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South Carolina Institute of Archaeology and Anthropology--University of South Carolina

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THE ANALYSIS OF LATE ARCHAIC–EARLY WOODLAND
ADAPTIVE CHANGE ALONG THE MIDDLE
SAVANNAH RIVER: A PROPOSED STUDY

Glen T. Hanson, Jr.
The following contribution by Glen Hanson represents an ambitious and innovative approach to the study of prehistoric adaptive change. The culture change manifested during the Late Archaic through Early Woodland interval has occupied the attention of archeologists throughout the eastern United States. Generally speaking, in most areas of the Southeast, it is during this period that we see the first major evidence of village occupancy. Prior to the Late Archaic period, Archaic groups along the Atlantic Slope appear to have been much more mobile in their settlement strategies. The demographic and cultural factors surrounding the increase in sedentism and subsequent feedback relationships triggered by such geographic reorientations in man-land relationships are topics of great theoretical interest to anthropologically-oriented archeologists.

Hanson's model is noteworthy for its attempt to link archeological manifestations of this important settlement transition from more mobile to more sedentary systems as seen in the Savannah River Valley, with hunter-gatherer settlement behavior through time and space. The design of the research is explicitly explanation-oriented as opposed to simple description in service of no higher order goals. In order to make such a linkage, several important steps must be taken. His approach is exemplary with its comprehensive consideration of chronology, locational analysis, assemblage variability, and resource analysis. Each of these analytical domains is considered in terms of its role in the overall model. Such a study is also befitting of the long range problem-oriented approach to the cultural resource management of a major portion of the upper Coastal Plain, now occupied by the Savannah River Plant. The pursuit of this proposal will no doubt lead to more enlightened management of the Plant's archeological resources.

Although evaluation of the model has not been completed at this time, I encouraged Glen Hanson to make his ideas available to other scholars by publication of this dissertation proposal. It provides even at this stage a degree of synthesis badly needed for this important region of the Southeast. Furthermore, his approach to the archeological study of culture change can serve as a source of theoretical and methodological stimulation for other studies related to similar problems.

Albert Goodyear
INTRODUCTION

Archeological investigations along the Savannah River in both Georgia and South Carolina have been ongoing since the last quarter of the nineteenth century. Although much of the research has yielded significant information relevant to the general chronology and material culture variability in the region, few attempts at theoretically based synthesis have been offered to improve the general understanding of cultural processes and change in the area. The research proposed in this document is offered as a partial solution to the problem of theoretical and synthetic vacuity in the region.

Central to the proposed research is the combination of economic and ecological theory applied to human populations of hunter-gatherers. During the past several decades the literature of anthropology has been enriched by treatises addressing the nature of hunter-gatherer groups operating in diverse environmental contexts (Binford 1977, 1978, n.d.; Jochim 1976; Lee and DeVore 1976; Watanabe 1972). Common to all these studies has been the conclusion that populations of hunter-gatherers are subject to basic ecological interactions with their environments. Among the more relevant variables recognized in different adaptations are human population size, food resource seasonality, food resource aggregation, human group mobility and exploitive technology. The interplay of these and other variables has been seen to have significant effect on the structure of a particular group's adaptive strategy. Using the wealth of ethnographic and archeological studies pertaining to hunter-gatherer populations as a foundation, the proposed study will offer a model of prehistoric adaptive change to explain the Late Archaic-Early Woodland transition in the riverine province of the Savannah River below the Fall Line.

The archeological basis for this study is the data recovered from a survey on the Savannah River Plant in west-central South Carolina that has been sponsored by the United States Department of Energy. Research within the 777 square kilometer study area has thus far yielded 288 prehistoric sites representing 316 individual components. Documentation of the research conducted between 1973 and 1977 is presented by Hanson, Most and Anderson (1978) in a preliminary report that includes general descriptions and initial analytical results.

Present Research

Research directed toward the accumulation of archeological data from the Savannah River Plant has been a continuing, although intermittent, process since 1973 when the Institute of Archeology and Anthropology, University of South Carolina, implemented an initial reconnaissance of the area. The scope of research within the Savannah River Plant was limited on earlier occasions by financial and professional constraints relating to the immense size of the study area. For these reasons, survey was restricted to the examination of areas which offered above average ground surface visibility (e.g., dirt roadways, fire breaks and powerlines). Nonetheless, the distribution of sample
transects in the Savannah River Plant has resulted in a working sample of 288 prehistoric sites that range in age from the Early Archaic Period to the Mississippian Period (Hanson, Most and Anderson 1978).

In July 1978 a second phase of archeological investigations at the Savannah River Plant was initiated under the direction of the author for the purpose of completing an inventory of sites. This program has been funded for a period of two years and will be renewed for an additional five years to allow for a thorough examination of the region. Data collected through mid-1980 will greatly supplement the extant data base by adding additional sites to the inventory and by providing excavated material for comparative analyses. Most important among the results of the present research has been the partial excavation of the Tinker Creek Site (38AK244) and the location of other Late Archaic Period and Early Woodland Period sites.

Related Research

Prehistoric archeological research in the Savannah River Valley below the Fall Line has a long history beginning with the work of C. C. Jones (1861, 1873), Cyrus Thomas (1894) and Clarence B. Moore (1898). Most of the significant, scientific information to be derived from the basin, however, has resulted from the systematic excavation of sites such as Stallings Island (Claflin 1931; Sears and Griffin 1950; Fairbanks 1942; Bollen and Green 1970), White's Mount (Phelps and Burgess 1964), Hollywood Mount (DeBaillou 1965), Rabbit Mount (Stoltman 1972, 1974), Clear Mount (Stoltman 1974, Peterson 1971), Cox (Trinkley n.d.), Refuge (Williams 1968: 198-208), Spring Lake (Miller 1949), Bilbo (Williams 1968: 152-197), Dulany (Williams 1968), Chester Field (Williams 1968: 208), Deptford (Waring and Holder 1968), Irene (Caldwell and McCann 1941) and numerous coastal shell middens (see DePratter 1977; DePratter and Howard 1977; Crusoe and DePratter 1976). In all but the most recent cases, the results of the research have been directed toward the description of artifact assemblages, the formulation of ceramic chronologies and the search for the origins of fiber tempered ceramics.

Due to the nature of these problems the scope of research has been often limited to single site archeology in an attempt to refine existing chronologies. Although this problem is most important in understanding the prehistory of the Savannah River Valley, there has been a need for more regional approaches to problems of culture change and human adaptations in this diverse environmental context. During the past decade studies have begun to examine such problems using larger samples of sites and a diachronic perspective. Most noteworthy among these efforts are those of Stoltman (1972, 1974) for the Middle Coastal Plain area and of DePratter (1977) and DePratter and Howard (1977) for the Savannah River delta.

Stoltman (1974) presents a model of subsistence and settlement change for the Savannah River basin within the Coastal Plain province which uses a modest sample of sites dating from the Late Archaic through the Mississippian Periods as supportive evidence. Based on
data collected from Groton Plantation, he proposed a number of settle­ment shifts that are equated with major changes in subsistence prac­tices. The first shift occurs following the Late Archaic (circa 1000 B.C.) when settlement emphasis changed from a floodplain-aquatic orienta­tion to a mixed settlement pattern associated with both floodplain and upland areas during the Early Woodland (1000 B.C. to 500 B.C.). A second change in settlement is associated with the Middle and Late Woodland Periods (500 B.C. to A.D. 1000) when sites were restricted to non-floodplain environs. This shift is considered to correlate with the adoption of slash and burn horticulture (Stoltman 1974: 215). A final shift is inferred for the Mississippian Period (A.D. 1000 to A.D. 1700) which consists of an intensive utilization of the floodplain environment for purposes of intensive agriculture. Although much of this model is speculative, it is an initial attempt to synthesize the prehistory of the region in more than chronological terms. Portions of the model and its supporting data will be considered in the development of the proposed study.

DePratter (1977) and DePratter and Howard (1977) present two sig­nificant results which relate directly to the present research. First, through a compilation of data from coastal sites the authors have of­fered a refined chronology for the Georgia coast and Savannah River delta. This chronology allows for the relative dating of archeological sites within the Savannah River drainage; it is also based on a good sample of radiometric dates. Coupled with data from Rabbit Mount (Stoltman 1974) and Stallings Island (Bullen and Green 1970), a re­liable chronology for the study can be abstracted. Second, DePratter (1977) has demonstrated a significant correlation between relative sea level and settlement on the coast. Using settlement distributions and geological data, he was able to demonstrate two peak sea level stands at 2350 B.C. (sea level 1.5 to 2 meters below present) and 400 B.C. (sea level equal to present) separated by a low sea level of 3 to 4 meters below present between 1100 and 700 B.C. These fluctuations correlate quite well with his St. Simons (Late Archaic), Refuge (Early Woodland) and Oemler-Deptford (Late Early Woodland) phases, respec­tively. Further, DePratter discusses the subsistence implications of sea level variations, especially in relation to the availability of shellfish and other aquatic resources in estuaries. Although this research pertains to an area different from the Upper Coastal Plain riverine zone of the Savannah River in the proposed study, the implications of settlement and subsistence changes related to sea level will form a key proposition in the proposed model.

Finally, Stoltman (1972) has attempted the formulation of a spe­cific synthesis of the Savannah River region during the Late Archaic Period which purports to deal with all existing data. By using a sam­ple of 24 sites with evidence of fiber tempered pottery located in 5 distinct environmental zones [Piedmont Uplands, Interior Coastal Plain, Atlantic Littoral, Savannah River Valley (coastal plain segment) and Savannah River Valley (piedmont segment)], he contrasts two major sub­sistence-settlement strategies. On the one hand is a coastal, oyster gathering pattern associated with coastal shell rings in South Carolina and Georgia. On the other hand is an inland, riverine mussel-gathering pattern associated with the Coastal Plain segment of the Savannah
River. In both cases populations are thought to have relied on large and small game and plant materials for a considerable portion of the diet. A major cause of Late Archaic decline and abandonment of shellfish as a resource is thought to be a sea level rise and concomitant violent flooding, the flooding being the result of decreased river gradient and more frequent overbank erosion, which would have effected mussel productivity.

When examined in aggregate, the previous research in the Savannah River region for the period from 4,500 B.P. to 1,900 B.P. suggests a rather significant alteration in the adaptive systems of the resident populations. This general change in settlement and subsistence is by no means restricted to a single river system, but rather has been noted throughout the Atlantic Slope from Florida to Maine (Caldwell 1958; Griffin 1967; Ford 1974; Coe 1964; Dincauze 1976; Cleland 1976). During the Late Archaic Period along the Atlantic slope a similar pattern of seasonal resource use has been discussed by Turnbaugh (1975) which is related to aquatic resources. The hallmark of this period is the broadpoint artifact class, which includes the Savannah River Stemmed type (Claflin 1931), the Koens-Crispin type (Hawkes and Linton 1916), the Snook Kill type (Ritchie 1961), the Atlantic type (Dincauze 1972) and the Lehigh type (Witthoft 1959). Although inferences beyond similarities in lithic tool form are suggested by Turnbaugh, the significant formal similarity between the different areas suggests that a specific functional category was being utilized over 1,500 miles of the Atlantic Slope (Cook 1976). In addition to this similarity, there appears to be a definite orientation throughout the Atlantic Slope for Late Archaic populations to focus on riverine and coastal environments suggesting a biased reliance on these zones (Dincauze 1976). Following a universal rise in sea level along the coast, the formal artifact similarities among large segments of the Atlantic Slope populations become diminished indicating changes in local and regional adaptive patterns.

In summary, when the data from the Savannah River drainage below the Fall Line are examined in a broader framework, similarities exist to a level beyond which local variability becomes more significant. For this reason, the proposed research will concentrate on the adaptations of human populations to local and regional variability in the Savannah River basin. The primary data base for the study will be the detailed archeological and locational information gathered during the Savannah River Plant surveys. These data will permit a thorough examination of a settlement-subsistence stability and change between 4,500 and 1,900 B.P. and will be augmented by selective data from relevant sites in the vicinity. The following sections of the proposal will present the theoretical and methodological design for the study.

ENVIRONMENTAL AND ARCHEOLOGICAL BACKGROUND

The archeological research on the Savannah River Plant has the potential value of contributing a significant sample of settlement and
subsistence information to the previously biased data base for all periods of prehistory in the Savannah River Valley. As discussed in the preceding section of the proposal, settlement studies have been restricted to examinations of large, excavated sites without consideration for the total range of variability in the settlement pattern. Although such studies have provided useful observations and generalizations about site distributions, they have failed to provide either an accurate description or explanation of settlement variability and related subsistence activity. This archeological problem is most readily apparent when one tries to understand the change that occurred between the Late Archaic and the Early Woodland Periods. Most available data for this time frame are limited to selective excavations at large shell midden sites, coastal shell rings and large villages. Due to the biased faunal content and preservation in these sites, models have been formulated as though such loci constituted the entire settlement system. Little research effort has been made to survey systematically large parcels of land in order to determine the structure of the total system. It is with this previous, biased data base in mind that much of the following is proposed.

Contrary to the rather simplified reconstruction offered by Stoltman (1972) for the ecological variability in the Savannah River region, the Coastal Plain area of the valley between the delta and the Fall Line is a diverse natural environment composed of a multitude of ecological zones capable of supporting the subsistence needs of human populations. Within the Upper Coastal Plain Physiographic Province (Cooke 1931; Siple 1967) elevations range from 90 to 500 feet above mean sea level. Tributaries of the Savannah River have dissected the Cretaceous and post-Cretaceous sediments into extensive dendritic patterns with diverse bottomland and valley vegetation communities. Pleistocene terraces along the Savannah River provide suitable locations for mesic vegetation communities and diverse wildlife. The river and tributary streams contain numerous species of faunal and floral resources for use by human populations. In the context of such diversity in the natural environment, any model that considers only a limited segment such as the floodplain-terrace zone (cf. Stoltman 1974) ignores the potential of more than 90% of the drainage basin. Given our knowledge of modern hunter-gatherers throughout the world (Binford n.d.; Bicchieri 1972; Lee and DeVore 1976; Watanabe 1972), it would be naive to assume that prehistoric hunter-gatherers would restrict their activities to only a limited portion of an easily accessible and diverse environmental setting.

Within the confines of the Savannah River Plant, four major floristic communities have been described by Beavers et al. (1973) and Langley and Marter (1973): a xeric upland community; a mesic hardwood community; a small stream floodplain community; and a riverine floodplain community. The distribution of these modern communities is directly correlated with the factors of soil texture and topography. Areas above circa 200 feet in elevation (Fig. 1) are most generally associated with a xeric upland community dominated by Pinus palustris, Quercus laevis, Quercus marilandica, Quercus stellata, Quercus acer and Quercus falcata. The pine-scrub oak upland community occurs on inter-riverine ridges between all streams. A mesic variant of this
Figure 1: Topographic map of the Savannah River Plant.
community exists along ridgeslopes on less sandy soils and is dominated by Quercus alba, Quercus stellata, Quercus falcata, Carya tomentosa, Carya glabra, and Pinus echinata. This variant and upland xeric communities would afford a rich seasonal production of oak mast and high densities of fauna, especially deer.

Along the small streams and on the Savannah River terraces where soil texture promotes higher moisture levels, a mesic vegetation community predominates. The composition of this community is dominated by the following hardwood species: Quercus alba, Quercus velutina, Quercus michauxii, Quercus phellos, Carya tomentosa, Carya Glabra, Quercus nigra, Liquidambar styraciflua, Liriodendron tulipfera, Fraxinus spp., Diospyros virginiana, and Oxydendron arboreum. This composition of mixed hardwood species would provide substantial food resources to prehistoric hunter-gatherers. Further, the abundance of deer and other game species has been well documented for this community (Urbston and Rabon 1972; Jenkins and Provost 1964; Wood and Odum 1965; Golley et al. 1965).

The third major vegetation community occurs along small streams, which are subject to occasional flooding. This small stream hydric community is typified by Liquidambar styraciflua, Liquidambar tulipfera, Nysrea sylvatica, Fraxinus pennsylvanica, Aecr rubrum, Pinus echinata and Platanus occidentalis. Restricted to streams within the Aiken Plateau sandhills, this community would have been less productive in terms of plant resources than others, but it is quite high in faunal resources due to the dense cover for terrestrial fauna and the rich aquatic habitat for fish and certain mammal species (beaver and otter).

Situated on the regularly inundated floodplains of large stream mouths and the Savannah River below elevations of 100 feet, the riverine floodplain vegetation community is dominated by numerous oak species and other hardwoods including Quercus phellos, Quercus nigra, Quercus lyrata, Quercus nuttallii, Quercus michauxii, Liquidambar styraciflua, Fraxinum pennsylvanica, Populus deltoides, Populus occidentalis and Aecr rubrum. In areas subjected to near-permanent inundation in the Savannah River floodplain, a swamp forest vegetation composition exists that consists of Taxodium distichum, Nysea aquatica, Nysea sylvatica biflora, Planera aquatica and Fraxinus caroliniana. These two floodplain variants afford not only rich floral resources but also abundant wildlife resources including large mammals, small game, aquatic mammals, fish and waterfowl.

From this rather general description of the environments of the Savannah River Plant and the Upper Coastal Plain, it can be seen that a wealth of natural food resources would have been available to hunter-gatherer populations during the Late Holocene. It is the structure and relative value of these environments that will form the basis from which the human adaptations during the Late Archaic–Early Woodland transition will be examined. The preceding description has been provided as a means of demonstrating the ecological diversity within the study area. A more fine grained examination of resource distribution and productivity will be offered in the final study.
To this point the specifics of the archeological record have not been discussed in more than general terms. However, before proceeding with the statement of problem, the development of a general hypothesis and the construction of a diachronic model, a discussion of the three pertinent archeological phases is necessary.

**The Stallings Island Late Archaic (5,000 B.P. to circa 3,000 B.P.)**

First recognized by Claflin (1931) at the famous Stallings Island site on the Savannah River, this period is identified most readily with shell midden sites on the Atlantic coast and along major rivers in Georgia and South Carolina Coastal Plains. As mentioned earlier Turnbaugh (1975) and others have noticed a pan-Atlantic Slope similarity in assemblage dating from this period suggesting a similar techno-economic context for the industries.

In his summary of the Late Archaic in the Savannah River area, Stoltman (1972) has outlined the basic assemblages associated with 24 sites. Among the more common tools in the assemblages are large, stemmed, projectile point/knives (Savannah River Stemmed), cruciform drills, unifacially retouched flakes and large preforms. Other common tool classes are hammerstones, chipped and polished axes, adzes, anvils, polished atl-atl weights, steatite "netsinkers" (or boiling stone), antler and bone pins, antler projectile points, bone awls, steatite vessels, and grinding stones. This basic assemblage is more common at large sites, which show evidence of intensive occupation over many seasons or years. The important characteristic of these assemblages is their diversity, indicating a broad range of functional variability. Within single sites tools used for procuring, preparing, and storing food resources are present, accompanied by faunal evidence of a diverse diet (Stoltman 1974).

Features are very common at well excavated sites (e.g. Stallings Island, Rabbit Mount and Bilbo), indicating both food processing and storage. A possible lean-to structure excavated at Rabbit Mount (Stoltman 1974) suggests the presence of at least temporary habitation units. In all cases examined by Stoltman (1972) shellfish remains were present, but where faunal analysis was undertaken, a diverse faunal inventory suggests reliance on terrestrial resources as well (Stoltman 1974; Trinkley n.d.). Based on the presence of a diverse faunal assemblage, massive shell middens, numerous features and the diverse tool assemblages found at sites from this period along the Savannah River, it is reasonable to infer that the sites represent relatively sedentary human populations who were extracting resources from both riverine and upland contexts.

An additional feature of the Stallings Island Late Archaic, which bears on the suggested low mobility or sedentism, is the presence of fiber tempered ceramics with dates as early as 2500 B.C. (Stoltman 1974). The importance of ceramics in the present study rests with their association with sedentary populations. Large ceramic vessels are subject to breakage during movement, and it is argued that they would be most common in sites used by populations who had relatively
low residential mobility (Binford n.d.). Further support for this contention is provided by the intensive use of shellfish and riverine aquatic resources by these populations. The concept of sedentism is used in this discussion as a relative term. An argument is not made for a permanently sedentary population but rather a population that is settled (i.e. mobility is reduced substantially to the point where one or two sites serve as longterm base camp for a year's residence).

In all cases where Stallings series fiber tempered pottery is found in association with a diverse lithic assemblage, a predominance of shellfish remains is found. As a food resource shellfish have been proven to be minimal in value as a major staple (Parmalee and Klippel 1974). However, in a setting with abundant and diverse vegetal and faunal food resources, mussels would provide a regular supplement to the diet. It can be argued that such a stable food resource would have allowed for a reduction in seasonal mobility and permitted an opportunity for residential stability. The fact that riverine shellfish utilization was restricted in the interior Savannah River basin to the Late Archaic Period can be partially explained by the potential effect of sea level changes on river gradients, which in turn altered mussel productivity. It will be argued in the proposed study that changes in sea level, river gradient, and channel location caused an increase in mussel availability between 2500 B.C. and 1000 B.C. and a subsequent decrease in mussel availability between 1000 B.C. and 500 B.C. (cf. DePratter 1977; DePratter and Howard 1977). This net decrease in resource availability would have caused subsistence stress on the resident populations, which would have been compounded by the apparent increase in population size caused by more sedentary residence. Archeological evidence for this stress is provided by the relative decrease in major riverine zone utilization in subsequent time periods (Stoltman 1974; Hanson, Most and Anderson 1978).

The Thom's Creek and Refuge Phases (3,000 B.P. to 2,500 B.P.)

These two phases in the Upper Coastal Plain of the Savannah River basin are indicative of an initial change in settlement and subsistence away from the riverine mussel and aquatic resources previously exploited by Late Archaic populations (Stoltman 1974; Phelps 1968). Although settlement pattern data are limited, sites with Thom's Creek and Refuge ceramics at Groton Plantation fail in all cases to contain evidence of mussel use. Aside from ceramic information, there has been little other assemblage description in the published literature on the riverine expressions of either Thom's Creek or Refuge (Stoltman 1974; Phelps 1968; Trinkley n.d.; Peterson 1970).

Thom's Creek pottery was first described by Griffin (1945), based on a sample of sherds collected at the type site along the Congaree River in central South Carolina. Subsequent research has resulted in the recovery of these sand tempered, punctate ceramics in both coastal and inland situations (Caldwell 1952; Waddell 1963; Calmes 1967; Phelps and Burgess 1964; Phelps 1968; Williams 1968; Edwards 1969; Hemmings 1970; DePratter, Jefferies and Pearson 1973; and Trinkley 1976). A
point of controversy in the literature exists over the contemporaneity of Thom's Creek ceramics (including Awendaw and Horse Island varieties) and Stallings Island fiber tempered ceramics (Trinkley 1976). Radiometric dates from coastal shell rings and middens clearly place Thom's Creek ceramics between 2200 B.C. and 1000 B.C., but such a pattern does not appear to exist in the riverine setting of the Savannah (Trinkley 1976; Stoltman 1972; Phelps 1968). In sites where Stallings and Thom's Creek ceramics co-occur (Rabbit Mount, Clear Mount, White's Mount, and Tinker Creek) the latter sand tempered sherds consistently postdate the fiber tempered wares (Phelps and Burgess 1964; Stoltman 1974). From these data it would seem that the agent of tempering changed earlier on the coast than in the riverine setting, but the plain and punctate designs are similar in all cases. Based on these results, it is possible to identify Thom's Creek ceramics in the central Savannah River area; however, it will be necessary to obtain data relating these ceramics to artifact assemblages and settlement patterns. In general, Stoltman (1974) at Groton Plantation has suggested the beginning of a non-floodplain-oriented settlement pattern.

Peterson (1970), in a summary of the Refuge Phase as seen from Groton Plantation, describes the phase in terms of ceramic differences compared to Thom's Creek. He suggests that the differences are in the "execution" of the punctate, incised, and simple stamped decorative elements; but the distinctions are unclear. Discussions of Refuge ceramics are restricted to a brief type site report by Waring (in Williams 1968: 198-208), statements by Peterson on the Clear Mount excavations (1970, 1971) and a brief summary of Stoltman (1974: 22). Two radiometric dates have been obtained from Refuge contexts at Clear Mount (920 ± 200 B.C.) and the Refuge Site (970 ± 110 B.C.) (Peterson 1970). Both dates place Refuge near the termination of the Thom's Creek Phase; it could be that Refuge ceramics are indeed one and the same with Thom's Creek. It is for this reason of contemporaneity that the two ceramic phases will be treated as a single unit in the proposed study. Emphasis will be placed on the accumulation of representative artifact assemblage data associated with these sand tempered ceramics so that a more thorough understanding of the techno-economic aspects of these temporal units may be ascertained. Settlement distributions will be examined to determine the range of variability in site type and location.

Deptford I Phase (2,500 B.P. to 1,900 B.P.)

Deptford is a moderately well known archeological phase in the Southeast based on the work of Milanich (1971, 1973a, and 1973b) along the coastal strands of Georgia and Florida. He describes the phases as predominately coastal, the outcome of a widespread Gulf and Atlantic Coastal Tradition, which relied on estuarine resources and seasonally available inland resources (1973a). Milanich's efforts to characterize Deptford in terms other than simply a ceramic complex represents a healthy contribution to the region's prehistory. From his research we know that Deptford is characterized by a diverse lithic assemblage containing many tools similar to those of the Late Archaic with the exception of point types, a settlement pattern of spatially discrete, con
temporaneous settlements along the coast and other ecotones, a subsis­
tence pattern that relied on almost all available food resources, and a
distinctive ceramic complex (Milanich 1973a). Although most of Mila­
nich's research has dealt with the coastal province, it is possible to
compare his summary with the results of the survey at Groton Planta­
tion.

In the latter locality Deptford sites were present in an inland, riverine context well removed from the coast. Settlement distributions
suggest more dispersed land use than during earlier phases, leading Stoltman (1974) to conclude that there was a greater reliance on non-
floodplain resources. Other riverine sites with Deptford ceramics
along the Savannah River have only been recorded in surveys with little
data collected. For this reason, a clear understanding of the inland
manifestation of Deptford is lacking at the present time. However,
preliminary results from the Savannah River Plant survey indicate a
large Deptford occupation recognized by the distribution of Deptford Linear Check Stamped, Simple Stamped, and Check Stamped ceramics. Con­
sidering these data, it can be stated that a substantial inland Dept­
ford occupation occurred within the Savannah River basin following the
Thom's Creek-Refuge Phase.

Recognition of the earliest segments of the Deptford occupation (Deptford I) will be based on the ceramic chronology developed by Caldwell (1971) and expanded by DePratter (1977). These authors in­
hude five ceramic types in their designation of Deptford I; Deptford Check Stamped, Deptford Linear Check Stamped, Deptford Plain, Deptford Cordmarked, and Refuge/Deptford Simple Stamped. The presence of these
types will be used to distinguish Deptford I sites in the proposed
study.

In summary, non-published evidence for the Savannah River indi­
cates the presence of numerous and widely dispersed Deptford sites,
suggesting a change in settlement-subsistence patterns following Thom's Creek-Refuge and Stallings Island Late Archaic. This difference in
prehistoric human land use has prompted the investigations outlined in
the proposed study.

Prehistory Summary

For the purpose of the proposed study, three general temporal
units have been described in terms of diagnostic artifacts, inferred
subsistence and settlement patterns, and temporal ranges. Although
such a brief discussion is limited in scope, it serves to familiarize
the reader with some of the apparent differences that have been recog­
nized in the Savannah River region. Evidence from Groton Plantation
and other localities along the river suggests a general change in adap­
tive pattern from the Late Archaic into the Early Woodland. It is a
central purpose of the proposed research to describe and explain accu­
rately this change using an economic-ecological model of human adaptive
processes.
Theoretical Considerations

The set of general archeological and environmental information summarized in the preceding sections leads to the definition of a general research problem that will be the major thesis of the intended research. Its foundation lies in the general observation of archeological settlement changes during the period between 4,500 B.P. and 1,900 B.P. in the Savannah River Valley of the South Carolina and Georgia Coastal Plain. Empirical observations by Stoltman (1971, 1974), Peterson (1970, 1971), Phelps (1968) and DePratter (1977) all indicate that a major reorientation of settlement location occurred immediately following the Late Archaic (Circa 3,000 B.P.), which is associated with reduced riverine aquatic resource utilization and increased reliance on inland terrestrial resources. Although this pattern is substantiated by limited samples of archeological data, it has the potential to direct more theoretical inquiry into the mechanisms effecting the change and the response of human populations to such change. It is this general problem that constitutes the basis for the planned research.

General Proposition

Linkage between archeological studies and general propositions has been argued by Binford (1977) to be crucial in order to assure the development of a body of theory. In the domain of hunter-gatherer studies, both ethnographic and archeological, a body of theory is being formulated to describe and explain the mechanisms and processes operating on these adaptive systems. Research by Binford (1977, 1978, n.d.), Osborn (1977), Binford and Chasko (1976), Jochim (1976) and others has begun to integrate ecological and economic theory with archeological studies of hunter-gatherers. These researchers have demonstrated the efficacy of applying general theoretical models to synchronic archeological context. Reidhead (1976) and Keene (1979) have contributed to this body of theory by applying the methodological principles of linear programming to examine synchronic and diachronic subsistence systems in temperate forest ecosystems. Of importance in these latter studies has been the use of explicit economic principles in examining human adaptations. Overall, the studies mentioned above have initiated an explicit economic-ecological orientation in the current research of American archeology.

The proposed study will attempt to contribute to this body of archeological theory by evaluating a general proposition that is not limited in either time or space. The following proposition sets forth a set of conditions and responses expected to occur during the process of adaptive change in a hunter-gatherer economy.

Under conditions of economic stress caused by a concomitant increase in local human population and an independently caused reduction in a key resource base, a structural change will transpire in the economic strategy that resulting in a net increase in labor intensification in subsistence economy.
In the above proposition economic stress can be defined as an increased need for resource production (food and other essentials) without an associated increase in the resource base. This stress would result in a reduction in per capita resource production. Labor intensification in the subsistence economy can be defined as a change in the procurement cost of food resources that requires a greater input of energy to procure sufficient nutritional needs of the population. In essence, this change in labor intensity is expressed by an increase in labor without a change in production. Thus, the overall relationship presented in the general proposition predicts a structural change in economic structure due to both internal and external factors.

As expressed above, the proposition does not have any direct implications in operational terms. To evaluate this proposition in an archeological context, a specific proposition was formulated to apply to the problem of Late Archaic–Early Woodland change.

**Specific Proposition**

When considered in the empirical context of the existing body of archeological, paleo-environmental, and demographic information available for the central Savannah River area, the following general proposition of economic change can be framed in specific testable terms for the problem in question.

During the latter half of the Late Archaic in the interior Coastal Plain portion of the Savannah River Valley, subsistence stress developed as a result of population growth prompted by reduced residential mobility and a relative depletion of the riverine aquatic resource base caused by a change in river gradient. These factors affected a change in the subsistence economy during the subsequent Thom's Creek–Refuge and Deptford I phases in which there was reliance on less productive portions of the regional environment.

Underlying this proposition is a basic economic assumption concerning human subsistence systems that developed by Jochim (1976) in his treatment of modern and prehistoric hunter-gatherers. The assumption is that human food procurers will operate under a *Simon satisficer criterion* of economic decision-making stating that they will "seek, not to maximize, but to satisfy some predetermined aspiration level" (Jochim 1976: 6). In the case of hunter-gatherers the criterion is translated to state that the producers will strive to provide the minimal nutritional requirements of their populations in the most efficient, lowest cost, manner. As mentioned by Jochim (1976: 6-10), this statement is a description that attempts to explain the actions of people, instead of attempting to determine how they should behave. In the context of the specific proposition, this decision-making criterion will affect the manner in which Late Archaic and post-Late Archaic populations respond to stress. It is the limits within which the criterion is exercised in the culture change process that is of scientific interest.
To operationalize the specific proposition of subsistence-settlement change, a three-part diachronic model is proposed that sets forth the implied consequences of the proposition and their archeological implications. The tripartite division used in the model corresponds to the three chronological periods outlined in the introduction: Late Archaic, Thom's Creek-Refuge and Deptford I. Each of these represents time increments of variable duration, which, although not ideal for the study of culture change (cf. Plog 1974), are the most refined units presently available to the author.

**The Late Archaic System**

During this time period three conditions are expressed in the proposition that may be examined in the archeological record. Stress in the subsistence system is attributed to population growth resulting from reduced residential mobility and to a depletion of the riverine aquatic resource base caused by a change in river gradient. The identification of these conditions in the archeological record requires their transformation into observable units. The following presentation outlines the sets of correlates in outline form.

**Reduced Residential Mobility**

The recognition of reduced residential mobility, or semisedentism, relies on the examination of the overall settlement distribution within the environmental parameters of the region. Since more sedentary residence of a hunter-gather group requires a rich mix of locally available food resources throughout most seasons of the year, settlement location would be expected to correlate strongly with environmental zones with high food resource productivity. On the site level reduced residential mobility could be indicated by the presence of highly variable tool assemblages, the presence of storage facilities, the presence of food remains characteristic of multi-seasonal occupation, and the presence of habitation features. All of these conditions would strongly suggest the occurrence of a more settled residential pattern. However, this does not preclude the presence of broad based logistic mobility for resource procurement.

**Implications**

i. A settlement pattern centered on large base villages with contemporaneous small extractive (limited activity) sites.

ii. Large base settlements should be associated with resource zones capable of providing a stable resource food base during multiple seasons of the year.
iii. Tool assemblages should reflect high functional variability at large base settlements because of the diversity of requisite tasks that would have been conducted at such semi-permanent locations. The assemblages should reflect multiple maintenance and extractive activities.

iv. Food remains found in large base settlements should indicate procurement, processing, and storage during multiple seasons of the year.

v. Evidence of habitation features should be present in the form of structures.

Population Growth

Direct measurement of this variable in the archeological record has resulted in numerous difficulties, especially in the Southeast where conditions of preservation are minimal. Due to the severe problems encountered in attempting accurately to estimate prehistoric populations in numerical terms, the proposed research will evaluate population size and growth on a regional basis using site size and habitation site measures as indices of relative population size.

On a theoretical level Binford and Chasko (1976) present a convincing set of arguments that linking population growth directly to residential stability (i.e., reduced residential mobility). In essence, the argument states that population increases are a direct by-product of reduced residential mobility, or sedentism, because of increased male presence in the settlement, decreased infant mortality, reduced generation spacing, and changes in dietary composition. These implications of more settled residence, though not directly observable in archeological contexts, suggest a mechanism of population growth that may have been operating during the Late Archaic and other prehistoric periods. The utility of this theoretical model of population growth will receive expanded discussion in the dissertation, especially in conjunction with the empirical results of the following implications.

Implications

i. During the Late Archaic a relative population increase should be indicated by an increase in the size of individual sites.

ii. A concomitant increase should be seen in the overall number of large base settlements within the central Savannah River basin from 4,500 B.P. to 3,000 B.P.

Reliance on Riverine Aquatic Resources

The literature review indicated that riverine shellfish (i.e., mussels) and other aquatic resources were an essential part of the Late
Archaic diet. In order to demonstrate this on a regional level, the following conditions should obtain.

**Implications**

i. Base settlements should be situated in locations which afford access to floodplain and riverine environments rich in fish and mussel resources.

ii. Base settlements should contain food remains indicative of aquatic resource consumption.

iii. Sea level and other geological data should provide evidence indicating optimum shellfish habitat conditions along the central Savannah River between 4,500 B.P. and 3,500 B.P.

**Depletion of Riverine Aquatic Resources**

Two separate data bases can be used to determine whether a reduction in aquatic resource productivity took place during the latter half of the Late Archaic. Archeological data would point to reduced resource utilization, and geological data would indicate changes in river gradient and mussel habitat.

**Implications**

i. Food remains associated with terminal Late Archaic settlements should show a reduction in mussel and other aquatic resource use.

ii. Sea level information and geological studies of the Savannah River and delta should indicate a drop in the relative sea level and an increase in river gradient, which would greatly diminish the exploitive potential of mussels and fish in backwaters and inundated floodplains.

**Summary**

The positive test of the above implications should strongly support the causal direction implied under the specific proposition. If verified, the correlates would indicate the initiation of subsistence stress in the subsistence system of the terminal Late Archaic populations. This stress in the food procurement system would have necessitated an adaptive response.

**The Thom’s Creek-Refuge System**

The Thom's Creek-Refuge system, which follows the immediate impact of the proposed changes in the terminal Late Archaic, can be considered
to represent the initial response period in the process of adaptive response. During this period change in the resource procurement system would have been most readily reflected in the distribution and structure of the settlements. A correlate of the specific proposition is that two possible responses could have resulted from the terminal Late Archaic economic stress. On the one hand, resident populations could have initiated procurement strategies within the existing settlement system that would require increased labor to support all consumers. On the other hand, populations would have attempted to defray the overall cost in labor intensification by dividing into smaller residential units and relocating in marginally less productive base settlement locations. In either case the subsistence economy would have become more intensive because populations would have been utilizing a greater proportion of more costly resources. The following set of alternate systems and implications are set forth to determine which strategy was employed.

Alternate 1: Intensification Within the Existing Settlement System

Under this alternative, Thom's Creek-Refuge populations would have remained in the same base settlement-peripheral extractive camp settlement pattern. If this were the case, the following implications should be observed in the archeological record.

Implications

i. Thom's Creek-Refuge settlement systems should be similar in distribution and location to the Late Archaic system.

ii. Food remains evidenced at these sites should indicate the reduction in aquatic resources and an increase in material indicative of a labor intensive procurement operation (e.g., more small game and secondary vegetal food resources).

iii. The tool assemblages may reflect labor intensification by an increase in food processing implements used for secondary resource processing (e.g., mortars for grinding seeds).

iv. The number of associated extractive camps should increase indicating an expanded utilization of peripheral resource zones.

Alternate 2: Population Fission and Settlement Location Change

Under this alternative system, Thom's Creek-Refuge populations would have responded to subsistence stress by reducing the number of individuals occupying each base settlement through the formation of additional splinter base settlements. This expansion in the settlement
system would, by necessity, have required the location of settlements in diverse environmental settings away from the Savannah River. The expected settlement model would predict the location of base settlements in settings where procurement of diverse terrestrial and small stream aquatic resources would have been accomplished and in settings similar to those of the Late Archaic sites. If population fission similar to that discussed by Binford (1968) occurred during this period, the following expectation should be recognized in the archeological record.

**Implications**

i. Settlement pattern change should be indicated by an increase in the total number of sites relative to the Late Archaic pattern and a relative decrease in settlement size.

ii. Food remains should indicate a reliance on resources extracted from the immediate surrounding of the sites and reflect labor intensification in procurement and use similar to that expected under 2a: ii in alternate model 1.

iii. Tool assemblages should reflect labor intensification by an increase in specialized food processing utensils employed in rendering large quantities of secondary resources.

iv. Settlement location should be associated with more diverse environmental contexts, which would partially reduce the labor expenditure for procurement as expected under the satisfying criterion.

v. Extractive sites associated with base settlements during this time should increase in numbers relative to the Late Archaic, suggesting greater use of secondary resource zones.

**Summary**

The two alternative models for Thom's Creek-Refuge represent the possible responses to the conditions of economic stress first seen in the terminal Late Archaic. Both models could have been operative during the transition from a riverine resource focus to a more diversified resource base. However, existing data from the Savannah River Plant and Groton Plantation tend to support Alternate 2, the population fission and settlement location change option. Nonetheless, whichever alternate is supported by the complete analysis of the data, the demonstration of adaptive change should be substantiated.
The Deptford I System

According to the general expectations of the model, subsistence stress on the population of this Early Woodland phase should have resulted in the completion of the adaptive change process. The resultant settlement pattern would be expected to be similar to that expressed in alternate 2 in the Thom's Creek-Refuge discussion. If Thom's Creek-Refuge populations followed the expectations of Alternate 1, the increased pressure on the riverine zone resource base would have caused the ultimate change in settlement-subsistence pattern. Thus, by at least early Deptford I times, a shift in population distribution distribution implied under Alternate 2 (above) would have occurred. The implications of this system would be expected to be similar. If population fission and settlement relocation occurred during Thom's Creek-Refuge, then the Deptford I record should express the stabilization of the new adaptive system.

Model Summary

The preceding discussion has presented a very general model of subsistence and settlement change that relies primarily on limited archeological and paleo-environmental literature relating to the target time period. It has been offered in a rather flexible format to permit a feedback relationship to develop during the research process. It is the author's belief that a rigid research proposition with attendant implications often prohibits a maximal accumulation of knowledge in the research process. When the relative paucity of background information on settlement variability, artifact assemblages, and subsistence practices is considered with respect to the proposed research, it would be unwise to attempt a programmatic and restrictive research strategy. Instead, an open, exploratory research approach will be taken allowing for an interaction between the stated propositions and the results of empirical inquiry; for in situations where little knowledge exists, it is best to proceed with both guidance and caution. The following discussions present specific archeological considerations necessary in the operationalization of the model and the data bases that will be utilized.

METHODOLOGICAL CONSIDERATIONS AND DATA SETS

Implementation of the model and its evaluation will require a methodological format that utilizing analyses of multiple data sets. For the purpose of this proposal an outline of pertinent analytical categories and variables is presented with discussions of methods.

Environmental Reconstruction

This aspect of the proposed study is one of the more critical
because an evaluation of the model requires a thorough understanding of both local and regional environmental variability during the target time period. On the regional level paleo-environmental studies indicate an overall stability in climate and terrestrial vegetation from the end of the Hypsithermal at circa 6,000 B.P. (Denton and Karlen 1973; Flint 1976; Watts 1971; Wendlund and Dryson 1974; Wright 1976). To support the environmental stability argument, a thorough literature review will be conducted.

Fluctuation in relative sea level and its effect on the riverine environment will be examined in detail in the geological and archeological literature. The statements of DePratter (1977) and DePratter and Howard (1977) require additional substantiation from independent sources. One such study is presently being conducted along the Cooper River (Brooks, Colquhoun, Pardi, Newman and Abbott 1979). Additional research into the Savannah River floodplain depositional history is being undertaken by a graduate student in geology within the Savannah River Plant. This latter study is being supported by the Savannah River Plant Archeological Research Program. The combination of results from this research should provide an accurate reconstruction of the riverine environment, especially where reconstruction relates to the productivity and habitat requirements of mussels and other aquatic resources.

Assuming the general stability of terrestrial environments during the period from 4,500 B.P. to 1,900 B.P. is demonstrable, a reconstruction of the local vegetation communities within the study area will be based on modern botanical studies. Using soil texture, soil productivity, hydrological, and topographic factors and their association with plant communities in the Upper Coastal Plain Physiographic Province (Quarterman and Keever 1962; Bozeman 1971, Wells and Shunk 1931; Sharitz 1972), a vegetation community map will be generated for the study area. The communities will be primarily identified by soil types since much of the study area is presently used as pine plantation. The vegetation zones will be presented in terms of their potential for wildlife habitat and vegetal resource production. These zones will also be ranked in order of resource potential and used in locational studies of archeological sites.

Faunal distributions (both terrestrial and aquatic) will be evaluated for the reconstructed environment in terms of density, seasonality and potential food value. Data appropriate to this portion of the study will be derived from the literature of wildlife management and animal ecology (e.g., Martin, Zim, and Nelson 1951; United States Forest Service 1971; O'Hara 1978) and results of specific research on the Savannah River Plant (Wood and Odum 1965; Jenkins and Provost 1964; Urbston and Rabon 1972; Academy of Natural Sciences of Philadelphia 1953). These data will be used to assess economic species in terms of habitat and density. The combination of faunal and floral food resources will then be considered in conjunction with the proposed variations in settlement location. Economic species will be determined on the basis of ethnographic observations of the Creek Indians who were living in similar environments of the Southeast (Canouts 1971; Bartram 1853, 1928; Lawson 1972; Swanson 1922).
In the absence of a comprehensive series of radiometric dates for sites in the central Savannah River region, the chronological position of archeological components used in this study will be determined through the cross dating of diagnostic artifacts. Two types of artifacts reflect chronological sensitivity during the target time period: ceramics and hafted bifaces. Since ceramics in the area date from circa 2500 B.C. at Rabbit Mount (Stoltman 1974), variation in ceramics is most useful. Diagnostic hafted bifaces, on the other hand, have not been demonstrated to be as sensitive in chronological studies in the region (Stoltman 1974; Peterson 1971). Nonetheless, a study by Bullen and Green (1970) at Stallings Island provides some basis for the use of hafted biface types as chronological indices. Using the results of the cited studies, the following outline of temporal indices will be used to determine the relative chronological position of sites in the study.

- **Late Archaic**
  - Ceramic indicators: Fiber tempered pottery with plain, punctate, incised, and linear punctate surface treatment
  - Hafted biface indicators: Savannah River Stemmed Points

- **Thom's Creek-Refuge**
  - Ceramic indicators: Sand tempered pottery with plain, punctate, incised, linear punctate, and simple stamped surface treatment
  - Hafted biface indicators: Small stemmed points (Otarre and Gary types)

- **Deptford I**
  - Ceramic indicators: Sand tempered pottery with simple stamped, linear check stamped, and check stamped surface treatment
  - Hafted biface indicators: Large and medium sized points

This set of chronologically sensitive material culture correlates is far from the most accurate index of temporal location; however, it will permit a relative dating method suitable to the study. Throughout survey and testing, data useful in refining this chronological system will be sought. Examination of other material culture correlates in excavated contexts may allow for an expansion of diagnostic indicators. However, given the failure of previous investigators to derive such information when chronology building was the central focus of study, the refinement of the chronology may have to depend on the scanty radiometric determinations on materials excavated from sites with well preserved organic materials.
The sample of archeological sites used to test the proposed model will be derived from two sources: previously excavated sites in the central Savannah River basin and sites recorded from the Savannah River Plant. The former group consists of Rabbit Mount, Clear Mount, Stal­lings Island, White's Mount, Cracker's Neck (Hanson and Most 1918) and Cox. These sites will provide assemblage, faunal, and chronological information for large base settlements throughout the central Savannah River basin.

The second source of archeological data, the Savannah River Plant, has been the focus of the author's research since mid-1976 (Hanson, Most and Anderson 1978). Approximately 50 sites from the Savannah River Plant bear directly upon the research. Twelve recognizable Late Archaic components have been investigated (Fig. 2); 38 components represent the combined Thom's Creek-Refuge-Deptford I occupations (Fig. 3). An additional 23 sites contain pottery which could be associated with the latter temporal unit, although this association will require detailed analysis. Finally, over 175 nondiagnostic lithic scatters have been recorded in the Savannah River Plant. These surface scatters lack diagnostic artifacts but have the potential for providing information relating to the extractive activities discussed in the model.

Settlement data derived from the Savannah River Plant constitute the most systematically collected archeological information from the Upper Coastal Plain in that all environmental zones have been sampled. Survey between 1973 and 1977 examined approximately 730 linear kilometers (450 miles) of high visibility areas within the 777 square kilometer (300 square mile) study area. Although the sample strategy was somewhat opportunistic, it provided adequate information on all environments except the Savannah River floodplain, which is usually inundated. To compensate for this lack of coverage a survey of sand ridges and islands in the Savannah River floodplain is presently underway.

To complement the information derived from surface collections, sites pertinent to the study within the Savannah River Plant will be tested for representative samples of assemblage information. The expanded data base will improve the understanding of interassemblage variability during the three time periods under consideration.

Analysis of settlement location will be an important component in the research since it will compose the only evidence of extractive practices. Due to adverse preservation conditions related to high soil acidity (Aydelott n.d.), the direct analysis of food remains will be difficult. Thus, much of the subsistence pattern inference in the study will rely on settlement/environment/assemblage covariation. Settlement location studies will therefore emphasize resource productivity and diversity within .5, 1.5, and 3.0 kilometer catchments. Other site related environmental values will be used to determine the specific factors affecting settlement location selection (e.g., slope, aspect, proximity to water, soil drainage, elevation and relative elevation). The combination of site catchment and discrete location data...
Figure 2: Late Archaic site distributions on the Savannah River Plant.
Figure 3: Early Woodland site distributions on the Savannah River Plant (Thom's Creek/Refuge/Deptford).
will be used to explore commonalities in site context. One of the expected results of this analysis will be the segregation of site settings into specific "niches," which represent different resource bases. An expected change should be seen in these data, which correlates with the adaptive restructuring predicted in the model.

Assemblage Analysis

Lithic artifacts will be analyzed from a functional perspective in order to determine the presence of intersite variability indicative of different procurement and processing strategies. Both tool and non-tool categories will be examined to establish correlative sets of artifacts (i.e. assemblages) within the environmental "niches" derived in the locational analysis. Debitage analysis has been designed to determine the sensitivity of this artifact class to environmental variability. It is expected that debitage from extractive loci will be less variable and smaller than debris recovered from base settlements. Further, debitage patterns may reflect different types of extractive activities, as yet unknown.

Comparison between artifact assemblages from different sites is planned. One approach to total assemblage study will be a cluster analysis, which will generate a number of similarly composed toolkits from the total sample. The clusters will be compared with environmental zones to test expected correlations. The other approach to assemblage analysis will involve the use of an index of variability to measure the relative complexity of the toolkits. The combination of these two methods will enable an unbiased approach to toolkit analyses.

Food Resource Analysis

As stated, the preservation of floral and faunal materials in non-shell containing sites in the Coastal Plain is rare. Acidic soils have, in large part, destroyed all bone, seeds, and organic debris. Fortunately, recovery of these perishable materials from shell midden sites (e.g., Rabbit Mount, Clear Mount, Cox, and Stallings Island) has been excellent. Although the remains from such sites are biased, the food remains from these sites should provide an excellent reference for the Late Archaic subsistence behavior. Where possible, previously analyzed collections will be used in the proposed research. In the case of materials from the Cox site, which are not yet analyzed, Dr. Robert L. Stephenson will provide basic identification.

Methodological Summary

As outlined in the preceding sections, all appropriate data set will be examined in the test of the model. The outcome of the multiple method approach should result in a comprehensive statement of Late Archaic through Deptford I settlement, assemblage, and subsistence information previously unavailable in the region. The environmental analyses with respect to settlement location should provide future
researchers with a baseline statement for research into prehistoric man-land relationships in other periods.

Hanson, Most, and Anderson (1978) recognized general patterns of changing site locations on the Savannah River Plant, but were unable to deal with the details of these relationships from an integrated human ecological approach. The proposed research will use data from their report, supplemented by excavation and survey data from other sources. Exact methods or, more appropriately, techniques, have not been specified since they must be catered to the measurement scale, sampling errors, and specific questions. However, it is likely that the most common statistical techniques will be a combination of univariate, bivariate, and multivariate.

SUMMARY

A theoretical and methodological approach has been presented for the study of a major episode of culture change in the prehistory of the Southeast. Using a satisfying criterion of decision making, a general proposition has been presented that links change in adaptive systems to stress in the subsistence base caused by population growth and resource depletion. The Savannah River Late Archaic, Thom's Creek-Refuge, and Deptford I Phases will be used to test this general proposition in the central Savannah River region. A model of adaptive response using these three archeological cultures was offered in which specific implications of change were outlined. Data and analytical methods suitable for testing the model were suggested.

In general, the proposed research is intended to be an integrated examination of human ecology in the diverse Upper Coastal Plain Physiographic Province of South Carolina and Georgia. Although there is strong reason to believe that the general and specific propositions will be supported by the analyses, a possibility exists that there will be deviation from the expected. In those cases where divergence occurs, inferences will be made to account for the variance so that future researchers may benefit from the results. In fact, the dissertation's major contribution will be its synthetic treatment of the causes, mechanisms, and manifestations of adaptive change for a temporal period and geographic area, which have only limited examination in the archeological literature.
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RECONSTRUCTION OF POTTERY
USING BJK DOUGH

Emily Goldberg
FOREWORD

by Robert L. Stephenson

Emily Goldberg has been on the staff of the Institute of Archeology and Anthropology since January 1981 as an assistant conservator. Her background includes training and experience in archeological conservation and illustration at the Etruscan site of Poggio Civitate sponsored by Bryn Mawr and Bowdoin Colleges. Her work here at the Institute has included some ceramics restoration and stabilization of prehistoric and historic pottery.

Discussing these restorations and stabilizations, I urged her to experiment with various dental plasters, plaster of Paris combinations, and other restorative media that I have used in past years. She surprised me with a totally different medium that she had learned to use. I suggested that she prepare this article explaining the use of "BJK Dough"; something I had not heard of although it has been in use for some twenty years.

For the most part, the vessels that she has restored here are large and small pots, bowls, and cups. Most of these are represented by sherds that constitute the majority of the vessel. Thus the principal effort in the restoration is to fill in the "holes" or "gaps" left by missing fragments of the vessel. The "BJK Dough" method seems to be a good one with real advantages over the various kinds of plaster. I hope that this article will prove useful to others.
INTRODUCTION

Using plaster is not the only valid way to approach the reconstruction of pottery. Gap-filling with BJK (Butvar [Rohm & Haas], Jute, Kaolin) dough provides a good alternative which has several advantages over the plaster reconstruction technique. BJK was developed at the University of London's Institute of Archaeology specifically for this purpose, and has been used internationally with great success for over twenty years.

BJK dough is, as its name suggests, a substance which, when properly prepared, has a consistency not unlike that of "Play-Doh" (Kenner). It is composed of 100 parts (by weight) of Butvar B-98 (Rohm & Haas) polyvinyl butyral,* 120 parts of acetone, 50 parts of industrial methylated spirits, 40 parts of amyl acetate, 100 parts of toluene (benzene or xylene), and 60 parts of water—to which is added as much jute and kaolin (in the ratio of two dry measures of jute to one of kaolin) as is necessary to reach the desired doughy consistency (Sturge and Greene n.d.). (See Appendix for Recipe.)

How BJK Works

BJK becomes hard through the evaporation of the solvents within it. Thus, it remains malleable as long as it is stored in an airtight container (with an acetone-soaked cotton ball for added assurance of moisture retention) and will only begin to harden when exposed to the air for several minutes. The most effective method of gap-filling with BJK takes advantage of both its flexibility (when soft) and its durability (after it has hardened) by creating a sturdy latticework grid of hardened strips of BJK and gradually filling in this framework with successive applications of the still plastic dough. (See Method section below).

Hazards and Precautions

Before working with BJK dough, one should be fully aware of the hazards it presents and the necessary precautions that must be taken to avoid the dangers associated with the material. BJK is composed of several toxic chemicals and therefore should be treated as a TOXIC SUBSTANCE. (Toluene is especially dangerous; substituting the solvent xylene substantially decreases intrinsic health risks. Even the milder ingredients, jute and kaolin, can act as skin and respiratory irritants during the mixing and kneading processes.)

*originally Alvar 770 (Rohm & Haas) polyvinyl acetal
BJK preparation and reconstruction should be done in well-ventilated areas, and the conservator should insure further self-protection from the narcotic effect of inhaling the toxins by wearing a face mask which will not allow fumes or vapors to penetrate. Furthermore, it is inadvisable to let the dough come into contact with the skin, since toxins such as toluene are easily absorbed through the pores. Since working the dough with the hands is an integral part of the gap-filling process, gloves are often impractical; however, the hands can be protected with a chemical barrier such as Skaid (3M) which actively repels the solvents in BJK as long as it is reapplied to clean hands at frequent intervals. It is extremely unwise to expose oneself to BJK dough unprotected for any period of time, no matter how brief.

Method

After the dough has been concocted according to Sturge's and Greene's recipe, most of it is rolled into balls and placed in a jar for storage as described above. The remainder is laid out on a clean, flat surface and flattened with a rolling pin (or suitable substitute) until it resembles a thin pizza crust (about 1/16-1/4" thick, depending upon the thickness of the pottery for which it is intended). A knife can then be used to divide the dough into designated strips of desired width and length, although it is not necessary actually to cut through the dough until it has air-dried thoroughly and is needed for immediate use.

Once cut, the hardened strips are warmed one at a time (as needed) on a thermostatically-controlled laboratory hotplate until they regain a small measure of their former malleability. Each strip should be flexible enough to assume the contours of the area to be filled. This curve or angle is most accurately reproduced by using a similarly inclined section of the original piece of pottery as a solid guide against which the heated strip can be pressed; as the strip cools, it will then reharden conforming to the inclination of the section upon which it was modeled.

When the strip has been satisfactorily shaped, it is fixed in place to bridge the gap (either horizontally or vertically) using an adhesive (usually cellulose nitrate) such as Duco cement (DuPont) to secure the ends to the broken edges of the vessel. A series of parallel strips is constructed so that each strip is no more than an inch apart from the next; then a network of strips is glued in between and roughly perpendicular to the first set so as to create a grid wherein, optimally, the roughly square areas of space formed do not exceed 1/2" square (Fig. 1).

Once the glued framework has dried thoroughly, the soft BJK dough can be removed little by little from its storage container (which must be kept tightly sealed at all other times during the process) and applied, filling in the gaps and gradually building on it to reach the required wall thickness. The dough can be smoothed into place with the fingers or with the underside of a metal spoon.
It is important that the dough be added in small increments and in many successive layers because it tends to shrink as it dries, pulling away from the sides and decreasing its capacity to fill the gaps. Applying only a small amount of dough at a time and allowing each section to dry before adding a new layer minimizes the negative effects of shrinkage.

After the appropriate wall thickness has been attained, the patch can be surfaced with any of a variety of materials (e.g. a plaster crack-filling compound, a synthetic resin gap-filler with sand or paint mixed in, etc. [Sturge and Greene, n.d.]) or simply sanded with fine-graded sandpaper and consolidated with a light coat of polyvinyl acetate or an acrylic resin such as Acryloid B72 (Rohm & Haas) (15% in toluene) (Fig. 2).

The entire process of gap-filling with BJK dough is completely reversible; the application of cotton balls soaked in methylated spirits (alcohol) will effectively soften the BJK dough in the reconstructed areas. The edges of the reconstructed areas, where they adhere to the ceramic itself, must then be softened with acetone and the framework is then easily disassembled.

Advantages

Although the process of gap-filling with BJK will certainly not satisfy those eager for instant results (especially when the work is large-scale), the slower, more methodical approach has several advan-
tages over the "kwik-fill" plaster filling method. First, the material itself possesses inherent strength which no plaster can possibly equal.

![Reconstruction of a vessel illustrating the gap-filling process.](image)

Figure 2: Reconstruction of a vessel illustrating the gap-filling process.

Often BJK gives a pot added support in weak areas, and it is highly unlikely that the reconstruction will be damaged in transit. Second, the more gradual process of using BJK allows for greater accuracy in the approximation of the sometimes quite subtle curves and angles of a given piece of pottery. Not only can the framework of dried strips be constructed so as to reproduce with reasonable precision a general shape, but more specific modeling can be achieved also as each new layer of dough is applied. (This is especially important when the pottery is irregular or ageometric and certain areas require more attention—and dough—than others.)

BJK maintains a distinct advantage over plaster by providing enough time in the process for continuous modification; whereas plaster is optimally "workable" for 10-15 minutes at the very most, BJK dough remains readily manipulable virtually ad infinitum. This also allows for interruption of work without disastrous results; since the process does not demand completion within a set time period, work can be put aside and easily resumed when convenient.

Aesthetically, BJK works especially well for reconstructing coarse-ware vessels since it more closely approximates both the density and the texture of coarse-ware ceramics than does the finer consistency of plaster, and, if it is to be used for gap-filling a more delicate piece of pottery, such as porcelain, it can easily be surfaced with materials such as those mentioned above in order to attain a more compatible finish.
It is the practical and aesthetic versatility of BJK dough which often makes it a better conservation choice than plaster for pottery reconstruction.
Reconstruction of Pottery with B.J.K. Dough

Recipe

ALVAR, JUTE, KAOLIN DOUGH (B.J.K. DOUGH)

800 gms.  ALVAR 770 (POLYVINYL ACETAL)  100 parts
or BUTVAR B98 (POLYVINYL BUTRAL)  100 parts

1,260 ml.  ACETONE  120 parts by weight

504 ml.  INDUSTRIAL METHYLATED SPIRITS  50 parts

370 ml.  AMYL ACETATE  40 parts

Stir and leave for twenty-four hours in covered container.

Add

928 ml.  XYLENE (BENZENE OR TOLUENE)  100 parts by weight

Stir well and add

680 ml.  WATER  60 parts by weight

Stir until well emulsified, then stir in, with a wooden spoon, jute flock and dry kaolin in the proportion of two dry measures of jute to one of kaolin, until too still to stir. Turn out into a large tray or slab and knead in more jute and kaolin in the same proportions, until the mixture does not stick to the hands. Good kneading is essential.
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Sturge, Theodore, and Virginia Greene