UNIVERSITY OF CALIFORNIA - LOS ANGELES

Cultural Change and Continuity on the San Diego Coast

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Anthropology

by

Claude Nelson Warren

Final Examination for the Degree Doctor of Philosophy

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1964

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PREFACE

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Studies in American Archaeology. Professors Clement W. Meighan and H. B. Nicholson

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ABSTRACT OF THE DISSERTATION

Cultural Change and Continuity on the
San Diego Coast

by

Claude Nelson Warren
Doctor of Philosophy in Anthropology
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The La Jolla Complex of the San Diego Coast, California, is especially well suited for the study of cultural change and continuity because it is in a marginal area geographically and culturally, and was therefore little influenced by diffusion of cultural traits from other areas. The La Jolla Complex thus affords an opportunity to study cultural change and continuity in relative isolation and the variable of culture contact is held to minimal importance.

A deductive model which attempts to explain cultural change and conservatism is based on two general principles: (1) that culture is an adaptive mechanism by which man copes with and exploits his total environment. Culture thus fulfills the needs of man, psychic as well as biological and social; and (2) that man selects from the total range of possible cultural behavior a segment which in itself represents a considerable range of variation

and that within this segment he focuses his attention on still more limited segments of the aspects of culture. Under conditions of free choice, these foci are more susceptible to change than other areas of the culture. These general principles operate in a dynamic universe where the setting of the culture is changing and represents the selective force which in turn cancels out or endorses the creative acts of the individual man.

The model based on these principles is tested by application to empirical data from the La Jolla Complex of the San Diego Coast and related complexes from Santa Catalina Island. The cultural remains are projected against reconstructed environments of the area over the past 8000 years. The reference material used in this reconstruction varies from specific radiocarbon dates and floral remains to generalized schemes of climatic change for the west. The cultural reconstruction is based on published material and field work of the author.

The ecology of western San Diego County changed considerably during the past 8000 years, but the La Jolla economic pattern remained unusually stable. The explanation of this stability is looked for in the concept of economic focus and in ecological adaptation. The ecological changes on the San Diego Coast brought changes in the ecological adaptation of the La Jolla economic pattern, but the economic focus on collecting activities exhibited

considerable stability. The La Jolla Complex represents the continuity of a given economic pattern through adaptation of that pattern to changes in environment.

The San Diego Coast exhibits some variation in ecology and environment from north to south, and is environmentally distinct from the neighboring Santa Catalina Island situation. Four economic stages (Adaptive Gathering, Incipient Maritime, Maritime, Land Resource Collecting) are outlined for different periods and places on the San Diego Coast and Santa Catalina Island. In each area of environmental variation, cultural change and continuity are explained in terms of adaptation of the economic focus to changing environment, or by a change in the economic focus itself, to meet the ecological pressures of the "new environment."

Chapter i. La Jolla: History of the Concept and Significance for the Study of Culture Change and Continuity

In terms of the archaeological data, the La Jolla Complex of the San Diego Coast in Southern California represents an unusually long period of cultural continuity with relatively little change. This is even more striking when the potential of the ecological setting and pressures of environmental changes are considered (see ch. iv and v, below). It is this unusually long period of cultural continuity and the extreme conservatism evidenced that raise questions regarding the cultural processes for maintaining continuity and the mechanisms for resisting change.

Geographically also, the La Jolla Complex is especially well suited for a study of the processes of cultural continuity. The La Jolla Complex, during the entire period from about 8000 years ago until the introduction of the San Luis Rey Complexes (Meighan 1954) and the Yuman Culture (Rogers 1945), reveals not the slightest indication of any strong outside influences. Essentially, the La Jolla pattern was a development in isolation, which can be at least partially explained by the presence of the California deserts to the east and northeast, especially formidable barriers during the Altithermal. Also, similar cultures

extended northward along the coast at least as far as Santa Barbara County (W. J. Wallace 1955), and north of this area the Transverse Range apparently served as a barrier to extensive contact.

History of the La Jolla Concept

The La Jolla Complex has long been recognized on the coastal terraces of San Diego County, first having been recorded by M. J. Rogers in 1929, under the name of "Shell Midden peoples." On the basis of surface finds, he characterized this complex as containing "metates, manos, hammerstones, teshoa flakes, and a great amount of split stone, but no chipped stone artifacts which may be recognized as finished implements unless it be the teshoa flakes. Potsherds are entirely absent . . . . many of the middens produce nothing that would associate them with man, except the split stone" (Rogers 1929: 457).

Rogers felt then (1929: 466) that the La Jolla Complex preceded the San Dieguito Complex, which at that time was called the "Scraper Maker Culture." However, in a later paper he reversed the sequence when he stated: "Immediately after the disappearance of the San Dieguito peoples with their excellent stone-flaking technique, a new stock with a sea food--sea gathering complex and no ability to work stone moved in" (1945: 171).

Rogers also felt (1945) that, from stratigraphic studies of the shell middens, he could discern two developmental

phases of the La Jolla Complex, beginning about the time of Christ. These phases were described in terms of "diagnostic" artifacts and burial patterns. Unfortunately, the phase descriptions were too brief and lacked adequate elucidation by site reports.

Harding (1951) presented some evidence in support of Rogers' developmental phases, but again the evidence was not adequately presented, and was not conclusive. Carter (1957) extended the La Jolla Complex temporally back to the time of the Wisconsin glaciation, and areally inland to the vicinity of Escondido. However, his evidence is not convincing in either instance, and his interpretations have been severely criticized (Krieger 1958; Johnson and Miller 1958; Oakley 1959).

Extensive surveys undertaken by the Archaeological Survey, University of California, Los Angeles, were reported by Warren, True and Eudey (1961), who recognized two, roughly contemporaneous, cultural complexes in western San Diego County: the La Jolla, restricted primarily to the coastal terraces and shoreline; and the Pauma (True 1958), between the Peninsular Range and the Coast Range (Black Mountain Volcanics).

Excavations along the San Diego Coast (Moriarty, Shumway, and Warren 1959; Warren and True 1961; Shumway, Hubbs, and Moriarty 1961; Crabtree, Warren, and True 1963) and a series of carbon-14 dates from those sites (Hubbs, Bien, and

Suess 1960, 1962) established an initial date of about 8000 years ago for the La Jolla Complex and illustrated a long period of cultural continuity with little change, ending with the introduction of Yuman Culture between 1200 and 600 years ago. The recent work of Shumway and others (1961) and Crabtree and others (1963) illustrates the inapplicability of the developmental phases of earlier workers, e. g., Rogers (1945), Harding (1951), Carter (1957). The more recent works have viewed the La Jolla development in terms of ecological adaptation while recognizing slight and elusive changes in artifact types.

Characteristics of the La Jolla Complex

The La Jolla Complex was based on a shellfish and seed collecting economy. The archaeological artifact assemblage consists of metates, manos, crudely flaked scrapers, and, rarely, projectile points and other tools or ornaments of steatite, shell, and bone. Burials were flexed, placed on the side, with the head most often oriented toward the north. Mortuary offerings occasionally accompanied the bodies. Burials occurred individually or in cemeteries, and occasionally were covered by inverted metates or small piles of stones and broken rock.

Areal Relationships on the Southern California Coast

Population centers during the peak of La Jolla occupation (6000 to 4000 B. C.) were found around lagoons, at

favorable locations on the open coast, and perhaps where vegetable foods occurred in unusual quantity, such as in the pine "forests" on Torrey Pines Mesa. Torrey Pines on the San Diego Coast now form a relictual stand, but probably were found in greater numbers during the earlier portions of the La Jolla occupation. It seems reasonable to assume that, with the basic collecting economy of the La Jolla Complex, the people would have taken advantage of the edible pine nuts supplied in abundant quantities by these trees. The fairly large number of sites reported for Torrey Pines Mesa (Shumway and others 1961: 46) appears to support this suggestion. The La Jolla Complex thus appears to have been adapted ecologically to the shores of lagoons and coast, and to adjacent hills. This cultural pattern began about 6000 B. C. and persisted in an unusually stable form until the influences from the Colorado River area were felt, about 1300 A.D.

The La Jolla Complex has been limited to the coastal terraces and shores in San Diego County (Warren and others 1961). However, the northern and southern limits remain unknown, and relationships to other related complexes are at most poorly understood. Southward, material apparently similar to La Jolla remains is found as far as Vizcaino Bay on the west coast of Baja California (Massey 1947: 355).

Wallace has placed the early portion of the La Jolla Complex in the Milling Stone Horizon of the Southern California coast (W. J. Wallace 1955: 219-21). The distinctive

traits of the Milling Stone Horizon include: collecting economy, mullers, milling stones, few mortars and pestles, few large and crude stone projectile points, retouched flakes and core tools, few shell, bone, and stone beads, rare bone objects. Burial patterns differ somewhat from area to area. The northern representative of the Milling Stone Horizon (Oak Grove) has extended burials, whereas extended and flexed burials as well as reburials are known from Ventura and Los Angeles Counties, and flexed burials from San Diego County. Rock cairns over corpses and paucity of grave goods are characteristic of the entire southern coast, while red ochre is abundant in only the burials of Oak Grove and apparently decreases rapidly in importance toward the south (W. J. Wallace 1955: 220). Stone discoidals are widely spread throughout the southern coastal area, occurring from Ventura County on the north to San Diego County on the south (W. J. Wallace 1955: 220; Shumway and others 1961: 83-4). Cogged stones are found from the Ventura-Los Angeles County line southward into San Diego County (Eberhardt 1961: 364).

The initial date for the Milling Stone Horizon in San Diego County, placed at 6000 B. C. (Warren and True 1961: 265-6), is probably not significantly earlier or later than the initial date farther north. The data now available for the Milling Stone Horizon strongly suggest that the differences between the cultural complexes on the Southern California coast are far less numerous and less important than

their similarities. In order to emphasize these cultural similarities, the cultural remains of the Milling Stone Horizon might well be viewed as a single Southern Coastal Culture.

Regional variation, through adaptation to different and changing ecological conditions and to differences in nature and intensity of cultural contact, must have occurred. Wallace's (1955) Intermediate Horizon appears to represent a period when such variations were becoming more apparent. This horizon is primarily characterized by the introduction of mortar and pestle and by more numerous chipped stone points. The Hunting Culture of Santa Barbara Coast would appear to be the best representative of this horizon (W. J. Wallace 1955: 221). However, southward from Santa Barbara this horizon becomes progressively less well defined and the Intermediate Horizon in San Diego County is indicated only by the occurrence of pestle and mortar (largely out-of-context, "ocean bottom artifacts"), and a slight increase in projectile points.

The culture change reflected by the introduction of these traits in San Diego County is not of the same magnitude as that found on the Santa Barbara Coast. In San Diego County, the cultural assemblages after the introduction of these traits are so similar to the earlier inventories that it is difficult to justify a different designation. This is apparently due to the fact that the La Jolla Complex was in

a more insular position than the complexes of the Milling Stone Horizon found farther northward. If the Milling Stone Horizon is viewed as the Southern Coastal Culture, it can be seen to persist much later in time on the San Diego Coast than on the coastal strips of Santa Barbara, Ventura, and perhaps Los Angeles counties.

It is believed that the explanation for this cultural conservatism on the San Diego Coast which forms the thesis of this dissertation, may be found in the low intensity of culture contact on the San Diego Coast, and the ecological adaptation and economic orientation of the La Jolla Complex. The La Jolla Complex was geographically and culturally marginal and essentially isolated during most of its development. External impulses to change were relatively unimportant in La Jolla prehistory, making it possible to study the responses of the La Jolla peoples to ecological changes with only limited concern for problems of introduction of new ideas from outside sources.

Chapter ii. Cultural Change and Continuity: Review of Concepts and Models

Before setting up a model for culture change which would explain the La Jolla phenomenon of conservatism, it is necessary to review the more important of the concepts and models found in the literature.

Change has been considered an integral attribute of culture since the earliest days of anthropology. The old "schools" of evolution and of diffusion debated about mechanisms by which culture changes. In the last half century or so, both diffusion and independent invention have been recognized as important processes in culture change. Later developments in anthropology have altered somewhat the concept of how culture changes. The functionalist approach to culture and the studies of acculturation have introduced analytical concepts and "tools" and have directed the studies of culture change more and more toward analytical study of cultural process. Such studies are replacing to a large extent the descriptive reconstructions of "history" and "evolution," undertaken over the decades just prior to and immediately following the turn of the century.

That culture change is not yet viewed in the same manner by all anthropologists is evident. The very fact that culture has been defined in over 160 different ways

(Kroeber and Kluckhohn 1952) makes the definition of culture change at least equally as varied. Linton (1936: 61), writing of a definition of society, stated: "According to the dictionary a definition is a brief description or explanation . . . . Since all objects or phenomena have multiple qualities, no descriptive definition can ever be complete and the test of a good definition is whether it selects for emphasis those qualities which are pertinent to the work at hand."

Any descriptive definition of culture change is necessarily incomplete; explanatory definitions of culture change may not necessarily be incomplete, but we may assume that those to date have been, since there appears to be disagreement on the attributes of culture itself.

A descriptive definition of culture and change must be "pertinent to the work at hand." An anthropologist studying culture-personality defines culture differently than the anthropologist studying prehistory. This is not due to the nature of culture but to the nature of the cultural data with which the individual anthropologist is working. The data of prehistory have peculiarities that set prehistory apart from studies of contemporary peoples. The archaeologist cannot reconstruct the behavior of individuals in prehistoric societies. The limitations of archaeological data and archaeological inference preclude the individual and psychological points of reference used by ethnologists

in their studies of culture change, e. g., Spindler 1955; A. F. C. Wallace 1961; Barnett 1953).

Secondly, the archaeologist is at a loss to reconstruct social structure, political organizations or religion with the precision of the ethnologist and social anthropologist. The archaeologist will never be able to infer the range of variation or the norms of a social structure that allows for Nadel's (1957) concept of "gradient" and its move by variation that affects the structural alignment. Some archaeologists have undertaken the task of extending archaeological interpretation into the realm of socio-religious studies (e. g., Willey 1953; Beardsley and others 1956; Bluhm 1960), through the study of settlement patterns. The extent to which such reconstructions can be pushed is as yet unknown. It is clear, however, that only through ethnology will the structural and functional details of a large portion of culture, and culture-personality relationships, be known.

Language, kinship systems, and music of prehistoric peoples are also lost to the past and no archaeologist can learn of these segments of the prehistoric cultures except through recovery of written records. On the other hand, the archaeologist can demonstrate cultural continuity and change over a far greater period of time than can the ethnologist. On the basis of his own field work, the ethnologist is hard put to substantiate culture change over long periods of time. It is probably no accident that it was those approaches

that emphasized function and structure of culture and society that at first neglected change (Opler 1960). Function here may be defined as the relation of interdependence of activities of objects or entities (Firth 1955: 244). Those approaches include culture-personality studies and both Malinowski's and Radcliffe-Brown's approaches to the study of man.

The discussion thus far has treated the ethnologist and archaeologist as if they were working in isolation. Such is, of course, not the case. The archaeologist often utilizes ethnographic data through the direct historical approach (e. g., Strong 1935) and use of analogy (Ascher 1961). Conversely, the ethnologist uses prehistory in the study of culture change. Finally, both archaeologists and ethnologists make use of historic documents. A clear-cut boundary cannot be drawn between the data of the archaeologist and those of the ethnologist in their studies of culture change.

With respect to culture change, the ethnologist and archaeologist may be viewed as specialists in two different aspects of culture change. The ethnologist is the specialist in culture content and function; the archaeologist is a specialist in time. In the study of culture change, the ethnologist and archaeologist are both concerned with culture in its time-dimensional aspect, with its content and function through time.

The Nature of Cultural Behavior

The differences between archaeological and ethnological studies of culture change appear to be more a matter of data than of concepts. Culture may be defined as a class of regularities of learned behavior; a "class of regularities" is generally termed "traits," "trait complex" and "culture complex." Both "trait" and "complex" are relative terms. In practice, almost any trait or complex can be analyzed into smaller entities or considered to be functionally related to a complex of other traits or complexes. Prayer may be considered a trait of Western European culture. However, the act of praying may be analyzed into a number of smaller entities also termed traits: kneeling position , folded hands, bowed head, closed eyes. Prayer may also be considered one trait of the Christian religion, which may itself be considered a trait of Western European culture.

As Bagby expressed it (1963: 89): "Any trait then may be regarded as a complex; it is merely a question of the fineness of the distinctions we wish to make in any given context; there are no atoms of behaviour, either psychological or cultural."

Certain cultural regularities may or may not occur in the life of a single individual, but they recur or fail to occur in a regular pattern. An individual may pass through puberty rites only once in his lifetime, but he may address his uncle in prescribed manner many, many times. A man may

always have his hair "styled" within a given range of variation, while a woman may never have her hair styled like a man's. Cultural regularities are learned behavior patterns that may be said to occur, recur, or fail to occur, in regular instances, in any given society.

These regularities are both overt and covert behavior patterns. The covert behavior of repugnance at the idea of eating grubs and overt behavior of not eating them is found among Western Europeans. The reverse is true of the Australian aborigines, for whom grubs are edible. Overt and covert actions may be seen as opposite sides of the same behavior pattern, or as two different acts. Nonetheless, such behavior may occur regularly and is then termed cultural.

Finally, culture is learned and on this basis may be differentiated from biologically inherited behavior. Learning is here used in a broad sense and includes the acquisition of behavior patterns through symbols (language), imitation, and also invention and discovery. Learning is thus seen to act as a process that makes for both cultural conservatism and cultural change. An individual, born into an existing society, learns the behavior patterns from others through language and imitation, resulting in cultural conservatism. However, new behavior patterns making for change may be learned either from other cultural groups by the same processes as outlined above, or through inven-

tion and discovery. Each new generation thus receives a cultural trandition from the preceding generations, and also makes inventions and discoveries and learns new patterns of behavior from its own experiences. The process of change seldom, if ever, results in culture change encapsulated within a single generation; there are always some learned behavior patterns passed from one generation to the next.

What is Culture Change?

MacIver (1956: 451) noted that the term "change" itself is a neutral word, implying nothing but a difference through time. Continuity is introduced when "change" is referred to as a process, meaning continuous change taking place in a definite manner, through the operation of forces present within the situation. "In process we observe a series of transitions between one state of being and another. There is no necessary implication as to the relative quality of the two states of being, or as to the direction followed. A process may be up or down, forward or backward, towards integration or disintegration. All that is meant by process is the definite step-by-step manner through which one state or stage merges into another" (MacIver 1956: 452).

MacIver defines four types of change (1956: 453), all of which have been applied at least to some extent to aspects of culture. The four types are:

1. Growth: quantitatively defined, with respect to size.

2. Evolution: qualitatively defined, with respect to structural or functional differentiation.

3. Progress: qualitatively defined, with respect to conformity to a standard of value.

4. Adaptation: defined by reference to some other object or system, with respect to their compatibility within a common process.

These "types of change" are not mutually exclusive in the study of culture change. L. A. White, an avowed evolutionist, views culture as passing through a series of stages, each arising as a consequence of an increase in the amount of energy source tapped by man. With each energy increase, there comes a period of rapid cultural growth (L. A. White 1959: 39-40). White also equates progress and evolution or cultural development: "Progress was due almost wholly to increase of efficiency or economy of mechanical means in the first stage of cultural development. In subsequent eras development has come from both sources" (1959: 56). Among other evolutionists, similar statements equating progress or growth and evolution can be noted (Service 1960: 759: Childe 1951: 20-36).

Kroeber, as a culture historian, notes that: "The process of cultural development is an additive and therefore cumulative one" (1948: 297), and he considers how they "grow" (1948: 326) and how they progress "may legitimately be considered a property . . . . of culture" (1948: 304).

In studies of culture change, growth, evolution and progress are not clearly differentiated. The studies of culture change might be better understood by examining the traditional division between the evolutionists and the relativists. Steward (1953: 313-5) has discussed the differences between these approaches to culture change. His concise summary makes a clear distinction between evolutionism and relativism: "Evolutionism is distinguished from relativism by the fact that the former attributes qualitative distinctiveness to successive stages, regardless of the particular tradition, whereas the latter attributes it to the particular tradition rather than to the development stage" (1953: 314).

Progress and growth have been considered as attributes of evolutionary change and cannot be distinguished from it. Likewise the relativistic approach to the study of culture change also includes progress and growth as attributes of culture history. However, historical and evolutionary approaches may be distinguished by their "evolutionary stages" and "historical traditions" regardless of qualitative distinctions.

History and evolution may be considered interpretations of macro-temporal processes (A. F. C. Wallace 1961: 136), covering hundreds or thousands of years. In this way they can be differentiated from the processes of adaptation which are micro-temporal (A. F. C. Wallace 1961: 136). There is no defined boundary between macro- and micro-

temporal processes. They are taxonomic conveniences and have no objective reality. However, macro-temporal processes are generally termed evolution or history while micro-temporal processes go under the rubric of acculturation, nativistic movements, ecological adaptation, and the like. By and large, they may be considered adaptive. Further, history and evolution emphasize chronology of cultural forms; the adaptive processes emphasize sequence of events.

Finally, these processes of change may be arrived at by reasoning from given premises to their necessary conclusions (deduction) or from particular to the general (induction). Cohen (1962: 321-48) has recently reviewed "the strategy of social evolution" in terms of inductive and deductive approaches and the varying time scales of 0-25 years, 25-500 years, and over 500 years. Cohen's use of the term "evolution" refers to both specific and general evolution as defined by Salhins:

> The fundamental difference between specific (multilinear) and general (universal) evolution appears in this: the former is a connected historic sequence of forms, the latter a sequence of stages exemplified by forms of a given order of development (Salhins and Service 1960: 33).
>
> . . . . . .
>
> General cultural evolution, to summarize,

> is passage from less to greater energy transformation, lower to higher level of integration, and less to greater all-round adaptibility. Specific evolution is the phylogenetic, ramifying, historic passage of culture along its many lines, the adaptive modification of particular cultures (Salhins and Service 1960: 38).

In these terms, specific evolution is synonymous with history as we have defined it above.

After examination of a sample of deductive and inductive studies of social evolution of different time scales, Cohen concludes:

1. ". . . . large scale studies can develop no explanatory theory of evolution sui generis. Society considered as a unit cannot cause itself to evolve, rather the relationship of its various parts one with another and with external forces bring about whatever developmental regularities we are able to isolate. Large scale evolutionary theory is therefore essentially reductionist" (Cohen 1962: 339).

2. In middle scale studies, factors put forward as determinants of change include a wide range of variables such as the impact of one institution on another, as the church's impact on the state. Environmental factors may

offset the development of socio-cultural types, or "great men" may affect an institution or society in general. Cohen sees the causal forces of middle scale change breaking down into two major categories:

> First there are the ideal goals and functions of the institution which tend to influence the behaviour of members of these institutions such that they will act to further these goals even if this means doing so at the expense of the other institutions in the society. Secondly, environmental trends in the situation such as geographical factors, or relations with other societies tend to promote or hinder the advancement of particular institutions or tendencies within these institutions over time within any one society. Small scaled causal factors if continued through time can also bring about transformations at the middle scaled level (Cohen 1962: 340).

3. At the small scale level the range of causal factors is very large. It included demography, values, surplus, conflict, personality patterns, and others. Finally, "What is obvious . . . . is that no satisfactory theory of social change exists at present which could be utilized for evolutionary purposes. Such a theory requires that small scaled changes not only be explained, but that the manner of

their articulation with larger scaled changes be predicted as well" (1962: 341).

In looking for an adequate theory of change, Cohen feels that the approach should be basically deductive since "Greater concentration on inductive work will simply turn up more and more undigestible facts for a discipline that is already bursting with literature" (1962: 341). Further, "It is useful to approach the problem from a reductionist point of view and regard this process from the position of an evolving phenomenon. Then factors within the phenomenon are said to interact with one another and with the external world to produce changes in the phenomenon as a whole" (1962: 343). And, "the problem of scale may be solved when we consider all levels of scale as possible and simultaneous sources for selective factors that operate through small scale processes in society to promote the multiplicity of adaptations that human history has witnessed" (1962: 344).

Explanation in Social Science

Implicit in Cohen's discussion is the idea that a theory of social change must explain change. Yet at no point does he define explanation and the ramifications of any definition of explanation for a theory of cultural or social change. Recently Beattie (1959: 45-60) has discussed the nature of explanation in social anthropology. An explanation, states Beattie, ". . . . relates what is to be explained to some-

thing else, or to some order of things or events, so that it no longer appears to hang in the air, as it were, detached and isolated . . . . What is unintelligible considered in and by itself becomes meaningful as soon as it is seen as part or as an examplification of a wider system or process; that is, as soon as it is placed in an appropriate context" (1959: 49).

Beattie outlines four types of explanation: (1) historical explanation, (2) explanation in terms of mediating factors, or functional explanation, (3) teleological explanation, and (4) explanation in terms of general laws or principles, or taxonomic explanation.

Historical explanation shows that an event or state of affairs has followed from some pre-existing state of affairs, in accordance with certain principles of efficient causation already familiar from other contexts. In an historical explanation, event A follows event B because of causation X; or B + X -- A.

Explanation in terms of mediating factors (functional explanation) consists simply of demonstrating connections between things which at first sight appear to be separate. "If the entities connected are on the 'what actually happens' level, these connections will in the last resort be found to be of a causal kind, different events being seen to be linked in a common causal nexus with other events" (Beattie 1959: 50). Our understanding of the widespread

institution of marriage payment has been added to by showing how marriage payment is linked to other social institutions such as status system or the maintenance of inter-group relations. The functionalist approach to anthropology has afforded innumerable examples of this kind of explanation. "The pointing out of necessary but not always obvious interdependence between things is an integral part of the functionalist approach, as this has been variously understood in social anthropology" (Beattie 1959: 50).

The third type of explanation, teleological, consists in showing that what is being explained has the quality to bring about a certain consequence. It is necessary for the consequence to be some sort of meaningful complex.

> What is implied in teleological explanation, then is not simply reference from a cause to an effect . . . . ; what is essential to it is the notion that what is explained has causal implications for some kind of complex, comprehended as a working system, and having some kind of value, such as utility or efficiency, attached to it. What is being explained is teleologically understood when it is shown how it contributes to the maintenance or working of that system (Beattie 1959:50).

Efficient causation is demanded here in that the factor to be explained is understood <u>because</u> it results in the given

consequences. "This provides the second meaning of teleological explanation. The end is thought of as somehow foreseen . . . ., and the thing to be explained is understood when it is seen to be adapted . . . . to that end" (Beattie 1959: 51). This second kind of teleological explanation is appropriate to many social phenomena, since it enables one to understand the conscious behavior of human beings, who act with the intention of achieving a given end at least some of the time. However, "behavior" of other organisms or of prehistoric cultures cannot be explained in terms of intent. The fact that a plant located in a dark crevasse grows toward the light cannot be explained by the plant's intention to reach greater light. Nor can prehistoric culture change be explained by intentions of prehistoric cultures, since neither plants nor cultures can be said to have intentions. The teleological explanation makes it possible to understand forms of certain phenomena by showing that "that particular form conduces to the production or maintenance of a particular systematic complex" (Beattie 1959: 51), for example, the maintenance of life through the ingestion of food.

However, the teleological explanation, by its very nature, implies another question: "How did it come about that the form of what is to be explained is so conveniently adapted to the consequences by which we explain it?" (Beattie 1959: 51) This question obviously requires an historical explanation.

The fourth type of explanation is that which refers to general laws or principles. Generally this kind of explanation only asserts that the phenomenon to be explained belongs to a class or category of phenomena, and either possesses the characteristics of the class or else possesses some of the characteristics invariably found associated with the class. In the first instance, the "explanation" is a tautology and in the second the association itself demands explanation in some other terms. "When, however, there already exists some understanding of the category to which the datum to be explained is referred, then the process of subsuming the particular under the general certainly adds to our understanding and so may be called explanatory" (Beattie 1959: 53).

Any theory of culture change must explain change in one or more of the types of explanation outlined above, or by some other type of explanation. The first three types, historical, functional, and teleological, all imply dynamic interrelationships between phenomena, while taxonomic explanation implies a static quality or qualities of the phenomenon to be explained. On this basis, taxonomic explanation appears to be the least applicable to the dynamic phenomena of culture change. However, it has been widely used in prehistoric studies, both in the Old and New World. The well-known cultural stages of prehistoric Europe and the historical developmental stage of Willey and Phillips (1958)

for the New World, may serve as examples.

This approach to explanation is inductive and generally of limited scope when successful. Other types of explanation may be arrived at through deductive and in some cases inductive reasoning. The implied dynamic quality of the phenomena explained by these types of explanation and the ability to arrive at these types of explanation by deduction, makes it desirable to apply them to culture change. This, then, is the desired end for a model of culture change.

Requisites of a Model for Culture Change

If we accept Cohen's reductionist approach and deal with factors within culture that are said to interact with one another and with the external world to produce change in culture, we must isolate those factors that are interacting and they must be universal if our model is to be universally applicable. In this respect, Herskovits has stated (1948: 229):

> All cultures are made up of institutions that represent formalized and sanctioned responses to the demands of living. The institutionalized ways of behavior in which these responses are manifest, appertain to the various aspects of culture. These are like great blocks of experience which the student carves out of a functioning body of custom in order the better to achieve a workable description of it.

> Aspects are, so to speak, a kind of table of contents of culture; the framework about which, however unrealized, a people organize their life.

Herskovits further "justified" the universality of aspects of culture in spite of their variety of forms when he wrote (1948: 237-8):

> . . . . viewed in the large, culture does fulfill the needs of man, psychic no less than biological; that it solves for him problems whose solution is demanded both by the character of his bio-psychological make-up and the need to meet the demands of his habitat. He does this by setting up institutions which, for each society, exact conformities from the individuals who compose it, in the interest of adjustment and survival. That they vary so widely from one society to another only means that multiple solutions stemming from an underlying universal base characterize human culture.

These aspects of culture supply the physical wants of man, order social relations, give meaning to the universe, sanction everyday living and afford man some of his deepest satisfactions through their aesthetic manifestations (Herskovits 1948: 239).

The universal aspects of culture are, according to Herskovits (1948: 239): technology, economics, social organization, education, political structures, belief systems, the control of power, graphic and plastic arts, folklore, music, drama, dance, and language. If the interaction among aspects of culture and between the aspects of culture and the external world are to be studied, the prehistorian is placed at a disadvantage because of limited cultural content and function in archaeological remains. Language, drama, music, folklore, and education are almost always lost to all the yesteryears. The ethnologist may observe behavior directly and question living informants; the archaeologist must reconstruct culture from the lifeless products of the learned behavior of members of a human society. Obviously the archaeological data are more limited.

The limitations of archaeological data are generally stressed in every general text on anthropology. However, Sears (1961) has recently shown, while there are limits to the cultural or social reconstruction that can be made on the basis of archaeological data, these limits have not yet been determined. Or, as Willey and others optimistically stated:

> The importance of associations (of material objects) in archaeological research cannot be overestimated because they reflect human behavior outside of the limits of what ethnologists call 'material culture', and under

> favorable circumstances of preservation, may permit archaeological study of most aspects of human culture except those, like folksongs and kinship systems, which are totally dependent on language. In most cases, accidents of preservation and carelessness or lack of skill on the part of the archaeologist set up more serious limitations to reconstruction than does the nature of the subject matter of archaeological study (1956: 5).

This does not mean that the anthropologist need only refer to recent archaeological works to find full cultural reconstructions. On the contrary, cultural reconstruction is rare in the archaeological literature. Taylor's (1948) criticism of American archaeologists who see his taxonomic system as an end in itself, appears to be applicable to a large extent 15 years later. There is, however, some progress being made. Archaeologists are realizing that the limitations of the archaeological data are still unknown and more extensive reconstructions are now being undertaken (e. g., Willey 1953; Martin and Rinaldo 1950; DiPeso 1951, 1953, 1956).

Through development and refinement of techniques and conceptual tools, the archaeologist's description of culture may become not too different from that of the ethnologist.

With this tendency toward convergence of description of culture in archaeology and ethnology, more common ground may be found for the basis of a theory of culture change that unites the "specialists in time" with the "specialists in content and function."

The more thorough the cultural reconstruction by the archaeologist, the deeper can be his analysis of the processes of culture change, or as Sears stated: "With whatever reconstruction of social and religious structures are available, the student should be able to move to a study of the hows and whys of cultural process. If he knows something about the what of a particular religious manifestation, he is in a position, never attainable through sherd analysis, to work on the whys of its intercultural spread" (1961: 231). In short, the more reconstruction of cultural content and function the archaeologist is able to string on the threads of his chronologies of potsherds and point types, the greater his contribution to the study of cultural process and to the general body of anthropological knowledge.

This added problem of reconstruction in archaeology has been prohibitive in the development of analytical models of cultural change. Culture change is most often represented by a descriptive model in both ethnology and archaeology; however, steps have been attempted at deriving analytical models. Steward's (1955) multilinear approach is an attempt to factor out the variables in culture change and may be

considered analytical in that respect. Several of the culture-personality approaches to culture change may be considered analytical in the same way (A. F. C. Wallace 1956; 1961).

The fact that it is archaeological complexes rather than reconstructed cultures which hinder the development of analytical models is amply illustrated by the following example. The so-called Middle Mississippi Culture came into contact with the so-called Swift Creek Culture, in western Georgia. After a period of time, they were replaced by or developed into a single culture: the Lamar (Willey and others 1956: 11-12). Sears, however, noted that the Lamar and Macon Plateau (the Middle Mississippi Component) are essentially unknown or undefined, while the Swift Creek "culture" is actually a ceramic tradition. All that can really be stated is that Camar ceramics blend styles from Swift Creek and Mississippi traditions (Sears 1961: 224).

If this is so, what variables can the archaeologist factor out for an analytical study of culture change? First, analytical models of culture change cannot be constructed on the basis of changes in ceramics or point types alone. In studies of culture change, the ethnologist and the archaeologist at least appear to be working toward the same ends--an analysis of the processes of culture change. The ethnologist and the archaeologist approach this problem with at least a small body of concepts that are apparently the same in both fields, or at least similar and related. The arch-

aeologist, however, is at the disadvantage in having to reconstruct by inference the cultural content and function, before he can deal adequately with problems of cultural process.

Does the statement that the archaeologist must make cultural reconstructions before he can adequately deal with culture change, mean that the archaeologist should not attempt to develop analytical tools until cultural reconstructions have been taken as far as they can? Should the archaeologist postpone attempts at analytical studies of culture change and concentrate on methods and techniques for cultural reconstruction? It does not seem possible to overstress the importance of cultural reconstruction, and the fact that any analytical study is limited by every aspect of culture not reconstructed. However, methods and techniques for cultural reconstruction might well be set in relief by attempts at analytical studies of culture change. Further, the "wait until all the data are in" attitude has proven to be unrewarding and is a lesson the archaeologist should have learned well.

The value of any analytical tool will be greatly enhanced if it is applicable to both archaeological and ethnological data. However, we must operate only on the cultural level (i. e., deal with traits, institutions, aspects, and cultural patterns) and cannot depend directly on the psychological level for explanation, if our tool is to be of

any value in analyzing archaeological data.

If we are to develop a theory of culture change applicable to both archaeological and ethnological data, the archaeological data must be presented in terms of cultural reconstructions, not in terms of sequences of potsherds or point types. However, cultural reconstructions based on archaeological data are necessarily incomplete and must be limited to one or two aspects of the culture. The aspects of culture which are best represented in archaeological remains are the technology and economy. The relative wealth of remains of these aspects and the relative ease with which ecological studies of prehistoric peoples can be made, has resulted in a considerable quantity of these data. Consequently it is in this area that a theory of culture change is best focused at this time. The following theory is limited primarily to change resulting from interaction among technology, economy, and physical environment. However, other aspects of culture are dealt with whenever possible.

Vogt (1960:126) has pointed out that there is differing importance of technological, environmental, social structural and value systemic variables in various types and phases of culture change: "The impact of technological environmental elements upon what happens in a simple hunting society, such as among the Great Basin Shoshones (Steward 1938), is direct and overwhelming, and there is virtually no possibility for either social structural or value-system factors to affect the course of events."

On the other hand, twentieth century American society has reached the point where "human choice" based on our value system accounts in large measure for the current direction in which our system is moving. "The widest proposition I think can be defended with our present evidence is that the importance of value-orientation in shaping the directions of change is proportional to the amount of economic and technological control a society has achieved. In other words, the less economic security a society has, the less decisive will be social-structural and value system variables in shaping the course of events" (Vogt 1960:126).

If we accept this proposition, it becomes apparent that the theory proposed below is most applicable to societies with little economic security. In other words, the probability of the theory is inversely proportional to the amount of economic security of the society. This may be regrettable, but perhaps with more complete cultural reconstructions, a theory of this type can be developed that includes more complex societies and more aspects of culture.

Chapter iii. A Theory of Culture Change: Economic Activities

A theory of culture change must explain change. An explanation is the placing of the phenomena of change in a frame of reference that shows relationships which bring about change, i. e., causal, functional, or teleological relationships. It is our contention that causal relationships are to be recognized in the interaction or functional relationships among the aspects of culture and between culture or aspects of culture and the physical environment. Each aspect is thus viewed as a dynamic institution or structure that is capable of adjusting to change in other aspects of culture or to changes in the physical environment. In the following theory, the causal explanations are derived ultimately from two general principles: (1) that culture is an adaptive mechanism by which man copes with and exploits his total environment. Culture thus fulfills the needs of man, psychic as well as biological and social; (2) that man selects from the total range of possible cultural behavior a segment which in itself represents a considerable range of variation and that within this segment he focuses his attention on still more limited segments of the aspects of culture. Under conditions of free choice, these foci are more susceptible to change than other areas of the culture.

These general principles operate in a dynamic universe

where the setting of a culture (its physical environment and cultural contacts) is changing and represents the selective forces which in turn cancel out or endorse the creative acts of the individual man. The central aspect for the following theory is economy, or more specifically, production. In the study of prehistoric economy, the archaeologist is limited primarily to the study of production; distribution, exchange and consumption are little if at all represented in the archaeological record. Production is on one hand intimately related to the available resources, on the other to the technology, social structure, and value systems. The resources of a given area comprise the range of available raw materials from which commodities are produced. The technology, social structure, and value systems together determine what part of the natural resources are utilized and what commodities are produced.

The Economy: Technology and Production

Technology and production are obviously closely interrelated and a discussion of this relationship is required at this point.

Technology may be defined as the method, techniques, and knowledge utilized in the manufacture of material culture. Production, on the other hand, refers to the exploitation of the natural resources of the environment. A productive system is thus dependent upon the interrelationship of technology and environment, and the productive system may

be viewed as the organization of the technology for the exploitation of the environment. The form of the productive system results from not only the interrelationship between technology and environment, but also from influences originating in the social structure and value system. Changes in any of these aspects of culture or in the environment could result in changes in any one or all of the aspects of culture, for these are only arbitrary divisions made in a functioning body of custom, in order to achieve a workable description of them.

Production Sets

Economies of non-industrial peoples are generally classified in a crude manner on the basis of their most important productive activities. The major categories in this classification are: (1) collecting, (2) hunting, (3) fishing, (4) herding, (5) horticulture, (6) agriculture. No people have been known to rely exclusively on one productive activity alone, these modes of production being elements of economy that are combined in varying manners and degrees among different peoples (Forde 1950: 461).

Originally these divisions represented a four-fold classification based on whether or not the resource utilized was plant or animal, wild or domesticated (Herskovits 1948: 247). Since then, the four-fold division has been refined and expanded due to addition of new criteria such as the distinction made between horticulture and agricul-

ture (Lowie 1937: 112-17). The classification of productive activities used in the following discussion is similar to those currently in use. It differs in emphasizing the productive activity (including technology) rather than the quality of the resource utilized.

Herein the productive activities of non-industrial peoples are divided into four production sets: collecting, hunting, cultivating, and animal husbandry. Each of the production sets includes a number of productive activities that are assumed to be related through a complex of tools, motor habits, and knowledge and ideas about their use. This complex represents a certain segment of the technology and its application to the environment. It is assumed that this complex of tools, motor habits, and knowledge and ideas about tool use and application to the environment, are interconnected through historical, functional, or psychological factors.

For example, the collecting of acorns, pine nuts, camas, and shellfish is considered to embody the "idea" of collecting, as opposed to the "ideas" of hunting, cultivating, and animal husbandry. The process of "digging" or "picking" of the crop, the cracking of shells, peeling of skins, etc., and the grinding and/or pounding or chopping of the foodstuff may be considered as an extension of a single segment of technology and its application to the environment. The extension of gathering and cracking nuts to the collecting

and "cracking" of shellfish is quite admissible, as is the extension of the seed grinding use of mano and metate to acorn mashing use of the mortar and pestle. The digging of roots and the digging of clams or grubs or ants falls into the same category of operation. Throughout the following discussion, the expressions "productive set" and "complex of ideas, tools, and tool uses" are used. It is the broad, assumed, general relationship of activities, ideas, tools and tool uses as described immediately above, that is meant.

The production sets may be defined as follows:

1. Collecting: the acquiring of wild plant or animal resources by use of hands or specialized "digging" and "picking" tools. The resource need not be immobilized in the process of collecting and prior to its being gathered, there has been no intentional technological treatment of the resource or its immediate environment in order to assure or increase productive potential of the resource. These foods include, besides plants, those animal foods that may be collected in a similar fashion, such as shellfish, grubs, ants, larvae, baby birds, eggs, honey, and the like.

2. Hunting: the acquiring of animal food by means of specialized tools or aids for dispatching or immobilizing, such as projectiles, nets, traps, snares, poisons, and fire. This technique as defined here includes the taking of land mammals, sea mammals, and fish. Neither the manipulation of the resources nor their physical environment in order to as-

sure or increase their productive potential is involved in the hunting set.

This production set may be, and traditionally has been, divided into two major divisions on the basis of whether the resource was a land or water animal. Fishing may be viewed as a distinct productive activity from a number of points of view, but it is not distinctive on the basis of the criteria for production sets as discussed above. Fishing requires a technology for immobilizing the fish and the techniques utilized are so similar tc those of land hunting that it appears one could easily have been adapted from the other. Fishing thus includes all or nearly all of the same general methods of taking animals as does hunting: projectiles, snares, nets, and poisons. Fishing, like sea mammal hunting, may be viewed as a specialized development within the hunting production set, resulting from the basic difference between the nature of land and water.

3. Cultivating: the control or change of the plant or the physical environment, by technological means, in an attempt to assure or increase the productive potential of the plant. The cultivating productive techniques include both simple horticulture as well as agriculture with plow and draft animals. The tools used vary from the digging stick to the plow, and techniques range from irrigation to dry farming, from slash-and-burn to use of fertilizers. The range of techniques is great but always it involves the

changing or controlling of the environment or of the plant resource itself. The irrigation practices of the Great Basin Paiute, and the weeding of clover patches on the Northwest Coast, are thus as much cultivating techniques as the slash-and-burn agriculture of the Amazon Basin or the irrigation of rice paddies in Southeast Asia, and use of ox-drawn plow in the Near East. Cultivation can generally be equated with tilling of the soil, but not necessarily with domesticated plants.

The technological equipment of the cultivating techniques of production grades into tools often used in the collecting set. Often, among simple cultivators, the tools are identical to those of collectors. This is especially true where people who are basically collectors also practice some simple cultivation. The major tools which indicate cultivation are the hoe and the plow. The digging stick is often used by cultivators, but does not distinguish cultivating from collecting. In such cases, other factors such as the presence or absence of domesticated plants must be taken into consideration. Also such factors as settlement patterning may give additional insight into the productive technique of a prehistoric people. Nevertheless, in many instances, when the cultivating techniques are little used or just beginning to be developed, the archaeologist will have difficulty not only in evaluating their relative importance but in illustrating beyond doubt their presence.

The harvesting tools of the cultivating technique, and in some cases of the collecting set as well, are distinct from those of hunting or animal husbandry, in that projectiles are absent. Occasionally there are some similarities such as in the microlithic blades of the Near East used as reaping knives and the microlithic blades used as arrow tips in Northern Europe during the Mesolithic. This is also true of the processing tools, where the cultivators utilize grinding implements distinct from hunting tools. Thus, the cultivating productive technique utilizes a technology which is generally distinct from animal husbandry and hunting, but shows considerable similarity to the tools of collecting. It may be extremely difficult to distinguish between the remains of cultivating and collecting, while remains of hunting and animal husbandry are generally recognizably quite distinct from those of cultivating.

4. Animal Husbandry: manipulation of either the animal or its physical environment by technological means, in an attempt to assure or increase the productive potential of the animal. Animal husbandry includes the raising of animals for food, for draft, and for by-products such as milk and eggs. In its "formative" stage, animal husbandry may be difficult to differentiate from hunting. In a simple form, animal husbandry may be little more than the following and protecting of a herd of animals, as with the Chukchi and Koryak, or it may be the careful tending of cattle as

practiced by the Masai. It may take the form of keeping chickens or pigs or sheep, each of which requires its own techniques.

The archaeological evidence for animal husbandry may be severely limited, and traits characteristic of it are difficult to isolate. The most obvious trait is the faunal remains themselves, which may be identified as those of domesticated animals. Other traits include harnesses and other such trappings (unfortunately usually of a perishable nature), used in conjunction with draft animals. Often people who are primarily herders follow such a nomadic life that they leave little if any remains that can be detected archaeologically. In short, the most dependable indications of animal husbandry in archaeological remains are the faunal remains of domesticated animals.

We may conclude that where evidence has been preserved in the archaeological record, the sets of productive techniques can be isolated. However, in some cases there may be overlapping or marginal instances where these sets are impossible to detect archaeologically. The irrigation of wild plants by the Great Basin Paiute and the reindeer herding of the Chukchi serve as two such examples.

Within each production set, there are activities that can be isolated or factored out from the archaeological data. These may be as specific as the collection of a particular seed or shoreline animal food. However, generally the

archaeologist must lump these activities into seed collecting and shellfish gathering. These categories must come from the archaeological data dnd represent only approximations of "reality." These activities may be arranged with respect to the ecological zones utilized by the prehistoric society, e.g., collecting of shellfish along the coastal shoreline, and seed collecting inland. The latter may be distributed through more than one ecological zone, but this again must be determined from the archaeological data.

Ecological Pose

The exploitation of each ecological zone by means of a production set is here termed an ecological pose. Each production set can be used in varying ecological zones; an ecological pose represents the functioning of a production set within a given ecological zone. This concept of ecological pose is an adaptation of Gearing's structural pose (1958: 1148). Gearing's statement is, in part, that "in every human community, a series of social structures come and go recurrently." A structural pose is visualized as each recurrent social structure. Similarly, in every human community, the production set may be seen as being adapted in different ways to the different ecological zones, and each ecological adaptation of the production sets may be termed an ecological pose. This is possible whether or not the productive activities are undertaken simultaneously, or serially, as in a seasonal round.

Economic Focus

We have stated above that no people rely exclusively on any one production set. On the other hand, most people rely more heavily on one production set than on others. As Benedict (1934: 237) has noted, any culture "makes use of a certain segment of the great arc of potential human purposes and motivations . . . . (and) any culture makes use of certain selected material techniques or cultural traits." Herskovits (1948: 542) also noted a "tendency of every culture to exhibit greater complexity, greater variation in the institutions of some of its aspects than in others." In most studies of primitive economy, where societies may be classified on the basis of their most important economic activities, this kind of selection and focusing on certain segments is noted (Forde 1950; Herskovits 1948: 247-52). In other words, the production sets are not of equal importance in any given economy. One production set is generally of greater importance and is found to be more complex. The most important production set is termed herein the economic focus.

Here an analogy is drawn from Herskovits' cultural focus concept (1945: 164-5; 1948: 542-53). Herskovits makes the following statements regarding cultural focus and it is assumed herein that these apply equally to economic focus:

> A people's dominant concern may be thought of as the focus of their culture; that area

> of activity or belief where the greatest awareness of form exists, the most discussion of values is heard, the widest difference in structure is to be discovered (1945: 164-5).

Again,

> We can state that the greatest variation in custom, manifest in the greatest complexity of form can be looked for in the focal aspect of a culture, and that this represents either potential or achieved cultural change (1948: 544).

Cultural focus, we are told, operates for either cultural stability or cultural change, under different circumstances:

> . . . . where cultures are in free contact, the focal aspect will be likely to be the one where the new elements are most hospitably received. On the other hand, in situations where one people is dominated by another, and pressure is brought against customs lying in the focal aspect, retention will be achieved by devious ways (Herskovits 1948: 550).

This generalization does not, however, take into consideration all of the possibilities regarding culture contact and its influence on the cultural focus. Herskovits

himself (1948: 547) notes an instance where the cultural focus was destroyed. In this case, the sacred buffalo cult, which is the cultural focus of a Toda village, was destroyed when the British took over the sacred dairy of the village. Because of the loss of cultural focus, this village alone has taken to raising potatoes and keeping cattle as well as buffalo. This represents a considerable number of foreign traits. In contrast, the other Toda villages continue to maintain ritual, retain the old economic pattern, and remain relatively impervious to foreign ways.

Loss of cultural focus could also result from non-cultural factors, for instance when disease and drought remove large segments of a population and destroy plant and animal resources. In such cases, cultural focus may not aid in determining the direction or rate of cultural change, although some influence may still be exerted through mechanisms of transference.

The concept of cultural focus is one of limited use, since change of focus cannot be explained sui generis. The concept of cultural focus has been criticized by Nash (1957: 149):

> The explanation of persisting features of non-Western cultures in situations of acculturation is frequently made in terms which approach tight and seemingly irreducible tautologies. Such theoretical

> notions as . . . . 'cultural focus', and similar conceptions purport to explain why, for example, elements of aboriginal religion have survived in one Mexican community and not in another . . . . This kind of explanation rests on the idea that some parts of culture or of a culture, are in themselves more 'viable', more resistant to change or modification than other parts. Since the viability of a cultural feature is only judged after the fact of its having persisted while other parts of the culture have been lost or undergone change, the explanation is of necessity either a sterile labeling of parts of culture or an empirically meaningless tautology.

This characterization of cultural focus is erroneous. For Herskovits stated (1948: 543) that the "hypothesis of cultural focus refers the dynamics of culture to the only instruments through which change in culture can be achieved--the individuals who compose a society where a way of life is undergoing change," and he criticized the "culturologists" for disregarding the psychological factors involved in culture change. The interrelationships between the psychological

factors involved and cultural factors which explain the functioning of cultural focus in an acculturative situation are clearly outlined by Herskovits (1948: 544):

> The things that outstandingly mark the culture of a people . . . . also tend to dominate their lives. Because such matters are important to them, people will think and talk a great deal about personalities, events, and possibilities lying in this aspect of their culture. As a result of this interest and the concomitant discussions that are carried on, possibilities for realignment will emerge, and emerge with enough frequency so that resistance to the idea of something new will be lessened. It is apparent that a suggestion of change in a phase of life that is taken for granted and seldom discussed will meet with greater resistance than in one where the phenomenon is under common discussion, and various possibilities in its form and function are thus constantly being suggested. In the former instance, the seed falls on barren ground; in the latter, the soil is fallow.

Herskovits thus sees a functional relationship between individuals, culturally inherited dominant "interests," and

alternatives presented to the individuals, as an explanation for direction of culture change. It is herein assumed that a concept of economic focus, similar to that of cultural focus, may be constructed by analogy.

Economic focus may be considered to designate the tendency for every economic system to exhibit greater complexity and greater variation in the ecological poses of one of its production sets than in the others. All societies have a tendency to specialize in the field of economy. This specialization may be seen in the greater emphasis placed on one production set. Within that production set greater complexity of technology and greater variation in the utilization of environment is observable.

A production set may be shown to be relatively more complex or varied than other sets by the number and complexity of tools used within it. The number and range in size and form of projectile points or of manos and metates may be taken to indicate complexity and variation within a set. The number of ecological zones exploited (i. e., number of ecological poses) by a production set also indicates complexity. The economic focus can thus be said to correspond to the production set which contains the greatest number of ecological poses and greatest number, complexity and variation of tool types.

Unfortunately, archaeological data often limit the possibilities of inferring the relative degree of complexity or

variation of the production sets. For example, in the collecting set, the gathering of various types of grass seeds and pine nuts, representing several ecological zones, may all be represented in the archaeological remains by the same tool types, as manos and metates. Under such conditions, the archaeologist must treat them as representing a single ecological pose. Further, certain production sets, by their very nature, include a very limited number of ecological zones--cultivating and animal husbandry, for example. The archaeologist must therefore consider the inherent ecological limits of any given production set.

In similar fashion, an economic focus may have a relatively simple tool assemblage. The possible elaboration of a mano is severely limited by its function, for example. The archaeologist must consider what is required of the tool and how much it is elaborated beyond the requirements, how much it can be elaborated beyond them, how many different variations of the basic tools occur, and finally, how these qualities of the technology of the various production sets compare with one another.

Another variable that may be considered is productivity. The production set which results in the greatest food supply may or may not fall within the economic focus. It is conceivable that in a society where the focus coincides with elaborate hunting techniques and equipment of the men, the greatest food supply nonetheless could come from the collect-

ing or cultivating activities of the women, using simple technology. Furthermore, productivity of two or three production sets may be equal or nearly so, or at least appear that way to the archaeologist. Economic focus and productivity are thus separate variables. However, as will be shown below, there is a tendency for the economic focus also to be the most productive set.

By following Herskovits' reasoning (1948: 542-53), we may explore some of the ramifications of the concept of focus. Economic focus is the production set in which the greatest manipulation of ideas, environment and tools has taken place. The result is seen in the greatest range of variation, thus widening the range of choice of action. We may ask at this point, who is doing the manipulating and who is choosing the course of action? Obviously, we must either refer to the individuals operating within the given cultural milieu or reify or deify our concept of culture and economy. The choice of action, the choice of what to manipulate and how to do it, is made by the individuals. However, no individual is an isolated substance of creativity. The choice and its acceptance by the society as a whole take place within a cultural context. It is most probable that the choice of action and the manipulation will take place in the segment of economy that is most often dealt with on a conscious level, but this choice and its acceptance are influenced by other factors: environment, technology, social

structure and value system. The latter two are poorly controlled by the archaeologist and until techniques for their reconstruction can be developed, they must be considered essentially uncontrolled variables.

However, if we accept Vogt's (1960:126) proposition that "the less economic security a society has, the less decisive will be social-structural and value system variables in shaping the course of events," then we may continue to speak with some assurance about probability of direction of economic change, based on the interrelationships of environment, technology, production sets and focus.

The Interrelationships of Environment, Technology, Production Sets and Focus

We have stated that all productive techniques may be divided into production sets (collecting, hunting, cultivating and animal husbandry) based on the assumption that each production set represents an application of a complex of ideas, tools, and tool uses to a whole series of resources in a variety of ecological zones (Fig. 1). The complexity and variation which characterize the economic focus may be the function of the number of ecological zones to which it is adapted. That is, the more ecological zones to which a production set is adapted, the greater the diversity and complexity of its ideas, tools, tool uses. However, variability and complexity in ideas, tools, tool uses are not always immediately observable in archaeological remains.

Economic focus must be determined more subjectively and a number of variables must be considered before the focus can be assigned to a production set. The set of greatest productivity tends to equate with the economic focus, as will be shown below, but this is not always the case. However, if the combination of greatest complexity of tools, greatest number of tool types, greatest productivity and greatest number of ecological foci fall within one production set, that set can be said to be the economic focus.

In applying this model, we may first project it against a specific economic (i. e., cultural) setting and whole production sets may be eliminated, such as cultivation and animal husbandry. Secondly, the number of ecological zones is limited when it is projected against the environment of a given area. In this manner, the number of variables is considerably reduced.

If we make the assumption that a culture operating at a given time is expending an amount of energy equal to or less than the intake of energy (the productivity of all production sets), then any decrease in productivity of an ecological pose must be compensated for by another or other poses through either increase in productivity or increase in number of ecological poses, or the population and/or general cultural complexity will decrease. The population density and general cultural complexity are two more variables one must consider in the application of the model,

but for the sake of ease of discussion, these will be considered constant herein unless specifically stated otherwise.

Increased productivity of existing ecological poses or the development of new poses occurs as a recombination of the ideas, tools and tool uses of the existing production sets. That is, new combinations of existing technology and new resources may be formed, or reinterpretation of tool use may be applied to a new resource. These changes may be seen as "extension" and reinterpretation of ideas regarding tools and tool uses as applied to the environment. That is, there develop new interrelationships between technology and the environment which result in new methods of exploiting the environment (i. e., changes in the realm of production).

The combination of existing technology with a new resource is illustrated by the Paiute of the Great Basin, who in times of plenty did not use the seeds of the sagebrush, but in years when other seed resources were not productive, used sagebrush seeds for food (Forde 1950: 35). Presumably, if there were a permanent reduction in the productivity of the sources of other seeds, the sagebrush seed would have been collected regularly. No special tools were required for processing: it was merely redefined as a food supply during times of need.

The reinterpretation of tool form and tool use in application to a new resource is not so easily illustrated. However, the introduction of the mortar and pestle in

Southern California may represent the reinterpretation of the form and use of the mano and metate. Its associated use in preparation of acorns may have been introduced at the same time and represent the extension of the "idea of edible resource" to a new foodstuff.

To summarize briefly before following further the ramifications of this model, we have made the following assumptions and postulates:

1. It is assumed that within a production set, productive techniques are related through a complex of tools, tool uses and ideas, regarding the use and forms of tools.

2. It is postulated that if the productivity of an ecological pose is reduced, it will be compensated for by increased productivity in other poses, population and general cultural complexity being held constant.

3. It is postulated that the economic focus is the production set about which most conscious thought and activities concerned with productive techniques are centered and the economic focus is therefore the set most likely to change under conditions where choices can be freely made.

If the above are true, it follows that the economic focus will increase in productivity if an ecological pose either inside or outside the economic focus is reduced in productivity. Therefore the economic focus will tend to be the most productive production set as well as the most complex and variable, since it is the place where compensation

is made for reduced productivity in other ecological poses.

The economic focus as presented in this model indicates the probable direction in which economic change tends to move. However, under certain circumstances, the economic focus may change from one production set to another. This change of focus may be attributed to causes originating outside the economic system, or to internal influences of a developmental nature.

External influences that result in change of economic focus may be viewed as either increasing productivity in production sets other than the economic focus, or decreasing productivity of the economic focus. We may postulate that if all or most of the ecological poses of the economic focus are being reduced in productivity, there will be a tendency for new ecological poses in other production sets to be created, as well as for an increase of productivity of already existing ecological poses lying outside the focus. In other words, if productivity of the focus is severely limited, there will be a tendency for individuals to spend more time manipulating ideas and tools and tool uses of production sets outside the focus. If such a development occurs, the direction of change cannot be predicted without taking into consideration the relative complexity and productivity of the other production sets and their relationship to the environment.

If an efficient innovation is made in a production set other than those of the existing economic focus, the focus

may change to that set. The Pawnee (Strong 1935; Wedel 1953) may illustrate this kind of change. Prehistorically, the Pawnee (Upper Republican Culture) may be considered primarily horticulturalist (cultivating focus), with a secondary production set of hunting, which included hunting of small game in the river bottoms and large game along the margins of the Plains as two ecological poses. An extended decrease in rainfall severely limited the productivity of cultivating during protohistoric times. During the same period the horse was introduced. Given the horse, the great bison herds were relatively easily accessible and highly productive in terms of food and material for tools, clothes, etc. During the historic period, the cultivating set was completely overshadowed by the seasonal buffalo hunts, to such an extent that the "permanent villages were occupied only long enough to plant and again to harvest the crops" (Strong 1935: 298). Thus, the economic focus changed from cultivation to hunting because of environmental pressures adverse to cultivating and the simultaneous introduction of the horse, which ultimately increased productivity and complexity of the hunting set.

Another way in which the economic focus may shift economic sets is by the introduction of a highly productive innovation or series of innovations from an external source which leads to a new production set which then becomes the focus. This may have been the pattern for the introduction

of horticulture into the Southwest and the Mississippi Valley.

All the ramifications of this model cannot be exhausted here, but another dimension to the model may be pointed out. If an ecological zone is being utilized by two or more production sets, there is the possibility of very definite and consistent relationships between these sets, that may make for a regular pattern in the change of the economic focus. For example, in the oak forest of Southern California, the acorn and seed gathering represent an ecological pose of the collecting set; deer hunting represents an ecological pose of the hunting set. These two poses are complementary when operating in this ecological zone. However, if the acorn supply is reduced, the number of animals that feed on them will also decrease. Therefore, when the acorn-seed gathering ecological pose decreases in productivity, a compensatory increase in productivity will probably not occur in the deer hunting pose. On the other hand, if the animals feeding on the seeds are severely decimated, a compensating increase in productivity may well come in the acorn-gathering pose, since the animals no longer compete with man for seeds and acorns. These kinds of ecological relationships clearly limit the directions in which change of economic focus can occur.

Pose and Set Fulfillment

If we turn now to internal influences that may result in change of economic focus, we find the possibilities are more limited and more hypothetical, virtually unrecorded in

anthropological literature. If impetus for change does not come from outside the economic system, then it is more likely that change will occur in the economic focus than in the other production sets. This postulate might be adequate if the ecological zones and techniques of production sets were limitless. They are not, however. Theoretically, given a set of productive techniques operating in an ecological zone, a maximum productivity may be reached beyond which productivity cannot pass without a change in the basic "ideas, tools, tool uses" of the production set. This phenomenon may be called pose fulfillment. Theoretically, this could happen in all ecological poses of a production set and set fulfillment would be achieved. It is also theoretically possible for all sets to reach maximum productivity and economic fulfillment would occur. These phenomena are most likely to be approached in desert or arctic regions, where food resources are scarce and ecological zones limited to a very small number.

If the economic focus is approaching set fulfillment, it implies that the existing complex of "ideas, tools, tool uses" is reaching its maximum efficiency, and as a result one of two kinds of change may occur. First, the concern with alternatives within the set may decrease because none of the new ideas is more efficient and efforts to increase productivity may shift to a new production set, thus changing the economic focus. Secondly, if man continues to

manipulate "ideas, tools, tool uses" of the economic focus even though it is approaching its maximum potential, the ideas, tools, tool uses may be substantially changed and a new economic set developed which would then become the economic focus.

This latter means of change may be illustrated by the development of horticulture from the collection set. As the collecting of vegetable foods increased in productivity and complexity, manipulation of "ideas, tools, tool uses" resulted in a means of food production through protection and care of the resources before harvesting. This kind of development may be illustrated by certain "contemporary primitives" who were masters in the techniques of food collecting. The Great Basin Paiute on one hand irrigated certain wild plants (Forde 1950: 35), and the Australian aborigines threw the peelings and shoots scraped off in preparing wild yams, in a place where the soil was black. They would return to this "wild" yam patch the following year to harvest the yams (Linton 1957: 90). This means of developing a new economic focus may also be represented by cultural development of some of the pastoral nomadic groups of Asia. It seems possible that reindeer domestication could have resulted from a similar sequence of events from hunting to protecting and so on.

Finally, it seems possible that when maximum productivity of the economic focus is approached in an area where

ecological zones are few in number and resources relatively scarce, a state of economic stability may ensue, since all the productive sets may be approaching maximum potential and there is little opportunity for an increase in efficiency of exploiting the environment with the given technology. This situation may have occurred among Indians of Baja California and the Bushmen of the Kalahari Desert.

With this final example, we may now assert that the model, while not describing change in any particular instance, may be used as an analytical tool to aid in the testing of hypotheses regarding changes in economic patterns. Furthermore, it does not necessarily explain change in terms of the economy itself, but in terms of interrelationships between individuals (as implied in concept of focus), technology, environment, and economic production. Variables from other aspects of culture other than economics and technology have not been considered, and therefore the model has limited value. As stated above, the probability of accuracy in analysis of change decreases proportionately with the degree of economic security of the society. The more man controls his environment the less accurate the model becomes.

The greatest value of this model probably lies in the fact that it is analytical, not descriptive, and that it presents a series of hypotheses to be tested. In the following chapters, it is proposed that such hypotheses will be tested using cultural material from western San Diego County

and neighboring Santa Catalina Island.

We have seen that the La Jolla culture may be viewed as extremely conservative, exhibiting a basically uniform economic pattern for approximately 5000 to 6000 years. For the duration of the La Jolla pattern (pattern hereafter refers to economic pattern, unless otherwise stated), important and far-reaching environmental changes occurred that undoubtedly brought pressures to bear on certain of the ecological poses. However, in some instances, instead of economic changes occurring to meet the changes in environmental situation, the economic pattern remained basically the same.

Before stating the hypotheses to be tested, it seems necessary to reiterate that the La Jolla development was virtually isolated culturally in that cultural stimuli from other areas had to cross great stretches of desert or filter through the narrow channel along the coast, which at 7000 years ago and for a period of several thousand years' time, exhibited a culture very similar to that of La Jolla. Therefore, the introduction of new traits was held to a minimum and consequently the introduction of new traits from outside the area does not constitute a great problem in terms of an uncontrolled variable.

The above model forms the bases for several hypotheses, not all of which can be tested by materials on the San Diego Coast. The hypotheses to be tested are stated below, follow-

ing a series of basic assumptions and postulates of the model that lead up to them.

Given: A culture operating at any given time is expending an amount of energy equal to or less than the intake of energy provided by all of its production sets.

Given: All economic systems have a production set which is more consciously manipulated and thought about than other production sets. This is termed the economic focus.

Given: Because the economic focus is most consciously manipulated it is most susceptible to change in a situation where free choice is possible.

Hypothesis 1: If the productivity of an ecological pose is reduced, this reduction will be compensated for by increased productivity in other ecological poses or the population and/or general cultural complexity will decrease.

Hypothesis 2: If the reduction of productivity in one ecological pose is compensated for by increased productivity elsewhere, it is more probable that such increase will occur in the economic focus than in other sets, unless the increased productivity is limited by external factors and the condition of free choice no longer exists.

Hypothesis 3: If the productivity of the economic focus is severely limited in all or most of its ecological poses, it is probable that a new focus will develop in a potentially more productive production set.

In the following chapters, the environments and cultural remains are reviewed and presented with an orientation toward the above hypotheses. In the final chapter, the sequence of environmental changes and cultural changes is summarized and the hypotheses presented here are tested in terms of the empirical evidence from the San Diego Coast.

Chapter iv. Changing Ecology of the Coastal Province: The Plant Succession

In San Diego County, the Peninsular Range of the interior, a granitic mass uplifted and now eroded, forms the boundary between two major ecological zones. This range of mountains drops steeply to the desert on the east, while the western slopes, gentler and interrupted by the Black Mountain Volcanics, extend to the coast. The western slopes of the Peninsular Range in San Diego County can be divided into two physiographic provinces, which correspond to two less-pronounced ecological zones. Using the Black Mountain Volcanics as the dividing line, the broad, flat-topped coastal plain is found to the west and is herein referred to as the Coastal Province. To the east lies the most mountainous and irregular Inland Province (Fig. 4). The La Jolla Complex is limited to the Coastal Province (Warren and others 1961). The ecology of that province is therefore of primary importance to an understanding of the historical developments of the La Jolla Complex.

The Black Mountain Volcanics, more recently termed the Santiago Peak Volcanics (Larsen 1948: 22-7), are exposed in a north-northwesterly trending belt that is over 80 miles long and generally less than 5 miles wide, although approaching 10 miles wide in some localities. These crystalline rocks

are "mildly metamorphosed volcanic flows, breccias, agglomerates and tuffs, with some interlayed fine-grained argillaceous sedimentary beds" (Jahns and Lance 1950: 7).

The terrain of the Coastal Province represents primarily a series of wave-cut terraces which have been carved into conglomerates, sandstones, siltstones, and shales of Cretaceous, Eocene, and Pliocene age. Although often grouped with the Peninsular Range, these terraces form a segment of a narrow coastal plain whichhas been dissected by streams draining to the Pacific from the mountainous regions to the east (Hertlein and Grant 1954: 53).

The terraces range in elevation from sea level to more than 800 feet, and cover a strip up to 14 miles wide. These terraces are narrowest at the northern boundary of San Diego County, where they are represented by several "interrupted shelves along the coast, and become wider and better defined in the vicinity of Oceanside and then continue southward in a belt with an average width of about 12 miles" (Holmes and Pendleton 1918: 2510). The terraces north of San Diego County, except for the Los Angeles Basin, are narrower (Putnam 1954: 45-8). and do not form the broad, continuous coastal plain present on the San Diego Coast. The San Diego coastline has only two promontories, Soledad Mountain at La Jolla, and Point Loma at San Diego. There are also two embayments: Mission or False Bay, between Soledad Mountain and Point Loma; and San Diego Bay, protected by Point Loma,

the Silver Strand, and Coronado and North Islands.

Most of the valleys crossing the terraces have flattish floors above which steep walls rise abruptly for 150 or more feet. The flat floors have evolved as a result of aggradation of gorges that extended to below the present sea level. Probably during the glacial stages, when the sea level was lowered, the streams cut through the relatively weak sediments of the mesas to meet the lowered shoreline. Since the end of the last glacial advance, the ocean has risen and the valleys have been aggraded, possibly by as much as 200 feet in some cases (Ellis and Lee 1919: 33). The depth of the Tijuana Valley has been determined by a geological survey in connection with underground water studies, and it was shown that the bottom of the valley fill was as much as 120 feet below mean sea level (Hertlein and Grant 1944: 28).

Carter (1957: 9, 189) postulated that the stream valleys, converted into small bays by the post-glacial rise in sea level, provided an abundant supply of shellfish for prehistoric populations. This hypothesis is supported by the presence of shell middens around the now aggraded valleys and ecologically highly variable lagoons that no longer support shellfish.

However, there are conflicting interpretations of the post-glacial sea stands which, if resolved, would throw additional light on the ecology of the post-glacial bays and lagoons of the San Diego Coast, and the prehistory of that

area. Shepard, Suess, Moore, and Curray maintain that no post-glacial sea stand occurred higher than at present, that following the glacial retreat the rise in sea level was rapid but decreased in rate about 5000 years ago (Shepard 1956; Shepard and Suess 1956; Shepard and Moore 1955, 1960; Moore 1955; Curray 1960). Antevs, Flint, Zeuner, and Fairbridge, on the other hand, maintain that higher sea stands have occurred during post-Pleistocene times. Flint (1953) and Antevs (1954) believe that a higher sea stand occurred 4000 to 7000 years ago, during the climatic optimum or "Altithermal." Zeuner (1958: 97-9) feels that a sea stand at least as high as at present terminated circa 5500 years ago, and that a sea stand 8 to 9 feet higher than at present occurred 2000 years ago. Fairbridge (1958) goes even further, outlining four sea stands exceeding that of the present. During the period that Fairbridge considers to be the maximum of the climatic optimum 5000 years ago, he postulates a sea stand of 10 to 12 feet. A second sea stand of 10 feet is postulated for the period between 3900 and 3400 years ago, and sea stands of 5 to 6 feet and 2 to 3 feet are suggested for 2300 and 1200 to 100 years ago, respectively.

There appears to be a growing body of data to support a relatively stable coast in western San Diego County during post-glacial times. Hubbs and others have reported on two sites on the San Diego Coast that now slope below or can be inferred to have sloped below present sea level. One is

dated at 3700 ± 200 years (Hubbs and others 1960: 204, sample LJ-19). The second has three "occupation streaks" dated at 950 ± 200, 1450 ± 200, and 2100 ± 200 (Hubbs and others 1960: 208-9, samples LJ-34, -37, -38). In addition to the above sites, Hubbs and others also reported subtidal peat recovered at 2.0 m. below mean sea level, dated at 4230 ± 200 years (1962: 212, sample 208), and marine shells in Batiquitos Lagoon from 10.01 to 10.45 m. and from 5.24 to 5.61 m. dating at 6320 ± 250 and 3400 ± 240 years respectively (1962: 233-4, samples LJ-333 and -381). In commenting on the Batiquitos Lagoon dates, Hubbs and others stated that "the data are consonant with the idea that the lagoon, now completely unproductive of shellfish, remained baylike and productive of shellfish for at least six millennia, probably in large part because of the continuing rise of sea level . . . ." (1962: 233).

Either the fluctuating sea stand or a rapid rise in sea level followed by a more slowly rising sea level, could have resulted in the aggradation of the valleys on the San Diego Coast. However, if the fluctuating sea stand as postulated by Zeuner or Fairbridge resulted in significant change of the environment and fauna of the bays at the mouths of the rivers and streams on the San Diego Coast, such changes should be reflected in the faunal remains in the middens dating from these periods. Such is not the case, however. The rising sea level postulated by Suess,

Shepard, Moore, and Curray apparently best fits the situation reflected by the data now available for the San Diego Coast.

It becomes clear that in this geological setting, the eustatic and climatic changes during post-glacial times, in conjunction with the geological process and ecological changes which they precipitated, amounted to considerable pressures for change in the basically gathering La Jolla Complex. Following is an attempt to reconstruct the ecological changes that took place within this geological setting. The ecological zones as they existed at the time of European contact are first established, and these zones are then projected against the climatic changes of post-Pleistocene times as we now understand them. On this basis ecological changes are postulated.

Ecological Zones

Aschmann (1959: 50-1) divided the Coastal Province into two "ecological zones" as seen "from the Indian standpoint." These zones are termed the "Coastal Zone" and the "Alluvial Valleys and Included Hills." The Coastal Zone for Southern California in general, we are told, included a strip extending about one-half day's journey inland, and all of the offshore islands. Aschmann states that this zone was rather heavily populated, with archaeological sites indicating "substantial stratigraphic depth" (1959: 50-1).

The zone called Alluvial Valleys and Included Hills is described by Aschmann as including ". . . . the extensive

coastal lowlands, such as those around Los Angeles or Oxnard, and narrower valleys such as that of the Santa Margarita River" (1959: 51). From these lowlands, the Indians exploited the adjacent hills. The gallery forests and edible roots, stems, and seeds along the streams, and the animal life that was attracted to such localities, were important resources, as was the combination of valley grasses and herbs, and valley oaks, growing on alluvial soils. Sage scrub and chaparral were likewise exploited where they occurred in the more broken country.

Excluding San Diego Bay and Mission Bay, which must be considered separately, the coast of San Diego County is straight with sea cliffs that drop steeply to a relatively narrow beach, a condition not conducive to the development of a maritime economy. The bays once formed by the streams and rivers that cut through the old terraces have not silted in and form salt marshes. Generally, the beaches at the base of the sea cliffs are narrow and lack vegetation.

The Coastal Strand plant community (Munz and Keck 1949; Aschmann 1959) that occurs on coastal dunes and sandy beaches, is a low or prostrate growth and often succulent. This composition is limited to the ecological situation of relatively low rainfall but high humidity and a great deal of fog. The Indian population, ethnographically and protohistorically, was dense in this zone throughout most of the Southern California coast. However, north of Mission Bay in

San Diego County, the coastal strand was almost non-existent except at the mouths of streams and rivers, and perhaps in modified form along the tops and talus of the sea cliffs. Neither of these locations has produced many late prehistoric or protohistoric sites, and two explanations for this paucity of late sites present themselves. First, fresh water is severely limited to small seeps or springs. The nearest fresh water is sometimes 2-3 miles distant and occasionally as far as 5-6 miles inland. Second, there is little in the way of food resources here except the offering of the sea and of the nearby coastal sage scrub and salt marshes. Even the beaches generally lack the rocks upon which the easily gathered mussels cluster and do not support an abundance of Tivela and Donax.

In the Coastal Valley behind the coastal strand, a limited number of halophytic species characterize the salt marsh community. This plant community is limited largely to the mouths of coastal valleys and may extend from less than a mile to more than 4 miles inland. This community offered the native population virtually nothing in terms of food plants or associated animals, although these marshes may have been a major source of salt for the Indians. Fages, as early as 1769, described these coastal marshes, stating that the seas "penetrated between the hills through several channels where salt is deposited in abundance" (Priestly 1937: 5).

Two remaining plant communities described by Munz and Keck (1959) and Aschmann (1959), falling within the coastal ecological zone as well as other, inland zones, are the Coastal Sage Scrub, and Chaparral. Coastal sage scrub is composed primarily of semi-shrub plants, 1-5 feet tall, smaller and more widely spaced than chaparral, and may appear to be impoverished chaparral. It generally occurs in dry, rocky and gravelly slopes below 3000 feet and below the chaparral. Coastal sage scrub appears to have been found over much of the ancient sea terraces. Where the terraces are not now under cultivation or housing developments, this plant community often occurs.

An even wider distribution for grasses is suggested for these terraces in Father Crespi's description of 1769. Father Crespi journeyed northward from San Diego Bay, across the back portion of Kearney Mesa, to Soledad or Sorrento Valley. He described the region as follows: "We ascended a large grassy hill all of pure earth, and then found ourselves on some very broad mesas of good soft ground all covered with grass, not having encountered a stone since leaving San Diego nor any other trees than those spoken of in the preceding valley except that here and there we saw some very small oaks and chaparral" (Bolton 1927: 122).

Father Crespi mentions grassy mesas, sometimes covered in part by "young oak," rosemary, and other shrubs not known to him. These shrubs may well have been the coastal sage

scrub, but it does not appear to have been found as extensively as the grasses. Regarding the food potential of the coastal sage scrub, Aschmann states: "This is a widespread but not a productive plant community for Indians, and archaeological sites are few" (1959: 37).

Chaparral is composed of small trees and evergreen shrubs, and is found from about 1000 to 4000 feet on the west slope of the Peninsular Range. The lower margins are sometimes degraded and appear like the coastal sage scrub. In moist localities, live oak and grasses may be included and on the upper edge, yellow pine and big cone spruce appear in clumps. This community possesses a diversity of species, but chamise (Adenostema fasciculatum) is almost always the most abundant plant. Probably the most important plant of this community in the Indian economy was the scrub oak. However, other plants such as yucca and wild cherry were probably also used. Chaparral and coastal sage scrub were both heavily populated by game animals, including abundant rabbits and hares, antelope, squirrels, some deer and bear, and birds.

Another element found in the coastal sage scrub community but not discussed by Aschmann (1959) or Munz and Keck (1949) is the Torrey Pine. The Torrey Pine (Pinus Torreyana) is a prolific annual seeder, with large heavy seeds that may be eaten raw or cooked. This pine may have been of considerable economic importance to the aboriginal population

and as a relictual stand it is important for an understanding of ecological changes of the past.

If the coastal strand, coastal salt marsh, coastal sage scrub and chaparral are all that are represented in the Coastal ecological zone described by Aschmann, it may be said then with fair certainty that the late prehistoric population was very small and probably lived in this zone only seasonally, as part of an annual round of economic activities. Late prehistoric archaeological sites and historic (ethnographically known) sites are almost entirely lacking for this portion of the Coastal Province.

On the other hand, the Alluvial Valleys and Included Hills zone presents a somewhat different picture. In addition to the chaparral and coastal sage scrub communities, this zone includes the fresh water marsh and valley grass lands plant communities. The fresh water marsh community is generally found in river bottom lagoons and near the coast, in back of salty areas. These marshy areas are regularly flooded by fresh water, which supports a variety of reeds and rushes. The plant community is often widely scattered and varies with local topography and drainage conditions. Not infrequently, trees such as willows and poplars border the grasses and rushes. Such locations were reported by Crespi (Bolton 1927) for several coastal valleys in San Diego County

Valley grass lands plant community was also noted by

early explorers. These were originally covered by bunch grass such as Stipa pulchra, S. cernua, and Arislida divoricata, but these have been replaced by annual species of Bronus, Festuca, etc. This is a subtropical, open, treeless grassland, widely found along the Southern California coast. Although poplar, alder, and other trees including oak were noted along many stream courses by early explorers (Bolton 1927), grass lands were also noted in these valleys. The San Dieguito Valley, described by Crespi in 1769, was cited for its lack of trees:

> All the land is level, very verdant, with much pasture, many wild grapes and other herbs. To the south of this valley there are three large pools and to the north, according to the story of the explorers, there is a very verdant arroyo and some other very large pools . . . . The hills that surround this valley are not very high, and are all of pure earth, covered with pasture, the only thing lacking to the site being trees (Bolton 1927: 126).

The valley grass land community often lies at slightly higher elevation than the fresh water marsh, but small islands of fresh water marsh may occur in the valley grass land community. Both communities are found just back of the coastal salt marshes in the flat, low-lying valleys

along the San Diego Coast. Both the valley grass land and the fresh water marsh provide a variety of edible plants as well as fresh water, making them more attractive for human occupation than the plant communities of the Coastal zone.

If the valleys of the San Diego County coast "such as that of the Santa Margarita River" are not included in the Coastal zone, it is quite clear that the population of this zone farther north, above Mission Bay, must have been exceedingly small. The coastal strand and coastal salt marsh, in addition to being small in area, were apparently little used, lacking fresh water and productive plant communities as they did. The Alluvial Valleys and Included Hills zone, on the other hand, was close enough to the ocean to make the produce of the beach and sea accessible, contained several plant communities which were all more productive than those of the Coastal zone, and had fresh water.

Ethnographic records produce very few villages in the Coastal Province as a whole, with even fewer in the Coastal ecological zone. Archaeology has not done much better, in terms of late prehistoric sites. The early historic records appear to be of the most value here, making it possible to get some idea of the population size and the distribution of the villages. Father Crespi (Bolton 1927) wrote one of the more detailed accounts, listing villages and often giving estimates or actual count of inhabitants. The less detailed journals of Fages (Priestly 1937) and Costanso (van

Hement-Engert and Teggart 1910; Teggart 1911) support Crespi's account. Father Crespi noted 12 villages with populations ranging from 15 to over 100, between Soledad Valley and San Juan Capistrano. One of these villages was uninhabited.

The route taken by Father Crespi, as closely as we can determine, varied from about 1 to 5 miles inland between San Diego and San Juan Capistrano. The portions of the valleys described by Crespi vary from the treeless grass land in the San Dieguito to valleys full of alder and oak. Fresh water, in ponds or running streams, is always present in the valleys but never in great bodies. The villages in those valleys appear to be located behind the salt marshes, in the areas of fresh water marsh or valley grass land. This pattern of village location has been substantiated by an archaeological survey of a portion of western San Diego County. After noting extreme paucity of late, pottery-bearing sites, it was concluded that late sites are located at the back of the lagoons where fresh water was present, or on the few bays and inlets on the coast proper, where fresh water was obtainable and where shellfish and fish could be taken (Warren and others 1961). A later investigation of Batiquitos Lagoon supported this conclusion (Crabtree and others 1963).

Father Boscana, writing in 1822, recounted (in Harrington 1934: 62) that 15 rancherias or towns were founded by the first settlers of the canyon of San Juan Capistrano and

its environs: "It also should be noted that since these Indians never lived fixed in a single place, but moved from time to time from one place to another depending on the seeds, there were always some unoccupied rancherias." This kind of seasonal occupation may explain the uninhabited village reported by Father Crespi on Agua Hedionda Creek (Bolton 1927: 128) and suggests that part of the coastal population may have been migratory and spent the greater part of the year away from the ocean.

The existence of salt marshes at the mouth of nearly every major creek or river that fed directly into the ocean, presumably created a shortage of drinking water in the Coastal ecological zone. This shortage of potable water plus the unproductive plant communities were important factors in causing the population of the Coastal Province to be concentrated behind the salt marshes, in areas of fresh water marsh and valley grass land. But apparently even here, the population was kept relatively small, perhaps partly because of limited fresh water.

Turning now to San Diego Bay and Mission Bay, special attention must be given these two areas because they represent the only productive portion of the Coastal ecological zone. The shores of both bays are now under part of the modern city of San Diego, but it is assumed that much of the shoreline originally represented the coastal strand-salt marsh plant communities. These bays are considered

separately from the remainder of the San Diego coast because they also represent the only sizable embayments that would encourage the use of simple water crafts and the development of a maritime economy. Fresh water was always available here, unlike the remainder of this ecological zone.

That the waters of San Diego Bay were calm is attested to in Cabrillo's diary of his 1542 voyage: "While they were in this port a heavy storm occurred; but since the port is good, they did not feel it at all. It was a violent storm from the west-southwest and south-southwest" (Engelhardt 1920: 4).

In 1692, Vizcaino described San Diego Bay as follows: "It has very good water, many fish of all kinds of which we caught many with seine and hooks. On land there is much game, such as rabbits, hares, deer, very large quail, royal ducks, ..." (Engelhardt 1920: 6). Vizcaino also reported that while the ships were being repaired in San Diego Bay, the crew dug wells "in the sand bank or island of sand" where they camped. "When the sea was high the pools contained sweet and good water; but when the tide went out the water was brackish" (Engelhardt 1920: 6-7).

Members of the crew also went to investigate Point Loma and Vizcaino reported that ". . . . they found much live oak timber and other trees, such as the rock rose and others resembling rosemary, besides some very odoriferous and wholesome plants" (Engelhardt 1920: 6-7).

Father Crespi, in a letter to Father Guardian of San Fernando College, Mexico, dated June 22, 1769, stated:

> When we reached the port we found about one league distant, a good river running with sufficient water; but in a few days it ran dry. Yesterday, May 21, Fr. Viscaino and I went out to examine it . . . . We followed the course of the river which runs through a cañada of much level land, in places extending from a quarter to half a league. The soil seems to be good for raising corn and wheat. In some parts there seem to be marshes or humid soil. All along the river bed there are poplar, willow, and alder trees. We found it dry in many places. In some spots there were pools with water, and in other places there was only a streamlet. We walked about three leagues up the river bed and the valley; but conditions were the same, until we reached the sierra, when the bed narrowed, but there was no running water (Engelhardt 1920: 15-16).

Indian villages are reported by early explorers on the San Diego River, on several smaller streams south of the San Diego River, and at the mouth of Rose Canyon on Mission Bay. All of these locations had permanent water supplies. Unfor-

tunately, the size of these villages is seldom mentioned other than being "large" or "small." However, in 1769, Vila, commander of the frigate San Carlos, wrote in his diary: "The officers and the Missionary Fathers reported that they had walked about three leagues along the shore and at that distance had come to an Indian rancheria on the banks of a river with excellent water: that the Indians inhabiting the village to the number of thirty-five or forty families scattered along the stream in small rude huts, were friendly . . . ."(Engelhardt 1920: 11).

Francisco Palou, concerning the Indians, noted: "The natives are exceedingly numerous, and all of this coast of the South Sea along which we came from Ensenada at Todas Santos, so called on the maps and charts, live well on various seeds and on fish which they catch from rafts made of tules and formed like canoes, with which they venture far out on the sea"(Engelhardt 1920: 21). Later, in 1773, Father Palou reported to the viceroy regarding the San Diego Mission: "The beach, or also the vicinity of the mission, is well peopled by savages, since within a district of ten leagues there are more than twenty large rancherias, and one adjoining the mission" (Engelhardt 1920: 50).

In 1769, Father Crespi wrote of the San Diego Bay area: "In this part and its vicinity there are many large villages of heathen" (Bolton 1927: 121) and "all the part is well populated with large number of villages of Indians" (Bolton 1927: 9).

Although few specific data are available regarding population figures and number of villages on Mission Bay and San Diego Bay, it would seem from the evidence obtainable that the villages were more numerous and generally larger in the bay area than on the straight coast north of these bays. At this point, however, it should be emphasized that many of the early explorers came across much of Baja California on their way to Southern California from Mexico. The native population they saw there was sparse and very poor. Father Crespi made this trip and in a letter to Father Palou dated June 9, 1769, described these conditions:

> All along the road from Villacata, as we continually saw from the mountains, there were many footprints, and many well worn paths of the Indians, but although we came upon many villages, we did not find a very large number of people because the greater part of the mountains is very barren, so that the poor wretches do not have anything to eat. Even the mescal, their daily bread, is not to be found in the greater part of the mountains, and these tribes of Indians on the two slopes are forced to earn their living from the Sea.
>
> On all the mountains we saw no trees that produce food except some on a peak in the

> distance that appeared to be pines. Indeed all the trees that we came upon were on streams, and as far as we have penetrated the mountains continue even barer than those about the old mission (Bolton 1927: 10).

With this description in mind, the adjectives "large," "very large," and "numerous," when applied to the villages of San Diego and Mission bays, become less meaningful still. However, the abundant and varied flora and fauna of the bay areas, the easily navigated waters abounding in fish and the presence of permanent fresh water sources offered a potential resource for a larger population than the Coastal ecological zone of the sea cliffs to the north and south.

In summary, the Coastal Province may be divided into two ecological zones: Coastal, and the Alluvial Valleys and Included Hills. The Coastal zone north of Mission Bay is generally unproductive in terms of a land-oriented economy, being somewhat distant from productive plant communities and fresh water. The high sea cliffs, straight coastline and narrow beaches all combined to inhibit the development of a maritime economy. The sheltered waters and adjacent shores of San Diego and Mission bays, however, offered nearly everything that the sea cliff lacked: fairly abundant and varied flora and fauna, permanent fresh water, and easily navigated bays containing a plentiful supply of fish and shellfish. The aboriginal population of the Coastal

zone appears to have been concentrated along the shores of Mission and San Diego bays, while the straight sea coast to the north was virtually uninhabited.

Behind both areas of the Coastal zone, the Alluvial Valleys and Included Hills zone presented a variety of productive plant communities and game animals, permanent fresh water, and was close enough to the ocean so that the inhabitants of the valleys could and did make use of the harvest of the beach and ocean. In this area, the villages may have been less numerous and generally smaller than those of San Diego and Mission bays, but they were almost certainly more numerous and larger than the villages directly on the coast north of Mission Bay.

Plant Succession

At the time of European contact, the plant communities of the Coastal Province were essentially the same as they are today. The primary difference appears to be due to the introduction of grasses that have by and large replaced the native grasses. Although the grasses described by Crespi and the oaks on Point Loma may reflect more humid conditions or a greater ground-water reserve than at present, other causes of this replacement of native grasses may be modern agricultural practices and urban expansion.

It appears that the ecological zones described by Aschmann are applicable if modified to fit specifically the San Diego Coastal Province. The basis for this modification

is the location of the aboriginal villages in relation to the various plant communities. The Coastal zone is limited primarily to the region of San Diego and Mission bays, where a number of villages were located on the coastal strand. This population, while depending to a considerable extent on the resources of the Alluvial Valleys and Included Hills, made greater use of the sea resources than did the population to the north, in San Diego County. North of Mission Bay, the aboriginal villages were located primarily in the Alluvial Valleys, behind the salt marshes. Here there appears to have been a change of emphasis, the Coastal zone being little occupied or occupied only seasonally, while the Alluvial Valleys and Included Hills played a greater role in the aboriginal economy.

If we may project this outline of aboriginal ecology against reconstructed changes in the ecology of the lagoons and foreshore and the plant ecology of the neighboring hills, then pressures toward culture change can be seen in relief. The reconstructions of the changing ecology of the lagoons and of the neighboring hills, are dealt with independently, although "causes" for change are obviously related in some instances.

After studying the great physiognomic diversity of vegetation of the San Luis Obispo area, Wells (1962) noted that all physiognomic types, in pure form and in complex mixtures, sometimes occurred in close proximity on the same

slope, at the same elevation and distance from the ocean: "Since these coincidences were encountered repeatedly on a wide variety of substrata, it is difficult to avoid the conclusion that the physiognomic end-members are not segregated primarily on the basis of climatic or edaphic factors in this area. Consequently, if a mechanistic viewpoint is to be maintained, a poly-climax interpretation is untenable, or at least bears the burden of proof" (1962: 94).

Wells suggests further (1962: 94-5) that the vegetation has been subjected to prolonged and profound disturbances. Before the coming of the Europeans, the disturbing forces were primarily fire, of both human and nonhuman origin, and drought. That fire was an important factor in the prehistoric ecology is more than an assumption. Historically there is ample evidence of "limited" fires by man in several activities. Sampson (1944) has reviewed the mass of documents published between 1542 and 1853 regarding this subject, and has amply illustrated its wide and common occurrence in connection with hunting and securing of plant foods. For example, Crespi, on his 1769 overland trip from San Diego Bay to Monterey, made the following observation: "We ascended a little hill and entered upon some mesas covered with dry grass, in part burned by the heathen for the purpose of hunting hare and rabbits, which live there in abundance" (Bolton 1927: 132).

The use of fire for fire drives during prehistoric times

cannot be documented at this time. However, its use in animal and insect drives has an extremely wide distribution ethnographically and was "probably practiced almost everywhere in the United States in aboriginal times" (Driver and Massey 1957: 191). On this basis, such use of fire may be assumed to be of considerable antiquity and to have been an important element in the environment affecting the vegetation success in prehistoric times.

The Altithermal or Long Drought of the Western United States, which followed the retreat of the glaciers (and Anathermal), has been recognized in both geological (Antevs 1952, 1955; Hunt 1953) and ecological studies (Cottam and others 1959). The recent criticism of this interpretation of paleoclimate, based almost entirely on pollen columns (Martin and others 1961) does not seem to have stood the test of critical analysis (Antevs 1962). The increasing aridity beginning about 7000 years ago remains substantiated. In discussing the climatic history of California, Antevs (1952: 23-6) noted that the present rainfall in California is controlled by an area of high atmospheric pressure in the eastern Pacific. During summer this anticyclone blocks cyclonic storms, with the result that summer rains are scarce. In winter, the high pressure area is weaker and located farther south, or is absent, allowing the cyclonic storms to reach the coast and bring rain.

During the Pleistocene, the belts of pressure and

precipitation were forced south by the large ice sheets. The Pacific anticyclone did not develop and block the cyclonic storms, resulting in a longer winter and rainy season in California and the Great Basin. The last great Pluvial, the Provo, can thus be correlated with the Mankato maximum of the Wisconsin glaciation. With the retreat of the glaciers, the Pluvial became less marked and was followed by a transitional stage and this in turn by the Long Drought or Altithermal, which began about 7000 years ago.

Recent pollen analyses and radiocarbon dates have tended to support Antev's interpretation. Recent C-14 dates for Lake Mohave (Hubbs and others 1962: 209, sample LJ-200) would place the final recession of that pluvial lake between 9000 and 10,000 years ago. Flint and Gale (1958) have a carbon-14 date of 10,500 ± 560 (C-894) for the top of an organic layer below 90 feet of salt at Searles Lake, and a date of 21,200 ± 2170 (Y-267) for the bottom of the layer. This organic layer shows considerably higher proportions of arboreal pollen than the sediments above it (Roosma 1958).

Sears and Roosma (1961) have presented a pollen sequence for Fishbone and Guano caves in Pershing County, Nevada, covering over 15,000 years. This sequence also shows predominately arboreal pollen prior to about 10,000 years ago (8000 B.C.), with a few exceptions when the desert flora were more important for relatively short periods.

Between 10,000 years ago and 7380 years ago (8000 B. C. and 5430 B. C.), there are no pollen samples. However, during this period the arboreal pollen became less important so that grass land pollen is the most significant by 5430 B. C. Between that time and 4300 B. C., there is a sharp decrease in grass land pollen and a sharp increase in desert pollens, reflecting the beginning of the Altithermal period. Immediately after 4300 B. C., the percentage of desert pollen decreases slightly and then maintains approximately the same importance until just prior to 1250 B. C., when the grass land pollen increases at the expense of the desert plants. The desert reasserts itself at 1250 B. C., with the highest pollen percentage except for the desert advance dating from 4300 B. C. After 1250 B. C., there is a constant decrease in desert pollen.

During recent decades the paleoclimate of the Southern California and Baja California coasts has been under scrutiny, with the results now being made available. Hubbs (Hubbs and others 1960, 1962; and in Shumway and others 1961) has presented convincing evidence for changes in past temperatures of the San Diego Coast, based on calculations of water temperatures of the ocean. He suggests that from about 7500 years ago to about 1600 years ago (5550 B. C. to A. D. 350), and perhaps somewhat earlier, a prolonged mild climate seems indicated. From A. D. 350 to A. D. 1350, the climate was considerably cooler than at present, and

from A. D. 1350 to the present, warmth has again prevailed.

Shumway and others (1961: 111) would have the period between 7500 years ago and 5000 years ago (5550 B. C. and 3050 B. C.) drier than it had been prior to 10,000 years ago, but more moist than at present because "the extensive population that existed along the now semidesert coast . . . . could hardly have been supported by the amount of surface water that exists now in the area . . . ." Physiographic evidence "leads to the inference of heavy rainfall during the pluvial period and moderate rainfall, but greater than at present, in the La Jolla period." What is meant by the "La Jolla period" is not clear in this context, since the terminal date for the La Jolla Complex is not discussed. However, it is assumed that this "La Jolla period" equates with the 5550 B. C. to 3050 B. C. period mentioned earlier.

These data taken together strongly suggest a period of relative aridity on the San Diego Coast, and throughout the west in general, beginning about 7000 years ago and persisting in Southern California, probably with periods of greater and lesser aridity, until approximately 2000 years ago or 50 B. C. Against this background of climates, we may project the fire ecology, presumably introduced in the area at least by the beginning of the La Jolla period. In so doing, factors sufficient to create a "prolonged and profound disturbance" of the plant communities of the Coastal Province, may be recognized.

Another factor influencing both the plant succession and the fire ecology is the edaphic diversity of the area. In this respect, the geology and soils of the coastal terraces of the San Diego Coastal Province are briefly discussed. North of the San Diego River, the major substrata are comprised of Eocene marine deposits which include the Poway Conglomerate, Rose Canyon Shale, and Del Mar and Torrey Sands. The Poway Conglomerate is composed of cross-bedded boulders and cobbles of andesite, basalt, basalt porphyry, and contains lenses of sandstone. Rose Canyon Shale is composed mainly of shales and silty mudstones, with minor amounts of conglomerate and a few beds of limestone. Both Torrey and Del Mar Sands are composed primarily of sandstone, the latter containing some sandy shale.

South of the San Diego River, the Sweitzer Formation caps most of the mesas. The Sweitzer Formation is a reddish brown conglomerate and pebbly sandstone, about 20 feet in maximum thickness. At places it forms a continuous blanket over the edges of the mesa top (Otay Terrace, for example) to lower terraces. This formation is believed to be of late Pliocene or early Pleistocene age. The Sweitzer Formation rests unconformably on the San Diego Formation, which is composed chiefly of sandstone and siltstone, with minor amounts of conglomerate. The San Diego Formation is of Pliocene age and rests on Rose Canyon Shale, Poway Conglomerate, or Black Mountain Volcanics.

Pleistocene deposits occur as terrace material at many localities along the coast. Also some of the non-fossiliferous terrace cover and deeper valley fill may be Pleistocene in age. Most of the valley bottoms, delta flats and bay flats are aggraded by recent alluvium (Hertlein and Grant 1954). Sand ridges are found on the Linda Vista or Torrey Pines Mesa and are apparently derived from the Sweitzer Formation (Carter 1957: 46-7). Elsewhere, farther north, sand ridges are present also, as at Leucadia just south of Batiquitos Lagoon (Carter 1957: 11).

Holmes and Pendleton (1918) describe three major groups of soils for the Coastal Province: (1) residual soils weathering from consolidated rock; (2) soils derived from old unconsolidated rock; and (3) recent valley fill. The soils from coastal mesas are distinguished by the "development of prevailing heavy, compact subsoils, hardpans or cemented strata" (Holmes and Pendleton 1918: 2524).

Storie and Carpenter (1930) have classified the soils of the El Cajon area into 4 groups. Group 4 of this classification correlates roughly with Holmes and Pendleton's soils derived from old unconsolidated rocks. Storie and Carpenter state (1930: 26): "The soils of group 4 . . . . have friable sandy surface soils that give way abruptly at a depth ranging from about 8 to 16 inches to heavy intractable clay which is practically impervious to air, water or plant roots . . . . These soils occupy elevated terraces,

and the surface relief is smooth or undulating. The group includes mainly the coastal plain or sea terrace soils that occupy the mesas surrounding San Diego."

These same soil types were also recognized by Carpenter and Storie (1929) farther north on the San Diego Coast, and Ellis and Lee (1919: 176) noted that where "conglomerates lie at the surface they are as a rule, covered by a thin soil of sandy or gravelly clay. This formation differs from most coarse deposits in being nearly impervious and incapable of absorbing much water. The clay soil by resisting the descent of water into the gravel serves as an additional obstacle to the absorption of water."

The coastal terraces are considerably dissected by the rivers and small streams which have cut steep-sided canyons, oftentimes exposing the underlying conglomerates, sandstones and clays. These areas are generally classed as rough broken land by Storie and Carpenter (1929, 1930), while the fill in the coastal valleys is largely Recent and is a deep, loose and friable alluvium. The subsoil is porous and absorbs water quickly, but has a low water-holding capacity (Storie and Carpenter 1930: 19).

Intermediate between the valley fill and the soils of the terrace (group 4) is group 3. Group 3 differs from the valley fill in that these soils have slightly compact and heavy textured subsoils. The surface soils are permeable to water and air and the subsoils only slightly less so.

These occur on low terraces which are higher than the valley fill, and they are less droughty than the valley fill because of their heavier textured subsoils (Storie and Carpenter 1930: 22).

The geological history of the San Diego Coastal Province appears to have included periods when a considerable amount of erosion took place. Some large streams have cut steep-sided canyons over a mile wide near the coast. Small streams have dissected the ancient sea terraces into numerous "mesas" and "ridges." Today, the Coastal Province may be seen as a land of steep-sided valleys and arroyos and flat-topped mesas. A rough and somewhat over-simplified picture of the coastal topography may be drawn as follows.

The stream cutting in conjunction with Recent alluviation of the coastal valleys has resulted in bottom lands of deep, loose alluvium with considerable ground water, surrounded by steep broken slopes where the underlying conglomerates and/or clays of Eocene, Pliocene, and less often of Miocene and Pleistocene age, are exposed or form an important constituent of the "soil." Above the broken slopes lie the "hardpan" soils of the mesa tops. Elsewhere, on terraces of lower elevations, are soils with only slightly compacted and heavy textured subsoils. Generally these lower terraces are separated from the valley fill by a shorter and more gentle slope than they are from the mesa top, which is set off by the steep, broken slope.

These major soil groups are apparently reflected in the vegetation pattern. Grass lands are found in both the bottomland and on the mesa tops. Rough, broken and rough stony lands are covered with chaparral or coastal sage scrub, depending on the elevation, moisture and other factors. Other, more restricted plant communities are found interspersed among the grasses, chaparral, and coastal sage scrub where local conditions favor their growth.

By examination of the physiognomy and means of dispersal of the various plant communities, Wells arrives at a succession of plant communities in a fire environment (Wells 1962: 96-7). The local coniferous and broad-sclerophyll forests are least adapted to the fire environment. The conifers are killed outright by fire, and must start from seeds, which are heavy and not widely dispersed except by rodents. The broad-sclerophyll forest requires the greatest time span for recovery from a burn, since it is dominated by the slow-growing oak. The heavy nature of the seeds again prevents wide dispersal. Despite the fact that these trees usually crownsprout vigorously when destroyed by fire, full recovery of the canopy closure requires a span of time on the order of 50 to 100 years.

Fire-stimulated crownsprouting and germination of chaparral assures regeneration after a burn, but the hard-wooded chaparral shrubs regenerate less rapidly than the coastal sage scrub and grasses. Furthermore, the range of

seed dispersal lies closer to the heavier oak and conifer than to the coastal sage scrub and the grasses. The coastal sage scrub is exceeded only by the grass land in the rapidity with which the plants regenerate following a fire. Most, if not all, of the dominant shrubs crownsprout, and they also freely invade chaparral burns, where they grow rapidly from seeds. The dust-like propagules of the coastal sage scrub are the most widely spread of all seeds, being easily carried by the wind.

Grass land is probably least disturbed by fire, although the seeds are not as widely dispersed as those of the coastal sage scrub. The perennial herbs, which die back and grow to full size anew each year, are essentially undamaged by the burning of the old, dry tops. The annuals are not at all affected by fire, after the seeds have been shed.

These "wide differences in rate and habit of growth, in conjunction with differences in seed dispersal, suggest the possibility of differential adaptation to frequent fire, which permits some types to spread at the expense of others" (Wells 1962: 96). Wells has likened these disturbances "to a game of musical chairs. Each fire affords a chance for a reshuffling of species in accordance with the individualistic traits which govern dispersal, establishment, and dominance or competition" (1962: 101).

The nature of the substratum may also affect the fire susceptibility of the vegetation by its influence on water

relations. It has been proven by experience that fire is most frequent and most devastating during droughts, and that it is related, in part, to the increased water content of the plants. In sub-humid to arid climates, the argillaceous soils have high water retention capacity which is disadvantageous to plants because water is held close to the evaporating surface, and a great deal of it is bound water, unavailable to plants. Furthermore, soils of high clay content are relatively impervious to oxygen, as well as water, when the surface is wet, which promotes shallow rooting. On the other hand, sandy and rocky soils have a low water retention capacity, but they do have a high rate of infiltration, which reduces runoff and surface evaporation. Water, oxygen, and roots penetrate to considerable depths, and nearly all this water is available for uptake by deeply rooted plants.

The shallowly rooted grasses are poorly represented on this rocky soil; they are relatively restricted on deep, sandy soils and such areas are dominated by shrub land. On the other hand, chaparral is so poorly developed on deeper, clayey soils, that it is doubtful that it has ever been of any importance there.

In this situation, "when woody vegetation is burned on 'poor' rocky, or sandy soils, the relatively thin stands of successional herbs produce an insufficient amount of fuel to conduct hot ground fire. Hence, the crownsprouts and

seedlings of the woody plants receive an important respite from fire and usually regenerate the woody cover before another fire can take place" (Wells 1962: 99). On the other hand, on argillaceous soils which can support a dense stand of grasses, the "crown-sprouts or seedlings of woody plants are then immersed in a sea of summer-dry fuel. An inflammable fire-conducting matrix has been established which can serve as an annual threat of destruction to the regenerating woody vegetation" (Wells 1962: 99). The interaction of drought, fire, soils, and edaphic adaptability of the flora tends to segregate the grasses from the chaparral and sage scrub, all of which expand at the expense of the coniferous and oak forests.

The Torrey Pine (Pinus Torreyana) and its present distribution on the San Diego Coast well illustrate this disturbance and plant succession. The Torrey Pine is found on the San Diego Coast about the mouth of Soledad or Sorrento Valley, on Torrey Pines Mesa near Del Mar, and ranging inland about a mile and a half (Jepson 1910: 91). Little is known of the optimum condition for the growth of Torrey Pine; however, at present on the San Diego Coast, it "grows on the highlands adjacent to the sea on sides of deep ravines and washes leading to the coast . . . . in disintegrating yellowish sand rock" (Green 1933: 66). In the area the average yearly rainfall is about 10 inches (Carter 1957: 105) and the air is often humid and foggy, with a heavy dew in

the winter months. These trees also are found on Santa Rosa Island, where they grow in "soil of mingled earth and loose rock, or sometimes in rather thick soil over unbroken rock" (Sudworth 1908: 42). Rainfall on Santa Rosa Island is greater than on the San Diego Coast, approaching an average of 20 inches a year.

On the San Diego Coast, the largest trees are on sheltered sides of hills and spurs of canyons protected from the sea winds. In these locations, the trunk is straight and the tree reaches a height of 50 to 60 feet. Where exposed to the sea winds, trees are low and crooked, bent or sprawling, from 25 to 35 feet tall and 8 to 14 inches in diameter. Little is known about the longevity of this pine, but trees from 10 to 12 inches in diameter are from 75 to 80 years old. It appears to be a comparatively short-lived tree, probably from 100 to 150 years, and not more than 200 years maximum age (Green 1933; Sudworth 1908).

Torrey Pines are prolific annual seeders and the seeds are large (3/4 to 1 inch long) and heavy (Green 1933). Some seeds are shed in September but many cones retain their seeds for several years. Germination takes place in crevices and washed mineral soil. Seedlings are rather numerous in the vicinity of trees, both on the mainland and on Santa Rosa Island (Green 1933; Sudworth 1908).

That the Torrey Pine exists at all on the San Diego Coast, is probably related to two factors: (1) the sea

winds, which disfigure the trees in exposed locations, also undoubtedly served as protection against fires burning across the mesa tops; and (2) the heavy dew and mist in winter which would provide a certain amount of moisture to supplement the low rainfall. (Indeed, this mist is so heavy that the unknowing camper may duck for cover in early morning, mistaking it for rain.) A possible third factor in the persistence of the Torrey Pine may be that it is adapted to the rocky soils and is a prolific annual seeder. At least some of the seeds dropping in rock crevices in an area of sparse grass cover, would presumably be sufficiently protected from fire to allow germination. However, seedlings would probably be destroyed by fire.

That the Torrey Pine had a wider distribution in the past, and especially during the Pluvial, seems to be indicated. There is further evidence for a wider distribution during periods of cooler and more moist climate, although not conclusive. Jepson (1910: 91-2) noted that "under the influence of a different climate and of cultivation the Torrey Pine exhibits at Berkeley a much modified habit." In the Botanic Garden at the University of California, Berkeley, a 17-year old tree (in 1908) had a perfectly straight axis, symmetrical crown and regular whorls of branches. It stood 30-3/4 feet tall, with a diameter of 3 feet 9-1/2 inches. Between the years 1898 and 1905, it grew 25-1/3 feet (average of 3.17 feet per year). While most plants do better

under cultivation than in the natural state, the vast difference between the 30-3/4 foot, 17-year old tree and the 25 to 40 foot, 150-200 years old tree, strongly suggests that the Torrey Pine is a relictual stand on the San Diego Coast and had a much wider distribution, probably during the Pluvial and early post-Pluvial time.

The oaks in the San Diego Coastal Province are now limited primarily to the canyons at some distance from the sea, and in general are not numerous throughout the area. Wells' (1962) argument for their replacement by grasses, sage scrub and chaparral is further substantiated by Vizcaino's 1692 report of live oak on Point Loma (Engelhardt 1920: 6-7), an area now covered almost entirely by grasses and coastal sage scrub.

It would appear that at the end of the Pluvial, the distribution of oaks and conifers was greater than at present. The archaeological surveys of the area (Warren and others 1961) in conjunction with recent C-14 dates (Hubbs and others 1960, 1962) indicate a rapid increase in population of the Coastal Province between 8000 and 6000 years ago (6050 B. C. and 4050 B. C.). With the rise in population it may be assumed that the number of fires used for obtaining food was increased. This increase in fires and the beginning of the Altithermal would presumably increase the rate of plant succession, thus hastening the replacement of conifers and oaks by grasses, chaparral and coastal sage

scrub. The rate of plant succession cannot at present be determined, but the combination of these cultural and climatic factors must have had a significant effect on the rate between 5000 and 3000 B. C., so that by about 2000 to 1000 B. C., the plant cover may have been fairly similar to what it is today.

Chapter v. Ecological Changes and the Shellfish Supply on the San Diego Coast

The lagoons, salt marshes and aggraded valleys of the San Diego Coast are bordered with shell midden, mute testimony of the existence of the narrow bays that once extended inland in these valleys for several miles. Shell middens are also evidence of the importance of shellfish in the aboriginal diet and it is in this respect that the changing conditions of these prehistoric bays and adjacent coastline are of importance here. A reconstruction *in toto* of the ecology of the coastal waters is not attempted here, but rather an isolation of the factors that are reflected in the species changes in the shell middens, and which were important in the decrease of food resources of the aboriginal population.

The importance of the silting in of the lagoons in the interpretation of culture change on the San Diego Coast has been independently noted in at least two studies (Shumway and others 1961; Warren and others 1961). There is disagreement at present in the literature regarding the date that the lagoon silting took place, and what effect it had on the prehistoric population. Warren and others (1961) maintained that the La Jolla Complex apparently reached its population and cultural climax between 7000 and 4000 years

ago (5050 and 2050 B. C.). Warren and others feel there is evidence for a decrease in the supply of shellfish after about 3000 to 4000 years ago, as a result of the silting in of the lagoons. With the reduction in food supply in the lagoons, the human population on the coast must have decreased, and seed gathering, possibly hunting, took on more importance for the economy. There was apparently a movement of population centers away from the lagoon margins, leaving a small population near the mouths of the larger rivers and lagoons, where shellfish and fresh water were still available. This does not imply that the entire coastal area became depopulated, but that the population apparently decreased in some areas to a relatively small proportion of what it had been formerly.

Shumway and others (1961: 116-7) feel that the lagoons remained open to the sea and supported large populations of bay molluscs until about 1000 years ago (A. D. 950), when the "bay like estuaries became the more or less ephemeral and ecologically highly variable lagoons no longer suited for significant shellfish production," at which time the shellfish gathering population "largely abandoned the coast north of La Jolla, although they persisted in southernmost California and Baja California where bays and rocky shores remained." Shumway and others state further that:

> . . . . where lagoons apparently were less developed, the bay shellfish supply

> seems to have been depleted early through changes in the habitat. The Scripps Estates Site seems to have been abandoned by La Jolla people about 5000 years ago, although some shellfish-gatherers lived nearby as late as about 600 years ago but nearer the remaining rocky shore of the La Jolla region; they fed largely on mussels and other rocky-foreshore molluscs. Near some of the larger lagoons, such as Batiquitos Lagoon, the consumption of bay molluscs in large numbers persisted until about 1000 years ago (1961: 117).

Later, Hubbs and others (1962) on the basis of a series of three radiocarbon dates from a site on Batiquitos Lagoon, criticized the conclusion of Warren and others (1961). The C-14 dates from the first, fourth and seventh decimeter levels of the midden are 870 ± 200 A.D. 1080 (sample LJ-242, Chione undatella), 825 ± 200 A. D. 1125 (sample LJ-243, Chione undatella), and 1075 ± 150 A. D. 875 (sample LJ-254, Chione undatella). Regarding the 870-year date from decimeter 1 level (LJ-242), Hubbs and others state:

> The shell-gathering culture seems to have

> persisted around the lagoon, at least intermittently, for ca. 7 millennia, in response to adequate food supply and water at or near the surface . . . . Evidence of LJ-242, LJ-243, and LJ-245 negates the conclusion of Warren, True and Eudey (1961, p. 25) that 'from about 2500 to 3000 years ago it appears that Batiquitos Lagoon could no longer support a supply of shellfish adequate to maintain a sizable aboriginal population' (1962: 222).

Hubbs and others (1962: 222) in discussing the LJ-243 date of 825 ± 200, also state:

> The slightly older (nearly identical), rather than the earlier date that would be expected, presumably indicates accumulation over a very short period. The Decimeter 4 level is unique in the extremely high density of shells (65,000 in 0.05 M^3). Obviously conditions for human existence were very favorable.

The early date of 1075 ± 150 from Decimeter 7 was as expected and no additional inferences were made based on it.

These dates are from a site on the north side of Batiquitos Lagoon exposed by a road cut (J. Miller, Personal

communication), located 33° 05' 28" N Lat, 117° 17' 33" W Long (Hubbs and others 1962: 222). This description fits the location of site SDi-693 recorded in the University of California Archaeological Survey, Los Angeles, and was described briefly by Warren, True, and Eudey (1961: 8):

> Sites SDi-690 and -693 are 2 sites exposed by the road cut on the north side of the lagoon. They are seen as heavy concentrations of shell fish remains (primarily Chione and Pecten) and dark midden at the base of a steep slope. In both cases the area at the top of the slope exhibits indications of extensive occupation. The sites at higher elevation (SDi-211 and SDi-691) are characterized by light midden and scattering of shell apparently in less quantity than the sites at the bottom of the slope. The relationship of SDi-690 and SDi-693 to SDi-211 and SDi-691 is unknown but the situation suggests 2 alternatives: 1) that the sites represent 2 different occupation areas with greater use of shellfish in sites at lower levels, 2) that the lower sites represent the refuse from the sites at higher elevation.

Sites SDi-693 and -690 also share the traits of being located on a narrow strip between the base of the slope and the edge of the old lagoon shore, and being covered with an overburden of wash from the higher slope. This description also fits the "midden" at sites SDi-604 and -607 on the south side of the lagoon. In the case of SDi-604, it can be shown to be in a shallow gully which extends up the steep side of the slope to the midden on top. There can be little doubt that SDi-604 is either slough or refuse from the midden at higher elevation. If SDi-693 is considered a refuse heap rather than a midden derived from debris in a living area, the high concentration of shellfish remains has different significance than the one attributed to it by Hubbs and others. The interpretation of heavy population concentration can be replaced satisfactorily by the interpretation that there was heavy concentration of refuse in a relatively small area by a relatively small population. The location of the site, the shell concentration, rapid accumulation of the debris and relatively small size of SDi-693 all support this latter interpretation.

That SDi-691 maintained only a small population at this time cannot be shown conclusively. However, SDi-211 (Crabtree and others 1963) lacked indication of heavy population, and yet at the base of its slope, SDi-690 contains relatively high concentration of shell.

A third possible interpretation presents itself if the

heavy shell concentration in refuse heaps rather than in living sites, is considered. That is, refuse heaps are not necessarily derived from the middens at higher elevations, but may derive from small groups utilizing the lagoon area as a whole and moving about it to points where the shellfish were available, at least occasionally. If this were the case, heavy concentrations of shellfish of small size could build up at various points around the lagoon. If we accept the refuse heap interpretation for SDi-693, we have an explanation for the high concentration of shellfish remains; however one that makes the "very favorable" conditions for human existence at 800 to 1000 years ago no longer so obvious.

At present, no live shellfish are found in Batiquitos Lagoon. However, there was almost certainly a large shellfish population in the lagoon around 5000 B. C., as indicated by shell midden analysis (see below). The problem is not to date when the shellfish supply in the lagoon became extinct, but rather to date any rapid decrease in the shellfish population which would affect the human population whose subsistence, to a considerable extent, was based on the collecting of shellfish.

Shumway and others also suggest that from 7400 to 3700 years ago (5450 to 1750 B. C.), the shoreline must have been much rockier than at present to have produced the quantities of rock-inhabiting molluscs consumed by the aboriginal groups:

Thus we are confronted with good indications that, during the period from 7300 years ago or earlier until at least 3700 years ago, the shore north of La Jolla was considerably more rocky than at present with estuaries sufficiently deep and in sufficient contact with the sea to maintain, in baylike conditions, flourishing populations of Pecten and Chione. These conditions would be met by a rapidly rising sea level, during which the accumulation of shore sand would be kept low (1961: 113).

. . . . . .

. . . . As the rise in sea level slackened (to become slight in recent centuries) the rocky foreshore became largely replaced north of La Jolla by sandy beaches as sand accumulated. At the same time sedimentation in the stream mouths came to exceed the effects of the slackened rise in sea level, so that the former baylike estuaries became the more or less ephemeral and ecologically highly variable lagoons no longer suited for significant shellfish production (1961: 116).

That the lagoons silted in and reduced the food supply of the aboriginal population along the San Diego Coast appears to be an obvious and accepted fact. The disagreement lies in the date when the lagoons silted in to the extent that they could no longer support large populations of shellfish. Shumway and others (1961) and Hubbs and others (1962) would have Batiquitos Lagoon and apparently other, similar lagoons on the San Diego Coast, maintain sizable shellfish populations until about 1000 years ago. Warren and others (1961) would have the shellfish population depleted to the extent that the La Jolla population had declined considerably by about 3000 to 4000 years ago, and Batiquitos Lagoon shellfish population severely depleted by about 2500 to 3000 years ago, or 550 B. C. The argument presented above regarding the significance of the shell content and C-14 dates of site SDi-693 on Batiquitos Lagoon leaves open the problem of dating the silting in of the lagoon.

The discussion following is a restatement of the conclusions of Warren and others (1961: 24-8), somewhat modified to incorporate more recent data. It is maintained that there is little evidence for a heavy population on the San Diego Coast after about 2000 B. C., except where permanent fresh water supplies and bays now exist, such as around Mission and San Diego bays, the Santa Margarita River, and possibly the San Dieguito River. Even at these places, it may be that the populations were also declining

by about 2500 B. C. The series of radiocarbon dates now available for the San Diego Coast tends to support this conclusion. The 42 dates shown on Chart 1 are recorded geographically from San Diego and Mission bays on the south to Agua Hedionda on the north.

These dates cannot be considered unbiased or a random sample; however, the lack of any carbon-14 dates north of Torrey Pines Mesa for the period between 1500 B. C. and A. D. 860 is suggestive. The smallest number of radiocarbon dates (6) recorded for the entire San Diego Coast for any two-millennia period, is found between A. D. 1 and 2000 B. C. This also suggests a smaller number of sites being occupied at that time. While this evidence is not convincing, it was a somewhat more limited list of C-14 dates that first suggested a reduced population after 1500 B. C. to the author (Warren and others 1961). The total number of dates used has almost doubled, and there still remains a paucity of dates between 2000 B. C. and A. D. 760.

Other data, newly available, are more convincing. Warren and Pavesic have completed analysis of column samples taken at SDi-603 on Batiquitos Lagoon (1963), and the changes in relative quantity of certain species and in rate of accumulation of shellfish remains support the suggested decline in population at a relatively early date, as a result of silting in of the lagoons.

Site SDi-603 has three stratigraphically superimposed

radiocarbon dates. The earliest, 7300 ± 200 [5350 B. C.] (Hubbs and others 1960: 209, sample LJ-36, C. californiensis) was collected from near the bottom of the site. Charcoal from a hearth 14 inches below the surface assayed at 6250 ± 150 [4300 B. C.] (Hubbs and others 1962: 224, sample LJ-256) and a date of 3900 ± 200 [1950 B. C.] (Hubbs and others 1960: 207, sample LJ-31, C. californiensis) was located at a higher elevation than that of the hearth. Pottery is present in the upper levels of the site, which has been disturbed by cultivation and by rodents. The ceramic ware dates from protohistoric times.

Prior to 6250 years ago (4300 B. C.), Mytilus was the most common species found in the midden. During the latter half of this period, Ostrea reached its most extensive use. Throughout this period, Mytilus decreased in importance and Chione and Pecten increased, so that at about 6200 years ago (4250 B. C.) they were slightly more important than Mytilus. The increasing relative importance (percentage) of Chione and Pecten suggests that the lagoon was becoming increasingly fit ecologically for Pecten and Chione and decreasingly so for Mytilus. That is, sandy beaches and mud flats were replacing the rocky foreshore: Batiquitos Lagoon was silting in.

Shortly after 6250 years ago (4300 B. C.) other ecological changes apparently occurred and are reflected in the shell midden accumulation. Average rate of accumulation

of shell prior to 6250 years ago is slightly more than 10 times the average yearly accumulation after that date. In the 17 column samples where stratigraphic control was maintained the average accumulation of shell drops from 393.6 gms. per 1000 years, to 38.8 gms. per 1000 years. This rather sudden drop in abundance of shell may be explained in part by leaching action, dissolving the shells and redepositing them as a limey deposit in the lower strata. However, this leaching action is not considered by Warren and Pavesic (1963) to be sufficient cause for the vast difference in midden accumulation.

Furthermore, the difference between the rates of accumulation at 7300 years ago (5350 B. C.) and just prior to 6250 years ago (4300 B. C.) is not taken into consideration. The lowest stratum of the site contained less shell than the other strata, and presumably represents a small population and a period of slower midden development. If this is indeed the case, the 393.6 gms. per 1000 years is excessive for a lowest portion of the midden, and much too slow a rate of accumulation for the period just prior to 4300 B.C.

In short, there is evidence to support a much sharper curve as well as a less pronounced curve in midden accumulation. The interpretation presented apparently approaches reality as closely as possible with the information now available.

It is concluded that between 5350 B. C. and 4300 B. C., the rock-dwelling shellfish (Mytilus) were being replaced by shellfish of the sandy beaches and mud flats (Chione and Pecten). However, shortly after 4300 B. C., the ecology of the sandy beaches and mud flats of the lagoons became unfavorable even to these species, and they were no longer able to maintain the large population of former years.

After 6000 B. C., there is ample evidence of widespread erosion and deposition of fine sediment in the coastal lagoons and river valleys. At the C. W. Harris site, a deposit of clayey silt 2 to 3 feet thick was laid down prior to 4300 B. C., and 3 to 4 feet of silt were deposited after that date (Warren and True 1961). Site SDi-213, on Batiquitos Lagoon, a La Jolla site, has wide gently sloping erosion channels dividing the midden into three parts. Evidence of heavy erosion and silt deposition at about 4300 B. C. is further supported by core samples taken in Batiquitos Lagoon. A date of 6300 ± 200 years or 4350 B. C. (Hubbs and others 1962: 233-4, sample LJ-333) was obtained from shells of Pecten circularis aequisulcatus at a depth of 10.01 to 10.45 m. in the alluvium just off the north side near the middle of Batiquitos Lagoon. A second date of 3400 ± 240 or 1450 B. C. (Hubbs and others 1962: 233-4, sample LJ-381) was obtained from C. undatella in the same locality at a depth of 5.24 to 5.61 m.

Rate of deposition is difficult to estimate, however,

unless such factors as rate of compaction and location of old, refilled channels are known. Still, further support of a period of heavy deposition and presumably erosion shortly after 6000 B. C. is presented by Shepard and Moore for bays of the Central Texas Coast, where "there was rapid deposition between 5,000 and 8,000 years before the present with a maximum of 4.5 feet per century; whereas, during a period of about 3,000 years before the present the rate reached a low of about 0.3 feet per century. A relatively recent increase brought the present rate up to approximately the average for the entire period" (1960: 142).

This period of deposition in the lagoons corresponds to the period of rather extensive erosion between 3000 and 5500 B. C. noted by Martin and others (1961) in Arizona. The date of 6250 years ago (4300 B. C.) for maximum quantity of desert pollen at Fishbone and Guano Caves in Nevada (Sears and Roosma 1961), a date which may be viewed as the climatic maximum, correlates almost exactly with the critical date at site SDi-603 on Batiquitos Lagoon, when the most severe erosion set in.

The importance of the sea in the rate of sedimentation of the coastal lagoons should not be underestimated. The role of the sea becomes apparent in the concepts of erosional and depositional coasts described by Emory (1960). The sea cliffs of the San Diego Coast are clearly erosional. Emory states that (1960: 12):

> The ocean washes continually against the base of some sea cliffs but is separated from others most of the time by the talus or by sand beaches. During single exceptionally large storms, or as the cumulative effects of a winter season of smaller storms, beaches are commonly narrowed by seaward transportation of sand. While the beach is absent or narrow, the ocean can do more erosion of the cliff than during the whole remaining bulk of the year. Thus, ... the greatest effect comes during short periods separated by much longer intervals of very slight erosion or even of deposition.

Depositional coasts in Southern California consist chiefly of sand beaches, about 30 percent of which are backed by lowlands, mostly marshes or mud flats. "These are the only truly depositional coasts of the region, ones which have prograded over a long period of years" (Emory 1960: 25). Once on the beach, whether derived from streams or sea cliffs, the sediments come under the influence of waves. Before being lost to the sea, the sand and heavier material is moved along the shore for greater or lesser distances. The results of this process in more recent times are still visible at Batiquitos Lagoon, where the longest

gravel beach in Southern California extends across the mouth of the lagoon and along the adjacent shore (Emory 1960: 184). These gravel bars, formed by longshore movement, wholly or partly blocked the mouths of the lagoons and may well have acted as sediment traps.

Stewart (1958), in his studies of sediments of lagoons in Baja and Southern California coasts, found (1) sediments that had been subjected to wave processes; (2) sediments that had been subjected to river processes; and (3) sediments deposited from quiet water. The lower lagoon sediments that fall within the first group are "interpreted as having been subjected to the same wave processes and subsequently carried into the lagoon primarily by tidal currents operating when the channel was open, but also by wind action and by washovers when the channel was closed" (Stewart 1958: 2592).

Sediments deposited from quiet water are found on the border marshes of the lagoons. "Sedimentation on the marshes at San Miguel Lagoon occurs periodically when rising lagoon waters inundate the marshes. Current action is diminished by the thick growth of plants, and the particles in suspension settle out of the quiet water" (Stewart 1958: 2595). The limits of the areal extent of the sediments subjected to river processes extend far out into the lagoon, "suggesting that these lagoon sediments also were brought in by the river during floods, or at least at a

time when the transporting power of the river was greater than at the time of sampling" (Stewart 1958: 2595).

The sediments subjected to wave processes and those subjected to river processes are of particular importance. The bay barriers, commonly found extending across the mouths of the Southern California lagoons, are a feature which may be attributed to the wave processes. These barriers are important because they serve as a more or less efficient trap for the sediments deposited by the rivers. During high runoff periods or flood stages of the rivers, the bay barriers may be broken through and sediments carried far out to sea. The San Miguel Lagoon, described by Stewart (1958: 2568), is fed by a permanent stream. Nevertheless, during most of the year, the lagoon is shallow and narrow. "During the late fall and early winter hard rains often swell the stream to flood proportions and a plume of brown sediment-laden water has been observed to extend as much as 2 miles seaward from the lagoon."

The lagoons with bar barriers may be viewed as silt traps for the streams feeding them. Furthermore, bar barriers constructed partially of gravel derived from adjacent sea cliffs would probably be somewhat more effective than those of finer sands. Barriers containing such gravels must have formed across the mouth of Batiquitos Lagoon as well as other lagoons in the vicinity, judging from the gravel beach found at present at the mouth of Batiquitos

Lagoon. If such barriers were present during periods of heavy erosion, the deposition rate in the lagoons would have been considerable. It has been reported that during the flood of March 2, 1938, more than 6,000,000 cubic yards of sand were deposited at the mouth of the Los Angeles River and 7,303,000 cubic yards at the mouth of the Santa Clara River. This material formed temporary deltas and there was probably a much greater quantity of finer sediments carried seaward (Emory 1960: 25).

On the basis of the data presented in the foregoing pages, the following reconstruction of the sequence of events is here postulated. As the glaciers retreated and the sea level rose, the mouths of the rivers and streams along the San Diego Coast were drowned and converted into deep, narrow bays. The rising sea level eroded the sea cliffs, washed the lighter materials seaward and deposited the heavier sediments across the mouths of the bays and along the foreshore. About 6000 B. C., the rate of sea level rise slowed considerably. At about this time, the arboreal plant cover in the interior was giving way to grass and desert plants, and a period of erosion set in. The more slowly advancing sea now no longer carried sand seaward and sandy beaches appeared, reducing the rocky foreshore. The silts brought down by the streams also covered over any rocky shores that existed in the lagoons. The rock-dwelling shellfish decreased in number and were re-

placed by those dwelling on the sandy beaches and mud flats. As the Long Drought reached its climax in the desert region, about 5250 B. C., more severe erosion occurred and greater quantities of silt were deposited in the lagoons, so that not only the depth of the lagoons decreased but presumably their length as well, by the advance of the stream deltas at the rear of the lagoons.

The reduction in area created by the deltas and the abundant yearly supply of silt deposited in the lagoon significantly decreased the number of shellfish. The reduction or decrease in shellfish supply was an important factor in the decline of the aboriginal population along the San Diego Coast. How long the lagoons continued to exist is uncertain but between about 2000 B. C. and A. D. 700, the shellfish and human populations appear to have been considerably smaller than between 4000 and 5000 B. C. From A. D. 700 to A. D. 1100, there may have been a slight human population increase. This may reflect the first influences from the Colorado River area and the introduction of San Luis Rey I Complex into the area west of the Peninsular Range (Meighan 1954). This possible increase in human population on the coast also corresponds to the period of cooler weather described by Hubbs (1961) and may reflect a period of more intense and frequent storms that would break down the barrier bars across the lagoons and open up at least a portion of them. With the return to the warmer and drier period of the

present, the lagoons silted in again and formed the salt flats that were reported by early explorers and which are still visible today, severely limited in food potential and incapable of supporting more than a small population.

Chapter vi. The La Jolla Complex: A Critical Review

The temporal placement of the La Jolla Complex, while debatable in the recent past, is now firmly established. A relatively large number of radiocarbon dates for La Jolla sites (Hubbs, Bien, and Suess 1960, 1962) has yielded several dates in the range of 5500 B. C., with only one (LJ-454) slightly older, at 7530 ± 190 [5580 B. C.] for a site on the University of California campus at San Diego (Hubbs, Personal communication 1962). Other similar dates have been 7300 ± 200 [5350 B. C.] for SDi-603 on Batiquitos Lagoon, and 7370 ± 100 [5420 B. C.] for SDi-525 in the city of La Jolla. The La Jolla component at the C. W. Harris site is stratigraphically later than the San Dieguito component. The latter is clearly a regional expression of an earlier culture to which the Lake Mohave Complex also belongs. The Lake Mohave Complex is now believed to date from about 7000 B. C. (Warren and True 1961; W. J. Wallace 1962). Thus, the initial date for the La Jolla Complex can be placed between 7000 and 5500 B. C., but on the side of the later date. A date of 6000 B. C. is here considered the earliest probable date for the La Jolla Complex.

The terminal date for La Jolla presents a more difficult problem, and will be reviewed in detail below. However, it appears to the author that this complex continued

in essentially the same form until cultural influences from the Colorado River, reflected primarily in the introduction of pottery, were felt on the San Diego Coast. That the so-called "Yuman" occupation of the San Diego Coastal Province remained basically La Jolla in economy, remains a distinct possibility in the opinion of the author, and will be discussed at length below.

Several developmental schemes have been presented for this extremely long cultural continuum. Rogers, in his pioneer study (1945: 171-2), divided La Jolla into two developmental phases: La Jolla I and II. La Jolla I is characterized by basin metates, unshaped manos, a few primary flakes of stone, and an even lesser number of crude beach cobble choppers. Stone projectile points are absent and unsegregated interment without mortuary offerings was the method of disposing of the dead.

La Jolla II, we are told, evolved gradually and is characterized by the common occurrence of stone flaking, increase in the use of metates, burials that are more segregated and occurring in cemeteries. At this time, contact with the Channel Islands is reflected in "typical Channel Island beads and stone digging-weights" included with the burials, which were often marked with inverted metates.

Work at the Scripps Estates Site has presented contradictory evidence, as noted by Shumway and others (1961:

118). "The cultural features of the Scripps Estates Site hardly confirm the separation into such substages, for this is one of the earliest of such sites, yet it has concentrated burials, abundance of flaked-rock implements (a few of which are rather refined), and some inclusion of ornaments in burials."

Harding (1951), in discussing what is apparently the Sorrento Site (SDi-531), noted a development from very simple flake tools in the lower levels through the addition of metates and manos and more chipped stone tools including projectile points. Spire-lopped olivella beads, a shell ring, and a "softstone" pendant also occur. She equates this development with Rogers' La Jolla I and II. Shumway and others (1961: 118) suggest that this represents a gradual build-up and stabilization of a village population rather than two cultural phases. This alternative appears to be a better interpretation, since the artifact frequency in the lower levels of La Jolla sites is generally low and often does not represent an adequate sample.

The earliest dates from two sites, 7300 ± 200 [5350 B. C.] at SDi-603 and 7370 ± 100 [5420 B. C.] at Scripps Estates Site, derive from "mano-bearing" levels. The later date of 6950 ± 350 [5000 B. C.] (Crane and Griffin 1958, sample M-114) from the 18-24 inch level of the Sorrento Site, also tends to support the interpretation that the phases "represent the development stabilization of the

village." However, this date has yet to be tied into the cultural development at the Sorrento Site.

Carter (1957: 269-73) would have the La Jolla industry extend back into the upper part of the last interglacial and preserve a remarkably stable cultural continuum until Yuman influences were felt on the coast. Johnson and Miller (1958), Krieger (1958), and Oakley (1959) have shown certain shortcomings in Carter's work, leaving him little in the way of evidence for third interglacial man or for a La Jolla Complex of Wisconsin age. Probably the most glaring weakness in Carter's interpretation of the La Jolla sequence is the vast difference between some of his "geochronological" dates and the radiocarbon dates. For example, in discussing Batiquitos Lagoon, Carter stated (1957: 191):

> Where the road along the south side of the lagoon climbs to the prominent 75-foot terrace one mile inland from the sea, there is an extensive and deep site. The upper levels are dark and contain numerous artifacts . . . . The evidence of human occupation extends to a depth of more than four feet and is then poor in artifacts, the shell is weathered and the soil formation is one of bleached and cemented sand . . . . The soil record

> suggests the presence of a zone indicating human occupation that was weathered during part of Wisconsin time and overlain by a later occupation.

This description fits only site SDi-603. Hubbs (Hubbs and others 1960: 209) collected a sample of clam shell (C. californiensis) "from the lower of two soil horizons" at this site. The sample was "taken about 1 m. down in yellowish sand, indurated with lime, overlain unconformably by loose, dark midden soil." This sample (LJ-36) gave a date of 7300 ± 200 or 5350 B. C. In short, the mass of evidence now available for study and comparison certainly would have "Pleistocene man" in San Diego at a much later date than that suggested by Carter.

Shumway and others (1961) feel that the data show "an essential continuity of the shellfish-gathering habit along this coast for more than seven millennia" (1961: 124). However, they do not mean to imply that "the shellfish gatherers up and down the coast were genetically or socially continuous, either in space or time." It is suggested (1961: 119) that the La Jolla gathering culture evolved from "some preceding hunting culture(s), San Dieguito or other."

Recent work at Batiquitos Lagoon (Crabtree and others 1963; Warren and Pavesic 1963) supports the hypothesis of Shumway and others that the La Jolla Complex persisted with

very little change over several centuries. However, the suggestion that the La Jolla Complex "evolved" from the San Dieguito or some other hunting culture(s) is not supported by the studies made by University of California Archaeological Survey, Los Angeles (Warren and True 1961; Warren and others 1961). These complexes are considerably different in artifact assemblage and apparently in ecological adaptation and economy. The San Dieguito Complex, which appears to represent the only basically hunting culture in the area, has a distribution along the slopes of the Black Mountain Volcanics (Rogers 1929; Warren and True 1961) and is not known to be found in the vicinity of the lagoons and coast.

The La Jolla Complex is basically a gathering culture, and is found primarily near the lagoons or coast, with only smaller campsites located farther inland. There is a most striking difference in the artifact assemblages: seed grinding tools are apparently absent in the San Dieguito Complex, while knives and points make up about 30 percent of the artifact inventory. The La Jolla Complex essentially reverses these percentages: manos make up roughly 15 to 30 percent of the artifact assemblage, while points and knives represent less than 3 percent (Warren and others 1961; Warren and True 1961; Crabtree and others 1963).

These differences, in themselves, do not rule out a development of the La Jolla Complex from the San Dieguito.

However, the fact that no "intermediate" assemblage has been recognized severely lessens the probability of such a development. As stated elsewhere (Warren and others 1961: 23), we feel that the La Jolla gathering economy does not appear to have been adapted originally to the coastal ecology, and it has been suggested that the La Jolla Complex originated in the interior. Lack of data from the interior makes confirmation of this hypothesis impossible at this time. However, certain manifestations of the Desert Culture--Pinto, Gypsum and Cochise--appear to be more similar to the La Jolla than does the San Dieguito Complex. This interpretation, although arrived at independently, is in agreement with Meighan's (1958) interpretation and the more general pattern proposed by Osborne (1958).

We therefore propose that the La Jolla Complex represents actual migration of peoples to the coast, bringing with them a basically gathering economic pattern adapted to an arid, inland environment; that this pattern was easily adapted to the gathering of shellfish along the beaches but not readily adapted to the resources of the ocean; and that the abundant supply of shellfish in the lagoons and on the coast, once recognized as a food source, made possible an increase in population and the development of what we now call the La Jolla Complex.

Findings of work undertaken by the Archaeological Survey have also been interpreted differently from those of

Shumway and others in another respect. Where Shumway and others interpret La Jolla conservatism as cultural retrogression, Warren and others (1961) and Warren and Pavesic (1963) have looked to ecological adaptation and cultural isolation for the sources of conservatism. Shumway and others feel it plausible to assume "that the La Jolla people not only degenerated in habits and in tool-making ability but also, after such early retrogression, stagnated. The Scripps Estates Site seems to have been inhabited for more than two millenia with little evidence of change in culture. The same general type of food and the great paucity of sophisticated tools or weapons argues for a long-continued, unprogressive existence . . . ." (1961: 124). Warren and others see the La Jolla Complex as capable of adapting its economy to a variety of situations where gathering activities were possible, but incapable of adequately coping directly with the resources of the sea under the pressures of climatic change. The climatic and geologic changes that occurred, were met primarily by shifts in importance of gathering activities by the La Jolla populations.

The interpretations of the La Jolla development, presented above, are of two distinct types. The first, and perhaps the most common in American archaeology, is the development of a phase sequence based on specific traits, such as artifact types, burial patterns, etc. The problems are great in such interpretation of the La Jolla development

and the more recent work has illustrated the inapplicability of Rogers', Harding's, and Carter's attempts in this area.

The second type of interpretation is based more on ecological adaptation of the prehistoric culture than on specific traits. The ecological analysis does not deny the possibility of establishing developmental phases based on specific traits. However, no such developmental phases have yet stood the test of close examination. Ecological interpretations do not deny culture change, but only emphasize that it is more difficult in this particular case, to establish culture change by means of trait lists than through studies of ecological adaptation. These two kinds of interpretations are in fact complementary and the utilization of both is desirable, for together they present a much more complete picture of the La Jolla development than they do individually.

In the following discussion of the temporal development of the La Jolla Complex, changes in both ecological adaptation and in artifact assemblages are discussed. However, it must be pointed out that it is the ecological changes that form the basis for the discussion and the temporal distribution of the specific diagnostic traits is sometimes tenuous.

Chapter vii. Temporal Periods and Cultural Stages on the San Diego Coast

The analysis below makes use of several concepts not generally used simultaneously. The first is that of period. Periods are considered units of time or units of contemporaneity (Rowe 1962). Since significant changes in artifact types in the La Jolla Complex are difficult to isolate and there are enough radiocarbon dates available to allow for fair temporal control, the basic taxonomic units are periods, which are not necessarily determined by changes in artifact inventory. In the following discussion, the three periods discussed are not completely arbitrary. The terminal date of each period is set at a point in time which seems to be one of accelerated culture change. However, the changes that occur throughout the San Diego Coast and offshore islands are not always in the same direction in all areas.

Cultural changes from Period II to Period III on the coast represent different cultural developments from those of Santa Catalina Island, for example. Periods are therefore considered nothing more than temporal units and the cultural remains placed in each period are selected only on the basis of the date assigned to them.

The second concept used is that of stage. Stages are units of cultural similarity (Rowe 1962) characterized by

a dominating pattern of economic existence (Krieger 1953: 247). However, stages are generally considered units which have differences of greater magnitude than those considered here. The Lithic, Archaic, Formative, etc. Stages of Willey and Phillips (1958) may serve as an example. The La Jolla Complex falls within the Archaic Stage and the units we are concerned with are subdivisions of the La Jolla Complex. Such subdivisions might be termed substages, but this is an overly cumbersome term. Furthermore, the units with which we are concerned are not substages of the Archaic Stage, but rather subdivisions of the La Jolla cultural development, which is in turn a cultural unit within the Archaic Stage.

An alternative term would be "phase." However, Willey and Phillips would attempt to relate "phase" to "society" (1958: 49), and it is therefore not applicable to the unit of cultural similarity termed stage in this report. The stages described below are not general cultural stages, but rather are primarily stages of the La Jolla cultural development, and as such are units within that culture that are culturally more alike than "stages" generally are, and are characterized by rather minor changes in patterns of economic existence.

Finally, the concept of <u>phase</u> as defined by Willey and Phillips is not directly applicable to the La Jolla cultural remains as they are now understood. A phase is defined as

"an archaeological unit possessing traits sufficiently characteristic to distinguish it from all other units similarly conceived, whether of the same or other cultures or civilizations, specially limited to the order of magnitude of a locality or region and chronologically limited to a relatively brief interval of time" (Willey and Phillips 1958: 22).

Further, it is desirable to have phase equal the prehistoric society. In this respect, Willey and Phillips would "think of a society in its minimal sense, as a group of people acknowledging a single political authority, obedient to a single system of law, and in some degree organized to resist attack from other such societies" (Willey and Phillips 1958: 49). However, as they readily admit, in practice the archaeologist can seldom relate these criteria to an archaeological assemblage. Further, in Restricted Wandering or Central Based Wandering groups, political authority may be limited to a small village and be poorly defined (Beardsley and others 1956). Consequently, defensive organization may also be virtually non-existent. On the other hand, a single system of law may extend far beyond the limits of this small, loosely organized political unit.

The La Jolla community pattern is viewed here as a Restricted Wandering or a Central Based Wandering type, and it is only after full consideration of the implications of these community patternings, that the society or basic social units may be defined with some reliability. Discussion

of this problem here is not only premature, but is of little or no use to the present study. Suffice it to say that these contemporaneous units (i. e., sites or components of sites) in close proximity to one another (for instance, on the shores of a single lagoon), utilizing the natural resources of the same area, are assumed to recognize themselves as a social unit, distinct from other such clusterings of communities and are thus considered one society, a basic social unit. The concept of phase as defined here may be useful for a more detailed analysis of the cultural remains than is the definition of phase presented by Willey and Phillips.

Briefly then, in the following analysis of the La Jolla development, two major concepts are used in organizing the data in an historical sequence: period and stage. A period is a temporal unit and cultural remains are placed within each period by virtue of the dates assigned to them. The organization of cultural remains into periods is not dependent upon cultural data, only on their temporal placement.

A stage, on the other hand, is a unit of cultural similarity characterized by a dominating pattern of economic existence. Stages here are clearly "economic stages," dominated by a pattern of productive technique. Changes in dominant productive techniques may be made within a given period or may persist through two or more periods and are therefore not dependent upon temporal periods.

Periods and stages are thus mutually exclusive concepts: periods are units of time; stages are units of cultural similarity.

Periods of La Jolla Development

The earliest cultural remains on the San Diego Coast lie outside the scope of this paper. These include such remains as the San Dieguito Complex (Warren and True 1961) and possibly earlier material found in the sea cliff at Scripps Institute of Oceanography (Sellards 1960). The vast time range possibly represented by this material is considered Period I.

Period II begins circa 6000 B. C. and terminates at about 3000 B. C. The initial date for Period II corresponds to the initial date for the appearance of the La Jolla Complex on the San Diego Coast. This period terminates during a time of ecological change, when the extent of rocky foreshore had been considerably reduced, lagoons had been reduced in size and depth by heavy silting, the shellfish supply had dwindled, and potable water was presumably considerably lessened near the lagoons and beaches. Further, the vegetation had undergone some important changes, with reduction in the distribution of pines and oaks and the increase in areas of chaparral, grasses and coastal sage scrub.

A relatively large number of sites falls within this period, and it is from this period that most data are known. The entire occupation at Scripps Estates Site (Moriarty

and others 1959; Shumway and others 1961) falls within Period II, as does the earlier portion of the occupation at the Sorrento Site in Soledad Valley (Harding 1951). The Del Mar Site, SDi-191 (Warren and Thompson 1959; Carter 1957), and the La Jolla Component at the C. W. Harris Site, SDi-149 (Warren and True 1961), on the San Dieguito River, and SDi-603 on Batiquitos Lagoon (Crabtree and others 1963) are all Period II sites.

Each of the above sites has one or more samples dated by radiocarbon method that fall within Period II, roughly from 5400 B. C. to 3400 B. C. Several more sites in the vicinity of La Jolla are dated within the range of Period II (Hubbs and others 1960, 1962; Hubbs, Personal communication 1962), but little or no archaeological data are available for them. Additional sites which lack carbon-14 dates appear to be culturally related to the dated sites and may also fall within this period. These are dealt with below in the discussion of cultural stages.

Period III, dating from 3000 B. C. to A. D. 1300, is the most poorly documented of the three periods with which we are concerned, and the most crucial to the understanding of cultural adaptations made to the changing ecological conditions of the San Diego Coast. SDi-603 on Batiquitos Lagoon is the only site excavated on the coast that has a radiocarbon date falling within this period. The Period III occupation may be correlated with the major portion of

stratum 2 at SDi-603, from which the date of 3900 ± 200 [1950 B. C.] was obtained by Hubbs and others (1960: 207, sample LJ-31). Other sites on Batiquitos Lagoon that have dates falling within this period are: SDi-604, dated at 3500 ± 200 [1550 B. C.] Hubbs and others 1960: 209, sample LJ-35); and SDi-693, with three dates ranging between 825 ± 200 [A. D. 1125], and 1075 ± 200 [A. D. 875] (Hubbs and others 1962: 222, samples LJ-242, -243, -245). An unexcavated site on Agua Hedionda Lagoon was dated at 1030 ± 200 [A. D. 920] by Hubbs and others (1962: 234, sample LJ-335).

Other unexcavated sites include Site SDM-W11 at the base of the northern tip of Torrey Pines Mesa, on the southern edge of Sorrento Valley, with a date of 3700 ± 200 [1750 B. C.] (Hubbs and others 1960: 204, sample LJ-19), and the Torrey Pines Grade Midden, with three radiocarbon dates ranging between 4970 ± 200 [3020 B. C.] and 4740 ± 200 [2790 B. C.] (Hubbs and others 1960: 229-30, samples LJ-274, -276, -277).

South of Torrey Pines Mesa, in the vicinity of the La Jolla embayment and Mission and San Diego bays, there are several sites with radiocarbon dates falling within Period III. However, there are no archaeological data available for most of them. These include:

1. Chollas Creek Site. Three "occupation streaks" exposed in the bank, dated in stratigraphic order at 2100 ± 200 [150 B. C.], 1450 ± 200 [A. D. 500], and 950 ± 200

[A. D. 1000] (Hubbs and others 1960: 208-9, samples LJ-34, -37, -38).

2. Silver Strand Site. Dated at 4520 ± 200 [2570 B. C.] for sample LJ-336, and 4020 ± 300 [2070 B. C.] for sample LJ-211, drawn from the lower levels of "transitional occupation" (Hubbs and others 1962: 213, 234).

3. Scripps Institution of Oceanography Cliff Site. 3240 ± 240 [1290 B. C.] for bottom of surface midden (Hubbs and others 1962: 235, sample LJ-382).

4. Site near Scripps Institute. 4400 ± 150 [2450 B. C.] (Shumway and others 1961: 123, sample LJ-299A).

5. Sweetwater River Midden. 760 ± 100 [A. D. 1190] (Hubbs and others 1960: 216, sample LJ-103).

In addition to the above sites, the Spindrift Site at the La Jolla Beach and Tennis Club has several dates that fall within Period III. Some archaeological data from this site have accumulated over the years. At the Spindrift Site, the following dates were obtained:

1270 ± 250 [A. D. 680] for decimeter 6 in dark, friable soil (Hubbs and others 1962: 235-6, sample LJ-386). This date deserves special attention and is discussed below.

4770 ± 210 [2820 B. C.] for decimeter 8 (Hubbs, Personal communication 1962, sample LJ-449).

3190 ± 200 [1240 B. C.] for decimeter 11 in the lime-indurated B horizon (Hubbs and others 1962: 235, sample LJ-385).

4650 ± 160 [2700 B. C.] "from near the junction of the upper and lower soil levels." Associated with a prone burial. (Hubbs, Personal communication 1962, sample LJ-512).

Another site within this period, althrough marginal to the coastal La Jolla development, is the Little Harbor Site on Santa Catalina Island. Little Harbor has a date of 3880 ± 250 [1930 B. C.] (Meighan 1959, sample M-434).

The terminal date of Period III is estimated at A. D. 1300. This date is tentatively set as the beginning of the effective cultural influence from the east, marked by the introduction of pottery. The date for the introduction of pottery into western San Diego County is a controversial matter. Rogers (1945: 173) would place it in the 15th century, while Meighan (1954: 221) would date the arrival of pottery in the San Luis Rey Basin "not earlier than 1500 A. D. and would not be too surprised if future investigation places pottery as late as 1600 or 1700 A. D. for the Luiseno." Wallace (1955: 226) feels these dates are too moderate and do not "allow enough time for subsequent cultural-historical developments" and would prefer a date of 1000 A. D. However, as Meighan has illustrated (1954), cultural development after the introduction of pottery in the San Luis Rey Basin is marginal to the distribution of pottery in Southern California, and pottery therefore may have been introduced somewhat earlier farther south on the San Diego Coast. The radiocarbon dates from that area tend to support Meighan's guess date.

Hubbs and others (1962: 235-6) report a C-14 date of 1270 ± 250 [A. D. 680] for sample LJ-386 from the lower part of the upper level of dark, friable soil at the Spindrift Site. This date was thought probably to approximate "the time of introduction into this section of the coast of pottery and of more refined stonework, which are here diagnostic of the Diegueño Culture." A date obtained at a later time from this site resulted in an inversion, with a sample dating from 4770 ± 210 [2820 B. C.] (sample LJ-449) from a higher level than 3190 ± 200 [1240 B. C.] (sample LJ-385). Regarding this inversion, Hubbs stated that the site was heavily eroded between the La Jolla and Diegueño occupation, resulting in the filling in of some of the erosional cuts by darker materials of a younger age. It seems that later deposition on an uneven erosion-cut surface might well have resulted in a contaminated or mixed sample, giving an erroneous age for the introduction of pottery. Further, the possibility that potsherds had been disturbed by rodent activity and moved to an older level remains a distinct possibility. Such was obviously the case at SDi-603, where potsherds were found in relatively large numbers in a level dated at 1950 B. C. One sherd was recovered from a rodent hole near the bottom of the site in a level dated at 5350 B. C. (Crabtree and others 1963).

Three other dates for pottery-bearing sites on the coast are of interest here. Sample LJ-210 for a site on the

Silver Strand, assayed at 270 ± 150 [A. D. 1680] (Hubbs and others 1962: 212). Two samples from a large rock shelter on Rancho Cuevas, between Rosarita Beach and Ponto Descanso, Baja California, resulted in an inversion. The older date of 400 ± 200 [A. D. 1550] (Hubbs and others 1960: 208, sample LJ-33), was from the second decimeter while the younger date of 70 ± 180 [A. D. 1880] was from a 5 cm. level at the bottom of the deposit, below 7 decimeters of midden. The discrepancy is unexplained.

These data suggest that pottery was present at least as early as A. D. 1560 on the Southern California coast. The Chollas Creek occupation, as noted above, covered a period of time earlier than this date. However, although the artifact inventory indicated a "culture more advanced than the La Jollan" no mention is made of pottery, and the location is not listed as a pottery-bearing site in the subject index (Hubbs and others 1960: 198-200, 208-9). A charcoal sample (LJ-103) from a midden on the Sweetwater River in Chula Vista was assayed at 760 ± 100 [A. D. 1190] (Hubbs and others 1960: 216). "Accompanying the charcoal are many crudely flaked artifacts"--but no pottery.

While not conclusive, these dates suggest that pottery was introduced earlier than A. D. 1560, later than A. D. 690, and perhaps as late as A. D. 1300. On the basis of the available data, the initial date for pottery on the San Diego Coast is tentatively placed at A. D. 1300. This date is

taken to mark the end of Period III and the beginning of Period IV, which continues until historic times and the disappearance of the aboriginal culture on the San Diego Coast.

Cultural Stages

Each period is characterized by one or more cultural stages. Each stage has been given a descriptive name indicating the economic orientation. These stages are Adaptive Collecting, Incipient Maritime, Maritime, and Land Resource Collecting. In the following discussion, the cultural sequence is taken up to the period of European contact and extended to Santa Catalina Island during Period III, thus taking in both the Yuman Culture and the Little Harbor Maritime development. It is felt that in both cases the economic activities may be seen as a development out of the La Jolla Complex (or at least a very similar one, in the case of Little Harbor). Little Harbor and the Yuman Culture represent culture change in different directions from a common cultural base, and as such are valuable in illustrating the application and limitations of the theoretical model presented here above.

Two cultural stages may be outlined for Period II, Adaptive Collecting and Incipient Maritime. The first, Adaptive Collecting, is largely hypothetical and undocumented. This stage represents the earliest La Jolla occupation on the San Diego Coast. Presumably this was a small population which had moved to the coast from the interior.

Between circa 6000 and 5500 B. C., this population was adapting to the resources of the coast which would later allow for a cultural florescence and population increase. Presumably the vegetation provided a greater range of vegetable resources, with a wider distribution of oak and pine, though grasses, chaparral and coastal sage scrub were all presumably fairly widespread. The coastline presented a rocky foreshore, was wrinkled by finger-like bays at the mouths of rivers and streams, and supported a plentiful supply of both rocky foreshore and bay molluscs.

The Adaptive Collecting stage may be recognized in the earliest levels of SDi-603 (Crabtree and others 1963), the Scripps Estates Site (Moriarty and others 1959; Shumway and others 1961), and perhaps in the Sorrento Site (Harding 1951), where relatively few shells are present. The paucity of shells may reflect either or both a small population and the incomplete use of the shellfish supply.

In this stage, the artifact inventory is small and virtually indistinguishable from the major part of the assemblage from the next stage. One possible diagnostic artifact type may be suggested for this stage. At SDi-213 on Batiquitos Lagoon, 3 large knives were recovered that resemble those from the San Dieguito component at the C. W. Harris Site (Warren and others 1961; Warren and True 1961; Crabtree and others 1963). These differ from the San Dieguito knives in one important characteristic. The Batiquitos knives are

very crudely percussion flaked, while the San Dieguito knives exhibit an extremely well-controlled percussion technique. The Jimmy Site (SDi-319), on the San Dieguito River near the C. W. Harris Site, presents a similar picture. Here there appears to be a mixing of San Dieguito and La Jolla traits, with both well made knives and scrapers, similar to those of the San Dieguito Complex, and cruder scrapers, manos, a metate and crude hammerstones reminiscent of the La Jolla tools (Warren and others 1961). Unfortunately, the assemblage from the Jimmy Site is a very small surface collection and may represent a mixing of artifacts from different periods in time.

These data, though severely limited, suggest the possibility of contact between the initial La Jolla population and the earlier San Dieguito, and may thus account for the large knives from SDi-213 and also for the small domed scrapers found in small numbers in the La Jolla occupation throughout Period II. The most characteristic tools of even the earliest La Jolla occupation as we now know it, are the crudely percussion flaked cobble bifaces and unifaces, scraper planes, large primary flake scrapers and the mano and metate. These traits clearly distinguish it from the San Dieguito Complex and make it virtually indistinguishable in terms of tool types from the (following) Incipient Maritime stage of the La Jolla Complex.

Burials in the Adaptive Collecting stage are rarely found. Some of those reported from the Scripps Estates Site may date from this period, but this cannot be illustrated at the present time. One of two burials from SDi-603 was clearly from the earliest occupation of that site, being placed in a pit in the subsoil below the midden. The outline of the pit was unclear, but it contained none of the darker midden and quantities of shell that marked the Incipient Maritime stage at that site, clear indication that the burial was derived from the earliest occupation. This burial was flexed on its left side, with the head oriented toward the north.

Faunal remains from the Adaptive Collecting stage are not numerous. Shellfish are primarily those of the rocky foreshore, and mammalian remains are extremely rare, with rabbit and/or hare, and deer and/or antelope and possibly larger rodents such as the wood rat, being represented. The settlement pattern for this stage is unknown, since only a few sites representative of this stage have been recognized.

The Adaptive Collecting stage probably was to be found along all of the San Diego Coast between 6000 and 5500 B. C. Although impossible to illustrate at this time, it seems reasonable to assume that all along the coast people were beginning to adapt the collecting economy to the shellfish resources of the coast. By about 5500 B. C., this adaptation was sufficiently complete to allow for a recognizable

settlement pattern oriented toward the lagoons, embayments, and productive areas of the open beach, for an upward trend in population, and some cultural elaboration.

The Incipient Maritime stage is clearly present in the greater portion of the Scripps Estates Site, and in portions of the Sorrento Site and SDi-603. In addition to these dated sites, a number of others also appear to represent this stage of cultural development. These are the Gonzales Site (SDi-687) and the Wilson Site (SDi-194) on the lower San Dieguito River, and SDi-532, farther inland near the Black Mountain Volcanics, on the San Dieguito River; also site UCLJ-M1 in La Jolla, Black's Site just north of La Jolla, and SDi-213 on Batiquitos Lagoon.

The Incipient Maritime stage began circa 5500 B. C. and continued until some time after 4300 B. C. The terminal date for the stage may vary from area to area and appears to be dependent on changes in the local plant cover and shoreline. It is characterized by maximum use of marine resources during the La Jolla occupation of the coast, as reflected in the relatively large amount of shell present in the middens.

The artifact assemblage is characterized by the continued use of small domed scrapers and very rare occurrence of leaf-shaped points and knives. Spire-lopped olivella are first reported during this stage, as are disc clamshell beads, an occasional stone pendant, discoidal-shaped and doughnut-

shaped stones. Artifacts such as manos, metates, and a whole range of large, crude scraping, chopping and hammering tools increases in number, apparently reflecting an increase in population. Most of the La Jolla burials known are reported from this stage and the flexed position with northerly orientation of the head persists from the earlier stage.

In the Torrey Pines Mesa--Sorrento Valley area, this stage may have persisted until about 3000 to 2500 B. C. During the latter part of the stage, notched points may occur and points and knives become more numerous though still rare. The Sorrento Site yielded a small number of notched points in the uppermost "layer" of the site, and a smaller number of leaf-shaped points occurred somewhat earlier (Harding 1951). The radiocarbon date of 6950 ± 350 [5000 B. C.] from this site applies to the 18 to 24 inch level (Crane and Griffin 1958) and presumably is earlier than the points.

A single "spearpoint" was recovered in a column sample taken from the Torrey Pines Grade Site. The point was found in decimeter 5, and a shell sample from that decimeter was dated at 4970 ± 200 [3020 B. C.] (Hubbs and others 1962: 229-30, sample LJ-274). Shells from the same midden gave dates of 4840 ± 200 [2890 B. C.] for decimeter 2 (sample LJ-276), and 4740 ± 200 [2790 B. C.] for decimeter 7 at the base of the midden (sample LJ-277). A single projectile point from a column sample is not unusual in itself, but the almost complete lack of points known for La Jolla sites prior to

3500 B. C. makes such a discovery highly improbable unless points had become more numerous after that time.

At the Scripps Estates Site, the latest radiocarbon date was 5460 ± 100 [3510 B. C.] and a terminal date of 3000 B. C. was estimated for the site (Shumway and others 1961). Only one leaf-shaped point was believed to belong to this artifact assemblage. Site UCLJ-M1, now considered a continuation of the Scripps Estates Site, has a lower portion of the midden dated at 6370 ± 210 [4420 B. C.] (Hubbs and others 1962: 217, sample LJ-225). Five points have been recovered from this site, and all were found in the disturbed upper soil (Shumway and others 1961: 94).

No points were found at SDi-603 between circa 4300 B.C. and some time after 1900 B. C. (Crabtree and others 1963). This may be explained by the pronounced decrease in population inferred from rate of shell accumulation (Warren and Pavesic 1963). Apparently the site was occupied only seasonally, for short periods of time, and artifact yield was very small for this time period. Sometime after 1900 B. C., projectile points and/or knives appear in greater numbers than at any time earlier in the history of the site.

Knives and points also occur in surface collections from various sites on Batiquitos Lagoon. However, they are few in number and most cannot be placed chronologically except where pottery occurs on the site. Only two notched points were noted in over 1000 artifacts from the lagoon

area. One was from SDi-213, a large La Jolla site which may have been occupied fairly early and for a considerable period of time. The second was from SDi-608, which yielded a very small surface collection.

The terminal date of 3000 B. C. for the Scripps Estates Site, the apparent increase in points, and the introduction of notched points shortly after at the Sorrento Site, suggest that a terminal date of circa 3000 B. C. might be assigned to the Incipient Maritime stage in the Torrey Pines Mesa and Sorrento Valley areas. The decrease in rate of shell accumulation at SDi-603 on Batiquitos Lagoon beginning about 4250 B. C. and the lack of points and general scarcity of artifacts until sometime after 1900 B. C., suggest that the population on Batiquitos Lagoon decreased somewhat earlier or at a more rapid rate than in the regions of Torrey Pines Mesa and the Sorrento Valley. On this basis, it appears that the Incipient Maritime stage ended at Batiquitos Lagoon about 4000 B. C. Farther south, at San Diego and Mission bays, the Incipient Maritime stage may have persisted for a considerably longer period. The information for that area, however, is not available at this time.

In Period II, in addition to radiocarbon-dated sites with large artifact assemblages, there are dated sites yielding but a few artifacts, and there are sites with relatively large and interesting inventories but as yet lacking C-14 dates. The former are useful in study of settlement

patterns and have been used in that way. However, most sites that have not been dated either by C-14 or pottery have not been considered in the following discussion. The exceptions are the Gonzales Site and the Wilson Site on the lower San Dieguito River. Both have yielded large surface collections, and the Wilson Site has been tested (Warren and others 1961; Warren and Crabtree, MS 1962). The Wilson Site has not produced any projectile points, and their absence suggests a date earlier than 3000 B. C. This is further supported by the presence of small domed scrapers, which apparently become less common after 4000 B. C. This site was also extensively eroded, with a shallow midden remnant found in a small portion while a much greater eroded area exhibited a surface littered with artifacts and broken rock. The extensive erosion also supports a date of considerable antiquity. The Gonzales Site is a large one, with a midden extending to a depth of at least 3 feet and containing a considerable quantity of shellfish remains. The artifacts from the surface collection here included 4 leaf-shaped points and knives, and 8 small domed scrapers, suggesting an occupation ending about 3000 B. C.

Black's Site on Torrey Pines Mesa is discussed by Carter (1957: 209-14), who illustrates a number of small domed scrapers that are not numerous but certainly typical of the early La Jolla occupation at SDi-603 on Batiquitos Lagoon and of the Scripps Estates Site, which is only a

short distance from Black's Site. The other artifacts illustrated by Carter are the crude cutting, scraping, chopping implements typical of the La Jolla occupation. Other artifacts described by Carter for the site included manos and metates and crude, bifacially flaked leaf-shaped knives. All suggest an occupation earlier than 3000 B. C.

Site SDi-213 on Batiquitos Lagoon has produced a large number of artifacts from surface collection and limited testing, all suggesting an occupation covering a considerable period of time. A notched point, several large, crude "San Dieguito" type knives, and a number of small domed scrapers were recovered, possibly indicating development from the Adaptive Collecting stage through the Incipient Maritime stage. Other artifacts from this site include a wide range of crude scraping, cutting and chopping tools, abundant manos and metates, and a discoidal of vesicular basalt. SDi-213 is also fairly heavily eroded, with a rather large portion of the midden apparently washed away, again suggesting considerable age.

Briefly then, the Incipient Maritime stage begins about 5500 B. C. and continues until about 4000 B. C. at Batiquitos Lagoon, 3000 B. C. st Sorrento Valley and Torrey Pines Mesa, and probably considerably later at San Diego and Mission bays. The characteristic La Jolla inventory such as manos and metates, crude chopping, scraping and cutting tools, is found in large quantity, and in addition

stone discoidals, spire-lopped olivella and disc clamshell beads are first reported. Toward the end of the stage at Sorrento Valley, ca. 3000 B. C., leaf-shaped points and/or knives increase in number and later still, notched points occur. Small domed scrapers are found throughout this stage and may be considered typical. The sites are usually marked by an abundance of shellfish remains, and burials occur in greater numbers at this time. The Scripps Estates Site, UCLJ-M1, Black's Site, and a site on the U. S. Department of Agriculture Horticultural Station on Torrey Pines Mesa (Hubbs and others 1962: 230) and SDi-203 on Batiquitos Lagoon, all have produced burials from this stage totaling over 50 individuals. This seems to represent a period of heavy population and relative cultural elaboration.

The economic pattern for the Incipient Maritime stage can be outlined in some detail because a large number of tools and some faunal remains have been analyzed. Metates and cores have been omitted from the assemblages in determining the relative percentage of the various tools. Metates are more often fragmentary than not, which makes it impossible to arrive at a reliable number of metates for a site. Cores which have not functionedas tools do not reflect the economic activities other than tool manufacture, and are therefore omitted.

The following sites have been used in determining the relative percentage of tools: SDi-603, -213 on Batiquitos Lagoon; SDi-687, -194 on the San Dieguito River; and the Scripps Estates Site (SDi-525), in part, at La Jolla. The only tabulation of artifacts for the Scripps Estates Site is comprised of only 158 artifacts (Warren, in Moriarty and others 1959). The remaining calculations are based on Crabtree and others (1963) for the Batiquitos Lagoon sites, and Warren and others (1961) and Warren and Crabtree (MS) for the San Dieguito River sites.

The crude workmanship and multiple function of many of the La Jolla tools makes a functional analysis of many of the tools a difficult undertaking. The seed grinding implements, and the projectile points clearly indicate seed grinding and hunting activities. These activities certainly do not appear to be of equal importance. Manos comprise between 15 and 30 percent of the assemblages, while knives and projectile points make up less than 3 percent. Manos and projectiles (including knives) cannot be weighed equally in the comparison made above. Although there are no data available on the length of time a projectile or mano is used, logically manos would be useful for a greater length of time than projectiles. The projectiles are more delicate tools and are often made on more brittle cryptocrystalline materials than manos made on only slightly modified cobbles, most often of tough,

granitic material. Manos also appear to wear out only rarely; they apparently were "resharpened" by pecking the surface of the grinding area. Although often found in fragmentary condition, complete manos appear to be more common than broken ones (Warren and others 1961: 35-54). On the other hand, projectiles are seldom if ever worn out, but frequently are broken. Well over half of the projectiles are fragmentary (Warren and others 1961: 20). Finally, one or two manos are all that would be required per person for seed grinding, while one or two projectiles is scarcely sufficient for a hunter. Therefore, if both hunting and seed grinding were of equal importance to the economy, projectile points and knives should be more common than manos. In La Jolla assemblages of this period, manos far outnumber knives and projectiles, suggesting a strong focus on collecting activities.

The majority of the remaining artifacts fall in what has been termed the "hammerstone complex" by Crabtree and others (1963). They have illustrated that while the "types" of cobble unifaces and biface tools, angular choppers, scraper planes, certain scrapers and cores may originally have been made in a distinct form, they all are used in various ways and through use as hammers and choppers, tend to develop into "hammerstones." The tools that most often developed into hammerstones were the cortex-backed and cortex-based scrapers, and the cobble uniface and bi-

face tools. These categories of artifacts (excluding hammerstones) make up between 10 and 35 percent of the tool assemblages. The multiple use of these tools in scraping, chopping and cutting makes their function, in terms of the economy, difficult if not impossible to determine (Fig. 2).

There are some characteristics of these tools that would suggest certain kinds of use. Some (cobble unifaces, scraper planes, cortex-based and cortex-backed scrapers) are unifacially flaked and when unbattered, have a sharp and often well-trimmed edge, suggesting their use as scrapers. The cobble biface is bifacially flaked with a more sinuous edge, suggesting a chopping or crude cutting tool. The most common indication of use on all types however is battering. This battering is present in varying degrees in a continuum from these scrapers and choppers into various forms of hammerstones.

Grinding wear is the second pattern of use found on these tools. This rarely occurs on the thinner type of scrapers, but is present on the edges of some cobble unifaces and bifaces, and most commonly on the scraper planes. It is even occasionally found on flakes exhibiting no other modification. This wear surface on the cobble unifaces, bifaces, and thin scrapers and flakes takes the form of a narrow facet on a sharp edge. The same wear pattern is found on the leading edge of the scraper planes, but is

more often and more pronounced on the trailing edge. The precise use which brought about this wear has not been determined. However, it is clear that these tools were not specialized chopping, scraping or cutting tools, as might be assumed from a formal description. They give the impression of having been used in processing that required scraping, cutting and chopping of a hard and/or abrasive material, or in conjunction with a hard and abrasive nether stone.

For example, scraper planes are generally prepared from a large, thick flake by unifacial percussion flaking at a steep angle. The "sharp" working edge thus prepared is sometimes battered and ground as if some material was prepared by scraping and light pounding on a hard and abrasive platform, such as a nether stone. This same process may have been undertaken with a cobble uniface or with a combination of scraper and "hammerstone." This process would appear to be applicable in the preparation of plant food such as roots or meaty seeds, or perhaps shellfish, but is not well adapted to the butchering of animals and preparation of animal foods.

Another function of certain of these tools was undoubtedly the production of other tools. The hammerstones were probably used in the production of flaked stone tools. The battered cobble uniface and biface tools as well as the battered sharp angle core hammers and angular choppers could

have been used in the production of metates and in roughening the grinding surface of manos. Some of the hammerstones which show grinding facets, called "hammer-grinders" by Warren and others (1961), would be especially well adapted to manufacturing metates from the soft sandstone material commonly used for grinding slabs. These hammerstones exhibit both battering and grinding which could result from the production of metates.

Thus, the majority of the tools found in La Jolla sites belong to an unspecialized, multi-purpose category, appearing to have been used in the processing of plant foods and in the production of other tools.

Tools that might be ascribed to hunting or preparing of animal foods are relatively few, making up less than 6 percent of the assemblage. These include: projectile points, knives, and a variety of small, well-made scrapers. The points are "intermediate" in size, probably used as dart tips, but of a size that could also function as arrow tips (ca. 2.5 to 5.0 cm. long and 1.5 to 2.5 cm. wide). Most are fragmentary and size and weight ranges of complete specimens cannot be considered representative. The workmanship varies from extremely crude, "chunky" specimens to those with well-controlled pressure flaking. The well made specimens are most commonly made of chalcedony or jasper, materials not common to the area. The cruder specimens are often of quartz or felsite, abundant locally.

Points and knives are nearly all leaf-shaped (Fig. 3, a-c, e-f), although notched and stemmed points (Fig. 3, g-j) may appear near the end of the Incipient Maritime stage at Sorrento Valley and Torrey Pines Mesa. They were almost certainly introduced after that stage at Batiquitos Lagoon. Knives are always leaf-shaped, with either parallel edges (Fig. 3b) or edges that taper gradually toward the tip from a rounded or straight base (Fig. 3a, c). The workmanship here again exhibits a wide range of control, from very crude percussion flaking to well-controlled pressure flaking. Again, the crude specimens are made of local quartz and felsite, while the well made ones are most often of foreign cryptocrystallines.

The range in both form and workmanship together with the small number of tools, suggests that no well established pattern for point and knife types existed, perhaps due to a lack of interest in or necessity for their production.

The small scrapers are almost always made from felsite or fine-grained basalt, but occasionally from cryptocrystalline materials. These tools are manufactured by a well-controlled pressure and/or percussion technique, and are less variable in type than the points. They are most often oval in outline, with plano-convex cross section. The planar surface may or may not exhibit a bulb of percussion and the working edge may vary from one-fourth to the whole periphery. The working edge is sharp and forms

a small, even curve, occasionally showing some indication of wear (Fig. 3d).

The limited number of hunting tools may be somewhat misleading with regard to the importance of hunting, however. As noted earlier, the use of fire in hunting was important to historic peoples on the San Diego Coast, and presumably is a technique which had considerable time depth. Costanso also mentions the throwing stick among historic Indians of the San Diego Coast, and stresses its importance: ". . . . they use a sort of throwing-stick of very hard wood, similar in form to a short curved sabre which they throw edgewise, cutting the air with great force. They throw it farther than a stone, and never go into the surrounding country without it. When they see a snake, or other noxious animal, they throw the throwing stick at it, and generally cut the animal in two" (van Hement-Engert and Teggart 1910: 121).

Such tools may also have been used by the La Jolla peoples, but no indication of them is to be found in the archaeological record. However, the tool assemblage of La Jolla sites appears to indicate that hunting was of relatively little importance, even if certain adjustments are made for perishable items.

Fishing gear is virtually absent. No fishhooks or harpoons have been recovered. The only probable fishing tools are: one girdled net weight (Hubbs, Personal com-

munication 1964); small, conical bone points, of which so far only fragmentary specimens have been recovered; and small, doughnut-shaped stones. The bone points are represented by only tip fragments generally measuring not more than three-quarters of an inch long. These points could have functioned as fish gorges, or equally well as dart or arrow points, or awls. The perforated stones may have served as net sinkers, ornaments, possibly as digging stick weights. This artifact "type" is found throughout the Southern California Coast and offshore islands and varies in size and shape. Most often they are roughly doughnut-shaped, but range to a cylindrical form. They vary in size from about 2.5 cm. to 10.0 cm. in diameter. The larger ones sometimes have battering over one half of the surface, perhaps resulting from use as a digging stick weight (McKusick and Warren 1959: 145).

Specimens that unquestionably date from the Incipient Maritime stage number only two. These were both recovered at the Scripps Estates Site (Moriarty and others 1959: 205), and their small size and lack of battering suggest use as ornaments or net weights rather than as digging stick weights.

Bone points and doughnut-shaped stones occur in small numbers and make up less than 2 percent of the artifact inventory during this stage. In short, the hunting-fishing set is poorly represented in the Incipient Maritime stage

of the La Jolla Complex. A strong emphasis is suggested on collecting activities. The importance of manos in relation to the amount of hunting and fishing gear is most indicative. The large portion of the assemblage composed of crudely made multi-use tools, is difficult to evaluate, but appears to be more readily adapted to processing of vegetable foods and perhaps shellfish than to the preparation of animal foods such as land mammals. The tool assemblage thus suggests a collecting focus with less emphasis placed on the hunting-fishing set. This analysis is also generally supported by the floral and faunal remains reported from La Jolla sites.

Preservation of plant remains in the open La Jolla sites is exceedingly rare; such remains have been found in only two instances. At the C. W. Harris Site (Warren and True 1961), in a "hearth" or "earth oven" dated at 6300 ± 200 [4350 B. C.] , some charred seeds were recovered. These seeds were examined by Dr. Mathias of the Botany Department at University of California, Los Angeles, and identified as piñon and Malvaceae. However, their carbonized condition prevented sectioning and more detailed identification. At the Scripps Estates Site, Hubbs has recently recovered some cores of charred pine cones. However, at present, further information regarding the date of these remains is not available (Hubbs, Personal communication 1964).

Faunal remains that represent gathering activities are the most plentiful type in the middens along the shorelines. These are the shellfish remains found in all La Jolla sites located in close proximity to the present shoreline or those of the ancient lagoons. Where analysis of shell has been completed, an interesting picture is presented. At the Scripps Estates Site, the proportion of major species showed a remarkable consistency: "Among the molluscs, those from the rocky foreshore constituted about eight tenths of the total shell, the mussels alone amounting to about two thirds to three fifths of the grand total shell content. The sand beach molluscs contributed hardly more than an inconsequential amount. The bay molluscs contributed about 6 to 16 per cent, with an indication of a drop in relative quantity with time" (Shumway and others 1961: 102).

The importance of molluscs from the rocky foreshore and from the bay is also noted at Batiquitos Lagoon (Warren and Pavesic 1963). At SDi-603 on Batiquitos Lagoon, there is a shift from the molluscs of the rocky foreshore to bay-dwelling shellfish. The California mussel makes up about 62 percent of the total weight of shellfish remains in the early period, ca. 5300 B. C., while Chione and Pecten comprise about 18 percent. Chione and Pecten gradually increase in importance while the mussel decreases. By ca. 4300 B. C., they are all roughly equal in weight, varying between 22 and 32 percent. In the terminal phase of the

site, ca. A. D. 1000, the mussel makes up only 11 percent of the shell, while Chione and Pecten, in almost equal weight, total about 75 percent of the sample.

At Batiquitos Lagoon, the shell made up between 0.2 and 13.8 percent of the midden by weight, with an average of 4.1 percent for the Incipient Maritime stage. Bone of all kinds seldom exceeded more than a trace in the column samples analyzed at Batiquitos Lagoon. Bones were recovered during excavation and though rare, included rabbit, hare, deer and/or antelope, fish, and possibly some birds. Sea mammals are apparently absent. The occurrence of vertebrate remains at Scripps Estates Site is similar:

> Vertebrate remains (other than human) constitute a very small proportion of the midden material, ... The bird and mammal bones, largely fragmentary, have not been identified. Conspicuously lacking are remains of pinnipeds, sea otters (Enhydra lutris), and cetaceans such as occur (often plentifully) in some younger middens along the coasts of southern California and Baja California. Nor have any traces been found of large pelagic fishes such as sword fish (Xiphigs gladius) and tunas (Thunnidae), that are well represented in some of the other sites (Shumway and others 1961: 103-4).

The fish remains from Scripps Estates Site (Shumway and others 1961: 104-6) include sheephead (Pimelometopon pulchrum), spotfin croakers (Roncador stearnsii), white croakers (Genyonemus lineatus), a species of rockfish (probably Sebastodes miniatus) and a small shark (not further identified). From the size and species of these fish, it is believed that fishing was done along the shore, probably in several habitats, and that rafts or boats were used to some extent in deeper water. Further, Shumway and others state (1961: 104): "The rockfish probably was not taken by spear or by poison. Either hooks or gill nets might have been used. Among the relatively few fish vertebrae that have been found in the A soil horizon and the upper part of B, are a number that came from fish so small as to suggest capture in tide pools along the rocky foreshore, by poisoning or by hand capture, perhaps facilitated by bailing out the water."

This brief resume of the available data seems to support the conclusion that the La Jolla economic pattern was directed toward collecting activities and that hunting of sea and land mammals and fishing were secondary economic activities. The faunal remains thus support the pattern indicated by the tool assemblage.

The settlement pattern of the La Jolla peoples would seem to support further this economic pattern for the Incipient Maritime stage. The available data on settlement

patterns is incomplete, with rather large ecological zones almost completely unsurveyed. Furthermore, the chronological placement of the vast majority of the sites remains unknown. However, if we consider the settlement pattern for the La Jolla Complex as a whole, a certain picture evolves which is probably most applicable to the Incipient Maritime stage.

The most intensive archaeological surveys have been carried out along the coastal lagoons and wide, aggraded river valleys found along the coast. Sites are numerous around these "ancient bays;" for example, 40 sites have been recorded on or near Batiquitos Lagoon. These sites are generally located on old terraces and mesas surrounding the lagoon, only 3 being located at less than 20 feet above the level of the lagoon. Midden composition varies considerably, with midden marked by dark "organic soil" containing large quantities of shell found most often toward the mouth of the lagoon, where sources of water are or were available in the past. Toward the rear of the lagoon, the shell remains appear to be less numerous, at least at the surface, and the soil of the middens is generally less altered by organic material, though usually located near water sources.

A number of sites on Batiquitos Lagoon do not contain either the quantity of shell or the dark colored soil modified by organic material that mark well developed middens.

They are distinguished primarily by a scattering of artifacts over a slightly modified or unmodified soil. These are generally back from the margins of the lagoon, on knolls not associated with visible water sources. One large site, SDi-763, on Batiquitos Lagoon, is exceptional in that it is found on a high mesa near the rear of the lagoon. It has a shell concentration comparable to the large sites near the front of the lagoon, but is not situated near any apparent fresh water source.

The San Dieguito River presents a similar picture of the settlement patterns. Two sites are large, with well developed middens--SDi-191 (the Del Mar Site), and SDi-687. Both are located at relatively low elevations, less than 50 feet above the valley floor. A number of small sites and one large site (SDi-194) are found along the mesa to the south of the valley, and only the large Wilson Site (SDi-194) has any midden development. Both of the lower well-developed middens are located near former water courses, while no water sources are apparent in the vicinity of the sites at higher elevation.

The Sorrento Valley, though less well surveyed, presents the same pattern. The larger sites with well developed middens, are located near sources of fresh water such as small streams. Smaller sites, apparently not as intensively occupied, are located at other points along the lagoons and adjacent hills.

One area away from the lagoons and coast has been extensively surveyed, the Buena Vista Watershed (W. J. Wallace 1960). This area is roughly 7 miles long and 2-1/2 miles wide, ranging from 120 to 1363 feet above sea level. The El Salto Narrows, where Buena Vista Creek drops abruptly over a vertical fall, marks the western boundary of this area, about 2-1/2 miles inland from Buena Vista Lagoon.

Wallace (1960: 287) described both the Pauma Complex and the La Jolla Complex for the Buena Vista Watershed. Later studies of the two complexes (Warren and others 1961) do not support this division of the Buena Vista sites. Wallace states that the Buena Vista sites did not produce any projectile points or blades, and comparatively few crudely chipped stone tools. Without these traits, these sites would now appear to represent La Jolla rather than the Pauma Complex. The 8 sites Wallace thought to be Pauma sites are located on exposed knolls or low hills without regard to modern water supplies. They "contain no shell, animal bones or other camp debris and the soil is not discolored" (1960: 287).

Five watershed sites were designated as La Jolla by Wallace (1960: 287-8). These sites have a soil darkened by occupation and in most cases containing marine shell. Interestingly, the La Jolla assemblage is characterized by "handstones, milling stones and half cobble tools,"

and the Pauma assemblage by "seed grinding implements and cobble hammers." A distinction in tool assemblage obviously cannot be made. It therefore appears more appropriate to consider all of the so-called "Pauma" sites in the Buena Vista Watershed as belonging to the La Jolla Complex.

Without further investigation of settlement patterns, it appears that these "La Jolla" sites in the Buena Vista Watershed represent the more permanent sites, while the so-called "Pauma" sites are camp sites associated with certain economic activities. If this is so, then permanent sites away from the lagoons and coasts are rare and temporary camping sites are relatively more numerous. This pattern has been noted by the author in a brief and very limited survey on the higher elevations between Batiquitos and San Elijo Lagoons. Here, two sites tentatively identified as La Jolla were located, but neither exhibit midden development and the majority if not all of the cultural remains were to be found on the surface.

Another area of rather intensive La Jolla occupation is Torrey Pines Mesa, where approximately 12 sites are known (Moriarty and others 1959, Map 1). A few of these sites have been tested and a few have been given radiocarbon dates. Torrey Pines Mesa is the northern "triangular" projection of the Mesa Complex, which includes Kearney and Linda Vista mesas farther to the south and east. Torrey Pines Mesa is bordered on the west by the Pacific Ocean and

on the north and east by the Sorrento Slough. While this area cannot be considered a far distance from either the ocean or the slough, it lies 300 to 400 feet above sea level and its borders are steep cliffs. Approaches to it are difficult, except perhaps through some of the erosional valleys, suggesting that peoples depending to any considerable extent on shellfish would not occupy the mesa top unless other resources on the mesa made such occupation desirable. It seems obvious that the Torrey Pines, now a "relictual forest" on the coast, may well have provided that resource during the time of La Jolla occupation.

Farther south, on the western edge of Torrey Pines Mesa, the Scripps Estates Site, UCLJ-M1, the Scripps Parking Lot Site, and the Spindrift Site at a lower elevation, may have been associated with a relatively small and less well-developed bay that existed, during a period of lower sea level, where the La Jolla embayment is now located. A stand of pines may well have existed along the mesa top which would encourage human occupation of the area.

The settlement pattern as we now know it appears to suggest a concentration of peoples where either shellfish or plant foods were most readily available. Virtually every location examined along the shores of the ancient coastal "bays" where fresh water is or was available, has yielded a La Jolla site. The bay and rocky foreshore molluscs served as a basic food resource for the La Jolla

population. This food resource required little in the way of tools for gathering or for preparation, and the tool assemblage itself therefore lacks indication of the importance of this economic activity. The settlement pattern and the midden refuse, however, clearly illustrate its importance.

The emphasis on seed collecting, on the other hand, is clearly indicated by the relatively large numbers of manos in the La Jolla tool assemblage. Indications of the importance of such activities are rarely preserved in the refuse of middens. However, again there is sufficient evidence from settlement patterns in terms of site locations, to suggest that individuals and groups spent considerable time in temporary camps gathering and preparing seeds, especially on Torrey Pines Mesa, where presumably the piñon nuts were available in some quantity. These collecting activities clearly overshadow the hunting-fishing set, which is represented by fewer tools in the assemblage and fewer faunal remains in the midden.

In terms of settlement patterns, fishing appears to be of some importance, since so many sites are found along the bays and coast. However, the virtual lack of specialized fishing equipment strongly suggests that it was the mollusca and not the fish that were the attraction of the coast. Hunting equipment is meager in the middens, and the few point forms and their generally crude manufacture suggest lack of a developed pattern and relative little

importance to the economy.

It is clear from the analysis of these data, that the focus of the La Jolla Incipient Maritime development lay within the collecting set and that the collecting of shoreline produce as well as pine nuts and grass seeds, were all important economic poses. Hunting and fishing were relatively unimportant in any ecological zone thus far included in the investigation of the Incipient Maritime stage.

A reconstruction of the social organization must be based primarily on settlement patterns which, as noted above, cannot be controlled temporally and must be considered as a somewhat more general statement for much of the La Jolla Complex in general. However, it would appear that the interpretations made probably apply more closely to the Incipient Maritime stage than to any other.

In the review of the economic pattern above, it was illustrated that the heaviest population density was probably situated around the ancient bays that have since been aggraded until they form shallow lagoons and sloughs wrinkling the San Diego Coast. The larger sites, with midden up to 54 inches deep, were undoubtedly permanent sites in that they were occupied at least seasonally over a long period of time. Several such sites have a series of radiocarbon dates and represent several thousands of years of occupation (Hubbs and others 1960, 1962). It seems likely that during the Incipient Maritime stage, such sites were

occupied most of the year by most of the group, and perhaps all of the year by some. These sites with well-developed middens are found most often in close proximity to the shores of ancient bays. There are exceptions, especially on Torrey Pines Mesa, where sites are known to have been occupied for several centuries and exhibit well-developed middens. Most of these, however, also contain plentiful quantity of shellfish remains. Other exceptions probably occurred along the open coast in localities where rock-dwelling shellfish were abundant.

It appears that a population concentration was to be found where local plant and shoreline resources could be gathered in quantity. These localities as we now know them were most often around the lagoons, where the shellfish, fresh water and plant foods were all near at hand. Torrey Pines Mesa may present a somewhat different picture, due to the resources of the pine forest in relatively close proximity to both the ocean and the Sorrento Slough. The concentration of population around the lagoons plus the deep middens (up to 4 feet) representing respectable periods of time, suggest that a group or groups of people occupied the shores of each lagoon and utilized the surrounding hills and nearby interior to a greater or lesser extent, depending on the resources of those "marginal" areas.

Population movements up and down the coast do not appear to have been great. Warren and Crabtree (MS 1962), after analyzing collections from the lower San Dieguito River and Batiquitos Lagoon, concluded that the differences in tool assemblages and material sources for the tools are as pronounced as the temporal differences for Batiquitos Lagoon, but no more so. They further state:

> The apparent cultural conservatism expressed in both the slight areal and temporal differences in tool assemblages may indicate that those features that made the lagoons the population centers also made for a 'semisedentary' population which moved about within the limits set by the accessibility of the lagoon, the fresh water that fed into the lagoon, and their related food supplies . . . . It appears that one might postulate a series of relatively small 'semisedentary' populations centered around the lagoons and bays on the coast, and moving no great distance from the lagoons. Contact with peoples from any great distance would not be extensive, and peoples on the various bays and lagoons may have been developing along slightly divergent lines (MS 1962: 17).

The larger sites located on Batiquitos Lagoon are as much as one-quarter mile long and several hundred feet wide, extending along the margin of the terrace or mesa. These sites are also as much as 54 inches deep, and suggest a considerable population. Excavations on two large sites have not produced any structural remains (Crabtree and others 1963). However, a considerable number of "stone features" consisting of broken stone and artifacts, sometimes associated with charcoal, may be interpreted as hearths and roasting platforms. If each of these may be assumed to be the hearth for a "family" living area, then the settlement pattern within these sites might be roughly reconstructed.

To date, however, no site has been excavated in a manner that would clearly reveal any pattern to these hearths. SDi-603 (Crabtree and others 1963) has been more thoroughly excavated than other La Jolla sites. At this site, a combination of checker-boarding and trenching was used, and a rather large number of "hearths" was uncovered. No visible pattern was noted to their arrangement, other than that the majority did occur within the strata representing the Incipient Maritime stage. It appears that these hearths were randomly scattered and that if they are representative of the living areas of the "families," then there is no set arrangement to the La Jolla villages.

In light of this lack of pattern, then the large area covered by the sites may be somewhat misleading. The individual family may have been quite mobile, at least part of the year, moving to different temporary camps to gather foods as they came into season, and returning to the "base" camp during the greater portion of the year. However, upon returning to the base camp, they may not have gone back to their previous dwelling area, thus causing the site to cover a greater area than it would if there were a more restricted settlement pattern. The hypothesis of loosely organized residence pattern is also supported by the relatively slow rate of vertical midden accumulation (54 inches in ca. 6500 years at SDi-603).

The community pattern of the La Jolla Complex may, by the process of elimination, be limited to two types: Restricted Wandering or Central Based Wandering. Restricted Wandering is defined as (Beardsley and others 1956: 136): "Communities that wander about within a territory that they define as theirs and defend against trespass, or on which they have exclusive rights to food resources of certain kinds. Movement within the territory may be erratic or may follow a seasonal round, depending on the kind of wild food resources utilized." Central Based Wanderers are (Beardsley and others 1956: 138): "A community that spends part of each year wandering and the rest at a settlement or 'central base', to which it may or may not consistently return in subsequent years."

Examination of the economic aspects and archaeological criteria for each of the community patternings allows an argument to be made for a Central Based Wandering pattern for the Incipient Maritime stage of the La Jolla development. Pertinent points in this argument are that the Restricted Wandering Community and the Central Based Wandering both have economies based on hunting, fishing and collecting. In both patterns, community mobility is required by the seasonal nature of the food supply, and by the low productivity of the territory in any one locale for the Restricted Wandering community. The significant differences are that among Central Based Wandering communities, food surpluses are accumulated for winter or rainy seasons when food resources are not abundant, or there is a locally abundant food supply available for most if not all of the year. The Restricted Wandering communities lack both of these (Beardsley and others 1956: 136-9). The Central Based Wandering community "represents an adjustment to one of three different types of subsistence resources: 1) a storable or preservable wild food harvest, such as acorns or mesquite beans; 2) a locally abundant food, such as shellfish; and 3) incipient agriculture producing a small harvest" (Beardsley and others 1956: 138).

The La Jolla communities clearly were adapted to both storable wild harvests of pine nuts and grass seeds, and to the locally abundant shellfish of the lagoons. Finally, the

archaeological criteria established by Beardsley and others (1956) also suggest a Central Based Wandering pattern for the Incipient Maritime stage. The constant mobility of Restricted Wandering communities "prevents extensive accumulation of camp refuse in any one place." Central Based Wandering Communities leave "thicker midden accumulations than are associated with Restricted Wandering . . . . Shell middens are probably the most numerous and widespread type of site identifiable with Central Based Wandering" (Beardsley and others 1956: 137-9). La Jolla cultural remains clearly conform more closely to the Central Based Wandering type than to Restricted Wandering, both in archaeological criteria and economic aspects. A Central Based Wandering community patterning is therefore postulated for the Incipient Maritime stage of the La Jolla Complex.

Reconstruction of religious pattern is dependent, for the La Jolla Complex, upon the noted burial patterns. Unlike the settlement pattern, the available data are fairly well controlled temporally and this discussion applies only to the Incipient Maritime stage. Little in the way of ceremony can be shown to be associated with disposal of the dead although there is an established pattern (Rogers 1945; Moriarty and others 1959; Shumway and others 1961). Burials are by interment with body flexed, head most often oriented toward the north. Interments are found individually or in groups. A small pile of stones and broken artifacts is

sometimes placed over the body or a metate may be inverted over the head. Grave goods are rare and generally limited to beads or ornaments. More rarely, other items such as large shells (perhaps used as dishes or dippers) and doughnut-shaped stones are placed in the grave with the body.

This simple burial pattern suggests that no ceremony involving any number of people or any elaborate paraphernalia was a part of the burial rite. Furthermore, there is considerable variation in the pattern described, specifically in regard to orientation of the body. There is a tendency for the head to be oriented to the north, with a range between northeast and northwest most common. However this is not invariably true, and they may be oriented in other directions. The degree to which the individual is flexed also varies, from tight to quite loose, and he may be placed either on the left or the right side. The variation thus seems to support an interpretation of loosely organized burial procedure and lack of well defined ceremony associated with interment.

The ceremonial life of the La Jolla population will probably always remain poorly documented, since ceremonial objects other than those associated with burials have yet to be recovered, or perhaps recognized. This lack of durable ceremonial paraphernalia paints a picture of ceremonial simplicity for the archaeologist. And since the burial pattern seems to indicate lack of paraphernalia or a rigidly

structured burial pattern, this is the only interpretation open to the archaeologist at the present time.

These inferences regarding both social and religious patterns suggest relative cultural simplicity. The settlement pattern in conjunction with the economic pattern indicates a Central Based Wandering people that resided part of the year in base villages which were reoccupied after seasonal excursions from them, and in this sense may be considered permanent. Though the entire population surrounding a lagoon may have recognized themselves as a unit, it appears that the largest organized socio-political unit was probably the central base. The arrangement of "hearths" suggests that even this level of organization was loosely structured. During part of the year, small groups, such as a nuclear family or a small number of families, split off from the central base and collected foods and occasionally hunted in the hills marginal to the lagoon. They participated in a very loosely structured ceremonial and religious life, with a quite flexible pattern revealed archaeologically in the treatment of the dead.

Beardsley and others note further, regarding the social organization of groups of this type (1956: 138-9):

> . . . . solidarity is broken down by self-sufficiency of smaller units during the year, and in some instances by failure of the community to have the same members

> during its sedentary phase on successive years. This atomistic orientation is reflected in the absence of coercive power in the hands of the chief, who serves as a symbol of the community. Differences in social status among adults are minor or absent in conformity with the communal access to food supplies and their total consumption for survival.

In societies characterized by simple ceremonial life, as Central Based Wanderers, religious leaders are the shamans, who employ magic for curing, and group ceremonies may be recurrent, occasional, or absent (Beardsley and others 1956: 139).

In summary, the Incipient Maritime stage of the La Jolla Complex is characterized by the development of a collecting economy oriented toward the resources of the ancient beaches as well as to the plant foods available in the neighboring hills and valley grass lands. Once this adaptation was made to the resources of the coast, the population increased and a population and cultural climax apparently was reached on the San Diego Coast between 5000 and 3000 B. C. The collecting production set continued to be the economic focus and apparently all available ecological zones were exploited by this means.

The major ecological pose was dependent on the richness of the ecological zone of any locality. For instance, the Torrey Pines and perhaps other plants on the mesas near Sorrento Valley may have been of greater importance than comparable ecological zones near Batiquitos Lagoon.

Incipient Maritime developments are suggested by the presence of occasional deep sea fish at the Scripps Estates Site and possibly seal at the Sorrento Site (Harding 1951). Contact with Catalina Island during this period may be suggested by occasional artifacts made of steatite found in middens on the coast (Rogers 1945; Warren, in Moriarty and others 1959).

Activities of the hunting set are of little importance during most of the Incipient Maritime stage, but appear to have become more heavily emphasized toward the close of the stage in the southernmost quarter of the San Diego Coast here discussed.

North of San Diego and Mission bays, this stage ends between 4000 and 3000 B. C., depending on local ecological changes. The silting in of the lagoons was undoubtedly of major significance in this respect. That the lagoons silted in simultaneously with one another seems unlikely when the variation in drainage pattern and size of the basins is considered. The lattice drainage pattern of Batiquitos Lagoon and its relatively small size suggest that it may have silted in before such "inlets" as the

mouth of the San Dieguito River.

While the bays were silting in and being converted to marshy lagoons, the rocky foreshores were being covered over by the development of sandy beaches and the shellfish supply everywhere along the coast was dwindling. Presumably the plant cover of the nearby hills was approaching its present distribution, but perhaps with wider coverage of oak and pine. Water supplies in the streams and springs probably were only a fraction of the size they had been a few centuries earlier.

By 3000 B. C., climatic and ecological changes were creating stresses in the La Jolla cultural pattern. At Batiquitos Lagoon, changes in rate of shell accumulation are interpreted as reflecting a decline in shellfish and ultimately human populations. At La Jolla, the Scripps Estates Site was abandoned. Apparently the Sorrento Site was vacated a short time later. If the stresses created by the climatic and ecological changes were not causing a population decline, they were certainly resulting in movements and adjustments of the population to different food resources, since the shellfish supply had decreased and presumably at least part of the plant resources (Torrey Pines) was steadily diminishing. Two alternatives appear to have been present for adaptation to the changing ecology: greater use of sea resources through fishing and sea mammal hunting, or more extensive and intensive use of land

resources through more hunting and use of greater range of plant foods. The second alternative was apparently adopted by the La Jolla population north of Mission Bay. Elsewhere, as on Santa Catalina Island, a true maritime culture may have developed from a La Jolla cultural base, while in the Mission and San Diego bays area, an Incipient Maritime stage may have contrived to persist.

Period III is difficult to discuss, not only because of the paucity of adequate data, but also because it was apparently a time of readaptation, this time to the newly developing environment. Along the straight coastline to the north of La Jolla, the lagoons were becoming increasingly silted in, the rocky foreshore had essentially disappeared, and the conifers and oaks were becoming more and more restricted. At La Jolla, the rocky foreshore persisted and Mission and San Diego bays presumably maintained the shellfish resources of former years. It seems reasonable to postulate that the Silver Strand was considerably enlarged during this period, when the sandy beaches formed, thus making the resources of that bay even more accessible to people lacking the material culture of a well-developed maritime economy. It seems reasonable therefore to expect that in the San Diego region the Incipient Maritime stage continued, perhaps in modified form, throughout this period.

From La Jolla northward, as the bays became largely reduced in size and food resources, an increased orientation of the economy toward emphasis on either the land or the sea would seem predictable. It is therefore postulated that there were three stages of the La Jolla development coeval during Period III, representing cultural continuity with the earlier Incipient Maritime stage. These stages are: Incipient Maritime in the vicinity of Mission and San Diego bays; Land Collecting in the Coastal Province north of Mission Bay; and Maritime on the offshore islands.

The first of these postulated cultural stages must remain a speculation at this time, since no archaeological data are available at present for this period in the San Diego-Mission Bay area. The second and third stages are inadequately documented, but some evidence is available that supports this interpretation.

North of Mission Bay, the economic pattern appears to become oriented more toward Land Resource Collecting, and this pattern appears now to persist throughout Period III and into Period IV. This development is reflected in the midden at SDi-603, in stratum 2, which has been dated at 3900 ± 200 [1950 B. C.]. The rate of shell accumulation drops rather suddenly and the percentage of manos rises, suggesting greater use of seeds with the decline in shellfish supply. Projectile points are not present in stratum 2, but are present in stratum 1 in greater numbers than

earlier, but still very infrequently. The lack of projectile points in stratum 2 may be explained by a general paucity of artifacts. There appears to have been only a small population occupying the site, presumably only seasonally.

This interpretation is supported by site SDi-762, a short distance east of SDi-603. SDi-762 is located on top of the mesa and was discovered when the county road at the base of the steep slope cut through a sparse shell deposit (SDi-604), which was later found to be slough from the top of the mesa (SDi-762). The shell in the slough was dated at 3500 ± 200 [1550 B. C.] (sample LJ-35). The main area of the site on top of the mesa appeared to be a thin surface layer of concentrated shell with virtually no midden accumulation. A surface investigation yielded only one artifact, a small, thin slab metate. The shell deposit apparently accumulated in a relatively short period of time and the site was clearly a temporary camp.

SDi-693 on the north side of Batiquitos Lagoon has had three dates run on samples from it (Hubbs and others 1962: 222): 860 ± 200 [A. D. 1090] for decimeter 1 (sample LJ-242), 825 ± 200 [A. D. 1135] for decimeter 4 (sample LJ-243) and 1075 ± 150 [A. D. 875] for decimeter 7 (sample LJ-245). Decimeter 4 yielded an extremely high percentage of shell, which Hubbs and others (1962: 222) have interpreted as indication of very favorable conditions for human

existence. However, the site is located at the bottom of a steep slope in a narrow area between the base of the slope and the edge of the lagoon, and the area open for occupation is small. Consequently this site is here interpreted as a refuse heap, perhaps from site SDi-691, located at the top of this same steep slope, or from a series of temporary occupations at the time. There is a number of other sites along the edge of the lagoon that present the same physical characteristics: high shell concentration in a narrow strip between the edge of the lagoon and the steep slope of the mesa. These sites (SDi-607, -612, and -690) may all represent the same cultural expression, and in this case are interpreted as sites seasonally occupied by a small group of people, creating a high shell density in a relatively small area.

Another site (SDi-1100) in the vicinity of Batiquitos Lagoon may date from this period, on the basis of large percentage of manos in the collection. It is located about 1-1/2 miles north of the lagoon and 1/2 mile from an intermittent stream that flows into Batiquitos Lagoon. The site is about 100 yards in diameter, with relatively few shells. A surface collection yielded a rather unusual assemblage of 68 tools. Manos are the most common artifact, composing 46 percent of the total; crude scrapers and cobble tools comprise 25 percent, hammerstones 26 percent, and 2 projectile points the remaining 3 percent.

At SDi-603, the later part of the Land Resource Collecting stage may illustrate an increase in hunting activities. There is an increase in projectile points and knives and a simultaneous decrease in manos (Crabtree and others 1963: 342). This decrease in manos, however, may be interpreted in two ways at this particular site: (1) It may reflect a decline in the importance of seed grinding activities in general, or (2) a decrease in importance of seed grinding at this site only. It may be that SDi-603 was not situated in a favorable location for the collection of seeds during the closing phases of the occupation, since coastal sage scrub was replacing areas presumably covered by the more productive oaks and conifers. Finally, the sample from stratum 1 is small and may not be representative.

The stratigraphic sequence at SDi-603 suggests an increase in the importance of seed gathering with the reduction in shellfish supply at about 4000 B. C. Sometime after 1900 B. C., the seed gathering activities appear to become less important and hunting activities increase, though the focus was still clearly on the collecting set. Unfortunately, this sequence is only noted for this site, and until more data are available for this period, the changes and relative importance of seed gathering and hunting activities during this stage remain tentatively evaluated. This stage nevertheless still clearly indicates a focus on collecting.

In Sorrento Valley, Torrey Pines Mesa, and La Jolla embayment, a somewhat different picture is seen. Projectile points apparently increased in frequency shortly after 3000 B. C. at the Sorrento Site and at UCLJ-M1. Also mortars appear at this time, with 3 small mortars reported from the Scripps Estates Site (Shumway and others 1961: 74-5). Tuthill and Allanson (1955) have reported a large number of small mortars recovered from the ocean bottom at La Jolla, Solano Beach, Point Loma, and Imperial Beach. However, the problem of dating these artifacts and placing them in a cultural milieu is next to impossible. Tuthill and Allanson report that in the La Jolla embayment, mortars have been recovered in up to 100 feet of water and nearly one-half mile from shore, but most have been found at a depth of about 20 feet and about 800 feet offshore. They believe that some of these mortars have been derived from the Sprindrift Site by erosion, and then transported seaward by water action. It is reported by Tuthill and Allanson that the early inhabitants of the city of La Jolla collected mortars from the Spindrift Site and from the beach.

Another alternative offered by these same authors, is that these mortars represent drowned sites. They feel it is quite improbable that the mortars were moved by wave action from their original location, ". . . . as the exterior surfaces of the mortars show no signs of battering,

a factor that would be concomitant with prolonged rolling in a surf zone. Furthermore, the soft nature of the sandstone from which most of the mortars were fashioned could not withstand any prolonged battering without disintegrating, and . . . . only three broken mortars have been found" in a collection of several hundred (Tuthill and Allanson 1955: 231). Further, Tuthill and Allanson also note that the mortars are often covered with marine shells, identified as Ostrea lurida, primarily an inhabitant of bays and other protected waters.

Additional data are now available to support the second thesis. Subtidal peat, including fragmentary plant materials, was exposed by erosion of overlying sand off the La Jolla Beach and Tennis Club (Spindrift Site). This peat was dated by radiocarbon method at 4230 ± 200 [2280 B. C.] (Hubbs and others 1962: 212, sample LJ-208). Hubbs and others add: "The fresh water pond on the Club grounds was transformed from a salt water lagoon and the presence of the peat (usually buried in the subtidal part of beach) shows that a lagoon existed off the present shoreline when sea level was lower (Hubbs and others 1962: 212).

The peat was located 6-1/2 feet below mean sea level and ca. 450 feet seaward from the La Jolla Beach and Tennis Club, suggesting that many of the mortars could have derived from sites along a now-drowned salt water lagoon, perhaps at the end of Scripps Submarine Canyon, at or about

the time the peat was forming at a slightly higher elevation in a fresh water marsh.

The presence of the mortar at sites of this antiquity is further supported by their presence at Little Harbor sometime after 1050 B. C. and at Topanga Canyon before 490 B. C. (K. Johnson, Personal communication 1962). In both instances, the mortar is associated with several types of points, including notched varieties. Mortars also appear at the Zuma Beach Site, dated at 3000 B. C.

In the San Diego Coastal Province, mortars have been recovered occasionally from other sites, but most often late sites bearing pottery. North of Torrey Pines Mesa, mortars are exceptionally rare. Excluding the submarine mortars from Solano Beach, only two sites lacking pottery have yielded mortars: SDi-610 on Batiquitos Lagoon (Warren and others 1961), and SDi-641 in the Buena Vista Watershed (W. J. Wallace 1960). In neither instance can the site be dated with the information now available, except that the sites probably are earlier than the introduction of pottery in the region.

From the data we now have, it appears that ecological changes in both coastline and plant communities had a far-reaching effect on the La Jolla population between 3000 B.C. and A. D. 1200. With the relatively rapid deposition of silt beginning at least 4300 B. C., lagoons decreased in size and in shellfish population, rocky shorelines were

covered with sandy beaches and a shortage of fresh water may have developed in the immediate vicinity of the lagoons. The pine and oak cover probably decreased in distribution at this time, perhaps more rapidly than previously due to the influence of man and fire.

During this period in the San Diego Coastal Province, north of San Diego and Mission bays it appears that man turned to the land for a possible increase in food resources. Hunting may have gained importance during this period, as is suggested by the slight increase in projectile points (from none to a few). Secondly, man almost certainly intensified his collecting efforts on the land, judging by the increase in percentage of manos at SDi-603 on Batiquitos Lagoon, and by the introduction of a new seed grinding tool, the mortar. It seems reasonable that the mortar, whether introduced from another area or a local invention, probably reflects the use of a new food product, possibly the acorn. However, these early mortars are generally much smaller than those used in historic times for acorn mashing.

In the Coastal Province generally, there seems to have been great cultural continuity, at least in nonperishable items. The vast majority of tools from this period at SDi-603 is typologically identical to those of earlier and later levels of occupation. Under the pressure of ecological change, the economic pursuits appear to have altered

only in relative importance, with surprisingly few innovations in the form of new tool types or use of new food resources. The settlement pattern, while poorly understood, does indicate some change. The decline in shellfish remains at SDi-603 may also reflect a population decline and/or a shift in settlement pattern. The series of shell middens including SDi-762 and -693, which appear to be temporary camps, supports the suggestion that the older, lagoonside "central bases" became less utilized and perhaps only seasonal camps.

It seems reasonable to assume that as the bays lessened in surface area and depth due to alluvial deposit, and as the rocky foreshore was converted to a sandy beach, the economic importance of the coast decreased. Once the economic attractions of the lagoons decreased, the population was no longer drawn to these areas and the "central base" villages of an earlier period became temporary camps while the resources of the mesas and of the developing valley grass lands became more important. The establishment of the Torrey Pines Grade Site and perhaps SDi-1100 at some distance from Batiquitos Lagoon, appears to support this interpretation.

The settlement pattern would appear to have been shifting from a lagoon-oriented to river valley-oriented type. With increased gathering of vegetable foods, a greater range in surrounding mesas and valleys was probably

exploited by each village. Presumably this could not be accomplished without an accompanying decrease in population. Such a population decrease could have been accomplished through migration to more permanent bays such as San Diego or Mission Bay, and perhaps to the La Jolla embayment, as a result of reduced food resources. The settlement pattern established during this period apparently approximated that found by the early explorers along the San Diego Coast. Such a pattern for the prehistoric population is suggested by the ecology of the region and some archaeological data. The best-known late sites found on the coast, the Spindrift Site and the Rose Canyon Site, both have a pottery-bearing component overlying a La Jolla component, which at least in part dated from this stage. Farther north, the same situation is found at the C. W. Harris Site on the San Dieguito River, and at SDi-603 on Batiquitos Lagoon. The latter two appear to be small seasonal campsites in both the La Jolla Land Resource Collecting stage and in the later "Yuman Culture."

The major rivers, such as the San Dieguito and the Santa Margarita, probably had fairly large villages located in the area behind the salt water marshes near fresh water pools in the valley grass lands. Very small communities were probably located on the lesser streams and valleys such as Soledad Creek (Sorrento Valley) and Batiquitos Lagoon. Under these conditions, the settlement pattern

would probably fall within the Central Based or Restricted Wandering type, and the political and social organization probably changed very little from that of the earlier period. There are some possible significant changes of stronger and perhaps more elaborate socio-political organization developing due to the population decline and regrouping into a fewer number of central based villages. It is tempting to postulate a change from the politically autonomous village based on a simple lineage, to a politically autonomous village containing several lineages, and perhaps to development of clans and moieties, as suggested for ethnographic peoples of central and southern California (Gifford 1926). However, there need not have been much of a reduction in the number of villages. Any population reduction could have been reflected in smaller and smaller groups but not necessarily uniting with other "village remnants" to any great extent. Only when a more thorough knowledge of the size of sites and the settlement pattern for this stage of La Jolla development is available, will it be possible even to make such inferences.

The religious pattern for this stage cannot be reconstructed except as discussed above as inferred by Beardsley and others for these types of community patternings. Only one burial is known from this stage. At the Spindrift Site, a prone burial is dated at 4650 ± 160 [2700 B. C.] for sample LJ-512 (Hubbs, Personal communication 1962), which may

indicate either some change in burial patterns or perhaps a less well-controlled pattern than in the earlier stage of La Jolla Complex.

The economic poses of the Land Resource Collecting stage of the La Jolla Complex represented a continuity with the older, Incipient Maritime stage in the same area. There was, however, a difference in importance of the various ecological poses. The shoreline collecting decreased and land collecting activities increased, as presumably did the land hunting pose. There appears to have been a change in settlement pattern, with the shoreline being inhabited only seasonally and the larger villages probably being found on the major streams or in localities especially rich in plant foods. The community mobility pattern was probably Central Based Wandering, but perhaps Restricted Wandering, and as such there would have been little change in the social and political organization. Religious organization would have been little changed also, although new modes of burial may have been adopted.

The Maritime stage of the La Jolla Complex, if it is indeed La Jolla, is not found on the mainland. This stage illustrates another ecological "change" and cultural adaptation that is strikingly different from both the La Jolla economic pattern of the San Diego Coast and the material culture of the later maritime development along the Santa Barbara Channel.

Only one excavated site is known from this stage, Little Harbor on Santa Catalina Island (Meighan 1954). Although historical relationships cannot be illustrated with any certainty, the artifact assemblage and the economic pattern of this site seem to indicate a basically La Jolla Complex undergoing considerable change in response to a different ecology. The artifact inventory from Little Harbor contains a great number of traits that are duplicated in the La Jolla material on the mainland. These include: all of the five projectile point types, the knives, flake scrapers, teshoa flakes, scraper planes, hammerstones, mortars, pestles, grinding slabs, cobble manos, tarring pebbles, doughnut-shaped stones, discoidals, spire-lopped olivella beads, shell rings, and pointed bone objects (fish gorges or awls).

Items recorded at Little Harbor not generally found in coastal La Jolla sites, include charmstones, "effigies" of steatite, steatite vessels, net sinkers, two shellfish hooks, bone pries, tubes, flakers, barrel-shaped olivella beads, and a Haliotis pendant.

This simple listing of traits does not reveal the really vast differences between the Little Harbor and mainland La Jolla material. While a great number of traits is shared, there are great differences in the relative frequencies of artifacts. The 55 projectile points included in the 480 artifacts from Little Harbor total more than were found in 1100 artifacts at Batiquitos Lagoon. Whereas grinding

tools and crude scrapers are of primary importance in mainland La Jolla assemblages, they are relatively rare in Little Harbor, numbering only 50. Even greater cultural differences are revealed when the faunal remains are compared. At Little Harbor, the vast majority of animal remains were derived from the ocean. Large quantities of shellfish were gathered (the midden is up to 58 percent shell by weight), with Haliotis and Mytilus being the predominant species. Of the animal bone, 97 percent was from sea mammals, including large quantities of dolphin, porpoise, and seal. Fish were also a major part of the diet, while birds were less important and land mammal remains were rare. In spite of this emphasis on maritime resources, it has been accurately noted that: "Interestingly, the artifact sample gives no direct indication of cetacean hunting . . . . There are no harpoons in the collection, and it appears that the cetaceans were hunted with spearthrowers. If this is so, it is clear that the people had developed great skill as boatsmen and marksmen" (Meighan 1959: 402).

Although Little Harbor shares a few characteristics with San Nicolas Island sites of the same age (Reinman and Townsend 1960; Orr 1962), many of the artifact types are very reminiscent of the San Diego Coast and strongly suggest an origin from that source. The less well-known assemblages from Eel Cove Canyon Shelter (SDlI-49) and Eel Cove Village Site (SclI-118) on San Clemente Island, are

even more reminiscent of La Jolla mainland manifestations, with many of the same crude choppers, scrapers, and hammerstones, and a lack of the finer tools as well as absence of the great quantity of sea mammal and fish remains found at Little Harbor (McKusick and Warren 1959). On the basis of these data, it appears that the La Jolla population had reached the southern two islands sometime during the Incipient Maritime stage and had developed, on Santa Catalina Island, a full-blown maritime economy.

This development is understandable when the topography and ecology of Santa Catalina are considered. The island is rough and steep-sided, with few lowlying areas. Though it contains some vegetable resources, it probably was not as rich as the coast of the mainland, and presumably with the onset of the Altithermal, the plant resources were decreased. The same appears to be true of the land mammal population. One species of deer is present, as are the island fox and ground squirrel; there are no rabbits. Marine birds and migratory water fowl were probably available, but the island has little marshy habitat to attract such birds as geese and ducks. On the other hand, the rocky coastline of the island abounds in shellfish and seal rookeries are found on the beaches (Meighan 1959).

The shellfish collecting pose of the La Jolla Complex was admirably suited to the coastline of Santa Catalina. The presumed shortage of plant foods would, theoretically

at least, have been compensated for by the increased use of shellfish. The collecting of shellfish undoubtedly acquainted the inhabitants with the seal rookeries and opened a new ecological pose, seal hunting, a pose not possible on the mainland since there are no rookeries there.

With the development of seal hunting, the increase in shellfish gathering, and presumably great amount of true fishing, most economic activities were concentrated in a single ecological zone, the beach. With the intensive development in economic activities of this zone, two changes apparently took place. Collecting activities were limited in the beach area and apparently developed to their maximum. As set fulfillment approached, innovations occurred in the hunting set. Once the hunting of seals in rookeries became an established ecological pose, it was only a matter of extending these techniques to another ecological zone, the sea, and a true maritime-oriented economy evolved.

The paucity of tools used in preparation of plant foods and the relatively rare remains of land mammals at Little Harbor, in conjunction with the great quantity of shellfish, fish, and sea mammal remains, all indicate the strong orientation toward beach and sea. Yet many of the tool types of the Little Harbor assemblage are typical of a land-oriented La Jolla economy. These data suggest a change in economic focus of the island "La Jolla" complex from land resource collecting to sea hunting, through the adaptation of existing

tools and heavy exploitation of the resources of the beach. In this instance, the production set changed more rapidly than its technology.

How long this kind of maritime adaptation persisted is not known at the present time. However, once man became aware of the vast resources of the sea and the means of exploiting them, it seems reasonable to expect an economic focus based on the sea foods would develop, and greater use of this focus would stimulate innovations and borrowing, until the climax xulture, such as the Canaliño, was reached. That the Little Harbor cultural manifestation represents an early parent culture for the later maritime cultures is not known, but similar developments could be expected to have taken place on the islands off the Santa Barbara Coast, and it may be postulated that such developments gave rise to the later Canaliño maritime climax.

Little can be inferred regarding the socio-religious patterns of the Little Harbor population. The fact that the dependable and rich resources of the sea were realized suggests that they may have had a fairly sedentary population and a basis for more elaborate social and religious systems than did the mainland. Certain of the artifacts may support this interpretation; charmstones from Little Harbor are felt to be of magical and religious significance (Meighan 1959: 392), and the effigies and "souvenir" pebbles may also have had a similar use. While limited in

number, these manifestations are greater than anything achieved by the La Jolla peoples on the mainland.

On the San Diego Coast, the Incipient Maritime stage of the San Diego and Mission bays, and the Land Resource Collecting stage north of San Diego, apparently persisted until influences from the east were felt. These influences, which note the beginning of Period IV, apparently signalled the end of the La Jolla Complex. The subsequent cultural manifestation has been termed the Yuman Culture (Rogers 1945) and the San Luis Rey Complexes (Meighan 1954). This manifestation is characterized primarily by the addition of pottery and a series of small triangular projectile points.

On the basis of the available data, the initial date for pottery on the San Diego Coast is tentatively placed at A. D. 1300, or 660 years ago. There can be little doubt that these sites are remains, both culturally and historically, closely related to the ethnographic groups. Unfortunately the coastal population was dispersed at a very early date, being among the first to feel the effects of contact with European culture. Consequently there is little in the way of ethnographic data available for the historic aboriginal population on the coast. The lack of data has created somewhat of a problem, since a number of attempts have been made at cultural reconstruction for the San Diego Coast. These reconstructions have been based on

data pertaining to the Luiseño and Diegueño of the Inland Province of San Diego County, and the coastal culture of the Los Angeles, and Santa Barbara Channel, areas.

In discussing the settlement patterns of the Southern California coast, Heizer and Baumhoff (1956: 42) state:

> The late, or Canaliño, culture is similar to others farther south on the coast (M. J. Rogers, 1929a; McCown, 1945; Meighan, 1954). These late sites usually show a high degree of adaptation to marine life: they are very large, some being as much as a mile long, and all are directly on the sea shore . . . .
>
> The population of the south coast area was calculated at about 22,000 persons by Kroeber, or about 60 per 100 sq. km. Whatever the true population was at the time of contact, it must have been larger in late periods than it had been previously because the late sites are both more numerous and much larger than the earlier ones.

The papers by McCown and Meighan cited above deal with Diegueño and Luiseño sites located not on the coast, but rather in the foothills of the Peninsular Range. Rogers' paper pertains to the coastal terraces, but only mentions the late Yuman cultural remains in passing, dealing

primarily with the San Dieguito remains, from a much earlier period in prehistory.

Aschmann (1959), in discussing the populations of various ecological areas of Southern California, states that the Coastal zone, which includes a strip of land extending about one-half day's journey inland and all the offshore islands, was most heavily populated. He says:

> The size and proximity of villages reported both by explorers and by modern archaeologists make it clear that this was the zone of densest settlement. Almost every permanent water source close to the beach has a large campsite nearby: some have several, though probably not all were occupied concurrently. They represent large and apparently permanent settlements, and many, such as Point Sal, Malaga Cove, and the La Jolla Beach and Tennis Club show substantial stratigraphic depth (1959: 50-1).

Regarding the economy, Aschmann writes:

> The coastal and island peoples fished, collected shellfish, and hunted sea mammals with technologically more refined equipment . . . . All of the coastal peoples also hunted and gathered and prepared plant foods, but the marine resources

> provided additional food security and permitted far greater population concentrations (1959: 48).

This "extension" of Santa Barbara Channel ecology and inland San Diego County cultural traits to the San Diego Coastal Province has resulted in an erroneous cultural reconstruction for the coastal region. The evidence is reviewed below.

The so-called Yuman Culture on the San Diego Coast may be distinguished primarily by the introduction of pottery and small, well-made projectile points. Meighan (1954) defined two developmental phases of the San Luis Rey Complex and correlated them with Rogers' (1945) older, less well-defined concept of the Yuman Culture. Using ethnographic information, San Luis Rey II has been equated with the Luiseño and Dieguẽño of the western slope of the Peninsular Range and possibly extending as far as the coast (Meighan 1954). Recent evidence, however, does not support a distribution of San Luis Rey I into the Coastal Province, and possibly not San Luis Rey II.

Both San Luis Rey I and II are characterized by small, finely-made triangular points, bedrock and portable metates and mortars, manos and pestles, doughnut-shaped stones, pendants, olivella disc and spire-lopped beads, quartz crystals, deer bone awls, chipped cannon bones, bone and antler flakers. San Luis Rey II includes also pottery.

vessels and tubular pipes, cremation urns, ground steatite arrow straighteners, red and black pictographs and contact items such as glass beads in terminal sites.

In the Coastal Province of San Diego County, no San Luis Rey I sites have been recorded. However, there are sites that yielded pottery in association with a complex of stone tools typical of La Jolla. In a few instances this combination is superimposed on an earlier La Jolla component. At SDi-603 on Batiquitos Lagoon the artifacts throughout the midden are typical crude implements of the La Jolla Complex, except for one small triangular point, recovered from the surface, and potsherds found in the disturbed plow zone and in rodent burrows at a somewhat deeper level. Unfortunately, because the upper portion of the deposit was disturbed, it is impossible to determine if the pottery and point represent a very late veneer or if they were cultural additions to the La Jolla inventory.

One other site (SDi-763) on Batiquitos Lagoon yielded a relatively large sample of pottery. This site has not yet been excavated, but yielded over 100 artifacts and several dozen potsherds from the surface. The stone artifacts, again, are typical of the La Jolla Complex, with the exception of one fragmentary stone bowl with a squared lip. The pottery, in addition to the usual Palomar Brown Ware so characteristic of the San Luis Rey

Complex, includes a ware from the Colorado Desert and a bichrome historic Mexican ware. That pottery was a cultural addition to the La Jolla Complex rather than a late veneer cannot be definitely demonstrated here either. The general paucity of San Luis Rey artifacts other than the pottery, however, suggests that pottery as an individual trait may have been introduced to the La Jolla Complex at these sites.

At the stratified C. W. Harris Site on the San Dieguito River, near the base of the Black Mountain Volcanics, the Yuman component overlies a poorly-represented La Jolla component (Warren and True 1961). The 30 stone artifacts from the Yuman component contain only two artifacts that are distinguishable from those typical of a La Jolla assemblage. These are two small triangular points. In addition seven potsherds were recovered from the Yuman component.

Wallace (1960) reports that 3 of the 37 sites located in the Buena Vista Watershed belong to the San Luis Rey II Complex, but identifies none as San Luis Rey I. The crude hammerstones, choppers, scrapers and manos and metates are much more common in these sites than in the San Luis Rey I type site described by Meighan (1954). Furthermore, the small triangular points and possibly portable mortar and pestle are far less common.

Carter's (1957: 293-5) comments regarding the Rose Canyon Site, which was occupied as late as 1890 and noted by Father Crespi (Bolton 1927), suggest a similar case:

"Evidence of late occupation consists of the presence of pottery and of stone arrow points. The latter, however, are comparatively rare. Years of collecting along the surface by one long-term resident produced only six. These are simple triangular points with concave bases ...."

Carter also reports a similar observation in the most recent occupation at the Spindrift Site at the La Jolla Beach and Tennis Club (1957: 246-7). Manos, "cobble cores" and metates are most common, mortars are reported; "pottery fragments and stone arrow points are rare."

These data appear to indicate that the San Luis Rey I Complex did not effectively penetrate the Coastal Province of San Diego County and that San Luis Rey II did not immediately replace the older La Jolla Complex, but blended with it to produce a cultural manifestation somewhat unique from both San Luis Rey and La Jolla. The relationships between the peoples of these two cultural manifestations were undoubtedly complex and are reflected to some extent in the ethnographic data available. R. White (1959: 60) notes that the Luiseño of the San Luis Basin "owned" territory on the ocean shore which they visited periodically to collect clams and fish. He also cites personal communication with Wissler and Steffens, who obtained similar stories of periodic visits to the ocean from Diegueño informants living at Mesa Grande, and J. P. Harrington, who described the route taken by

inhabitants of Temescal Canyon through San Juan Capistrano to the beach.

That a different people were, at least at one time, recognized on the coast by the inhabitants of the Inland Province, is strongly suggested by the Luiseño legend of the "Origin of the Notish Ceremony" (DuBois 1908: 148-50). The legend tells of a contest between the "Western people" and the "Mountain people," and is interesting not only because of the dichotomy indicated between these two peoples, but because of the individuals named to make up each group and the food they brought to the contest. The Western people included: Sea Fog, Michish (a sea animal), fish, chicken hawk, Emamel (birds of the seashore), butterfly, grasshopper, and antelope. The Mountain people were: a bird with a big mouth, owl, thundercloud, hawk, eagle, raven, and deer. People of the West gathered "fish and other things" for the ceremony, while the Mountain people brought "deer meat and much food."

In summary, the simple tool assemblage of the La Jolla Complex persisted in the Coastal Province into protohistoric times. Pottery and small triangular points both occur, but with a basic La Jolla assemblage distinct from the San Luis Rey Complexes of the interior. That the groups of the Inland Province made periodic visits to the coast, but that there was a distinction between the coastal population and the interior peoples, is suggested by the

ethnographic data.

The second problem with the "reconstructed" cultures of the San Diego Coast, is the assumed maritime orientation. Aschmann (1959: 48), Heizer and Baumhoff (1956: 42), and R. White (1959: 47) have explicitly and implicitly stated that the coastal people were oriented toward the sea, with a considerable adaptation to marine life. Yet the data available do not support such a conclusion. If the marine resources played an important part in the economy of the coastal groups, evidence of tools such as fish hooks, harpoons, nets and well-developed water crafts should be abundant in the reports by the early explorers and later ethnographers. Thus it is very enlightening to read the following reports.

Sparkman (1908: 200), regarding the Luiseño, states that fish were

> . . . . the chief dependence of those who lived on the coast. They used a canoe or raft of rushes, with which they went out some distance from the shore to fish with a dip net. Seine nets were also used. Some wooden canoes were also made from the trunks of trees. It is stated that voyages were formerly made with these as far as San Clemente Island. The coast people also fished with the hook and line. The line was

> made from the fibre of *Yucca mohavensis* and the hook from abalone shell . . . . Fish hooks were also made of bone. The Coast people also consumed large quantities of shellfish of several species. Some say that they used a harpoon for spearing fish . . . . Others say that no harpoon was ever used by them. This may be true, but it is certain that the Diegueño used one, and it seems improbable that the Luiseño would not have employed it.

Drucker (1937), using Diegueño and Luiseño informants from the Inland Province, reports fish nets and traps, and circular hooks of abalone. The latter were used by people on the coast only. Also reported were tule balsas used with a paddle on the ocean itself.

Heizer and Massey (1953) have discussed in detail the distribution of the tule balsa, dugout canoe, plank canoe, and double-bladed paddle. The double-bladed paddle is found in San Diego and Mission bays, but not elsewhere on the San Diego Coast. The tule balsa was found along the entire coast, and the dugout canoe was apparently limited to the portion of the coast held by the Luiseno. The plank canoe, often mentioned for the Chumash area to the north, was not reported from the San Diego Coast.

Miguel Costanso, who accompanied the Portola Expedition in 1769, stated with regard to the inhabitants of San Diego Bay (van Hement-Engert and Teggart 1910: 111):

> Fish constitute the principal food of the Indians who inhabit the shore of this part, and they consume much shell-fish because of the greater ease they have in procuring them. They use rafts made of reeds, which they manage dexterously by means of a paddle or double-bladed oar. Their harpoons are several yards long, and the point is a very sharp bone inserted in the wood; they are so adroit in throwing this weapon that they very rarely miss their mark.

All of these data make it clear that the coastal inhabitants did indeed make use of the sea. However, that they used the ocean resources is not in question, but rather the extent to which they used them. The early explorers often noted the economic activities of the people of the San Diego Coast. In 1692, Vizcaino wrote (Engelhardt 1920: 6-8):

> Quite transported with the good treatment accorded them on this occasion, the Indians came every third day for biscuits and fish, bringing in return skins of martens, wild cats and other animals, together with the traps in which they caught them . . . .

[emphasis mine] .

. . . . . .

. . . . the Indians came peaceably and took us to their rancherias where they were gathering their crops and where they had made their paresos of seeds like flax.

In 1769, Captain Vila of the frigate San Carlos wrote that while the ship was anchored in San Diego Bay, the "Indians came alongside on their rafts and, in exchange for a few trinkets, gave us several skins of sea otter and of other animals caught in traps" (Engelhardt 1920: 20). The fact that the Indians of San Diego Bay were trading animal pelts for fish and biscuits, and for a few trinkets, rather than trading fish for other items, suggests that they were not great fishermen, although Father Serra in 1769 noted (Engelhardt 1920: 21): "The natives . . . . on all of this coast . . . . along which we came from Ensenada at Todas Santos, so called on the maps and charts, live well on various seeds and on fish which they catch from rafts made of tules and formed like canoes, with which they venture far out on the sea."

In 1812, Fathers Payri and Suner, in answer to the Interrogatoria, wrote of the Indians of the San Luis Rey Mission: "Their food consists at times of deer, rabbits, squirrels, rats, which the men kill and of acorns and other seeds, which the women gather. It is to be observed,

however, that among those who live near the sea shore fishes form the more abundant food" (Engelhardt 1921: 30).

Fish, including shellfish, undoubtedly then did play an important role in the economy of the coastal peoples. However, their ability as fisher folk was a far cry from that of the people of the Santa Barbara Channel, where in 1769 Father Crespi reported large villages which gave them such great quantities of fish they could not use it all and therefore only accepted part of it (Bolton 1927). The contrast between the highly developed fishing economy of the Santa Barbara Channel and the economy of the San Diego Coast is heightened by a comment written during the early, difficult years of the San Diego Mission. Father Palou informed the viceroy that the savages "subsist on the seeds of the zacata (wild grass) which they harvest in due season. From these they make sheaves as is the custom to do with wheat. They also live by fishing and hunting hares and rabbits which are plentiful . . . . The Missionary Fathers have sent to San Blas for a canoe and a net so that the new Christians might subsist on fish" (Engelhardt 1920: 51, emphasis mine).

Interestingly, Fages makes a very similar statement when discussing the San Diego Mission (Priestley 1937: 11): "The natives of the adjacent villages do not lack for their customary seeds, and they add to their food supply by fishing. They would secure better results if they had canoes in which to go out. It would be well if the mission had a

canoe of its own and a good fish net to use in supplying its needs" [emphasis mine] .

These statements strongly suggest that the inhabitants of the San Diego - Mission Bay area were relatively poor fishermen who had to depend heavily on seed plants, small game and shellfish for major food supplies. Since San Diego Bay is ideally more suited to a maritime economy than the remainder of the coast, the most advanced maritime developments might be expected to have taken place there. This area does, in fact, show at least one innovation toward a maritime economy not found elsewhere on the San Diego Coast. The double-bladed paddle was used with the balsa, presumably making it more sea-worthy. Shell fishhooks also have been found at the Spindrift Site in La Jolla, but are generally rare in the Coastal Province of San Diego County. In fact, they number less than 6 at the Spindrift Site collection at the San Diego Museum of Man, and no other occurrence of them on the San Diego Coast is known to the author. These few specimens, in conjunction with the double-bladed paddle, are important, however, since they apparently reflect influences from maritime cultures to the north.

North of San Diego and Mission bays, data regarding fishing equipment are even more limited. Fish nets of plant fiber reported by Crespi (Bolton 1927: 130) at a village on the San Luis Rey River, and the dugout canoes

of the coastal Luiseño noted by Heizer and Massey, may be taken as indications of use of marine resources. There are other data to suggest that marine resources were not important in the economy in this area, however. Jose Longines Martinez wrote regarding his visit to Southern California in the 1790's (Simpson 1938: 50-1):

> The gentiles who live between San Diego and San Buenaventura heap up the plants which yield the most seeds, against the winter. In many rancherias they use great skill in storing a certain quantity of seeds against that season. But when the rains are long and the cold somewhat severe these natives suffer great hardships, because their scanty stores give out and their resources are cut off. Because of these necessities they have accustomed themselves to eating everything Nature offers: weeds, seeds, rats, etc. . . . . In all of New California from Fronteras northward the gentiles have a custom of burning the brush, for two purposes: one for hunting rabbits and hares (because they burn the brush for hunting); second, so that with the first light rain or dew the shoots will come up which they

call pelillo [l]ittle hair and upon which they feed like cattle when the weather does not permit them to seek other food.

The peoples north of the San Diego region appear to be even less adapted to the marine resources, and at no place along the San Diego Coast can a flourishing maritime economy be illustrated. Nets, including gill, dip, and seine, and the thrusting harpoon, are widely distributed throughout California (Kroeber 1922), and cannot in themselves be considered indicative of a maritime development. On the basis of these tools, it appears that there was some use of the sea and shoreline, but a greater emphasis was placed on the collecting of shellfish and vegetable foods. The economy of the San Diego Coastal Province cannot therefore be described as maritime. The San Diego Bay region appears to have maintained an Incipient Maritime economy, while the area north of Mission Bay would seem to have been more land oriented.

The settlement patterns of the aboriginal population at the time of contact appears to support the interpretation of economy above, based on the material culture. Crespi (Bolton 1927), Fages (Priestley 1937), and Costanso (Teggart 1911) were members of the Portola Expedition of 1769, and their reports agree in the location and setting of the Indian villages encountered on the journey north from San Diego. The expedition left San Diego Bay, crossed the back

of Mission Bay, from which they traveled northward through Rose Canyon, across the mesas and valleys at a distance of from 1-5 miles inland, until they reached the present site of San Juan Capistrano. By following this route they crossed the aggraded valleys behind the salt marshes, which were noted a number of times, in the zones of valley grass lands and fresh water marshes. It was in these locations that the villages were noted. Further, there appears to be a correlation between the amount of water available and the size of the village. The "large" villages (between 40 and 200 inhabitants) occurred on the San Dieguito River, Buena Vista Creek, San Luis Ray River and Santa Margarita River, while small villages numbering as few as 15 persons (and one uninhabited) were found on the small streams. Wherever water was found adequate for the needs of the expedition, an Indian village was present nearby.

No villages or camps were noted in areas away from the streams, although areas burned for hunting were found on the mesa tops. And though the ocean could be seen at the mouths of several of these canyons, no villages were reported directly on the coast except on San Diego and Mission bays. It would appear that fresh water was the determining factor in location of the villages and that this fresh water was most often found in the aggraded valleys behind the salt marshes at a distance of ca. one-half mile to 3 or 4 miles from the ocean. Thus the population was somewhat removed

from the beaches and probably located in an area of abundant game and vegetable food sources.

If the water source was indeed the determining factor in village location, it becomes evident that such villages were permanent in that they served as a central base. That they were sometimes left vacant for a period of time is evident from the report of an empty village (Crespi, in Bolton 1927: 128), and the comments of Father Boscano (Harrington 1934: 62) regarding the mobility of the Luiseño in the vicinity of San Juan Capistrano, have already been noted above. The Central Based Wandering community pattern as discussed previously thus probably persisted into historic times.

The socio-religious pattern of the protohistoric culture was probably similar to that of the protohistoric peoples of the interior. This represents a marked change from the earlier La Jolla pattern in treatment of the dead. Simple interment, as practiced by the earlier La Jolla population, was apparently unknown in protohistoric times; cremation was then the exclusive means of disposal of the dead. Cremations are known from the Spindrift Site (Carter 1957: 246) and from the San Dieguito Valley (Warren and others 1961: 6-7). Cremations at the Spindrift Site include one instance where the remains were placed in a pottery vessel. On the lower San Dieguito River, a single isolated cremation was discovered on the north side of the

valley about 2-1/4 miles inland. Although not placed in a pot, it was associated with two or three fragmentary, trumpet-shaped clay pipes, and several small, exceedingly well-made triangular points. The cremation from the San Dieguito River is interesting because the pipes had not been smoked. The lack of carbon in the pipes may indicate that the pipes were made specifically for burial goods, or they may have been shaman's sucking pipes. Two cremations placed in urns were reported to the author from the vicinity of Rancho Santa Fe by an amateur. However, the exact locations could not be obtained.

The significant difference to be noted here between burial practices of the early La Jolla peoples and the protohistoric population, is the attention given the body after death. More elaborate and more formalized burial ceremonies seem to be indicated, representing a substantial change in burial practices, and almost certainly as well a change in religious beliefs about life after death. Also, the unsmoked pipes in the San Dieguito Valley cremation suggest the occurrence of shamanism and of the belief in curing by sucking foreign objects from the body, a belief widespread in western North America and found among the Diegueño and Luiseño ethnographically.

The treatment of the dead during Period IV represents a distinct change from the early La Jolla pattern, and was almost certainly introduced simultaneously with pottery.

The historic cultures of the San Diego Coast may be viewed as a culmination of an economic pattern which had long been indigenous to the region and influenced only slightly by outside forces, a settlement pattern resulting from adaptation to the seasonal round in a changing ecology, and a religion primarily derived through late cultural impulses from the Colorado River area. The protohistoric coastal peoples were thus neither maritime oriented nor representative of the same cultural tradition of the peoples of the Inland Province of the San Diego Coast. They appear to represent a blending of the San Luis Rey with the older La Jolla economic pattern, and an addition of a different burial pattern introduced from the east. To what extent other aspects of the socio-religious organization were changed or how similar in this respect the two cultural traditions were at the time of contact, is unknown. The settlement pattern of the coast appears, on the basis of rather scanty material, to be at least similar, if not the same, during Periods III and IV. To what degree the socio-political organization may have changed, however, cannot be known at this time.

Chapter viii. Cultural Continuity and Change on the San Diego Coast

The preceding chapters have outlined a theoretical model for the analysis of economic change, a reconstruction of the major aspects of the changing ecology of the San Diego Coast, and a sketch of the La Jolla cultural development, including the marginal (to La Jolla) developments on Santa Catalina Island, and the later Yuman and San Luis Rey Complexes on the San Diego Coast. In the following discussion, a summary of the prehistory of the San Diego Coast is presented in terms of economic stages. Pertinent statements are made regarding the environment and limiting factors, evidence for economic focus, dynamics-producing factors, and direction of change. Then the hypotheses presented in chapter iii are tested by the application of these data to them.

I. Adaptive Gathering Stage

A. Environment and Limiting Factors: Plant cover was probably more lush than at present, with wider distribution of coniferous and broad-sclerophyll forests, though chaparral, coastal sage scrub and grasses were probably beginning to replace the forests to some extent. The coast line was wrinkled with long narrow bays supporting large populations of bay molluscs and the rocky

foreshore was ideal for rock-dwelling shellfish.

B. Evidence for Economic Focus: This stage is largely hypothetical and evidence for relative importance of the economic sets is not conclusive. The early portion of La Jolla middens is often characterized by relatively few shellfish remains, manos, metates, and large, crude percussion-flaked chopping and scraping tools, indicating a collecting set. Knives and points are rarely found but do occur along with a small quantity of small mammal bones. Fishing is not represented either by tools or faunal remains but the lack of evidence may be a function of the poor representation of this stage in the archaeological sites. Economic focus during the Adaptive Gathering stage, as understood at this time, is a collecting focus oriented more toward land than the resources of the beach. This is inferred from the relatively few shellfish remains and the more numerous tools utilized in collecting and preparing plant foods. The hunting and fishing set is poorly represented both in artifactual and faunal remains, but within this set the foci of beach and bay are poorly developed if at all.

C. Dynamics-producing Factors: It has been stated that the La Jolla Complex represents a movement of people to the coast from the interior. This Complex appears to have been originally oriented toward collecting activities and only secondarily toward hunting. How and why these peoples came to the coast remain unknown. Once

on the coast, the new ecological zones of beach, bay, and ocean were open for exploitation. The collecting focus, operating in this new environment, represent the dynamics-producing factors.

D. Direction of Change: Given the economic focus of collecting and the increased number of ecological zones, an increased complexity and productivity of the collecting focus as it adapts to the new ecological zones, seems to be the direction indicated. Secondary and less-pronounced increases in complexity of the hunting and fishing set may also occur.

II. Incipient Maritime Stage

A. Environment and Limiting Factors: Plant cover during this stage was undoubtedly moving toward the historic plant communities and their distribution. With increase in drought and number of fires, the oaks and conifers were being replaced by chaparral, coastal sage scrub, and grasses. During the first part of this stage the bays and rocky foreshores along the coast were still in existence, and produced large quantities of shellfish. However, the rocky foreshore and bays were being reduced in size and productivity north of Mission Bay during the latter part of this stage.

B. Evidence for Economic Focus: Large numbers of shellfish remains in the middens of this stage, in conjunction with a variety of tools of the collecting set found in large numbers, are evidence for a more complex and

productive collecting focus utilizing more fully the range of ecological zones. Evidence for the hunting and fishing set is scanty during this stage, although hunting tools in the form of knives and points occur in small numbers and a few possible fishing tools such as "net weights" are present. Faunal remains of land mammals hunted and fish taken are few. Sea mammal hunting is suggested by possible seal bones from the Sorrento Site, but it was not important to the economy. However, at this time contact with Santa Catalina Island was made, indicated by the presence of steatite. Water crafts of some type must have been in use and people must have been inhabiting the offshore islands at this time.

C. Dynamics-producing Factors: The most productive plant community, broad-sclerophyll forests, was being replaced by chaparral, coastal sage scrub, and grasses. North of Mission Bay, rocky foreshores were disappearing under sandy beaches, and bays were being reduced in size and productivity by aggradation. In the Mission-San Diego Bay area, the sand carried by longshore movement developed a long spit across what is now Mission Bay, between Mt. Soledad and Point Loma. South of Point Loma, the Silver Strand was built up by the same process. The bays found at the mouths of rivers such as the San Diego and Otay were aggraded, but the larger San Diego and Mission bays were formed during the same period. Beaches and bays continued to be productive ecological zones in the San Diego-

Mission Bay area.

On Santa Catalina Island, the plant cover was presumably undergoing the same changes as on the mainland, and any coniferous stands that may have existed disappeared, as did most of the oak, while chaparral, coastal sage scrub, and grasses increased their distribution. The coastline of the island remained rocky and continued to support a large number of rock-dwelling shellfish as well as productive seal rookeries.

D. Direction of Change: Due to the variation occurring in the environment at this time, it appears that no one direction can be indicated, but rather that direction of change for the three areas discussed above is distinct for each. In the San Diego-Mission Bay area, the environment of the beach and bays remained essentially the same, with rocky shores persisting near the present town of La Jolla and on the outer coast of Point Loma. Quiet water behind the Silver Strand supported large quantities of fish and shellfish. The decrease in the conifers and oaks must have had some influence; however, oak trees were reported on Point Loma by early explorers and Torrey Pines must have persisted a few miles to the north of this area. In the San Diego and Mission bays area, the economy of the Incipient Maritime stage probably persisted. Unfortunately information for the critical period of 3000 B. C. to A. D. 500 is lacking. The description of the historic groups

inhabiting the San Diego Bay region seems to support the conclusion that the Incipient Maritime stage persisted until historic times.

On the coast north of San Diego and Mission bays, the economic pattern of the La Jolla people seems to have been put to the most severe test. Both land and littoral resources appear to have been depleted, with the aggradation of the bays and the pronounced reduction of oaks and conifers. The direction of change indicated here is away from the beach and toward land resources, due to the aggradation of the bays and the presumed increasing scarcity of fresh water near the coast. The abandonment of some villages and the decrease in population of others on the coast and bays, and the increase in the frequency of manos and the appearance of a somewhat larger number of projectiles (though still not found in quantity) seem to support this conclusion. There is also the possibility that there is an increasing importance of hunting activities in the latter part of Period III and a decreasing importance of seed gathering. It is clear, however, that these changes in relative importance of hunting and seed collecting are minor and that the collecting set, now oriented more toward the land resources, remained of primary importance.

III. Maritime Stage

A. Environment and Limiting Factors: The Maritime stage, at the present time, is represented by only the

Little Harbor Site on Santa Catalina Island. This site dates from a period of dessication (1924 B. C. and somewhat later), when presumably any coniferous or oak trees that may have been on the island had vanished. The productive plant communities were more limited than they had been earlier and were presumably in the process of decreasing even more. If the contemporary fauna of the island is any indication of past conditions, it, too, was severely limited except on the beaches.

The beaches of Santa Catalina Island are today considerably more rocky than those of the coast and support large numbers of abalone and mussels. This was apparently the condition of the beaches during the period of occupation of the Little Harbor site, since large quantities of shellfish remains are found in the midden. During this time, the environment of the island appears to have been quite different from that of the mainland. The flora and fauna of the island were at least equally as limited as on the mainland, with the exception of the island beaches, where shellfish abounded and seal rookeries were productive. The inland ecological zones of the island were as limiting as those of the mainland if not more so, while the island beaches provided an abundant supply of food and the potential of a new ecological pose in the hunting of sea mammals.

B. Evidence for Economic Focus: Large numbers of shellfish remains in the midden at Little Harbor point

to the importance of shellfish gathering. However, seed grinding tools are rare, being represented by a few mortars and pestles and manos and milling stones. The hunting and fishing set of the Little Harbor Site presents quite a different picture from that of the mainland. Projectile points are far more frequent, as are bone fish gorges and doughnut-shaped stones that may have been net sinkers. Finally, two shell fishhooks were recovered from the final phase of occupation at the site. The faunal remains in the midden included small numbers of land mammal and bird remains, while remains of sea animals were plentiful. The midden contained the highest proportion of shell by weight that has been recorded in California. Fish were an important part of the diet, as indicated by over 1883 fish bones recovered. Whale remains were noted in the form of fragmentary vertebrae and some unidentifiable fragments. By far, the most important animals hunted, however, were seals, dolphins and porpoises; combined they total more than 90 percent of the mammal bones recovered from the site.

The economic focus at Little Harbor is clearly distinct from that of the mainland. While the collecting set has one important ecological pose, as seen in the large quantity of shellfish remains, it is equally clear that the greatest concern was with the hunting of sea mammals and fishing. The economic focus clearly lies on the hunting set, with a well-developed maritime orientation.

C. Dynamics-producing Factors: The most productive ecological zone on the island was the beach. The collecting set thus had only one highly productive ecological pose: beach gathering. Such collecting activities undoubtedly brought man in contact with the rookeries and a new potential for the hunting set was recognized. This potential was not found on the San Diego Coast, where rookeries were absent or at least far less productive. That man at the Little Harbor Site hunted seals in the rookeries is confirmed by the fact that the identifiable seal bones recovered from the site were almost exclusively female. However, the most important hunting pose appears to have been fishing and hunting of porpoise and dolphin in open water. The hunting of these mammals requires techniques not directly evident in the archaeological remains. Further, there is a hiatus in the cultural development from a specialized collecting economy to a developed maritime hunting economy, and a lack of knowledge concerning environmental changes on Santa Catalina Island. The dynamics-producing factors, therefore, are largely unknown.

There is, however, a certain "imbalance" between the technology and the hunting production set at Little Harbor that suggests that certain changes might occur. This "imbalance" was noted by Meighan (1959: 401-2), when he wrote that the specialized maritime economy which exploited dolphins and porpoises to a great extent nonetheless produced

an artifact sample with no direct evidence of cetacean hunting. The "imbalance" between technology of generalized hunting tools and production by specialized hunting techniques suggests that the direction of technological change would be toward specialization of the tools and even greater productivity and complexity of the hunting set. The two shell fishhooks in the late occupation of the Little Harbor Site, may suggest a "correction" of this "imbalance" between technology and production.

D. Direction of Change: The Little Harbor Site appears to represent a distinct break from the cultural expressions recognized on the San Diego Coast. The intermediate steps between the specialized collecting economy like the La Jolla pattern and the specialized maritime economy of the Little Harbor Site are at present absent from the archaeological record. However, on the basis of the theoretical model presented in chapter iii above, and the known archaeological data, it is possible to postulate an "economic pattern" similar to that represented by the Milling Stone Complex on San Clemente Island (McKusick and Warren 1959) that will predate the Little Harbor Site and represent the earliest adaptation of the La Jolla-like cultures to the southern Channel Islands.

The "imbalance" between the hunting technology and the specialized hunting techniques at Little Harbor suggests that the hunting set represents a new economic

focus, and that specialization of tools and an increase in complexity and variability within the hunting set follows and leads to the historic maritime cultures of the Channel Islands.

IV. Land Resource Collecting Stage

A. Environment and Limiting Factors: This stage is restricted to the San Diego Coast, north of Mission Bay. The plant cover was probably very similar to what it is now with perhaps a slightly wider distribution of oaks and conifers. The coastline was characterized by ecologically highly variable lagoons which were largely silted in. The beaches were straight and sandy for the most part, with stretches of rocky foreshore appearing here and there.

B. Evidence for Economic Focus: Collecting activities still were the most important economic undertaking. The importance of these activities is reflected in the continued utilization of manos on a large scale, the introduction of the mortar and pestle, and continued use of shellfish wherever they were to be found in quantity. Evidence for hunting and fishing is very limited, though a slight increase in projectile points and the occasional occurrence of abalone shell fishhooks suggest that these two activities may have been becoming more important to the economy than they had been previously.

C. Dynamics-producing Factors: The population of the San Diego Coast appears to have been disrupted at

this time; some sites were abandoned and others were occupied for the first time during this period. This disruption has been interpreted as a population decline during a period when the economic adaptation was less productive than formerly due to changes in ecology. These changes are seen as the forces which brought about a situation in which the experimentation with new ways of food production probably would have been attempted in order to relieve hunger. Such attempts may be seen in the adoption of the mortar and pestle and the increase in use of hunting tools.

D. Direction of Change: Given the focus of collecting, with a decrease in economic potential of this activity because of environmental changes, a change in the direction of new economic activities would seem predictable. The increase in projectile points may represent the development of hunting. The protohistoric contacts with the east and with the Santa Barbara Channel probably had considerable influence on cultural developments of the San Diego Coast, and it cannot be determined what might have happened to the La Jolla pattern if it had not been so influenced.

Test of the Hypotheses

The cultural developments outlined above and presented in detail in chapter vii, may be viewed as empirical data against which we may test the hypotheses drawn from the theoretical model and presented in chapter iii.

Hypothesis 1: If the productivity of an ecological pose is reduced, this reduction will be compensated for by increased productivity in other ecological poses or the population and/or general cultural complexity will decrease.

The condition of reduced productivity of an ecological pose is documented for the area north of Mission Bay on the San Diego Coast. Here the bays that were present at the mouths of the rivers and streams became silted in and the rocky foreshores covered by sandy beaches. The productivity of the beach collecting pose was therefore reduced. That this reduction in productivity was at least in part compensated for by increased productivity in other ecological poses is indicated by the increase in the frequency of manos and projectile points and the introduction of the mortar and pestle. These changes in technology suggest increased activity occurred primarily in the land collecting poses and the development or acceptance of a new set of tools (mortar and pestle) suggests an attempt at coping with severe environmental changes. Secondary changes in technology in the form of increased numbers of projectiles appear to represent increased activities in the hunting pose, though of a lesser magnitude.

That these attempts at compensating for the reduction of shellfish by more concentrated efforts at land-oriented

collecting and hunting were unsuccessful seems highly probable. Environmental changes had apparently reduced the productivity of the land-oriented activities as well as the beach collecting. This decrease in total productivity appears to have resulted in a population decrease on the San Diego Coast north of Mission Bay. This population decrease is evident in the terminal date of ca. 3000 B. C. for the Scripps Estates Site and in the reduction of midden and artifact accumulation at SDi-603 on Batiquitos Lagoon after ca. 4000 B. C., and in the pausity of sites north of Mission Bay that date between 2500 B. C. and A. D. 1000. The few sites that were occupied between these dates are small and apparently represent temporary camp sites. Finally, burials are extremely rare for this period, whereas prior to 2500 B. C. they are quite common in midden sites.

There appears to be adequate evidence for not only a shift in economic activities, but a decrease in population on the San Diego Coast north of Mission Bay. This shift in economic activities may be explained by the environmental changes that severely reduced the productivity of beach and bay ecological zones. The data for the area north of Mission Bay appear to be adequate (though not ideal) for the testing of hypothesis 1.

The Little Harbor Site on Santa Catalina Island may represent a second test of this hypothesis if the

historical connection with the La Jolla cultural base is accepted. Here the land-oriented collecting poses were severely reduced as were the land hunting poses. The reduction in the productivity of these poses was clearly compensated for by the increased activity and productivity in the beach collecting pose, and the newly-developed beach and maritime hunting and fishing poses.

Hypothesis 2: If the reduction of productivity in one ecological pose is compensated for by increased productivity elsewhere, it is probable that such increase will occur in the economic focus, unless the increased productivity is limited by external factors and the condition of free choice no longer exists.

The data from the San Diego Coast north of Mission Bay may serve to test this hypothesis also. The reduction in productivity of the beach collecting pose has been established above for hypothesis 1. That there was increased activity primarily in the other poses of the collecting set appears to be indicated by the increased number of manos and the introduction of the mortar and pestle. That this activity fell short in supplying the needed increase in productivity seems likely. However, the greatest activity in the other ecological poses of the collecting set indicates that economic change was limited primarily to the economic focus and only secondarily to the hunting set. The conditions presented here are not ideal for the testing

of this hypothesis because the environment did limit the productivity of the economic focus as a whole. These developments on the coast as they are now interpreted, however, strongly suggest that economic change does take place in the manner stated in the hypothesis.

Hypothesis 3: If the productivity of the economic focus is severely limited in all or most of its ecological poses, it is probable that a new focus will develop in a potentially more productive set.

The conditions necessary for testing this hypothesis are present on Santa Catalina Island, if historic connection with a La Jolla-like culture is accepted. The productivity of all of the land collecting poses was severely limited by the changes in the environment and the size of the island. The only collecting pose that was highly productive was that of the beach. There was thus a decrease in productivity of the collecting set. At the same time, the presence of rookeries on the beaches of Catalina Island represented a potentially highly productive hunting pose. Once this pose was utilized the extension of hunting to other sea mammals at sea would seem reasonable, since seals retreat to the open water when threatened. The hunting of seals by boat appears likely and once this occurs, the porpoise and dolphin become potential food supplies.

Here again the conditions for testing the hypothesis are less than ideal. However, the data do suggest such

developments. However, before these hypotheses can be adequately tested certain kinds of evidence are needed, such as changes in vegetation and more complete cultural sequences on Santa Catalina Island and in the vicinity of San Diego and Mission bays. With such data, these hypotheses can be tested more reliably on the Southern California coast.

Some General Interpretations of San Diego Coastal Prehistory

On the coast, the La Jolla Land Collecting stage persisted until historic times in the area north of Mission Bay while in the Mission and San Diego bays area, the Incipient Maritime stage appears to have lasted an equally long time. The economic activities of the inhabitants of the San Diego Coast described by the early explorers are very similar to the activities visualized for the La Jolla pattern which developed about 3000 years B. C.--Incipient Maritime in the San Diego-Mission Bay area, Land Collecting stage north of Mission Bay.

The cultural pattern in general, however, obviously changed with the introduction of the "Yuman" and San Luis Rey influences. Not only were material objects added to the artifact inventory, but new methods of disposing of the dead were adopted, and presumably new beliefs concerning life after death and perhaps religion in general. The socio-political organization of the La Jolla peoples between 3000 B. C. and A. D. 1300 is anything but clear, and any changes that may have been introduced with the Yuman

and San Luis Rey influences remain equally unclear. Data concerning settlement patterns for that period and for the later period of Yuman and San Luis Rey influences are poorly understood and a greater knowledge of this aspect of San Diego Coast prehistory might throw additional light on the socio-political developments.

What is clear is that the model designed in chapter iii above, while useful in the analysis of economic change and continuity, does not allow for analysis of changes in many other aspects of culture. The settlement pattern, the economic activities, and even most of the tools of the Land Resource Collecting stage of the La Jolla culture, as nearly as we can now determine, were identical with or very similar to those of the later period of Yuman and San Luis Rey influences. However, it is apparent that those influences resulted in a culture distinctly different in many ways from the earlier La Jolla culture.

The emphasis on the studies of economy and ecology found in archaeological work of recent decades obviously has potential for increasing our knowledge and understanding of prehistory. However, the necessity of studying the cultural patterns reflected in the typology of the artifacts, burial patterns, house types and so on, is amply illustrated by the cultural changes which took place during the time of Yuman and San Luis Rey influence on the San Diego Coast. The ecological adaptation of the old La Jolla

pattern was apparently so well suited to the resources of the San Diego Coastal Province that little change in economic pattern was induced. Furthermore, the Yuman and San Luis Rey Complexes apparently also had a gathering focus. On the other hand, there is ample evidence for changes in burial patterns and, by inference, changes in religious beliefs. Such changes are not reflected in the economic pattern of these prehistoric societies.

The analytical model outlined in chapter iii has, I think, provided new insights into the cultural continuity of the San Diego Coast and possibly into the development of the maritime culture of the Channel Islands. The application of this model makes possible the analysis of cultural remains in light of ecological changes and ecological adaptation. Particularly, it negates the concepts of a culturally regressive and stagnated population on the San Diego Coast. Instead, the culture and the population are viewed as adapted to the environment and changing with it, within the limits set by the economic focus and environmental factors.

The cultural orientation in which the population was enculturated apparently inhibited change away from a collecting focus. This is especially true during the Incipient Maritime stage, when opportunity for a maritime economy was greatest. With the environmental changes of the coast, pressures for change in economic pattern occurred, but

these same environmental changes inhibited the development of a maritime economy by the reduction of the coastline productivity and the increasing scarcity of fresh water near the beaches. Pressures for change were thus directed toward productive activities of the land. The economic focus determined the direction this change was to take, that is, toward increased collecting activities with hunting activities seeming to increase only slightly under severe reduction of the collecting set. The apparent cultural regression and stagnation in fact reflects ecological changes resulting in an environment less hospitable to the La Jolla economic pattern. The apparent regression thus seems to be the function of the focusing principle in the realm of economics. Economic stability in a changing environment appears to be a better description of the La Jolla development on the San Diego Coast.

Once the shellfish supply had been depleted by silting in of bays and the development of sandy beaches, there was little opportunity to develop a maritime orientation north of Mission Bay, since most economic activities and the settlement pattern became located at some distance from the seashore, near sources of fresh water. Economic activities on land were restricted primarily to the gathering set, although hunting probably increased to some extent after the lagoons silted in. That small game animals were present in some numbers, cannot be proven, but is strongly suggested

by the reports of early explorers and the reconstructed plant succession and climate. It therefore seems probable that the ecology would not prevent greater development of hunting activities.

The conservative nature of the La Jolla pattern may best be explained by a pronounced collecting focus which first functioned in an environment of plentiful littoral resources, but when ecological changes reduced these resources, the pattern shifted to a primarily land-oriented economy because the ecological changes along the San Diego Coast north of Mission Bay prohibited the development of large, permanent occupation sites directly on the coast. Under these conditions, the land-oriented collecting economy of the historic groups of the San Diego Coast may be seen as the cumulative conservative effect of the operation of a collecting focus in the changing environmental conditions.

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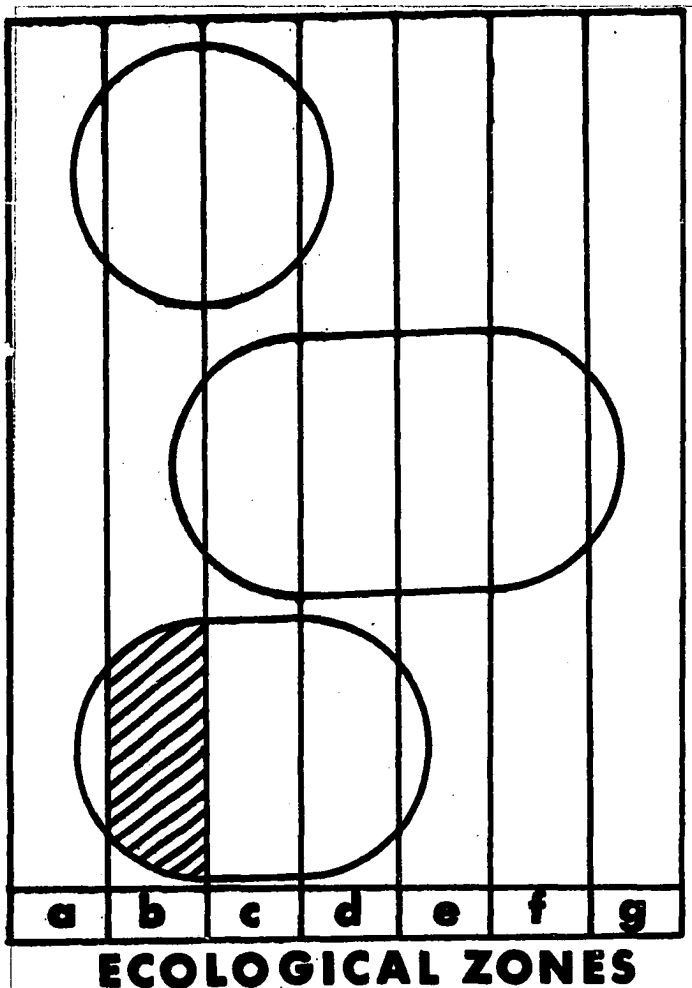

i. Production set of minor importance.

ii. Production set of major importance (economic focus).

iii. Production set with non-contiguous ecological zones.

Explanation of figure: Vertical columns represent ecological zones. Circles and ovals represent production sets. Segments of vertical columns in each set represents the ecological poses of that set.

Figure 1: Production Sets, Ecological Zones and Ecological Poses

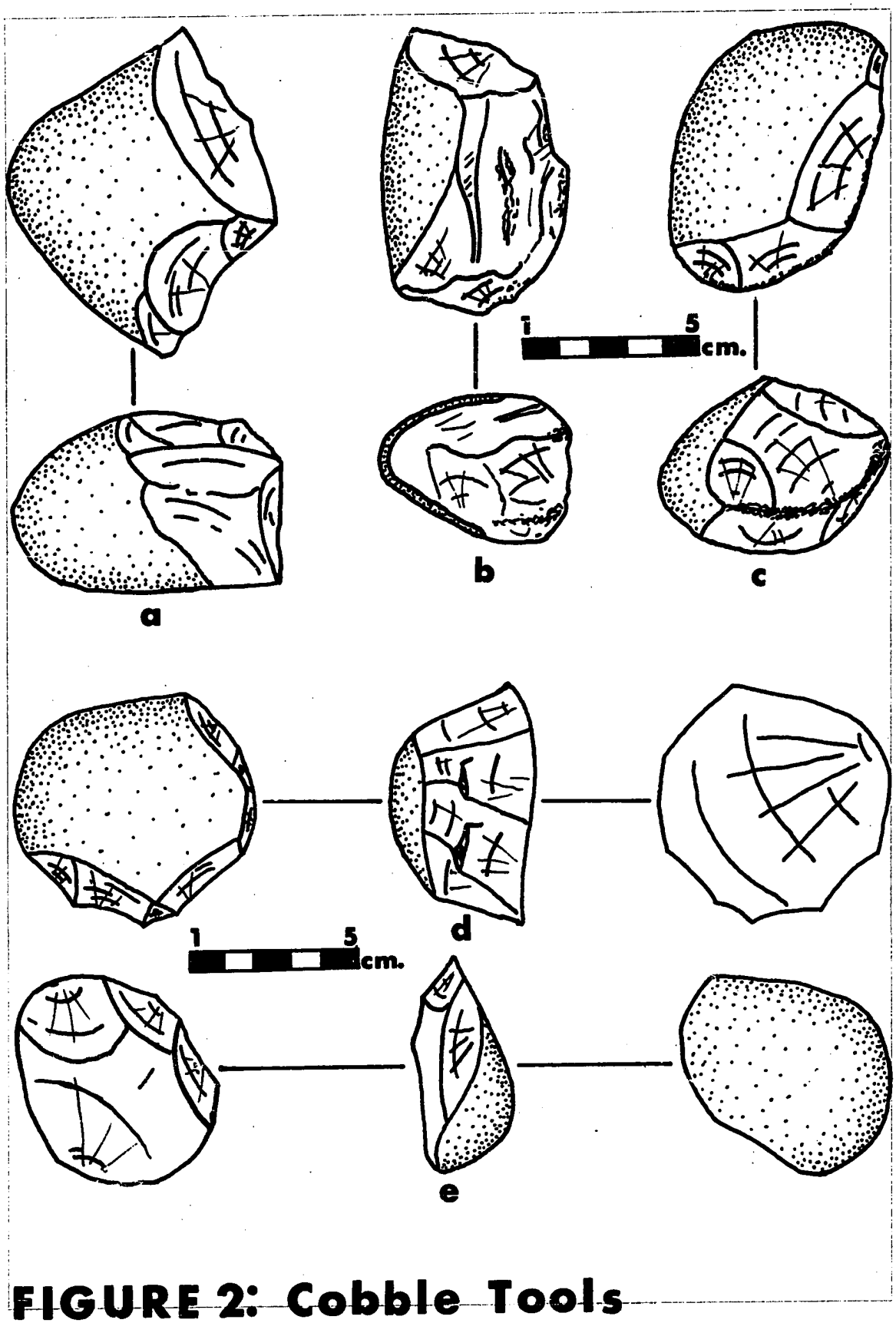

FIGURE 2: Cobble Tools

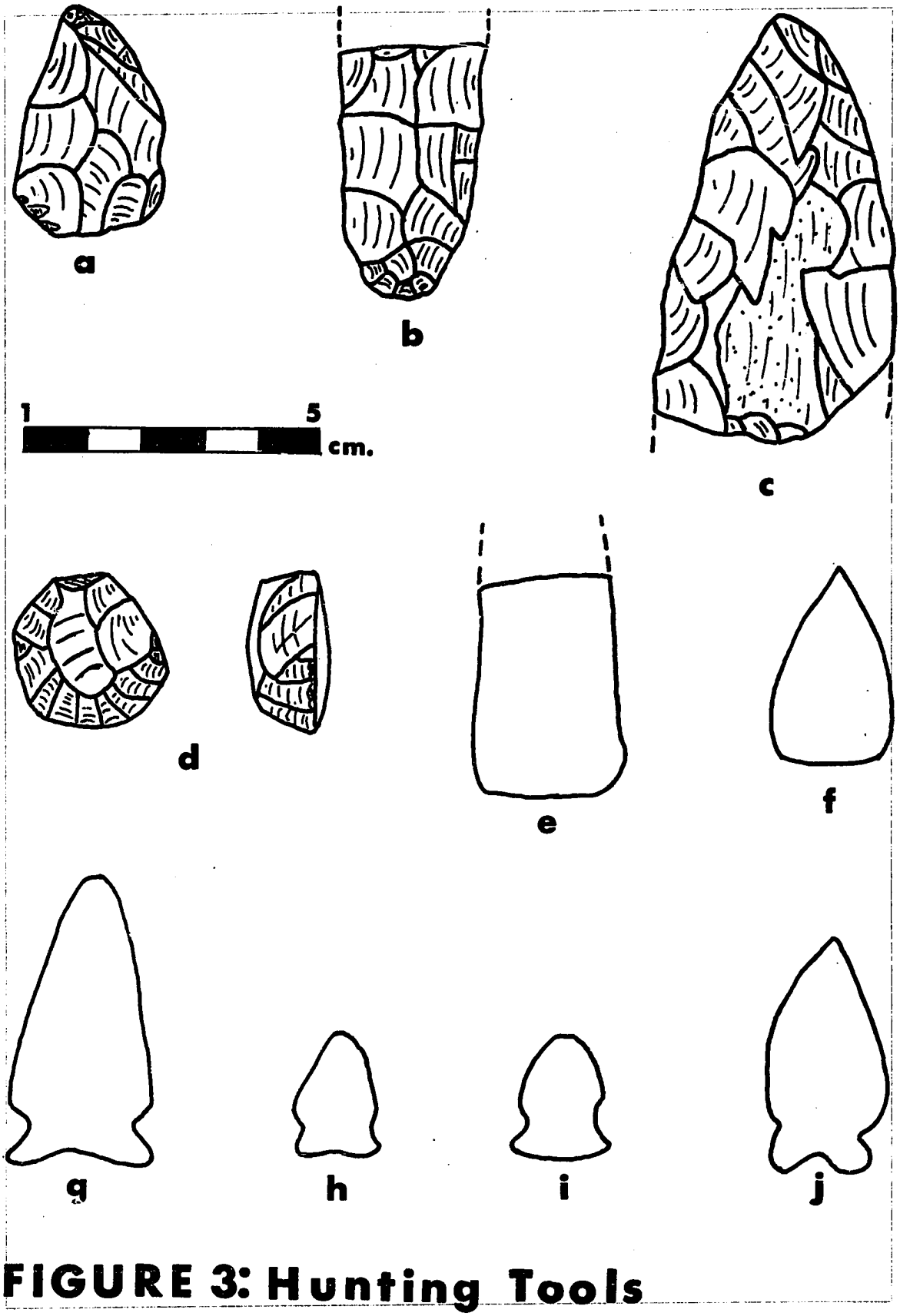

FIGURE 3: Hunting Tools

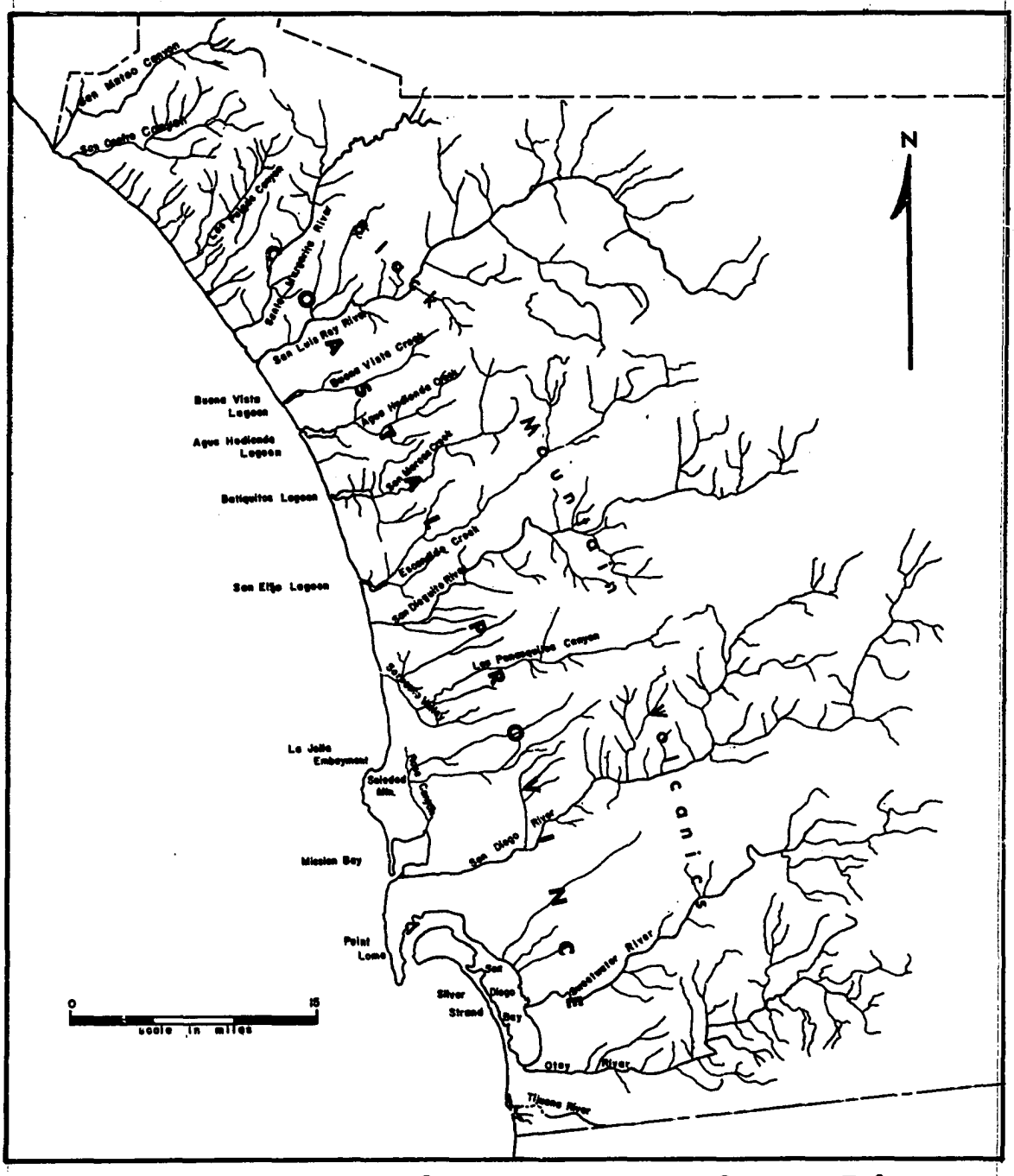

FIGURE 4: Map of Western San Diego County, California

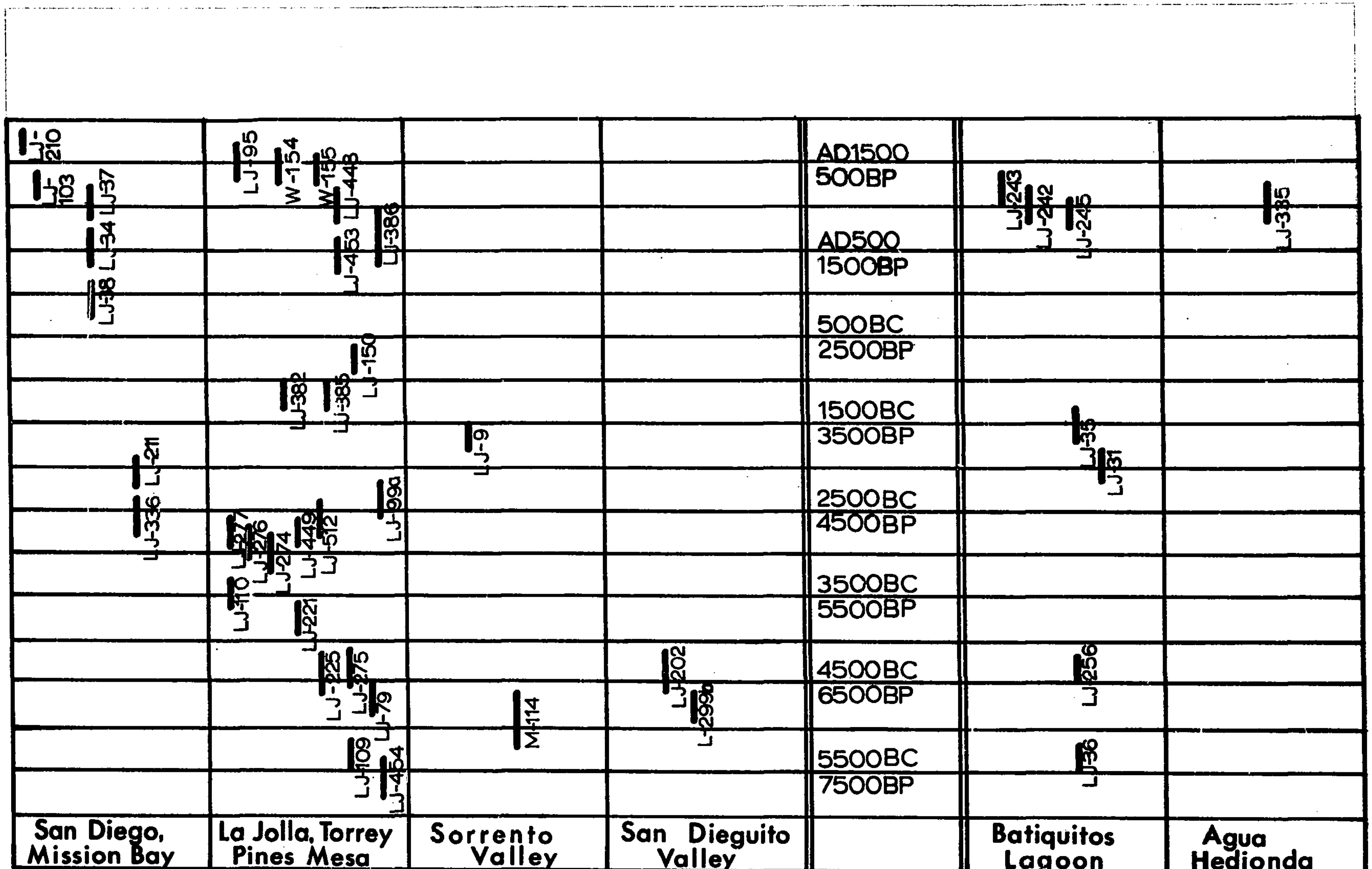

CHART 1: Radiocarbon Dates on the San Diego Coast