EXPLOITATIVE ECONOMICS AND CULTURE CHANGE IN CENTRAL CALIFORNIA

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INTRODUCTION

Problems of culture change in Central California have long engaged the attention of archaeologists. The result of this interest has been a remarkably detailed regional sequence as well as a number of unique studies in the composition of ancient mound deposits. The area referred to as Central California in this paper lies within approximately a one hundred mile radius of San Francisco, and it is the purpose of this report to attempt a description of culture change within this region as seen through changes in the exploitative economy. The discussion relies primarily upon published sources, though it must be realized that a vast amount of unpublished data exist for this area.

This paper will also provide a critique of the regional sequence which has become definitive for the area—the Central California sequence. In a sense, this review and the discussion of the bases for culture change in the shifts in the exploitative economics are two sides of the same issue because the Central California sequence postulates changes in culture on an entirely different basis. The primary basis of the sequence is bead typology, together with certain burial features, and the question is whether these avowedly stylistic elements point in all instances to the changes in Central California culture. Thus it will be necessary not only to discuss changes in the exploitative economy, but also to at least summarize the existing bases for the Central California sequence.

ARCHAEOLOGY IN CENTRAL CALIFORNIA

Systematic archaeological work in the region began in the early years of the present century. A surprisingly intensive survey of the shellmounds of the San Francisco Bay area was completed in 1908 by N. C. Nelson (1909) during which a total of 425 shellmound sites were located and plotted on a map. Although he had located this great number of sites, Nelson pointed out that at one time there had probably been many more such sites, but these had been leveled as the city of San Francisco expanded. Since the time of Nelson's survey most of the mounds he located have also been destroyed due to the development of commercial and residential areas. Excavations were also carried on in the Bay area at the Ellis Landing shellmound (Nelson 1910), the Emeryville shellmound (Uhle 1907; Schenck 1926), and the Stege mounds (Loud 1924). Early efforts at quantitative analysis of shellmound constituents were undertaken by Nelson at the Ellis Landing mound and by Gifford (1916), who collected samples from eleven Bay area mounds as well as from three other California mounds. Although the

main purpose of these quantitative samplings was an attempt to infer the approximate antiquity of the shellmound culture through rates of debris accumulation, analysis of mound constituents has continued to stand as one of the major continuing efforts in Central California archaeology, but more recent work with this method has been based upon the subsistence implication of the data.

Archaeological work inland from the Bay began in the latter part of the nineteenth century. Artifacts collected by H. C. Meredith in the late 1800's were shown to W. H. Holmes when he visited California in 1898. By 1900 P. M. Jones (1923) was excavating mounds in the vicinity of Stockton under a commission from Mrs. Phoebe Apperson Hearst. In 1929 W. E. Schenck and E. J. Dawson published the results of their survey of 43 sites in the Lodi-Stockton area, many of which Dawson had excavated earlier.

These surveys and excavations took place before archaeological techniques had reached any real degree of refinement; however, it is to the credit of these early workers that, for the most part, they recognized the value of vertical stratigraphy and tried to record the levels and associations of burials whenever possible. This was done with particular success at the Ellis Landing mound and the Emeryville shellmound. It must be remembered, too, that in the Bay area these excavators were often forced to act hurriedly in the face of the imminent destruction of these sites. In the case of the Emeryville shellmound, the excavator took notes while steamshovels were actually at work clearing the mound away for a factory!

Later work was, of course, much more precise, but even today the data accumulated by these early excavators remain our main source of information concerning Bay area occupations. The first work to proceed toward a coherent scheme of Central California prehistory was undertaken by J. B. Lillard and W. K. Purves in their report (1936) of the results of a program initiated by R. Van Valkenburgh, a part time librarian at Sacramento Junior College in 1933-34, in the Sacramento region; this was followed closely by the excavations of J. B. Lillard, R. F. Heizer and F. Fenenga (1939) in roughly the same area. The series of sites excavated in the Sacramento area provided the key typologies and sequences for the formulation of the Central California sequence which, though modified by later evidence, remains the basic outline of the spatial and temporal relationships of prehistoric Central California.

Since this original work was completed several detailed summaries have been produced concerning these and other data, mainly to amplify the substance of the Central California sequence. Recent surveys in the Napa Valley (Heizer 1953) and excavations in the adjacent North Coast region of

Marin County (Beardsley 1954), as well as intermittent work on the few remaining Bay area sites, have suggested additions and modifications to the sequence scheme. The most recent formulation of the Central California sequence has been presented by Beardsley (1948, table 1).

The Central California sequence

The chief merit of the Central California sequence is that it provides both a spatial and a temporal framework for the interpretation of the archaeological data. Classifying archaeological data from California has always been a problem. While considered as generally "Archaic" by many, California cultures tend to show certain specializations which do not lend themselves to easy comparison with other Archaic cultures of North America. With this problem in mind, Heizer (1949:2) introduced a new set of classificatory terms to describe the Central California region: "horizon," "province," "facies," etc. He states concerning them: "The introduction of a new series of terms...is intentional, since to employ either the Midwest or Gila Pueblo terms would imply strict semantic equivalence." Nevertheless, the usage of these new terms does, in at least a general way, classify the data in much the same taxonomic manner as the Midwest and Gila Pueblo systems.

Culture change (or lack of it) has been a subject of considerable interest to archaeologists in this area. Beardsley (1948:1) points out:

"For many years, the fundamental theme of California archaeology was its lack of recognizable change. The most frequently cited examples of this cultural stagnation were the shell mounds around San Francisco Bay. These were first examined almost half a century ago for evidence of evolution in culture. Since artifacts of excellent workmanship frequently appeared in the lowest levels, it was properly insisted that no site showed convincing evidence of local cultural evolution. But the opinion that evolutionary change was unproven soon changed imperceptibly into the reiterated thesis that all cultural change was lacking."

Most of the efforts undertaken to set up and revise the Central California sequence were geared to this problem, and the mere existence of a sequence presupposes that changes did, in fact, occur. But these changes are actually only changes in bead types and burial forms, so it was still possible for Beardsley (1954:104) to state: "The dynamics of culture change in Central California are but poorly understood."

The changes which occur in bead types throughout the sequence are not unimportant; indeed, such a typological sequence is a prerequisite if one is to speak of a sequence at all. But it is the view of the author that

one of the reasons the processes of culture change in Central California are not well understood is because the primary elements used to form temporal and areal patterns have been the very elements least directly related to the problems of subsistence in the various regions of Central California—namely, beads. There has, however, been some awareness of this problem by the Central California archaeologists themselves, as evidenced by the statement:

"Haliotis ornaments and beads...were non-utilitarian objects, yet they are extremely important to us in their role as cultural classifiers or 'time-bearers.' The point to be made here, then, is that we do not propose our cultural sequence as a cultural picture of antiquity; it is mainly a demonstration of cultural succession using the total mortuary complex as the datum" (Lillard, Heizer and Fenenga 1939:2).

The Central California sequence provides a detailed chronological and spatial framework for this area, hence all discussion of culture change must be in terms of its categories. But the taxonomic character of the sequence, based as it is upon bead types, at times tends to mask changes in culture by other lines of evidence more closely related to information regarding subsistence.

The quantitative analysis of mounds

R. E. Greengo states (1951:1): "A method of attacking the problem of the nature and extent of aboriginal man's exploitation of his environment is by quantitative analysis of refuse deposits." Certainly this method has received a tremendous concentration of attention in Central California since the beginnings of archaeology there. There has been much heated debate over the relative merits of various types of sampling techniques, so much so that this area of study has tended to become separate from the main stream of archaeological interests. It has therefore become very difficult to utilize the data obtained in these studies for any kind of cultural analysis. In most of the cases where such quantitative studies have been made there is little or, more commonly, no mention of the artifactual or stratigraphic evidence which occurred at the site. There is one exception to this statement—the McClure site—which will be discussed below.

The central issue of the technical debate over sampling methods was raised by Schenck (1926:171) as a result of his excavations at the Emeryville shellmound:

"Where large masses of homogeneous material are dealt with, typical sampling is easy.... Yet the mound at Emeryville is essentially a mass of pockets, now of ash, sometimes of clam, or again of mussel, etc. There are certainly hundreds of square feet of cross-section where the pocket is more truly representative of the content than is the balance of the area."

This statement came at a time when a methodological debate over quantitative midden analysis between Nelson (1910), who utilized analysis by volume, and Gifford (1916), who upheld analysis by weight, was in its final phases. While it is difficult to comment on the effects of Schenck's criticism, one does note in the literature that there was silence on this issue of methodology until 1946, when a short paper by S. F. Cook, largely stimulated by the shellmound studies in Central and South America, reopened this area of study. Cook and others noted that the method of analysis by volume utilized by Nelson failed to account for the highly variable textures of deposited shells of differing species in a midden. For example, while mussel shells tend to crumble into a relatively fine-grained mass, clam and oyster shells, being thicker, tend rather to retain their shape even under the pressures of a mound accumulation.

Thus analysis by weight gained favor, and a series of systematic excavations for midden samples followed in an effort to provide a quantitatively sound method of analysis of mound constituents. The important thing to note is that Cook's paper stressed the nutritive values of the various species of shellfish found in the middens. In the earlier studies of Nelson and Gifford this aspect had not been overlooked, but it was to the possibilities that this method seemed to offer for the dating of the sites that these workers gave their greatest attention.

Schenck (1926), in his description of the Emeryville shellmound, also raised the possibility of seasonal occupations on the Bay mounds, a possibility which, if accepted, would completely upset the dates being postulated for these occupations since one of the fundamental assumptions of both Gifford and Nelson was that of a constant, rather than an intermittent, rate of midden deposition. In this regard it is worthwhile noting the remarkable study carried out by H. Howard (1929) on the remains of avifauna at the Emeryville site. She demonstrated quite conclusively, on the basis of the known migratory patterns for the avifauna which were predominant in the remains of the site, that the Emeryville shellmound site, as well as other similar shellmound sites nearby, was occupied the year round. In spite of this convincing demonstration by Howard, however, there may be something to be said for the proposition that perhaps Schenck's Emeryville report raised questions concerning mound analysis (and particularly concerning the validity of samples obtained from mounds) which could not be dealt with until the whole study had been put on a new basis—the basis of adaptive exploitation later suggested by Cook.

In 1947 Cook and Treganza excavated and compared samples from a Bay and an inland mound; the following year these two workers first sampled a small mound in the Sacramento Valley (Peterson III) and then excavated the mound

in its entirety in order to compare the accuracy of their samples with the actual total mound composition. They calculated that with 68 samples there occurred an error of ±2.95 per cent in the estimates of the relative weights of the mound constituents, with 24 samples the error increased to roughly ±5 per cent, and with 6 samples to about ±10 per cent. They suggested that samples be taken from various parts of the mound in order to give some impression of the internal variations in density, thus meeting Schenck's earlier skepticism concerning the irregular compositon of mounds. At the conclusion of their work Cook and Treganza wrote (1948:292): "The study of mound Peterson III indicates certain general principles which may be applied, with appropriate local modification, to any similar aboriginal site."

Later work by Cook and Heizer (1951), at an Amador County cave site in the Sierra foothills, was conducted along similarly systematic lines. Four samples were taken from the dry midden deposit within the cave and the organic content of these compared with the organic content of 2 samples taken from the more moist, exposed midden in front of the cave. While about 4.5 per cent of the dry weight of the interior deposit material consisted of perishable organic material, virtually no such organic debris was noted in the 2 samples taken outside the cave, a strong suggestion of the conditions one would expect in the open sites of Central California.

Only the artifacts from the Peterson III mound have been described in published form. Generally, when quantitative midden analyses have been performed, however, no really adequate account of the relationship of the artifact assemblages to the midden materials has been presented. There has been such intense concentration on the technical problems of midden analysis up till now that the relationship of the various midden constituents to the activities of the people who occupied the sites has been left largely unexplored. For this reason it will not be possible to make much use of the information arrived at by this method of analysis in this discussion.

FOOD RESOURCES IN CENTRAL CALIFORNIA

Principally this involves a discussion of the shellfish and acorn resources, but it should be remembered that Central California was an area rich in an enormous variety of wild plant and animal species, nearly all of which were exploited to varying degrees. Subsistence specialization in this region has always meant, as the archaeological evidence will show, that a group of people depended more heavily on one type of wild food than they did on others, not that they specialized on one type of wild food to the exclusion of others.

Shellfish

The following genera and species of shellfish are present in shellmounds along the Bay and Marin County coasts:

Soft-shelled Clam (Macoma nasuta)
Soft-shelled Mussel (Mytilus edulis)
Oyster (Ostrea lurida)
Hard-shelled Clam (Tapes staminea)
Horn Shell Snail (Cerithidea californica)
Hard-shelled Mussel (Mytilus californicus)
Cockle (Cardium corbis)
Abalone (Haliotis rufescens)
Long Clam (Mya arenaria)
Clam (Saxidomus nuttali)

Of the above listed genera, only the first three mentioned appear in large quantities and of these only the first two appear in large quantities throughout nearly every excavated shellmound in the San Francisco area.

In their natural habitats Macoma nasuta, Mytilus edulis, and Ostrea lurida are all present in large quantities the full year round. Of the three, M. edulis is the easiest to gather, for being a mussel it clings to rocks in the tidal zone and needs only to be scraped off. It is a form which thrives on wave shock, hence its abundance on the more exposed Marin County coast as well as in the Bay. Offsetting the ease with which this genus is gathered is the fact that the individual mussel supplies on an average only about one-eighth the weight in meat provided by the individual clam (M. nasuta). Though more difficult to gather because it burrows in the sand, M. nasuta rarely occurs below 18 inches and so is taken without much effort; the only disadvantage is that it takes in considerable sand and must be allowed to soak in a container of fresh water for a while before it can be eaten. Both M. nasuta and O. lurida are quiet water genera (though each has a high degree of tolerance) so they tend naturally to be plentiful in the Bay. The natural recolonization rates of all three of these genera is extremely high, and it seems unlikely that the Indians could ever have depleted the supply. The maximum population densities of these three genera are very high; for example, M. nasuta is often as dense as 20-30 per cubic meter.

Systematic samplings have shown that all molluscan genera appear in the highest densities in the central areas of San Francisco Bay; they seem to be slightly less abundant at the southern end of the Bay and appear still less frequently at the north end (Packard 1918). This situation is generally reflected on Nelson's map (1909) of shellmounds in the Bay area, with the highest density of sites appearing on both the east and west shores of the Bay just north of the Golden Gate and the lowest site densities appearing around San Pablo Bay to the north and in the waters near the Palo Alto area to the south. In fact more sites are seen at the south

end of the Bay than at the north end (where in fact almost no sites at all appear), thus correlating still further with Packard's finding. Packard attributed the differing population densities of these portions of the Bay to two main factors: (1) the central portion of the Bay shows the smallest annual range of temperature fluctuations; and (2) the central portion of the Bay shows the smallest range of fluctuations in salinity. No doubt other factors, such as shore and bottom conditions, could also be taken into account concerning this matter, but it does appear that factors in the natural ecology of San Francisco Bay did much to influence the relative densities of aboriginal population abong the shores of the Bay.

At various levels in a few of these shellmounds there appear to be differing concentrations of genera. For instance, at the three large sites of Emeryville, Ellis Landing, and the West Berkeley mound—all quite close to each other along the central portion of the Bay—there is a sharp increase in the appearance of M. nasuta (Greengo 1951). At Emeryville and the West Berkeley mound Mytilus edulis remained abundant, but at the Ellis Landing mound Greengo noted that M. nasuta tended to replace Mytilus edulis. Ostrea lurida, a rocky bottom genus like Mytilus, tends also to decline in frequency as Macoma becomes more prevalent at these sites. Greengo contends that these variations are due to natural causes (i.e. isostatic shifts which are known to have occurred along the coast during periods of prehistoric occupation) which brought about differing rates of sediment depositon by rivers leading into the Bay causing fluctuations in the abundance of molluscan life; essentially this is the same argument presented by Packard. However, recent studies on shellfish tolerances raise doubts as to whether these shifts in the rates of silt deposition actually had any significant effect on the availability of these molluscan genera (R. G. Johnson, personal communication). This is even more doubtful on the Marin County coast where there are no large rivers to carry and deposit silts. To go more deeply into this ecological problem would be to venture beyond the scope of this paper, but it is sufficient to point out that there is at least some case to be made for cultural factors affecting this shift in shellfish frequencies. In rightfully discarding Gifford's much earlier (1916) concept that the mound dwellers had overtaxed the supply of one species and been forced thereby to utilize another species, later scholars have perhaps gone too far in their emphasis on ecological rather than cultural determinants for these shifts. Certainly no one has concentrated on looking for cultural factors as yet, so it is not possible at this time to point to concrete possibilities in the assemblages available from these sites (mainly because the proveniences of the artifacts and the levels of the shifts in shell frequencies have never been correlated).

Only at the McClure site on the Marin County coast has such a correla-

tion been provided. The cultural implications of the data from this site will be discussed in the final section of this paper.

Acorns

The following description of acorn resources is presented only in the degree of detail needed for this discussion. For a fuller account of the acorn resources of California in general and Central California in particular the reader is advised to examine the chapter pertaining to acorn resources in Baumhoff's (1963) paper on ecological determinants of aboriginal California.

Ethnographic sources for this area are unanimous in their expression of the importance of acorns to the subsistence economy of the Indians. Some of these sources provide detailed accounts of the preparation of acorns for consumption, and a few even supply information concerning the preferences of the Indians for certain species of acorns over others. Mound remains, however, provide little direct evidence of acorn and other vegetal remains. The controlled study by Cook and Heizer (1951) of an Amador County cave showed graphically the difference between the abundant amounts of organic material recoverable from a dry, sheltered deposit as compared to the lack of organic materials in the exposed part of the midden. Since, without exception, the mound sites of Central California are exposed, one should not be surprised at the scarcity of vegetal remains. The most to be hoped for at the present time in the way of direct evidence is the "greasy" texture of the mound soil so often mentioned in the literature as possibly having been caused by the natural oil from acorns. However, the relative frequencies of mortars and pestles in different locations and periods can provide at least some measure of indirect evidence for the degree of reliance by groups on acorns and other seeds.

The following species of oak are known to exist in large numbers in the Central California area: Englemann Oak (Quercus englemannii), Blue Oak (Q. douglasii), Black Oak (Q. kelloggii), Live Oak (Q. wislizenii), Valley Oak (Q. lobata), and Tan Oak (Lithocarpus densiflora).

Oak is so typical of Central California that Benson (1957) classifies this region of the United States as within the "California Oak Woodland" habitat. He is careful to note, in dealing with these trees, that one must realize at least some of these species tend to intergrade at their distributional frontiers. That is, these species must actually be regarded as different genetic concentrations which exhibit a sharing of certain characteristics wherever they meet. Without exception acorns ripen in the fall, with the greatest abundance generally appearing around October

(although this may vary locally). Some of these species produce acorns only biennially, but total production seems to have been abundant in most areas every fall.

Barret and Gifford (1933), in their study of the Miwok, were able to show that the primary preference of the Indians was for Black Oak and Live Oak acorns. Next came acorns of the Valley Oak; these did not crack open so readily and tended to mash when pounded. And finally came acorns of the Blue Oak, which made a watery soup and bread or biscuits which tended to crumble easily. Baumhoff (1963), carrying this kind of investigation even further, found it possible to scale native preferences (preferred =1, commonly used = 2, undesirable = 3) as follows:

Tan Oak = 1.0	Blue Oak = 1.5	Interior Live Oak = 2.3
Valley Oak = 1.9	Coast Live Oak = 2.0	Black Oak = 1.5

Other food resources

Obviously other foods besides shellfish and acorns were important to the Indians of the Central California region. Not only early explorers but late visitors as well were quick to notice the abundance of wild game. In particular, tule elk (i.e. marsh elk), mule deer, and waterfowl were common. If the Miwok can suggest an example, techniques for drives, snares, and nets were very highly developed for wild game formed an important dietary supplement. The remains of wild game as well as projectile points appear in both inland and coastal mounds, but precise statistics for faunal remains are still lacking in all but a couple of site reports. At the Emeryville shellmound, the Stege mounds, and the Ellis Landing mound the remains of sea mammals such as seal, sea otter, and (at Emeryville) some whalebone are reported, though again quantitative data are lacking. Perhaps the dearth of this type of quantitative archaeological data is, at least in part, a function of the similar lack of quantitative information regarding subsistence patterns in the ethnographic literature. Without any specific ethnographic situations to compare his data against, the archaeologist is understandably less likely to take pains to collect and analyze this kind of evidence.

The sites provide little direct information concerning the importance of fishing to the Indians, for fishbone tends to deteriorate rapidly in these exposed middens. However, the presence of various types of harpoon points, fishhooks, and grooved stones which probably served as net-sinkers, as well as the discovery in several sites of the carbonized remains of nets (on one occasion with the sinkers attached), suggests a developed awareness of fishing techniques. The ethnographic accounts of the Miwok show that a variety of fishing techniques were utilized, with the emphasis on communal

fishing where, in one way or another, the fish would be driven toward large nets in which they would be taken. This worked especially well in securing anadromus fish, which were once abundantly present in this area. Salmon were available well into upland Miwok territory, and sturgeon, although no longer present around San Francisco, was taken along the Sacramento Plain, where sturgeon plates and artifacts made from sturgeon plates have been found in several sites. Again, however, there exists a shortage, both in terms of archaeology and ethnology, of accurate quantitative data for making precise judgments as to the relative importance of this type of food in the aboriginal diet.

STRUCTURAL REMAINS IN CENTRAL CALIFORNIA

The matter of shelter could not have been too critical for the Indians of Central California, for the climate is outstanding in its mildness. In the Cosumnes Basin, for example, the mean monthly temperature for the coldest month, January, is 46.4 degrees Fahrenheit, with a record low of 23 degrees F. The mean monthly temperature for the warmest month, July, is 76.6 degrees F., with a record high of 114 degrees F. The mean annual precipitation for the Cosumnes Basin is 18.67 inches, with records ranging from 33.6 to 9.05 inches, with most of the rainfall occurring in the winter and spring (Lillard and Purves 1936).

However, periodic fogs and rains which tend to be heavy make shelter of some kind necessary for comfort, and the ethnographic sources provide detailed accounts of the various house types in use. The description of structural types is one of the best handled aspects of the ethnography of Central California, and it is without question one of the most poorly documented aspects of the archaeology here. Only two instances exist in the published literature of house structures which have been described for Central California. One was at Ala-328, where it was possible for W. Wedel (unpublished field notes) to define a house structure of probable Middle Horizon contexts. The careful description of this house suggests that, despite the technical difficulties presented by the peculiar compacting of refuse in many Central California sites, it may at times be possible to describe such structures. Unfortunately, no plan drawings are given for this building, but at Mrn-115 (the Thomas site) such a plan was recorded. Here charred timbers were found which marked the plan of a small, circular house set in a shallow pit. Structural evidence such as the circular central hearth, clay smoke-hole rim fragments, and earth heaped along the outside edge of the wall suggested to the excavator, C. W. Meighan (1953), that the house was of a late type not much different from house types reported ethnographically among the Pomo and Northern Maidu. Its general similarity to a type of house used by the Miwok is also striking.

These are the sole examples available in all the published literature regarding the archaeology of Central California of the careful application of horizontal profiling to determine structural plans. Mention should, however, be made of the large and exceptionally well-defined (though as yet unpublished) structural plan at Col-1 (the Miller site), excavated by the University of California in 1936. This housefloor, outlined by a circle of post-holes, was of Late Horizon provenience, possibly built by the ethnographic Patwin, although this association has never been demonstrated in any final way.

Of archaeological information concerning storage facilities and structures there is none. This is a most serious gap in our understanding of ancient Central California cultures and particularly of our understanding of the processes of culture change (this problem will be dealt with in detail in the final section of this paper). Ethnographic sources often provide excellent descriptions of such facilities and these supply clues to the archaeologist of what to watch for in his excavations. It is proposed here that attention to the horizontal relationships at sites in Central California, with special interest in settlement and particularly storage patterns, may assist in suggesting definite answers to some of the most perplexing questions of culture change in this region.

It should be pointed out, however, that any attempts to define the remains of structures in Central California are bound to encounter severe technical difficulties. Intractable soils, disturbed or poorly preserved floors, and patchy or incomplete posts, pits, and other structural remains have plagued most past efforts at this kind of work, and it will probably never be possible to organize any real "typology" of structures in this region. At the most, all one can probably hope for are isolated examples of storage or residential structures, bare hints of the variety of structures actually used.

HORIZON "TIME-MARKERS" IN CENTRAL CALIFORNIA

Since excellent summaries of the data concerning the "time-markers" and typological bases for the Central California sequence are available in Heizer and Fenenga (1939) and Beardsley (1948; esp. 1954), it would be redundant to present more than the essential framework here. The tables presented below are to be regarded only as simplifications based solely upon published data. Using this same approach, it is possible to go on to show the similarities and differences in ornament styles between the different subregions, and finally between the various sites themselves. This aspect of Central California prehistory has been extensively covered in the sources mentioned above.

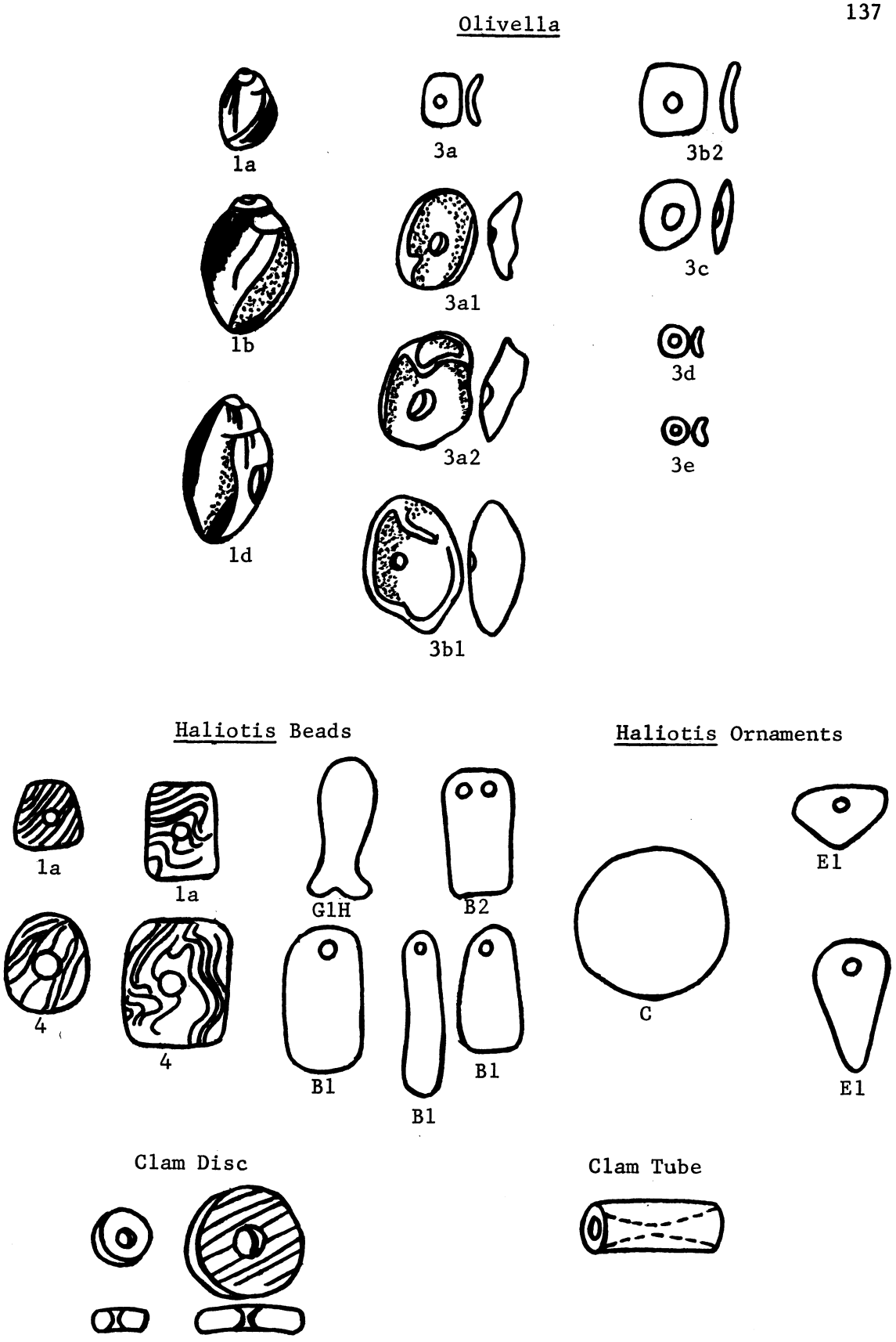

Figure 1

"Time-Marker" Beads and Ornaments
(after Lillard, Heizer and Fenenga 1939; Beardsley 1954)

As discussed above, the precise bead typology which is the basis for the Central California sequence is exceptional and commands attention. While shell beads are perhaps easier to analyze typologically than pottery because there are fewer variables involved, this analysis is still far from simple. Illustrated in Figure 1 are the major types of shell beads which form the basis of the Central California sequence.

The Early Horizon

This horizon is known in published form from only four sites: Sac-107 (Windmiller); SJo-56 (Phelphs); SJo-68 (Blossom); and SJo-142 (McGillivray). All of these sites are located on or near the Mokelumne River and, except for the Windmiller site, they are all very close together. These four sites comprise the Windmiller Facies; Beardsley (1954:63) rightly refers to the stratigraphic associations of these sites and others nearby as the "kingpin" of the Central California sequence. These sequences and associations will be summarized in the succeeding section.

In addition to the bead associations, the modes of burial present are also highly diagnostic for the horizon. The burial pattern from this horizon is without question the most distinctive for any time level in Central California. Fully extended burial—face down, arms at the sides with hands brought together under the pelvis, legs tied together at the ankles, hands sometimes bound as well—was the pattern for 93.7 per cent of the 267 burials found. Eighty-seven per cent of the burials were oriented to within five degrees of true west. Artifacts were associated with 78 per cent of the burials for which adequate records exist (187). These artifacts show "in general a high degree of elaboration" (Beardsley 1954:66), with shell beads, flaked projectile points, and quartz crystals being the usual inclusions. As the number of burials might suggest, at least three of these sites (and perhaps the fourth as well) were almost certainly cemeteries, all of them being low rises of ground just high enough to escape the periodic flooding of the Sacramento Delta marshes. So it is still an open question as to what degree the apparent "functional specificity" of these sites was a function of specific social practices or the peculiar Delta environment. It may be, for instance, that Early Horizon burials may be present elsewhere in the Central California area in less concentrated groups—that this concentration may have been partly a function of a type of terrain (i.e. heavy swamp) not seen much elsewhere in Central California.

Charmstones are plentiful and varied in this horizon; there being fourteen distinct types made of many different kinds of stone. Nearly all of these charmstones are extremely well finished. Included among these types were both double and single ended phallic charmstones.

Early Horizon bead frequencies in the Sacramento Valley:

Olivella	1a	-	49 occurrences[1]
	2b	-	22
	1b	-	2
	3b	-	1
Haliotis	1a	-	71
	2	-	4

A series of C-14 dates is available from SJo-68 (Blossom site) which may very well date Early Horizon materials. One is a combined sample which yielded a date of 4052 ± 160 B.P.; two other samples provided dates of 4100 ± 250 and 4350 ± 250 B.P. These suggest something of the age of the Early Horizon, at least in its terminal phases.

Another line of evidence which supports these C-14 dates is the heavy degree of mineralization noted for the bones which were recovered from the Early Horizon burials. As in the case of fluorine dating, this procedure is useful only as a general check on the antiquity of the remains; it does not provide absolute dates in years. The chemical tests made on the bones from Early, Middle, and Late Horizon burials did not entirely agree with the sequence as it has been proposed on archaeological grounds, but further work with this technique may indicate what factors determined the aberrant results. Generally, the results of the analysis of the bone chemistry corroborated the general outlines of the sequence, but the difference between Early and Middle Horizon dates was not as great as had been anticipated. As it turns out, this finding is in general agreement with the results of C-14 analysis, for, as will be seen in the summary of Middle Horizon C-14 dates, there is much less difference in time from the Early Horizon than one might expect on purely cultural grounds.

The Middle Horizon

For the Middle Horizon a long series of C-14 dates is available from the coastal shellmounds. The dates recorded are:

C-690 (2 samples from Ala-328, the Newark site)	2588 ± 200 B.P.
	2090 ± 220 B.P.
L-187A (sample from SMa-77, University Village site)	2700 ± 350 B.P.

[1] As in all the succeeding charts frequencies of occurrence rather than the actual number of beads are given. This is because, with few exceptions, numbers are not given in the literature.

LJ-199 (sample from Ala-309, the Emeryville shellmound, 96-195 in. below present surface)	2310 ± 120 B.P.
L-187B (sample from SMa-77, University Village site)	3150 ± 300 B.P.
M-121 (sample from Ala-307, West Berkeley site, 96-108 in. depth)	2200 ± 400 B.P.
	2700 ± 300 B.P.
M-122 (same as M-121, 132-144 in. depth)	3210 ± 300 B.P.
M-123 (same as M-121, 144-156 in. depth)	2880 ± 300 B.P.
M-124 (same as M-121, 156-168 in. depth, west)	3500 ± 300 B.P.
	3700 ± 350 B.P.
M-125 (same as M-121, 156-168 in. depth, east)	3860 ± 450 B.P.
M-126 (same as M-121, 180-192 in. depth)	3140 ± 300 B.P.
M-127 (same as M-121, 192-204 in. depth)	2700 ± 400 B.P.
	3700 ± 300 B.P.

Notes on C-14 dates: As is apparent, these dates vary considerably. However, a possible interpretation of some cultural importance may be suggested by them. A number of these dates are very early and clearly overlap with the C-14 dates of Early Horizon materials. This possible overlap is also suggested by the relative degrees of mineralization apparent in the bones recovered from some of the sites of both Early and Middle Horizon affinities. So it may be, although the evidence available from burials and burial associations indicates a sharp cultural break between the Early and Middle Horizons, that other lines of evidence (C-14, mineralization of bone) point to no such break but rather a continuity of culture between these horizons. Thus these alternative lines of evidence make it increasingly difficult to describe cultural continuities or discontinuities in Central California solely on the basis of changes in modes of burial. The later C-14 dates are perhaps more representative of the actual Middle Horizon, but, more important, the succession of earlier to later dates points strongly to a similar continuous succession of culture change.

The sites known to contain components of this horizon are:

Ala-309 (Emeryville)
Ala-328 (Newark)
CCo-137 (Monument), uncertain
CCo-141 (Orwood #2)
CCo-150 (Vail Tract)
CCo-250 (Maltby)
CCo-259 (Fernandez)
CCo-283 (Potrero)
CCo-295 (Ellis Landing)
CCo-300 (Stege)
Mrn-76 (Greenbrae)
Mrn-232 (Estero)
Mrn-242 (Cauley)
Mrn-266 (McClure)
Mrn-315 (San Rafael)
Nap-1 (Goddard)
Nap-14 (Las Trancas)
Nap-32 (Kolb)
Sac-43 (Brazil)
Sac-60 (Hicks)
Sac-66 (Morse)
Sac-73 (Van Lobensels)
Sac-99 (Deterding)
Sac-107 (Windmiller)

Sac-113 (Calquhoun)
Sac-151 (Need)
Sac-157 (Wamser)
SCl-1 (Castro)
SFr-7 (Bayshore)
SJo-59 (Koontz)
SJo-68 (Blossom)
SJo-142 (McGillivray)
SMa-77 (University Village

Burial modes are noticeably more variable than in the Early Horizon. Flexed burials are common to all regions, but the degrees of flexure vary from extremely loose (knees bent) to extremely tight. Some cremations appear, but these are confined to the Sacramento Valley (this is of 1954, at which time a total of 464 burials belonging to this horizon had been uncovered, 18 of which were cremations; considerable work has been done since 1954, much of it not yet or only partly published, so these statements must remain tentative). No particular pattern of orientation has been noted, but the use of powdered ocher—especially red—in the graves becomes suddenly more lavish than it had been in the Early Horizon. The practice of burying unworked animal bones in or near graves, seen occasionally in the Early Horizon, also becomes much more common. Forty-one per cent of the 243 burials in the Sacramento region contained artifacts, while 75 per cent of the 28 burials in the McClure and Cauley sites in Marin County contained artifacts. The series of burials from Napa Valley is too small to be of use for percentages, and the data from most of the other regions either is not published or is less reliable. The presence of charmstones declines noticeably from what had been seen in the Early Period, particularly phallic charmstones which disappear completely. Objects such as charmstones now are generally "killed" before insertion in burials. Ornaments, as always, form the major type of burial offering, with green-backed abalone (Haliotis cracherodii) dominating sharply over red-backed abalone shell (H. rufescens) in the realm of Haliotis beads and ornaments. The frequencies for beads and ornaments are tabulated below.

		Sacramento and Napa valleys (inland)	San Francisco Bay (coastal)	Marin County coast
Olivella	3b	35	24	
	3c	31	11	17
	3b1	14	9	
	3b2	17	25	
	3d	4	7	1
	2a	4	7	
	1a	8	24	
	1b	7	4	
	3a2		1	
Haliotis	3	6		
Clam Disc			3	

Late Horizon: Phase I

A single C-14 date of 1229 ± 200 B.P. is available from site CCo-138 (Hotchkiss) in the Sacramento-San Joaquin delta region from a Late Horizon, Phase I provenience. Cook and Heizer (1962:1-2) regard Phase I as well under way by this date and suggest 300 A.D. as a likely beginning date for this period. So far no attempt has been made to use the C-14 method to learn whether the coastal and inland manifestations of this phase correspond at all in time.

The sites known to contain Phase I traits are:

Ala-309 (Emeryville)	Mrn-275 (Mendoza)
CCo-138 (Hotchkiss)	Sac-21 (Hollister)
CCo-250 (Maltby)	Sac-43 (Brazil)
Col-1 (Miller)	Sac-60 (Hicks)
Col-3 (Sandhill)	SCl-1 (Castro)
Mrn-76 (Greenbrae)	SFr-7 (Bayshore)
Mrn-242 (Cauley)	Sol-236 (Glen Cove)

Flexed burials continue to be important in all regions, but the tendency towards tighter flexure becomes apparent. Beardsley (1954) notes that artifacts accompany from 50 to 65 per cent of the burials. Cremation, which had been seen only in the Sacramento Valley in Middle Horizon times, now becomes more common and appears on the Marin County coast as well. As in Middle Horizon times, nearly all the cremations contain artifacts. The distinctive practice of burning acorns, matting, fibres, etc., before actual inhumation appears in the Cosumnes Valley (inland). Charmstones continue to appear, though not in large numbers (however, phallic types rather like those seen in the Early Horizon appear once again) for the tendency in this period was to include utilitarian implements like mortars, still "killed" as before, with burials in place of charmstones. Beads, as usual, remain the most important burial artifacts, with the only noted difference between Phase I and Phase II burial practices being the appearance in Phase II of clam disc beads, and, often associated with these, steatite disc and tubular beads, tubular clam beads, and magnesite beads. The use of red ocher, seen continuously from Early Horizon times, persists on into Phase II times, but decreases sharply from the lavish use seen in the Middle Horizon.

Not explained by Beardsley (1954) is the enigmatic independence of the Marin County sites as regards diagnostic bead types from other manifestations of the Phase I period of the Late Horizon. At least he makes no mention of these bead types for this period in his publication, which is, so far, the only report available on the Marin County sites.

Bead type frequencies for the Late Horizon, Phase I, are as follows:

		San Francisco Bay (inland)	San Francisco Bay (coastal)	Marin County (coastal)
Olivella	2a	33	46	
	3a2	5	4	
	1b	16	6	
	1a	9	5	
	3e	8		
	3a3		3	
	3d	2	1	
	3a1	4	1	
Haliotis	G		x*	
	3a1			x
	B1			x
	B2			x
	C			x
	E1			x
Clam Disc				2

* x indicates that presence only is known

Late Horizon: Phase II

As indicated above, the most diagnostic trait for this period is the appearance of the clam disc bead and other related types. It has been suggested that this was due to contact with the Pomo, located to the north (Beardsley 1954), who were known ethnographically to have virtually monopolized the manufacture and trade of these objects.

A pair of C-14 dates from site Mrn-115 (Thomas) in Marin County of 633 ± 200 B.P. and 911 ± 180 B.P. seems to confirm the generally accepted view that this phase began a few hundred years prior to European contact and continued into the period of the groups which have been recognized ethnographically.

Sites known to contain components of Phase II are:

Ala-328 (Newark)
CCo-138 (Hotchkiss)
CCo-259 (Fernandez
Col-1 (Miller)
Col-2 (Howells Point)
Mrn-115 (Thomas)
Mrn-201 (Tom's Point)
Mrn-232 (Estero)

Mrn-242	(Cauley)	Sac-56	(Mosher)
Mrn-266	(McClure)	Sac-60	(Hicks)
Nap-1	(Goddard)	Sac-83	(Nicolaus #5)
Nap-32	(Kolb), uncertain	Sac-86	(Nicolaus #4)
Nap-39	(Tulukai)	Sac-113	(Calquhoun)
Sac-6	(Johnson)	Sac-121	(Goethe)

The period of European contact begins with Sir Francis Drake's landing somewhere along the Marin County coast or just slightly south of there (Heizer 1947) in 1579, followed some sixteen years later by the wreck of the Spanish ship San Agustin in this same area. However, no artifacts from either the Golden Hind or the San Agustin have yet been identified from any interior Central California sites. Systematic European exploration of this region did not begin until about 1790; intensive occupation, primarily by the Spanish, followed soon after with extensive missionary efforts being conducted even into the Sacramento and Napa valleys. So it was by about 1800 that the true contact period, archaeologically speaking, began in Central California, with European objects appearing abundantly in sites from then on.

		Sacramento and Napa valleys (inland)	San Francisco Bay (coastal)	Marin County
Olivella	1a	2	3	
	1b	8	2	
	2a	1		
	3a1	30	15	11
	3d	4		1
	3e	3	4	2
Clam Disc		153	22	31
Tubular Clam		x	1	2
Tubular Steatite		x	3	5
Tubular Magnesite		5	3	3
Steatite Disc		x (frequent)		

As can be seen from the charts which have been presented, each horizon has at least a couple of distinctive bead types which cut across all of its regions to serve as "time-markers" for the horizon. The single exception to this is the Marin County coast region in Phase I of the Late Horizon, where, at least in terms of the descriptions provided in the literature, one cannot see any bead types which relate to other regions of that period.

In addition, certain bead types such as Olivella 1a and 1b persist throughout all the horizons of the sequence, suggesting at least one element of continuity. The published data are not complete enough to permit an analysis of bead types by percentages; otherwise this would have been attempted.

Similarly, these charts show that each region has a bead type or set of bead types which is unique to that region in a given horizon. Thus it is that the Central California sequence has been divided into regional manifestations as well as temporal divisions.

"Time-marker" burials and their stratigraphy

As mentioned earlier, the sites located in the Cosumnes-Mokelumne rivers area of the Sacramento Delta contain the key stratigraphic relationships upon which the entire Central California sequence is based. While these relationships are almost entirely cultural, certain elements of soil stratigraphy are important as well. The most obvious characteristic, however, is that it is all vertical stratigraphy, where burials and features have been studied with regard to their relative depths to determine time relationships. This vertical stratigraphy was done with great care and attention to detail, and one only wishes that there were many more such examples of good vertical stratigraphy in California.

At site Sac-107 (Windmiller) all three major horizons have been recognized, making this the only site so far discovered in Central California where this is the case. However, as will be explained, the actual sequence of the final two horizons is not clear at Sac-107. Therefore the sequence of the final two horizons had to be established on the basis of findings at several other nearby sites where the situation was clearer.

Two natural levels were noted at Sac-107. Level I, the lowest, was the natural mound base—a layer of sterile reddish-brown subsoil. However, grave pits containing Early Horizon burials with their distinctive characteristics and associations were found cut into Level I (the only level in which such burials appeared). The composition of fill in these pits was noted to be quite different from the ashy refuse accumulation of Layer II (the true midden deposit), suggesting that there had been a layer of less ashy soil above Layer I during Early Horizon times which had eroded away before the Middle Horizon occupation. Moreover, there are definite differences in the bone chemistry of burials belonging to the Early Horizon from burials in Layer II. Thus it is thought that there may have been a discontinuity of undetermined length between the Early and Middle Horizon occupations. Layer II contained Middle and Late Horizon burials, each with its

distinctive "time-marker" ornaments, but there was no clear differentiation of these by levels (the Middle Horizon had not been recognized at the time site Sac-107 was excavated).

The position of the Early Horizon as prior to the other horizons was confirmed by the consistent findings of Early Horizon burials as the deepest cultural materials at each of the other sites which contained this and other horizon remains. At site SJo-142 (McGillivray) the same pattern of Early Horizon burials appearing in pits dug into the substratum underlying the rest of the site was noted, only in this instance the substratum appeared to have been disturbed—presumably by the Early Horizon occupants. If such is the case, this site presents the sole instance of an actual Early Horizon occupation (fugitive as the evidence may be); the others are all burial sites. At site SJo-68 (Blossom) Early Horizon burials were also noted as occurring below those of the Middle Horizon in much the same way as at the other sites, and here, too, there occurred materials suggestive of a sizable Early Horizon occupation.

The Middle Horizon (in 1939 it was known as the "Transitional Period") was first defined at site Sac-66 (Morse), but here, again, the stratigraphic positions of Middle and Late Horizons were inconclusive. Better stratigraphy for these two horizons has been found at Sac-60 (Hicks). Here Middle Horizon burials definitely lay deeper than Late Horizon burials, and there was no evidence of this having been due to the digging of pits from above. The same situation held true for Col-1 (Miller), where a single distinctive Middle Horizon burial occurred at a depth of 105 inches. The deepest Late Horizon burials there did not extend much below 40 inches, and here it was also possible to see the stratigraphic positions of Phases I and II of the Late Horizon. The Phase I burials occurred at an average depth of 41 inches while the pits dug for the burials distinguished as belonging to Phase II averaged a depth of only 20 inches in the midden.

With this stratigraphic column in mind, the archaeologists working in other regions of Central California have consciously sought, since 1939, to see how their own regional sequences fitted into this key scheme. This has been done both in excavation—as in Marin County, a few Napa Valley sites, and a few Bay sites—and in the reanalysis of materials excavated much earlier, as is the case for most of the Bay sites. For both approaches the distinctive bead types associated with the burials provided the bulk of the defining characteristics. Thus it has been possible for Beardsley to distinguish Middle and Late Horizon manifestations in Marin County and along San Francisco Bay. The relative stratigraphy correlated with these manifestations has generally confirmed the sequence displayed in the Sacramento Valley (details of these correlations

appear in Beardsley 1954), though Beardsley and others are careful to point out that the question of the contemporaneity of the regional manifestations of the respective horizons is still very much an open issue.

THE EXPLOITATIVE ECONOMICS OF CULTURE CHANGE IN CENTRAL CALIFORNIA

It is Beardsley who has most strongly upheld the view that changes have occurred in the cultures of Central California. In seeking out such changes, Beardsley was quick to realize, as had Lillard, Heizer and Fenenga before him, that bead types would be an extremely useful tool. As regards his view of bead typologies in cultural analysis, Beardsley (1954:103) states:

"There are clear trait differences among the various spatial divisions of culture [of Central California]. But when individual traits such as bead or ornament types, bone implements, or stone utensils are examined, the spatial differences are unimportant when compared to differences in time level. This is especially true of bead types. It may be argued justifiably that minute variations of individual beads are not important per se. Their simple forms, however, lead to recognition of significant and comprehensive changes in culture that are signalized by material traits rare enough in themselves to escape notice unless searched for with the aid of some such guides as bead types."

Beardsley's point is well taken. What he has said in essence is that before one can criticize a given framework or sequence as not being entirely representative of the culture it stands for, one must first be given the sequence. By providing a sharply defined typology of bead styles, the archaeologists of Central California have performed an essential first step in the analysis of the cultures in this area. The framework provided by the Central California sequence (based as heavily as it is on bead types) is indispensable—all subsequent discussion must be in terms of it.

But there must also occur some "subsequent discussion" if a closer understanding of the culture is to occur. In this paper I shall try, at least tentatively, to bring together the two themes which have occupied this discussion until now—the occurrence of natural food resources in Central California on the one hand and the Central California sequence on the other. The question posed in this attempt is simply this: does the Central California sequence in all cases point to the changes in culture which an examination of the evidence of the demography and exploitative

patterns suggest? Or do the interests which are the basis of the Central California sequence in fact tend to divert the attention of the archeologist at work in this area away from much of the evidence which is relevant to these changes?

The Early Horizon can be dealt with rapidly, mainly because so little is known about it. It is a burial complex of a very definite configuration, the major details of which have been described. Until the present research of Moseley on the occupational remains at SJo-68 is completed, inferences concerning the exploitative economy must be based upon grave goods—artifacts which one always suspects may not reflect a true picture of the more mundane facets of life. Beardsley (1954:67) is correct in stating about this horizon: "There is still some doubt...of the principal economic orientations of culture." A handful of artifacts are present which suggest seed-gathering—several possible pestles or mullers made from river pebbles and a couple of mortar fragments (definitely identified but not yet published). A trident spear with curved bone points as well as a gorge hook and a curved hook make it clear that at least some fishing was practiced, but there is no evidence for net fishing. Most suggestive are the 128 stone knife and projectile points which have been found, pointing to hunting patterns as probably the most important for this early culture. Many of these points, however, show the markedly broad shoulders which one might associate with the taking of fish (where the points are designed to remain fixed in the flesh of the prey, making it possible for the fish to be pulled out of the water) rather than a configuration which would suggest that they were designed to be easily pulled loose from game. Certainly all four sites of this horizon are located on rivers where it is known that anadromus fish once ran freely. The average weights for these projectile points run as high as 6 to 7 grams, making the use of the bow unlikely, and it seems reasonable to assume that they were used with atlatls (though no definite evidence exists in this horizon for the atlatl) and thrusting spears.

With the evidence presently available one cannot demonstrate any signs of specialization in economic adaptation for the Early Horizon. Far more is presently known about the burial practices of these people than about their exploitative economy. While the large projectile points might suggest that hunting was their primary occupation, the scarcity of animal remains in or near the two apparent occupation sites must be reckoned with. The marked scarcity of grinding implements as well as the complete absence of any "greasy" texture to the soils of these sites (though this may be accounted for by changes in the soil over a long period of time) argues against acorn gathering as a primary food source though it probably was supplementary.

Because the remains of the Early Horizon are so scarce and constitute

only the burial complex of the culture, it is difficult to ascribe bases for the marked expansion in population which characterizes the Middle Horizon. One can point to a few specific traits which continue from the Early to the Middle Horizon, such as Olivella 1a and 1b beads, but the relationship of Early to Middle Horizon cultures is not well understood. For example, there are no Early Horizon sites known from the coast at all, yet many important Middle Horizon sites occur there. In the Middle Horizon along the coast one can see greater economic specialization, but it cannot be demonstrated that this specialization developed out of an earlier, less specialized culture such as was present in the Early Horizon.

With thirty-three excavated sites reported for the Middle Horizon, as well as others which have been reported from surveys but not excavated, one can certainly speak of a population expansion of some importance. New sites appear in all regions of the San Francisco Bay area, with the number of sites being about evenly divided between coast and inland. The largest shellmound sites appear now, particularly Emeryville, Ellis Landing, and the Stege mounds. No exact figures are available for estimating the population of the Middle Horizon, but if the size and numbers of sites are any guide it would appear that the populations of the Late Horizon were no larger overall than those of the Middle Horizon.

Along the coast, for this period, it is clear that the principal reliance was on shellfish. This is evidenced by the great quantities of shell in the coastal mounds, all shells of species which have already been described and which were abundantly available near the sites.

The definite evidence for economic specialization present along the coast is not paralleled by developments in the inland sites. Evidence of a greater stress on seed and acorn gathering is attested by the increased presence of mortars and pestles over that seen in the Early Horizon. At least twenty occurrences of pestles and four of mortars are recorded for the Sacramento Valley, and it is obvious that while this is an increase over the Early Horizon, it still does not evidence anything like a major dependence on acorns. When dealing with mortars and pestles, however, one must always remember that wooden mortars and pestles were quite common ethnographically (Driver and Massey 1957:240-241, map 48) and that these artifacts might not have been favored with preservation. Thus the remains of stone mortars and pestles may represent only a fraction of the implements used for grinding and preparing acorns. In the Bay sites for this horizon there are recorded at least three occurrences of pestles and nine occurrences of mortars, while in Marin County there are eighteen reported occurrences of pestles and eight of mortars. Thus the coastal sites show as great, if not in fact a greater, percentage of grinding tools as the

Sacramento Valley. This suggests both that the coastal dwellers did, at least to some extent, rely on seeds to supplement their diet and that the utilization of seeds by the inland dwellers was probably only supplementary to their diet as well.

Hunting was apparently important to the inland groups, for a total of thirty-eight occurrences of projectile points (this time of types almost certainly used for hunting only) is recorded for the Middle Horizon of the Sacramento Valley. All of these points are large and heavy, suggesting that the bow and arrow were still not in use. Far fewer burial occurrences of projectile points appear on the coast, there being only four recorded occurrences for Marin County and three for the Bay sites, which would suggest that here the gathering of shellfish was clearly dominant over hunting.

Evidence for net fishing appears for the first time, with the best evidence coming from the Marin County coast where 108 notched stones were recovered in clusters of Middle Horizon provenience at site Mrn-266 (McClure). Although figures are not available, notched stones which probably served as net sinkers were also recovered from most of the Middle Horizon components in the Bay area, the notable exception being at the Ellis Landing site. For the inland region, few probable net sinkers have been recovered from Middle Horizon locations except for some sites in the northern part of the Sacramento Valley area. In all regions bone and antler harpoon points and fishhooks continued to appear sporadically. One should keep in mind, however, the fact that many of the taking techniques associated with fishing call for artifacts (such as dip nets, wooden liesters, temporary wiers, etc.) which are perishable and would not often survive archaeologically. Fishing, it would seem, supplemented the diet of all regions of Middle Horizon occupation, with some areas probably adopting practices of net fishing. This appears to have been more important on the Marin County coast, where, indeed, one can point to an intensification of the aquatic adaptation throughout the Middle and Late Horizons.

However, the inland regions possessed a natural food resource which not only matched but indeed exceeded those of the coastal areas in availability and, particularly, in storage potential—namely, acorns. From this point on one may examine the prehistory of Central California in terms of differing degrees of exploitation of this remarkably useful resource.

A sharp decline in the frequency of projectile point occurrences appears in Phase I of the Late Horizon in the Sacramento Valley. Eighteen

burial occurrences are reported, with the projectile points falling into two general classes—those which weigh more than 9 grams (probably spear or dart points) and those which weigh less than 3.5 grams (probably arrow points, the first to appear in Central California). Of the ten points which were whole and could be weighed, six were of the light and four of the heavier type. While the likeliest explanation for such a decline in projectile point occurrences would seem to lie in the direction of a greater reliance on acorns as a staple food, the reporting of grinding implements from this area has been spotty (since much of the work here was done before Phases I and II had been distinguished, and the material has never been completely reanalyzed), with specific references to only one appearance of a mortar and six occurrences of pestles. In the literature passing references are made to other mortars and pestles which did appear in Middle Horizon contexts here, though tabulations and types are not given. Specific instances of the occurrence of projectile points in the Bay sites of this horizon are rare, again largely due to the early date of the excavations and the fact that it has not been possible to reprovenience all of the artifacts. Projectile points do occur throughout the Late Horizon middens, but it is apparent that they are scarce. Also, only a couple of mortars and pestles can definitely be attributed to Phase I along the Bay. For some reason, not given, Beardsley's report of the Marin County sites does not provide any clear attempt to separate Phase I from Phase II manifestations in his tabulations of mortar and pestle types and frequencies. These artifacts do appear frequently, for a total of forty-four mortars was recorded for the entire horizon as was a total of ninety-six pestles (this time actual numbers, not just occurrences) for the entire Late Horizon of Marin County. All this probably means is that seed and acorn gathering continued to supplement a basically shellfish diet in the Marin County sites, for shellfish remains continue to be as abundant here as before. Projectile points are plentiful for the Late Horizon on the Marin County coast, but, again, they cannot be separated by phases. In all there was a total of eighty-five points found in fourteen separate burial occurrences. This indicates that hunting was of some importance to the dwellers along the Marin County coast, though it was almost certainly only supplemental to the esentially aquatic diet.

There is evidence to show that a major shift in population was almost complete by Phase II of the Late Horizon. While the number of sites on the Marin County coast remained about the same as it had been before, only two sites—CCo-259 (Fernandez) and Ala-328 (Newark)—show components for this horizon in the Bay area. Meanwhile, twelve sites are so far known to represent this horizon in the inland regions. The great shellmounds along San Francisco Bay were being abandoned, and by ethnographic times this abandonment was complete; hence there are no ethnographic accounts of Bay groups.

This situation is also reflected in the accounts provided by the earliest explorers of San Francisco Bay. The first European exploration of the Bay occurred under the leadership of Pedro Fages in 1772. He mentioned sighting some Indians along the northern and southern ends of the Bay, but did not speak of any Indians along the eastern side (the central portion, where the majority of shellmound sites occur). Commander Ayala, in his explorations of the Bay in 1775, mentioned meeting some Indians on balsas, but that is all. The two Spanish explorers, Anza and Moraga, likewise mention no encounters with Indians along the central portion of the Bay where the heaviest shellmound occupation is known to have been. Only a mound at Sausalito seems to have been reported as occupied by these explorers, and even this is not a certain instance (for details concerning these historic accounts see Schenck 1926 and Nelson 1909). However, early nineteenth century explorers of the interior, particularly of the Sacramento and Napa valleys, all encountered Indians, and it was to these Indians that the intensive missionizing effort was subsequently to be directed.

Thus, while it is not certain when this important population shift began, there can be little doubt that it had progressed considerably by the time of the earliest European explorations of San Francisco Bay. To what can we attribute this well documented shift? The likeliest explanation is that the means of subsistence available in the inland regions proved, in the long run, to be more productively efficient than the means of subsistence on the coast of San Francisco Bay. That is to say, that an acorn-based means of subsistence proved more satisfactory to a large population than did a means of subsistence based primarily on shellfish. But immediately certain questions can be raised concerning this hypothesis. For example, why then did the Marin County coast continue to be occupied into ethnographic times by a population (the ethnographically known group here was the Coast Miwok) whose primary means of subsistence was shellfish? And what is it about acorns which makes them a more efficient means of subsistence when, as we have seen, shellfish in the San Francisco area are available the full year round while acorns are not?

Site Mrn-266 (McClure) is worth mentioning in regard to the first of these questions (see fig. 2). Although work remains to be done at this site, several observations can be made here. This site provides about the only instance so far of an excavation where the natural and cultural stratigraphy has been correlated with the shifts in the shell species which comprise the mound. Here, while Mytilus remained important throughout, a sharp increase in Saxidomus nuttali and Macoma nasuta occurred in the upper levels. Level II, the upper level, is dark and soft, containing much charcoal and organic material. It is in this level that the increased concentrations of both S. nuttali and M. nasuta and burials attributable to

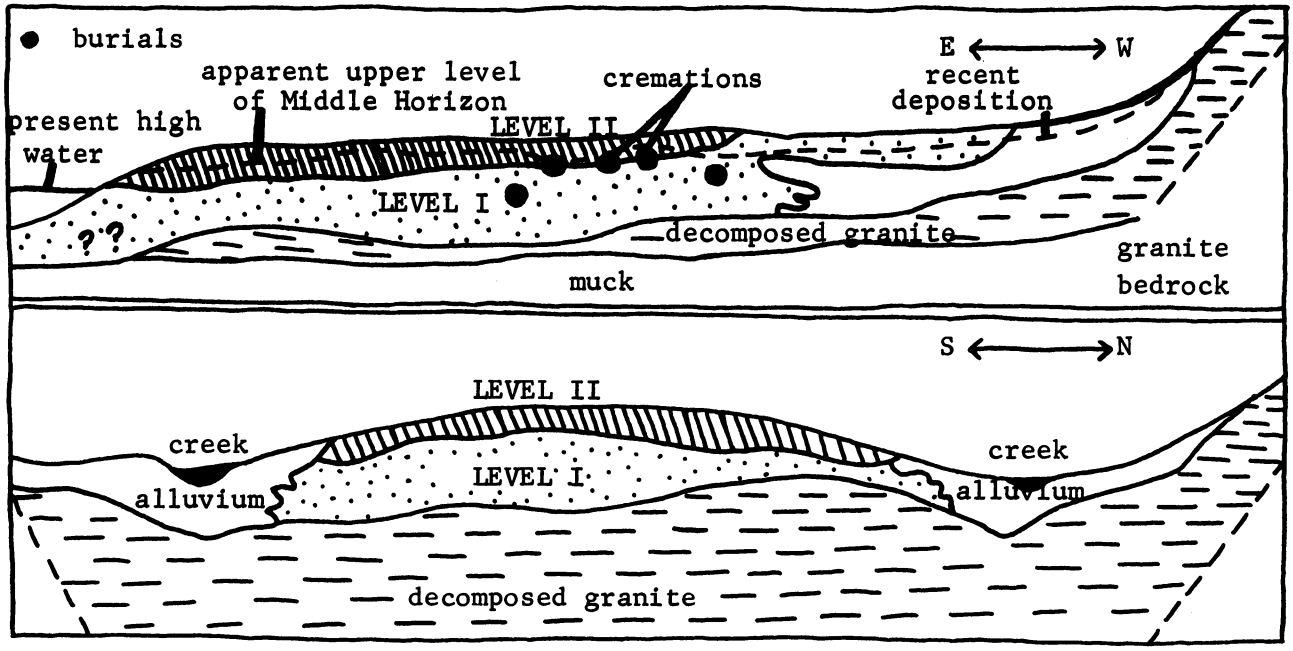

Figure 2. Site Mrn-266 (McClure)
(after Beardsley 1954)

Phase II of the Late Horizon occur. Mytilus, while present in Level II, predominates in Level I, the lower cultural and soil level. A sandy layer was noted between the two soil zones; although it was considered to be a part of Level II, it contained Middle Horizon burials. Generally, Phase II, Late Horizon manifestations were confined to the uppermost 15 inches of topsoil. Beardsley shares the view of Greengo (and earlier, of course, Packard) that the shift in shellfish species frequencies was due primarily to natural causes (described in an earlier section of this paper); he does not stress possible cultural factors as having a role in this shift (Beardsley 1954; Greengo 1951).

While the isostatic shifts discussed by Beardsley, Greengo, and others almost certainly did occur, there has been some doubt expressed (as discussed earlier) as to the significance of these shifts for the shellfish populations. Certainly one cannot completely exclude the possibility of cultural determinants for these shifts. And the McClure site lends itself very easily to such a cultural interpretation. From the descriptions given earlier in this section it should be apparent that, while a major population shift was underway in the Bay region, such was not the case on Marin County shores where, in fact, populations with a decidedly maritime subsistence persisted into ethnographic times. It was probably one of these groups that Drake encountered in his landing here in

1579 (Heizer 1947). In short, archaeology and ethnology both suggest a consolidation of maritime patterns on the Marin County coast during Middle and Late Horizon times. It does not seem improbable that one of the first signs of such a consolidation would be the gathering of a greater variety of shellfish as their subsistence potential became realized. Phase I of the Late Horizon is not present at the McClure site, so that by the Phase II reoccupation these new shellfish-gathering patterns could have become well established elsewhere nearby (several other unexcavated sites show the same shift in shellfish frequencies—these were discussed earlier) and have been brought in during Phase II. Such conclusions are only tentative, of course, but they do suggest an alternate line of interpretation to the strictly ecological interpretation which has so far been voiced by the excavators here.

While, as has been so often the case, exact figures are not available, the incidence of mortars and pestles in the Sacramento Valley during Late Horizon, Phase II times is very high. A greater number of types of both mortars and pestles appears here than at any other time or place in the Central California sequence. The ethnographic groups from this inland region, such as the Wappo, Yokut, and Inland Miwok, are all known to have based their subsistence primarily on acorns. These groups supplemented their basic diet through a wide variety of activities, mainly to obtain protein (acorns are deficient in high-grade protein[2]). The varied subsistence activities of the Inland Miwok have already been described, and the archaeological sites of Phase II in the Sacramento Valley show a wide variety of projectile point types and the not uncommon appearance of carbonized net remains, as well as occasional fishhooks and harpoon points. But if acorns do not supply protein, and thus require supplementary hunting and fishing activities, what is their advantage over shellfish? Moreover, shellfish did not require the elaborate preparation (grinding, leaching of acids, etc.) that acorns did. Obviously the Indians in this region of California did find some advantage in exploiting acorns over shellfish, and the archaeologist is simply left to explain this _fait accompli_.

The solution to this problem may lie in the direction of storage. Storage of shellfish is possible by drying and it is known that shellfish actually were processed in this manner, though in relatively small amounts, by many of the ethnographic groups in this region. But as Cook (1946) points out, it takes about five thousand mussels to make only about one kilo of dried meat, for the total weight of each mussel is reduced about

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[2] Acorns do contain 5.1 per cent low-grade protein, but this is quite insufficient for human needs. Their chief value lies in their high fat content.

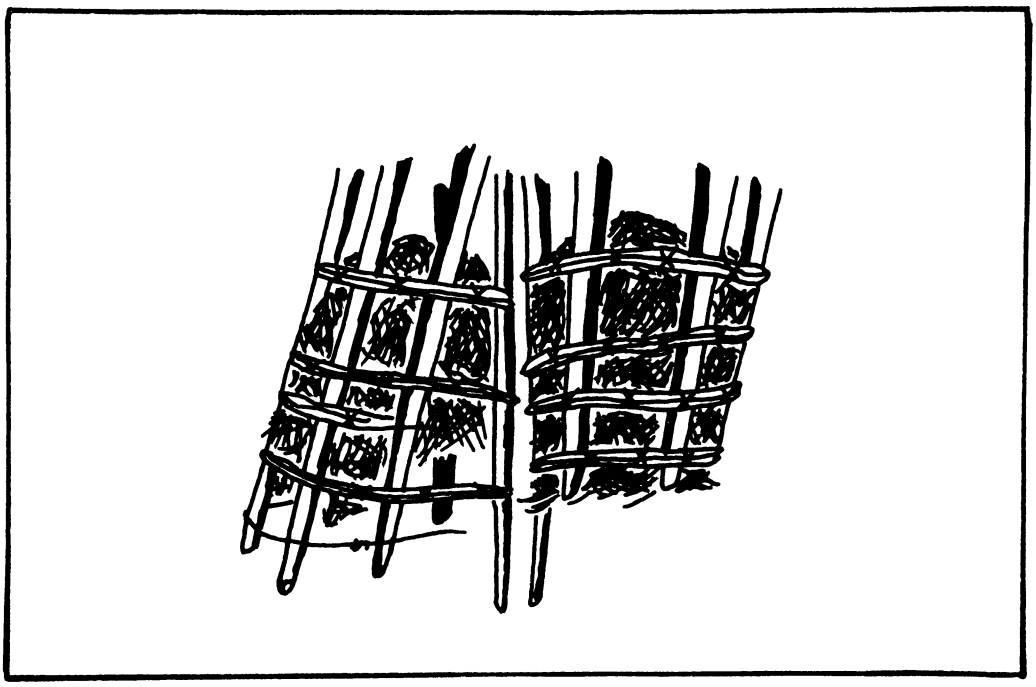

Figure 3. Inland Miwok Granaries
(Drawn from a photograph in Barrett and Gifford 1933)

80 per cent in the process. The individual shellfish do not provide much nutrition. It is obvious, as Cook shows, that Indians relying on shellfish as their primary means of subsistence would find it necessary to be constantly gathering them, day after day, all year long. Acorns, however, can be stored in baskets set in pits or in large outdoor granaries (both methods were used by the Inland Miwok; see fig. 3) where they will keep until they are to be used, at which time they are processed and eaten. Apparently storage in this manner does not affect the nutritional value of the acorns, for they are already a dry food when obtained. Acorns cannot be stored indefinitely because of frequent weevil infestation, but groups such as the Inland Miwok still found it possible to gather a sufficient quantity of acorns in the fall to provide them with the bulk of their diet until, or almost until, the next fall's gathering season. When regarded in the light of their storage possibilities, acorns obviously do provide a much more efficient means of subsistence than do shellfish. As Cook (op. cit.) points out, however, animal foods such as dried shellfish provide a valuable source of high-grade protein which could serve as a supplement to a low-grade protein diet of acorns, so there probably was some system whereby, from time to time, the Indians could return to the coast to gather and dry shellfish to supplement their inland diet. The

greater storage utility of acorns may go far toward explaining the population shift which occurred by and during Phase II times.

However, the groups along the Marin County coast remained shellfish gatherers right into ethnographic times. Here the archaeologist is presented with another fait accompli which requires an explanation. The problem is, if, as has been discussed, acorns probably provide a more efficient food source for a large population, why didn't the Indians of Marin County avail themselves of this means of subsistence?

The importance of rivers to inland adaptation in Central California is pronounced. If one examines a map showing the distribution of sites, this fact becomes obvious. Each of the major rivers leading into San Francisco Bay has sites located on its banks, and the tributaries of these rivers also have sites near them. The main reason for this, of course, was the need for fresh water. But the rivers also provided a ready source of the additional high-value animal protein needed to supplement the principally acorn diet. Evidence for at least some fishing appears in every horizon of the California sequence. It does not seem at all extreme to propose that without rivers and streams close at hand, inland adaptation could not have occurred in a given locale; that is, rivers and streams are a prerequisite for any inland adaptation, especially in Central California where in addition to the need for fresh water the need for protein supplements existed. Unlike the Sacramento and Napa valleys, Marin County does not have any true rivers. All along the Marin County coast there occur small freshwater creeks; usually these have sites located near them since they provided the only source of fresh water there. However, none of these creeks extend very far inland, rarely even as much as a few miles. So in Marin County a truly significant inland adaptation would have been very difficult, if not impossible. The acorns were there but not the rivers, with their abundant supplies of fresh water and anadromus fish.

Thus it seems that there is at least a case to be made for the greater efficiency of acorns over shellfish as a basic food source as having been the major factor in the population shifts of the Late Horizon. But this still does not describe how this might actually have happened. Archaeological inference of social processes is a tricky business at best, but it may be possible at least to suggest what appears to be the most likely process which can be called to account for this increased awareness of the potentialities of acorns through time. It seems likely that among the groups in these regions there existed definite seasonal rounds, though these probably varied with the groups involved. The presence of mortars and pestles even in coastal sites suggests that perhaps at least some time was spent by

these people further inland where acorns tend to be more concentrated. At this point it is well to cite the evidence from site Mrn-20 where the excavators noted that over 50 per cent of the remains of avifauna there consisted of species which are present in the area only during the fall and winter. They also noted that fresh water in the area of the site is scarce or absent during the summer, and, on the basis of these observations, concluded that the site was occupied more intensively during the winter half of the year (McGeein and Mueller 1955). In terms of the bead types noted there, the site was dated as being transitional between the Middle and Late Horizons. The evidence from site Mrn-20 suggesting limited seasonal movement can thus be fitted meaningfully into the hypothesis that an increased reliance on inland resources occurred during the Middle Horizon, for seasonal rounds may well have been the principal vehicle for this shift. While fine oak groves did exist in areas along the coast in certain places (i.e. Oakland), it was back in the low hills and plains further inland that the oak woodlands covered large areas. There is historic and ethnographic data to show that the late groups in this and nearby regions did, in fact, practice periodic movement to varying degrees. Gifford (1949) reports that the Coast Yuki of Mendocino County occupied their shell middens only six months of each year and spent the other six months inland. Driver (1936) mentions that the Wappo would periodically make trips to the coast for fish. Kroeber (1925) records that the Yokuts ranged on a seasonal basis between the large streams swollen with fish in the winter and the hills where the oaks would yield their acorns in the fall. In no case were the distances covered by these seasonal movements necessarily very great, but, then, the area under consideration in this paper is not very great either. The few Indians seen by Commander Ayala at the northern and southern ends of San Francisco Bay in 1775 were most likely not living there permanently but had come from the hinterland for a period (perhaps to dry shellfish as a protein supplement).

But while seasonal movements can be documented ethnographically, this is more difficult with the archaeology. Certainly such seasonality can be invoked as perhaps the likeliest means by which a group could discover and learn to exploit a new resource, such as acorns. It is not difficult to visualize the Indians occupying shellmounds along the Bay coast also engaging in periodic movements up the river valleys to obtain acorns. The mortars and pestles found in Bay mounds testify to at least a certain amount of foraging for seeds and, perhaps, acorns. And it is easy to see how, over an extended period of time, such a group could come to realize the greater subsistence efficiency of acorns through storage and would, consequently, spend less and less time along the coast. However, such a view of the processes behind the population shifts in

Central California is in serious danger of remaining an archaeological "just so" story unless definite evidence can be provided to demonstrate the developing maximization of acorn resources during the Middle and Late Horizons. One approach, suggested earlier in this paper, lies in a study of settlement patterns, for it is through such studies that facilities for storage often become apparent. An archaeologist, aware of the value of horizontal stratigraphy, might be able to discover the remains of Miwok-style storage pits and granaries, though it must be remembered that these structures are not always highly patterned and may be difficult to recognize.

However, as was mentioned earlier, this is without doubt the most fragmentary aspect of Central California archaeology. Over and over in the literature there appear instances of floors, posts (sometimes whole or carbonized), and post-holes which, because of severe difficulties posed by awkward soil texture, disturbances, and the poor preservation of structural remains, could not be followed out and defined. Because of this, and in keeping with the principal concern of the Central California sequence—namely, the need for a definition of temporal relationships—the emphasis in the archaeology here has largely been on vertical rather than horizontal stratigraphy. A greater emphasis on horizontal relationships might reveal changes in type and frequency of houses, storage pits, and granaries, ultimately providing information concerning seasonality versus permanence of residence and other related matters. The possibility of seasonal movements could present a complicating factor in the picture of temporal and spatial relationships as it now exists in the Central California sequence. For example, could it be that some of the groups assigned to different facies might in fact be only the seasonal manifestations of the same group?

This again raises the problem of the value of a taxonomic system of culture classification such as one sees in use in Central California. While this sequence has been valuable and has provided the frame of reference for all discussions of Central California prehistory, it also is apparent that it might, in some cases, mask many of the essential problems of culture change in this region by leaving unanswered questions concerning changes in basic subsistence patterns.

Interest in exploitative economy has not been neglected in Central California. However, as was pointed out earlier, this interest has been largely confined to the technical problems associated with the analysis of mound constituents. There may well be enough of this kind of evidence available now to warrant research into the meaning as well as the method of midden analyses. This, like the typological studies of burials and

burial associations, has tended to become a separate field of interest. Using published data, it is still not possible to correlate changes in mound components through time with changes in culture. Only at the McClure site in Marin County has anything like this been possible, and the results there are sill highly tentative. Certainly more is needed in Central California archaeology than exercises in the methodology of mound analysis or burial typology if we are ever to be able to reconstruct the sequence of basic culture change of the aboriginal occupants here. Much more can probably be done with these methods and others to lead to a view of Central California prehistory which might demonstrate significant changes in culture and even suggest explanations for these changes.

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AAnt American Antiquity
UC University of California
-AR Anthropological Records
-AS Archaeological Survey
-R Reports
-IA Ibero-Americana
-PAAE Publications in American Archaeology and Ethnology
-PG Publications in Geography
-PZ Publications in Zoology

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