller components. Following, the Anatidae, *Uria troille* (Murre) and the Phalacrocoracidae (Cormorants) contained the next highest number of specimens. This is in agreement with Howard's findings, her series showing the same high frequency for these forms. There was no apparent stratigraphic differentiation at West Berkeley. It may be noted, however, that there was a higher percentage of bird bone below the 24 inch level.

The material analyzed seems to indicate a rather wide utilization of the available avifauna. From the forms identified it would appear that the prehistoric population primarily made use of migratory winter waterfowl of the family Anatidae (ducks and geese).[1] There was less dependence on the year-round inhabitants of the San Francisco Bay area such as the Murre and Cormorant. The ways in which the birds were used by the West Berkeley people remain conjectural. Most species, particularly the water birds, were undoubtedly captured for food. Others may have been caught for their feathers. Bird bones were occasionally used in making artifacts.

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[1] Some of the smaller species are year-round inhabitants of the Bay area.

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Table 1

BIRDS REPRESENTED IN WEST BERKELEY SITE

Species	
Gaviiformes. Loons	
Gaviidae	
Gavia immer (Brunnich) - common loon	6
Gavia pacifica (Lawrence)? - Pacific loon	1
Gavia stellata (Pontoppidan) - red throated loon	2
Colymbiformes. Grebes	
Colymbidae	
Colymbus (Brehm) - grebe	1
Pelecaniformes. Pelicans, cormorants, boobies, etc.	
Pelecanidae	
Pelecanus occidentalis Linnaeus - brown pelican	1
Pelecanus erythrorhynchos Grelin - white pelican	1
Phalacrocoracidae	
Phalacrocorax auritus (Lesson) - Farallon cormorant	9
Phalacrocorax penicillatus (Brant) - Brant cormorant	17
Phalacrocorax pelagicus Pallas - Pallas Pelagic cormorant	1
Anseriformes. Ducks, geese and swans	
Anatidae	385
Falconiformes. Vultures, kites, hawks, falcons, etc.	
*Cathartidae	
Gymnogyps californianus (Shaw) - condor	
Accipitridae	
Circus hudsonius (Linnaeus) - marsh hawk	1
Gruiformes. Cranes, rails, coots, etc.	
Gruidae	
Grus canadensis (Linnaeus) - little brown crane	2
Charadriiformes. Gulls, auks, etc.	
Scolopacidae	
Numenius americanus Bechstein - long-billed curlew	2
Laridae	
Larus sp. - gulls	2
Alcidae	
Uria troille (Linnaeus) - murre	42
Strigiformes. Owls	
Tytonidae	
Tyto alba (Scopoli) - barn owl	1
Strigidae	
Bubo virginianus (Grelin) - great horned owl	2
Passeriformes. Perching birds	
Corvidae	
Corvus brachyrhynchos Brehm - American crow	6
Unidentified specimens	68

*Not in sample, but a ceremonial burial.

Appendix E

HUMAN SKELETAL REMAINS

Sheilagh Thompson Brooks

The West Berkeley collection of human skeletal material is quite small with less than ten measurable males and an equally small representation of measurable females. Even so limited a series is important, nevertheless, because of the paucity of published data from San Francisco Bay mounds. With such a small group, however, there is a tendency in a statistical analysis to give an incomplete and perhaps erroneous picture, especially for the postcranial material where the collection is even more limited. Therefore, only ranges and means for the standard cranial and postcranial measurements and observations are presented. In order to amplify the data from the excavation of 1950, skeletal material collected earlier was also analyzed; the latter are referred to as Ala 307 Old and the former as Ala 307 New. The two have been kept separate, as the location in the site of the earlier trenches is not certain.

Skeletons from the Emeryville mound (Ala 309) form an excellent comparative series and aid in presenting a more complete picture of the prehistoric population living on the east shore of San Francisco Bay. The Emeryville material contained 33 measurable male crania and 32 female; again the postcranial material was inadequate. The ranges and means of this series are included in Table 1 with West Berkeley data. For comparative material from other Central California localities, there is only the Central Valley male series examined by Russell W. Newman (Newman 1949) and the crania measured by Edward W. Gifford (1926) and Ales Hrdlicka (1906, 1927).

The three series Ala 307 Old, Ala 307 New, and Ala 309 vary only to a slight extent in any of the means of cranial measurements and indices. In fact, there is no constant deviation combining any two of the three in such a way as to form a contiguous grouping. Wherever there is a difference of more five points between means, it is usually due to the number of individuals being so small that one extreme weights the sample, i.e., byzygomatic diameter, menton-nasion height, basion prosthion, etc. A deviation of more than plus or minus five points has arbitrarily been chosen as being significant. The greatest measurable differences are in the averages of cranial capacity, using Pearson's formulae for auricular height and basion bregma height. The Bay population cranial ranges are similar to northern California crania measured by Hrdlicka, and the means are smaller than Newman's Central Valley males. Thus in considering the three San Francisco Bay groups as a whole, the cranial capacity deviations do not seem beyond those found in other California Indian skeletal collections. It appears that regardless of the lack of

contemporaneity in the occupation of the sites, the population was homogeneous.

The picture presented by the cranial measurements is that of a group on the narrow side of mesocephaly, with a mesoprosopic face bordering on broad, and with a nose on the broad side of mesorrhiny. Observational data round out this view of a medium type population, indicating few extremes for any cranio-facial features. There are some instances of a sagittal crest among the males, but most areas of muscular attachment are of medium extension. The facial profile presents a concavo-convex nose of medium height in conjunction with a medium to small amount of prognathism. Tooth wear shows the only occurrence of extremes in that the middle-aged and old individuals had worn the enamel down to the dentine and that there were quite a few abcesses and caries.

Because the postcranial material is fewer in numbers than the cranial, conclusions must be more cautious. The long bones were not heavy nor was there great indication of muscularity. The females had smaller measurements than the males more often postcranially than cranially. Estimates based on femora, tibiae, and humeri length show a medium short-statured population, 5 feet 3 inches - 5 feet 5 inches for the men, shorter for females.

The data derived from the San Francisco Bay mound skeletons indicates quite clearly that they represent a relatively homogeneous unit. It is on that basis that comparisons have been made with other series from northern and central California. There are two other series from the San Francisco Bay area, which consist only of crania and which probably overlap. One was measured by Hrdlicka in 1906 and 1927; the second by Gifford in 1926. Hrdlicka's data come generally from San Jose northward, with the majority centering around San Francisco Bay. The crania used by Gifford are divided by area, but the means for the Central Valley and coast are quite similar and contrast with the Yuki material from northern California. The third series from the Central Valley was measured by Newman in 1949. It includes both postcranial and cranial data, but only for male skeletons. This material has been separated into three archaeological periods of Central California, Early, Middle and Late horizons.

In comparing the San Francisco Bay mound material of Hrdlicka with the West Berkeley-Emeryville (Ala 307-309) series it was found that the measurements, in all cases where the latter group had more than three individuals, did not differ more than five points. There was one exception - orbital index - although the absolute figures fell within the arbitrary five-point variation. Considering the similarity of the remainder of the data, the one exception can be disregarded as the length and breadth measurements of the orbit correlated. With Gifford's material all the indices were found to agree, though the absolute measurements differed slightly. The Ala 307-309 crania, both male and female, were usually larger than Gifford's San Francisco Bay crania in most cranial and facial measurements, except prosthion-nasion height and byzygomatic breadth, where

they coincided. The divergences are not consistent nor large enough to constitute a problem. Rather, all three, Hrdlicka's, Gifford's and the Ala 307-309 series, appear to correlate closely. Grouping all three together furthers the possibility that the description, presented here and by Gifford, of a population medium in nearly all measurements and observations, is valid (Gifford 1926).

A comparison of the Ala 307-309 males with Newman's Central Valley males gives an entirely different result. Here in 36 out of 48 cranial measurements and indices compared, Newman's series are larger, frequently by five points or more; in 8 of the 48 the two groups coincided and in 4 the Ala 307-309 series was larger. The postcranial material agreed with the cranial in showing an overall smaller size in the Bay group, not only in absolute measurements but even in derived stature estimates. The San Francisco Bay group can be said to be smaller-sized than the Valley population regardless of the archaeological time period.

The age at death was determined where possible for each West Berkeley and Emeryville specimen (Table 1).

Table 1

AGE AT DEATH OF WEST BERKELEY AND EMERYVILLE POPULATIONS[1]

	307 Old	307 New	309
Child (infant)	17	46	54
Adolescent	4	9	15
Adult (sex indet.)	24	2	89
Male	22	17	129
Female	11	19	73
Total	78	93	360

[1] It will be noted that the actual number of specimens recovered archaeologically is not at all relative to the number of measurable skeletons, which is based on preservation and other factors.

Both sites present approximately the same picture of high infant mortality, a drop at adolescence and a subsequent rise again from 25 years of age onward. Males show an earlier average age at death than the females, though the difference is not sharp.

In summary, it is apparent that the San Francisco bayshore was occupied during aboriginal times by a relatively homogeneous population. This population can be briefly described as mesocephalic, mesoprosopic, and mesorrhine -- in the former instance being closer to the narrow range, in the latter two to the broad. They were a medium-statured people, without unusual muscularity. They diverged from the people living in the Central Valley of California, during the entire archaeological time span, by being smaller craniofacially and post cranially. The bay mound population's life span, once surviving infancy, reached its peak between 30 and 40 years of age. Few pathologies were discernible in the skeletal material.

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Appendix F

Excavation of 1954

William J. Wallace and Donald W. Lathrap

Early in 1954, the old factory building covering the western section of the West Berkeley mound was torn down. This afforded an opportunity for further digging in the deeper levels of the midden so on Saturday and Sunday, March 27-28, the Fall semester class in archaeological field methods worked at the site.

Obviously the shellmound had been cut down considerably when the factory was constructed many years ago. The surface underneath the building was essentially level, with a drop of only two to five inches in one direction and four in the other. A datum point established at the northeast corner of the area to be excavated lay two feet higher than the ground surface mark scratched on the nearby brick building during the 1950 investigation. As the midden extended three feet below the surface at this point, the 1954 excavation must have been in the 13-18 foot portion of the shellmound. The depth occurrence of certain artifact classes, particularly net sinkers, seems to confirm this correlation.

Fourteen 5 X 5 foot pits were excavated (Figure 1). Three were dug to a depth of 36 inches; the remainder were taken almost to subsoil. The depth of the deposit ranged from 41 to 48 inches, or perhaps slightly more, for in no place was absolutely sterile earth reached. The method of excavation was by straight shoveling in six-inch levels. Depth was recorded from ground surface.

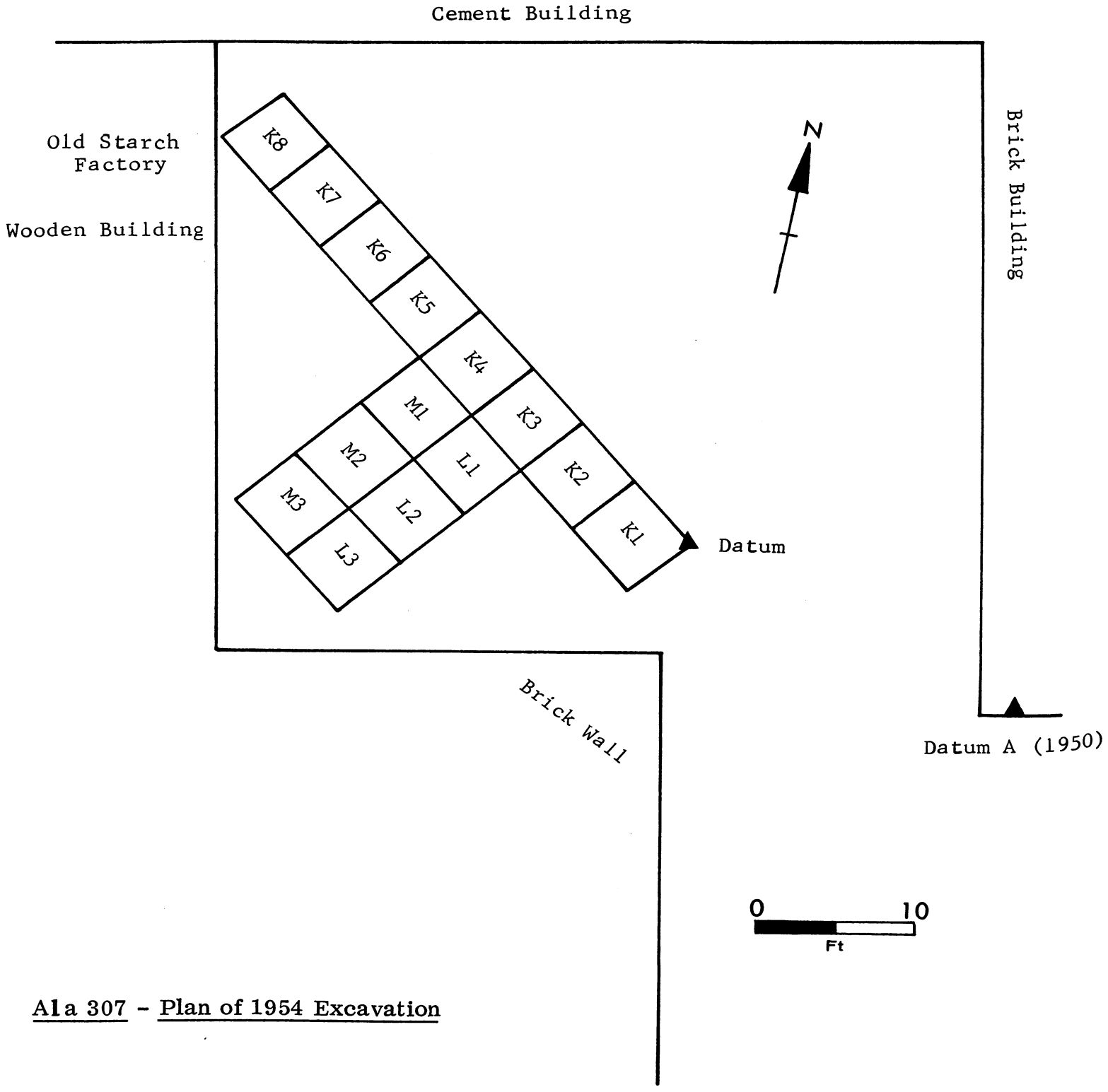
Description of Artifacts

Approximately 173 artifacts were recovered. A surprisingly large number of different classes are represented, though most by a single specimen. Only three represent types not found earlier.

Chipped Stone Objects

Projectile point - stemmed, leaf-shaped, expanding stem, rounded base with broad U-shaped side notches. This was found at a depth of 20 inches. It is made from obsidian and is rather coarsely flaked. Dimensions are: length 5.06 cm.; width 1.97 cm.; thickness .65 cm. The specimen weighs 6.8 grams.

Projectile point - stemmed, leaf-shaped contracting stem with square or slightly rounded base. The specimen has rather ill-defined shoulders



A1a 307 - Plan of 1954 Excavation

formed by lateral notching. Also of obsidian, it is coarsely flaked with some of the original stone surface remaining on one side. It is 7.64 cm. long; 3.33 cm. wide, and 2.8 cm. thick and weighs 20.1 grams. This point was recovered 14 inches beneath the surface.

Projectile point - stemless with concave base. Like the above it is made from obsidian and is coarsely flaked. Dimensions are: 4.34 cm. long; 2.50 cm. wide; .90 cm. thick. It weighs 9.3 grams. This example came from a depth of 17 inches.

Scraper - A large, rather crude chert flake scraper was recovered in the 0-6 inch layer. Irregular in outline, it is retouched along part of one of the longer sides. It measures 3.7 X 10.5 cm.

Chopper - A small chopper of blue-green chert is made from an untrimmed core. A sharp edge was formed by striking flakes off from one surface only. It is 3.99 cm. long, 3.81 cm. wide, and 2.80 cm. thick. This specimen was found in the 24-36 inch level.

Chopper - An almost identical example, also of blue-green chert, was found at a depth between 36 and 48 inches. It is somewhat larger than the above, measuring 4.24 X 4.30 cm., and 2.70 cm. thick.

Pecked and ground stone objects

Notched net sinkers - Twenty-seven examples of this class of artifact were obtained. Their depth occurrence follows:

0-12 inches - 14
12-24 inches - 11
24-36 inches - 2
36-48 inches - 0

Grooved net sinkers - Grooved sinkers were less numerous with only 10 specimens collected. Their depth range is listed below:

0-12 inches - 6
12-24 inches - 3
24-36 inches - 0
36-48 inches - 1

One example was fashioned from a fragment of a small mortar.

Pestle - A cylindrical pestle, its ends rounded by use was obtained 5 inches below the surface. It is 12.4 cm. long and 6.35 cm. in diameter. Three cavities are pecked into the sides of the specimen.

Pestle fragments - Four unclassifiable sections of pestles were collected. Three came from a 12 inch depth, the other was found 23 inches down.

Mortar fragments - Two unclassifiable mortar fragments were found. One was recovered 6 inches below the surface, the second in the 24-36 inch layer.

Charmstone - A perforated charmstone was unearthed at a depth of 24 inches. Of bluish glaucophane schist it is ovoid and has well-finished surfaces. The specimen is 7.55 cm. long, 4.45 cm. wide and 2.33 cm. thick.

Charmstone - An ovoid sandstone pebble is grooved along its long axis and is carefully shaped though with a fairly rough surface. One end is broken away but it originally measured about 6 cm. long. It is 4.10 cm. across and 3.35 cm. thick. This artifact is not duplicated in the earlier collections. An analogous specimen was unearthed in the smaller of the Stege mounds (Loud 1924:Plate 19, Fig. 15).

Unworked or slightly modified stone objects

Pebble hammerstone - An elongate pestle-like sandstone hammer, pecked or battered along one edge, was found 14 inches down. Its dimensions are: length 10.58 cm.; width 4.16 cm.; thickness 2.73 cm.

Pebble hammerstone - A small quartzite pebble hammer, modified by use only, is 4.64 cm. long, 3.85 wide and 3.30 cm. thick. It was pecked upon the surface.

Bone objects

Awl, deer or elk cannon bone, split head - The handle of this specimen consists of the quartered proximal end of the bone. The specimen is 11.70 cm. long. It was found at a depth of 12 inches.

Awl, deer or elk cannon bone, head intact - On this specimen the distal end of the bone of an immature animal forms the handle. The object is 10.89 cm. long and was recovered 21 inches down. No example of this form of awl was obtained in previous digging. However, flakers which may represent blunted awls of this type were found. This bone implement is of rare occurrence in California sites, being reported only for one Bay site (Emeryville) and one Santa Barbara County locality (Gifford 1940:168).

Awl, unclassifiable tip - A long sharp tip of a well-polished mammal bone awl was obtained at a depth of 36 inches.

Spatula - A highly polished bone object has a rounded tip and squared base. One edge is ground to a sharp cutting blade. It is 11.53 cm. long and came from a depth of 40 inches.

Spatula - A second spatulate object made from a section of split mammal bone is similar in form to the above but is sharpened on both edges. The butt is broken away but it appears to have originally measured about 9.35 cm.

Split mammal bone tools - Three splinters of bone are flaked along

the edges. Their depth provenience follows:

12-24 inches - 1
24 inches - 1
36-48 inches - 1

Antler objects

Wedge - A fragmentary wedge made from the base of an antler is beveled by grinding on one side. It is 8.78 cm. long. The specimen was found at a depth of 28 inches.

Wedge - A portion of the blade of a second wedge came from the 24-36 inch level.

Flaker (?) - A cut antler tine, 4.14 cm. long, may have served as a flaker though its tip is not noticeably scarred. This object was found at a depth of 17 inches.

Flaker (?) - A fragmentary tool made from a branched tine has a blunted working end which may indicate use as a flaker. It came from 18 inches down.

Curved blade - A well-polished section of a large curved blade was collected at a depth of 16 inches. Its width at the squared base is 4.15 cm.

Shell objects

The only shell items recovered during the 1954 excavations were abalone beads and ornaments found with a child burial (X-2) at a depth of 28 inches. The species of Haliotis is not identifiable in most cases but where it can be recognized it is that of the Black Abalone (*Haliotis cracherodii*).

Rectangular Haliotis beads - The fragmentary condition of many of the specimens made an exact count impractical, but approximately 100 were collected. Each has a central perforation. A selected sample yielded the following measurements:

length range: 1.-1.16 cm.
width range: .80-1.05 cm.
perforation range: .19-.28 cm.

Rectangular Haliotis beads - Two rectangular Haliotis beads each with two central perforations were found. In the first example the holes are side by side; on the second one is above the other. Their edges are plain. The dimensions are:

1.25 X 1.54 cm., perforations 25, 26 mm.
.96 X 1.23 cm., perforations 24, 28 mm.

No specimens analogous to these were collected previously. Four beads of this form were collected at one Early horizon site (C 107) in

the lower Sacramento Valley region (Heizer 1949:17); a few specimens have also been unearthed in the Santa Barbara region (Gifford 1947:29).

Circular Haliotis pendants, two central perforations - Four examples of this class of ornament were collected. One has shallow incisions around the border of one surface; the remainder have plain edges. Their diameters are: 1.28, 1.60, 1.80 and 2.27 cm.

Feature

A single feature (designated X-1) was noted. This consisted of a possible house floor which covered three pits and parts of a fourth. It has been described as a layer of "reddish brown clay, ash mixed with midden." No postholes were noted.

Burials

Five burials -- two adults, two children and one infant -- were uncovered.

Burial X1 - Infant, depth 16 inches; position indeterminate but appeared to lie on back, with skull oriented south-southeast; no associated artifacts.

Burial X2 - Child; depth 28 inches; flexed on face with femora bent up under body and arms up under chest and oriented northeast; square Haliotis beads in single row around neck, shingled mass of beads under chin; red ocher.

Burial X3 - Adult female, depth 36 inches; tightly flexed on left side and oriented to west; red ocher but no grave goods.

Burial X4 - Child; depth 11 inches; flexed on left side and oriented southwest; red ocher but no associated artifacts.

Burial X5 - Adult female, depth 27 inches; tightly flexed on right side and oriented north; trace of red ocher under pelvis but no accompanying mortuary offerings.

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Appendix G

FISH REMAINS FROM THE STEGE MOUNDS, RICHMOND, CONTRA COSTA COUNTY, CALIFORNIA

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Introduction

This is a report on a collection of fish remains from the Stege mounds, Richmond, Contra Costa County, California. These remains appear to be 15 of those mentioned in a report on the archaeology of the Stege mounds by Loud (1924:359), who stated that "only 17 specimens of fish bones were large enough to attract attention and be saved." Loud did not indicate from which of the two mounds these fish remains had been obtained, but he noted, "That the larger mound [CA-CCo-300] was preeminently the location of a fishing village is proved by the large quantities of net sinkers, 61 per cent of all artifacts being such implements. As relatively fewer sinkers but many more bird bones were found in the smaller mound [CA-CCo-298] an interesting contrast of mode of life is apparent."

The Stege mounds (see Loud 1924:356, Fig. 1) were situated about 1.6 km. (1 mi.) eastward from the Ellis Landing shellmound (CA-CCo-295; see Nelson 1910), about 5.6 km. (3.5 mi.) northward from the West Berkeley shellmound (CA-Ala-307; see Wallace and Lathrap this volume), and about 8.8 km. (5.5 mi.) northward from the Emeryville shellmound (CA-Ala-309; see Uhle 1907; Schenck 1926).

Fishes represented

The 15 fish remains of this collection (13 of which are identifiable) are incomplete or fragmentary. They represent 3 (or possibly 4) species, referable to 3 genera and 3 families:

Smoothhound Sharks--Triakidae
Leopard shark, *Triakis semifasciata* Girard

Sturgeons--Acipenseridae
White sturgeon, *Acipenser transmontanus* Richardson
Green sturgeon, *Acipenser medirostris* Ayres

Croakers--Sciaenidae
White seabass, *Cynoscion nobilis* (Ayres)

Leopard shark

(For notes on the leopard shark and for records of its remains at other archaeological sites, see Follett Appendix B this volume.)

Material: 2 vertebral centra; one shown in Pl. 1a. (Identified from the pattern of structures revealed by anteroposterior radiograph.)

Sturgeons

(For notes on sturgeons and for records of their remains at other archaeological sites, see Follett Appendix B this volume.)

Material: 1 ceratobrachial, 4 parasphenoid fragments, 2 pterygoids (one left and one right, from a sturgeon perhaps 178 cm. (70 in.) in total length; Univ. Calif. Lowie Mus. Anthro. No. 1-23280), 1 rib, and 1 dorsal scute. (These sturgeons remains do not appear sufficiently distinctive for differentiating white sturgeon from green sturgeon.)

White seabass

The white seabass (see Skogsberg 1939:19, Fig. 2) is a good food fish. It is known to attain a total length of 152 cm. (5 ft.), according to Miller and Lea (1972:154), and a weight of 38 kg. (83 lb. 12 oz.), according to Hulbrock (1974:26).

Material: 1 fin ray (caudal?) and 1 vertebra (caudal, from a white seabass about 114 cm. (45 in.) in total length and perhaps 13.6 kg. (30 lb.) in weight; Univ. Calif. Lowie Mus. Anthro. No. 1-23527; Pl. 1b). (For length-weight relationship, see Hulbrock 1974:27.)

Records from other archaeological sites: Arroyo Sequit, Los Angeles Co. (Mitchell 1959:153); Century Ranch sites, Los Angeles Co. (Follett 1963a:305; 1968b:136); Chumash village site Ven-87, Ventura Co. (Fitch 1975); Goff's Island, Orange Co. (Mitchell 1959:153); Little Harbor site, Santa Catalina Island (Meighan 1959:402); Malaga Cove, Los Angeles Co. (Walker 1952:40; Mitchell 1959:153); Rincon Point site SBa-1, Santa Barbara Co. (Huddleston and Barker 1975); San Nicolas Island (Fitch 1969:66, 69; Greenwood and Browne 1969:47); Shelter Hill, Marin Co. (Follett 1974:146); Shisholop, Ventura Co. (Fitch 1969:61, 66); Strawberry Point, Marin Co. (Follett 1957:68); Ventura inland site Ven-168, Ventura Co. (Fitch 1975).

Discussion

This collection is too small to be considered representative of the fish material that presumably was buried in the Stege mounds. The large number of stone sinkers (527) recovered from the larger mound

suggests that the 17 fish remains recorded by Loud constitute only a small fraction of the fish material that might have been recovered.

The leopard shark and both species of sturgeon may enter shallow water at times. The white seabass is known to enter water as shallow as 1.2 m. (4 ft.), according to Feder, Turner, and Limbaugh (1974:41). This small collection of fish remains therefore does not necessarily reflect the far-offshore fishing hypothesized by Loud (1924:363) on the basis of the comparatively heavy stone sinkers recovered from the Stege mounds.

These stone sinkers may have been used on gill nets or on seines. The white seabass is regularly taken by hook and line and by gill net (Thomas 1968:8). Since this species enters bays and coves to feed at night (Cannon 1964:124) and since it may enter shallow water, the specimen(s) represented might have been taken by seine.

The paucity of remains of the white seabass found at the Stege mounds may not be significant, in view of the small size of this collection. But only a few remains of this species were found at other sites on San Francisco Bay: the Emeryville shellmound (material identified March 1975 by W.I. Follett), the Shelter Hill site (Follett 1974:146), and Strawberry Point (Follett 1957:68); and none were found at the West Berkeley shellmound (Follett Appendix B this volume). This appears to indicate that even in aboriginal times white seabass were taken only occasionally in San Francisco Bay.

Acknowledgments

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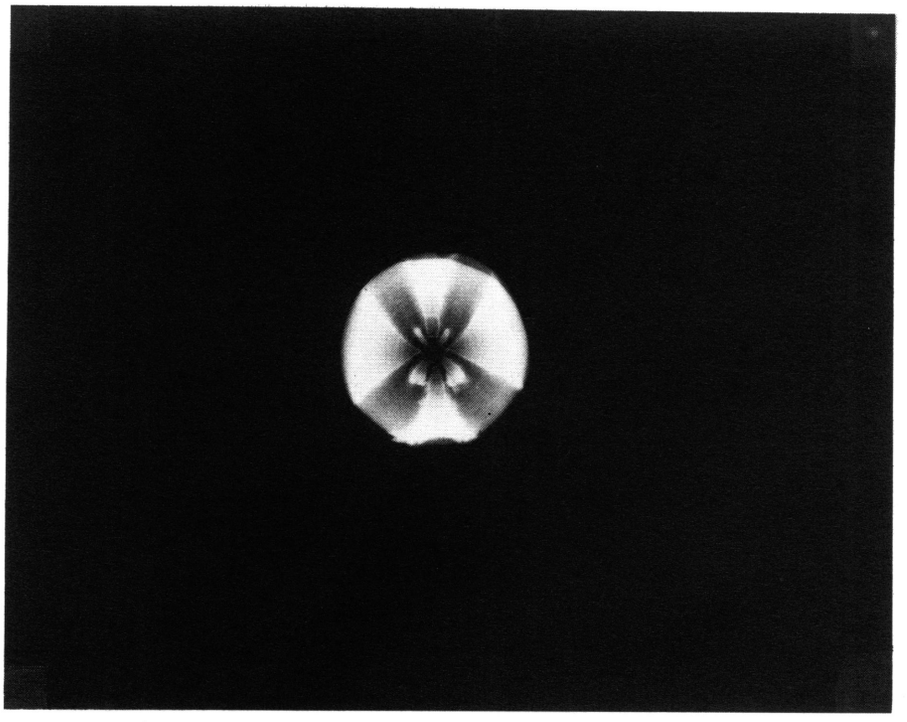
Explanation of Plates

Plate 1a — Vertebral centrum, length 7.8 mm., diameter 11.5 mm., representing an adult leopard shark (*Triakis semifasciata*). (Print from anteroposterior radiograph.)

Plate 1b — Vertebra (caudal), length 39 mm., representing a white seabass (*Cynoscion nobilis*) about 114 cm. (45 in.) in total length and perhaps 13.6 kg. (30 lb.) in weight; Univ. Calif. Lowie Museum Anthro. No. 1-23527.



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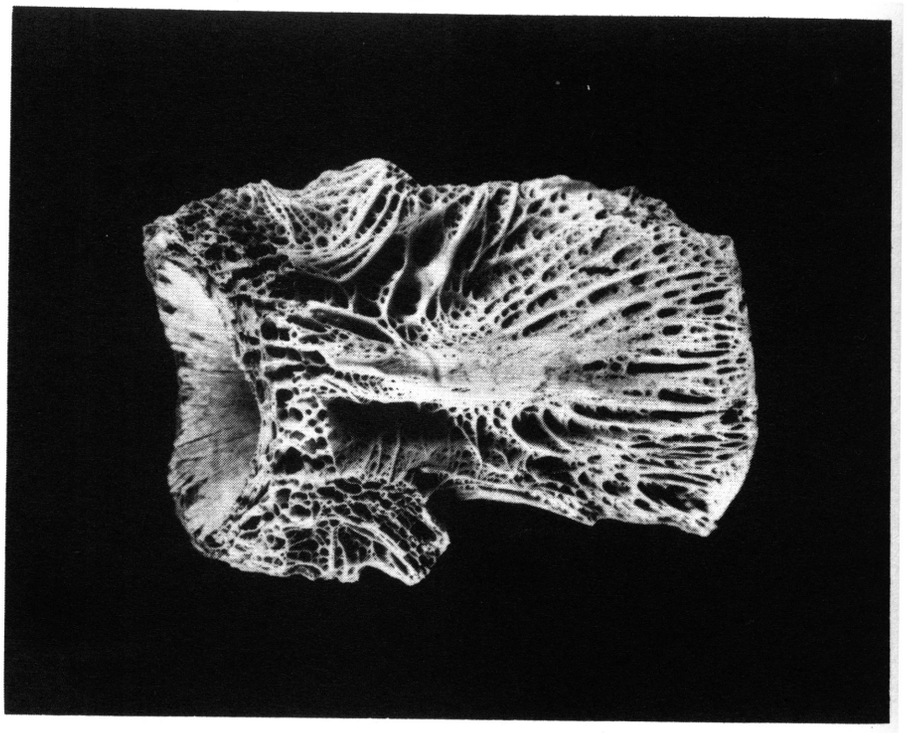

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