APPENDIX III

GENERAL RESEARCH DESIGN: BAY AREA ARCHAEOLOGICAL COOPERATIVE

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EDITORIAL NOTE

The research design presented below was developed during 1971-72 by Chester D. King and Linda B. King for use by the cooperating institutions that constitute the Bay Area Archaeological Cooperative. Although it has been circulated in mimeograph form, it has not been previously published. This version has been subjected to minor editing.

AN EXPLANATION OF SITE LOCATIONS

PROBLEM: Why are archaeological sites located where they are and why do the locations of archaeological sites representing different time periods differ?

HYPOTHESIS: The distribution of archaeological sites is the resultant of the optimum use of energy outputs in maintaining flows of energy inputs.

DISCUSSION: The above hypothesis can be deduced from the Darwin-Lotka Energy Law, which states that the maximization of power for useful purposes (system maintenance) is the criterion for natural selection. Systems which develop as a result of natural selection (all systems which are characterized by growth and reproduction) apportion incoming energy flows to optimize the reinforcement of energy flows into the system.

Also important in the deduction of this hypothesis are the concepts developed in locational theory which stress economic location. Economic locational theory (central place theory) is based on the existence of transportation costs. The minimization of costs involved in maintaining relationships (flows between two places) is theorized to result in systematic locational arrangements. Locomotion costs are a function of 1) distance, 2) mass, and 3) effort of movement. Locomotion (friction) costs are less in a boat in still water than when a load is carried on the back on level ground.

In order to correlate the location of consumers with energy sources, it is necessary to expend energy in locomotion (transport) costs, manufacturing costs, information costs, and processing costs. Cultural systems optimize the use of their energy budgets through the efficient placement of personnel in space; this results in regularities in archaeological site distribution and in the distribution of activity loci within sites. Changes in site distribution should therefore reflect changes or differences in available inputs due to technological changes or changes in the non-cultural aspects of the environment (i.e. climate, etc.).

Placement of personnel is determined by: 1) the distribution of resources and 2) the distribution of other personnel (social factors); for example, cooperating groups and the distribution of food stores used by members of these groups.

THE SPATIAL DISTRIBUTION OF RESOURCES

In order to optimally utilize resources, it is necessary to maintain flows of substances which allow efficient use of energy, such as proteins, firewood for cooking, and water. Inputs have to be in proportion relative to their usefulness. An example of the effects of this relationship is the requirement for efficient utilization of soaproot bulbs (amole). The utilization of soaproot as food required 1) soaproot bulbs, 2) heating rocks, 3) firewood, 4) clay for sealing ovens, and 5) roasting ovens (excavated pits). The location of the ovens can be postulated to be determined by the location of 1-4. Of these it is probable that good firewood would require the greatest cost in movement, followed by heating rocks (which, or course, could be reused) and clay, and lastly by the location of soaproot bulbs. It is probable that in economizing the costs of soaproot preparation a site would be chosen where at least firewood, heating rocks and clay were in proximity. Of course, locations where all of the components of soaproot bulb processing are in proximity are the best locations. The exploitation of other resources (such as water) also acts to introduce location-determining variables which can affect the location of soaproot bulb preparation.

THE TEMPORAL DISTRIBUTION OF RESOURCES

Within any given year the food (energy) sources which are available to a hunting and gathering cultural system vary from season to season. These changes can result in increased costs of staying in one place and decreased costs of staying at other locations. When it becomes more efficient to move to an optimum location than to remain at a previous location, it can be hypothesized that the population will move to the optimum location. Social factors, which will be discussed next, may act to prevent changes in locations, however.

The cultural systems occupying a given area evolve new feedback loops. Some examples are the grinding of seeds, baking of bulbs, leaching of acorns, food boiling, frying, use of nets, use of boats, and agriculture. These feedback loops result in the creation of new resources. The use of these resources results in changes in the values of previously used resources. The changes in the values of previously used resources can, as in the case of seasonal changes, result in changes in the values of different site locations, and often different site sizes.

THE DISTRIBUTION OF PERSONNEL

Resource distributions have been hypothesized to result in the distribution of personnel. In this section I shall discuss the relation of particular social responses in maximizing the use of available energy. These responses are due to the existence of systematic relationships between resource distribution and behavior.

There is evidence of specialization of labor for all known human groups. Individuals of different ages, classes, sexes or physical condition often perform different activities at the same time. Each of these activities requires particular behavior patterns. The preparation of the different input materials obtained and their consumption may often, however, be most efficiently carried out at a common location. In the case of human groups, eating in a central place evidently is more economical than dispersing from optimum locations determined by particular resources. The location of sites is determined by the solution of the system of equations defining the costs of locomotion for every resource.

Eating in a central place is also a function of the maintenance of food stores. Food stores are often maintained near food preparation areas or near food gathering areas in order to keep locomotion costs at a minimum. The location of food stores may be defined by the solution of the system of equations defining locomotion costs of resource acquisition for a number of seasons in which many different resources are being utilized. Some of the resources which can be utilized through trade are the food stores maintained by other groups. The location of these stores and the pathways (networks) along which energy flows can most efficiently occur often are significant in determining site locations. The importance of locating in relationship to trade networks should correlate with the importance of production of trade materials. The best locations for trade increase in value as the importance of other determinants decreases relative to trade.

Another social variable which can be important in determining particular site locations is warfare. The occupation of defensive positions often apparently results in increases in locomotion costs associated with resource acquisition. Warfare, however, is often associated with the maintenance of boundaries keeping energy flows within a system. Increases in population concentration and the choice of site location more in terms of defense than resources acquisition may represent the importance of costs of maintaining insulation against energy drains and ultimate resource degradation. Defense costs can also be greater than needed to maintain equilibrium systems when they are the costs of extreme competition which exists when populations are maintained at a level which is occasionally higher than can be efficiently maintained. High levels of competition can be maintained over an extended period of time when they result in the generation of new feedback loops, as in the case of our own cultural system. When technological changes occur at a decreased rate, equilibrium systems (alliances, nations, etc.) will evolve which will act to reduce defense costs and thereby result in an increased importance of locomotor costs related to resource acquisition.

TESTING THE HYPOTHESIS

This is a hypothesis of great theoretical importance because it is an expression of a basic theory of form inherent in evolutionary theory. This basic theory can be stated as follows: <u>the form of reproducing open systems (living systems) resulting from natural selection is a function of maximizing energy taken in by the most efficient movement of mass</u>.

The presentation of the above in the form of a hypothesis explaining site distribution is meant to serve as a guideline for the gathering of data on sites in the San Francisco Bay Area. The testing of systems theories such as the above can best be done by holding all but one of the causal variables constant and measuring the effects of changing one variable at a time. By holding most of the variables constant in different cases, it is possible to build a model of the total system which should accommodate all of the data concerning site distributions and allow us to predict the location of undiscovered sites or destroyed sites whose previous existence can be checked with informant data.

Data on site locations, size and surface characteristics are best gathered through intensive site surveys. Particular areas should be chosen for intensive reconnaissance, and the remainder of the area covered should be surveyed in the light of the knowledge concerning site locations produced by intensive surveys. The size and location of areas chosen for intensive surveys should be determined on the basis of 1) degree of site destruction, and 2) a conscious attempt to cover a large contiguous area which includes most of the microenvironments (plant communities) present in the area from which the sample is drawn. The intensive surveying of an area should include ridges separating drainages, the shores of bodies of water, or any other possible habitable place.

A small excavation program will probably then be necessary to date some of the discovered sites, although local collections by farmers or others will probably enable us to date many sites.

The discovered sites can then be sorted into types based on their surface characteristics and chronologically dated. In some cases sites of given types will all fall into the same time period, and in other cases will be common to many time periods. When we observe a change in the types of sites being used at a particular time, we can hypothesize that the change in site types is due to changes in the resources being used or in the social environment.

In cases where the change in site type involves the choice of more easily defended location or is located at an important intersection of trade networks, we should look for social causes. In other cases we can usually assume that the change in site location was due to changes in technology related to local resource acquisition.

One of the important features of the hypothesis explaining site locations is its ability to provide a framework for the organization of data relevant to our area's prehistory. In addition to strictly archaeological data, we need to obtain information on resource distribution, including maps of pertinent botanical distributions and studies of yield and nutritional value. It will also be necessary to accurately similate the costs of resource acquisition with the aid of physiologists, and to obtain data on population sizes, site locations, and intersite relationships during the historic period, from mission records, early diaries, and ethnographic reports.