BAHAMAS PREHISTORY

WILLIAM H. SEARS
SHAUN O. SULLIVAN

A program of surveys and test excavations has located 53 prehistoric open midden sites in the Bahamas and procured a large artifact sample from them. Sites in the central Bahamas, concentrated in the eastern islands of the area, are characterized by the shell-tempered Palmetto Series pottery. While sharing specific modes with Antillean cultures, it is an indigenous development, originating in the Caicos where the earliest sites have only ceramics imported from the Antilles.

Distribution of sites and ceramic analyses suggest a movement of Antillean Arawaks to the Caicos to secure salt. An indigenous cultural tradition developed there by shortly after 1000 A.D. and spread rapidly to the central Bahamas. Factors affecting the limits of cultural expansion were the temperature and rainfall requirements of bitter manioc agriculture, which eliminated the northern Bahamas, and perhaps, in part, a time factor affecting expansion to the west.

The Bahamas, Turks and Caicos Islands, known generically as the Bahamas, constitute the northernmost archipelago of the Caribbean culture area. This was the area of the highest latitude (approximately 26° NL) expansion of South American Arawaks. It also was the zone of the most northerly spread of tropical root agriculture employing a conuco cultivation regimen (Sauer 1969:138-9; Sturtevant 1961:71-2). The historical particulars and dynamic principles of the 1500-mile Arawak expansion into the Caribbean are of scientific interest throughout its course, but the spread of such agricultural populations out of the Greater Antilles into the ecologically complex Bahamas affords unique opportunities for isolating critical variables effecting that migration.

This paper will address the specifics of a portion of that migration and will delineate the relationship between three modes of adaptation and corresponding environmental zones within the Bahamas.

DESCRIPTION OF THE ISLANDS

The Bahamian chain includes two modern polities, the Commonwealth of the Bahamas, and the Turks and Caicos Islands. The latter remains a British Crown Colony while the former has recently become independent. Culturally both island groups may be considered as a unit historically and prehistorically. Geologically they are all outcrops of the same limestone plateau. There are 33 major islands and over 600 cays stretching 1000 km from 21-27° NL and from 71-79° WL. They are to the north and east of an obtuse angle formed by the axes of Florida and the Greater Antilles (see map).

There are three major variants in the vegetative cover of the islands and cays. Coppice islands, such as Cat, Eleuthera, and Long Island are the most common. They are characterized today by a growth of low (3-6 m) tropical hardwoods. Ongoing slash and burn agriculture keeps the trees a bleak shadow of the luxuriant forests reported by Columbus. These islands typically have moderate relief, possessing ridges with a maximum elevation in the range of 30-60 m. The second type, pine islands, are flat. They include Great Abaco, Andros, Grand Bahama, and New Providence. The largest islands are distinguished by the presence of localized stands of hardwoods interspersed with savanna and pine forests. The third variant, thorn forest and hardwood scrub islands, is encountered in regions of low rainfall. Such islands are marked by a thin growth of stunted hardwoods (2-3 m when mature) mixed with low thorn forest and cactus. This form of short tree and brush growth on limestone is properly termed "Garrique Scrub" (Riley and Young 1966:62). Islands of this type include the Inaguas, which are relatively flat, and the southern and western Caicos plus Grand Turk and Salt Cay, all of which have moderate relief.

Good soils are now rare in the Bahamas, although prior to clear cutting for plantation agriculture in the 18th century they were more abundant. They have always been rare or absent on the Garrique Scrub islands. There are four primary soil types in the islands (Shattuck 1905:145-169), they are: (1) White coral sand, which often forms coastal strands, dunes, and beaches. These formations are best suited for root crops because of their porosity. They provide an additional resource through the frequent formation of internal fresh water lenses. (2) Bahama Red Loam, which occurs in discontinuous patches primarily in areas of coppice vegetation. This soil is especially suited for the cultivation of pineapples and is known locally as pineapple soil. (3) Bahama Black Loam is the most common soil in the northern and central Bahamas but is easily degraded through oxidation when overlying vegetation is removed. Deep deposits of this soil are very uncommon. Where they exist their fertility has caused them to become known as "provision land." A wide range of crops can be raised in this soil including nitrogen demanding maize. (4) Bahama Marl is a thin soil derived from the direct breakdown of limestone in zones of permanent dampness. It is relatively fertile, but crops intolerant of constant high moisture cannot be grown in it. This description is in a sense misleading, for on many islands most of the vegetation is growing on virtually bare limestone, and although modern agriculture is partially responsible for this it was probably also true aboriginally.

Surface fresh water is virtually nonexistent. Exceptions include a seasonal stream on Andros, a tiny spring on Mayaguana, one natural sink hole on Middle Caicos, and, prior to inundation by Hurricane Donna in 1960, a couple of ponds on Pine Key (Caicos). Subsurface fresh water lenses are common on the coppice and pine islands.

Food resources today and in the past are primarily marine scale fish, shellfish, and crops. There are no quantities of native terrestrial fauna. There are native fruits and plants which supplement the crops, but it is very doubtful that they have ever been of any real significance.

CLIMATIC ZONES

Because of climatic factors, resources are not identical throughout the islands. Based on temperature and rainfall, factors which will be shown to be important variables which modify settlement patterns and economic strategies, the island chain may be divided into three environmental types and associated zones (see map). Archaeologically, as might be expected these zones are of some importance.

Zone I: Moist Subtropical

Rainfall is high, with annual rates above 1200 mm (Fig. 1). Winter temperature profiles are sufficiently low to place the zone outside the tropics (Nuttonson 1959:10; Burns 1954:31). Temperatures in the December-March period range below an agriculturally significant level of 10°C 10-20 days a year and below an economically critical level of 8°C with a frequency ranging from annually to slightly more than once a decade, depending upon the island in question. This climatic pattern is restricted to the northwestern Bahamas. All major islands here are pine islands and include Grand Bahama, Great Abaco, Andros, and New Providence.

Zone II: Moist Tropical

Rainfall varies by island between approximately 800 and 1100 mm per year. Temperatures of 8°C are never reached, although this level is occasionally approached, particularly in the western islands. The lower temperatures to the west, here and in other zones belie a simple latitudinal equation. The Moist Tropical Zone is restricted to the central Bahamas from Eleuthera to Mayaguana. A new pattern emerges in this zone since

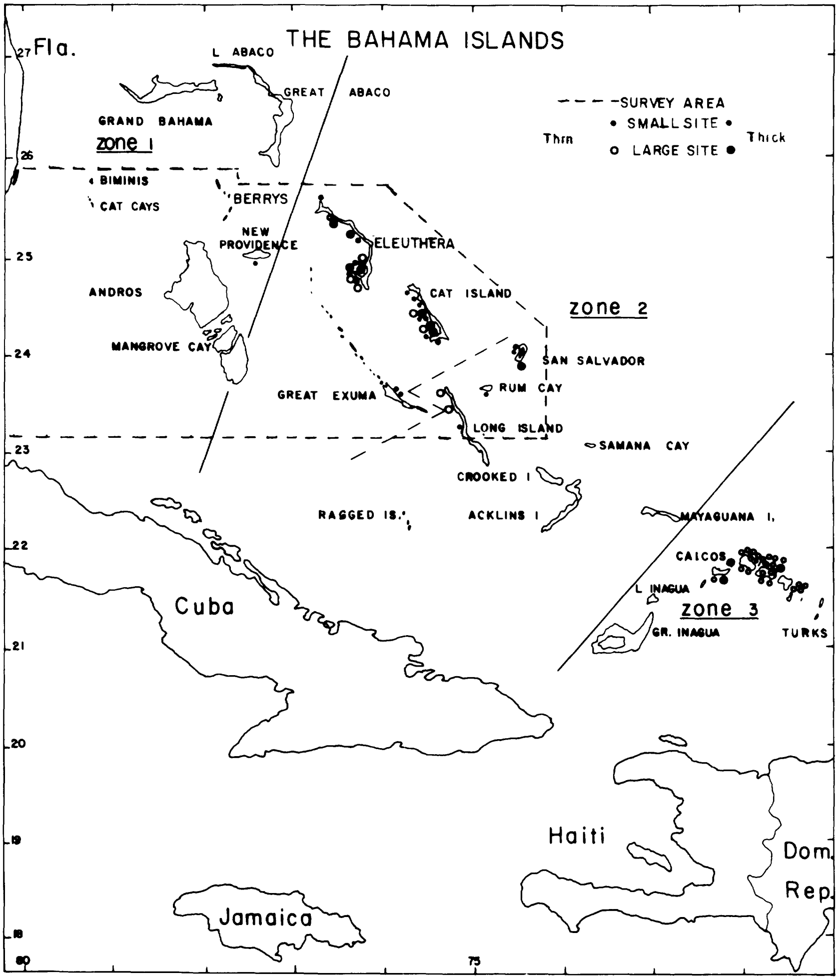

Fig. 1. The Bahamas.

the islands to the south and east such as Long Island, Crooked Island, and Mayaguana are drier than those to the north and west as Cat Island, San Salvador, and Eleuthera. This pattern and that of temperature variation is related to the NW to SE flow of continental cold air masses across the islands. All major islands in this zone are coppice islands.

Zone III: Dry Tropical

Precipitation ranges from 400 mm in dry years on Great Inagua to 800 mm in wet years on North Caicos. Thus its upper range just overlaps with the Moist Tropical, but the Dry Tropical Zone is distinguished by the presence of two intense dry seasons occurring in the summer and winter, by infrequent extensive cloud cover, and by a very high evapotranspiration to precipitation ratio (1/1) that is accentuated by strong south-east trade winds. All major islands, as a result, possess natural seasonal salt pans, another distinguishing trait. Temperature ranges are high, never reaching down to 10°C in the Turks and Caicos, although such levels are witnessed on rare occasions in the Inaguas. A localized rainfall pattern created by the flow of the trades over the central Caicos chain

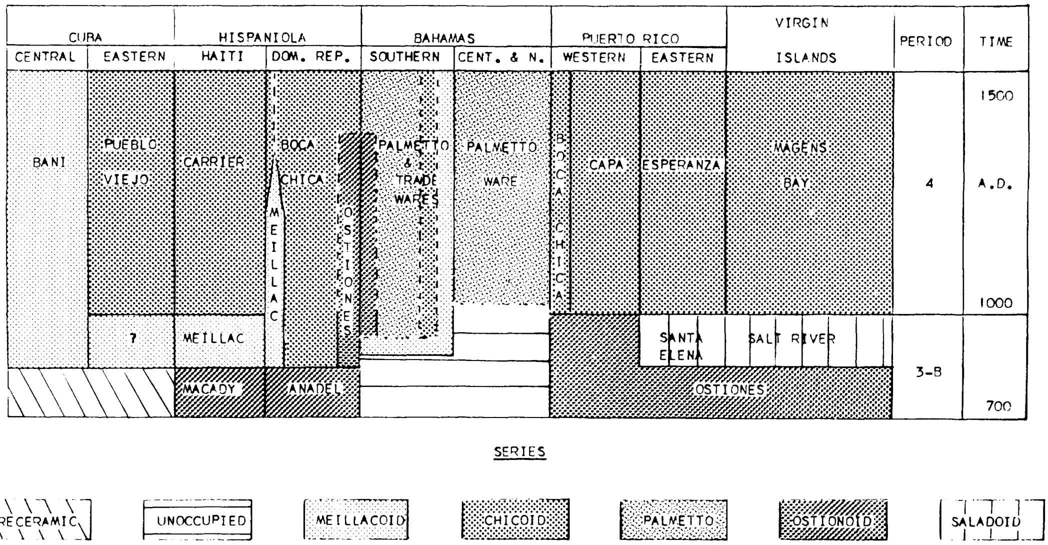

Fig. 2. Ceramics and time in the Greater Antilles and Bahamas.

causes Middle Caicos and North Caicos plus adjacent keys to receive enough moisture to support coppice vegetation. All others in this zone are Garrique Scrub.

ARCHAEOLOGICAL BACKGROUND

Julian Granberry's 1956 article, "The Cultural Position of the Bahamas in Caribbean Archaeology," is the only previous synthesis of Bahamian prehistory. Citing his limited survey of 1955 and earlier works by W. K. Brooks (1888), T. DeBooy (1912, 1913), F. Rainey (1934, 1935, 1941), H. Kreiger (1937) and John Goggin (1939), Granberry compiled a sample of 61 Arawak sites (1956:129). Forty-five of these were cave sites and all but one of the remaining 16 open air middens were from the Caicos.

Employing an originally extra-Bahamian classificatory system, Granberry applied Rouse's (1941, 1948, 1951) Haitian ceramic style names to Bahamian specimens. In so doing he was following a precedent set by Rouse (1951). Granberry deduced from modes shared with Haiti that there must have been two waves of Arawak stylistic influence and one or more associated migrations into the Bahamas (1956:132-31). This conclusion was based upon what he perceived of as a differential distribution of Meillac (Rouse 1939:42-43) and Carrier (Rouse 1941:113-155) modes in the Bahamas. For future reference it should be noted here the Meillac and Carrier are *styles* within respectively the Meillacoid and Chicold *series;* these two styles occurred in sequence in Haiti (Rouse 1964:503, 509) which Granberry suggested was the source of Bahamian Arawaks, commonly called Lucayans. Thus, Granberry's double wave model neatly dovetailed with events attributed at that time to Haiti. There are fallacies in this reasoning that will be examined during the presentation of new data.

Granberry (1956:132) described three cultural sub-areas within the Bahamas. A northern sub-area, which he defined as all islands north of and including Great Exuma and Cat Island, was said to possess only Meillac ceramics and "Sub-Taino" culture (Rouse 1948:508-21). A central "transitional" sub-area from San Salvador south to Mayaguana, contained Meillac sites, occupations with mixed Meillac and Carrier characteristics, and pure Carrier sites, the latter representing "Taino" culture (Rouse 1948:523-39). The southern sub-area, the Turks and Caicos plus the Inaguas, were reported to have only pure

Island	No. of months with minimums between 10°8 8°C.	No. of months with minimums at or below 8°C.	No. of Years between 1956-1967 for which data is available	Average annual rainfall
Grand Bahama	- - 17 - -	- - 11 - -	- - 10 - -	- - 1,268 mm - -
Abaco	- - 16 - -	- - 6 - -	- - 12 - -	- - 1,648 mm - -
Bimini	- - 7 - -	- - 2 - -	- - 10 - -	- - 1,108 mm - -
Andros	- - 10 - -	- - 2 - -	- - 7 - -	- - 1,231 mm - -
Abaco	- - 5 - -	- - 2 - -	- - 6 - -	- - N/A - -
New Providence	- - 13 - -	- - 1 - -	- - 7 - -	- - 1,288 mm - -
H.I., Eleuthera	- - 1 - -	- - 0 - -	- - 8 - -	- - 1,125 mm - -
San Salvador	- - 1 - -	- - 0 - -	- - 3 - -	- - 1,005 mm - -
Cat Island	- - 1 - -	- - 0 - -	- - 7 - -	- - 1,043 mm - -
Long Island	- - 2 - -	- - 0 - -	- - 8 - -	- - 881 mm - -
Crooked Island	- - 5 - -	- - 0 - -	- - 5 - -	- - 791 mm - -
Mayaguana	- - 2 - -	- - 0 - -	- - 4 - -	- - 854 mm - -
Great Exuma	- - 1 - -	- - 0 - -	- - 4 - -	- - 987 mm - -
Great Inagua	- - 3 - -	- - 0 - -	- - 7 - -	- - 687 mm - -
Grand Turk	- - 0 - -	- - 0 - -	- - 7 - -	- - 560 mm - -

Fig. 3. Temperature and rainfall in the Bahamas.

Meillac or Carrier occupations. No indigenous ceramic complex was recognized in any sub-area.

This proposed distribution was offered in support of a model (Granberry 1956:132-3) in which Sub-Taino Meillac potters swept from south to north in the Bahamas beginning in the middle of Rouse's period IIIb (1951:251) a period to which Rouse has subsequently assigned a time range of 700 to 1000 A.D. (1964:503). This was followed by a second wave of influence, and presumably to some degree people, bearing Taino culture and Carrier ceramics. This second development was dated sometime after the beginning of period IV, i.e., after approximately 1000 A.D. (Rouse 1964), and was believed to have still been in progress in 1492.

Non-ceramic artifact distributions were employed by Granberry in support of his model as well. He notes (1956:129) the similarity between stone celt materials and forms in the Bahamas and those from Haiti and employs the occurrence of zemis and monolithic axes in the southern Bahamas and in Taino material culture as confirming data for the period IV Carrier influence.

Neither the celt types nor the ceremonial lithics are exclusively Haitian or Taino, but there is a more basic criticism of such an explanatory scheme in the Bahamas. Employing celts that are not found in direct stratigraphic context is especially hazardous in these islands, and no celts have been found *in situ* north of Cat Island. Virtually all celts described prior to 1967, except for some secure finds in the Caicos, were purchased from Bahamians on the islands being investigated. The tacit assumption has been that the celts were of local derivation (Rainey 1935:274; Goggin 1939:23). Glover, in his study of the native boat building industry of the Bahamas (1974), found that celts, known locally as "thunderbolts" are prized as good luck pieces. When a Bahamian sailing vessel was built in the northern or central Bahamas, a celt was placed under the mast before it was stepped. The historically most significant centers of boat construction have been on Man of War Cay in the Abacos and in Mangrove Cay, Andros. Boat purchasers have descended upon these and other construction locales, with celts of diverse origins in hand, since the

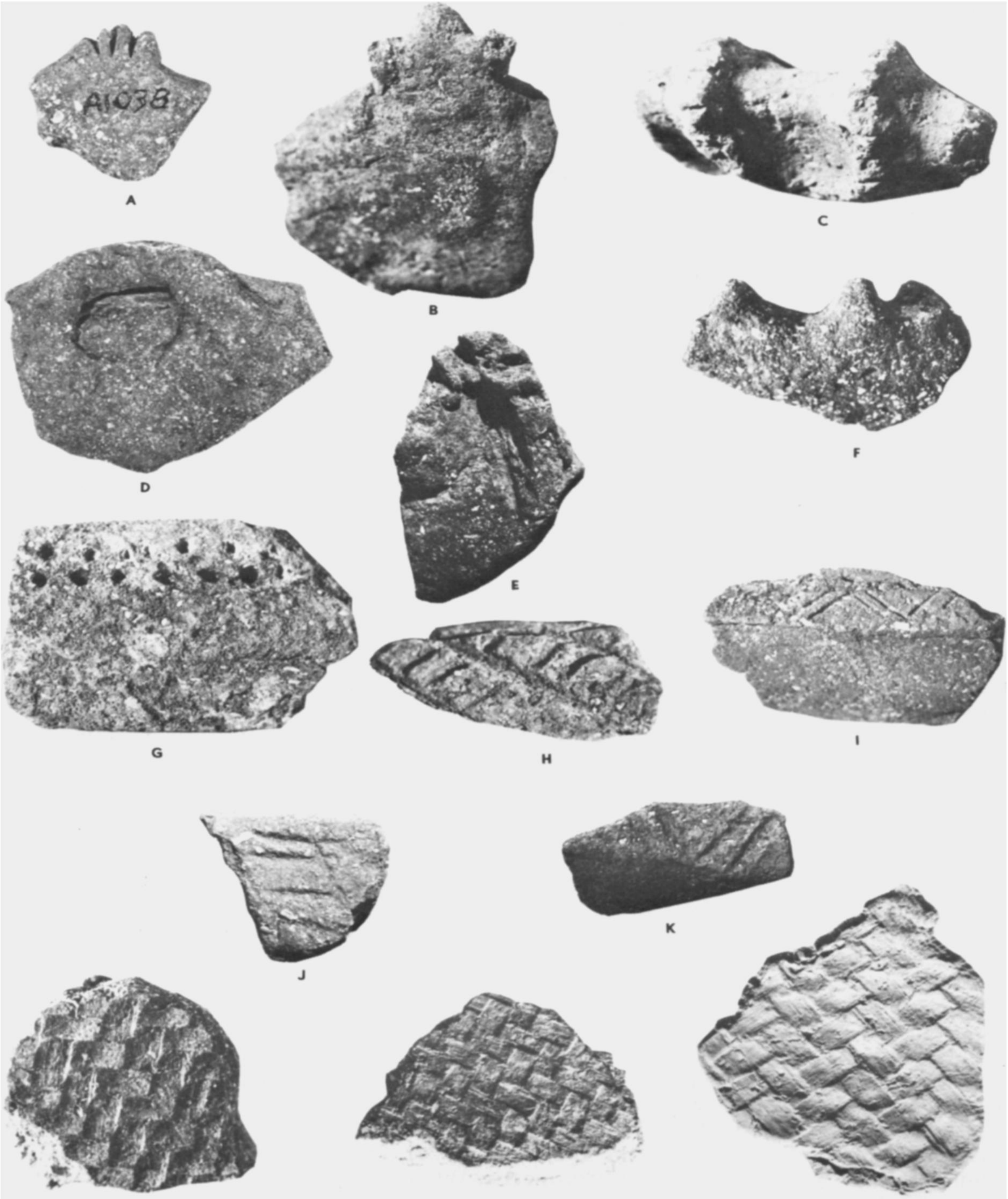

Fig. 4. Palmetto series pottery. (*A-F*) Palmetto Molded Applique; (*G-K*) Palmetto Punctate-Incised; (*L-M*) Palmetto Mat Marked; (*N*) Clay impression Palmetto Mat Marked sherd.

last century. One result of this activity was the exceptional collection of celts purchased by Goggin in Mangrove Cay (1939:23). Hence, the only reliable distributional evidence is for the zemis and monolithic axes which do appear primarily restricted to the southern islands.

NEW DATA

The majority of controlled surveys and excavations, and all detailed artifact analyses post-date Granberry's paper. Most of the research since that time has been generated by the Department of Anthropology at Florida Atlantic University under the direct or indirect supervision of Sears.

Disciplined investigations yielding concrete data that provide the basis for a new appraisal of Bahamian Prehistory include surveys and or excavations on San Salvador (Hoffman 1967, 1970), Cat Island (MacLaury 1970) Eleuthera (Sullivan 1974), Crooked Island (Hoffman pers. com., Winter 1974), a boat based survey by Sears in the central and northern islands conducted from 1971 to 1973, and a recent survey (Sullivan 1976) in the Turks and Caicos. These investigations have located 55 new sites in the archipelago. All save two are open air sites, which in turn are predominantly coastal middens.

Archaeological investigations in this environment are a peculiar proposition. As DeBooy (1913:1) and Sears (1975) have pointed out, one is somewhat restricted if the research hardware does not include a boat. Sears fortunately possessed one, without which many of the operations discussed below would not have been possible.

The first step in our program, more through accident and the initiative of Charles Hoffman than through planning, was a thorough survey of Cat Island. We eventually covered virtually all of the island. The patterns discerned here helped us define the environmental requirements of Lucayan Arawaks in the central Bahamas. In addition a substantial ceramic sample was acquired. The settlement and stylistic patterns identified on Cat Island then provided us with a comparative base for extending our investigations to other islands and zones.

Sixteen sites were located in the Cat Island survey, all that ever existed with a high degree of probability. A description of their characteristics, it has turned out, may be used as a generalization of Lucayan settlement activities elsewhere in the central Bahamas. All sites, excepting one with three sherds, were located on the lee (western) short on coastal sand dunes or strands. The larger and/or richer ones were all adjacent to shallow, well protected bays. Most of them were currently in use as gardens or coconut plantations and two were partially used for cemeteries, all of these activities being a function of soil depth. They ranged in size from nearly an acre down to a few hundred square feet: in depth from virtually zero, which did include some larger ones, to 60 cm.

All of the sites had a scattering of shells and sherds with some concentrations suggestive of activity areas. The dominant shell is a clam, variously classified as of the genus *Cadokia or Lucina*, which is also known as a major food source of the Arawaks to the south (Sleight 1962:37). The clams, although not eaten at all today, occur in quantities only in the very shallow, nearly landlocked, bays behind the sand dunes. Conch, *Strombus giguas* the contemporary staple of many Bahamian's diet, seems to have been used almost entirely as a raw material for celt blades, not as a food, and is not abundant in the midden refuse.

A sample of 6,028 sherds, which was obtained from 19 test pits in 5 sites excavated by MacLaury (1970) enabled us to begin a detailed analysis of the *indigenous* Palmetto Series pottery, described below. This series of excavations did not demonstrate any ceramic change, either vertically or horizontally, in or between sites. This is the same situation encountered by us everywhere in Zone II and by Hoffman (1967, 1970) with a sample of 5,250 sherds from a series of 2-meter pits that covered most of the 100-m diameter Palmetto Grove site on San Salvador. His work there, available to us during its course, helped greatly in developing this program and the efforts of synthesis described herein.

With a virtually complete settlement pattern and a large artifact sample from a major island in the central Bahamas recorded, we were then in a position to begin a regional survey.

The course of the northern and central Bahamian boat survey was dictated by geography as relevant to seagoing peoples as well as by gaps in existing knowledge of the area. Chains of islands could be and were checked at those islands nearest their ends which had the minimal environmental requisites for supporting a resident population. This gave us quick presence or absence data. Large islands needed more attention of course, often involving follow up surveys (e.g., Sullivan, 1974) and the use of rented automobiles, motor-bikes, bicycles, and much walking. Examining coasts by boat and the interior of islands by whatever means was available, we covered a wide range of environmental settings on the following islands, chains of islands, and cays.

In the boat survey in 1975, we used Morison (1942) as a guide to the location and interpretation of sites on San Salvador, Rum Cay, and Long Island. Our purpose was to secure an end date for the Palmetto Series by demonstrating its existence in 1492. We accomplished this and at the same time, not at all by coincidence, provided very strong support for the Morison interpretation of Columbus' 1492 voyage, landfall, and landing spot on San Salvador as well as other events there and his subsequent visits to Rum Cay and Long Island (Sears 1976).

Northern Bahamas

Bimini group—Extensive coverage of North Bimini, parts of South Bimini, Cat Cay and Gun Cay. *No sites.*

Andros—Extensive coverage north end, which has extremely good soil and shell-fish resources. Spot checks made to bights in center of island and Mangrove Cay. *No sites.*

Berry Islands—Coverage Frazier's Hog and Cub Cays to the south, Little Harbor Cay in center and Great Harbor Cay to north. Great Harbor has extensive areas with environmental parameters identical to those of sites in the central Bahamas. These were surveyed in detail. *No sites.*

New Providence—Examination of most undeveloped areas on north and south coasts. *1 site* found on south coast.

Central Bahamas

Exumas—Survey covered Highborn Cay at north end, the Staniel group and Great Guana Cay in center, and the northeast side of Great Exuma in the south (no survey of lee-coast). *2 sites,* both on Great Exuma.

Long Island—Rapid survey of northern half. *3 sites,* one of particular importance to be discussed later.

Rum Cay—Rapid survey of lee coast. *1 site.*

Eleuthera—Thorough coverage by boat, dinghy, motorcycle, and foot. All possible terrain investigated (Sullivan, 1974). *15 sites,* probably very nearly all that ever existed.

San Salvador—Complete and intensive survey before our visit (Hoffman 1967, 1970) *5 sites.* Probably all that ever existed.

Southern Bahamas

(Completed by Sullivan, 1976)

Grand Turk—Complete coverage of lee shore, majority of interior, and windward shore examined. *No sites.*

South Caicos—Extensive coverage of all environmental zones. *No sites.*

East Caicos—Close examination of eastern 1/2. *No sites.*

Middle Caicos—Thorough coverage of western 2/3. *7 sites.*

Pine Key—Complete coverage. *1 site.*

Providenciales—rapid survey of all but southwest quarter. *2 sites.*

Our surveys, combined with the reports of Hoffman, MacLaury, and Winters that were cited earlier, provided us with detailed artifact analyses from New Providence, Eleuthera, Cat Island, Long Island, Rum Cay, Great Exuma, San Salvador, Crooked Island, Providenciales, Pine Key, and Middle Caicos. The works cited by Granberry provided some information on settlement patterns and very generalized and selective artifact descriptions for some of these same islands and also for Grand Bahama, the Abacos, Great Inagua, North Caicos, and the western tip of East Caicos. Most of the data employed by Granberry referred to cave sites, which will not be dealt with here since they do not reflect settlement.

A compilation of all the sources listed above provides the following data base pertinent to sedentary open air occupations within the climatic zones detailed earlier:

Zone	*Number of Sites*	*Location*
I Northwestern Bahamas	1	Coastal
II Central Bahamas	43	42 Coastal 1 Inland
III Southern Bahamas	25	1 Coastal 24 Inland

The distribution of open air sites is shown on the map with symbols for two factors, size and richness. In some instances patches of midden near each other, recorded as separate sites in our survey files, have been combined here into single sites, probably a closer approximation of the aboriginal situation. There is of course a continuum in size, so that our division into small and large, splitting at 1/2 acre, is arbitrary. This is not true, with very few exceptions indeed, for the richness or density factor throughout the size range. Some sites clearly accumulated a lot of midden debris. Even without excavation, it is obvious that there is some depth to the midden deposits. Soil is extensively darkened by the decay of organic matter and both sherds and shells are common over the entire area, although there are spot concentrations. On the thin sites midden is essentially a surface scatter. There is little to no soil enrichment and sites consist of a series of thin but distinct concentrations of shell and artifacts, each presumably a house or some other activity center. The artifact yield for the thin sites is often very small. Several produced less than a dozen artifacts.

ARTIFACTS

Ceramics

The only pottery present on the single open air site in Zone I, and apparently in Rainey's small collection from a cave on Andros (1935:274) is the native shell tempered Palmetto Series, which Hoffman (1967:22,43) and MacLaury (1970) have identified as part of the material culture of the protohistoric Lucayans. In the central Bahamas Palmetto pottery is universally present, but some sites also have a small complement of igneous tempered sherds. These must be Antillean imports since Florida and the Bahamas are sedimentary formations. These trade wares never exceed a frequency of 1.8% of the collections. In the southern Bahamas three Palmetto Series sites are known, all of which have significant amounts of trade wares, the average being 10%. All the other sites from this zone for which we have detailed ceramic analyses have Meillacoid ceramics.

Palmetto Pottery was first described as a single ware with several variants by Hoffman (1967, 1970) and as a series of 2 types by MacLaury (1970). Sullivan (1974) divides it into a series (definition Willey 1949:6) with a larger number of related types, the practice adhered to here, based on a total sample of over 8,000 sherds in our collections plus the data from the over 5,000 reported by Hoffman (Willey 1949:6). These original analyses were based upon collections solely from the central and northern Bahamas where decorative and formal modes have a uniform distribution. There is some modal variation in the southern

Bahamian collections, but none that fall outside the type definitions derived from assemblages to the north.

It is recognized that much of our differentiation into types is on a single mode basis, a kind of classification which has occasioned a great deal of argument in American Archaeology. Sears' point of view in this regard has been expressed elsewhere (1960). It may be summed up here by stating that "types" work when the problems are the very basic ones of delineating cultural boundaries in time and space.

Detailed type descriptions of the Palmetto Series follow. They are provided for two reasons. First, the standard motivation, to provide a comparative base for other researchers. Second, the stylistic composition and affinities of the Palmetto Series is part of the basis for our interpretation of the location and culture contact environment in which it evolved.

TYPE DESCRIPTIONS: PALMETTO SERIES

Palmetto Plain: Approximately 95% of collections

Paste: The clay is derived from concentrated deposits of Bahama Red Loam. Approximately 2% of the clay has not been dampened and occurs in unmixed granular lumps. There are small accidental inclusion of carbonized vegetable matter and also of limestone fragments. These occur in less than 5% of the sherds. Generally the paste is free of accidental inclusions and is well mixed.

Method of Manufacture: Bowl forms are coiled, griddles are mass molded. Firing is in an oxidizing atmosphere.

Temper: Crushed shell, apparently genus *Lucina*. Ranges from fine powder to 4 mm, constituting 10 to 25% of the paste.

Hardness: Average 2.5 on Moh's scale.

Texture: Tends to be friable, breaks are uneven and edges crumble easily.

Color: Normally red, varying oxidation, norm about 70% completely oxidized. Cores may be dark gray-brown.

Surface Finish: Inner bowl surfaces normally moderately polished, may be highly polished, rarely rough. Outer surface less frequently polished than inner. Rare high polish on both surfaces. Griddle Sherds are commonly moderately polished on the upper surface, rarely highly polished. They are never polished on the lower, carbon stained, surface.

Form: *Rim:* Usually thickened and flat with sharper angle at the inner edge. Rounded forms are common. In the southern islands the rims are commonly beveled, sloping toward the interior in the vessel. All griddle lips are rounded and are not raised. *Shoulder:* Straight or slightly incurving, never outflaring. *Body:* Apparently restricted to hemispherical bowls and flat griddles. Boat shaped vessels and carinated bowls may occur, but no examples are known. *Base:* Bowls rounded, never flat, griddles flat.

Decoration: None.

Dimensions: Bowls, 20 to 40 cm in diameter, 5 to 20 cm in height. Griddles, 30-60 cm in diameter.

Thickness: Bowls, from 5-16 mm, the lips average 10 mm, basal sherds 14 mm Griddles average 20 mm, range from 16 to 32 mm with no significant change from edges to center.

Palmetto Mat Marked: (Fig. 4, L-N, Approximately 4% of collection) Paste, method of manufacture, temper, hardness, color and form, dimensions and thickness are the same as Palmetto Plain.

Surface Finish: Same as Palmetto Plain except there is no polishing of Mat Marked surfaces.

Decoration: At least 4 types of woven mat impressions are illustrated in Fig. 4. On bowl forms these impressions are always on the lower 1/3 of the vessel exterior. On griddles, the dominant Mat Marked form, the impressions are always on the lower side exclusively. Hoffman (1970:12) and MacLaury (1970:38) have stated that these impressions are not the result of intentional decoration, but rather are a by-product of the construction process which appears to have included drying on mats. We regard the question as open. On bowl forms the decoration extends over a wide arc of the vessel, too great an arc to be accounted for by postulating that the damp bowl was simply placed on a mat to dry. Also, on both bowls and griddles, there were never any overlapping mat impressions which one would expect from inadvertent imprints acquired while the vessel was being shaped on a mat. The impressions are clear, requiring that considerable force was applied from above, which also implies intention. Finally, as stated above, the decoration appears to be restricted to two forms, hemispherical bowls and griddles. This decoration is unknown from other types of decorated vessels suggesting some conceptual segregation that would not be present if the mat marks were accidental byproducts of construction.

Palmetto Molded Applique: (Fig. 2, Approximately .5% of collections) Paste, method of manufacture, temper, texture, hardness, color, dimensions and thickness as in Palmetto Plain.

Surface Finish: Same as Palmetto Plain, except zones of modeling and applique are never highly polished.

Form: Rim, shoulder and base as in Palmetto Plain. *Body:* Hemispherical bowls, boat shaped vessels, carinated bowls, never griddles.

Decoration: The uppermost coil has been molded into low ridges or peaks, or a lump of clay has been applied and worked to produce the same effect. Pronounced peaks are commonly incised, producing a 2 or 3 lobed effect. Some zoomorphic-anthropomorphic head lugs and some wedge lugs are present, usually on boat shaped vessels. In another variant, strips of clay have been appliqued along or just under the rim and/or upper 1/3 of the vessel wall, commonly in curvilinear form. Incised or impressed lines across the appliques are frequently present.

Palmetto Punctate Incised: (Fig. 2, G-K, Approximately .5% of collections) Paste, method of manufacture, temper, texture, hardness, color, dimensions, and thickness as in Palmetto Plain.

Surface Finish: Same as Palmetto Plain, except zones of punctation and incision are never highly polished.

Form: Rim, shoulder and base as in Palmetto Plain. *Body:* Hemispherical bowls, boat shaped vessels, carinated bowls, and there is one griddle example known.

Decoration: *Incision:* The most common motifs employ parallel lines which may be parallel to, perpendicular to, or oblique (approximately 45°) to the rim. Commonly the lines are cross hatched without intersection. Incisions are normally 1-2 mm wide, about 1 mm deep. The zone of decoration is restricted to the lip and immediately adjacent exterior of the vessel (upper 1/4). Incision is most common on carinated bowls. *Punctation:* Circular punctations, 1-2 mm in diameter, on or parallel to the lip or alternating with or terminating incised lines in a line and dot motif. The punctation is applied to the same zones as incision. Each type of decoration in this case is made with the same tool type, and in the instance of the line and dot motifs, the same tool. Although one line and dot motif is known from a griddle sherd, most punctation is encountered on hemispherical bowls. There is sufficient overlap in vessel forms and frequency of joint occurrence of incised and punctated designs that they are regarded as a single ceramic type.

REGIONAL AND STYLISTIC AFFINITIES OF THE PALMETTO SERIES

In this discussion comparisons will be made between modes within both stylistic traditions and pottery types. This is necessitated by the large volume of relevant literature generated by Rouse and emulated by others which employs the concept of series and styles (Rouse and Cruxent 1963:14-21) that exists along side typological definitions " . . .

designed to show differences in pottery which correlate with differences in either time or space'' (Bullen 1962:3). As stated above we have cast our lot with the latter approach. There is no theoretical reason why the two approaches can't simultaneously contribute to the reconstruction of culture history.

Ostionoid Series

This series (definition Rouse 1964:5) gave rise to the Meillacoid Series (described below) on Hispaniola (Veloz Maggiolo et al. 1973:142-147). It shares hemispherical bowls and griddles with the Palmetto Series (Rouse 1964:509), but the true relationship between the two is found in the presence of rim peaks (Veloz Maggiolo et al. 1973:Plates 10, 11, 14, 16). A few Ostionoid trade sherds are present at a Palmetto Series site in the Caicos, and this argues for the direct acquisition of this mode from an Ostiones style rather than from derivitive traditions on Hispaniola and Puerto Rico which continue the mode.

The Ostionoid Series includes the short lived Macady style in Haiti, from approximately 700-850 A.D., the Anadel in the Dominican Republic, and the Ostiones style in eastern Puerto Rico and the Virgin Islands from that same time period. This same style persisted to 1000 A.D. in western Puerto Rico (Rouse 1964:503 Fig. 5). Rouse (1964:503, Fig. 5) would date the close of Ostiones at this same time level in the eastern portion of the Dominican Republic, but radiocarbon dates recently published by Veloz Maggiolo et al. (1973:162-4) indicate that it persisted in this area to nearly 1400 A.D. and farther to the west on the island into the 13th and 14th century. There may be distortions in these conclusions because of the standardized use of arbitrary stratigraphy without adequate control for post depositional disturbance in the Dominican Republic, but the data cannot be dismissed out of hand. Regardless of whose dates are correct, Ostiones overlaps with both Meillacoid and Chicoid styles in the Dominican Republic.

This is important because in Palmetto Series sites in the Caicos, Meillacoid, Ostionoid, and Chicoid trade wares are present simultaneously. It can not be stated with any assurance that the Ostionoid influence came from Hispaniola since it is present in western Puerto Rico where it also overlaps with these other series. The presence of Meillacoid and Chicoid trade wares in the Caicos at the same time level as Ostiones does appear to preclude the nomination of Macady, Anadel or Ostiones in eastern Puerto Rico or the Virgin Islands, for these styles disappear too early.

Meillacoid Series

The Palmetto Series shares a number of modes with this series. The most specific relationships can be found in the incising and punctation techniques. Similarities may be seen in the presence of lines which are parallel and cross-hatched without intersection and shoulder and lip punctation. This series also possesses incised shoulder appliques which are almost identical to Palmetto modes (Rouse 1941:54-91). There are comparable vessel forms including wide mouthed bowls with flat and rounded lips, carinated bowls, boat shaped vessels, bowls with ridges and peaks, and mass molded vessels (Rouse 1941:54-91; Veloz Maggiolo 1972:29). This last set of traits is not exclusive to the Meillacoid series however, for each of these elements occurs in one or both of the Ostionoid and Chicoid Series.

Meillacoid characteristics which have no counterpart in the Palmetto Series are: (1) Thin hard vessels ranging from 3-7 mm in thickness; (2) frequent presence of a ridge below the rim on the outside, or less commonly the inside of vessels; (3) the use of red slip after polishing; (4) tempering with naturally occurring deposits; and (5) the presence of a reducing atmosphere during firing (Rouse 1941:54-91).

There are several Meillacoid regional styles. The Meillac style is known from Haiti from approximately 800-1000 A.D., the Báni from central Cuba from 800-1500 A.D., an unnamed style from eastern Cuba dating from 800-1000 A.D., (Rouse 1964:503, Fig. 5), and a Meillac-like style which has recently been identified from scattered portions of the

Dominican Republic where it dates approximately 800-1400 or perhaps as late as European contact (Veloz Maggiolo et al. 1973:145-152).

The present state of knowledge does not permit the restriction of Meillacoid influence on the development of the Palmetto Series to any single one of the regional styles listed above. Trade ceramics found in the Caicos include specimens that duplicate examples from both sides of Hispaniola and from Meillacoid sites in central and eastern Cuba. The range of modal variation in these regions has sufficient overlap so that definitive assignment of individual trade pieces to a regional culture on stylistic grounds is impossible. If and when detailed paste and temper analyses of a wide range of Meillacoid styles becomes available, then such assignments will be possible. Accepting all the present limitations, it is our impression on stylistic grounds, that trade ceramics from the Caicos include specimens from both Hispaniola and Cuba.

Chicoid Series

Traits shared by the Palmetto Series and Chicoid styles involve the following: (1) vessel walls of comparable thickness; (2) similar vessel forms—a comparison equally applicable to Meillacoid; (3) the use of the same tool for incising and punctation; (4) firing in an oxidizing atmosphere; and (5) similar modeling of anthro-zoomorphic lugs. (Rouse 1941:113-21; Veloz Maggiolo 1972:29-31, 34-36). The incised designs on Palmetto Punctate-Incised have been related to Meillacoid designs, but the combination of incision and punctation in immediate succession is a Chicoid trait (Rouse 1941:121).

The original Chicoid style, Boca Chica, developed in the Dominican Republic in the middle of Rouse's period IIIb, or about 800 A.D. It then influenced neighboring traditions which produced Chicoid styles beginning about 1,000 A.D. and lasting until contact in Haiti (Carrier), eastern Cuba (Pueblo Viejo), western Puerto Rico (Capa), eastern Puerto Rico (Esperanza), and in the Virgin Islands (Maggens Bay). (Rouse 1964:503, 510, Fig. 5).

Once again selecting an individual style as the contributor of Chicoid influence upon the Palmetto Series is a fruitless endeavor because of the generalized elements adopted into the Lucayan complex and the limited population of trade sherds available for analysis. Although none of the Chicoid styles can be excluded, the trade sherds present in the Caicos are stylistically most akin to the Boca Chica, Carrier, and Pueblo Viejo regional styles.

DISCUSSION—PALMETTO SERIES

The Palmetto Series is a unique ceramic complex which drew upon other regional traditions while evolving decorative and formal modes of its own. The terms Meillac and Carrier, as employed by Granberry are simply not applicable except in terms of tracing limited relationships. These terms carry with them suggestions of specific regional heritages and temporal units that are not justified by the new data. Carrier traits present in the Palmetto Series are generalized Chicoid traits just as the Meillac are also Meillacoid in the broader sense. There is no evidence that these traits entered exclusively from Haiti. Rather, Hispaniola and Cuba generally from period IIIb onward are the apparent sources. The same can be said for the Ostiones traits if we limit the source to the Dominican Republic and western Puerto Rico.

This raises the question of why the Meillac and Carrier labels were employed by Granberry. The primary reason seems to have been that the ceramic sample from the islands north of the Caicos prior to 1956 was extremely small, and the sample was evaluated along with the larger Caicos sample that includes trade wares from Hispaniola. In neither sample was ceramic analysis sufficient to detect the presence of an indigenous tradition. The pertinent literature available at that time was primarily restricted to the early work by Rouse in Haiti and Cuba and the complexity of overlapping series in the Dominican Republic was as yet unclear. More work in Haiti, something greatly needed, will probably reveal similar complexity.

Many Palmetto Series sherds show Meillacoid and Chicoid decorative and formal modes simultaneously (Sullivan 1974:42-3; Hoffman 1970:17). But, it is not uncommon for a trait of one or the other to be the only decorative mode on a sherd. This is also true for Ostionoid traits but their origin is easily masked by continuities between Ostionoid and Meillacoid. The association of diverse influences and the wedding of distinct traditions can only be discerned properly while watching the ceramic sample come from the same stratum.

In short, guilt by decorative modal association and analysis based upon a small sample out of stratigraphic context which homogenized indigenous and imported specimens skewed the early interpretation in favor of the Haitian succession.

CERAMIC CHRONOLOGY

As was noted earlier, the only non-Lucayan, non-Palmetto sites in the Bahamas are Meillacoid. These are in the Caicos chain. We have no absolute dates for these sites, just as we have none for any site in the Bahamas. We know from the discussion above that these sites might range from anywhere between 800 and 1500 A.D. There is good reason to believe they fall at the early end of this range. No Meillacoid sites in the Caicos show Palmetto Series trade sherds. This suggests that they are not contemporaneous. The Lucayans were the sole occupants of the Bahamas at the time of contact. Thus the Meillacoid sites appear to predate and be succeeded by Palmetto Ware sites.

There are, however, some indigenous ceramics on the Meillacoid sites, which have primarily imported igneous rock tempered ceramics. These indigenous sherds are local copies which employ crushed limestone tempering. A few sherds, which would be classified in the Palmetto Series but have crushed limestone included in the tempering material are known from one Palmetto Series site on Middle Caicos. This data permits the hypothesis that the first purely indigenous ceramics in the Bahamas, at a site yet to be found in the Caicos chain, are a Meillacoid derivitive employing crushed limestone as tempering. This first hypothetical native tradition is offered as a nascent Lucayan culture and as the progenitor of Palmetto pottery.

We know that Palmetto pottery existed as a fully developed tradition before the demise of the Ostionoid series because of the presence of Ostionoid trade ceramics on a Palmetto site. Although the Meillacoid series is here offered as the source of the first indigenous ceramics in the Bahamas, the analysis of decorative and formal modal similarities with other traditions presented above makes it clear that it is not the sole contributor to the Palmetto Series. That contact with other traditions was common is evidenced by the presence of Chicoid, Meillacoid and Ostionoid trade wares at Palmetto Series sites in the Caicos. The dynamics of that contact will be examined later.

The inception of the Palmetto Series and, by association, of Lucayan culture, must therefore predate by some margin the disappearance of the Ostionoid series. As cited earlier, Rouse would date this event at 1000 A.D., others later. Since our work in the central and northern Bahamas shows that they were occupied after Palmetto ceramics were fully evolved, and such an occupation is presumed to have taken some centuries, we are inclined to accept a fairly early starting date for the Palmetto series. As a fully developed complex it should date from no earlier than 900 A.D. nor later than 1100 A.D. A date exactly in the middle is seen as most probable. The colonization of the central and northern Bahamas would therefore be coeval with or postdate this time frame.

NON-CERAMIC ARTIFACTS

Zone I—Northwestern Islands

There is only one secure find of a non-ceramic artifact from this zone, a Lucayan cedar canoe paddle discovered by DeBooy in a cave on More's Island near Abaco (1913:2-31). Goggin purchased petaloid celts on Andros (1939:23) as was mentioned earlier. Given the problems that have been discussed regarding such material and his and our failure to find sites, their significance is in serious question.

Zone II—Central Islands

Five fragments of petaloid celts have been recovered in excavations in this zone. They are all made of serpentine, the color varying from olive to vivid green. Shell celts and adzes made from *Strombus giguas* are much more abundant than their imported stone counterparts. MacLaury (1970:35-6) and Hoffman (1970:11) interpret some Strombus fragments as "scrapers," "gouges," or "spoons." We have examined these forms under magnification from 10 to 40× and under maximum oblique light conditions. All of the fragments of conch examined to date appear to be scrap from the manufacture of celts, for no signs of wear have been detected. Shell and imported stone beads are relatively common in middens in the central Bahamas as are fragments of coral that appear to have served as abraders for some purpose.

DeBooy (1913:6) purchased an effigy celt on Mayaguana made of igneous rock. Its original provenience is unclear. Rainey has reported "Bone awls, shell pendants, a wooden object which was probably part of a fire-making apparatus, and several well made tortoise shell fish hooks . . ." from a cave on Crooked Island (1935:275). Petroglyphs are common in this zone. A ceremonial stool or "dujo" was recovered by DeBooy from Acklins Island (1913:5).

Zone III—Southern Islands

Dujos, wooden bowls, stone zemis (Rouse 1941:110), or spirit fetishes, monolithic axes, petaloid celts, and bone awls are known from the Caicos (DeBooy 1912). No shell celts have been identified from these islands but this probably reflects our limited knowledge rather than true absence. Petroglyphs are also known from the Caicos.

SYNOPSIS OF ARCHAEOLOGICAL TRAITS BY ZONE

A synopsis of the archaeological traits of the Bahamas, by zone and in sequence appear in order here. This will enable the presentation of non-archaeological data with a full archaeological comparative base already in mind.

Zone I

No open air middens have been found on the major islands of Grand Bahama, Great Abaco, and Andros, nor on any of their associated cays. One site is known from New Providence although Great Abaco and Andros particularly have many areas with the soil type and marine resources determined to be important to the Lucayan settlers of the central Bahamas. Further, neither we nor others have found any evidence at all of occupation in the Berry Islands nor in the Bimini-Gun Cay-Cat Cay chain. Cave sites occur infrequently on the larger islands. Although none are reported on Grand Bahama, Great Abaco and a neighboring cay each have one Arawak utilized cave. Andros and New Providence each have one to three caves which may have been utilized prehistorically, the data being questionable. None of these caves have petroglyphs. No zemis, monolithic axes or effigy celts are known from this area. The few sherds present appear to be of the Palmetto Series.

Zone II

All major islands have a dominant pattern of open air coastal middens. Eleuthera and Cat have more than a dozen each. San Salvador has five and Long Island three. One site is known from Rum Cay and two from Great Exuma. There are probably more than presently indicated on Great Exuma. No open sites are known from Crooked Island, but ethnohistorical accounts (Morison 1942:243) suggest that they are present. No systematic survey has been conducted on Mayaguana. It is ecologically suited for a thin agricultural population and probably was occupied. Cave sites are known from all the islands listed above except Mayaguana. Such sites are frequently the location of burials and petroglyphs. Midden deposition in them is rare and when present the artifact yield is scant compared with open sites.

There are no secure finds of zemis or monolithic axes, but a questionable effigy celt has been noted. Serpentine petaloid celts are uncommon but these and the most common Strombus forms can be regarded as characteristic.

Ceramics are primarily of the Palmetto Series but Antillean imports occur with a frequency as high as 1.8%. There is no differential distribution of ceramic modes or types in this zone.

Zone III

Occupation here is essentially restricted to the western and central Caicos chain. Although Granberry (1956:129, Fig. 1) suggests occupation of Grand Turk and Great Inagua, there is no reason to believe that these islands were ever actually settled. They appear to have been occasional overnight landfalls and no more. Open air occupations in Zone III are predominantly inland. This is a very different pattern from that of Zone II.

Three Palmetto series sites are known from the central and western Caicos only one of which has an unequivocally coastal orientation. These sites have great quantities of conch shell in the middens, another contrast with Zone II where it appears in cultural deposits with low frequency. Some two dozen Meillacoid sites are known from inland settings. These occur in two environmental contexts. Approximately half of them are found on the ridges of limestone hills which are covered with coppice vegetation; the remainder are on barren salina flats proximal to natural salt pans. Two of the three Palmetto series sites are in the latter locale, including the largest Palmetto Series site known from the Bahamas. Trade ceramics from the Palmetto sites were discussed earlier and are more common by a factor of five than in Zone II.

Zemis and monolithic axes are well represented in collections from these islands. Cave sites are known and appear to represent utilization similar to that described for Zone II.

ARAWAK SUBSISTENCE AND THE ENVIRONMENT OF THE BAHAMAS

In any agricultural system a primary position is held by that cultigen or cultigens which provide starch. Drawing upon Spanish accounts of the sixteenth century, Sturtevant (1961:69-73) has concluded that among the island Arawak the primary starch sources were sweet potato and manioc. Of the two, the latter appears to have been the most important, and the bitter varieties of manioc were the most preferred and extensively grown.

Bitter manioc is the form most amenable to processing into a storable form. Unprocessed manioc tubers deteriorate in a matter of days once harvested. A dry storable starch is an economic asset in any context but it is especially important to a seafaring society, making protracted voyages practicable. Its utility in this regard was quickly capitalized upon by the colonial Spanish (Santa Cruz 1918:458, c.f. Sturtevant 1961:70).

The Island Arawak possessed a bitter manioc centric agricultural system. Therefore, a critical attribute of any environment available for permanent settlement by these people would be its suitability for bitter manioc cultivation.

We do not have enough information on the Island Arawak cultural system to define with precision what sufficient conditions for settlement were. We are postulating that the ability to grow bitter manioc was a necessary condition. Thus, in the absence of a significant change in the economic foundation of the Island Arawaks, a zone chosen for colonization would have to be so constituted as to fulfill the minimum environmental demands of bitter manioc.

Whether one embraces propositions of a Mesoamerican (Bronson 1966) Venezuelan (Sauer 1969), or Brazilian (Vavilov 1951) hearth for manioc domestication, it remains undisputed that it is a tropical plant. Tropical plants are characterized by relatively high, above freezing, chilling temperatures (Ochse et al. 1961:22-23). Cold injuries to tropical plants generally begin at 10°C. Each species of plant, and each variety within a species, possesses a set of "cardinal temperatures." These are the maximum, beyond which growth stops, an optimum, where growth is at its peak, and a minimum below which growth stops.

The other most critical growth modifier, soil nutrients being held constant, is moisture. This is only crudely judged by rainfall since the evapotranspiration rate of the growth zone can greatly modify moisture retention (Papidakis 1970:III).

Bitter manioc stops growing at 10°C (Jones 1959:315). Some varieties of sweet manioc are more cold resistant (Euverte 1959:56) and these are the only varieties grown into "—extra-tropical latitudes and altitudes." (Sauer 1969:46). The leaves and upper branches of bitter manioc die at 8°C (Euverte 1959:56).

Jones (1959:55) in his work on *Manioc in Africa* has suggested a rough correlation between a significant decrease in manioc cultivation and zones receiving less than 760 mm of rain annually. Since he could not control for other variables, Jones did not venture to state an absolute correlation between this rainfall level and manioc moisture requirements. It is known that for the vast majority of manioc varieties, yields are considerably reduced where crop watering is by rainfall and there is less than 500 mm of annual precipitation (Euverte 1959: Hendershott et al. 1972:11). This assumes the most favorable conditions for moisture retention in the soil. The most productive range for most varieties is from 1500 to 2000 mm when this is combined with a marked dry season (Euverte 1959:55).

With these limits in mind, we may now view the distribution of Arawak sites in the Bahamas with respect to them. Figure 1 presents the basic data in tabular form. Our discussion is presented in terms of the three climatic zones which do not coincidentally duplicate the zonal distribution of cultural patterns.

Zone I—Northwestern Islands

In terms of rainfall these islands are the most favorable for manioc production in the Bahamas. Annual rates vary by island between 1648 and 1108 mm. The upper end of the variation is within the optimal moisture requirements of the crop. The temperature profiles are clearly prohibitive, however. We see no advantage in reviewing Zone I island by island, but an examination of the chart reveals a consistent pattern. The growth of bitter manioc in the zone would frequently be stopped by temperatures of 10°C and below and the upper portion of the plants would be killed with a frequency sufficient to discourage agricultural colonization.

The fact that these injuries occur in a period from December to March brings to the fore a critical element in the bitter-sweet distinction. Bitter manioc is normally grown for a minimum of one year before harvesting (Papadakis 1966:107). The actual harvest may postdate planting by two or more years. Sweet manioc on the other hand is commonly harvested from six to nine months after planting. Because of this cycle sweet manioc has a two-fold advantage in its adaptation to cooler climates. It is naturally more resistent to cold injuries, and it may be spared exposure to damaging temperatures through its capacity to be planted and harvested during the warmer portion of the year. Bitter manioc, as was pointed out, has stricter temperature requirements and as it is grown the year round, is exposed to winter temperature extremes.

The cause for the variation in the growing regimen is that both starch and HCN levels increase through time. The latter is a favorable development. It has been suggested that the increased HCN content induces changes in the starch structure; the higher the HCN, the more stable, in terms of storability is the starch produced (Dr. Earl R. Leng, pers. com. to Dr. Donald W. Lathrap).

It should be noted that the entire bitter manioc plant will not be killed until 0°C is reached. Temperatures of 8°C to just above freezing will kill off the upper branches of the plant. The stem bases survive and will eventually set new sprouts, but with a great reduction in annual tuber production. Only one station shown on the chart, Mangrove Cay in January 1957, has reported a reading below 0°C. The real issue is whether the Arawaks, faced with the new phenomenon of acres of apparently dead and leafless manioc would have judged it an opportune time to move back to warmer islands. It is unclear what the carrying capacity of a tropical agricultural system annually partially destroyed by cold injuries would be. That it was insufficient to invite permanent occupation is indicated by the rare archaeological remains in Zone I.

One partial exception to the patterns of Zone I is the island of New Providence. It is warmer than the islands to the north and immediate west. As winter fronts proceed from NW-SE or WNW to ESE the air is warmed by the semi-tropical Bahamian waters as it proceeds across the islands. The combined effect of this is that the temperature gradient runs from west to east as much as north to south. Hence, Dunmore town on Harbor Island, adjacent to northern Eleuthera, is by virtue of its eastern position warmer than New Providence airport although it is farther north by 28 minutes of latitude.

New Providence is the warmest island in the northwestern zone and it is the only one that has produced an open air midden. This site is not only small, but it was also produced during very short term occupation. It might have endured just long enough to experience a winter's eve of 8°C, and long enough for the inhabitants to witness the effect of this temperature on their crops. The most probable scheme for the Abaco cave, given the faunal remains cited by Rainey (1935:274) is that these islands were periodically visited to hunt Hutia (small rodents) and to exploit the local concentrations of wild plant and marine resources. There is no data available relevant to judgments concerning the seasonality of such activities.

Manioc is not of course the only tropical plant in the Bahamas and the distribution of others appears to confirm the suggested division between Zone I and II. Plants of the genus *Cereus* and *Opuntia* grow up to this line with one slight overlap (Shattuck 1905:200). They both appear on South Andros, below Mangrove Cay. This particular segment of Andros has never been surveyed. It may be that because of its lower latitude and proximity to warm currents flowing around the tip of the island from the Great Bahama Banks that South Andros is not properly included in Zone I.

Zone II—Central Bahamas

The data on figure 1 reveal that the islands of this zone have adequate but not optimal rainfall. It varies between 1125 and 791 mm and therefore the zone is less ideal in this respect than Zone I. These islands never experience temperatures at or below the critical level of 8°C. They do occasionally have temperatures low enough to stop the growth of manioc, especially in the western islands, but there is no evidence of killing temperatures.

Zone II has the largest number of open air sites of any of the zones and the proportion of rich to light occupations is highest here. All rich sites are coastal middens that have loose sandy soils which are well drained and are the most favorable soils in the Bahamas for the cultivation of root crops such as manioc and sweet potatoes. These sites are also close to sheltered waters possessing high clam populations. It appears that these site locations were chosen with the intention of maximizing the simultaneous exploitation of agricultural soils and shellfish resources.

The drier islands such as Long Island and Crooked Island do not show settlement as dense as the wetter islands further north in Zone II. If temperature barriers did not exist it would be expected that the still wetter islands of Zone I would have supported the largest populations aboriginally as they have historically. A complete survey of Great Exuma including the lee shore, something we presently lack, will presumably reveal several more Lucayan sites. The total absence of sites in the rest of the Exuma chain is something of an anomaly. There may be temporal factors involved here and elsewhere but it is worth noting that the unoccupied Exuma Islands are very small and are properly termed cays. The other islands occupied in Zone II are considerably larger than these cays and there may have been some selection factor favoring large islands.

That some time factor is in force in the settlement of the islands is suggested by the evidence from Long Island and Rum Cay. Three sites were found on the northern half of Long Island. The northernmost and largest of these, on a shallow interior bay system near the northernmost tip of the island, is certainly in our opinion the village Columbus visited on October 16-17, 1492. He secured water here with the willing help of the natives and visited several houses in which he saw his first hammocks (Morison 1942:234-9). A fair sized village in 1492 is represented now by a very thin site which could not have been in existence long when Columbus arrived. On Rum Cay we found only a tiny site, a hundred square meters of disturbed but apparently very thin scattered shell with only two Palmetto Plain sherds on the surface. There is a large cave with petroglyphs on the opposite, windward shore. Columbus reported meeting many natives here on October 16 (Morison 1942:233). Either they had arrived too recently to have left any amount of village debris or we missed a site in a fairly intensive survey of the lee shore. Crooked Island and Mayaguana have no village sites confirmed, although as noted earlier, Columbus visited one apparently small village on Crooked Island.

In contrast, Eleuthera has 15 sites, Cat Island 18, and the relatively small island of San Salvador has 5. There are middens 60 cm deep on Cat, one at least that deep on San Salvador, and one on Eleuthera is 110 cm deep.

The data lend themselves to two interpretations, or a combination of them. Either the lower carrying capacity of the dryer islands supported a lower population density and thus a slower accumulation of midden, or, if the rate of accumulation was roughly comparable to Eleuthera, Cat, and San Salvador then the period of accumulation was less. One would expect of course that the relative size of single component middens within the same settlement type of the same culture would be a factor of population size, and their depth of time. If the dryer islands were settled late, then this means that they were bypassed by migrants from the southern islands presumably in favor of agriculturally more attractive islands to the north. If this was the case then we might expect that attempts at colonization in the northern Bahamas, represented by the midden on New Providence, came early in the period when the central islands were being occupied. In such a model the occupation of the dryer islands in Zone II would postdate the discovery that migration to the northern Bahamas along with the traditional agricultural system was impossible.

Zone III—Southern Islands

Temperature is not a limiting factor in these islands. Regional rainfall varies considerably from year to year. On Great Inagua this variation can range between 400 and 700 mm. In the last decade the average on Grand Turk and South Caicos has been around 550 mm. Tropical storms or hurricanes boost the total considerably and occur with a frequency of every ten to fifteen years. The central Caicos chain which includes East, Middle, and North Caicos act as a single landmass in the creation of a local weather system in which the southeast trades combine with overland thermals to frequently create cumulonimbus clouds. These drift along the chain from southeast to northwest. The result is that rainfall increases with every mile one progresses along the chain in that same direction. The effect of this is that productive swidden agriculture is currently limited to the central Caicos chain west of East Caicos. Providenciales, to the west, receives rainfall produced by a more poorly developed but similar rainfall pattern born of the passing of the trades over the shallow Caicos Bank. There is a more limited amount of subsistence agriculture on Providenciales. Interestingly, the distribution of sedentary aboriginal occupations in the Caicos largely coincides with the present distribution of slash and burn agriculture.

The Inaguas, Grand Turk and associated cays, and East and South Caicos do not appear to have been settled because they are too dry to support an agricultural population, the only possible exception to this being the very western tip of East Caicos. DeBooy (1912:104) reported some hilltop sites here in a region where unsuccessful attempts at sisal plantation agriculture were made in the latter part of the 19th century. These sites may represent a similar experiment with different crops. Although the annual precipitation in these dryer islands is above the absolute minimum (500 mm) for manioc in most years, the evapotranspiration rate is so extreme that historically this and other crops have never been successfully raised.

The settlement pattern of the Caicos is distinct from that of the other zones. Inland sites predominate. The absence of coastal settlement with one notable exception, bespeaks a very different adaptation. We are not in a position to offer a rationale for the hill top settlements, except to note that these are favored settlement locales on the islands today and are also extensively used for garden plots. It may be that the lower rainfall in this zone causes the moisture retention in coastal dunes and strands to be so low that they cannot be as successfully farmed as in Zone II. The salina sites, which are quite common, are another matter.

Historically the two most common export items from the Caicos to Hispaniola have been salt and dried conch. The natural salt pans of the Turks and Caicos produce, on a seasonal basis, thousands of tons of raw crystalline salt. Sullivan took 20 seconds to gather three pounds by hand. With any crude scraping tool such as a conch shell, it is possible to harvest more than a human can carry in twenty minutes. It is hypothesized that one of the original motivations for Meillacoid visitation of the islands, and an integral part of the Lucayan economic system in this zone was the gathering and exportation of salt.

It was noted earlier that conch are common in Lucayan middens in Zone III but not Zone II. A large site in Zone II will have scores of specimens present while at a comparable site in Zone III, thousands litter the zone of occupation even at sites miles inland. Conch populations are comparable in both regions. It is possible that the consumption patterns were very different aboriginally. That is, however, doubtful. The most probable interpretation is that the historic trade relationships mirror the prehistoric. In addition to salt, dried conch was being traded to the Greater Antilles where populations of these shellfish are low and the terrestrial animal population was sufficiently scant so that the dense Arawak populations probably required a protein supplement.

This too is then suggested as an element in causing the original visitations to the islands by Greater Antillian Arawaks and as an element in the Lucayan economic system in this zone.

Since these activities could have been carried out on islands such as South Caicos that have no evidence of occupation, it appears that there were additional motivations and economic strategies involved. One auxiliary motivation could be that even if you are only gathering salt, the immediate environment must also provide water. Otherwise an adequate amount of this bulky item would have to be carried with the voyagers in their canoes, an unlikely proposition. As one proceeds from south to north through the Turks and Caicos, Middle Caicos is the first island encountered on which fresh water is readily available. It is also the first island with a significant prehistoric occupation.

For resident populations engaged in the exportation of salt and dried conch a complementary economic strategy would have been agriculture, which might be reflected in part in the ridgeline settlements among coppice vegetation. It was noted earlier that all the sites in the Caicos, excepting the few next to Middle Caicos on East Caicos, are in regions where agriculture is currently practiced.

Our overall model of the economic system located aboriginally in Zone III would therefore include a mixed system of agriculture and long distance trade.

CONCLUSIONS

The following outline of Bahamian prehistory appears consistent with the data.

The Bahamas were first settled in Zone III between 800 and 1000 A.D. by Arawaks who made Meillacoid pottery from either Hispaniola, Cuba, or both. These early Antillian immigrants were probably seasonal visitors since virtually all of their ceramics are of

Antillian manufacture. The original motivation for visiting the Bahamas was the exploitation of concentrations of crystalline salt and shellfish in the central Caicos Islands. Within approximately a century of the first Meillacoid contact a permanent occupation of the Caicos was established. This sedentary occupation was based upon an economy of mixed agriculture and long distance trade in salt and dried conch.

The first native ceramics in the Caicos were crushed limestone tempered copies of Meillacoid styles. This original native tradition gave rise to the crushed shell tempered Palmetto Series and associated Lucayan culture. The Lucayan culture patterns evolved in a context of strong influence from Ostionoid and Chicoid as well as Meillacoid traditions. This influence was the product of contact through trade in the commodities listed above. Commodities received in trade for salt and dried conch were probably quite varied, but seem to have included high prestige and high "expense" items such as stone *zemis* and *monolithic axes*. The processes described herein require the assumption that the trading network for sale and dried conch was *expanded* after an indigenous cultural tradition was established. As a fully developed tradition, the Palmetto pottery series was in existence no later than 1100 A.D. and probably by 1000 A.D.

After Palmetto pottery was fully evolved, outward migration to the central Bahamas occurred. The motivations for this migration are not known. There may be factors involved related to population pressures and competition for control of salt pans. The Palmetto Series coastal midden on Pine Key may represent an early example of the economic patterns which became dominant in the central Bahamas. It duplicates the coastal sandy soil characteristics of Zone II, and is near no salt pans. Although conch are more abundant here than in Zone II, the adaptation otherwise appears to be identical.

Within the central Bahamas the densest populations appear to have developed on the islands with the most favorable conditions for agriculture. It appears probable that the more southern dry islands of this zone were settled later than the wetter islands farther north, and therefore must have been bypassed during the original occupation of the central Bahamas. Settlements in this zone reflect an economy based upon root crop agriculture and the exploitation of marine resources, Antillian contact was quite limited. With one possible exception, no prestige trade items are known.

Although it is presumed that attempts at colonization of the northwestern Bahamas were made, the New Providence site being an example, it appears that there was never any truly long term occupation of the zone. After attempts at agricultural colonization proved impossible because of low winter temperatures, the northwestern Bahamas appear to have been visited only for the purpose of hunting and fishing expeditions based from permanent settlements in the central Bahamas.

Bahamian economic systems and associated settlement patterns seem to reflect both an extensive commercial exchange system in the aboriginal northern Caribbean and a definitive example of the ecological limits of conuco type root crop agriculture.

Bronson, B.
1966 Roots and subsistence of the ancient Maya, *Southwest Journal of Anthropology* 22:251-79.
Burns, Sir Alan Cuthbert
1954 History of the British West Indies. George Allen and Unwin Ltd., London.
Brooks, W. K.
1888 On the Lucayan islands, *National Academy of Science Memoirs* 4:215-23.
Bullen, Ripley P.
1962 Ceramic periods of St. Thomas and St. John island, Virgin islands. *American Studies*, No. 4. William L. Bryant Foundation, Orlando.
DeBooy, Theodor
1912 Lucayan remains on the Caicos islands, *American Anthropologist* 14:81-105.
1913 Lucayan artifacts from the Bahamas, *American Anthropologist* 15:1-7.
Euverte, Guy
1959 *Les climats et l'agriculture*. Presses Universitaries de France, Paris.

Glover, William G.
1974 *The decline of boat building in the Bahamas.* Masters Thesis, Department of Anthropology, Florida Atlantic University, Boca Raton.
Goggin, John M.
1939 An anthropological reconnaissance of Andros island, Bahamas. *American Antiquity* 5:21-26.
Granberry, Julian
1956 The cultural position of the Bahamas in Caribbean archaeology. *American Antiquity* 22:128-34.
Hendershott, C. H. et al.
1972 A literature review and research recommendation on cassava *(Manihot esculenta* Crantz) A.I.D. Contract No. csd/2497 by University of Georgia Team.
Hill, David
Personal Communication: Mr. Hill is a resident on Grand Turk who has been monitoring the rainfall records of the last decade. Conversation with Shaun Sullivan, Department of Anthropology, University of Illinois. July 31, 1976.
Hoffman, Charles A. Jr.
1967 *Bahama prehistory: cultural adaptations to an island environment.* Unpublished Ph.D. dissertation, University of Arizona, Tucson.
1970 The palmetto grove site on San Salvador, Bahamas, *Contributions of the Florida State Museum, Social Sciences* No. 16.
Jones W. O.
1959 *Manioc in Africa.* Stanford University Press, Stanford.
Kreiger, Herbert W.
1937 The Bahama islands and their prehistoric population. In *Explorations and Field Work of the Smithsonian Institution in 1936,* pp. 93-98. Washington.
Leng, Earl R.
Personal Communication: Dr. Leng is with the Department of Agronomy, University of Illinois. Conversation with Dr. Donald W. Lathrap, Department of Anthropology, University of Illinois, 1974.
MacLaury, James C.
1970 *Archaeological investigations on Cat island, Bahamas.* Masters Thesis, Department of Anthropology, Florida Atlantic University. Boca Raton.
Morison, Samuel Elliot
1942 *Admiràl of the Ocean Sea* (abridged). Little, Brown & Co., Boston. (Time Reading Program Edition 1962)
Nuttonson, M. Y.
1959 *Agricultural ecology in subtropical regions.* American Institute of Crop Ecology, Washington.
Ochse, J. J., M. J. Kijkman, M. J. Soule Jr., C. Mahlburg
1961 *Tropical and subtropical agriculture.* The Macmillan Co., New York.
Papadakis, Juan
1966 *Climates of the world and their agricultural potential.* Buenos Aires.
1970 *Climates of the world: their classification, similarities, differences and geographical distribution.* Buenos Aires.
Rainey, F. G.
1934 Diary beginning January 22, 1934, upon arrival in Port au Prince, Haiti. Ms, Peabody Museum. Yale University, New Haven.
1935 *Puerto Rican archaeology.* Ph.D. dissertation, Yale University, University Microfilms, Inc., Ann Arbor, Michigan.
1941 Excavations in the Ft. Liberte region, Haiti. *Yale University Publications in Anthropology,* No. 23. Yale University Press, New Haven.
Riley, Denis and Anthony Young
1966 *World vegetation.* Cambridge University Press, Cambridge.
Rouse, Irving
1939 Prehistory in Haiti: a study in method. *Yale University Publications in Anthropology,* No. 21. Yale University Press, New Haven
1941 Culture of the Ft. Liberte Region, Haiti, Yale University *Publications in Anthropology,* No. 24, New Haven.
1948 The West Indies. In *Handbook of South American Indians,* edited by Julian H. Steward, pp. 495-565. Bureau of American Ethnology, Washington.
1951 Areas and periods of culture in the Greater Antilles. *Southwestern Journal of Anthropology* 7:248-65.
1964 Prehistory of the West Indies. *Science* 144:499-513.
Rouse, Irving and Jose M. Cruxent
1963 *Venezuelan archaeology.* Yale University Press, New Haven.
Santa Cruz, Alonso de
1918 *Islario general de todas las Islas del Mundo.* Madrid.
Sauer, C. O.
1969 *Seeds, spades, hearths and herds: the domestication of animals and foodstuffs.* The M.I.T. Press, Cambridge.

Shattuck, George B. (editor)
1905 *The Bahama islands.* The Johns Hopkins Press, New York.
Sears, William H.
1960 Ceramic systems and eastern archaeology, *American Antiquity* 25:324-29.
1975 Cruising With a Purpose. *Yachting,* Nov., 1975:44-46.
1976 Columbus and the Arawaks. *Yachting,* Nov., 1976: 62-63.
Sleight, Frederick W.
1962 Archaeological reconnaissance of the island of St. John, United States Virgin Islands, *American Studies,* No. 3. William L. Bryant Foundation, Orlando.
Sturtevant, William C.
1961 Taino agriculture. *Anthropologica,* Supplement No. 2, The Evolution of Horticultural Systems in Native South America: Causes and Consequences—A Symposium, pp. 69-73. Caracas.
Sullivan, Shaun D.
1975 "*Manihot esculenta Crantz in the Caribbean.*" Manuscript on file with the Department of Anthropology, University of Illinois.
1974 *Archaeological reconnaissance of Eleuthera, Bahamas.* Masters Thesis, Department of Anthropology, Florida Atlantic University, Boca Raton.
1976 *Archaeological reconnaissance of the Turks and Caicos islands, British West Indies.* Report submitted to the Government of the Turks and Caicos.
Vavilov, N. I.
1951 The origin, variation, immunity and breeding of cultivated plants. *Chronica Botanica* 13:1-366. Translated by K. Starr Chester.
Veloz Maggiolo, Marcio
1972 Resumen tipologico de los complejos relacionables con Santo Domingo, *Boletin del Museo del Hombre Dominicano* 1:21-61.
Veloz Maggiolo, Marcio, Elpidio Ortega y Plinio Pina
1973 Fechas de radiocarbon para el periodo ceramista en la Republica Dominicana, *Boletin del Museo del Hombre Dominicano* 3:138-98.
Willey, Gordon R.
1949 Archaeology of the Florida Gulfcoast. *Smithsonian Miscellaneous Collections, Vol.* 113.
Winter, John
1974 Current Research report in *American Antiquity* 39:381.