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Precolumbian Flaked Stone Assemblages in the West Indies

Agamemnon Gus Pantel

To the Graduate Council:

I am submitting herewith a dissertation written by Agamemnon Gus Pantel entitled "Precolumbian Flaked Stone Assemblages in the West Indies." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Anthropology.

Charles H. Faulkner, Major Professor

We have read this dissertation and recommend its acceptance:

William M. Bass, Jan F. Simek, Paul W. Parmalee, Lydia M. Pulispher

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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PRECOLUMBIAN FLAKED STONE ASSEMBLAGES IN THE WEST INDIES

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Agamemnon Gus Pantel

March 1988

To Sofia Irene.

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ABSTRACT

The present work examines the history of the development of West Indian lithic research and proposes a new classificatory mechanism for West Indian flaked stone tool analysis based on technological process. Precolumbian flaked stone assemblages in the Caribbean have been classified in the past using continental models of hunting and gathering societies and stylistic variation in the artifacts has been used to explain cultural variation among early precolumbian periods. Samples of lithic assemblages from Cuba, Jamaica, Haiti, the Dominican Republic, Puerto Rico and the Virgin Islands are the materials used in the present research. The effect of raw material on stylistic variabiltiy is shown using paradigms and demonstrates the applicability of this analytical method to West Indian assemblages. The work is a methodological study in the applicability of this analytical scheme and demonstrates some of the non-cultural variables which affect these island assemblages.

PREFACE

This work grew out of what began as a trip to the west coast of Puerto Rico in 1973 to view an interesting archaeological site that was made up of stone tools. The invitation was made to me by Mrs. Dorothy Pike, an amateur geologist, and her husband Mr. Otto Pike. They are to be credited with the discovery and recognition of the key site in Puerto Rico which began my research work on Antillean flaked stone assemblages.

Prior to this time, the near exclusive interest on the part of both amateur and professional archaeologist in Puerto Rico was the discovery of, and excavation of, ceramic bearing shell middens.

Under the constant and unfailing support of the Foundation of Archaeology, Anthropology and History of Puerto Rico, and primarily its president, Lic. Wilfredo Geigel, I was able to carry out research on the nature and antecedents of this discovery of flaked stone sites on the island of Puerto Rico.

Since that time we have grown considerably in the Caribbean as the professional community of trained archaeologists, anthropologists and historians has steadily continued to increase.

In retrospect it is always easier to see that which lacked the purported foresight of the present.

Initial naïveté, the urge to gather a broad spectrum of flaked stone samples from as many sites as possible, limited logistical support, limited access to professional colleagues and field collaborators were all contributing factors to those lacunae which may exist in the field data for the sites surveyed and/or excavated. Laboratory analysis of the collected material was based on the same continental models used by previous researchers. The stylistic classificatory categories of Europe and North America were the analytical schemes used by the author during the years of initial fieldwork and collection studies. Hence, opportunity remained fossilized in the time/space continuum while we, on the other hand, moved on through these dimensions.

Ironically, however, these same shortcomings made it possible to test the viability of the technological classificatory scheme utilized for the analysis of these collections. The applicability of this classificatory process was important, not just as an analytical mechanism to deal with those sites yet to be excavated, but also as a tool in the analysis of extant flaked stone collections from precolumbian West Indian sites. I was also able to realize that many of the shortcomings of previous researchers were initially reflected in my own approach.

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CHAPTER 1

INTRODUCTION

Problem Statement

Flaked stone artifacts in the archaeological record of the islands of the Caribbean[1] have constituted the basis for cultural differentiation of the earliest inhabitants of the West Indies. Over the years, researchers have classified Caribbean lithic assemblages in stylistic terms, in order to demonstrate cultural differences in these precolumbian assemblages based on artifact types. These differences may, however, reflect no more than technological limitations inherent in the raw materials at hand.

Fundamental analytical questions which need to be addressed in order to understand whether or not cultural differences exist concern: (1) the recognition of the lithic resources available to peoples in these individual island biospheres; and (2) the acquisition and/or development of technological skills necessary to exploit that environment. What has been interpreted previously as stylistic variation reflecting cultural-chronological variants, is, quite possibly, the result of culturally

[1] Specifically the Greater and Lesser Antilles which herein will also be referred to collectively as the West Indies or Antilles.

contemporary groups (at similar socio-cultural stages of development) sharing similar lifeways, yet producing "different" assemblages as a result of raw resource material of variable quality.

From about 1950 b.p. onwards, the archaeological record of the West Indies indicates that agricultural groups migrated northward into the Lesser and Greater Antilles from northern South America. They brought with them ceramics, agricultural practices and a fully developed cultural assemblage new to the West Indies. The first agricultural groups are known as the Saladoids. They evolved and probably intermixed with subsequent migrations to eventually form the Taino Indians encountered by Columbus on his voyage to the New World. The basis for this historical record has been principally developed by tracing ceramic traits in the archaeological record.

The evidence and cultural history of the West Indies for the inhabitants of the islands prior to approximately 1950 b.p. is not as clearly developed as is that of the post-Christian era. In large part, the problem with the identification and historical reconstruction of these early inhabitants is founded on the often contradictory and nebulous identification of the principal remains of these groups. Since stone tools often constitute the primary artifactual record for these sites, their proper identification and analysis are fundamental in the

reconstruction of the earliest historical records for the habitation of these islands. Although these early inhabitants are believed to have been hunters and gatherers, the basis for these arguments have relied more on continental analogies than on intensive analysis of the sites themselves. The cultural chronological associations for early habitation sites in the West Indies have been based on a handful of dated sites whose primary diagnostic material has been flaked stone artifacts classified using European and/or North American typologies. The need to develop a West Indian typology is seen as essential in understanding the pre-ceramic sites of the Caribbean.

It is important to recognize that the production of flaked stone tools requires a process of lithic <u>reduction</u> exclusively. That is to say, all flaked stone tools ultimately begin from a larger mass that is reduced constantly in any flaked stone manufacturing process. As a reduction process, the technological steps taken in reducing the initial mass are normally observable and measurable elements on stone artifacts. Unlike the production of ceramic artifacts, in which the medium is plastic and can be added to or reduced, stone can <u>only</u> be reduced. It is also reasonable to accept that the nature of the raw material itself (to a lesser or greater degree) is a delimiting factor in the production process.

In the development of an analytic scheme for flaked stone tools, the material from which a tool is made may be as important a mode as are the flaking attributes of the object. That there was a selective process taking place in the determination of the raw material is potentially measurable and may have analytical value on an inter-island as well as intra-island basis. The availability of a higher or lower quality of raw material may have been a geographically deterministic factor which affected the ultimate morphology of a lithic assemblage as much as cultural, or time/space variances.

Although the potential effects of variable lithic raw material on an assemblage has been discussed by various authors (Cruxent and Rouse 1969; Pantel 1977a) it has not been incorporated into any of the analytic schemes used to date for West Indian lithics. Partly for this reason, the analyses in this work were developed. This is a technological analysis in that form and manufacturing evidence are analyzed without consideration of function, either intended or realized.

The development of groups along a continuum from hunters and gatherers to that of sedentary agriculturalists should be reflected in the archaeological record in various ways. Whether or not stone tools "evolved" commensurate with the degree of cultural development, or whether they remained relatively "static" in their form and/or function

in the islands of the Caribbean is presently an unknown. There is a need to examine the question of whether flaked stone technology changed through time in the islands or, as a result of it being so fundamentally rooted in basic exploitative patterns that persisted through time, remained unchanged throughout the precolumbian period. Though the introduction of ground stone is commonly seen in the Caribbean as an indicator of a transition from a poorly defined preceramic to a more clearly defined Archaic period, there is a limited understanding of flaked stone tool technology and its development even through subsequent ceramic periods.

Style and stylistic variation has been considered a fundamental indicator of cultural variation in West Indian archaeology. The concept of "style" has been extensively debated in archaeology, and the most comprehensive discussions have been generated by authors such as Dunnell (1978) and Sackett (1986, 1985, 1982).

Dunnell differentiates style from function. He sees style as a random set of cultural occurrences through time and space ("stochastic"). He sees function as being integrally related with the environment, and somewhat evolutionary, (a kind of "survival of the fittest") (Dunnell 1978). He sees style and function as totally independent:

> Explanations of stylistic phenomena will be found in stochastic processes and devices such as Markov

> chains; styles will continue to be useful tools for chronology and defining spatial interaction. Functional elements can be explained with evolutionary processes [Dunnell 1978: 200].

Sackett, on the other hand, defines style as showing ethnicity and related to function, which reflects activity (Sackett 1982). Sackett's concept of an <u>isochrestic</u> approach to style is based on style and function being interrelated and manifest in the artifact itself:

> . . . the isochrestic approach . . . is grounded upon the notion that function and style are most profitably viewed as fully complementary aspects which . . . share equal responsibility for <u>all</u> formal variation observable in artifacts; also, the nature of these aspects is such that neither can be comprehended except in terms of the other [Sackett 1982: 68].

The relevant issue for West Indian lithic assemblages is the interpretation of "style". Style is, in the views of both Dunnell (1978) and Sackett (1982) a methodologically useful tool for the definition of cultural-chronological histories. Stylistic variations in stone tool assemblages, as interpreted in the analyses of past Caribbean researchers, have been used to show cultural chronological variation between sites and islands. It will be shown in subsequent chapters how this use of "style" and stylistic variation has been the methodological basis for much of the current debate of early lithic sites in the Caribbean.

Technological analysis of the West Indian lithic assemblages is paramount to understanding the Caribbean's archaeological record. Stylistic variations can not be

relied upon to demonstrate cultural variation since style itself is the result of cultural plus technological processes. Hence, style can not be disassociated from the technological aspects of the artifact assemblage. If we have technological restraints or options in the raw material itself, these may ultimately be reflected in variations which may appear to be stylistic, but actually be factors of technological variability inherent in the source materials of the artifacts. If we can effectively isolate technological processes in these assemblages, then cultural variations will be more easily and certainly identifiable.

Approach to the Problem

A preliminary study, the present work defines a series of technological modes which are designed to measure the lithic reduction process. If there are truly cultural differences occurring through time which are measurable in the technological record as occurs in the cases of continental developments (e.g. European Paleolithic periods or North American projectile point development), then these should be demonstrable in the archaeological record within each island as well as on an inter-island basis.

The absence of stone projectile points in the islands of the West Indies led to an initial lack of interest and subsequent confusion in defining these early assemblages,

since projectile point typologies were fundamental bases for continental chronological typologies. Much of the early emphasis on precolumbian flaked stone artifacts centered upon the more spectacular "point-like" or "dagger-like" artifacts which most closely resembled lance or projectile points (cf. Rouse 1939, Cruxent and Rouse 1969). In these cases, the identification of technological features centered upon items bearing direct relationships to "hunting-type" artifacts oriented towards food procurement, and food processing (i.e. projectile points and chopping/scraping tools).

A probable reason for the lack of development of flaked stone projectile points in the islands of the Caribbean may have been due to the use of hardened wooden points. The availability of abundant hardwoods and no need for a dense lithic projectile point for killing small game such as birds and reptiles would not have encouraged development of flaked stone projectile points among the island occupants. The lack of megafauna or even mid-size fauna (i.e. deer-sized game) made this type of artifact unnecessary. The precolumbian archaeological record shows manatee is the largest animal to be found in West Indian sites of the Antilles. The only exception to this is the dubious exploitation of ground sloth on the islands of Cuba and/or Hispaniola. The island fauna requiring a hunting technology would have been small game such as the agutia

(a rabbit-sized rodent) or birds, which would necessitate no more than a minimal-piercing artifact to kill. Even in the case of the manatee which is a relatively soft-bodied marine animal, an artifact would require minimal piercing ability for killing. The lack of "tough-hided" animals allowed the facile use of wooden-tipped projectiles for effective exploitation. Hence, the emphasis on a "projectile-based" cultural-chronological typology for flaked stone artifacts in the islands of the Caribbean is inappropriate.

It should be made clear that the present study is introductory and preliminary in nature. Numerous obstacles and gaps in data exist in the present knowledge of the Caribbean in general. These lacunae limit to a degree the conclusions formed in the present study. By design, then, this work should be viewed as a heuristic and methodological study, demonstrating problems, potential solutions, and theoretical considerations.

Some of the problems beyond the scope of this study which affect our ability to properly analyze fully the archaeological data include: (1) our lack of detailed geological studies of the petrography of archaeologically suitable source materials in the Caribbean; (2) shifts in sea levels which would have affected early littoral site preservation; and (3) paleoenvironmental data important in

correlating inter-site and intra-site data of the assemblages of the precolumbian West Indies.

CHAPTER 2

BACKGROUND AND PROBLEM DEVELOPMENT

Previous Work in Region

As stated in the previous chapter, early research efforts in the Caribbean centered on finding archaeological sites of hunters and gatherers using the established cultural evolutionary models of continental archaeology.

The development of archaeological research in the Caribbean, near the beginning of this century, focused on explanations phrased in terms of migrations of peoples and the diffusion of ideas. However, in examining the surviving artifacts of the precolumbian peoples of the West Indies, the effects of the subtropical climate on the preservation of perishable materials became quite evident. Artifacts made of organic materials such as wood, cotton, reeds, and other fibrous plants had long since disappeared from the archaeological record with few exceptions[1]. The primary study of precolumbian materials was therefore soon centered on non-organic materials, primarily ceramic and stone, with shell artifacts being the only primary organic material still abundant in the archaeological record (Mason 1877; Duerden 1897).

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[1]Some notable examples do exist from the Greater Antilles of precolumbian wooden ceremonial objects (Fewkes 1907; Krieger 1931) as well as a few artifacts made from indigenous cotton (Vega 1971-72).

The question of migrations was (and is) considered important by many researchers in understanding the lithic assemblages of the West Indies. Migration theories have been used to provide comparative material for the precolumbian assemblages. Northern South America, Central America and even the southeastern United States have been sources for comparative lithic (and non-lithic) cultural assemblages which researchers have used to demonstrate functional as well as chronological explanations of West Indian artifacts. This diffusionist trend needs to be reassessed and tempered with a broader understanding of what some of the primary researchers actually used as their theoretical bases.

Many of the problems, questions and misconceptions produced through previous years of archaeological research will not be clarified in this dissertation; however, it should demonstrate that many of these can be addressed through lithic analysis.

In 1921, Harrington's work in Cuba led him to present evidence for a preceramic component in the West Indian archaeological record (Harrington 1921). This component he termed "Ciboney", using the ethnographic evidence gathered by the first Spaniards entering the area. These groups were described as primitive cave dwellers who lived in the more remote parts of Cuba and Hispaniola. The Ciboney were thought to be marginal groups; however, it was never

clearly demonstrated what their subsistence pattern was, other than a heavy reliance on shellfish.

Harrington's work in Cuba was followed by Cornelius Osgood in 1936 who did work on Cayo Redondo (Osgood 1942). Osgood, from Yale University, was followed in Cuba by Irving Rouse who published jointly with him in 1942 on the Maniabon Hills complex (Rouse 1942a). None of the later research efforts in Cuba significantly changed the original premises of Harrington. The primary and diagnostic artifact of this period was the shell gouge or "gubia" as it was termed in Spanish.

Around this same period, Herbert W. Krieger of the Smithsonian Institution was sent to the Caribbean with W. L. Abbott of the Biology Division. Krieger and Abbott examined archaeological sites in Hispaniola and the Virgin Islands and Krieger recovered preceramic site materials consisting primarily of flaked stone artifacts. Despite numerous publication opportunities, only minor reference to this significant material was made by Krieger in the published annual field reports of the Smithsonian (Krieger 1929, 1931a, 1931b, 1932, 1933). No descriptive or analytical work was done on any of this material, but it was given some consideration by Rouse in his later work in Haiti (Rouse 1939, 1941).

As part of the Yale Peabody Museum's field program in the Caribbean during the thirties, Froelich Rainey

conducted research on the islands of Puerto Rico, Hispaniola and Cuba. Rainey's work in Haiti resulted in the discovery of a number of sites along the northern shores of the island in the region of Ft. Liberté (Rainey 1941). The sites were characterized by artifacts of large flaked stone blades with no apparent antecedents in the Greater or Lesser Antilles. Rouse later continued the work of Rainey in the Caribbean.

A few years after his 1939 publication, Rouse began looking for possible cultural connections for the Antillean tools based upon similar artifacts in Central America. He postulated a migration of peoples from Central America directly to Hispaniola via a "mid-Caribbean chain", which was a small series of cays between Central America and Hispaniola. The existence of these islands or cays was clearly in keeping with the raising and lowering of sea levels, since many of these were submerged except in periods of lower sea levels (such as the end of the Pleistocene). This "stepping stone" theory was initially convenient but later abandoned by Rouse when no supporting evidence could be found in Jamaica, a probable and logical stopping point along the route. He then opted for a South American route when he and José Cruxent began working together in the field.

In the course of his survey work, Rouse found a number of shell middens in Puerto Rico which he used to postulate

a preceramic phase in his "period" scheme of processual cultural chronology (Rouse 1952). He had doubts, however, of their true preceramic nature and ventured to say that the sites of the "Coroso culture", as he called it, may have been merely shell-gathering sites for the historic Europeans. He later discarded the concept of a Coroso culture altogether.

Lithic classification soon gave way to ceramic classificatory schemes for West Indian assemblages. These classifications, based on morphological analyses, were later developed into tables of temporal correlations (Rouse 1952) using various indices, including chronological periods based upon associated dietary remains found with these ceramics (Rainey 1935, 1940; Rouse 1952).

It is essential to interject at this point how the course of Caribbean research led to the development of the definitions commonly utilized for preceramic groups and much of the theoretical considerations of precolumbian historical development. Fundamental to these discussions is the question of human adaptation to the island biosphere.

Julian Steward developed his theory of a Circum-Caribbean concept (1947, 1948; Steward and Faron 1959). In his work, Steward proposed that South America was initially inhabited by groups of Indians at what he called a marginal level of development. He defined this marginal level as

"hunting and gathering groups" characterized by a simple social and religious organization and lacking all traits of agriculture (Steward 1948). He postulated that development accelerated in the area of the Central Andes wherein the groups there developed a stratified society, pottery, agriculture, weaving, a territorial form of government, a denser population and a temple-priest idol complex. Steward called this level of development, "formative". He then proposed that this formative level of development spread northward, either by migration or diffusion, into Central America, northern Colombia, Venezuela, and the Antilles, where it raised marginal groups in these regions to this formative level. In these areas he termed the culture as "Circum-Caribbean".

The technological, social and religious traits of the formative level were easily adapted to the Circum-Caribbean area. Cultural development continued in the Central Andes and Formative cultures soon became civilizations. Formative cultures in the Circum-Caribbean area remained, however, at the formative level. Steward saw civilization as a highland development, not adaptable to the direct areas of the Circum-Caribbean.

Steward proposed that the technological traits of the Circum-Caribbean culture spread along the coast to the Guyanas and Amazonia where the marginal groups there were raised to a level of culture he called "tropical forest".

He defined this culture level as having a slash-and-burn agriculture supplemented by hunting and fishing. This tropical forest culture possessed simple undecorated pottery, netted, rather than loomed weaving, and simple, rather than twilled basketry.

In terms of Caribbean archaeology and the concept of the Circum-Caribbean, Steward was dealing with definitions of a "cultural ecology approach" (Steward 1955). Steward stated that cultural ecology was to be viewed as both a method and a problem. It was a method, in that it attempted to understand man's adaptability to his environment, and a problem in that it looked for man's variations of adaptation within environments. In this sense, Steward emphasized the difference between social and human ecology and demonstrated that cultural ecology was not aimed at geographical determinism (Steward 1955).

Out of the ideas of Julian Steward came the development of a new hypothesis in 1969 by James Ford. Ford's hypothesis proposed a period of rapid expansion of shell-gathering groups in the Circum-Caribbean area. He termed his concept the "colonial formative". Briefly stated, Ford's concept of the colonial formative proposed that during post-Pleistocene times, the gradual raising of the sea level created substantially large areas of shallow shoreline beaches which produced large numbers of shellfish. This dramatic increase in shallow water

shellfish resources provided a stable subsistence resource previously unavailable to the Indian population of the Caribbean. Ford postulated peoples moving along the coasts of South and Central America in search of abundant mollusk resources (Ford 1969); one of the most typical Caribbean archaeological sites is in fact the "conchero" or shell midden.

The period of colonial formative expansion was seen to have been from 4950 b.p. to 3450 b.p., during which time pottery making traditions were carried from South America through the Circum-Caribbean area northward as far as Florida and Georgia in North America[2]. This time period corresponds to the earliest radiocarbon dates of human occupation in the Greater Antilles.

The stability of these shell midden groups allowed them to become more sedentary, increase their population density, and develop a cultural level equal to Steward's definition of the formative level. On the other hand, marginal groups, that is hunters and gatherers, would have had to remain more mobile and could not adapt the technological traits of the formative level such as pottery and other similar material items. This question of sedentarianism and technological trait development may not be relevant to the islands of the West Indies. Relevant

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[2] Evidence of this was thought to be seen in the Stallings Island and Orange period fiber-tempered pottery of Georgia and Florida.

models for hunters and gatherers for a continental environment and an island biosphere will most likely differ, as do their respective cultural assemblages.

Although Steward recognized that there was a suggestion of a developmental sequence in his series of classifications, he stated (and we must realize) that he allowed for expansion and leverage within his Circum-Caribbean concept.

In defense of Ford's colonial formative concept however, it may be noted that as early as 1938 Alfred Kroeber recognized and demonstrated that the North American tribes of hunters and gatherers living in coastal environments were able to maintain a population density almost twice that of inland hunting and gathering groups.

In 1953, Rouse used Puerto Rico as his model to refute, in large part, Steward's Circum-Caribbean theory:

> The archaeology of the eastern Caribbean thus fails to corroborate the Circum-Caribbean theory, except in giving priority to the Marginal cultures. It indicates that the Tropical Forest tribes have been in the area longer than supposed; that they were responsible for the introduction of agriculture and pottery; and that their culture was succeeded by the Circum-Caribbean only in two widely separated parts of the area. . . .
> . . . .
> . The validity of the foregoing hypothesis is best attested on the island of Puerto Rico, where a survey of some 300 sites and excavation in 59 of them has revealed a detailed picture of cultural development (Rouse, 1952). Here, the poorly defined Coroso culture of Period I is Marginal in type . . . . An agricultural people (marked by the Cuevas style of pottery) came in during Period IIa but appear to have been limited to the coastal regions in both Periods IIa and IIb, presumably because they relied on fishing as well as agriculture. Their culture, which is

variously known as Igneri or Crab, lacks all traces of ceremonialism and consequently has to be considered Tropical Forest in type [Rouse 1953: 196].

It is important to recognize that these arguments of marginal groups in the West Indies were based on previous classification of assemblages which had produced cultural definitions of early hunting and gathering sites for the islands.

In 1957 Ricardo Alegría discovered a cave site on the northeastern coast of Puerto Rico which contained crab claws and edge-ground cobbles with no ceramic remains. Using the example of Rainey's 1939 work at the site of Canas in Puerto Rico, Alegría utilized a differentiation in the stratigraphy based upon food remains[3] (Rainey 1940) and the absence of ceramics to propose that the cave site was evidence of a preceramic component in Puerto Rico (Alegría 1955). He later named the site Cueva Maria la Cruz.

In the Lesser Antilles, evidence of preceramic components was apparently non-existent and ceramic research in the 1930s, 1940s and 1950s well overshadowed any impetus which may have existed for preceramic research in these islands.

All through the period from Harrington's work in Cuba, up to the 1960s the problem of a clear preceramic cultural

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[3] Rainey's excavations at Canas showed what he termed a "crab culture" predating a "shell culture".

component demonstrating hunters and gatherers in West Indian sites was still undefined in many aspects.

In the 1950s Cruxent and Rouse joined forces to publish two volumes on Venezuelan archaeology (Cruxent and Rouse 1959, 1961). Although the resulting publications dealt primarily with ceramics, they were significant in marking the beginning of a long-standing research association between these two researchers. Much of the subsequent work in preceramic West Indian sites was the result of Cruxent and Rouse's combined field work and writing.

Cruxent was later invited to the Dominican Republic to investigate previously known lithic sites in the south coast area of the province of Azua. His excavations on the site of Mordan and Casimira produced a flaked stone preceramic component for the western part of the Dominican Republic, similar to the Couri material found by Rouse in Haiti and the Cabaret material found by Krieger[4]. Fieldwork was carried out on this site by Jose M. Cruxent, Elpidio Ortega and Luis Chanlatte Baik during the 1960s. The sites they investigated and collected materials from were actually a series of closely located deposits in the

[4] It was a flaked stone assemblage clearly associated with an earlier occupational phase or period (as Rouse termed them) than the Ciboney groups which had been relegated to an archaic component. These flaked stone assemblages were obviously pre-archaic and attributed to a paleo-type occupation by Cruxent and Rouse.

Azua region of Hispaniola and reported by them as "Mordán", "Rancho Casimira", and "Las Alejandrinas". These deposits subsequently all became part of a Casimiroid Series as defined by Cruxent. The Casimiroid Series was presented as a cultural developmental scheme for hunters and gatherers in the Antilles. Radiocarbon dates from stratigraphic levels within the Mordan site were later dated by three different labs; the materials yielded dates between 4050 b.p. and 5350 b.p.[5]. During this same period radiocarbon dates had been determined for the Puerto Rican Maria La Cruz site at 1990 b.p.

Cruxent's earlier work in the area of Falcón, Venezuela had established the Joboid series for a Paleo-Indian component in Venezuela. He used this background in the development of the Casimiroid sequence for eastern Hispaniola. Primarily on the basis of geological terracing, Cruxent postulated that material from the site of Casimira was much older than that of Mordan. He supported his chronological hypothesis with the fact that Casimira was on a "terrace" above Mordan, and that the gross size and "crudeness" of the Casimira artifacts demonstrated a more "primitive" group. He then postulated

[5] The actual sample taken from 55-100 centimeters below surface was divided into three parts and sent to three different laboratories for comparative dating. These samples yielded the following dates BP:
sample Y1422 = 4560±80
sample TX-54 = 41401±30
sample IVIC-5 = 44001±70

the date of 5000(+) B.C. for the site of Casimira, and hence, the associated lithic artifacts.

In the decade of the 1970s and into the 1980s, major contributions in the field of Caribbean archaeology were made by Marcio Velóz Maggiolo from the Dominican Republic and Mario Sanoja Obediente from Venezuela. These researchers addressed some of the fundamental problems of both ceramic and preceramic occupations of the Antilles. They began to redirect research questions, not just to origins and migrations, but also that of insular cultural development. As a consequence, researchers began to look at not just how people arrived in the islands but what they did once they arrived and remained. Lifeways, autochthonous developments, and issues such as how different groups co-existed were becoming valid research issues. With these new research focuses, the need for better site identification and analysis of whole cultural assemblages became more critical. Research on hunting and gathering sites also became focused on inter-site analysis rather than predominantly on ancestral associations.

In 1972, research in Puerto Rico led to the recognition of a major lithic site, named Cerrillo, on the southwestern coast of the municipality of Cabo Rojo (Pike and Pantel 1974; Pantel 1976a, 1976b). The initial results of the excavations showed a dense lithic "workshop" which contained no evidence of ceramics or any associated dietary

remains. The absence of all other types of material assemblage, other than flaked stone, opened this site to interpretation as a potentially early hunting and gathering site. In the investigation of this site, the only known antecedents to the material were the sites in the Dominican Republic and Haiti. The sites of Mordan and Casimira were subsequently re-excavated by the author, and the areas of preceramic sites of Cabaret in Haiti were re-visited. Comparative examinations of the sites from Hispaniola and Puerto Rico indicated possible cultural (and hence chronological) linkages. Therein was the need to further assess the Casimiroid dates assigned by Cruxent.

It was also during this period of time that archaeologists initiated substantive work on Cuban lithic assemblages, primarily through the efforts of Janusz Kozlowski from the University of Krakow in Poland. Kozlowski's work on the collections from the site of Levisa, dated to 5050 b.p., and his application of European classifications to the lithic complexes of Cuba were major efforts in explaining the preceramic periods of the island. In the Lesser Antilles other developments were taking place around this same time in Antigua, Martinique and Trinidad. Dave Davis investigated a preceramic site in Antigua, called Jolly Beach (Davis 1974a, 1974b, 1976), which yielded a radiocarbon date of 3625 b.p. He concluded that the Cerrillo site of Puerto Rico was ancestral to the

Jolly Beach site, therein suggesting an east to west movement down the Antillean chain. In Martinique, Henri Petitjean Roget (1976) reported a preceramic site that led to renewed debate and speculation of a southern origin of early groups moving northward through the Lesser Antilles up the Antillean chain to Puerto Rico and Hispaniola.

A significant change occurred in the research focuses of Caribbean archaeology during the seventies with the formation of multi-disciplinary archaeological teams. The primary impetus behind this was a result of the efforts of Marcio Velóz Maggiolo directing the research program of the "Museo del Hombre Dominicano". Velóz Maggiolo's prolific publications signalled a renewed understanding of the necessity for Caribbean archaeology to assess the processes of precolumbian human adaptation to the island environment. His publication of Medioambiente y Adaptación Humana en la Prehistoria de Santo Domingo (Velóz Maggiolo 1976) is most noteworthy in this context.

Velóz Maggiolo focused on the problem of independent insular adaptation by dealing with the existing evidence in the archaeological records of both the Greater and Lesser Antilles and formulated a cultural development of these marginal groups from an ecological approach. He was able to avoid the problems Julian Steward had noted in the tendency of researchers to misinterpret cultural ecology, especially in relation to human adaptation to the

environment. Steward pointed out that at the basic subsistence level, man's interaction with his environment is very much a limiting or directive factor; however, above this level, numerous other factors are involved which supersede the cultural ecological aspects. No longer is it merely how the environment affects the culture, but the technological, social and religious factors that come into play (Steward 1955).

Velóz Maggiolo looked at the archaeological record and proposed a number of theoretical revisions. He proposed that the concept of a Ciboney culture was outdated and had been unilaterally attached to all sites possessing any Ciboney-like traits. He stated that the Ciboney were obvious historic survivals of previous groups and that each of these earlier groups adapted to their individual local environment. In accordance with this, he further saw a process which he termed "hybridization" having evolved as a result of local variations. He suggested that investigators look at each group of sites as adaptations to local environments, interacting with one another, and forming "hybrids" of the "core" cultures (Velóz Maggiolo 1976, 1980, 1984).

A second seminal work in the Caribbean around this same time was the 1976 publication on the excavations and analysis at Yuma in the Dominican Republic (Velóz Maggiolo, Vargas, Sanoja Obediente, and Luna Calderón 1976). The

authors demonstrated the interaction and development of a single West Indian site from an early aceramic group dating to circa 2250 b.p., through to a densely populated, stratified village complex of plazas, dwellings and burials. The results of this investigation showed the benefit and productivity of excavation and analysis of a complete site using a multi-disciplinary research approach. Elements of Velóz Maggiolo's hybridization concept were demonstrated in the site's archaeological record, and the Yuma study showed cultural development in the Dominican Republic through elements of independent invention rather than solely by means of cultural diffusion. The introduction of this approach opened the way to reassess the earlier concepts of diffusion as the primary source of cultural variation in West Indian assemblages.

Previous Approaches to Lithic Classification

Due to the use of continental models, little attention has been given to the field investigation and analysis of the technical aspects of the tool making process on these islands (Rainey 1941; Rouse 1941, 1942a, 1947, 1947a, 1966; Kozlowski 1974, 1975; Kozlowski and Ginter 1973). Most publications on West Indian archaeology have utilized the taxonomies already developed and fit the artifacts into the appropriate pre-set category, such as blade, chopper, flake, and the like. In so doing, there has been little

attention given to developing a classificatory scheme which qualifies and quantifies the fundamental technological aspects of these West Indian archaeological assemblages. Continental models have been seen as readily available pragmatic classifications. They have become admixtures of functional and morphological classes, developed on assemblages of non-island groups. The identification of gross tool types such as choppers, scrapers, blades and similar groupings have inherent limitations as to their usefulness in explaining the archaeological record of the precolumbian Antillean complexes. The present classification of a West Indian stone tool as a "chopper", for example, does not merely imply a morphological type of artifact but also implies a clear function for that object - that of forcefully cutting or severing something with a series of massive blows. Although ultimately the end result of a combined classification may be useful, there is a need to re-examine the initial classificatory schemes put forth in the definition of West Indian flaked stone tools. We must look at both technology and function as separate analytical approaches which will allow us to initially create a taxonomy free of preconceived cultural associations.

Previous flaked stone classifications used in the Antilles have, in large degree, impeded our understanding of precolumbian archaeology in terms of answering

fundamental questions such as; which precolumbian groups were using which stone tools for what purposes? (Cruxent and Rouse 1969; Pantel 1977a); were these groups culturally related or distinct cultural groups? (Bullen 1976a, 1976b; Velóz 1980; Velóz and Ortega 1973, 1976; Pantel 1983); what were the ecological determinant factors for these groups and what were the factors of lifeway options in a given historical development? (Sanoja 1985, 1986a, 1986b; Velóz 1971-72, 1976, 1984).

Rouse's publication of Prehistory in Haiti (1939) predated the publication of Rainey's Excavation in the Ft. Liberté Region, Haiti (1941) and Rouse's own Culture of the Ft. Liberté Region , Haiti (1941). The excavations and analysis of the Ft. Liberté materials, however, served as the basis for his 1939 publication. Rouse stated in his earlier work (Rouse 1939) that his analytical approach was aimed at developing modes and types; however, the work resulted in a classificatory scheme geared more to a ceramic, rather than a lithic classification. His classification of lithics was a mixture - partial technological and functional analyses created rather broad categories of artifacts. He applied his modal analysis in his subsequent publication on Haiti (Rouse 1941) which dealt more with lithics. Nevertheless, the final result was not greatly different from his 1939 work. His analytical method became more applicable to ceramic

classification and the development of regional chronologies based on the classification. As a result, he subsequently focused his efforts on ceramic analysis and only marginally dealt with lithic analysis.

To date, there have been no clear methodological approaches developed to deal with the precolumbian lithic assemblages of the islands. The usage of European and/or North American taxonomic classifications fit uncomfortably into the Antillean archaeological record. Most of the taxonomies used are either too specialized to a specific region or functional category (i.e. projectile points), or their categories are so broad as to provide no clearly defined culture traits for the island assemblages. The specialized categories, such as those originally designed for the European Paleolithic periods, focus the assemblage analysis on retouched artifact groups. As stated earlier, the majority of researchers identifying lithic assemblages in West Indian sites only deal with a selective division of broad categories such as flakes, blades, choppers and the like (Rouse 1942a; Davis 1974a; Kozlowski 1980; Febles 1982; Pantel 1976a, 1977b: Ortega and Guerrero 1981). This approach has led to a quasi-stylistic/functional explanation of preceramic hunting and gathering sites rather than a useful and dimensional taxonomy of flaked stone tools for the precolumbian periods.

Still, in quantifiable taxonomic terms, some publications (especially during the 1970s and 1980s) have made serious attempts at isolating distinct lithic cultural assemblages (Davis 1974a; Kozlowski 1980; Febles 1982; Pantel 1976a, 1977b). All, however, fall somewhat short of developing a taxonomic system which begins to differentiate cultural characteristics from technology and function. Although all deal with the manufacture and use of stone tools, either implicitly or explicitly most archaeologists have created classifications which deal with limited elements of these factors. There is a need to look at the full process of technology from procurement to finished product (Geneste 1985) and to deal with technological differences and factors such as raw material, as well as examining their probable function. Again, what may appear to be cultural differences in a flaked stone assemblage may be merely differences in technology resulting from the inherent qualities of the raw material base.

A major plateau in understanding the flaked stone traditions of the West Indies can be traced to the identification and analysis of the assemblage for the site of Casimira in Hispaniola. It was the set of radiocarbon dates and other data from the Azua sites which served as the basis for a key article of Cruxent and Rouse (1969). In it, they introduced a series of diagnostic elements which later became the primary reference for preceramic

definitions of lithic assemblages for West Indian sites. It was this article which provided the basis for the redefinition of the preceramic periods of the West Indies. Thereafter, debate centered on the antiquity of the lithic assemblages of the Antilles rather than on refining definitions of hunting and gathering assemblages.

In essence, the crux of Cruxent and Rouse's definition of the development of West Indian lithics was as follows:

> The absence of ground stone artifacts means that the Cabaret complex belongs to one of the Paleo-Indian ages. Included among its flint artifacts are projectile points, showing that the Cabaret people were of the Late Paleo-Indian age; the points having stems for hafting. . . .
> . . . .
> The Mordán workers did not follow the Cabaret practice of retouching their flakes to facilitate hafting. The absence of hafting and of projectile points shows that the complex belongs to the Early Paleo-Indian age. . . .
> . . . .
> . . . . . in view of the virtual certainty that the Casimira complex substantially predates the Mordán, the Casimira complex could date back as far as 5000 B.C.[Cruxent and Rouse 1969: 45-46].

Once a date had been established for the site of Mordan, Cruxent postulated that the material he found at the site of Casimira (and Las Alejandrinas) was evidence of an earlier precolumbian occupation that predated the Mordan deposit by approximately 3000 years. The basis for the assumption was placed upon three factors, two of which were partially technological and one ecological. Cruxent first pointed to the inordinately large size of the lithic artifacts in Casimira in comparison to all the rest of the

material known for Hispaniola, and secondly the apparent lack of any secondary work or retouch on the artifacts. He envisioned this assemblage as that of a "Paleolithic" hand-axe type culture clearly predating the later groups which made more "refined" tool types and points for hafting.

The final consideration for the early dates for the "Casimiroid series" was based upon a continental model which Cruxent had encountered in Venezuela - terracing. The site of Casimira is located some meters uphill from the site of Mordan in what is roughly equivalent to a series of terraces. Cruxent's assumption, which was taken from a South American continental model, was that those sites on low geological terraces were later than those on higher terraces, since the formation of the terraces along river systems was due to the lowering of the water level of the estuary system (Cruxent, personal communication 1977, Chanlatte Baik, personal communication 1987). There are, however, fundamental chronological and geographical problems in using the analogy of topographic alteration in these insular Dominican sites to those on the continental South American mainland (Pantel 1977a).

It is vital to re-assess the importance of the site of Casimira since it has been used as a primary basis for West Indian lithic chronologies using tool morphology. It was in large part this particular site and the methodological approach used in the identification of this assemblage as a

distinct cultural group, that provided the present impetus to develop a classificatory scheme that would qualify and quantify West Indian lithic assemblages.

Approach to the Problem of Lithic Classification

To be able to begin resolving some of the problems inherent in previous classifications oriented primarily towards cultural chronologies required that an "island-based" classificatory scheme for the identification of lithic technology be developed. This technologically based classificatory scheme should better lend itself to isolating natural, cultural and chronological variables since it would not contain inherent biases of cultural affiliations. As a means of achieving this end, the first step needed was the development of a basic classification method which isolated the technological dimensions of flaked stone assemblages.

This work examines the technological attributes of West Indian lithic assemblages using a classificatory scheme applying paradigms for stone tool technology (Dunnell 1971).

In the initial classification of the material, a set of 15 dimensions was established with a total of 84 modes. This modal analysis was designed to cover nearly all of the possible variants that could be found in Antillean assemblages from a technological perspective. The initial

set of dimensions and modes was designed as a working model, using a set of lithic assemblages from the major islands of the Greater Antilles and some of the Lesser Antilles. It was the intent, in the development of this classificatory scheme, to create combinations of dimensions and modes for the purposes of analyzing technological variability (Dunnell 1971).

As Dunnell explains in his identification of a classificatory scheme:

> . . . classes, (mode, type, and phase) denote the scale of phenomena for which they are constructed, their paradigmatic nature, and the cultural quality of their defining criteria. These are the only characteristics which can be included for the discipline as a whole in a problem free context. The number of defining criteria and the particular criteria chosen are a function of the requirements of particular kinds of problems, and variations in these aspects produce the large number of modes, types, and phases, sometimes recognized under special labels such as tradition, horizon, ware, or functional type, and sometimes terminologically undifferentiated. [Dunnell 1971: 195-196].

As stated above, the intent of the present classificatory scheme is to develop a working model, a model which is specifically applicable to precolumbian West Indian assemblages and is a means of examining and explaining stone flaking technology. The immediate goal, however, is not the explanation of historical process in the islands. Lithic technology, and how it is applied in West Indian assemblages is one of the key elements of the present work. The methodology proposed should serve as a

mechanism to be combined with subsequent analyses of tool function. As a preliminary step, this would aid in isolating that formal variation that is clearly cultural.

CHAPTER 3

GEOGRAPHY AND LITHIC SOURCE GEOLOGY OF THE REGION

Overview of Area

The area of research is alternately referred to in the literature as the Antilles, the West Indies, the Greater and Lesser Antilles, or at times the Caribbean. The division of the Antilles into "Greater" and "Lesser" has certain relevance for this particular study since the majority of flaked stone sites appear to be found primarily in the group of islands known as the Greater Antilles.

The islands of Cuba, Jamaica, Hispaniola (presently divided geopolitically into Haiti in the West and the Dominican Republic in the East), and Puerto Rico, constitute the group known as the Greater Antilles. The Lesser Antilles are composed of the group of islands that begins with the Virgin Islands in the East and stretches southward to the island of Trinidad off the northeast tip of Venezuela (see Figure 3-1).

The islands of the Lesser Antilles are often further divided in the literature into the Windward and Leeward Islands. These are composed of many smaller islands and

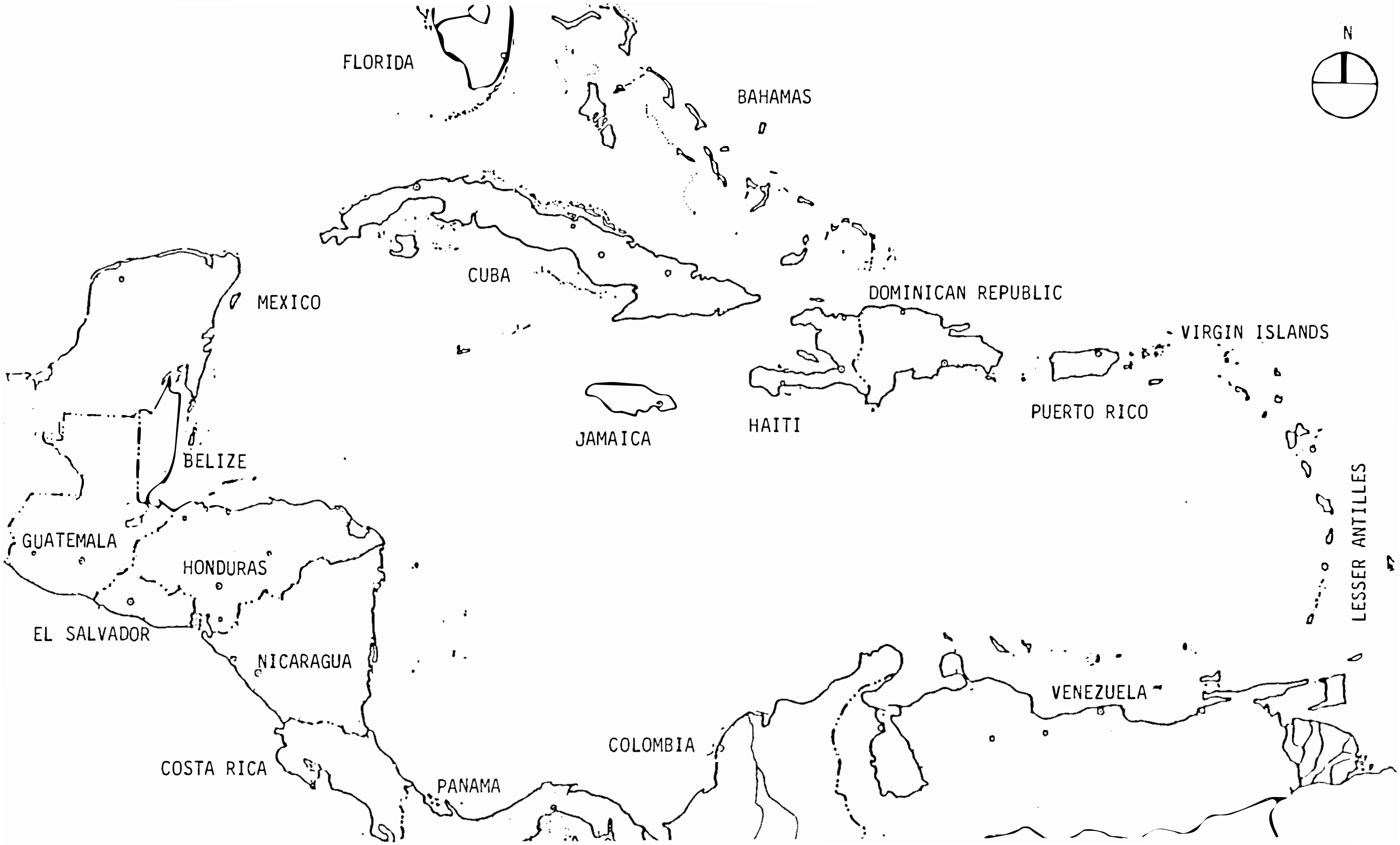

Figure 3-1. General map of the Caribbean, showing the Greater and Lesser Antilles, northern South America, the Caribbean coast of Central America, Florida, and the Bahamas.

island groups which, in many cases, remain today under the rule of North American or Western European colonizing countries[1].

The geology of the two major divisions of the Antilles, Greater and Lesser, can be characterized by two basic geological divisions. The formation of the Greater Antilles predates that of the Lesser Antilles as evidenced in the still active volcanic status of some of the islands in the Lesser Antillean chain. The occurrence of limestone formations is greater in the larger islands of the Greater Antilles and chert formations more common than in the Lesser Antilles.

The largest and most westerly island in the Antillean archipelago is Cuba, and is described by Picó (1974: 3) as an island greater in size than that of all of the other Greater Antilles combined. It is relatively flat to hilly with less than a quarter of the island being mountainous. Hispaniola is the second largest of the Greater Antilles and possesses complex mountainous interiors, valleys and

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[1] The principal Windward Islands are those of Martinique (French West Indies [F.W.I.]), St. Lucia, St. Vincent, Grenada, and the Grenadines. The principal Leeward Islands are composed of the United States Virgin Islands (U.S.), the British Virgin Islands (British West Indies [B.W.I.]), St. Kitts, Nevis, Anguilla, Antigua, Barbuda, Redonda, Montserrat (B.W.I.), Dominica, Guadeloupe (F.W.I.), Marie-Galante (F.W.I.), St.-Barthélemy (F.W.I.), St. Eustatius (Netherland Antilles [N.A.]), Saba (N.A.), and St. Maarten (F.W.I./N.A.).

coastal plains. Jamaica and Puerto Rico are comparable in size and topography, with the most similar features being the mountainous interiors and coastal plains. Puerto Rico is the smallest of the Greater Antilles but also the most diversified in geography with nearly 50 percent of the island being mountainous (Picó 1974).

The topography of the Greater Antilles is quite varied and many of the mountain ranges reach fairly impressive heights: Pico Turquino in Cuba (2,000 meters), Blue Mountain Peak in Jamaica (2,256 meters), Pico Duarte in Hispaniola (3,175 meters), and Cerro de Punta (1341 meters) in Puerto Rico.

In addition to the main islands of the Greater Antilles there are numerous satellite islands and off-shore cays that belong to the Greater Antilles. Some of these secondary islands, such as Isla de Pinos off of Cuba, measure in area as much as several hundred square kilometers (Picó 1974).

Geological research in the Greater and Lesser Antilles over the past decades has been primarily oriented towards explaining the origins and development of these islands (Hess 1933, 1938, 1960). Much of the pioneer work in the area was done by H. H. Hess (1933, 1938, 1960) and his students (see Hess 1960; Hess and Maxwell 1953), under the aegis of Princeton University. The emphasis in these studies was oriented towards explaining the development of

island archipelagos and other fundamental geological concerns. Lithic formations cogent to archeological concerns, however, such as lithic source materials for flaked stone implements, were not a key concern to these authors. Most of the silicious stone suitable for flaking (be it chert, chalcedony, flint or any other cryptocrystalline material) is the result of relatively late geological developments with limited interest for fundamental geological research on island formation. Thus the geological literature on the islands of the Caribbean does not deal with descriptions of source materials which would have been potentially usable by the indigenous inhabitants.

In the geological literature of the West Indies, references are made occasionally to the occurrence of chert as a generic category (Weyl 1966). One problem with the majority of these references is that the geological citation of these silicious or chert materials does not detail the stratigraphy of the deposits for archaeological purposes. The occurrence, for example, of a chert or silicious material overlaying an earlier geological deposit may indicate its relative stratigraphic position geologically but does not necessarily mean that the materials are (or were) accessible to human exploitation. The use of cherts and other suitable flaking source materials most often requires that the materials are

initially exposed through a variety of natural processes. The literature for identifying these potential source areas of the West Indies is woefully impoverished.

As will be seen in this chapter, a further problem exists in most of the geological literature, in that references to the occurrence of chert or chert outcrops do not usually describe the nodule size, nor the degree of homogeneity of the lithic material. Both of these factors are key elements in understanding availability as well as the flaking characteristics of the materials from an archaeological point of view. The absence of this kind of data puts the information into a very general interpretive level. The occurrence of geologically reported outcroppings can only give us a broad idea of those areas which could have been used potentially by precolumbian groups.

The need is clear for first-hand field data which describes the physical characteristics and the locations of sources of suitable raw flaking materials, but there are some cases in Antillean archaeology where source materials were investigated as part of the archaeological research. In the Greater Antilles, a geologist (Roobol) joined efforts with an amateur archaeologist (Lee) and attempted to identify flaked stone source materials for several precolumbian Jamaican sites (Roobol and Lee 1976). Field work in the Dominican Republic, Haiti, and Puerto Rico

included the identification and examination of potential lithic source sites for most of the collections utilized in the present study (Pantel 1976a, 1977a, 1977b, 1983). In the Lesser Antilles, notable efforts have been made by Davis in the identification of potential sources for the flaked stone assemblages of Antigua (Davis 1982).

Although the criticisms of Khudoley and Meyerhoff may seem extreme, they effectively illustrate some of the problems present in the Caribbean:

> The Greater Antilles. . . geology can be studied with reasonable thoroughness, although political accessibility has been a handicap in their study. . . Yet careful surface and subsurface geologic mapping, through sedimentary province studies, systematic geochronology investigations, and detailed geophysical surveys have been carried out in very few places within this arc . . .
> . . . .
> . . . it is incredible that the Greater Antilles islands, exposed as they are and available to thousands of geologists and geophysicists for study, are poorly mapped, poorly studied, and poorly understood. The published literature on Cuba is a maze of contradiction. . . . The island of Hispañola is almost totally unknown. The few "detailed" reports from that island are at best reconnaissance studies. Puerto Rico and the Virgin Islands, like Cuba, are becoming sources for numerous contradictory publications. . . [Khudoley and Meyerhoff 1971: 166].

Lithic Raw Materials

When discussing the terms flint, chert, and chalcedony, archaeological and geological considerations of lithic materials tend to differ. The archaeological concerns are with the "workability" or flaking characteristics of a lithic material; the geological

concerns are more towards the development of the lithic material in a geomorphic context.

Archaeologically, these concepts are well summarized by Crabtree:

> Flint, fine-grained basalt, chert, chalcedony, jasper and the volcanic glasses were widely used aboriginally for they are solids having the properties of heavy liquid. All have the necessary qualities of elasticity, homogeneity; are cryptocrystalline, isotropic and highly siliceous. Homogeneity allows the worker to fracture the stone in any direction. The material must also be free of flaws, cracks and inclusions, otherwise it would break prematurely or cause step and hinge fractures. Coarse-grained rock will not fracture smoothly but tends to crumble from the applied force. Other materials such as feldspar and slate will fracture only along certain lines and cannot be controlled by the worker [Crabtree 1972: 5].

In geological terms, the most common reference found in the geological literature and cartography of the Caribbean is that of "chert" which is defined as follows:

> A hard, extremely dense or compact, dull to semivitreous, microcrystalline or cryptocrystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz less than about 30 µm in diameter; it may contain amorphous silica (opal). It sometimes contains impurities such as calcite, iron oxide, and the remains of siliceous and other organisms. It has a tough, splintery to conchoidal fracture, and may be white or variously colored gray, green, blue, pink, red, yellow, brown, and black. Chert occurs principally as nodular or concretionary segregations (chert nodules) in limestones and dolomites, and less commonly as areally extensive layered deposits (bedded chert); it may be an original organic or inorganic precipitate or a replacement product. The term flint is essentially synonymous, although it has been used for the dark variety of chert . . . . [Bates and Jackson 1980: 108].

Keeping in mind the limitations detailed in the previous section, an examination of the geological

literature of the Greater and Lesser Antilles does offer us some initial data on lithic sources which could have served as potential raw materials for precolumbian groups.

Although some geological maps may show chert deposits, this is usually not the case. However, limestone is often shown and since flint, chert and/or chalcedony are often found eroding out of limestone deposits, this may be significant. Still, unless the occurrence of chert in limestone deposits is specifically shown, the information is not archaeologically useful. A second problem occurs in that the occurrence of chert on a geological map may not necessarily represent sufficient quantities of material in nodular or bedded form. The occurrence of the chert may be in microscopic quantities in thin sections and not in the quantities necessary for use as raw materials for tool manufacture. What may seem as a simple matter of locating those areas which have chert or other silicious materials, and targeting them as potential source areas is not feasible. Often times the existence of cherts or other silicious and workable material is not shown on geological maps due to their relative unimportance geologically. These obstacles are further compounded by the difficulty of trying to infer stratigraphic location and qualitative data for potential source materials from these references.

For the previously detailed reasons, most all of the data in the remainder of this section relies primarily on

textual information, using cartographic data only as a corroboration of the literature.

<u>Cuba</u>

The general geology of Cuba, as part of the Greater Antillean chain, makes it highly likely that local deposits of flint, chert and/or chalcedony occur in the limestone deposits of the island. The geological literature of Cuba lends little to aid in the location of potential silicious deposits and is fairly limited to local references (Alvarez Conde 1957, 1961; Bermúdez 1963; Furrazola-Bermúdez, Judoley, Mijailovskaya, Miroliubov, Novojatsky, Núñez Jiménez, Solsona 1964). Only the works of Alvarez Conde (1957, 1961) offer some type of correlation between the geology of the island and the archaeological record. The data provided in Alvarez Conde's works, however, are very general, referring only to the existence of "silex" which was used aboriginally for cutting instruments in the central and eastern sections of the island (Alvarez Conde 1961: 162).

The availability of usable silicious material for the manufacture of flaked stone tools is evident in the existence of precolumbian sites such as Levisa, Seboruco, Canimar I and other lithic tool sites. It is assumed that these sites reflect the product of locally available silicious materials. The quantity of material in these (and other Cuban sites) would seem to support a local

material, as does the existence of primary production flakes found in many of the collections.

Jamaica

Limited useful data are available on the geology of Jamaica for source sites; however, a brief definition of the area is given in an attempt to define source materials by Roobol and Lee:

> Unlike other islands of the Greater Antilles, most of the rocks outcropping at the surface are limestone (66.7% of the area of Jamaica) containing abundant flints. The older volcanic and metamorphic rocks which underlie the limestone are exposed in a number of small inliers or erosional windows where the limestone has been removed [Roobol and Lee 1976: 305]. (see Figure 3-2).

It is significant that the term "flint" has been used by Roobol and Lee rather than the term "chert" which is a more common geological term. The use of the term "flint" implies the potential archaeological nature of the raw material, that is to say its potential suitability as a usable material for the manufacture of flaked stone tools.

In the same publication Roobol and Lee begin to define geographic parameters for potential sources based on the inherent qualities of some of the flaked materials. Still, if one looks at the areas defined and the corresponding map (Figure 3-2), it becomes clear that even this effort only reduces the potential resource areas to more than half the island:

> The Lee collection contains numerous flint specimens, chiefly from north coast sites in the Montego Bay area... but also from other major sites in Trelawny and St. Ann.... Secondary working flakes is extremely rare. These flints originate in the White Limestone Group which covers two thirds of Jamaica; some can be traced to particular horizons as they contain an abundance of silicified fossils. The flints are concentrated in the rivers and on beaches around the island [Roobol and Lee 1976: 309].

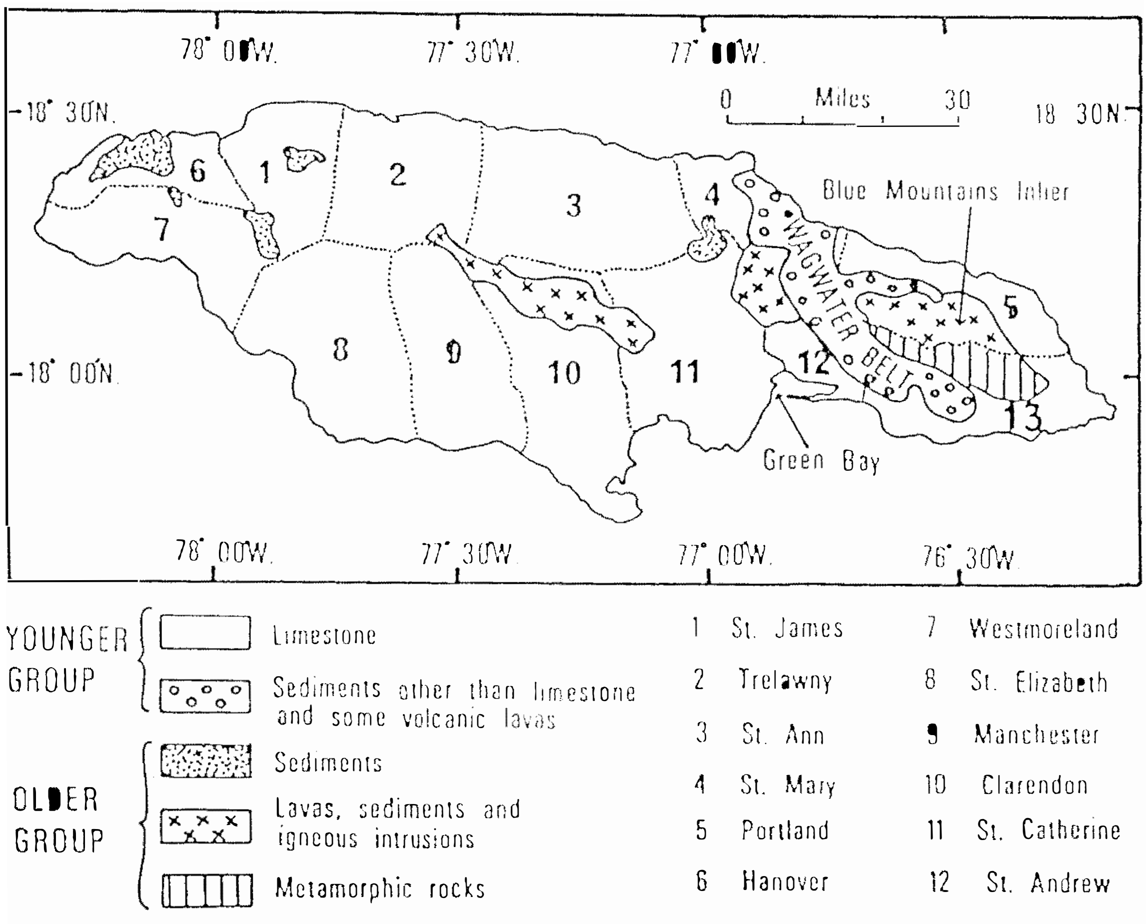

Figure 3-2. Map of Jamaica showing geological composition and parishes. (Source Roobol and Lee 1976: 306)

Haiti (Western Hispaniola)

The geological literature of Haiti is discussed in the works of Woodring, Brown and Burbank (1924) and Butterlin (1954); however, their application to archaeological inferences for source materials is not useful. This, unfortunately, seems to be very much the case for most of the literature on Haiti. The only major exception to this is the early work of Roumain (1943) in which he tries to correlate the source materials for the Cabaret complex located north of the Port-au-Prince area:

> Le site commence, si on l'aborde en venant de Port-au-Prince dans la région de la Source-Matelas, à quelques centaines de mètres d'une source résultant apparemment d'un jaillissement souterrain par dissolution de la masse calcaire à la base d'une colline. Il s'arrête à peu près à la limite des terres cultivées qui précèdent le bourg de Cabaret [Roumain 1943: 25][2].

It should be noted that the source materials for the Cabaret complex appear to have come from natural deposits within meters of the archaeological site. This may be the case in most of the early West Indian sites. Though the Cabaret area may have served as a primary source area for the sites in the Port-au-Prince region it is doubtful that it represents the sole source area for lithic assemblages throughout Haiti. The Ile à Vache materials, in the

---

[2] The site begins, along the road towards Port-au-Prince in the region of Source-Matelas, which is a few hundred meters from a source which apparently results from a subterranean spring which has dissolved the limestone mass at the base of a ridge. It stops just before the limits of the cultivated lands preceding the small town of Cabaret.

southernmost extremities of Haiti, most likely came from local deposits. Likewise, the northern archaeological sites around Limbè and the Fort Liberté region most likely utilized relatively local source materials.

Dominican Republic (Eastern Hispaniola)

The geological data for the Dominican Republic seem to be more abundant, possibly as a result of better accessibility to researchers for a variety of logistical considerations. Nevertheless, the information offers data only for a few areas within the country, primarily within the main cordillera section of the island. Some useful data are documented in the works of Bowin (1960) who describes massive chert deposits which could have served as primary source materials for precolumbian groups in the interior. Although specific data are given on some aspects of the deposits, there is a question as to the origin of some of the material by Bowin himself:

> . . . Red hematitic massive cherts were encountered at three localities in the Siete Cabezas formation. . . Thin white veinlets of very fine-grained quartz are common in the chert. Near locality 725 the chert occurs in a zone about a meter wide which may have been a fault zone for the rocks on both sides are highly sheared and fractured. The chert in this zone contains irregular veinlets of epidote. There are also several smaller lenticular zones of red chert here. The red chert northeast of locality 725 is highly fractured and joint or bedding planes are common. . . . The origin of the chert is not clear. Boulders of red chert were found by Koschmann and Gordon . . . over an area several acres in extent about 2.2 km northeast of Piedra Blanca [Bowin 1960: 49].

A second reference in Bowin is also worth noting in the type of geological data which could usefully serve archaeological analysis of potential source materials, despite geological questions raised in the descriptions. Locations of material, qualitative characteristics of the chert itself, and stratigraphic data are given - all cogent to an archaeological perspective:

> . . . Extensive outcrops of massive chert occur on Loma Trinchera. Indeed, almost the entire mountain is composed of chert and interlayered altered volcanic (?) rocks. Hematite veins and films are present everywhere in the chert. The chert unit lies between two volcanic units both referred to the Los Ranchos formation.
>
> The relationship between the cherty rocks and the inter-layered volcanic(?) rocks, now composed primarily of quartz and a clay mineral or pyrophyllite, is not completely clear. On the slopes of Loma Trinchera, particularly the northeastern slopes, zones of chert can be traced by alignment of boulders of chert. . . . Commonly three or four chert zones are fairly well defined on the northern slopes, and there are suggestions of other thinner more discontinous chert zones. The material between the chert zones does not crop out well.
>
> The chert occurs as both hard and crumbly types, and it is massive in all outcrops examined. Thin banding was observed only in one piece of float. The thin banding is dislocated by several small faults. Whether the banding is layers of primary chert or a preserved texture of a silicified rock is unknown, but the available evidence suggests silicification [Bowin 1960: 68].

This characterization of Hispaniola has been confirmed by the present author in field situations. The occurrence of massive outcrops of chert in Hispaniola is so striking as to permanently impress upon one's mind the size and abundance of high quality raw material available in the island. Although this type of geological field data is not

available for Haiti, it is highly probable that the same geological potential exists in that half of the island as well. Archaeologically, the inordinate size and quality of flaked stone artifacts for both the Dominican Republic and Haiti seem to indicate similar source materials for the assemblages, either from multiple geologically similar types of sources or a single lithic source.

Puerto Rico

The geological information, although somewhat more complete for Puerto Rico than many of the other Greater Antilles, still has limitations. The primary references are those of Picó (1974) and Mattson (1960) in addition to the quadrangle mapping reports of the United States Geological Survey. The detailed reports of Mattson of the southwestern portion of the island detail the existence of chert in various locales. Mattson's data are important in that he begins to document qualitative and quantitative data on the lithic materials as well as their stratigraphic location. The references here, though extensive, show much of the useful type of geological data needed for archaeological interpretation:

> The [Sierra] Bermeja complex occurs chiefly in the centers of most anticlines in southwestern Puerto Rico. . . . .
> . . . .
> The complex is composed mainly of serpentinized periodotite, now serpentinite with spilite, ampnibolite, and minor silicified volcanic rock and/or chert [Mattson 1960: 323].

Most of the Sierra Bermeja is composed of a black or greenish-gray siliceous rock that weathers reddish. It is massive and intensely brecciated; bedding is rare. Thin sections show that most of the unit is cryptocrystalline silica, but there are some specimens of silicified volcanic porphyry and conglomerate.

. . . .

The extensive silicified rocks in the complex, only finely recrystallized, are perhaps the product of low-grade regional metamorphism. . . [Mattson 1960: 324].

The Río Loco basaltic (bronzite) andesites are porphyritic rocks . . . Pillow structures are common in the northern outcrop area and absent in the southern area. The pillows are outlined by a facies of the porphry with sperules of silica and chlorite in a light-colored, probably silicified, matrix. Veins of quartz are common. The pillows average 1 m in diameter an have no marked dimensional orientation. Interstices are filled with quartz, chert, or finely recrystallized limestone. The rocks weather to a coarse sand, and spherioidal weathering is common [Mattson 1960: 326].

Parguera limestone. . . .

. . . .

At the west end of the Vertero hills limestone rests on the serpentinite. There, where a dirt road crosses the hills, a small outcrop exposes conglomerate containing chert pebbles and chromite grains probably from the Bermeja complex, Parguera limestone pebbles, and some shattered shale.

. . . .

The Parguera limestone and the serpentinite are in contact on the coast at the Sierra Melones. Here the following sequence occurs:

(4) Parguera limestone

(3) A 2-3-m zone of conglomerate or breccia containing angular, microcrystalline chert fragments and chromite grains in a yellowish siliceous matrix

(2) Zone of siliceous serpentinite breccia

(1) Serpentinite with amphibolite inclusions (poorly exposed

Zones (2) and (3) are interpreted as a pre-Parguera lithified zone of weathering on the serpentinite. The chert and chromite are apparently derived from the Bermeja complex; no serpentinite pebbles were found in the upper zone, probably because serpentinite decomposes quickly. These outcrops indicate that the Parguera limestone is deposited unconformably upon the serpentinite [Mattson 1960: 334-335].

> Melones limestone. . . .
> . . . .
> Wacke, common in the Melones formation, is composed of fragments of porphyries, green tuff, chert, pyroxenes, and feldspars. Authigenic quartz is present on some chert grains. The matrix is in part calcareous, in part argillaceous [Mattson 1960: 336].

> Sabana Grande andesite . . . .
> . . . .
> At the base of the andesite in the Tea syncline and the Guanajibo anticline are lenses of poorly sorted conglomerate that contain rounded to sub-angular (1-10-cm) pebbles and granules of porphyries, radiolarian chert, and amphibolite or partially amphibolitized diabase. The chert and metamorphic pebbles are from the serpentinite complex below; the porphyries are probably derived from contemporary vulcanism. The matrix of the conglomerate is noncalcarceous tuffaceous mudstone containing some quartz and feldspar fragments [Mattson 1960: 338].

It should be emphasized that even though geological studies, such as Mattson's, make mention of the existence of chert and/or silicious materials in the individual formations, that does not necessarily mean that they occur (or occurred) in any archaeologically significant or usable amounts (Mattson 1960).

The occurrence of chert and/or silicified lithic sources in the geological record does not automatically indicate that such a resource was readily available or even known to the precolumbian groups inhabiting the islands. Outcropping of lithic sources may occur much after the precolumbian periods, especially with the resultant deforestation of the islands through European colonization activities which accelerated normal erosional rates for the

islands. Only in the cases where we have clear evidence of outcropping with evidence of precolumbian flaking of the material (such as is the case at Cerrillo) can we unequivocally state that a particular geological formation was a utilizable resource by conscious choice. All other resources are theoretically potential resources for the inhabitants, but they may not have been aware of a source's existence. Hence, the lack of their use by precolumbian groups may not have been a conscious choice but rather a lack of knowledge of their existence.

Virgin Islands

Of the references which exist for the geology of the Virgin Islands, one of the few specific references to any potential archeological source materials is found in Whetten (1966). Whetten's work is limited to the island of St. Croix, which technically falls within the formation of the Lesser Antilles. His references, however, are worth noting in the type of data they may provide for archaeological potential:

> . . . Cherty rocks interbeded with sandstones and mudstones are observed in the Caledonia Formation only along the north coast of the eastern half of St. Croix from Ft. Louise Augusta to East Point. In the places where chert is particularly plentiful, as at Cottongraden Point, it may occur regularly in turbidite sequences between sandstone beds (above) and mudstones (below). In field appearance chert differs from other fined-grained rocks only by its slightly more massive character and greater hardness. Chert beds 3-4 inches thick at Ft. Louise Augusta are interbedded with several inches of highly weathered unidentified rock, probably mudstone. Thin sections

of chert show recrystallized grains which coarsen in the vicinity of the intrusion at Southgate.

It is reasonable to assume that silica in chert beds is the recrystallized remnant of siliceous micro-organisms which accumulated between turbidity currents, and which were not replaced by calcite. Had extensive calcite replacement not occurred, chert layers probably would be more abundant than they are now [Whetten 1966: 190].

Lesser Antilles

For the islands of the Lesser Antilles, a primary reference exists in the geological summary of Martin-Kaye (1969) which covers the general area.

One interesting geological note is a mention of petrified wood which could have served as suitable flaking material for precolumbian peoples. Martin-Kaye (1969: 182) states, "Petrified wood is common in parts of Antigua, Martinique and St. Lucia . . . " Petrified wood was also located in the southwestern portion of Puerto Rico near Sierra Bermeja by Pantel during the 1976 field season. Although no known examples of flaked stone implements from petrified wood exist in the Caribbean, the material is a potential raw material resource.

Martin-Kaye, as in most other geological reports, makes general reference to the occurrence of chert materials for some of the islands of the Lesser Antilles:

> Antigua . . . the island is made up of limestones resting on volcanic rocks, all tilted to the north-east at 5°-20°. The volcanics consist of agglomerates and of tuffs intercalated with, or cut by, basalt-andesite-dacite flows and minor intrusions. These form a rather mountainous district occupying the south-western third of the island. They give place

upwards to a more clearly stratified series of largely tuffaceous, often water-laid pyroclastics, with both marine and fresh-water horizons. Cherts and conglomerates are particularly prominent at the top of this succession which occupies a central, rather low-lying belt cutting diagonally across the island [Martin-Kaye 1969: 187-188].

> Islands of the Grenada-Grenadine Bank . . . .
> . . . .
> The Pillories . . . . Silicified zones trending at 100°-280° and minor quartz veins also occur. . . .
> . . . .
> Balliceaux . . . . The north of the island is apparently all igneous rock and shows a marked chert-alunite-kaolinite alteration. . . .
> . . . .
> The Tobago Cays . . . . Baradal (NE Tobago Cay) is composed largely of agglomerate but the northern end consists of well and thinly stratified metasediments (including thin limestones and some cherty beds) dipping north-west at 75° [Martin-Kaye 1969: 197-199].

Any initial attempt to develop a map of potential source materials for the Greater or Lesser Antilles will be restricted by the literature available and limited direct field observation. As a preliminary effort at providing base-line lithic source information, Figures 3-3 and 3-4 incorporate geological and archeological data onto maps of the area. In all the sites studied by the author in the field, the source material was found immediately within the site limits or within a radius of less than a few hundred meters from the archaeological site. The geological data are very preliminary and there is a far greater number of unknown than known sources.

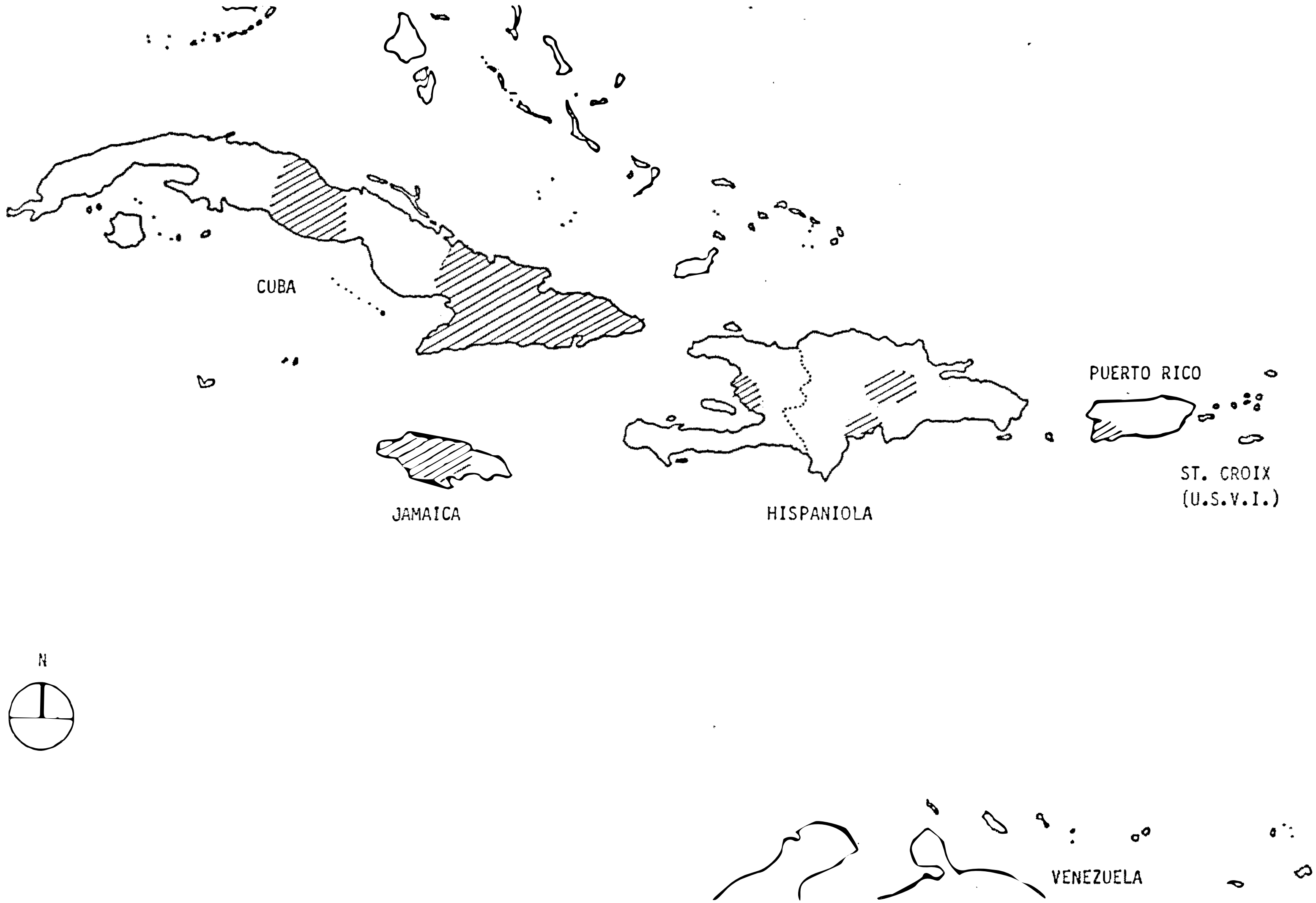

Figure 3-3. Map of the Greater Antilles showing putative raw material source areas for cherts, based on geological data and archaeological field observations.

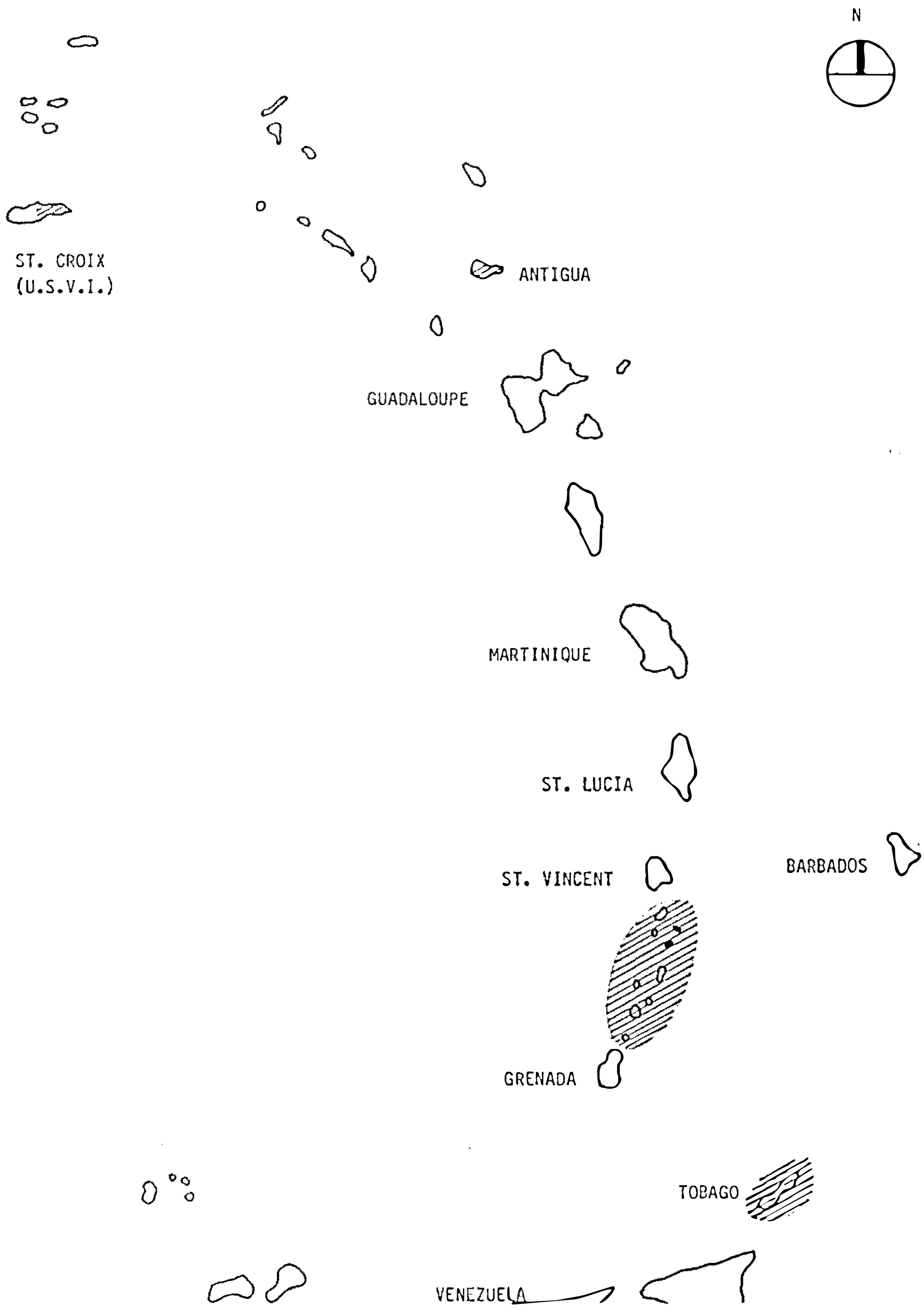

Figure 3-4. Map of the Lesser Antilles showing putative raw material source areas for cherts, based on geological data.

Raw Material Classification Scheme

Geologically, we can see that the Greater and Lesser Antilles have raw material sources which were used in the production of precolumbian flaked stone implements. The occurrence of chert (in the geological definition) provides the potential gamut of usable raw material from fine grained flint all the way to a low grade of chalcedony[3]. The geological data, however, do not provide us with the information necessary to determine the quality of the raw material. Factors of homogeneity, inclusions, grain, nodule size or bedding characteristics, cortex, and other cogent aspects of raw material desirability are not available through most of the geological references. For these reasons, the present analytical scheme utilizes a series of relatively broad groups for geologic classification which are described in detail in the subsequent chapter.

The dimension in the classificatory scheme which deals with geologic type (Dimension 2) utilizes a series of terms which were created by the author. The terms "Hispaniola Flint", "Barrera Mordan Chert", "Cerrillo Chalcedony" and "Virgin Island Basalt" are listed in a somewhat descending order of quality of the raw material. This is to say that Hispaniola Flint is considered the most desirable of raw

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[3] Here referring to the term chalcedony and chalcedonic chert as defined geologically (Bates and Jackson 1980).

materials for flaked stone tools due to its flaking qualities[4]. Barrera Mordan Chert is considered less desirable, and Cerrillo Chalcedony the least desirable of the siliceous raw materials. The category of Virgin Island Basalt is placed last in the dimension as it is a non-siliceous, yet fine grained lithic material which will fracture well. Unlike the other three types, the basalt does not create sharp cutting surfaces when it is flaked.

The geologic types created for the classification are to be recognized as heuristic terms and not geologic definitions of lithic types existing in the West Indies. It should be stressed, however, that the four types have been based on archaeological field studies carried out by the author and are representative of general lithic types found both in the field and in extant collections of West Indian assemblages.

The validity of carrying out these types of source studies has been demonstrated in such works as that of Geneste (1985) and Larick (1983) to mention a few. Source material analysis and site locations can be shown to be

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[4] It should be understood that the determination of desirability is an extremely general appreciation. It is recognized that the desirability of raw materials may be based on other factors besides homogeneity and the degree of siliceous material in the resource. Certain artifacts may require less siliceous material or fine grain to give them durability. The category's desirability is primarily assessed here from a technological aspect in that the material reacts in a much more predictable manner for flaking than the other geologic divisions.

markers of artifact variability and regional procurement patterns.

CHAPTER 4

FIELDWORK AND METHODOLOGY

Sites

Research for the present work involved field surveys, site excavations and the examination of extant collections. The three primary countries in which field work was carried out were Puerto Rico (United States), the Dominican Republic, and Haiti. Collections which were studied were located in Puerto Rico, the Dominican Republic, Haiti, and the continental United States[1].

Survey and excavations in Puerto Rico were effected during 1974 in the southwestern sectors of the island, primarily on the aceramic site of Cerrillo. In 1975, excavations were carried out on the complex of sites of Barrera, Mordan and Casimira in the Dominican Republic. The third set of excavations, undertaken later in 1975 was limited to survey work and minimal testing in the Bay of Port-au-Prince, Haiti. Follow-up work was done in Puerto

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[1] Additional comparative studies of lithic samples were carried out by the author in the Lesser Antilles (Antigua, St. Kitts, and Nevis) and South America (Venezuela and Columbia), as well as materials in the British Museum in London. The data for these investigations are not included quantitatively in this study and are only mentioned in that they provided supplemental background to the author in terms of understanding the problems and solutions developed in this work.

Rico in 1976 on a series of sites in the same southwestern region as the Cerrillo site.

From 1977 to 1979 and from 1980 to 1986 extant lithic collections in the West Indies were documented and materials were analyzed and photographed.

Surveys, Excavations, and Collections

Puerto Rico

Field work on the island was concentrated on the survey and later excavation of the precolumbian archaeological site of Cerrillo in the municipality of Cabo Rojo[2]. The site lay entirely within a sugar cane field on a small knoll overlooking a major littoral lagoon, approximately 700 meters to the west (see Figure 4-1).

The initial research focus for Cerrillo was oriented to obtain information about the site's horizontal and vertical parameters since this was the first wholly aceramic flaked stone site to be recognized and investigated in Puerto Rico.

Standard basic field methods, following Heizer and Graham (1968), were used to survey and test the site. An alpha-numeric grid system composed of two meter by two meter units was superimposed on a topographic map of the site and the site was systematically surveyed to determine

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[2] See Pantel 1976b.

areas of precolumbian surface evidence and artifact densities.

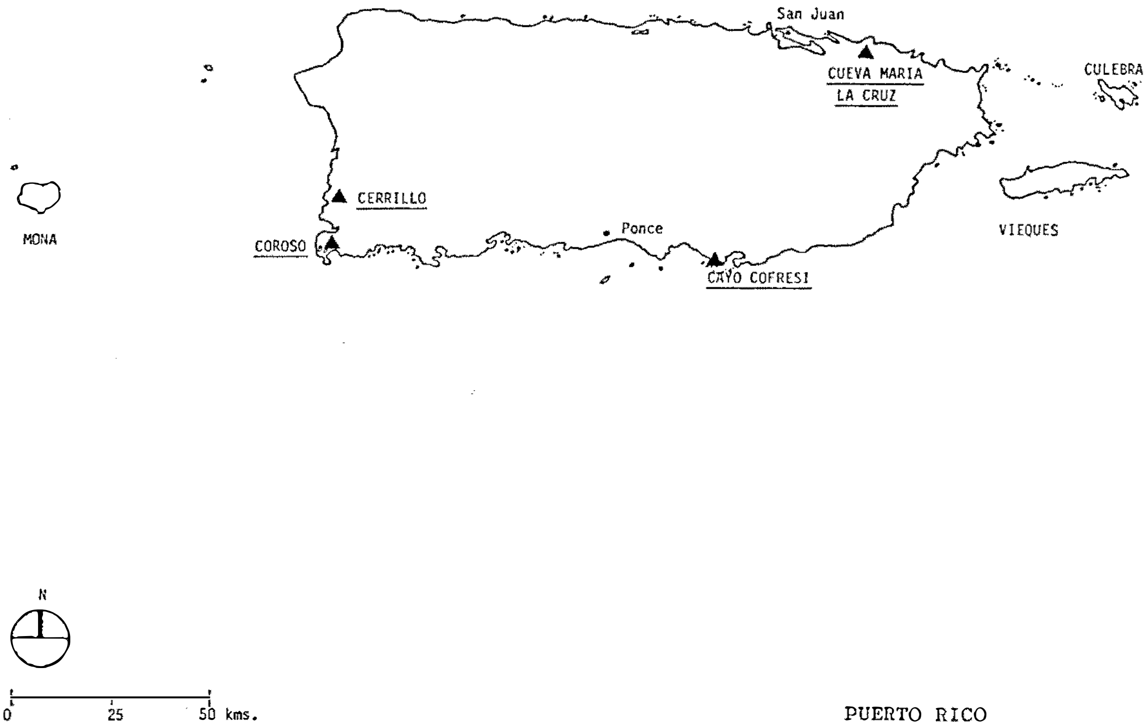

Figure 4-1. Map of Puerto Rico showing Cerrillo and other major aceramic sites.

After having established areas of surface concentrations, the site was tested by manual excavation methods using the test units within the grid. The test excavations consisted of an L-shaped trench created by excavating alternating two by two meter test units. A shovel testing program had established the depth of the cultural deposit to be within the plow zone. Given the intensive and extended degree of sugar cane cultivation of

the area, the decision was made to utilize artificial excavation levels rather than excavation by stratigraphic levels. Artificial 10 cm levels were used in the testing, breaking from the traditional 25 cm levels used in Puerto Rico and the West Indies since the 1930s. Although the entire site appeared to be located within a cultivated sugar cane field, it was hoped that some activity patterning may have survived the action of the plow or might occur below the plow zone[3].

All the excavated material was hand-screened through standard 1/4" wire mesh. Field logistics, coupled with the clayish content of the lateritic soils at the site, excluded the use of techniques designed for maximum data recovery such as water screening or finer mesh screening of the excavated matrix.

All artifactual material remaining in the screens was placed in clear polyvinyl bags. Each bag was tagged to identify the contents by site, unit and level for subsequent processing. The unit samples were transported to a field laboratory where they were washed, catalogued and returned to their provenience bags for temporary curation.

In the laboratory, the material was sorted by gross categories which divided each unit's sample into broad

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[3] The present mechanized plowing and disking methods used in Puerto Rico penetrate to a depth of approximately 46 cm below the surface.

categories on the basis of fundamental technological traits. At the time, the primary reference work and methods used for this classification were those of Donald Crabtree (1972, 1972a). This sorting was limited to separating out for further analysis those pieces which had any evidence of prepared flaking such as a platform, positive or negative bulbs or scars in any combination, or evidence of secondary flaking. This process reduced the sample to be further analyzed to a minimum. The end result of this analytical approach resulted in the categorization of a series of primary divisions of prepared blades, cores, and other worked artifacts following Crabtree (1972), Bordes (1967), and Movius, David, Bricker and Clay (1968).

In the initial analysis in 1976, metric analysis of the Cerrillo blade cores was done and four basic divisions were established.

The cores were divided into unidirectional cores, that is, those with one platform showing blade scars complete with negative bulbs of percussion as well as blade scars without visible bulb of percussion scars (i.e. the bulb scars were obliterated by subsequent removal of blades). It was understood at this point that there may have been a second platform during the stages of core reduction; however, this previous platform could have been obliterated through the subsequent removal of blades. This was indicated by the presence within the assemblage of what may

be loosely termed a "core tablet", that is to say truncated bases of cores removed to form a new platform. Sometimes the truncation of the core obliterated the previous platform. The second division was that of cores which contained more than one striking platform from which blades were removed. These cores were termed bi-directional cores or multi-directional (cf. Crabtree 1972) as the platforms within this division were opposing one another. A third class consisted of cores in which the bulb scars were totally absent, and a fourth division of cores with all the blade scars exhibiting negative bulb scars.

Out of a total sample of 25 cores, 15 fell within the first division (i.e. unidirectional) and six within the second (i.e. bi-directional), two into the third division and two were attributable to category four.

Of the unidirectional cores, nine were clearly identifiable. That is, the reduction of the core was through the removal of blades by direct percussion off of a primary striking platform. The remaining unidirectional blade cores exhibited a second platform off of which "flakes" rather than blades were removed. The removal of flakes rather than blade production from this second platform was often a consequence of low grade material rather than intentional flake removal. In some cases, the knapper appeared to have been shifting the core in an

effort to avoid internal imperfections in the core. Other examples appear to represent attempts to rejuvenate a core by rotating it on its side and using the previous blade scar face as a new platform to remove new blades at 90 degree angles to the former blades.

Prepared blades were further divided in a subsequent step on the basis of cross-section profiles. The blade profiles were divided into triangular, rectangular and trapezoidal groups.

This gross classification of the artifacts for Cerrillo was used as the basis for establishing the diagnostic traits of the site (Pantel 1976a). Photographs of the final groupings of the classified material were produced at the Smithsonian Institution and these constituted the sample used for the Puerto Rican materials in the present paradigmatic classification.

Lithic materials from precolumbian sites were also examined from the collections of the University of Puerto Rico Museum and the "Centro de Investigaciones Arqueológicas de la Universidad de Puerto Rico", both located in San Juan. Isolated groupings of artifacts were examined from numerous private collections on the island; however, the amount of flaked stone was minimal. Lithics were examined for production techniques, gross evidence of usage or wear, raw material type, and other diagnostic elements. Pieces of exceptional diagnostic or illustrative

importance, or having well documented provenience information, were photographed.

Dominican Republic (Eastern Hispaniola)

The sites of Barrera[4], Mordan, Casimira, and Las Alejandrinas, which are located in the south-central part of the Dominican Republic, were surveyed and excavated by the author in 1975 (see Figure 4-2).

All of the sites were located within a small modern village of two to three hundred inhabitants and as a consequence, much of the site had been disturbed by contemporary living activities. Surface evidence of the archaeological deposit was located among the waddle-and-daub residences (see Figures 4-3 and 4-4). The entire area had been subjected to repeated erosion due to the deforestation and defoliation of the area by contemporary subsistence practices. The site of Casimira was located a few meters uphill from the archaeological site of Barrera Mordan and its surface was marked by evidence of heavy erosion. The site of Barrera Mordan also showed evidence of erosion in addition to having had been partially

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[4]Also referred to as Barreras in the literature. The sites of Barrera and Mordan actually belong to a single site location. The two names evolved as a result of the names given to the upper and lower sections of the modern village, hence the author opted to utilize the name Barrera Mordan for the archeological deposit (Pantel 1976b, 1977b).

destroyed by the recent grading of an earthen roadway leading into the village from the east.

Figure 4-2. Map of the Dominican Republic showing the location of Barrera Mordan and Casimira.

Figure 4-3. Photograph taken from the area of Casimira, looking down on the site of Barrera Mordan (center of photo). Note the break in the mountain horizon with the sea visible a few kilometers to the south.

Figure 4-4. The site of Barrera Mordan. Note erosional conditions of the terrain and sparse vegetative cover.

Excavations at the sites of Barrera Mordan and Casimira were designed to locate areas of undisturbed archaeological deposits. Part of the research focus was directed at obtaining stratigraphic information on the development of the site and any possible patterns in the artifactual assemblages associated with the area (i.e. the Casimira to Barrera Mordan sequence). The second goal of the excavations was to obtain a sufficient sample of flaked stone material from the sites for the purposes of developing a more complete classification of the assemblage. In the case of Casimira, obtaining a controlled field sample was considered critical since there was extremely limited empirical data regarding the site's cultural and chronological association compared with that of Barrera Mordan.

One month was spent in the field surveying the area and excavating a series of four one-meter wide trenches within the site of Barrera Mordan and a series of two by two meter units in the site of Casimira. The excavation strategy consisted of establishing test trenches in those areas of the surface survey which contained archaeological material. Since a systematic transect surface survey was not possible within the village, the location of the units was chosen as much on accessibility as on projected site parameters. Another consideration in the placement of excavation units was the attempt to avoid areas previously

excavated by Velóz and Ortega and those of Cruxent, Ortega and Chanlatte. This was easily accomplished since both Velóz and Ortega were able, in the field, to define all previous excavation areas and the locations of previously documented concentrations.

Excavations in both sites were done with the assistance of the local residents of Barrera Mordan who worked at the excavation and the processing of the material. The trenches and test units were excavated in 25 cm arbitrary levels. General field methods, screening, recording and bagging procedures were the same as those used at the Cerrillo site in Puerto Rico.

All lithic samples from the excavations, and a limited sample of the shell remains recovered from the sites were collected, field processed and transported to the "Museo del Hombre Dominicano" (the national museum) in Santo Domingo for analysis.

As in the case of Puerto Rico, the analysis and classification of the flaked stone material from the tested Azua area sites, were based primarily on the definitions of Crabtree, Bordes and others. On the basis of their categories, a series of diagnostic artifacts was selected from the site (Pantel 1976c, 1977b). Photographs were made of these pieces by the "Museo del Hombre Dominicano" where the collection was deposited under their curation. It was

this final group of artifacts which were used for the Dominican sample in the present classificatory scheme.

In the Dominican Republic most of the material examined in collections came from material stored at the "Museo del Hombre Dominicano" and the Manuel García Arévalo Museum, both located in Santo Domingo.

Haiti (Western Hispaniola)

Archaeological investigations in Haiti were limited to a reconnaissance survey of previously reported sites in the Bay of Port-au-Prince. The sites, primarily in the littoral areas along the bay, were visited for the purposes of identifying those that could have been related to the Cabaret sites reported earlier in this century. Since most of the sites investigated by Krieger were not mapped in publications, nor in his field notes, it was hoped that contemporary sites in the area would correspond in material remains to those reported by him (Krieger 1929, 1932, 1933) and other investigators (see Figure 4-5). A total of seven sites was visited by the author in the bay area[5].

Lithic scatters were located at several points along the length of the northern arc of the Bay of Port-au-Prince. Limited surface samples were collected from the

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[5] These sites were: HHt7-1 Grande Saline (precolumbian); HHt7-2 Do Boas (Lithic, mixed precolumbian and colonial); HHt7-3 Mon Gateaux (Colonial mixed with precolumbian); HHt7-4 Yeyette (Colonial); HHt7-5 Simonette (Lithic); HHt7-6 Mon Bateau (Mixed precolumbian and colonial); HHt7-7 Petit Place du Cabaret (Lithic).

sites and, in the few cases where excavation was possible, the work showed that deposits were clearly limited to surface scatters which had been, for the most part, heavily eroded.

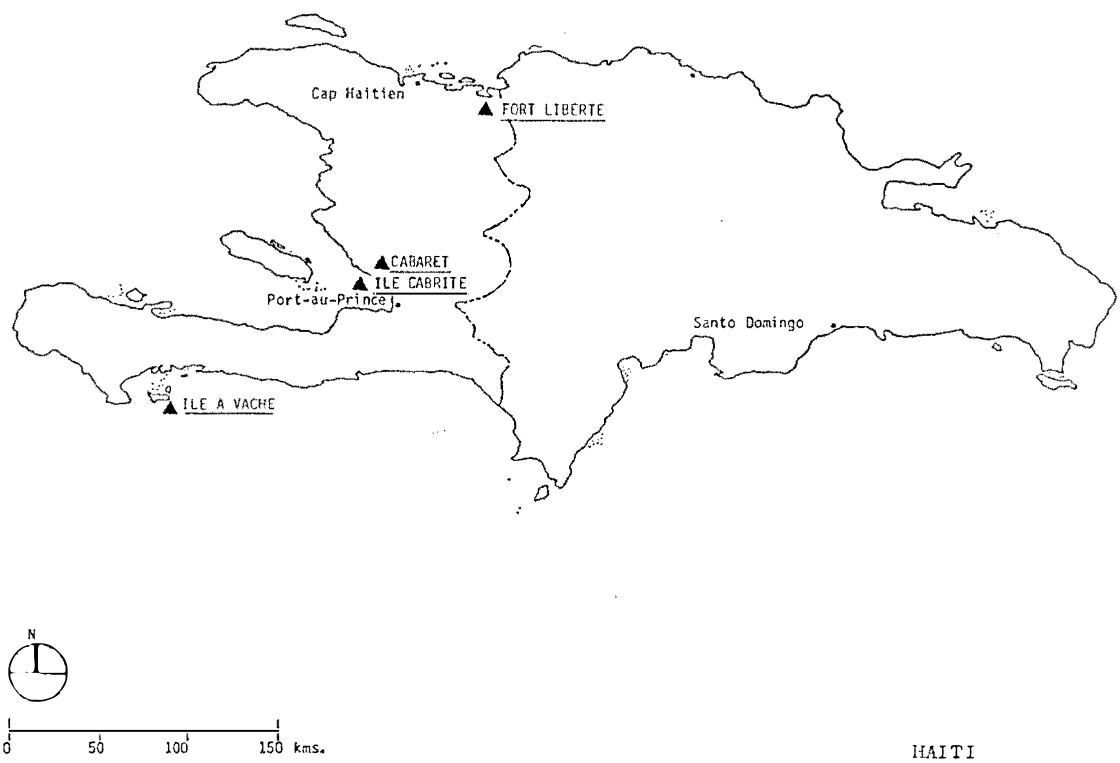

Figure 4-5. Map of Haiti showing principal precolumbian lithic sites.

One site worth particular mention was the site of Simonette (HHt7-5), located on a small knoll overlooking the beach-side of Duvalierville and Ile a Cabrite. This site exhibited prepared blades, cores and core preparation flakes from the production process. It is highly likely that this area (including "Duvalierville") was the location of the original lithic sites of Cabaret described by Jacques Roumain (1943).

The location and examination of these sites was considered important in that they were originally reported (Roumain 1943) as an area of Ciboney camp sites. The possibility existed that this particular zone could have served as a primary materials source for much of the preceramic assemblages of Haiti and it was hoped that raw material sources could be located close to the known sites. Unlike Cerrillo and the sites in the area of Azua, however, these Haitian sites did not have abundant primary source materials within the immediate parameters of the worked materials. Nevertheless, the area described by Roumain (cf. Chapter 3) was most likely located along a presently inaccessible high ridgeline visible a few kilometers to the east.

All of the samples collected from the survey work were field treated for curation purposes and left in Haiti.

According to previously collected data from Haiti, through the work of Krieger, Rainey and Rouse (see

Bibliography), this was one of the more intensely studied islands in terms of precolumbian flaked stone. As such, the number of available lithic collections was more abundant than in the case of other Greater Antillean islands such as Jamaica or Cuba.

The largest part of my lithic sample for Haiti was the Krieger collections at the Smithsonian Institution. These were excavated and/or collected by Herbert W. Krieger in the early part of the 1930s when the United States National Museum led a series of investigations in the Caribbean. As part of the Smithsonian Institution Exploration and Field Work Programs of this period, Krieger recovered material from nine sites in Western Hispaniola (Haiti). Between 1928 and 1937, he published various reports on his investigations in the Antilles; however, the articles did not include descriptions of the sites or any of the specimens (Krieger 1929, 1932).

Five regions in Haiti were covered in the Krieger samples - the North, the Central Plateau, the Port-au-Prince Bay area, the West and the Southwest.

In the North, the site of Terrier Rouge, located 15 kilometers southwest of the Ft. Liberté, and two sites reported as "east of Cap Haitian", were present in the Krieger samples. In the Central Plateau, material was collected by Krieger at the entrance to a cave located near "Hinche", about 38 kilometers due west of the Dominican

border. The Port-au-Prince Bay area was represented by material from Ile a Cabrite, and two sites which were only given a general provenience in the storage bins as being surface material along a highway 20 and 26 kilometers from Port-au-Prince. In the West, material from a site named "Voute L'Eglise" near Trouvin was included. The southwestern region is represented by a sample from Ile à Vache.

The absence of data on site locations, specimen provenience and site stratigraphy for the Krieger samples made initial analysis of the material limited in scope. Of the samples, those from Ile a Cabrite and Ile à Vache were the most useful in terms of analysis.

In the original analysis, that is, prior to the development of the present classificatory scheme, the same procedures used in Puerto Rico and the Dominican Republic were carried out on these samples. Blades produced from prepared cores were divided into three basic divisions based on profiles of their cross-sections (triangular, trapezoidal or irregular). Four variables were measured on the triangular and trapezoidal blades: these included blade width, blade length, platform width and platform length (i.e. distance from dorsal face to ventral).

The Ile a Cabrite sample contained 16 prepared blades which were triangular in cross-section. The average blade width was 2.55 cm., the average blade length was 7.11 cm.,

the average platform width was 1.76 cm. and average platform length 0.83 cm. In the sample from Ile a Cabrite, there were also 12 prepared blades with trapezoidal cross-sections. The average blade width measured 3.76 cm., average blade length 9.62 cm., average platform width 1.84 cm. and average platform length, 0.82 cm.

These figures seemed to suggest that a distinctive core preparation for trapezoidal-shaped blade production could have consistently produced a wider and somewhat longer blade than core preparation for a triangular cross-sectioned blade. The close correlation of platform width and platform length, however, suggested that a similar percussor or striking pattern was used for the removal of triangular and trapezoidal blades.

A sample of 30 prepared blades from a surface collection within the Port-au-Prince Bay area contained 17 full blades with triangular cross-sections. The average blade width for this sample was 2.49 cm., average blade length of 6.83 cm., average platform width of 1.66 cm. and an average platform length of 0.73 cm.

Within the Ile à Vache sample, there were nine full blades with triangular cross-sections. Average blade width was 2.62 cm., an average blade length of 6.88 cm., an average platform width of 1.78 cm. and an average platform length of 0.85 cm.

Prepared blades, triangular in cross-section, within the Krieger samples from Western Hispaniola clustered around 7.0 cm. blade length, 2.5 cm. blade width, 0.8 cm. platform length, and 1.7 cm. platform width.

In the surface collection of the site identified as "20 kilometers from Port-au-Prince", one prepared trapezoidal blade showed the removal of a burin spall as defined in North America by Crabtree and others. The striking platform of the blade had been used as the platform for the spall removal[6]. In association with this piece, Krieger also recovered a number of prepared blades, backed blades, and decortication flakes, but no cores.

The Ile a Cabrite sample, as stated previously, contained three divisions of prepared blades, blade fragments of snapped blades, utilized blades and flakes as well as many of the by-products of the manufacturing process.

Two noteworthy tool types in the Ile a Cabrite sample were a dihedral burin as defined by the European lithic terminology of Bordes (1967) and others, and a number of well-defined end scrapers, notched scrapers and spokeshaves.

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[6] Although this was a singular example, the occurrence of burin cores and burin spalls was also documented for the sites of Casimira and Barrera-Mordan in the Dominican Republic.

The Ile à Vache sample contained the most distinctive artifact assemblage of the Krieger samples. There were apparently three different samples represented, as the museum lot numbers originally assigned to the Ile à Vache material were divided into three acquisitions. These three lots were noted in the acquisition cards as being "non-ceramic" whereas all other Krieger samples were noted as "prehistoric".

The first of the Ile à Vache lots contained two edge grinders, a "mano", two stone balls, and three hammerstones. The second lot contained two large flake blades, a large tanged flake blade and a tanged rectangular flake tool. All of the artifacts of this second lot were analogous to those flaked stone artifacts from the Ft. Liberté region rather than artifact types known for the southern and western portion of Haiti. The third lot of the Ile à Vache sample was composed of prepared blades, both triangular and trapezoidal in cross-section, backed blades, utilized blades, blade fragments, steep retouched scrapers, core fragments, decortication flakes, debitage and detritus.

Among this last "lot" of material, there was a group of artifacts and manufacturing by-products made from a black to blackish-grey cryptocrystalline isotropic material. The material was notably unlike the major portion of the Krieger samples which were of a

characteristic cream-colored homogeneous flint. This high-grade of black flint most probably came from an extremely limited local source or from a foreign source, as it was distinctively absent from the other assemblages analyzed from either western or eastern Hispaniola.

The collections of Yale Peabody were also utilized in the Haitian sample and included materials from Ile à Vache which had been collected by Clark Moore during this decade (Moore 1982). A total of seven aceramic site samples was examined: Cacoq II, Anse-a-l'Eau, Anse Milieu, Coq I, Coq IV, Madame Bernard, and Pradel. One ceramic site collection, Gros Morne, was also examined (Moore 1982). In addition to the Moore materials, the Couri site material presently in the Yale collection and originally excavated by Rouse was also examined. These materials, coupled with the samples excavated and collections studied in Haiti by the author, constituted the samples used in the present classificatory scheme.

Haitian material was also examined in two main collections in Haiti - the Fischer Collection of the West Indies located in La Boule on the outskirts of Port-au-Prince, and the Hodges Collection located in the northern town of Limbé. A selection of these collections was examined and photographed and constitutes part of the Haitian sample used in the present analysis.

Cuba

Access to primary artifactual material from Cuba was most difficult to obtain for the purposes of the present study.

The island of Cuba is the largest of the Greater Antilles, yet it is the one least referenced in the present archaeological literature of the West Indies. Given the proportional size of the island to the rest of the West Indies, surprisingly little empirical data are available on sites in Cuba[7].

The number of sources for lithic raw materials is most likely high, given the island's size and geological diversity (see Alvarez Conde 1957; 1961). In examining the Cuban collections at Yale, the diversification of lithic materials, both silicious and non-siliceous, was very similar to that found in the rest of the Greater Antillean assemblages studied.

Although the number of publications available on Cuban assemblages is relatively small, it should be noted that there are some noteworthy analyses of lithic sites in Cuba. Recent examples of the analysis of flaked stone assemblages which can be used for comparative purposes include the

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[7] This is so, despite the active participation of the Cubans in pursuing field work in archaeological sites. Nevertheless, the amount of published data disseminated through the rest of the Caribbean and their professional contributions to regional meetings have, unfortunately, been limited.

numerous publications of Kozlowski on the Levisa site and the lithic assemblages associated with the Seboruco series (Kozlowski 1973, 1974, 1975, 1980). A more recent author, Jose Febles, has also contributed to the body of Caribbean knowledge by analyzing a lithic assemblage from the area of Matanzas (Febles 1982).

The only source of primary material available for study by the author for the present analysis was the Peabody collection at Yale. The materials were those collected during Cornelius Osgood's work in Cayo Redondo (Osgood 1942) and Irving Rouse's work in the Maniabon Hills (Rouse 1942a) (see Figure 4-6). Rouse's collections from Pinar del Río, Hutía, Oriente, Vega del Palmar, Mala Noche, Potrero del Mango, Banés, El Guayabo, and Baní were examined and measurements taken on the flaked stone materials associated with these sites even though they were primarily ceramic-bearing deposits.

Surprisingly, the material from Cayo Redondo was lacking in any type of flaked stone material characteristic of the rest of the assemblages studied. This was unexpected since the site has characteristically been typed as a preceramic site and Osgood compared "Flint Pattern Traits" between Cayo Redondo and Couri (Osgood 1942: 54-56). The collection was composed of large igneous and variegated volcanic rock which had been ground or abraded through use. No silicious materials were found in the

collection and there was very little flaking on the lithic materials found in the samples.

The collections from Maniabon Hills (the region around Banés) were nearly all from ceramic bearing sites which had flaked stone materials associated with the stratigraphic cuts made on each site. The materials were primarily of a highly silicious material and flaking ranged from lamellar flakes to specimens exhibiting bifacial discoidal cores. None of the samples analyzed from these collections were from preceramic or aceramic bearing sites.

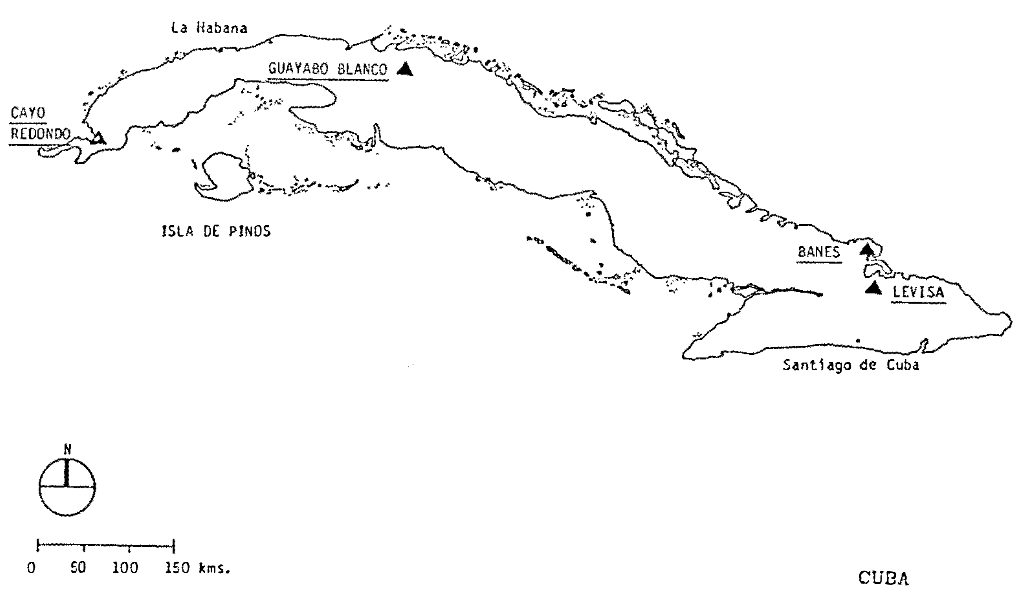

Figure 4-6. Map of Cuba showing major aceramic sites.

Jamaica

Archaeological collections for analysis of a Jamaican assemblage were as difficult to obtain as they were for Cuba, although for different reasons.

The quantity of data available on flaked stone materials from the island of Jamaica is small and very few published references exist for precolumbian flaked stone materials from Jamaican sites. It is not clear whether the basis for this paucity of information is due to a lack of intensive research in the island or to an extremely low existence of sites in Jamaica[8].

The earliest accounts of flaked silicious materials for Jamaica are to be found in the works of Duerden (1897: 7 and 36) and that of Sven Loven (1931). However, Loven's descriptions of flaked stone points from Jamaica are highly atypical of West Indian flaked stone assemblages and most likely represent artifacts brought into the island by a sailor from overseas.

The low incidence of precolumbian flaked stone sites cannot be attributed to the lack of resource materials for the island since it is clearly demonstrated in the geological descriptions of Roobol and Lee (1976) for

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[8]Cruxent and Chanlatte spent an entire month in Jamaica searching for lithic deposits after having completed work in the Azua area of the Dominican Republic. They were not able to locate any flaked stone sites in the island of Jamaica through their intensive efforts (personal communication Chanlatte 1987).

Jamaica (see Chapter 3). To date, the most extensive reporting of flaked stone materials for Jamaica has been by them; however, there are few photographs or illustrations published of these artifacts. Recent publications do show potential for reassessing the flaked stone assemblages of the island. Roobol and Lee describe the following materials for Jamaica:

> Flint scrapers - A fine set of about 20 elongate flakes or scrapers of flint was recently gathered... at... Bellevue (St. Andrew). A few others are present in the collections at the Institute of Jamaica. Many are mentioned by Duerden (1897). The Lee collection contains numerous flint specimens, chiefly from north coast sites in the Montego Bay area... but also from other major sites in Trelawny and St. Ann.... Secondary working flakes is [sic] extremely rare. [Roobol and Lee 1976: 309].

Only two sources were obtained for the study of Jamaican material; these were the Smithsonian Institution and the Peabody Museum at Yale University.

Jamaican material at the Smithsonian was limited to less than 20 specimens in the Krieger collections. Krieger collected material from three sites: Salt River, the Bogue Estate (Montego Bay), and Rose Hall Estate (St. James). This material was examined as part of the sample used in the present analysis.

The Yale material was collected and/or excavated by Rouse. The site of Claraden Hill #2 contained several rough-flaked silicious pieces; however, the material was associated with colonial historic material. The other site

in the Yale collections was that of Calabash Bay which had a few flaked pieces of chalcedony in association with middle period precolumbian ceramics.

United States Virgin Islands

No large samples of flaked lithic materials for the Virgin Islands exist which could be used for the present analysis. The amount of flaked stone materials from these islands is limited. Unlike the rest of the Greater Antilles, flaked stone artifacts for these islands are primarily found in fine grained basalt. The samples in the present study were part of extant collections from both the Smithsonian and Yale. The Smithsonian materials, from the Krieger collections, were from the sites of Magen's Bay (St. Thomas) and the Ackles site in St. Croix. Yale materials examined were from the Salt River site in St. Croix and Krum Bay in St. Thomas (see Figure 4-7).

Added Notes on the Smithsonian and Yale Collections

Research in the United States was carried out in two major repositories of West Indian precolumbian flaked stone materials. These were the Smithsonian Institution in Washington, D. C. and the Peabody Museum at Yale University in New Haven, Connecticut.

The Smithsonian Collection, housed in the Museum of Natural History, was composed primarily of the materials collected by Herbert W. Krieger in the early part of the

twentieth century under the authority of the Bureau of American Ethnology. The bulk of the flaked stone materials was from Haiti, with some material from the other islands of the Antilles.

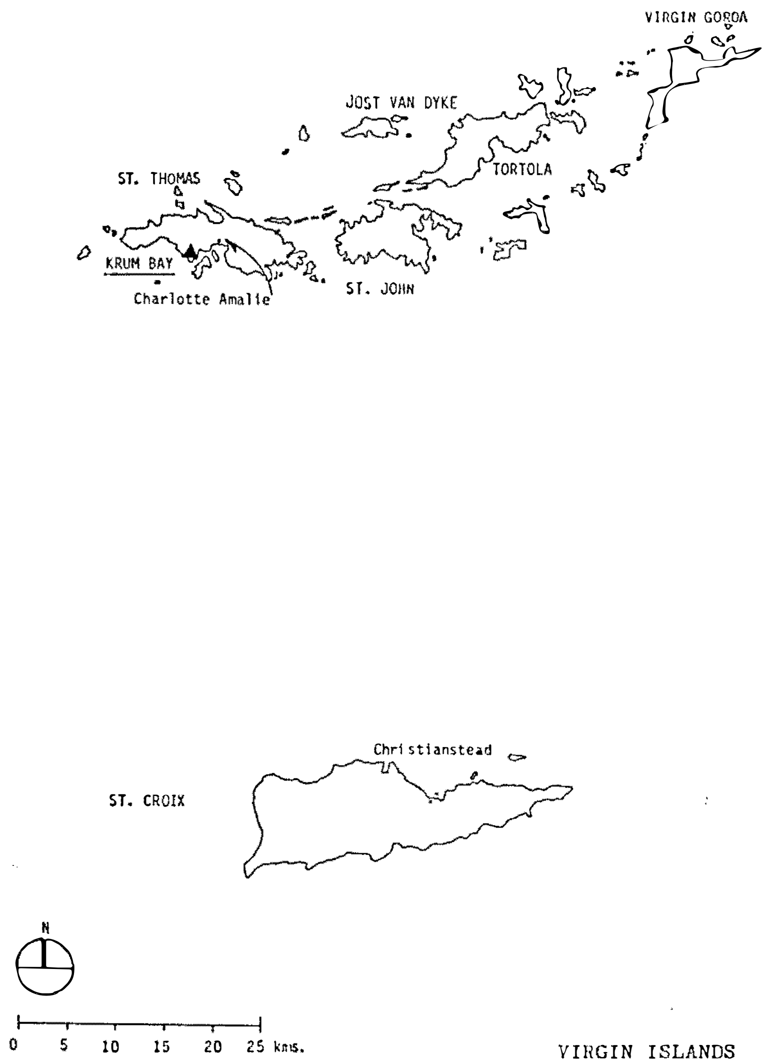

Figure 4-7. Map of U.S. Virgin Islands showing Krum Bay.

The Peabody collections at Yale housed most of the material excavated or collected by Cornelius Osgood and Irving Rouse since the early half of this century. The flaked stone collections at Yale Peabody covered many of the islands of the Antilles. However, the major collections were in materials from Haiti and Cuba.

In the case of the U.S. collections at the Smithsonian and Yale, the methodology for obtaining data initially consisted of examining the accession records for all the West Indies to determine which collections had (or were likely to have) flaked stone materials. Early collections (i.e. those from the first decades of this century) were more often the most difficult to cull. The accession records frequently listed collections only by lot numbers with little information on provenience of the materials collected. A second problem was often encountered wherein one or two sporadic flaked stone objects were interspersed with much larger samples of mixed assemblage material (primarily ceramics). Often the accession information listed lithics with no differentiation between flaked and ground stone (the latter being the most common in these collections). After making a preliminary records search, all of the materials physically housed in the West Indian collections were examined. In nearly all instances, it was necessary to cull large parts of the collections to locate those sites containing flaked stone materials.

Once the samples were located, the material was examined, general observations were made on the nature of the raw material, and the samples were sorted into general classes using the same criteria as in the Cerrillo and Azua analyses. Platform and overall measurements were taken on blades and cores, and the material was photographed.

The Smithsonian and Yale collections which were photographed constitute part of the sample in the present work. The islands represented in these samples are Cuba, Jamaica, Haiti, the Dominican Republic and the U.S. Virgin Islands.

Classification

Analytical Procedures During Original Data Recording

In the initial fieldwork and analysis of the assemblages, classification of the artifacts was based on measured artifact lengths, widths and platform dimensions of those specimens already grouped into broad classes utilizing continental typologies. General observations were recorded on the nature of the raw materials used for each artifact. Notes were made on any evidence of use damage which was discernable by simple ocular inspection of probable working edges[9].

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[9]Although the author was familiar with the techniques and applicability of the methods of analysis of edge-wear damage such as described by Odell (1975, 1980), Semenov (1970) and others (Crabtree and Davis 1968; Swanson 1975;

Once the material from each site or collection was separated into the general categories, the material was photographed (usually dorsal and ventral sides were taken of each artifact grouping). In the case of the Krieger material, and some of the Yale collections, the photographic documentation of the materials included all groups of materials including blanks, preforms, finished artifacts, debitage, detritus, and unclassified flaked materials.

Analytical Procedures for Present Work

The focus of the analytical scheme for the present work was based upon a technological understanding of the tool making process. The fundamental lithic process of reduction was used to analyze technology. Cultural definitions may be reflected in technological variation; however, to discriminate which factors are cultural it is necessary to identify and explain the reasons for each technological attribute. The present analytical scheme allows the examination of all possible technological factors so that those which are cultural can be ultimately differentiated from those which are not. Raw material is one example of a technological factor which can be shown to

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Wylie 1975), it was not a primary goal of the data recording for these particular studies.

be non-cultural using the classificatory scheme presented in this work.

The process of flaking stone can be viewed as a simple set of four aspects of lithic reduction; basically, a piece of raw material (1) is struck, resulting in a core (2) and a flake (3) with the residual material dropping off as waste (4). This process may be repeated innumerable times on any or all of the four divisions. At any point in time along the reduction process, any of the pieces (the core, flake and/or piece of debitage) can be utilized, discarded, or reworked through the initial process of flaking.

The flaking of stone invariably leaves scars and other visible evidence of actions carried out by the manufacturer. These bits of evidence can be documented to show the types of actions carried out on an individual artifact and in most cases even the steps in which they were effected. The analysis of this process and where along the reduction sequence an artifact falls can ultimately be accomplished with the analytical system set up in this present work. The types of combinations in technological steps, in which a piece of raw material can be worked, may also be analyzed through the present scheme. A codification of this evidence would produce quantified data which would potentially allow one to demonstrate the technological variants in any given artifact or group of artifacts. The combinations of technological "steps" taken

in the manufacture of an artifact (or group of artifacts) may be determined by numerous cultural as well as inherent technological factors. Factors such as the end function of an artifact, or the limitations of the material or worker are some of the considerations. These paradigmatic models may begin to show where technological variations occur in a given assemblage and provide new research issues fundamental to defining why any given set of variations exist.

Previous systems of lithic analysis in the Caribbean did not consider variation of artifact types based on the quality of the raw resources. Artifact size, such as the case of the Hispaniolan materials, was considered one of the cultural indices. The cultural affiliation attributed to artifact forms for West Indian assemblages needs to be assessed in reference to the raw materials available to the groups as a potentially deterministic element in flaked stone tool production. Under the present classificatory system, size is not a technological factor. As seen in Chapter 3, for example, the quality and quantity of lithic source material for Hispaniola (cf. Bowin 1960) is far different from that of Puerto Rico (cf. Mattson 1960). What effect this had on the resultant lithic assemblages may be evident in the production techniques of similar tool types using different quality raw material. This final point will be developed further on in the final chapters.

The present analysis begins to develop a paradigmatic classificatory system using a combination of dimensions and modes (cf. Campbell 1981). Here the term "dimensions" refers to major axes of variation in flaked stone assemblages while the modes represent specific individual variants which may be present.

This combination of modes and dimensions allows analysis of the individual technological characteristics of each artifact. It does not provide predetermined classes into which an artifact would be grouped, but rather examines each individual aspect of the artifact. Unlike previous systems, these modes and dimensions treat each artifact as a set of production attributes. The interrelationship of these is what defines similarity or variability in production techniques. That is to say, a unifacial lamellar direct percussion blank made on a high quality flint would technologically have a similar set of interrelated attributes to a unifacial lamellar direct percussion blank made on a low grade chalcedony, even though one may visually appear "more sophisticated" an artifact than the other.

An artifact having the same number and/or types of technological attributes will codify equally, irrespective of raw material. The correlation of purely technological manufacturing techniques can be done independently of raw material under the present schema. Likewise, it may be

possible to isolate correlations of specific technological traits to a specific raw material type if it exists. These types of combinations of paradigmatic correlations would allow us to examine lithic assemblages for any geographic and/or chronological combination. They will also allow us to examine assemblages irrespective of possible geographic and/or chronological admixture. This analytical approach permits analysis of artifacts on an inter-island and intra-island basis as well as that of inter-site or intra-site complexes. In all cases, the analytical data will be the result of technological correlations.

It should be clarified that since lithic reduction is of interest in this classification, chronological implications are not definable through this method alone. Since an artifact may be picked up and reused at any point in time and remodified, that sequence will be defined only as a specific and synchronic set of technological attributes.

The original research data collected for the present study was highly variegated in that it consisted of archaeological materials collected over a long period of time (approximately six decades), by different researchers using different procurement methodologies. As such, the degree of comparability and the statistical soundness of these diverse collections were open to question.

The fact that much of the data originally studied was physically spread out over a large geographic area of the West Indies and North America limited the possibility of physically re-analyzing the actual specimens using technological dimensions and modes devised later. Since the majority of the collections had been photographed in black and white with views of the ventral and dorsal sides, the information for technological attributes was visible. Data collected from the photos were corroborated with the laboratory notes taken during the original recording and analysis of the artifacts.

Description of Dimensions and Modes

The paradigmatic model uses a total of 15 dimensions with a variable number of modes for each dimension. One dimension was created to deal with provenience. Two dimensions deal the identification of variations in the raw material based on field observations of the author. Two dimensions were created to measure clearly definable traits of the raw material. The remaining 10 dimensions dealt with aspects of flaked stone tool production more specifically. Of these final ten dimensions six measure technology (primary flaking), while the remaining four measure secondary flaking or retouch.

Although the number of modes for each dimension varied, two conventions were implemented in the coding system. In those dimensions where the absence or presence

of that dimension were possibilities, the number zero (0) was utilized to express absence or none. In every dimension the number nine (9) was utilized to denote the inability to measure (observe, or determine) the mode for the artifact.

Dimension 1 (DM1) identifies provenience for the classified material. The Greater Antilles are coded 1 through 5 in which the island of Hispaniola has two modes denoting the present geopolitical division. Modes 6 through 8 comprise the Virgin Islands and the Lesser Antilles.

Dimension 2 (DM2) has four modes which express a series of broad geologic classifications for the pieces analyzed. This dimension was created as a general "control" mechanism in that it represents the major divisions of lithic materials found in the West Indian flaked stone assemblages. The degree of geological knowledge for the region merited the use of gross divisions for this dimension utilized rather than a much more detailed series of lithic divisions such as recommended by Crabtree (1972), for example. It was felt that this broad categorization was sufficient to differentiate the principal divisions in the assemblages through rapid observation using as few a set of definition parameters as needed.

Mode 1 (DM2.1), Hispaniola Flint was a mode used to classify the predominant lithic resource found in the sites of both Haiti and the Dominican Republic. DM2.1 was assigned to those artifacts in which the raw material was highly silicious, isotropic, fairly homogeneous, high to medium translucency, containing few inclusions, a hard, thin cortex, and varied in color from grayish black to a light cream color (see Figure 4-8).

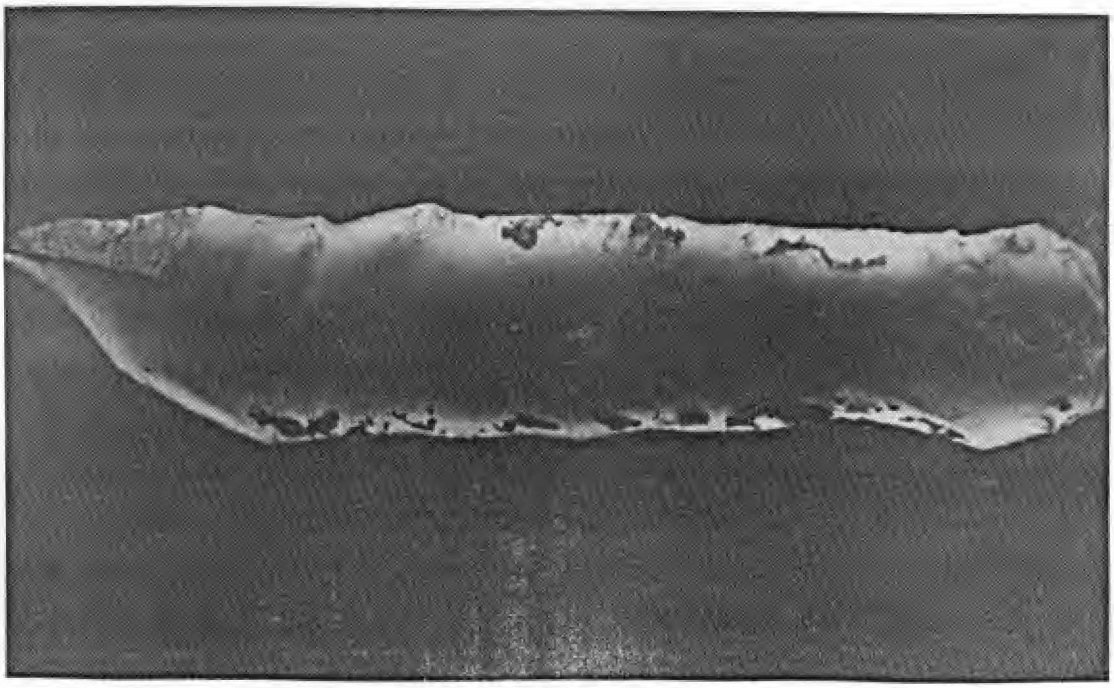

Figure 4-8. An example of Hispaniola Flint showing homogeneous qualities, fine grain and translucency (dark spaces along edges are encrusted earth). (Barrera Mordan site, Dominican Republic. Museo del Hombre Dominicano.)

Mode 2 (DM2.2), Barrera Mordan Chert was the predominant raw material used in the sites of Barrera Mordan[10]. The value of DM2.2 was assigned to those artifacts whose raw material was that of a medium-low to medium-high grade of chert, containing a low to medium degree of inclusions, medium translucency to opaque, a relatively thin, yet chalky cortex, and primarily light to dark-cream color (see Figure 4-9).

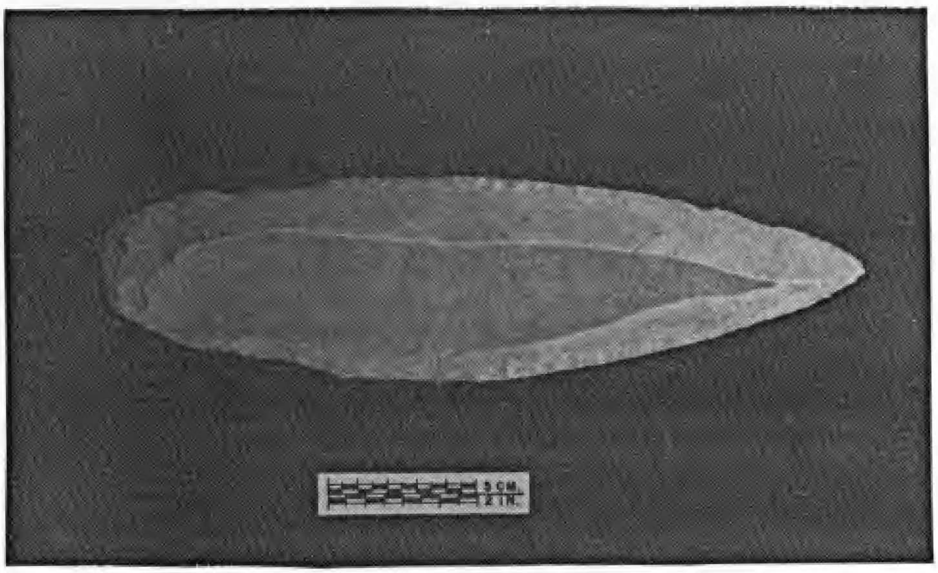

Figure 4-9. An example of Barrera Mordan Chert. (Barrera Mordan Site, Dominican Republic. Museo del Hombre Dominicano.)

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[10] Although the name reflects the site of Barrera-Mordan this reflects the bias of the author for the site since this type of raw material is predominant in many of the Dominican assemblages and may have carried the name of Dominican Chert. It is also important to note here (and it will be seen further on in the analysis) that both Hispaniola Flint and Barrera Mordan Chert were present in the site of Barrera-Mordan.

Mode 3 (DM2.3), Cerrillo Chalcedony, is representative of a great part of the Puerto Rican flaked stone material found in the site of Cerrillo. The material classified under this mode had the characteristics of being a low grade chalcedony, possessing a relatively thick, chalky cortex, a medium-high to high degree of inclusions, normally opaque material, and ranging in colors from a reddish brown to creamy brown color with veining and commonly an irregular cryptocrystalline structure (see Figure 4-10).

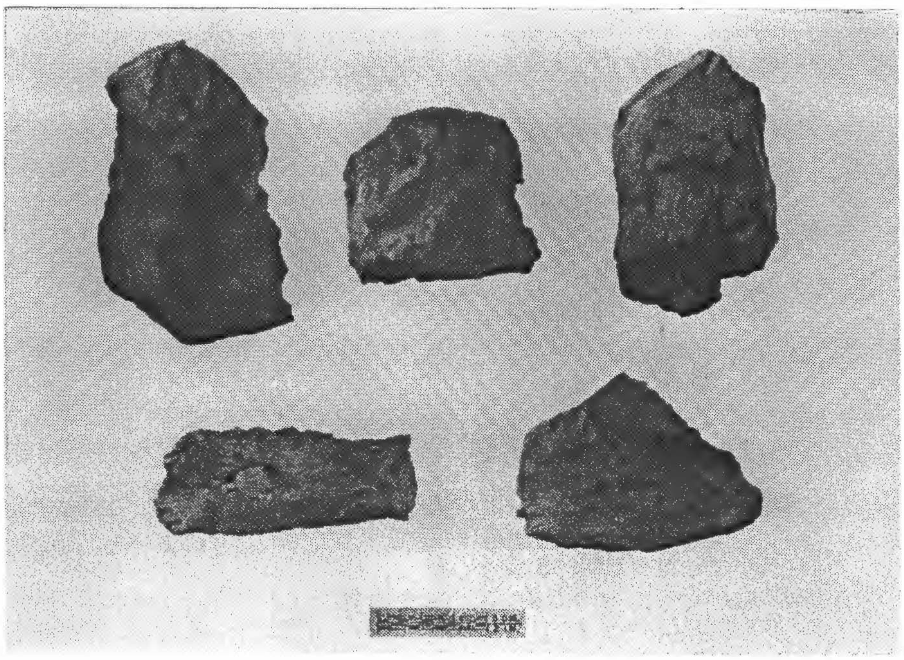

Figure 4-10. Examples of Cerrillo Chalcedony. (Cerrillo site, Puerto Rico. Fundación Arqueológica, Antropológica e Histórica de Puerto Rico.)

Mode 4 (DM2.4), Virgin Islands Basalt, was utilized to classify raw material common to the Virgin Island assemblages. It is characterized as a highly isotropic, fine grained basalt. The color range for this material is from a dark grey to a dark greenish-gray (see Figure 4-11).

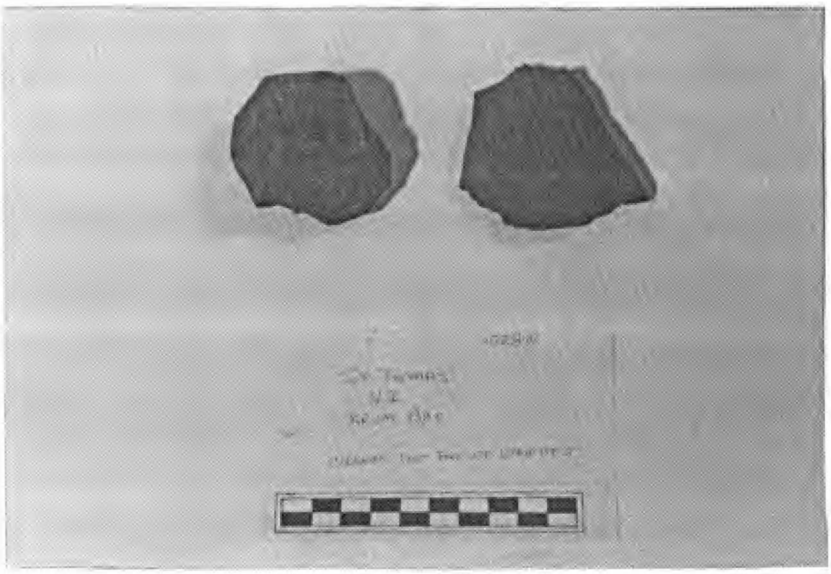

Figure 4-11. Examples of Virgin Islands Basalt. (Krum Bay site, St. Thomas. Yale Peabody.)

<u>Dimension</u> 3 (DM3) recorded the <u>size potential</u> of the raw material from which the artifact was produced. This was a highly intuitive classificatory dimension. It did not necessarily measure the potential size of the raw material on the basis of the actual size of the finished artifact, but rather on the field observations of the

author for quarry sources of the various sites and flaked material. From first hand field knowledge, the size potential of the various geologic types for the islands of Hispaniola, Puerto Rico and the Virgin Islands was known by the author. The higher grade material was observed as generally occurring in larger nodules than the poorer grades of stone.

Modes 1 and 2 classified the artifact as having potentially come from a small nodule or cobble (DM3.1) measuring less than 20 cm in size, while a classification for larger nodules or boulders (DM3.2) was assigned to those artifacts having the potential of having been formed from a larger raw stone. The third mode (DM3.3) was added to allow for the occurrence of artifacts produced from bedded lithic deposits rather than the more common nodular form for precolumbian West Indian flaked stone sources.

Dimension 4 (DM4) was developed to measure less subjective variants in the raw material - that of degree of inclusions in the artifact itself. Within this dimension only four modes were developed (see Figures 4-12, 4-13, 4-14 and 4-15). The zero mode (DM4.0) was created since there was the possibility of artifacts being made of a highly homogeneous raw stone which had no visible inclusions. Mode 1 (DM4.1) was used to identify those artifacts having a less than 10 percent degree of inclusions in the piece itself. Mode 2 (DM4.2) provided a

middle ground classification for inclusions which constituted 10-50% of the artifact. Mode 3 (DM4.3) was assigned to those artifacts which were heavily included to the degree in excess of 50%.

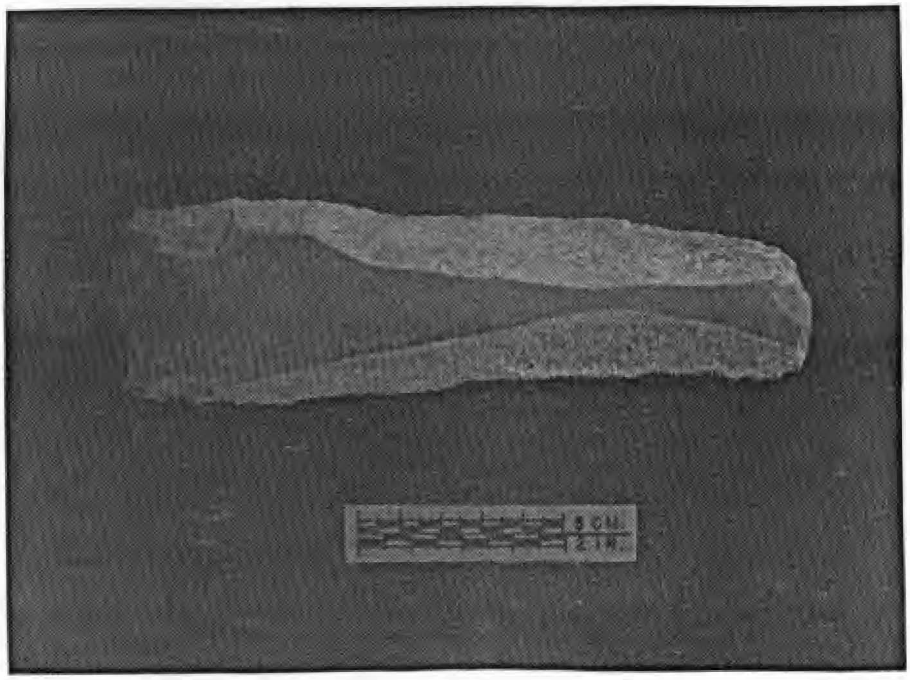

Figure 4-12. An example of no inclusions in the raw material (DM4.0). (Ft. Liberté, Haiti. Fischer Collection of the West Indies.)

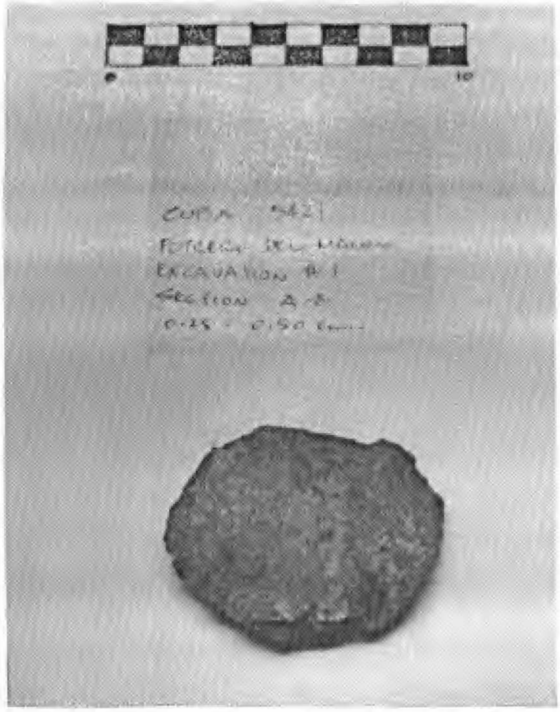

Figure 4-13. An example of less than 10% inclusion in the raw material (DM4.1). (Potrero de Mango, Cuba. Yale Peabody.)

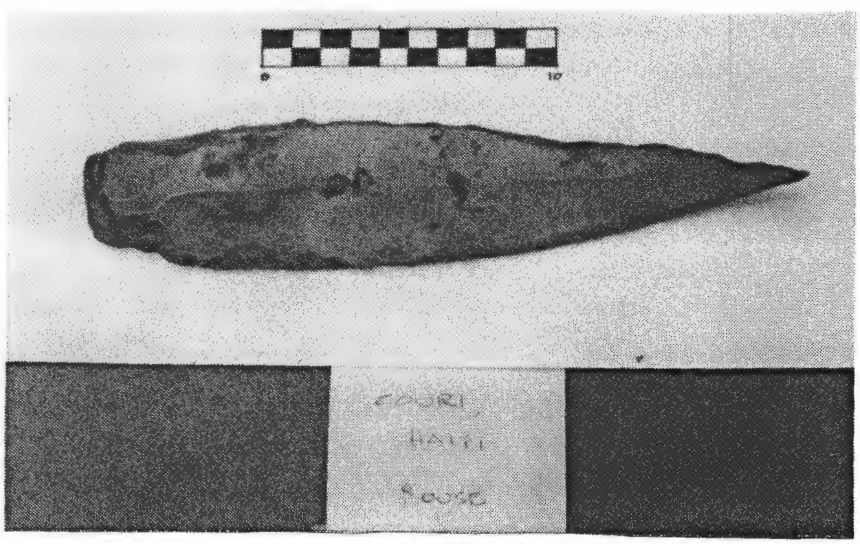

Figure 4-14. An example of material with 10-50% inclusions (DM4.2). (Couri site, Haiti. Yale Peabody.)

Figure 4-15. Two examples of material with greater than 50% inclusions (DM4.3). (Cerrillo site, Puerto Rico. Fundación Arqueológica, Antropológica e Histórica de Puerto Rico.)

Dimension 5 (DM5), as in the case of DM4, was used to provide an easily measurable and relatively non-subjective set of classifications to the raw material based on the texture of the grain of the stone (see Figures 4-16, 4-17, and 4-18). Three broad modes were used for this dimension. The modes were fine (DM5.1), medium (DM5.2) and coarse (DM5.3).

Figure 4-16. An example of fine grained material (DM5.1). (Barrera Mordan site, Dominican Republic. Museo del Hombre Dominicano.)

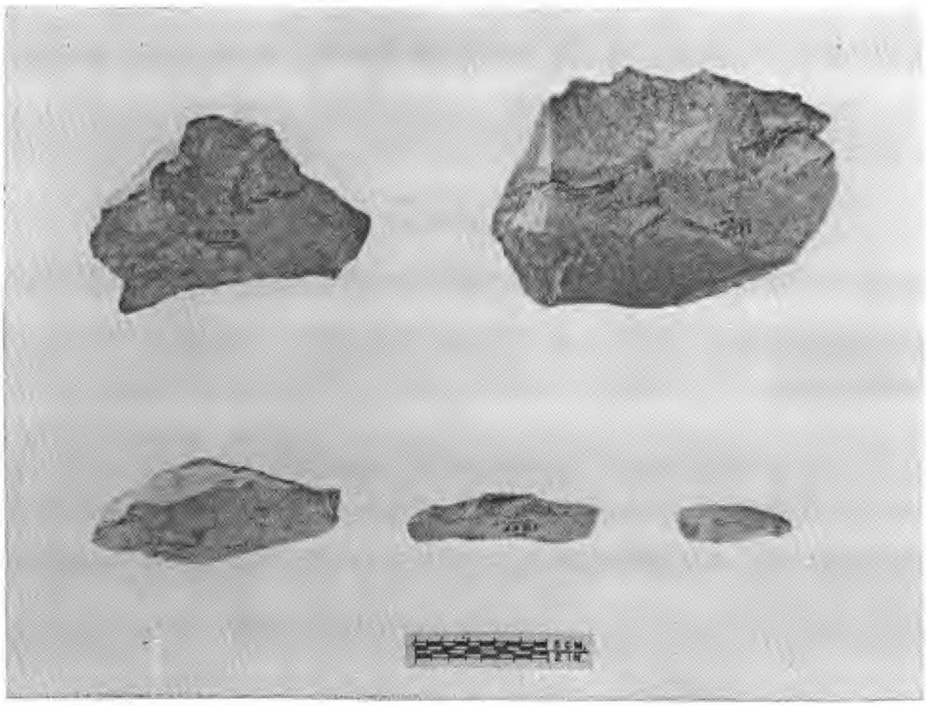

Figure 4-17. Examples of medium grained material (DM5.2). (Cerrillo site, Puerto Rico. Fundación Arqueológica, Antropológica e Histórica de Puerto Rico.)

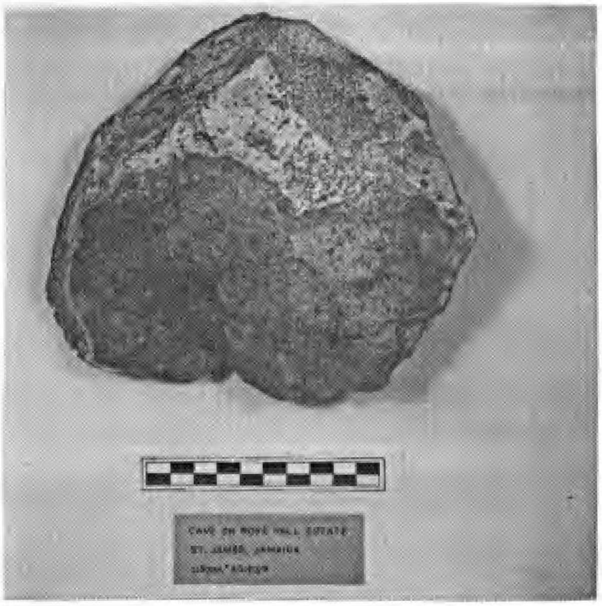

Figure 4-18. An example of coarse grained material (DM5.3). (Rose Hall Estate, Jamaica. Smithsonian Institution.)

Dimension 6 (DM6) begins the set of dimensions which constitute observable characteristics of the flaking process. This dimension (DM6) was developed to measure the degree of cortex present on the artifact being analyzed. A finer set of divisions than those used for the degree of inclusions (DM4) was considered necessary. The degree of cortex present on the artifact most likely reflects its relative point along the reduction sequence. That is to say, those pieces having more cortex are most likely earlier in the reduction sequence than those having less to none.

Five basic modes were developed for this dimension. The zero mode (DM6.0) was used to record those artifacts

lacking any traces of cortex. The next four modes divided the analysis into less than 10% (DM6.1), 10-30% (DM6.2), 30-60% (DM6.3) and those artifacts possessing greater than 60% of the cortex present.

Dimension 7 (DM7) addresses the technological trait of measuring number and type of bulbs and/or scars of percussion visible on the artifact as a result of the primary flaking processes. A basic consideration along nearly the entire lithic reduction process, the type, number and combinations of bulbs is perhaps the most diagnostic element in determining the technological location of an artifact in the reduction process. This is especially true in the West Indian assemblages which are notable for the high incidence of unifacial direct percussion flaking.

In addition to the zero mode (DM7.0), six other modes were created to measure the presence, type and number of strikes to the piece from primary flaking.

Mode 1 (DM7.1) records the presence of a single positive bulb on the artifact, while mode 2 (DM7.2) records the presence of a single negative bulb scar present on the piece. These two modes are used to differentiate those artifacts which were simply removed from a larger mass (DM7.1) and those which had one flake removed from them by direct percussion (DM7.2).

Mode 3 (DM7.3) is assigned to artifacts possessing one positive and one negative bulb on the same piece. This would measure those pieces which had been removed from a larger mass which had a previous flake removed from the same area.

Mode 4 (DM7.4) measures those artifacts possessing a combination of multiple positive and negative bulbs on a single piece. The differentiation of the ratios possible under this category were not further subdivided into more modes since the occurrence of any combination would be sufficient from a technological standpoint.

Mode 5 (DM7.5) is used to identify artifacts which had two or more positive bulbs. The occurrence of this technological trait would reflect pieces removed (at some point in time along the process) from a larger lithic mass and reduced by flaking this reduced mass.

Mode 6 (DM7.6) records pieces which have two or more negative bulb scars.

Dimension 8 (DM8) is utilized to record the direction of the primary flake scars on an artifact. The zero mode (DM8.0) existed for this dimension with four other modes to record flake scar directions (i.e. dorsal crests) when present.

Mode 1 (DM8.1) identifies artifacts with parallel flake scars , mode 2 (DM8.2) perpendicular flake scars and mode 3 (DM8.3) for convergent flake scars.

Mode 4 (DM8.4) is assigned when multiple flake scar directions are observed on a single piece. It was not considered necessary to further break down the types of combinations into a separate set of modes.

Dimension 9 (DM9) measures the number of primary flake scars and contains the zero mode (DM9.0) and two further modes to record the presence of flake scars.

Mode 1 (DM9.1) indicates the presence of a single dorsal crest and mode 2 (DM9.2) the presence of two or more dorsal crests.

Dimension 10 (DM10) measures the number of primary platforms. In addition to the zero mode (DM10.0), single, double and multiple platforms are given separate modes.

Mode 1 (DM10.1) is assigned to artifacts exhibiting a single platform, mode 2 (DM10.2) to those with two platforms, and mode 3 (DM10.3) to those artifacts with three or more platforms.

Dimension 11 (DM11) is used to measure the dominant angle of the primary platform. As a matter of convention, multiple angles were not recorded individually and considered subordinate to the dominant angle. A zero mode (DM11.0) and four other modes were used to represent platform angles.

Mode 1 (DM11.1) records those pieces which had angles between 90 and 100 degrees (perpendicular).

Mode 2 (DM11.2) is used to indicate artifacts with angles which measured more than 60 degrees but less than 90 degrees (i.e. steep angles).

Mode 3 (DM11.3) measures platform angles which were more than 60 degrees but less than 60 degrees (acute angles).

Mode 4 (DM11.4) measures artifacts with platform angles which were less than 30 degrees.

Dimension 11 is the final one developed to measure primary flaking technology characteristics. From D11 onward the final four dimensions address the measurable characteristics of secondary flaking technology, or retouch.

Dimension 12 (DM12) measures the number of secondary flake scars present on the total surface of a single piece. The type of secondary flake was not measured in this dimension (i.e. whether the secondary flake was the product of original shaping of the piece or whether it was the result of retouching a damaged tool). All secondary flakes were treated as solely technological manifestations on a piece irrespective of function.

The absence of secondary flaking was recorded in the zero mode (DM12.0) and three modes measure the number of scars when present.

Mode 1 (DM12.1) records those artifacts which had between one and 10 flake scars, mode 2 (DM12.2) those

artifacts with 10 to 20 flake scars present, and mode 3 (DM12.3) pieces with over 20 secondary flake scars.

Dimension 13 (DM13) records the direction of secondary flake scars (i.e. dorsal crests) on artifacts. A zero mode (DM13.0) and four modes for scar directions when present paralleled the modes developed for primary flake scars (DM8).

Mode 1 (DM13.1) is used for identifying parallel scars, mode 2 (DM13.2) for perpendicular scars, mode 3 (DM13.3) for convergent scars and mode 4 (DM13.4) for those pieces exhibiting multiple directions of secondary flake scars.

Dimension 14 (DM14) measures the number of secondary platforms with the same number of modes and definitions which had been developed for the case of primary platforms (DM9).

The zero mode (DM14.0) is used to indicate the absence of secondary platforms. Mode 1 (DM14.1) records a single platform, mode 2 (DM14.2) two platforms, mode 3 (DM14.3) three or more platforms.

Dimension 15 (DM15) is the final dimension in the classificatory scheme, and, as in the case of primary flaking angles (DM11), it measures the dominant angle or angles of secondary platforms.

A zero mode (DM15.0) is present in this dimension along with the same four modes as in DM11. Mode 1 (DM15.1) records perpendicular angles, mode 2 (DM15.2) steep angles, mode 3 (DM15.2) acute angles, and mode 4 (DM15.4) those pieces with secondary platform angles less than 30 degrees.

The Coding of Artifacts

The coding system described above is presented below in the tabular format which was utilized in the analysis of the samples used for this study:

DIMENSION 1. Island of Origin

1. Cuba
2. Jamaica
3. Haiti
4. Dominican Republic
5. Puerto Rico
6. Virgin Islands
7. Leeward Islands
8. Windward Islands
9. not measurable

DIMENSION 2. Geologic Type

1. Hispaniola Flint
2. Barrera Mordan Chert
3. Cerrillo Chalcedony
4. Virgin Island Basalt
9. not measurable

DIMENSION 3. Size Potential of Raw Material

1. less than 20 centimeters [cobble]
2. greater than 20 centimeters [boulder]
3. bedded
9. not measurable

DIMENSION 4. Inclusions in the Material

0. none
1. less than 10%
2. 10% to 50%
3. greater than 50%
9. not measurable

DIMENSION 5. Grain

1. fine
2. medium
3. coarse
9. not measurable

DIMENSION 6. Cortex

0. absent
1. less than 10% present
2. 10% to 30% present
3. 30% to 60% present
4. greater than 60% present
9. not measurable

DIMENSION 7. Bulb of Percussion

0. absence of bulbs or scars
1. one positive bulb
2. one negative bulb scar
3. both positive and negative bulb scar present
4. multiple positive and negative bulb scars present
5. two or more positive bulbs
6. two or more negative bulb scars
9. not measurable

DIMENSION 8. Direction of Primary Flake Scars

0. no scars
1. parallel scars [dorsal crests]
2. perpendicular flake scars [dorsal crests]
3. convergent flake scars [dorsal crests]
4. multiple directions
9. not measurable

DIMENSION 9. Number of Primary Flake Scars

0. no dorsal crests
1. one dorsal crest
2. two or more dorsal crests
9. not measurable

DIMENSION 10. Number of Primary Platforms

0. none
1. one platform
2. two platforms
3. three or more platforms
9. not measurable

DIMENSION 11. Dominant Angle(s) of Primary Platform

0. none
1. 90° to 100° [perpendicular]
2. more than 60° but less than 90° [steep]
3. more than 30° but less than 60° [acute]
4. less than 30°
9. not measurable

DIMENSION 12. Number of Secondary Flake Scars

0. none
1. one to ten
2. ten to twenty
3. over twenty
9. not measurable

DIMENSION 13. Direction of Secondary Flake Scars

0. none
1. parallel scars [dorsal crests]
2. perpendicular flake scars [dorsal crests]
3. convergent flake scars [dorsal crests]
4. multiple directions
9. not measurable

DIMENSION 14. Number of Secondary Platforms

0. none
1. one platform
2. two platforms
3. three or more platforms
9. not measurable

DIMENSION 15. Dominant Angle(s) of Secondary Platform

0. none
1. 90° to 100° [perpendicular]
2. more than 60° but less than 90° [steep]
3. more than 30° but less than 60° [acute]
4. less than 30°
9. not measurable

CHAPTER 5

ANALYSES

Computer Coding

Once the samples had been coded with the applicable mode for each of the 15 dimensions, the data were entered into a standard ASCII format using the PC-Disk Operating System (DOS 2.1) (IBM 1983). A desktop computer unit was used for primary data entry. This consisted of entering a string of fifteen numbers for each artifact (see Appendix A) which codified a mode for each dimension in the analysis. These data were transferred into Statgraphics (STSC 1986), a statistical package, for manipulation of these variables. Once entered into the statistical program, frequency histograms were generated for each of the fifteen dimensions. These histograms (Appendix B) show the distribution for each dimension by island.

A second set of analyses was carried out on the data in which cross correlations were made for the formation of paradigmatic models. The cross-referencing of ten-string number codes required a capacity larger than capable on available desktop computer units. To create the paradigmatic data, the VAX mainframe computer at the University of Tennessee, Knoxville Campus was used. The Statistical Analysis System program (SAS 1986) was used to generate the data tables and paradigms.

The results of these sets of analyses are illustrated in a series of tables in this chapter which show correlations between modes and/or dimensions. It should be remembered that within the total 15 dimensions of the analytical scheme there are basically four groupings: Dimension 1 gives insular provenience; Dimensions 2 through 5 codify observable factors of raw material; Dimensions 6 through 11 measure primary technological flaking traits; and Dimensions 12 through 15 measure secondary flaking attributes.

General Considerations of the Modal Analysis

Analysis of the lithic samples from the Greater Antilles and Virgin Islands resulted in certain trends within the dimensions of the classification paradigm. So as not to be misleading in the interpretation of the results of the classification, it must be made clear from the beginning that these discussions relate to dominant trends within the collections analyzed.

The occurrence of certain traits such as the impressive secondary flaking for backing and tangs on some of the Hispaniola material cannot be overlooked in this discussion, but should not be over emphasized either (see Figures 5-1, 5-2, 5-3 and 5-4). The secondary working of these artifacts, however, does not appear as a statistically dominant trait within the sample using the present analytical scheme.

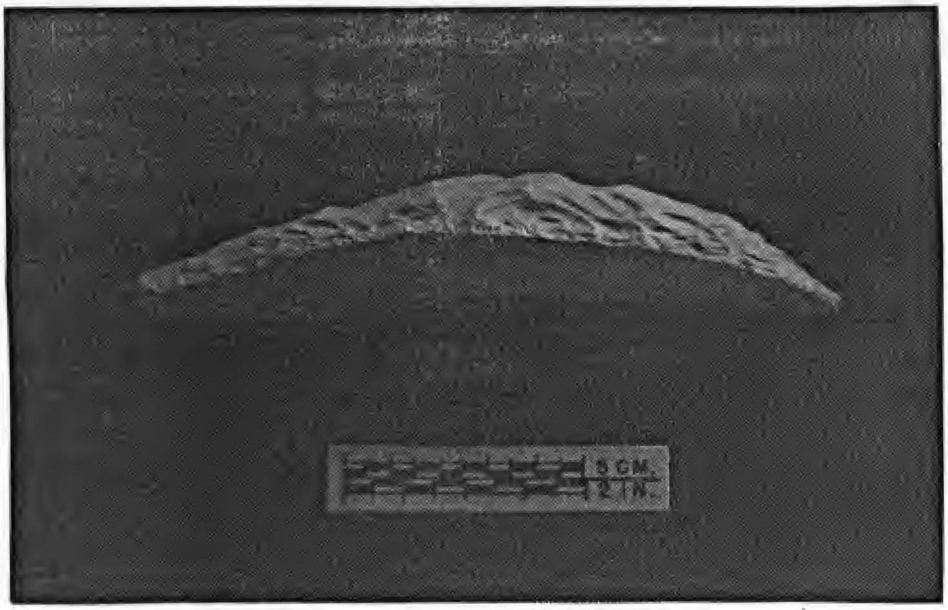

Figure 5-1. Secondary working on flaked stone material from Ft. Libertè region of Haiti (Fischer Collection of the West Indies).

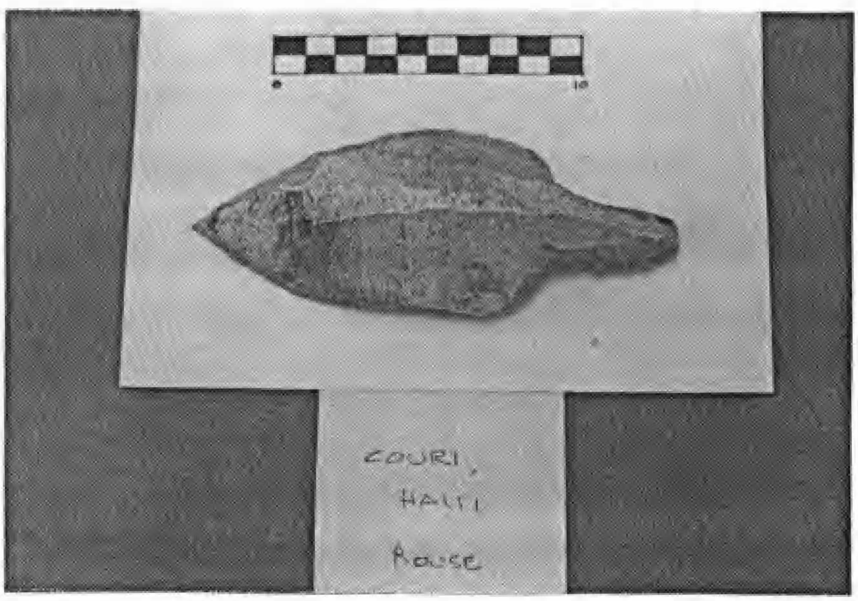

Figure 5-2. Secondary flaking in tang of artifact from Couri, Haiti (Yale Peabody).

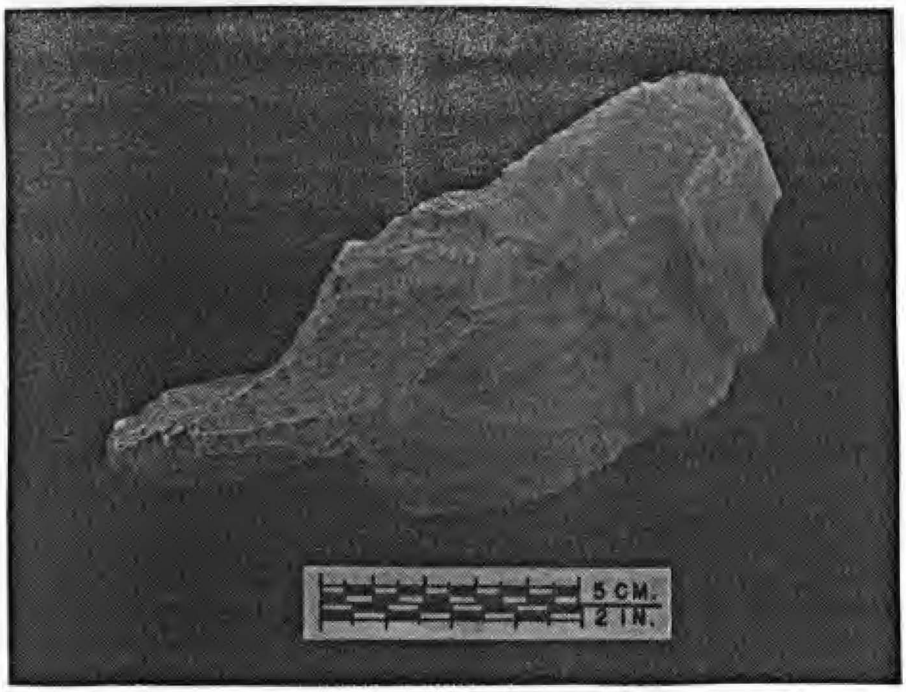

Figure 5-3. A example from the Ft. Libertè region of Haiti of secondary working for creating a tang (Fischer Collection of the West Indies).

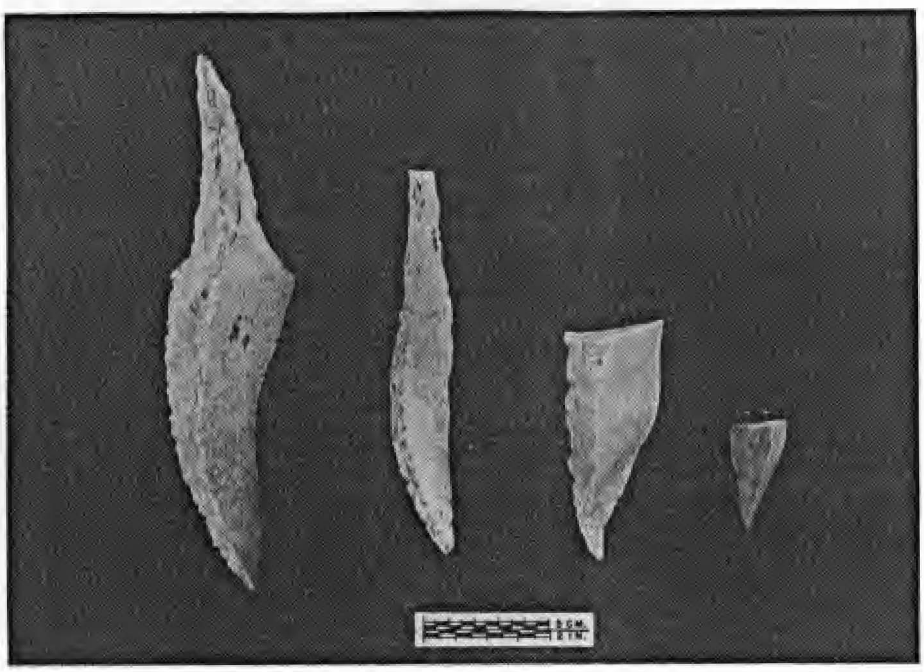

Figure 5-4. Examples of backing and tangs created by extensive secondary working from the site of Barrera Mordan (Museo del Hombre Dominicano).

Conclusions and observations have been made using the highest percentile figures resulting from the paradigmatic analysis of dimensions and modes. The total sample universe of 681 artifacts and coding for each are shown in Table A-1 (Appendix A). The primary data for the paradigmatic combinations are presented in Appendix D. The tables in Appendix D show the dimensions and modes, with the artifact count and relative percentages within the sample. Constants and variants in the dimensions are summarized at the bottom of each grouping.

The analytical data were synthesized into a series of illustrative figures which are presented in this chapter to show constant and variable modes in the paradigmatic models. Those modes remaining constant within the classes are illustrated in each figure by the numeric mode corresponding to that constant. Those cells of each figure which are empty represent variable modal values for the analysis.

The use of an asterisk next to a mode in the figures indicates that the data include a nine (9) mode (i.e. not measurable) and hence the degree of reliability, as to the constant nature of that particular mode, may be subject to future revision. Inversely, those modes which do not have an asterisk may be assumed to represent stable constants. The use of the number symbol (#) next to a mode indicates that the sample contained both the nine (9) mode and the

zero (0) mode. This occurrence of both the nine and zero mode is to be found in the figures containing dimensions 12-15 (retouch). Since the samples as a whole contained very high frequencies for the absence of secondary flaking, the nine and zero modes were factored out of the percentages to establish what modes were prevalent, if, and when, secondary flaking was present.

Site Analysis

The most useful of the samples for intersite analysis are the Haitian materials from the Smithsonian collections. The Krieger samples provide data on three sites from Ile a Vache (samples KR431060, KR431046 and KR431047) and from one site near Port-au-Prince (KR431068).

The data for Puerto Rico and the Dominican Republic both essentially consist of single sites. In the case of Puerto Rico the material is exclusively from the site of Cerrillo and in the Dominican Republic the material is from the site of Barrera Mordan.

KR431068. [Port-au-Prince area]

The highest frequencies characterize the raw material as fairly fine grained chert (DM2.2) cobbles with a low degree of inclusions.

Technologically the artifacts contain no cortex, a high variation in bulb scar combinations (multiple positive and negative being highest frequency, DM7.4), primarily

parallel or convergent dorsal crests (DM8.1 / DM8.3), one or more dorsal crests, and a single 90 degree striking platform.

Secondary flaking is virtually absent.

KR431060. [Ile à Vache]

The raw material is characterized as fine grained, low inclusion flint (DM2.1) from cobbles.

Technology exhibits a very high frequency of total cortex removal (DM6.0), multiple positive and negative bulb scars, both parallel and convergent dorsal crests, one or more dorsal crests, and a single 90 degree platform.

The existence of secondary flaking is negligible.

KR431046. [Ile à Vache]

The raw material from this site is both flint and chert (DM2.1 / DM2.2) from boulders and cobbles (DM3.1 / DM3.2). The primary material is fine grained and the degree of inclusions is less than 10% for nearly all the sample.

The artifacts are lacking cortex. Bulbs of percussion are either lacking or a single positive bulb (DM7.0 / DM7.1), but more often showing one or more multiple and negative bulbs in combination (DM7.3 / DM7.4). The dorsal crests are primarily convergent although half as many exhibit parallel dorsal crests. In the majority of the

cases there are two or more dorsal crests. A single 90 degree primary platform is the most common mode.

The use of secondary flaking is negligible.

KR431047. [Ile à Vache]

The raw material is primarily a fine grained flint (DM2.1) cobble with less than 10% inclusions.

Technologically, cortex is absent and there is either no bulb of percussion (DM7.0) or a single positive bulb (DM7.1). The direction of the primary flake scars is highly variable. The greatest frequencies occur in multiple directions (DM8.4) or parallel (DM8.1), though they may be convergent (DM8.3) or even absent (DM8.0). Two or more dorsal crests are most common on the artifacts, as is a single 90 degree primary platform.

Secondary flaking is not common although some unifacial retouch is evident (D12.1/D14.1).

The high incidence of an absence of bulbs or scars, coupled with an equally high incidence of single bulbs, may indicate sites where high quality raw material was being utilized for flakes and blade production. The great variation in flake scar directions also supports this supposition. The absence of cortex may indicate sampling bias or that the initial reduction of the raw material took place at a location not immediately within the site parameters.

Barrera Mordan. [Dominican Republic]

The raw material is predominantly a fine grained flint (DM2.1) from boulders and has variable degrees of inclusions (DM4.1 / DM4.2).

Technological traits include the lack of cortex, primarily multiple positive and negative bulb scars on the artifacts, two or more convergent dorsal crests, and a single 90 degree primary platform.

Secondary flaking is predominantly absent from the artifacts; however, when it is employed, there is a high degree of variation in number of flake scars (DM12.1 / DM12.3), direction of the scars (DM13.1 / DM13.3), number of platforms (DM14.1 / DM14.2) and the platform angle (DM15.1 / DM15.2).

Cerrillo. [Puerto Rico]

The raw material is predominantly a medium grained chalcedony (DM2.3) from cobbles with variable degrees of inclusions (10-50%)(DM4.1 / DM4.2).

The technological characteristics of the artifacts are a predominant lack of cortex, a high incidence of negative bulb scars (DM7.4 / DM7.6), a high frequency for two or more parallel primary flake scars, and a single 90 degree primary platform.

Although retouch is virtually absent, there is some incidence of unifacial secondary flaking.

Island Analysis

The analysis for Puerto Rico and the Dominican Republic are incorporated in the previous section. For the present section of analysis, Haiti and the Dominican Republic will be assessed as two distinct geographical units though the Dominican and Haitian material could be grouped into the single geographical division of Hispaniola. Specific analysis of the island of Hispaniola as a whole is incorporated into the comparative sections of this chapter. The samples for Cuba, Jamaica, Haiti, and the Virgin Islands are incorporated into this section. All the island comparisons are graphically represented in frequency histograms in Appendix B.

Cuba

The raw material, predominantly chert (DM2.2), varies substantially in degree of inclusions, size potential of the raw material, and grain.

Technologically, there is an absence of cortex, a relatively high absence of bulbs or bulb scars, two or more convergent dorsal crests, and a single 90 degree primary platform.

Absence of secondary working is statistically significant; however when present there are a minimal number of flake scars (DM12.1). These are convergent scars from two platforms with dominant angles of 30 to 60 degrees (DM15.3).

Jamaica

Raw material is both chert (DM2.2) and flint (DM2.1), although primarily chert. The predominant raw material size is from a cobble, inclusions are less than 10%, and the grain is either medium or fine.

Technologically there is an absence of cortex. Two or more negative bulbs of percussion (DM7.6), two or more dorsal crests and multiple directions of the primary flake scars (DM8.4) are highest in frequency. There are three or more primary platforms (DM10.3), and 90 degree platform angles are most common.

The lack of secondary flaking is predominant. When secondary flaking is present it is a minimum number of flake scars, the dorsal crests are in various directions, there are three or more platforms and the dominant angle is either steep (DM15.2) or acute (DM15.3).

Haiti

Flint (DM2.1) and chert (DM2.1) are exclusively predominant in the raw material with flint being the higher frequency. The predominant potential size is a cobble. Inclusions are less than 10% and the grain is primarily fine, yet there is also a fair amount of medium grain material.

Technologically the absence of cortex is very predominant. Bulb scars are rather variable with the highest frequency being the existence of multiple positive

and negative bulb scars on an artifact (DM7.4). There are most often two or more dorsal crests, and convergent dorsal crests are more common than parallel, though both are high in frequency. Single 90 degree primary platforms are most frequent.

The material is primarily lacking any secondary working. When employed it appears to be a few parallel flakes (DM12.1 / DM13.1) from one platform, with dominant either steep (DM15.2) or perpendicular (DM15.1) angles.

Virgin Islands

Raw material is predominantly basalt (DM2.4) from cobbles, fine (DM5.1) to medium (DM5.2) grained, and less than 10% inclusions.

Technology varies more than in other assemblages. Cortex is predominantly absent or 30 to 60 percent (DM6.0 / DM6.3). Primary flaking is shown in the occurrence of a single positive bulb or two or more negative bulb scars. There is either an absence of flake scars and crests or two or more dorsal crests in multiple directions (DM9.2 / DM8.4). Primary platform angles are predominantly 90 degrees, and the most frequent number of platforms is one, although three or more platforms are also present (DM10.3).

Secondary flaking is negligible. The small percentage of secondary flaking is unifacial, less than ten flakes, either convergent or in multiple directions (DM13.3 / DM13.4), with steep or less than 30 degree dominant angles.

Comparisons

The first half of the following analyses compares the islands on the basis of each of the fourteen dimensions (excluding dimension 1). The frequency histograms for these analyses are shown in Appendix C.

A second group of paradigmatic analyses compares the data sets which were created showing classes of artifacts (dimensions 6-15), technology (dimensions 6-11), and retouch (dimensions 12-15). Comparisons reflect the highest relative percentages for paradigmatic data sets. The conclusions reflect predominant patterns within each paradigmatic set (see Appendix D).

Dimension 2 (Geologic Type)

The occurrences of geological types in Haiti and the Dominican Republic are most similar, even though chert is nearly equal to the frequency for flint in Haiti.

Cuba has only chert and chalcedony. The absence of high grade flint is notable in this sample.

Jamaica has flint and chert, with a noted absence of chalcedony. The lack of chalcedony is noteworthy given the geological similarity of Puerto Rico and Jamaica.

Puerto Rico has flint, chert and chalcedony, although by far the highest frequency of material is chalcedony.

The Virgin Islands has a predominance of basalt, as anticipated in the geological record.

Dimension 3 (Size Potential of Raw Material)

Frequency distributions of potential size is most similar between Cuba, Haiti and Jamaica; boulders being more common than cobbles. The frequency of a primarily cobble-based raw material is most similar between Puerto Rico and the Virgin Islands. The Dominican Republic has the most atypical distribution in that it has an extremely high frequency of boulders (i.e. size potential of greater than 20 centimeters) and in that it is notably distinct from that of Haiti.

Dimension 4 (Inclusions in the Material)

Although the overall frequency distributions of inclusions is fairly equal in all the islands except Cuba, there are some notable aspects in the analysis.

The occurrence of no inclusions is fairly low throughout the islands (except Cuba). The frequency distribution between mode 1 and mode 2 varies notably between Haiti and the Dominican Republic. The frequency distribution between the Dominican Republic and Puerto Rico is more similar than that of the Dominican Republic with Haiti.

Dimension 5 (Grain)

The frequency profiles of Haiti, the Dominican Republic and the Virgin Islands most closely resemble each other; these are primarily fine grained raw materials.

Jamaica and Puerto Rico have similar frequency distributions between fine and medium grain material, with medium grained material the most prominent. Cuba also has medium grained material as the highest frequency although the frequency of coarse and fine material is distinct from that of the other islands. There is a relatively high percentage of coarse grained material in the present sample from Cuba.

Dimension 6 (Cortex)

The absence of cortex on artifacts has the highest frequency in all the islands, except the Virgin Islands. The frequency distribution for Haiti and the Dominican Republic are nearly identical and highly similar to that of Puerto Rico. The most atypical distributions of cortex present are found in Jamaica and the Virgin Islands.

Dimension 7 (Bulb of Percussion)

This is one of the most variable dimensions in the classificatory scheme.

Similarities exist in relative distribution of frequencies between Haiti and the Dominican Republic. In both parts of the island, the presence of multiple positive and negative bulb scars (mode 4) has the highest frequency. In Puerto Rico, the highest frequency is mode 6 (two or more negative bulb scars) although mode 4 is the second highest frequency. There is a high degree of similarity in

the overall distribution profiles of Haiti, the Dominican Republic and Puerto Rico.

It should be noted that the high frequency for mode 6 for Puerto Rico is also the highest frequency for Jamaica and the Virgin Islands. The Jamaica-Puerto Rico correlation may indicate similar geological constraints on technology protocol.

The most atypical high frequency occurs in the Cuban sample which is characterized by an absence of bulb scars.

Dimension 8 (Direction of Primary Flake Scars)

The frequency distribution of convergent flake scars (mode 3) to parallel flake scars (mode 1) is nearly identical for Haiti and the Dominican Republic.

For Puerto Rico, the distribution of convergent to parallel flake scars is the inverse of that for Hispaniola.

The question of parallel or convergent primary flake scars will be more fully discussed in Chapter 6 as there are potential implications for cultural as well as technological variability in these attributes.

The occurrence of high frequencies for multiple directions of scars (mode 4) for the islands of Jamaica and the Virgin Islands is atypical of the assemblages as a whole.

The Cuban samples exhibit a marked high frequency for convergent flake scars with only one modal variant. It is notable that the Jamaican, Hispaniolan and Puerto Rican

assemblages have a fair amount of variance in modes represented.

Dimension 9 (Number of Primary Flake Scars)

With the exception of the Virgin Islands, the highest frequency mode in all the island assemblages was mode 2 (two or more dorsal crests).

The frequency distributions of this dimension for Haiti and the Dominican Republic are identical. Notable is the distribution between mode 1 (one dorsal crest) and mode 2 for both Hispaniola and Puerto Rico.

Dimension 10 (Number of Primary Platforms)

A single primary platform is the predominant mode for all the islands with the exception of Jamaica which has three or more platforms (mode 3).

The histograms for Hispaniola are consistent for Haiti and the Dominican Republic. Although the frequency distribution for mode 1 is similar between Puerto Rico and Hispaniola, the Puerto Rican samples have a higher occurrence of multiple platforms than does Hispaniola.

It is also worth noting that the occurrence of multiple platforms is relatively common for Puerto Rico and Jamaica which may indicate similar raw material limitations or may be indicative of a specific set of unique tool types.

Dimension 11 (Dominant Angle of Primary Platform)

It is significant that the highest frequency for all islands (without exception) is a primary platform with a 90 degree dominant angle. There are minor variations in the modes (especially in Jamaica and to a lesser degree in Puerto Rico); however, they represent extremely low frequencies compared to mode 1.

Dimension 12 (Number of Secondary Flake Scars)

The absence of secondary flaking (mode 0) is predominant in all the island assemblages.

In those cases where secondary flaking does occur, the predominant mode is that of one to ten flake scars (mode 1). The only notable exception to this is in the Dominican Republic where there is the occurrence of artifacts with over twenty secondary flake scars (mode 3).

Dimension 13 (Direction of Secondary Flake Scars)

As in dimension 12 (and as a logical consequence of), the highest frequency in all islands is mode 0.

Secondary flake scars do occur in relatively low frequencies in the island assemblages. Cuba has only convergent flake scars when they occur in the present sample. In Hispaniola parallel and convergent flake scars are the predominant modes. For Puerto Rico, parallel and perpendicular flake scars occur. Jamaica has multiple directions (mode 4) as the second most predominant mode, in

addition to parallel and convergent scars. The Virgin Islands has convergent and multiple flake scars in equal frequencies.

Dimension 14 (Number of Secondary Platforms)

The overall frequency distribution of this dimension is uniform for Haiti and the Dominican Republic.

When secondary flaking occurs, the existence of single platform (unifacial) flaking is predominant in Hispaniola, Puerto Rico, and the Virgin Islands. Two platforms occur in Jamaica, Cuba and Hispaniola. Only in Jamaica does mode 3 (three or more platforms) occur.

Dimension 15 (Dominant Angle of Secondary Platform)

When secondary flaking is present, flaking angles vary considerably from island to island.

The frequency distributions for the Dominican Republic and Puerto Rico are relatively similar, in that perpendicular angles (mode 1) are more frequent than steep angles (mode 2). The frequency of modes for Haiti and the Dominican Republic is notable in that they are slightly reversed. Steep angles are more predominant in Haiti and the Dominican Republic than in other island assemblages. Cuba is unique in that acute angles (mode 3) are the only mode when secondary flaking is present, although mode 3 is also evident in Jamaica. The Virgin Islands is unique in

that it has the only occurrence of mode 4 (a dominant angle of less than 30 degrees).

<u>Classes: Dimensions 6, 7, 8, 9, 10, 11, 12, 13, 14, 15</u>

For classes as a whole, the lack of cortex (DM6.0), the dominant angle of the primary platform being 90 to 100 degrees (DM11.1) and the lack of any secondary retouch (DM12.0, DM13.0, DM14.0, and DM15.0) were predominant patterns within the total sample (see Figure 5-5).

Comparisons of the chert types with the classes formed showed identical constants for artifacts made from the raw material of the island of Hispaniola, that is to say the Hispaniola Flint and the Barrera Mordan Chert. Artifacts from these raw material sources had no cortex present (DM6.0), showed multiple positive and negative bulb scars (DM7.4), had one primary platform (DM10.1), a primary platform angle of 90 to 100 degrees (DM11.1), and lacked evidence of secondary flaking (DM12-15 all 0). Those artifacts made from Cerrillo Chalcedony (DM2.3) differed from the Hispaniola material in that the predominant modes of fabrication were parallel primary flake scars (DM8.1), a primary platform angle of 90 to 100 degrees (DM11.1) and a lack of secondary flaking.

	6	7	8	9	10	11	12	13	14	15
CLASSES	0					1	0	0	0	0
CHERT / CLASS										
Hispaniola Flint	0	4			1	1	0	0	0	0
Barrera Mordan Chert	0	4*			1*	1*	0	0	0	0
Cerrillo Chalcedony			1			1	0	0	0	0
INCLUSIONS / CLASS										
None	0			2	1	1	0	0	0	0
<10%	0				1*	1*	0	0	0	0
10-50%	0	4			1	1	0	0	0	0
>50%			1			1	0	0	0	0
GRAIN / CLASS										
Fine	0				1*	1*	0	0	0	0
Medium	0				1	1	0	0	0	0
Coarse				2	1*	1*	0	0	0	0
ISLAND / CLASS										
Cuba (all equal)										
Jamaica (all equal)										
Haiti	0				1*	1*	0	0	0	0
Dominican Republic					1*	1*		1		1
Puerto Rico						1	0	0	0	0
Virgin Islands		1*	0*	0*	1*	1*	0	0	0	0

Figure 5-5. Constant and variable modes for Classes. Dimensions are shown along the top of the figure. The numbers in the columns represent the occurrence of a constant mode for a given dimension.

It is interesting to note here that the generally higher grade flint material (i.e. that from Hispaniola) was selectively "cleaned" as a rule in so much as the cortex was almost always completely removed, wherein the lower grade chalcedony was not always "cleaned" of its cortex. It is also worth noting the fact that the lower grade chalcedony does not predominantly have a single primary platform, as does the higher grade flint of Hispaniola.

The effect of inclusions in primary material demonstrates that raw stone having anywhere less than 50% inclusions had its cortex removed, a single primary platform with a perpendicular dominant angle, and no retouch. Major exceptions to this were found in the materials having no inclusions. These had two or more dorsal crests, possibly indicating that the higher grade material was seen as potentially being more productive and hence a consistently higher number of flakes and/or blades were removed. In raw material with inclusions of 10-50% (DM4.2), there was a proportionally higher incidence of multiple positive and negative flake scars on any one artifact.

The most distinct constants in relation to the percent of inclusions was in those artifacts having inclusions greater than 50%. The direction of the primary flake scars was usually parallel whereas the presence of cortex varied as did the number of primary platforms.

The constants in grain closely parallel those of inclusions (Dimension 4). One unusual and unexpected constant occurred in coarse grained material having two or more dorsal crests as a constant. Even though there was a degree of cortex present, bulbs of percussion and direction of the primary scars varied within the classification.

On an island basis, once again the Cuban and Jamaican samples showed no significant differences in constants or variants; however, this could be a factor of sample size.

In treating the island of Hispaniola as two separate samples (i.e. Haiti and the Dominican Republic) it is interesting that differences occur in the assemblages and that these may reflect cultural, chronological, or site specific differences on an intra-island basis. The number and dominant angle of the primary platforms are the only uniform factor on an island-wide basis. The Haitian assemblages, for the most part, have no cortex present, whereas the Dominican ones vary more in that respect. The most significant aspect of intra-island differentiation occurs in secondary retouching. Whereas the Haitian assemblages tend to have no secondary work as a rule, the Dominican assemblages vary considerably more. Where secondary flaking occurs in the Dominican assemblages the flake scars are parallel and have a perpendicular platform angle. In these samples, however, the <u>number</u> of secondary platforms and flake scars is much more variable.

Technology: Dimensions 6,7,8,9,10,11

Three highly consistent technological characteristics of the Greater Antillean assemblages is the absence of cortex, a single primary platform and a striking angle between 90 to 100 degrees (see Figure 5-6). These characteristics are especially evident in the higher quality raw materials of Hispaniola (Hispaniola Flint and Barrera Mordan Chert).

Notable differences occur between the technologies used on Puerto Rican and Hispaniolan flints. These differences are most pronounced in primary flake scar direction and number of primary platforms. There is a high consistency of Cerrillo Chalcedony artifacts having parallel primary flake scars and, unlike the Hispaniola material, there is more variance in the number of primary striking platforms. As is to be expected from the inherent flaking differences of a non-silicious material, the technological pattern of the Virgin Islands Basalt is markedly different from those of the silicious cherts. It is, however, significant that in the total of raw materials (i.e. the cherts and basalts) the number of platforms and their angles maintain consistency.

The effect of grain on flaking technologies is significant in that the finer grained materials have no cortex present and the finest grain shows a high consistency in the presence of multiple positive and

negative flake scars. As a rule, the coarser the grain, the more variable the technology.

	6	7	8	9	10	11	12	13	14	15
TECHNOLOGY	0				1*	1*				
CHERT / TECHNOLOGY										
Hispaniola Flint	0				1*	1*				
Barrera Mordan Chert	0				1*	1*				
Cerrillo Chalcedony			1			1				
Virgin Island Basalt		1*	0*	0*	1*	1*				
GRAIN / TECHNOLOGY										
Fine	0	4			1	1				
Medium	0				1	1				
Coarse					1*	1*				
INCLUSIONS / TECHNOLOGY										
None	0			2*	1*	1*				
<10%	0	4*			1*	1*				
10-50%	0	4*			1*	1*				
>50%					1*	1*				

Figure 5-6. Constant and variable modes for Technology (primary flaking). Constant technological modes are shown by their numerical code under each dimension.

Unlike the effect of grain, the degree of inclusions in the material does not necessarily correlate with the consistency or variability of technology. As an example, material having no inclusions is highly consistent in four of the six dimensions of technology. In material with inclusions less than ten percent, and material with ten to fifty percent, there is still a high consistency in four of the six dimensions, even though one of the six is a different mode.

It is only when the raw material exceeds fifty percent inclusions that elements of consistency are reduced to only two of the six dimensions. It is worth noting that the existence of a single primary platform (DM10.1 and DM11.1), remains consistent throughout the variation in degree of inclusion. The implications of these patterns will be discussed later.

Retouch: Dimensions 12, 13, 14, 15

Within the classification of secondary flaking, or retouch, (Figure 5-7) the only clear trend in all of the assemblages analyzed was in the number of secondary flake scars being between one to twenty (DM12.1). The direction of the flake scars, number of platforms and the dominant angle of the secondary platforms varied much more than the number of flake scars. The least affected by variations in raw material was the predominant angle of secondary platform (Dimension 15). It should be kept in mind that

	6	7	8	9	10	11	12	13	14	15
RETOUCH							1#			
CHERT / RETOUCH										
Hispaniola Flint										
Barrera Mordan Chert								1#		1#
Cerrillo Chalcedony									1#	1#
Virgin Island Basalt								1#		1#
GRAIN / RETOUCH										
Fine								1#		1#
Medium								1#		1#
Coarse								1#	1#	
INCLUSIONS / RETOUCH										
None										
<10%								1#	1#	1#
10-50%							1#		1#	
>50%								1#		1#

Figure 5-7. Constant and variable modes for Retouch. The numerical value of those modes which are constant is shown within the columns under each respective dimension. Blank spaces indicate variability in the dimension.

this discussion is limited to those artifacts having secondary flaking, for as stated earlier, Greater Antillean assemblages in general lack secondary flaking (see Figure 5-5 pg. 139).

It is also cogent at this point in the discussion to emphasize that the present analysis of secondary retouch is wholly technological and not functional. That is to say, the consideration of whether the retouching represents shaping of the primary artifact or is the product of artifact retouch to compensate for use damage, is not addressed in this classificatory scheme. The cultural interpretive value of this factor, however, is not to be diminished in importance but is one which will eventually require future consideration in a functional analysis of the Antillean lithic assemblages.

Let us examine herein the effect the raw material had on the presence of secondary flaking.

The absence of any particular consistency in retouching in the Hispaniola Flint is significant, given the fact that in all other materials there are some general trends in retouch according to chert type. Unlike the other chert types of the West Indies, the high quality of the Hispaniola Flint essentially eliminates technological constraints in artifact production. The technological consistency of the lower grade lithic materials may

therefore be a direct result of these raw material constraints.

The number of secondary platforms remains fairly consistent (one platform) through all the cherts and in the Virgin Islands Basalt. The number of platforms is more variable only in the highest grade isotropic, homogeneous flints (Hispaniola Flint). This occurrence of a single platform in the lower grade materials may indicate technological limitations in the degree of secondary flaking possible on the material. It may, however, also be indicative of a functional factor attributable to a desirable less frail material (such as selective backing of harder scraping tools) which would be more pragmatic on a less silicious material.

The number of secondary flake scars in artifacts made from Barrera Mordan Chert and Virgin Islands Basalt are fairly consistent in being between one to ten (DM12.1). In the Cerrillo Chalcedony there is a predominance of parallel secondary flake scars off of one platform[1]

The effect of grain on retouch is fairly consistent in fine and medium grain material in terms of the number of platforms and flake scars. Flake scar direction and flaking angle are less consistent. Only in coarse grained material did the <u>direction</u> of the secondary flaking remain

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[1] Note how this contrasts with the variability in flake scar direction in the dimensions of technology (DM6-11).

relatively consistent (i.e. parallel flake scars). Unlike the finer grained material, however, the coarse grained material had much more variation in the number of secondary flake scars.

The effect of inclusions in the raw material closely parallels the effects of grain and chert type in that the most consistent modes were a low number of secondary flakes (one to ten), and the presence of a single platform. The most outstanding exception to this was in those artifacts produced from material with no inclusions. As can be seen in Figure 5-7, variability occurred in every single mode of retouch (DM12-15). The most consistent effects were found in flaked stone with less than 10% inclusions in that there was high consistency in the number of scars (1-10), the direction of the secondary flake scars (parallel), and the number of secondary platforms (one).

Chert Type By Island: Dimension 2 By Dimension 1

The effects of Geologic Type, or chert type, on an inter-island basis is illustrated in Figure 5-8.

In the Cuban assemblages there were no demonstrable trends in the chert type in any classificatory dimension. The predominant material was Barrera Mordan Chert with one example of a Cerrillo Chalcedony.

	6	7	8	9	10	11	12	13	14	15
CUBA / CHERT										
Barrera Mordan Chert (all 1's)										
Cerrillo Chalcedony (only 1 example)										
JAMAICA / CHERT										
Hispaniola Flint (all 1's)										
Barrera Mordan Chert (all 1's)										
HAITI / CHERT										
Hispaniola Flint	0				1*	1*	0	0	0	0
Barrera Mordan Chert	0				1*	1*	0	0	0	0
Cerrillo Chalcedony (only 1 example)										
DOMINICAN REPUBLIC / CHERT										
Hispaniola Flint					1*	1*				
Barrera Mordan Chert			4*			1*	1*			
Cerrillo Chalcedony (only 1 example)										
PUERTO RICO / CHERT										
Hispaniola Flint							0	0	0	0
Barrera Mordan Chert	0				1	1*	0	0	0	0
Cerrillo Chalcedony						1	0	0	0	0
VIRGIN ISLANDS / CHERT										
Cerrillo Chalcedony		6*	4*		3*	9	0*	0*	0*	0*
Virgin Island Basalt						1*				

Figure 5-8. Constant and variable modes for chert type by island. Constant modes are indicated by the numerical value under each column (dimensions). Those spaces left blank indicate that the mode is variable.

As in the Cuban assemblages, the Jamaican materials showed no significant trends. The predominant materials were Hispaniola Flint and Barrera Mordan Chert. It is interesting to observe that even though geological and geographical similarities exist between Jamaica and Puerto Rico, no Cerrillo Chalcedony or low grade chalcedony-like material was present in any of the samples.

The Haitian assemblages showed the most regularity in both Hispaniolan Flint and Barrera Mordan Chert. The absence of cortex, the presence of a single primary platform with a perpendicular angle and a lack of secondary working were strong trends in these chert types within the Haitian assemblages. More variability existed in the bulbs of percussion, number and direction of primary flake scars.

These data correlate well with the earlier discussion of consistencies of class in looking at all the dimensions (i.e. DM6-15) for the Haitian assemblages, indicating that the chert type may be viewed as a high correlation factor for technology.

In the Dominican assemblages the use of Hispaniola Flint is less consistent in technological dimensions than in the Haitian assemblages. In the Dominican Republic only the number and angle of the primary platform are highly consistent, while proportionally the degree of cortex present and the use of retouch are more variable in the assemblages. Even in the use of Barrera Mordan Chert in

the Dominican assemblages, a different set of dimensions maintain high consistency from those in the Haitian assemblages for the same raw material type. It is interesting that in the use of Barrera Mordan Chert in the Dominican assemblages, the proportionally high occurrence of multiple negative and positive bulbs of percussion contrasts with the more variable situation in the Haitian assemblages for the same dimension. This merits further examination to determine if this is a result of sampling, (i.e. a more selective blade sample from the Dominican Republic than the less selective Haitian assemblages) rather than a precolumbian cultural index. As in the case of the Hispaniola Flint materials, the Barrera Mordan Chert in the Dominican assemblages showed more variability in the modes and dimensions of retouch than in the case of the Haitian assemblages.

In both the Haitian and Dominican assemblages, the occurrence of Cerrillo Chalcedony was limited to a singular occurrence.

In the Puerto Rican assemblage, which contained three of the four chert types (i.e. Hispaniola Flint, Barrera Mordan Chert, and Cerrillo Chalcedony), it is significant that there was a consistently high percentage of the assemblage which lacked any retouch, irrespective of chert type. Technological differences (DM6-11) were highly variable in the Hispaniolan Flint, to a lesser degree for

that of Cerrillo Chalcedony (the exception was that of a perpendicular primary platform angle), with the highest consistency occurring in those lithic artifacts produced from the Barrera Mordan Chert. Those samples made from Barrera Mordan Chert were highly consistent in that they lacked any cortex and had a single primary platform with a perpendicular angle.

For the Virgin Islands, the two geologic types present in the samples studied were Cerrillo Chalcedony and Virgin Islands Basalt.

It is clear that the local Virgin Island Basalt is more highly variable in technological modes than the imported Cerrillo Chalcedony. It is also notable that the use of Cerrillo Chalcedony in the Virgin Islands, though it varies substantially from the technological pattern it has in the Puerto Rican assemblages, still has a high consistency in eight of the ten classificatory modes which represent technology and retouch. It would be reasonable for one to expect that an imported raw material (that is a non-local raw material) would have a higher consistency in technological dimensions. That is to say, that if one were utilizing an imported material it would be highly reasonable that it would have been imported or acquired for a specific purpose. This purpose then, would be reflected in a carefully executed specific technological pattern of artifact production and hence, in its residual waste

material. This does not imply that local raw materials would not necessarily have carefully executed specific technological patterns, only that the occurrence would be in a higher ratio of raw material to limited types of technological traits.

Furthering the inference for this particular case in the Virgin Islands assemblages, it can be inferred that the modes of multiple negative scars removed in multiple directions from multiple platforms with no secondary retouch may indicate the production of rudimentary flakes with a simple edge. Given the lack of a highly silicious lithic resource base for the Virgin Islands, it seems plausible that if fine sharp scraping or cutting edges were desirable, then an alternate lithic source would be required since fine sharp edges are not attainable with even the finest grain local basalt.

Numerous interpretations are possible at this point; however, we will leave them for the subsequent chapter.

Raw Material: Dimensions 2, 3, 4, 5

Figure 5-9 illustrates the distribution of potential raw material size (DM3) against geologic type (DM2), inclusions (DM4), and grain (DM5).

In the total sample studied, 65.5% of the sample was the product of cobble reduction, while only 33.6% of the

sample was a product of lithic reduction of boulders as a raw material resource.

Chert type, inclusions, and grain were examined as to their occurrence in raw material from boulders or from cobbles. In Hispaniola Flint, the highest percentages were divided relatively evenly between boulders and cobbles; however, boulders were the slightly more frequent. Barrera Mordan Chert, Cerrillo Chalcedony and Virgin Islands Basalt were consistently higher in percentage in cobbles than boulders.

	6	7	8	9	10	11	12	13	14	15
<u>SIZE / CLASS</u>										
Cobbles	0				1*	1*	0	0	0	0
Boulders	0				1	1	0	0	0	0
<u>SIZE / TECHNOLOGY</u>										
Cobbles	0					1*				
Boulders	0				1*	1*				
<u>SIZE / RETOUCH</u>										
Cobbles							1‡		1‡	
Boulders								1‡		

Figure 5-9. Constant and variable modes based on potential size of raw material.

Examining the effect of raw material size on the lithic assemblages, class as a whole does not indicate any substantive difference between cobbles and boulders. This is especially true in dimensions 6, 10, 11 and 12-15. Looking at technology as a single element, both cobbles and boulders have similar consistent dimensions. These constants being an absence of cortex (DM6.0) and a dominant platform angle of 90 to 100 degrees (DM11.1). Only in dimension 10 (number of primary platforms) do boulders show a consistency (one platform), whereas cobbles do not. This may in part be a factor of the Puerto Rican assemblage sample, in which two platforms occur on a single piece.

The most notable differences in raw material size occurs in retouch where cobbles are more consistent in the number of secondary flakes (DM12.1) and secondary platforms (DM14.1). In boulders, the highest consistency of retouch occurs in the direction of the secondary flake scars (DM13.1), which are parallel, even though the number of flakes and platforms becomes more variable.

Figure 5-10 shows the distribution of size potential between cobbles and boulders for geologic type, inclusions in the material and grain.

From the results of the raw material analysis it can be stated that the Greater Antillean precolumbian flaked stone assemblages are primarily a cobble-based industry.

	COBBLES	BOULDERS
	446 65.5%	229 33.6%
CHERT		
Hispaniola Flint	125 41.4%	175 57.9%
Barrera Mordan Chert	206 79.2%	53 20.4%
Cerrillo Chalcedony	102 99.0%	0 0
Virgin Island Basalt	13 92.9%	0 0
INCLUSIONS		
None	37 48.1%	40 51.9%
<10%	249 65.5%	128 33.7%
10-50%	133 70.4%	53 28.9%
>50%	26 76.5%	0 0
GRAIN		
Fine	161 45.9%	187 45.9%
Medium	263 88.3%	34 11.4%
Coarse	22 71.0%	7 22.6%

Figure 5-10. Size potential distributions based on chert type, degree of inclusions, and grain.

The predominant use of cobbles is not believed to be one of preference but rather one of raw material availability. It would be valuable to investigate the possible selective use of the higher grade boulder material for functional specificity and/or cultural implications in future research.

It is clearly seen in the analysis that the percentage of cobble material increases as the degree of inclusions and degree of coarseness of the raw material increases. The occurrence of higher grade material in the larger mass raw materials is consistent with field observations and geological potentials for the islands of Puerto Rico and Hispaniola particularly. Based on geological potential, it would be expected that Jamaican assemblages would most closely parallel those of Puerto Rico while those of Cuba would be anticipated as being more similar to the Hispaniola assemblages.

CHAPTER 6

DISCUSSIONS AND CONCLUSIONS

Radiocarbon dates from sites such as Levisa in Cuba and Barrera Mordan in the Dominican Republic provide sufficient chronological evidence to demonstrate that the Greater Antilles were inhabited at least 4,000 years ago. The artifactual evidence is limited almost exclusively to flaked stone artifacts. As a consequence, many other sites in the Greater and Lesser Antilles having flaked stone assemblages are frequently compared to these sites. As has been shown in this work, previous analyses of these lithic sites have had to rely on models developed for European or North American continental assemblages. These continental assemblages reflected the products of specific sets of artifacts designed to effectively address continental procurement strategies. The applicability of these mainland models to the island geography has been questioned and it was proposed that an examination of the technological aspects of insular assemblages may produce a distinct set of technological protocols. Within the Antilles, technological factors such as variable raw lithic resource materials have been presented as potentially deterministic aspects of tool production which may have resulted in assemblages that falsely appear to be culturally distinct.

As stated initially, the present work is a preliminary attempt to address problems of lithic analysis in the islands of the Caribbean. Historically, and to date, the models and classificatory schemes used for the analysis of lithic assemblages in the Antilles have not adequately addressed basic questions of cultural variation, chronology, or migration. The search for migratory routes and the development of chronological models based on these routes have not proven successful.

If a toolmaker has an option to create a specific tool type, then conscious technological steps will be taken to create that specific tool. If the raw material is not adequate to allow the production of the desired tool, then the manufacturer must either adapt to produce a different looking tool which will provide the same function or seek a different raw material. A relatively non-specialized tool kit, such as seems to have been the norm in the precolumbian West Indies, would not require a highly specialized raw material base. Most any raw material will serve the function of creating unspecialized flakes and unifacial flake blades. Although artifact size may vary between island assemblages, the fundamental technological process apparently does not. Fairly clear patterns of technology are seen for artifact production with minimal variations. The lithic reduction process is basically limited to unspecialized unifacial tool production.

Complete site samples need to be analyzed with the present classificatory scheme to provide a basis to examine the lithic reduction process from procurement to production. The present analysis deals with selective samples which have previously undergone classificatory selection (either formally or as a matter of initial acquisition). As such, much of the debitage and initial core reduction materials are not factored into the analysis. These basic lithic reduction artifacts are fundamental to our reconstruction of the entire technological protocol. The present classificatory scheme allows for the codification of nearly all the fundamental technological attributes measurable on a given artifact. As such, it provides the mechanism to analyze an artifact or entire assemblage and determine which aspects of the reduction sequence are represented. Cultural variations may show up as variations among a specific set of reduction sequences.

The design of the modes and dimensions also allows the classificatory scheme to be easily translated into Spanish, French and Dutch to allow broad geographical application to the multilingual research nature of the West Indies.

The application of this analytical scheme to a random (yet geographically representative) set of data created a series of comparisons which provide a beginning for the

development of new research questions for West Indian flaked stone assemblages.

The fact that the present samples, in large part, represent artifact clusters which had been selectively culled by previous researchers into broad cultural categories, lends even more weight to the results of the analyses which show a relatively low degree of technological diversity. These artifacts, which in many cases represent previously accepted cultural variants, show a relatively high degree of similitude.

Analyses of the technological processes of making flaked stone tools in the Greater Antilles have shown a number of predominant trends or patterns.

In examining the entire technological protocol (see Figure 6-1) several distinct patterns are seen. If we look at what are the relatively constant attributes for primary and secondary flaking throughout the region we see that the absence of cortex, a perpendicular primary platform and the absence of secondary flaking are predominant. It should be noted, however, that the absence of cortex on the artifact assemblages studied may be the result of sampling and not a real aspect of the technologies considered. This point will be developed later in the discussion of the need for further and new research foci.

CLASS FOR THE TOTAL SAMPLE	
Cortex	absent
Dominant Angle of Primary Platform	perpendicular
Number of Secondary Flake Scars	zero

CLASS BY GEOLOGIC TYPE	HISPANIOLA FLINT	BARRERA MORDAN CHERT	CERRILLO CHALCEDONY
Cortex	absent	absent	
Bulbs of Percussion	multiple +/-	multiple +/-	
Direction of Primary Flake Scars			parallel
Number of Primary Platforms	one	one	
Dominant Angle of Primary Platform			
Number of Secondary Flake Scars	**zero**	**zero**	**zero**

CLASS BY DEGREE OF INCLUSIONS	NO INCLUSIONS	<10%	10-50%	>50%
Cortex	absent	absent	absent	
Bulbs of Percussion			multiple +/-	
Direction of Primary Flake Scars				parallel
Number of Primary Flake Scars	2 or more			
Number of Primary Platforms	one	one	one	
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**	**perpendicular**	**perpendicular**
Number of Secondary Flake Scars	**zero**	**zero**	**zero**	**zero**

CLASS BY GRAIN	FINE GRAIN	MEDIUM GRAIN	COARSE GRAIN
Cortex	absent	absent	
Number of Primary Flake Scars			2 or more
Number of Primary Platforms	**one**	**one**	**one**
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**	**perpendicular**
Number of Secondary Flake Scars	**zero**	**zero**	**zero**

CLASS BY ISLAND OF ORIGIN	CUBA	JAMAICA	HAITI	DOMINICAN REPUBLIC	PUERTO RICO	VIRGIN ISLANDS
Cortex			absent			
Bulbs of Percussion						one positive
Direction of Primary Flake Scars						zero
Number of Primary Flake Scars						zero
Number of Primary Platforms			one	one		one
Dominant Angle of Primary Platform			perpend.	perpend.	perpend.	perpend.
Number of Secondary Flake Scars			zero		zero	zero
Direction of Secondary Flake Scars				parallel		
Number of Secondary Platforms						
Dominant Angle of Secondary Platform				perpend.		

Figure 6-1. Constant technological attributes of Class (Dimensions 6-15) by geologic type, inclusion, grain and by island. Constants represent the highest percentages of the analysis (see Appendix D). Uniform attributes are in bold face.

For primary flaking, as a rule, the higher quality raw materials are more constant in their technological protocol than lower quality raw materials. Although more variability is seen in technology when correlated with grain and inclusions, the occurrence of a single perpendicular primary platform remains stable.

On the basis of provenience, the only constant technological attribute among all the islands, is the occurrence of a perpendicular primary platform. The occurrence of a single primary platform and the absence of secondary flaking are also dominant patterns, although not as constant as that of platform angle.

The general absence of secondary flaking remains constant when examining class, irrespective of raw material variation. The only variation here is seen when on an area specific basis, as demonstrated in the case of the Dominican Republic.

The technology indicated by class as a whole (i.e. Dimensions 6-15) is clearly one of unifacial flaking, most probably by means of direct percussion.

When examining the technological process as two distinct divisions, that of primary and secondary flaking, the data reveal a somewhat varied set of patterns from that of class as a whole. Figure 6-2 shows the paradigmatic relationships of technology (primary flaking) in relation to raw material.

TECHNOLOGY FOR TOTAL SAMPLE	
Cortex	absent
Number of Primary Platforms	one
Dominant Angle of Primary Platform	perpendicular

TECHNOLOGY BY GEOLOGIC TYPE	HISPANIOLA FLINT	BARRERA MORDAN CHERT	CERRILLO CHALCEDONY	VIRGIN ISLANDS BASALT
Cortex	absent	absent		
Bulbs of Percussion				one positive
Direction of Primary Flake Scars			parallel	zero
Number of Primary Flake Scars				zero
Number of Primary Platforms	one	one		one
Dominant Angle of Primary Platform	**perpend.**	**perpend.**	**perpend.**	**perpend.**

TECHNOLOGY BY DEGREE OF INCLUSIONS	NO INCLUSIONS	<10%	10-50%	>50%
Cortex	absent	absent	absent	
Bulbs of Percussion		multiple +/-	multiple +/-	
Number of Primary Flake Scars	2 or more			
Number of Primary Platforms	**one**	**one**	**one**	**one**
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**	**perpendicular**	**perpendicular**

TECHNOLOGY BY GRAIN	FINE GRAIN	MEDIUM GRAIN	COARSE GRAIN
Cortex	absent	absent	
Bulbs of Percussion	multiple +/-		
Number of Primary Platforms	**one**	**one**	**one**
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**	**perpendicular**

Figure 6-2. Constant technological attributes of Technology (Dimensions 6-11) by geologic type, inclusion, and grain. Constants represent the highest percentages of the analysis (see Appendix D). Uniform attributes are in bold face.

As is demonstrated in Figure 6-2, West Indian flaked stone artifacts tend to lack the presence of cortex and have a single perpendicular primary platform. Platform angle

seems to be unaffected by raw material and with the exception of Cerrillo Chalcedony, assemblages continue to exhibit a single primary platform.

The higher grade geological material appears to have been selectively cleaned of cortex more often than the lower grades of lithic source material. There is a tendency in the assemblages towards higher variability in the technology as raw material quality decreases. This is best seen in the effect of grain on primary flaking. The higher number of constant attributes for the higher quality raw materials reflects a more precise set of protocols established on the more predictable raw material. The lower grade materials appear to have been subjected to more technological manipulation. This situation could indicate the artisan's efforts to extract the desired product out of a relatively unmanageable raw material.

It has been clearly demonstrated that secondary flaking is mostly absent from West Indian assemblages. Nevertheless, when we examine the evidence of when secondary flaking does occur, we can see a number of potentially revealing patterns (Figure 6-3). Secondary flaking is limited, for the most part, to light retouch (1-10 flakes). However, as we examine the effects which raw material has on secondary flaking we can see that the highest grade raw material has no constant pattern of

RETOUCH FOR TOTAL SAMPLE

Number of Secondary Flake Scars	1-10

RETOUCH BY GEOLOGIC TYPE	HISPANIOLA FLINT	BARRERA MORDAN CHERT	CERRILLO CHALCEDONY	VIRGIN ISLANDS BASALT
Direction of Secondary Flake Scars		parallel		parallel
Number of Secondary Platforms			one	
Dominant Angle of Secondary Platform		**perpend.**	**perpend.**	**perpend.**

RETOUCH BY DEGREE OF INCLUSIONS	NO INCLUSIONS	<10%	10-50%	>50%
Number of Secondary Flake Scars			1-10	
Direction of Secondary Flake Scars		parallel		parallel
Number of Secondary Platforms		one	one	
Dominant Angle of Secondary Platform		perpend.		perpend.

RETOUCH BY GRAIN	FINE GRAIN	MEDIUM GRAIN	COARSE GRAIN
Direction of Secondary Flake Scars	**parallel**	**parallel**	**parallel**
Number of Secondary Platforms			one
Dominant Angle of Secondary Platform	perpend.	perpend.	

Figure 6-3. Constant technological attributes of Retouch (Dimensions 12-15) by geologic type, inclusions, and grain. Constants represent the highest percentages of the analysis (see Appendix D). Uniform attributes are in bold face.

retouch. By and large, secondary flaking appears to be less varied as the quality of the raw material decreases. In the case of the West Indies, this may indicate that the higher quality material allowed the artisan a higher degree of options to produce artifacts than the lower grade materials; the latter would tend to limit the options available to the knapper. This tendency in the technological process may be a key to explaining the occurrence

of some of the more elaborate artifacts found on Hispaniola. The inordinate quality and quantity of source materials on the island of Hispaniola clearly would have given precolumbian groups there the opportunity to precisely control and to experiment with the production of elaborate and unusual artifact types such as seen in the assemblages of Haiti and the Dominican Republic (see figures in Chapter 5).

Whether or not these artifacts represent examples of what Sackett terms isochrestic style (Sackett 1982) or fall into the realm of debate for iconological phenomena (Wiessner 1985, 1983; Sackett 1985, 1986) is open to future discussion. Clearly, however, there is ample material here for Caribbean research to contribute to the debate.

Relations between raw material size and variability in the technological process are shown in Figure 6-4.

In combination, primary and secondary flaking are unaffected by raw material size. For primary flaking, however, cobble material is more variable than that of boulders. This could be a factor applicable to the nature of the geology of the West Indies rather than that of the knapper's free choice. The patterns for secondary flaking are opposite to those of primary flaking. More varied technological attributes are used for boulders than those for cobbles. Since the highest quality materials generally occur in boulder-sized material as a general rule in the

Greater Antilles, this trend may be indicative of the greater options available to the knappers which we discussed earlier.

CLASS BY SIZE	COBBLES	BOULDERS
Cortex	**absent**	**absent**
Number of Primary Platforms	**one**	**one**
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**
Number of Secondary Flake Scars	**zero**	**zero**

TECHNOLOGY BY SIZE	COBBLES	BOULDERS
Cortex	**absent**	**absent**
Number of Primary Platforms		one
Dominant Angle of Primary Platform	**perpendicular**	**perpendicular**

RETOUCH BY SIZE	COBBLES	BOULDERS
Number of Secondary Flake Scars	1-10	
Direction of Secondary Flake Scars		parallel
Number of Secondary Platforms	one	

Figure 6-4. Constant technological attributes of Class (Dimensions 6-15), Technology (Dimensions 6-11), and Retouch (Dimensions 12-15) by size potential of raw material. Constants represent the highest percentages of the analysis (see Appendix D). Uniform attributes are in bold face.

As shown in the previous chapter, on a dimension to dimension basis, the frequency distributions for Hispaniola are more often than not, identical to those for Haiti and the Dominican Republic. A relatively high number of

positive correlations are also clearly possible between Hispaniola and Puerto Rico in many of the dimensions. These correlations would support the contention that those attributes of "style" which in the past have been ascribed to cultural variation in the Greater Antilles, may in fact be the result of local raw material variability.

The inversion of parallel to convergent primary flake scar frequencies between Puerto Rico and Hispaniola, for example, can be directly attributed to the inverse quality of the raw material between the two islands best evidenced in Dimension 5 (grain). The higher quality material of Hispaniola most often has convergent flake scars and the lower quality material, parallel. The low incidence of high quality raw material in Puerto Rico correlates to a relatively low frequency of convergent flake scars. That is to say, when the Puerto Rican indigenous groups had a higher quality material, they most often created artifacts having convergent, rather than parallel flake scars. Likewise, in Hispaniola, when the groups there utilized a lower quality raw material they produced artifacts having parallel flake scars.

Here is a case for assemblage variability which appears to clearly demonstrate technological variability as a result of differential raw source materials rather than a factor of cultural variation. Relevant to this point are the arguments of Wilmsen for the site of Lindenmeier

(Wilmsen 1970, 1973, 1974) and those of Sackett (1982: 99-102). Wilmsen's contention that the difference in the Lindenmeier site projectile points are evidence of two distinct social groups is contested by Sackett who views these differences as isochrestic variations:

> . . . those tools that are the subject to the greatest amount of shaping may on occasion be those in which the mechanical restraints of raw material and functional design can combine to allow little latitude for iconologically significant variation [Sackett 1982: 103].

In this Caribbean example, at least, the question of association between style and cultural variation are open to discussion.

The relatively high occurrence of multiple primary platforms in Puerto Rico and not in Hispaniola may be indicative of the need of Puerto Rican tool makers to rotate their artifacts to obtain suitable striking surfaces, whereas the higher quality raw material of Hispaniola allowed tool makers to utilize a single platform for multiple tool production.

If we examine the effect of raw material on the total technological process (i.e. the combined use of primary and secondary flaking) by location we can see a number of patterns emerging in the assemblages for Hispaniola, Puerto Rico and the Virgin Islands as shown in Figure 6-5. The absence of any predominant patterns for Cuba and Jamaica are most likely the result sampling rather than a clear lack of technological protocols.

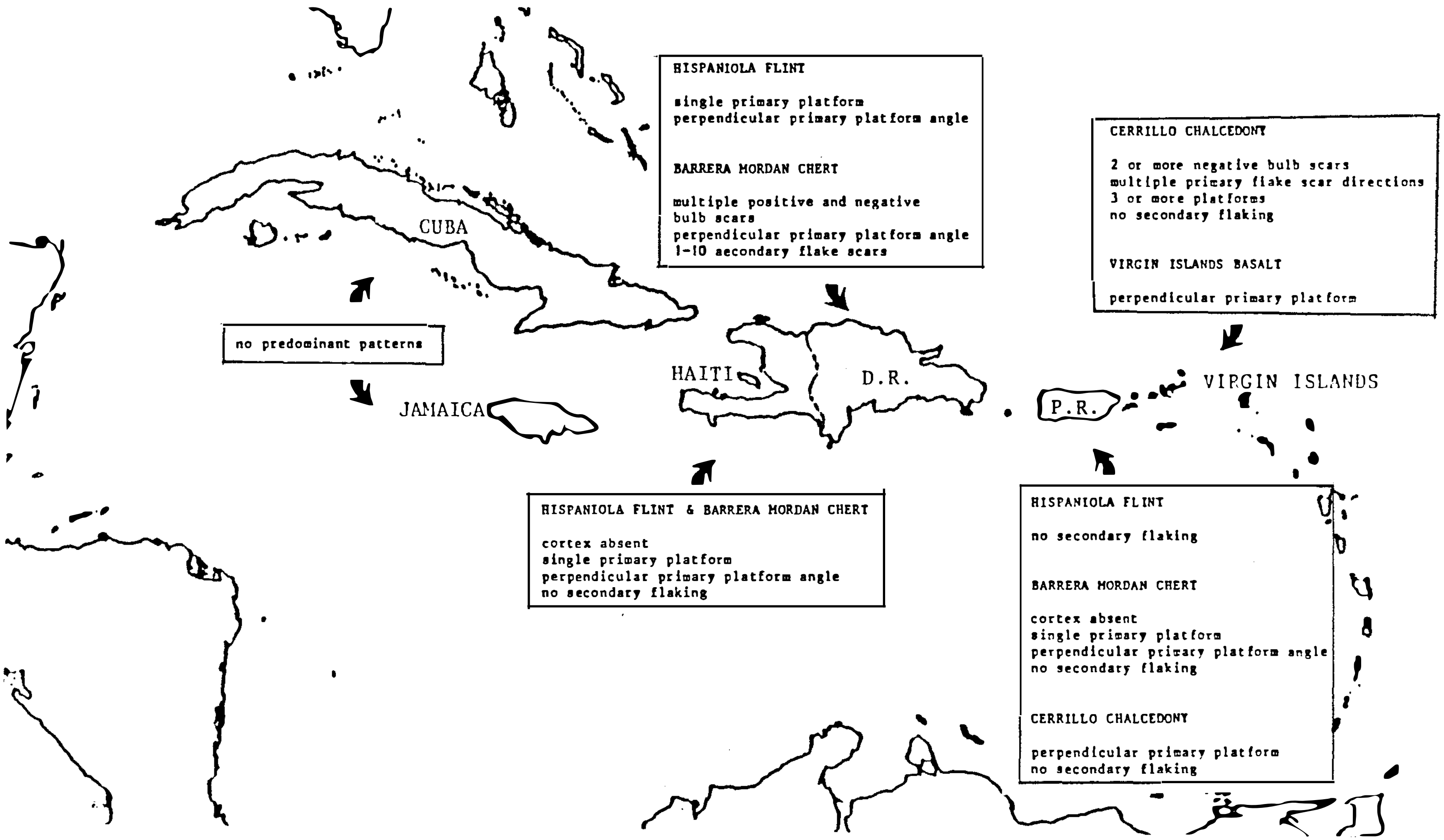

Figure 6-5. Map of the Greater Antilles showing which predominant technological patterns are produced by raw material.

The island of Hispaniola is interesting in that there are variable technological trait patterns between east and west (i.e. Haiti and the Dominican Republic). In Haiti, the technology for Hispaniola Flint and Barrera Mordan Chert are identical regarding cortex, platform number, platform angle and retouch. The Dominican Republic, on the other hand, seems to have more variable protocols for primary and secondary flaking depending on the raw material. The higher grade raw materials in the Dominican Republic are more variable in technology whereas the lower grade raw material has less variation in the flaking processes.

For Puerto Rico, the use of the Barrera Mordan Chert is similar to that of Haiti. It should be cautioned, however, that the variables of actual primary flaking (i.e. bulbs of percussion and flake scar patterns) are variable in these examples. Nevertheless, it is worth noting that unlike Hispaniola, the higher grade (possibly imported) raw material in Puerto Rico shows less variability in flaking patterns than the more local low grade raw material. The issue of Binford's arguments for "curation" of artifacts is applicable to this situation (Binford 1979). The argument is well condensed by Sackett:

> . . . expedient technology, wherein tools are made, used and discarded in one and the same locality in response to the immediate needs that arise for them.
> . . . .
> . . . the tool assemblages that represent them appear as segregated units in the archaeological record . . .

> . . . .
> on the other hand . . . curated technology . . . the primary tools are specific to given activities and tend to be designed with particular care and to receive considerable artisanal investment. . . . they are carefully husbanded ("curated") and are consequently used several times over in a variety of different localities. As a result, the key items of functional tool-kits play a minor role . . . . the only tools that are consistently discarded are the common ones . . . For this reason, the assemblages tend to look highly similar from one locality to the next even though quite different sets of activities might have been responsible for them. . . . [Sackett 1982: 89-90].

This same condition exists for the Virgin Islands in which the protocol for the less common Cerrillo Chalcedony is less variable than that of the local Virgin Islands Basalt. Although arguments on the concept of curation versus expediency have been questioned by Sackett (1982: 89-94) we may consider Dunnell's implications of function being a result of evolutionary development of tool types related to specific environmental needs (Dunnell 1978). This is to say, these particular Caribbean examples may represent necessary tool types for specific tasks. This potential example of curative processes in the West Indies will become more important as we examine Caribbean flaked stone assemblages in future investigations. Any further development of this argument within the framework of the present data set would be unfair to the potential importance of the issue.

The interpretation of sites which may represent hunting and gathering activities of the Caribbean (such as

Cerrillo in Puerto Rico, Barrera Mordan in the Dominican Republic, Cabaret in Haiti, and Levisa in Cuba) through lithic analysis, requires that we begin to develop new taxonomic systems. These systems should ultimately enable the explanation of such factors as raw materials, the availability of percussors, the expertise or idiosyncracies of the individual tool-makers, as well as the functional aspect of each tool. Each of these factors, apart or in combination, could produce demonstrable differences in similar tool types within the same assemblage or even within a single activity locus, which may be misinterpreted as cultural variations.

The hypothesis of a culturally distinct early West Indian flake tradition (such as Casimira) versus a later tradition (such as Barrera Mordan) is not supported by different technological complexes. The tool production process appears to be the same, in that the production of usable blanks is similar through all the samples studied. No technological specialization or highly variable tool technology is evident in the Greater Antillean assemblages as a whole. Overall, the flaked stone tool production process is uniformally that of a generally unmodified blank which would serve any (and many) general purposes.

We also need to fully assess problems such as nomadic band versus sedentary group behavior and their respective archaeological site manifestation in islands versus

continents. If indeed the preceramic sites represent a nomadic or semi-nomadic social structure, would it follow that we would then need to isolate and identify "type" sites? Would we find individual sites which would demonstrate the variable subsistence activities of a hunting and gathering lifestyle, rather than a multiple activity site being used over an extended period of time? Should there be a recognition of sites on the order of "kill sites" (as identified in the continental areas), seasonal recollection centers, as well as workshops or quarry sites?

In the archaeological record of the islands, there are many questions we can address through multidisciplinary analysis which would integrally involve lithic analysis. These research issues could be as basic as defining the types of tools needed to hunt, prepare and eat certain foods. Certainly the type of artifacts it took to hunt and prepare a sea turtle or manatee were very distinct from those necessary to hunt an "agoutia", grow crops or catch birds. Here zooarchaeological analysis as well as tool analysis of Caribbean sites is of paramount importance. Cogent questions of cultural variation in procurement strategies and the necessary tool kits to effectively exploit the environment will ultimately require the analysis of lithic assemblages for both preceramic as well as ceramic periods of occupation in the Caribbean. It

should be kept in mind that quantitative analysis, as well as qualitative analysis is most important. Shifts in subsistence and/or technology may be reflected in relative quantitative degrees (frequencies) rather than through the mere absence or presence of a resource and/or tool type. We may not anticipate the answers to come from one or two sites but rather from a collective data bank of sites that are accurately excavated, recorded and analyzed.

In continental models, where harsher environmental conditions are found, the family unit or biological unit may be forced to break up and develop procurement strategies based on logistically organized groups (Binford 1980). These same forces within the environment, be they geographical or seasonal, may not have existed in the precolumbian West Indian environment. Although seasonality and geographical variability of a resource base may have existed in the islands, it may not in effect have necessitated breaking up the nuclear unit. These considerations have been extensively discussed by Velóz Maggiolo (1976, 1980, 1984) and Sanoja (1980, 1984, 1986a).

The occurrence of abundant numbers of shell middens ("concheros") located relatively inland (rather than in a purely littoral zone), supports the supposition of a foraging nuclear unit utilizing area-specific resources rather than an encounter-type strategy in the Greater Antilles.

The extremely low incidence of secondary flaking on the assemblages analyzed for the Greater Antilles in this study indicate a rather unspecialized tool kit. This may relate to Binford's concepts of how different groups map on to resources, develop their procurement strategy and grow in complexity (Binford 1980).

These Greater Antillean island ecosystems seem to have required no more from the inhabitants than a fairly expedient group of stone tools which were generally adaptable to most situations they would confront within this environment. The continental models, based on distinct fauna and flora as well as temperate environments, coupled with substantial distances between resources, required the development of tool specialization and logistically organized collecting strategies. The West Indies, however, offered rewards even for expedient, unspecialized stone tool assemblages serving a viable foraging lifeway.

The classificatory scheme developed in this dissertation demonstrates how West Indian flaked stone assemblages reflect a low degree of variability in production. However, on the basis of this analysis, we have yet to fully differentiate those variants which are cultural, technological and those which are chronological. To test these models for island contexts such as the West Indies will require more inter-site and intra-site

comparisons beyond the scope of the present analysis. The value in further testing these models, however, could lie in terms of isolating those factors which may serve to define early hunting and gathering sites in the Caribbean.

What are now needed are new research goals which will begin to test our understanding of concepts of style, function, expediency, curation, and other theoretical issues pivotal to understanding lithic assemblages. We need to begin looking at raw material sources, examining not only the geological records, but also seeking out the immediate source areas of known lithic sites in Hispaniola, and Puerto Rico. We need to systematically investigate the existence of cave sites which would potentially provide information on subsistence activities. Food remains and other paleoecological data are fundamental to our development of explanations of function and functional variability in West Indian flaked stone assemblages. We must begin to excavate lithic sites in such a way as to obtain all the lithic materials present rather than selectively collecting the "diagnostic" items. Only through the collection and analysis of total site areas including all the lithic residue of the production process, will we be able to define West Indian lithic technology.

At present we only have partial pictures of what the precolumbian inhabitants of the islands did with stone tools. How and why they made the stone tools we find

archaeologically are only somewhat known to us today. In the past, the emphasis has been (and often continues to be) on who was where, when (time and space studies). If we can begin to emphasize how precolumbian peoples were making their artifacts, and what they were doing with these stone tools, our questions of where and when will also most likely be more easily resolved.

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APPENDIXES

APPENDIX A

Codification of Raw Data

Sample universe of precolumbian flaked stone materials from Greater Antillean archaeological sites. Table shows modes for each artifact. Dimensions 1-5 are presented as independent columns and Dimensions 6-15 as the coded string of ten digits.

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
1	1	2	2	1	2	0132110000
2	1	3	1	2	3	1699119999
3	1	2	2	0	2	0331110000
4	1	2	1	2	3	0000191323
5	1	2	2	1	2	2999999999
6	1	2	1	0	1	0999999999
7	1	2	2	0	3	9999999999
8	1	2	1	0	2	0032000000
9	2	2	1	1	2	2931110000
10	2	2	1	3	2	9942991199
11	2	1	2	1	1	2999999999
12	2	2	1	1	2	1999999999
13	2	2	1	1	3	4642340000
14	2	2	1	0	2	1442310000
15	2	1	1	0	1	3642220000
16	2	1	1	1	1	4642390000
17	2	1	1	1	1	4642290000
18	2	2	1	2	2	3642320000
19	2	2	1	1	2	0442311433
20	2	2	1	0	1	0022290000
21	2	2	1	0	2	0442310000
22	2	1	1	0	1	3100111423
23	2	2	1	1	2	0000002432
24	2	2	1	1	2	0100191112
25	2	1	2	1	1	0100110000
26	2	2	2	1	2	0990991313
27	2	1	2	1	1	2000001432
28	2	1	2	0	1	2990990000
29	6	4	1	0	2	3100111314
30	6	3	1	2	2	3642390000
31	6	4	1	1	2	9642390000
32	6	4	9	2	3	0999999999
33	6	4	1	1	2	9100111412
34	6	4	1	0	1	2642110000
35	6	4	1	1	2	9642310000
36	6	9	9	1	1	0999999999
37	6	3	1	1	1	2991999999
38	6	4	1	0	1	9100110000
39	6	4	1	0	1	9310110000
40	6	4	1	1	1	0999990000
41	6	4	1	1	1	9999990000
42	6	4	1	1	1	0999990000
43	6	4	1	2	1	3100110000
44	6	4	1	1	1	3100110000
45	6	4	1	1	2	9199110000
46	3	2	2	1	2	0032111111
47	3	2	2	1	2	0432111111
48	3	2	2	2	3	0111113112
49	3	1	2	1	1	0432113111
50	3	2	2	2	3	0399112111
51	3	1	2	1	1	0091912432
52	3	1	2	1	1	0032113432
53	3	2	2	1	1	0432112111
54	3	2	2	2	1	0332113112

SAS

CBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
55	3	2	1	3	2	3611110000
56	3	2	1	3	2	4100110000
57	3	2	2	1	2	2632110000
58	3	2	2	2	2	0432113112
59	3	2	1	1	2	0432112122
60	3	1	2	2	1	1999999999
61	3	1	1	1	1	0432211112
62	3	2	1	1	1	0431112112
63	3	1	1	1	1	0431111111
64	3	1	2	1	1	0411110000
65	3	1	2	1	1	0432110000
66	3	2	2	2	2	0132113112
67	3	1	1	3	1	0412119999
68	3	1	1	2	1	0131112121
69	3	1	1	2	1	0432112112
70	3	1	2	2	1	1412110000
71	3	2	2	2	2	0432211111
72	3	1	2	0	1	0431112112
73	3	1	2	1	1	0412213111
74	3	2	2	1	2	0432110000
75	3	2	2	2	1	0000003223
76	3	1	2	0	1	0132111112
77	3	1	2	1	1	0432111113
78	3	1	2	1	1	2100113412
79	3	2	1	1	2	1432110000
80	3	1	2	1	1	2131112112
81	3	2	2	1	3	0412210000
82	3	2	2	1	2	0132111112
83	3	1	2	1	2	0432112112
84	3	1	2	0	1	0142990000
85	3	2	2	1	3	0131113112
86	3	1	2	1	1	0432110000
87	3	1	2	0	1	0000193321
88	3	2	1	1	2	0031112211
89	3	2	2	1	1	0032110000
90	3	1	2	1	1	0431110000
91	3	2	2	1	3	0432112111
92	3	2	1	1	2	0431110000
93	3	1	2	1	1	0031103121
94	3	1	2	1	1	0432110000
95	3	2	1	1	2	0432112112
96	3	2	1	1	2	0432119999
97	3	2	1	1	2	0321110000
98	3	2	1	1	2	0431110000
99	3	2	1	2	2	0031191311
100	3	1	2	0	1	0932990000
101	3	2	2	1	1	0412110000
102	3	1	1	1	1	0031110000
103	3	2	1	2	2	0312110000
104	3	1	2	1	1	0999990000
105	3	1	2	1	1	0412119999
106	3	1	2	2	1	1999110000
107	3	2	1	0	2	0312110000
108	3	2	1	2	2	0992990000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
109	3	1	2	1	1	0431110000
110	3	2	1	0	2	0999990000
111	3	1	1	1	1	0300110000
112	3	2	1	0	1	0412110000
113	3	2	1	1	3	2311110000
114	3	1	2	1	1	0412110000
115	3	1	2	1	1	0332110000
116	3	2	1	1	2	1412110000
117	3	2	1	1	2	1412110000
118	3	2	1	1	2	0512210000
119	3	1	2	1	1	0999990000
120	3	2	1	1	2	2331110000
121	3	2	1	1	2	0432110000
122	3	1	1	2	1	0431110000
123	3	1	1	1	1	0032910000
124	3	2	1	1	2	0431110000
125	3	2	1	2	2	3121110000
126	3	2	1	1	2	0431110000
127	3	2	1	2	1	0431110000
128	3	2	1	2	1	0432110000
129	3	2	1	1	2	0431110000
130	3	2	1	1	1	0032110000
131	3	1	2	2	1	0431110000
132	3	2	1	1	2	0431110000
133	3	2	1	1	2	0331110000
134	3	2	1	1	1	0431110000
135	3	2	1	1	2	0111110000
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137	3	1	2	0	1	0312110000
138	3	2	1	0	1	0332110000
139	3	2	1	1	2	1432110000
140	3	2	1	0	2	0432110000
141	3	2	1	1	2	0332110000
142	3	2	1	2	2	0331110000
143	3	2	1	2	2	0431110000
144	3	2	1	1	1	0999990000
145	3	2	1	1	1	0999990000
146	3	2	1	1	2	2900990000
147	3	1	2	2	1	0999990000
148	3	1	2	0	1	0999999999
149	3	2	1	0	1	0999990000
150	3	2	1	2	2	0999990000
151	3	2	2	1	1	0610110000
152	3	1	2	1	1	0149110000
153	3	2	1	1	2	2142990000
154	3	2	1	1	1	0999990000
155	3	2	1	2	2	0410110000
156	3	2	1	1	2	0932110000
157	3	2	1	0	1	0431110000
158	3	2	1	2	2	2000990000
159	3	2	1	1	2	0031910000
160	3	2	1	1	2	0432110000
161	3	1	2	1	1	0432110000
162	3	2	2	1	2	0431110000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
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164	3	1	2	3	1	0431110000
165	3	2	1	1	2	0431110000
166	3	2	1	2	2	0312110000
167	3	2	1	2	2	0332110000
168	3	2	1	1	2	0100110000
169	3	2	1	0	2	0411110000
170	3	2	1	1	2	0011910000
171	3	1	2	1	1	0012990000
172	3	1	2	0	1	0432110000
173	3	1	2	1	1	0091990000
174	3	2	1	1	2	0112111312
175	3	1	1	1	2	0412110000
176	3	1	2	1	1	0331110000
177	3	2	2	1	2	0012910000
178	3	1	2	1	1	0991990000
179	3	2	1	1	2	0312110000
180	3	2	1	1	2	0412110000
181	3	2	1	1	2	0922190000
182	3	1	2	2	1	0911110000
183	3	1	1	1	2	0411110000
184	3	1	2	1	9	0911990000
185	3	1	2	1	1	0932190000
186	3	1	2	1	1	0411110000
187	3	2	1	1	2	0432210000
188	3	1	2	1	1	0332110000
189	3	2	1	1	2	0331110000
190	3	2	1	1	2	0131110000
191	3	1	1	1	1	2100111312
192	3	2	1	2	2	0999900000
193	3	2	1	1	2	0011110000
194	3	2	1	1	2	0312110000
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196	3	2	1	1	2	0199110000
197	3	2	1	0	2	0431110000
198	3	2	2	0	1	0132110000
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200	3	2	1	1	2	0999900000
201	3	2	1	1	2	0132110000
202	3	2	2	1	1	0111111112
203	3	2	1	1	2	0112111111
204	3	1	2	0	1	0100112223
205	3	1	2	1	1	0131112121
206	3	1	2	1	1	0131111312
207	3	1	1	1	1	3031990000
208	3	1	1	1	1	0032991112
209	3	2	1	1	2	0311110000
210	3	2	1	1	2	0132110000
211	3	2	1	0	2	2042990000
212	3	1	2	1	1	3131110000
213	3	1	2	1	1	0331110000
214	3	1	1	1	2	0332110000
215	3	2	1	0	2	0131110000
216	3	1	2	0	1	0112110000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
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218	3	2	1	1	2	CC3291CCCC
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220	3	1	2	1	1	031111CC0C
221	3	2	1	1	1	CC3119CCCC
222	3	2	2	1	1	043211CCC0
223	3	1	2	1	1	C31211CC0C
224	3	2	2	1	2	C33211C00C
225	3	2	2	0	1	0C3219CCCC
226	3	2	1	1	2	C412111123
227	3	1	2	1	1	CC31110CCC
228	3	1	2	0	1	0332110000
229	3	2	1	1	2	0C5199CC0C
230	3	1	1	1	1	143211CCCC
231	3	1	2	2	1	C432110C0C
232	3	1	2	2	2	C412110C0C
233	3	2	1	2	1	C332110C0C
234	3	1	1	1	2	C4321100CC
235	3	2	1	1	2	C232111111
236	3	1	2	1	2	0432110C0C
237	3	1	2	2	1	C43111CC0C
238	3	1	2	2	1	C63211CC0C
239	3	2	1	1	2	0432110CCC
240	3	1	2	0	1	C612110CCC
241	3	2	1	2	2	C13211CCCC
242	3	1	2	1	1	163211CC0C
243	3	1	2	2	1	C43111CCCC
244	3	1	2	0	1	C432110CCC
245	3	2	1	2	1	C132110C00
246	3	2	1	1	2	C412110CCC
247	3	1	2	0	1	0312110C0C
248	3	2	1	1	2	C31111CC0C
249	3	2	3	1	1	043211000C
250	3	1	2	2	1	C432110C00
251	3	1	2	3	1	030011C00C
252	3	2	1	1	1	0232110C0C
253	3	1	2	1	1	031111CCCC
254	3	1	2	1	1	034211CC00
255	3	2	1	1	2	0C12590C0C
256	3	2	1	0	2	CC1299000C
257	3	1	2	1	1	061211000C
258	3	2	1	0	2	CC1299C00C
259	3	1	2	1	1	0332110C0C
260	3	2	1	1	2	2332110C00
261	3	2	1	1	1	003299C00C
262	3	2	1	2	2	0332112112
263	3	2	1	2	1	2332112121
264	3	2	2	1	1	C412110000
265	3	2	2	0	2	0C32992111
266	3	2	2	1	2	C43211CCCC
267	3	1	1	1	1	041211CC00
268	3	1	1	1	1	0112110C0C
269	3	2	1	1	2	C43221CCC0
270	3	2	1	1	1	C41211CCCC

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
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272	3	2	1	1	2	0332110000
273	3	1	2	1	1	0932910000
274	3	1	2	1	1	0412210000
275	3	2	1	1	2	0412110000
276	3	2	1	2	2	0432110000
277	3	2	1	1	2	0312110000
278	3	1	2	0	1	2332110000
279	3	1	2	1	1	0331110000
280	3	1	2	1	1	3131110000
281	3	1	2	0	1	0100111412
282	3	1	2	2	1	0431110000
283	3	1	2	0	1	0412110000
284	3	1	1	2	1	0942990000
285	3	1	1	1	1	0132990000
286	3	2	1	3	3	0111110000
287	3	1	2	3	2	0131110000
288	3	1	2	2	1	0312110000
289	3	2	1	2	2	0000111312
290	3	1	2	1	2	3131110000
291	3	1	2	2	1	2000111323
292	3	1	2	2	1	0012111312
293	3	1	1	2	1	2100111312
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295	3	2	1	1	2	0000191112
296	3	1	1	1	1	0032110000
297	3	1	1	1	1	0412110000
298	3	1	2	1	1	0131111111
299	3	2	1	2	2	0412110000
300	3	2	1	1	2	0112111112
301	3	1	1	1	1	2111111112
302	3	1	1	1	1	0042990000
303	3	1	2	1	1	0612190000
304	3	1	2	1	1	1612990000
305	3	1	2	1	1	0632210000
306	3	1	1	2	2	[illegible]
307	3	1	1	1	1	2632110000
308	3	1	1	1	1	0042390000
309	3	1	1	1	1	[illegible]
310	3	1	1	1	1	0042390000
311	3	1	1	1	1	0632110000
312	3	1	1	1	1	2100110000
313	3	1	1	3	1	0199110000
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315	3	1	1	2	1	0942990000
316	3	1	1	2	1	0642110000
317	3	1	1	0	1	0642310000
318	3	1	1	1	2	0412110000
319	3	2	1	1	2	0042000000
320	3	2	1	2	2	0142000000
321	3	1	1	1	1	2100111312
322	3	1	1	1	1	2332110000
323	3	1	1	1	1	0042901312
324	3	1	1	1	1	0012000000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
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326	3	1	1	1	1	0212110000
327	3	1	1	1	1	0042990000
328	3	1	1	1	1	0432110000
329	3	1	1	1	1	0642990000
330	3	1	1	1	1	0000190000
331	3	2	1	1	2	0342990000
332	3	1	1	1	1	0432110000
333	3	1	2	1	1	0000190000
334	3	2	1	2	2	0044390000
335	3	2	1	1	2	0142990000
336	3	1	1	1	1	0412110000
337	3	2	1	1	2	0432120000
338	3	2	2	2	2	0612110000
339	3	1	2	3	1	0412110000
340	3	2	1	1	2	0411110000
341	3	1	2	2	1	0131110000
342	3	3	2	2	3	0942990000
343	3	2	1	1	2	0140110000
344	3	1	2	1	1	2012991112
345	3	2	1	2	2	0132111112
346	3	2	1	2	1	0100110000
347	3	1	2	3	1	1100111412
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349	3	1	2	1	1	0131111112
350	3	1	2	0	1	0111111411
351	3	2	1	1	2	0031991112
352	3	1	2	0	1	1331111312
353	3	1	1	2	1	2412210000
354	3	2	1	2	2	0642320000
355	3	2	1	1	2	0942990000
356	3	2	1	2	2	0100111411
357	3	1	1	2	2	0522210000
358	3	2	1	1	2	0631110000
359	3	1	2	2	1	0999999999
360	3	2	1	2	2	0000191412
361	3	2	1	3	1	0999990000
362	3	1	2	3	1	3100110000
363	3	2	1	1	2	0331110000
364	3	2	1	1	1	0100110000
365	3	2	1	1	2	0412110000
366	3	1	1	2	2	0432110000
367	3	2	1	2	2	0111111312
368	3	2	2	1	2	0432111211
369	3	2	1	1	2	0431110000
370	3	1	2	0	1	2922210000
371	3	2	1	1	2	0142990000
372	3	2	2	1	2	2121110000
373	3	2	2	3	1	3311110000
374	3	1	1	3	1	3311110000
375	3	2	2	2	1	0332210000
376	3	2	1	2	1	2990990000
377	3	2	2	2	1	0412111111
378	3	1	2	1	1	0032119999

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
379	3	1	1	1	1	0999999999
380	3	1	1	1	1	0131110000
381	3	1	1	2	2	0312111112
382	3	1	1	1	1	3642320000
383	3	1	1	1	1	3942310000
384	3	1	1	0	1	2910110000
385	3	1	2	1	1	2031111111
386	3	1	2	1	1	2412110000
387	3	1	1	2	1	4432110000
388	3	2	1	2	2	0942990000
389	3	1	1	0	1	1012190000
390	3	1	2	1	1	2111111111
391	3	1	2	0	1	0332110000
392	3	1	2	1	1	0242990000
393	3	2	1	0	1	0012910000
394	3	2	1	1	2	0332111111
395	3	1	1	2	1	0312110000
396	3	1	1	2	1	0912110000
397	3	1	1	0	1	2432110000
398	3	1	1	1	2	0432110000
399	3	1	2	2	1	0432110000
400	3	1	1	2	1	0932990000
401	3	1	2	1	1	0132110000
402	3	1	1	1	1	0132119999
403	3	1	1	1	1	0112110000
404	3	2	1	1	2	0332110000
405	3	1	2	1	1	0312110000
406	3	1	2	1	1	0412110000
407	3	1	2	1	1	0412110000
408	3	1	2	1	2	0412111312
409	3	2	1	1	1	0412110000
410	3	2	1	2	2	0311110000
411	3	2	1	2	2	1411110000
412	3	2	1	1	2	0432119999
413	3	1	2	1	1	0431110000
414	3	1	2	1	1	0411110000
415	3	1	2	2	1	0311110000
416	3	2	1	1	2	0432110000
417	3	2	1	1	2	0432110000
418	3	2	1	1	2	0432110000
419	3	1	1	1	2	0331110000
420	3	1	1	1	1	0431110000
421	3	1	1	2	1	0431110000
422	3	1	1	1	1	0911190000
423	3	1	1	2	1	2311110000
424	3	1	1	1	2	1311110000
425	3	1	1	1	2	0911111312
426	3	1	2	0	1	0411119999
427	3	1	1	1	1	0311110000
428	3	1	1	1	1	0912110000
429	3	1	1	2	2	0999990000
430	3	2	1	1	2	0311110000
431	3	1	1	1	2	0200110000
432	3	1	1	2	2	0311110000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
433	3	1	9	1	1	9432110000
434	3	1	1	1	1	1310110000
435	3	1	1	2	1	0999990000
436	3	1	1	1	1	1431110000
437	3	1	1	2	1	0332110000
438	3	1	1	2	1	2612110000
439	3	1	1	2	1	2412110000
440	3	2	1	1	2	0240990000
441	3	1	1	1	2	2412110000
442	3	2	1	1	2	1999990000
443	3	2	1	2	1	1311110000
444	3	1	1	1	1	0912110000
445	3	1	1	1	1	2111110000
446	3	1	1	1	1	0111110000
447	3	1	1	1	1	1311110000
448	3	1	2	2	1	2999990000
449	3	2	1	1	2	0411110000
450	3	1	1	2	2	2411210000
451	3	1	1	0	1	0091910000
452	3	1	1	9	1	0412110000
453	3	1	2	0	1	2999999999
454	3	2	1	1	1	1312110000
455	3	1	1	1	1	2100111311
456	3	2	1	1	1	0931110000
457	3	1	1	1	1	0931110000
458	3	1	2	1	1	4311110000
459	3	2	1	1	2	0331110000
460	3	2	1	1	2	0131110000
461	3	1	1	2	3	2431110000
462	3	1	2	0	1	2331110000
463	3	1	1	2	2	0311110000
464	3	1	1	2	2	0131110000
465	3	1	1	2	2	0331110000
466	3	1	1	2	2	0131110000
467	3	1	2	1	1	2111110000
468	3	2	1	1	2	1111111311
469	3	2	1	1	3	1100111412
470	3	2	1	2	2	0412110000
471	3	1	1	2	1	0431110000
472	3	2	1	1	3	2112110000
473	3	2	1	1	2	0999990000
474	3	2	1	2	2	0112110000
475	3	2	2	2	2	2100110000
476	3	2	2	2	1	0412110000
477	3	1	2	1	1	0431110000
478	3	2	2	1	2	0332110000
479	3	2	1	1	2	0312110000
480	3	1	2	1	1	1999990000
481	3	1	1	2	1	0612110000
482	3	2	2	1	2	0412110000
483	3	2	1	1	2	0912990000
484	3	1	1	1	1	0432110000
485	3	2	1	2	2	2311110000
486	3	2	1	1	2	1432110000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
487	3	2	1	1	2	2031911111
488	3	2	1	2	3	1100190000
489	3	2	1	1	2	0992990000
490	3	2	1	1	3	9100110000
491	3	2	1	1	2	3100111412
492	3	2	1	2	2	0412110000
493	3	1	2	0	1	0111111312
494	3	1	1	1	1	3942990000
495	3	1	1	2	1	0999990000
496	3	1	1	1	2	0999990000
497	3	2	1	2	3	0999990000
498	3	1	1	2	1	0100111112
499	3	2	1	1	3	0942990000
500	3	2	1	2	2	9999990000
501	3	2	1	3	2	9999999999
502	3	1	1	0	1	4640010000
503	3	2	1	2	1	1900990000
504	3	2	1	0	1	0100110000
505	3	2	1	2	2	0312110000
506	3	1	2	0	1	0432111421
507	3	2	2	1	2	0432112111
508	3	2	2	1	1	0032113411
509	3	2	2	1	2	0432110000
510	4	1	2	1	1	3931190000
511	4	1	2	1	1	3931190000
512	4	1	2	1	1	0132110000
513	4	1	2	1	1	0332110000
514	4	1	2	1	1	0632210000
515	4	1	2	2	1	1199110000
516	4	1	2	1	1	0312110000
517	4	1	2	1	1	0931990000
518	4	1	2	1	1	2131110000
519	4	1	2	2	1	0132110000
520	4	1	2	1	1	0432110000
521	4	1	2	2	1	1112110000
522	4	1	2	1	1	0912191112
523	4	1	2	0	1	0432113112
524	4	1	2	0	1	0030193121
525	4	1	2	0	1	0199193121
526	4	1	2	0	1	0030993121
527	4	1	2	0	1	0030993121
528	4	1	2	1	1	0010993121
529	4	1	2	1	1	0010993121
530	4	1	2	2	1	0432110000
531	4	1	2	2	1	2332221311
532	4	1	2	2	1	2221222312
533	4	1	2	2	1	0932991111
534	4	1	2	2	1	2031111011
535	4	2	2	1	1	3900190000
536	4	2	1	2	3	0432110000
537	4	1	2	1	1	0431110000
538	4	1	2	2	1	0432110000
539	4	2	1	2	2	0412110000
540	4	1	2	1	1	0911990000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
541	4	1	2	1	1	0911990000
542	4	1	2	1	1	0911990000
543	4	1	2	1	1	0911990000
544	4	1	2	2	1	0412110000
545	4	1	2	2	1	1911990000
546	4	2	2	2	2	0011991111
547	4	1	2	1	1	0942991111
548	4	2	2	1	1	0942990000
549	4	2	2	2	2	0932991111
550	4	1	2	2	1	9999990000
551	4	1	2	2	1	0932999999
552	4	2	1	1	2	0932990000
553	4	2	1	2	2	0942990000
554	4	1	2	2	1	0932990000
555	4	1	2	2	1	0942999999
556	4	1	2	1	1	0999999999
557	4	2	2	2	2	1412110000
558	4	1	2	3	1	0432119999
559	4	2	2	1	1	0432111111
560	4	1	1	3	2	0999990000
561	4	9	9	2	3	0432110000
562	5	1	2	1	1	0022200000
563	5	1	3	2	2	0642310000
564	5	3	1	2	2	0642310000
565	5	3	1	2	2	1642310000
566	5	3	1	3	1	1642320000
567	5	1	2	1	1	0412210000
568	5	1	2	0	1	0342210000
569	5	3	1	2	1	1111220000
570	5	1	2	0	1	0022220000
571	5	3	1	1	1	0032200000
572	5	1	1	1	1	1932100000
573	5	1	1	2	2	0132110000
574	5	1	1	2	2	0011100000
575	5	3	1	1	2	1042300000
576	5	3	1	1	2	1032300000
577	5	3	1	2	3	3111111111
578	5	3	1	3	3	0031101111
579	5	3	1	1	2	0142332223
580	5	3	1	1	1	0011110000
581	5	3	1	2	2	0042191411
582	5	3	1	2	2	2100111111
583	5	3	1	2	3	3100111111
584	5	3	1	2	2	2111111312
585	5	3	1	2	2	0612111211
586	5	3	1	0	2	0632121219
587	5	3	1	2	2	0032191111
588	5	3	1	1	1	4612230000
589	5	3	1	2	1	0011191111
590	5	3	1	2	2	2642210000
591	5	3	1	2	3	2632200000
592	5	3	1	2	2	1642320000
593	5	3	1	3	2	3612210000
594	5	3	1	1	1	2612210000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
595	5	3	1	2	2	1612211112
596	5	1	2	1	1	1612210000
597	5	1	1	1	1	0642310000
598	5	1	1	1	1	0632210000
599	5	3	1	2	2	2012191111
600	5	3	1	3	2	2612110000
601	5	1	2	2	1	2412110000
602	5	3	1	1	1	0042091011
603	5	3	1	2	2	0412910000
604	5	3	1	2	2	0412211212
605	5	3	1	1	2	0632110000
606	5	3	1	2	2	1642310000
607	5	3	1	2	2	0642310000
608	5	3	1	1	1	0412210000
609	5	3	1	3	2	2612210000
610	5	2	1	2	1	0412110000
611	5	2	1	2	1	0612110000
612	5	3	1	2	2	0642310000
613	5	3	1	2	2	0612110000
614	5	3	1	3	2	2612110000
615	5	3	1	2	2	3632110000
616	5	3	1	1	1	0642390000
617	5	3	1	2	1	0612110000
618	5	3	1	2	3	2612110000
619	5	3	1	1	2	1642310000
620	5	3	1	3	2	3612110000
621	5	3	1	2	2	4612110000
622	5	3	1	2	2	4612110000
623	5	3	1	2	1	3612110000
624	5	3	1	3	2	2612210000
625	5	3	1	3	3	2612110000
626	5	3	1	3	2	2642310000
627	5	3	1	3	2	3622210000
628	5	3	1	3	3	4112110000
629	5	3	1	3	2	2642390000
630	5	3	1	2	2	1422210000
631	5	3	1	2	2	0412110000
632	5	3	1	3	2	0432110000
633	5	3	1	0	2	0412110000
634	5	3	1	1	2	0412210000
635	5	2	1	1	1	0112110000
636	5	3	1	1	2	0412210000
637	5	3	1	2	2	0412210000
638	5	3	1	2	2	0412110000
639	5	3	1	2	2	0412110000
640	5	3	1	1	2	0432210000
641	5	3	1	2	3	0412110000
642	5	3	1	1	2	0112110000
643	5	3	1	2	2	0112110000
644	5	3	1	0	1	0112110000
645	5	3	1	1	2	0112110000
646	5	3	1	1	2	0112110000
647	5	3	1	2	2	0122210000
648	5	3	1	1	2	0412210000

SAS

OBS	ISLE	CHERT	SIZE	INCLU	GRAIN	CLASS
649	5	3	1	1	2	C412110C0C
650	5	3	1	1	2	0432210CCC
651	5	3	1	1	2	C112990C00
652	5	3	1	1	2	141211CC0C
653	5	3	1	2	2	C412210C0C
654	5	3	1	0	2	C432110CCC
655	5	3	1	2	2	0422111111
656	5	3	1	2	2	C131110C0C
657	5	3	1	1	2	0111110CCC
658	5	3	1	1	2	1111110C00
659	5	3	1	1	2	1111110C0C
660	5	3	1	1	2	1111110C0C
661	5	3	1	1	2	1111111112
662	5	3	1	1	2	1311110C0C
663	5	3	1	1	2	1411110000C
664	5	3	1	1	1	141111C00C
665	5	3	1	1	2	1111110CCC
666	5	1	1	1	1	C412110C0C
667	5	2	1	1	1	C131110C0C
668	5	3	1	1	2	143211CCCC
669	5	3	1	1	2	143111CC0C
670	5	3	1	1	2	1411110CCC
671	5	2	1	1	1	0432110C0C
672	5	3	1	3	3	233111CC0C
673	5	3	1	1	2	1131110C0C
674	5	3	1	2	1	CC3199C00C
675	5	3	1	1	1	C131110C0C
676	5	2	1	1	1	C13111CC0C
677	5	2	1	1	1	C111110C00
678	5	2	1	1	2	CC1119C00C
679	5	3	1	1	2	C411110000
680	5	3	1	1	1	C43211CC0C
681	5	3	1	2	2	041221CC0C

APPENDIX B

FREQUENCY HISTOGRAMS OF DIMENSIONS AND MODES BY ISLAND

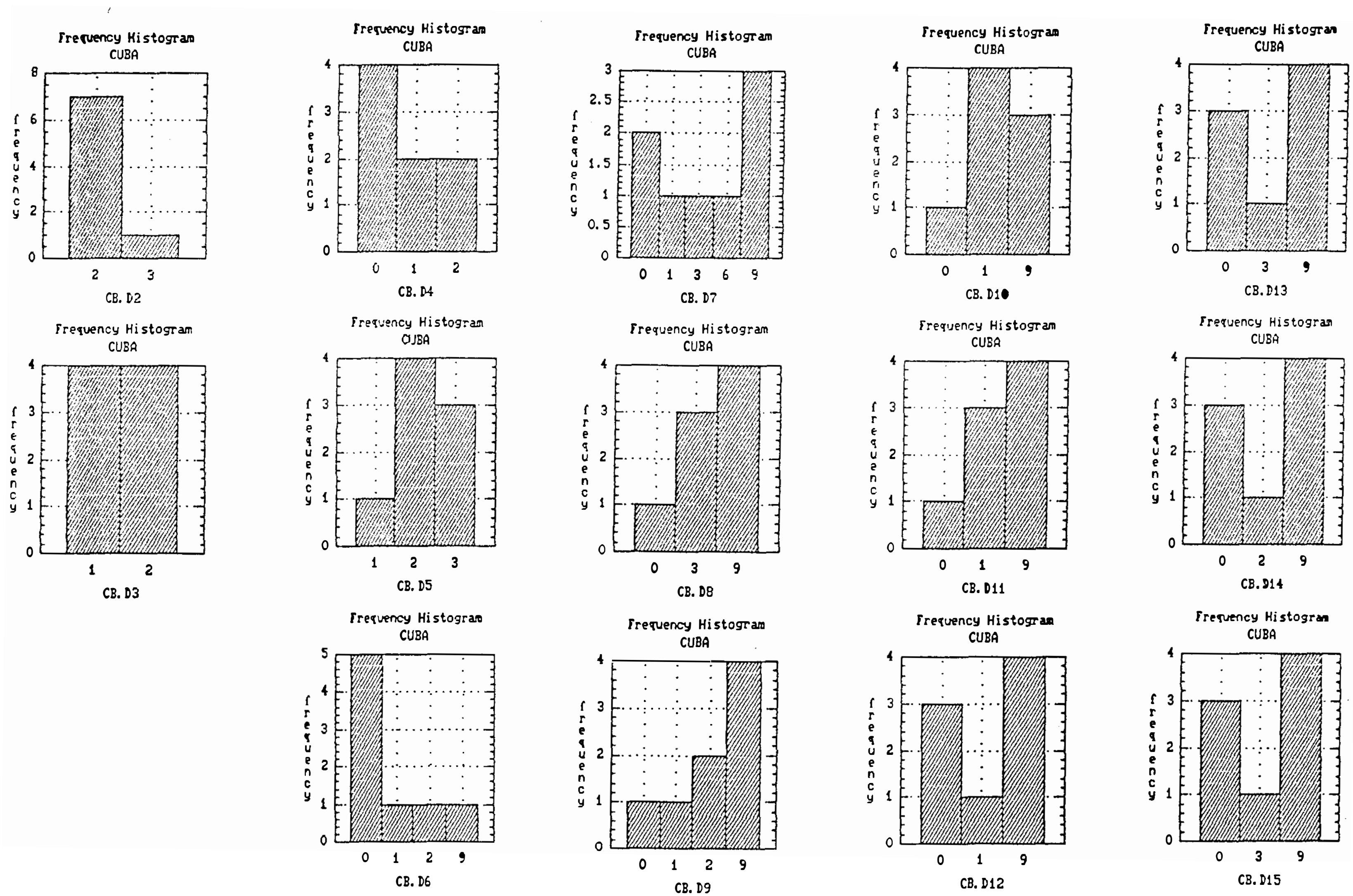

Figure B-1. Frequency histograms of all dimensions and modes for Cuba.

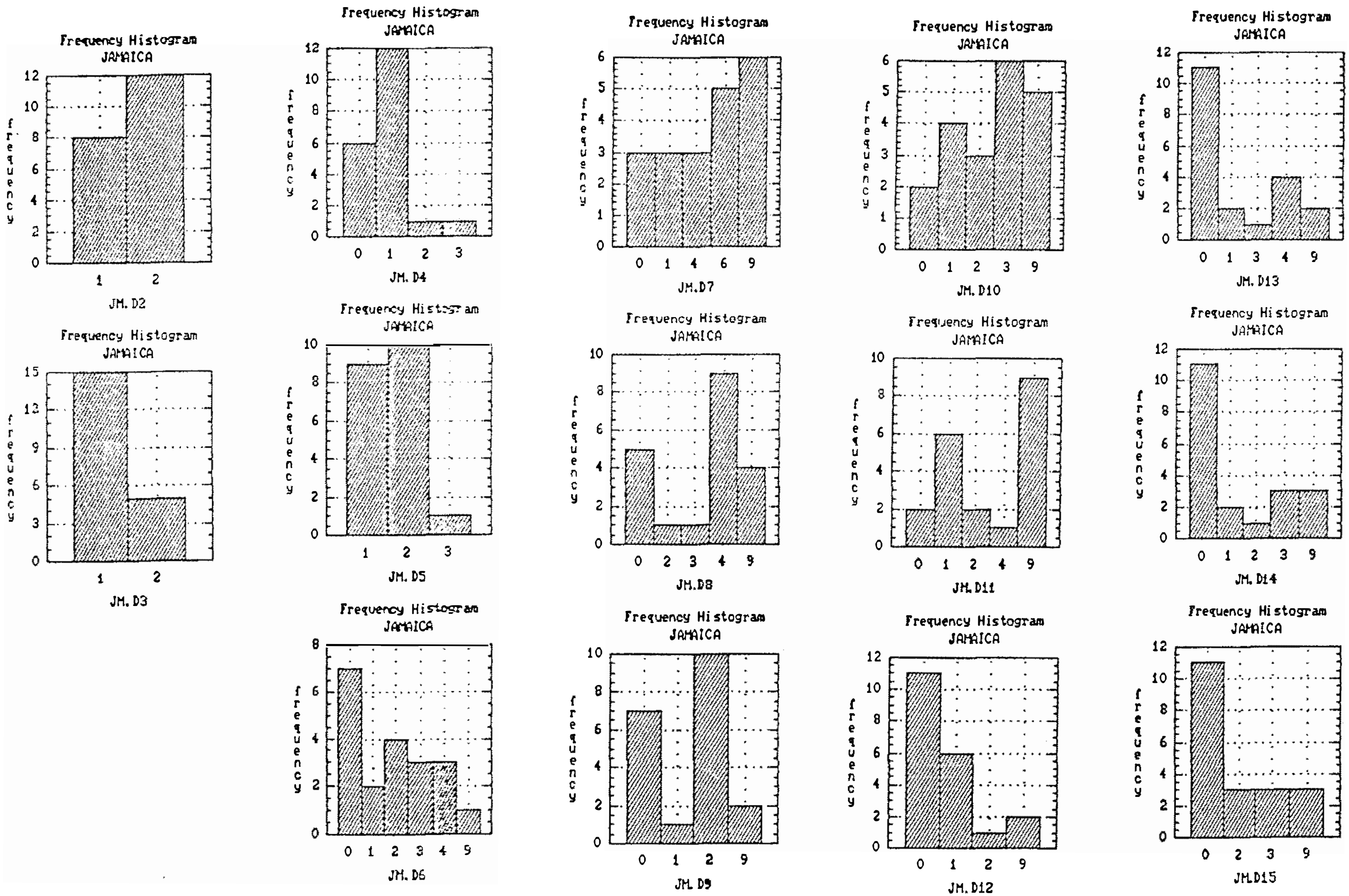

Figure B-2. Frequency histograms of all dimensions and modes for Jamaica.

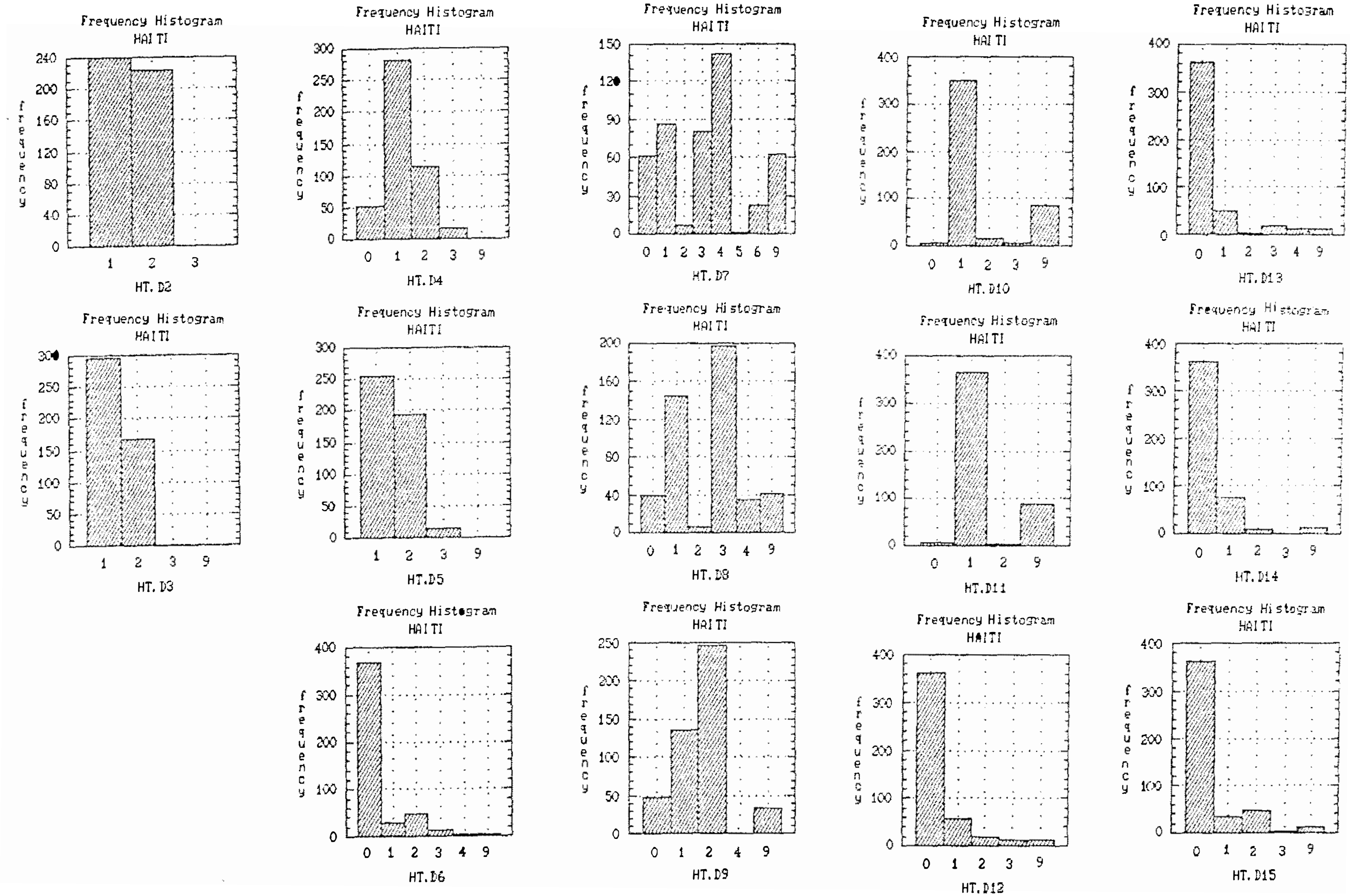

Figure B-3. Frequency histograms of all dimensions and modes for Haiti.

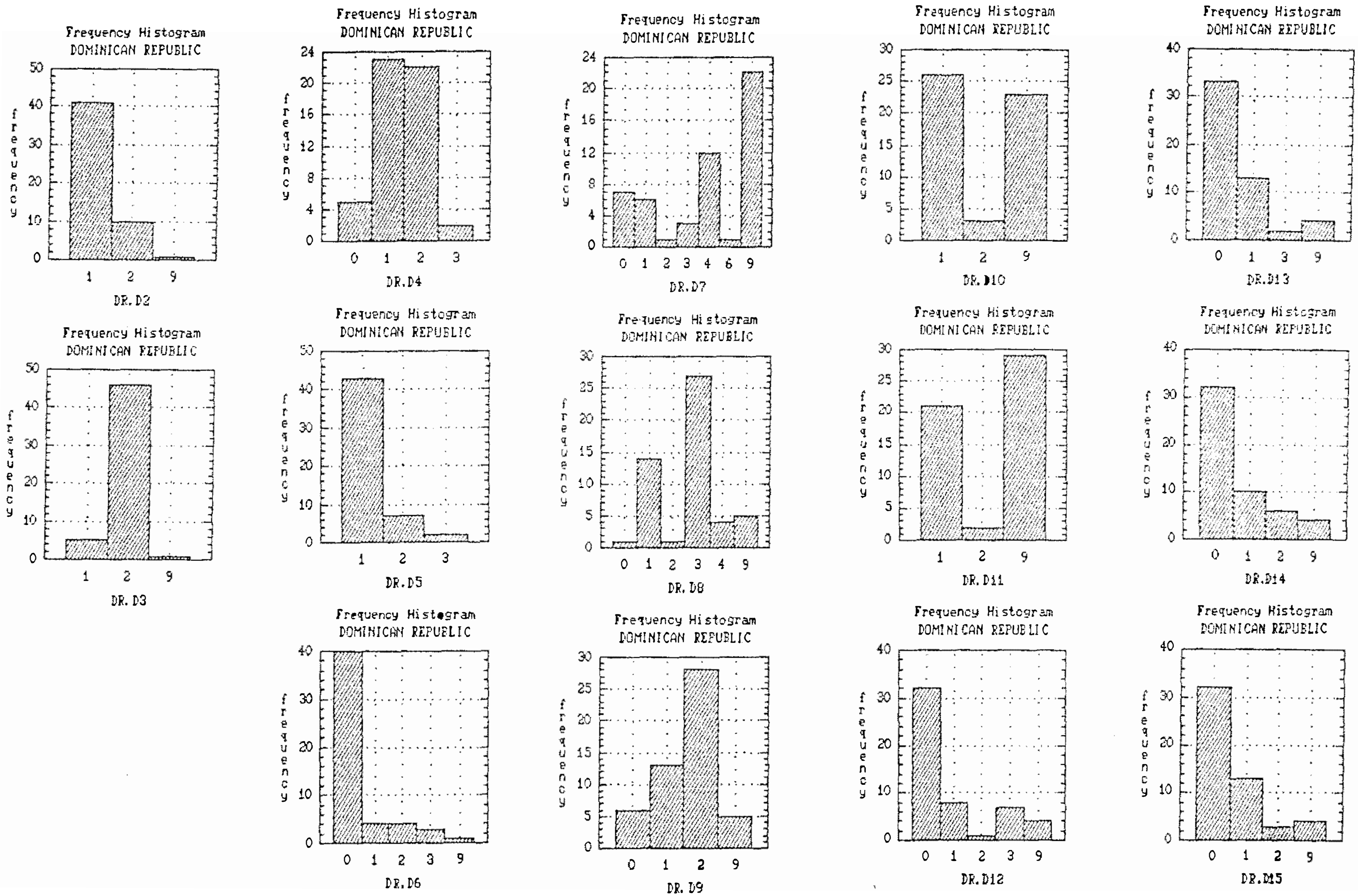

Figure B-4. Frequency histograms of all dimensions and modes for the Dominican Republic.

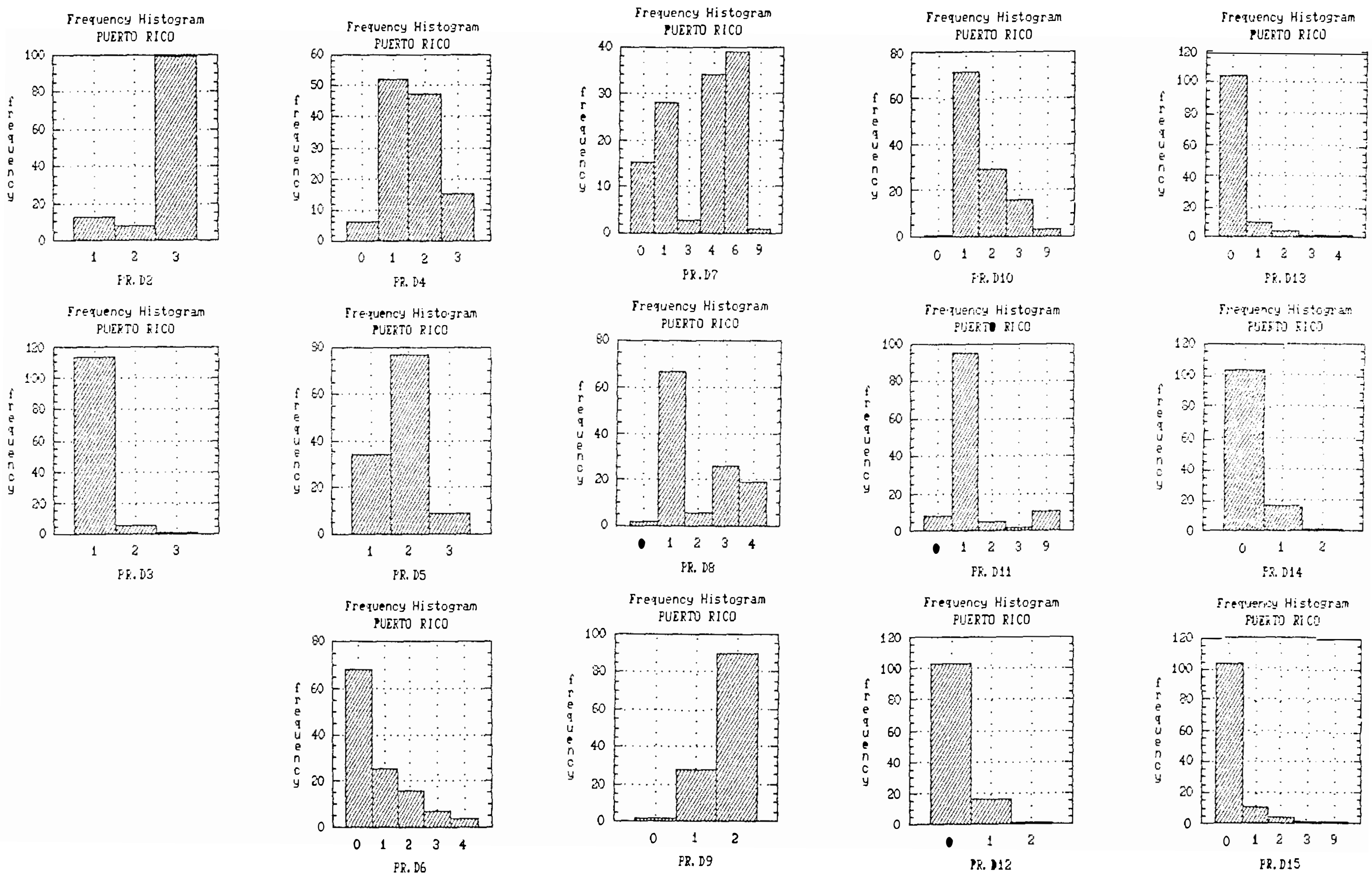

Figure B-5. Frequency histograms of all dimensions and modes for Puerto Rico.

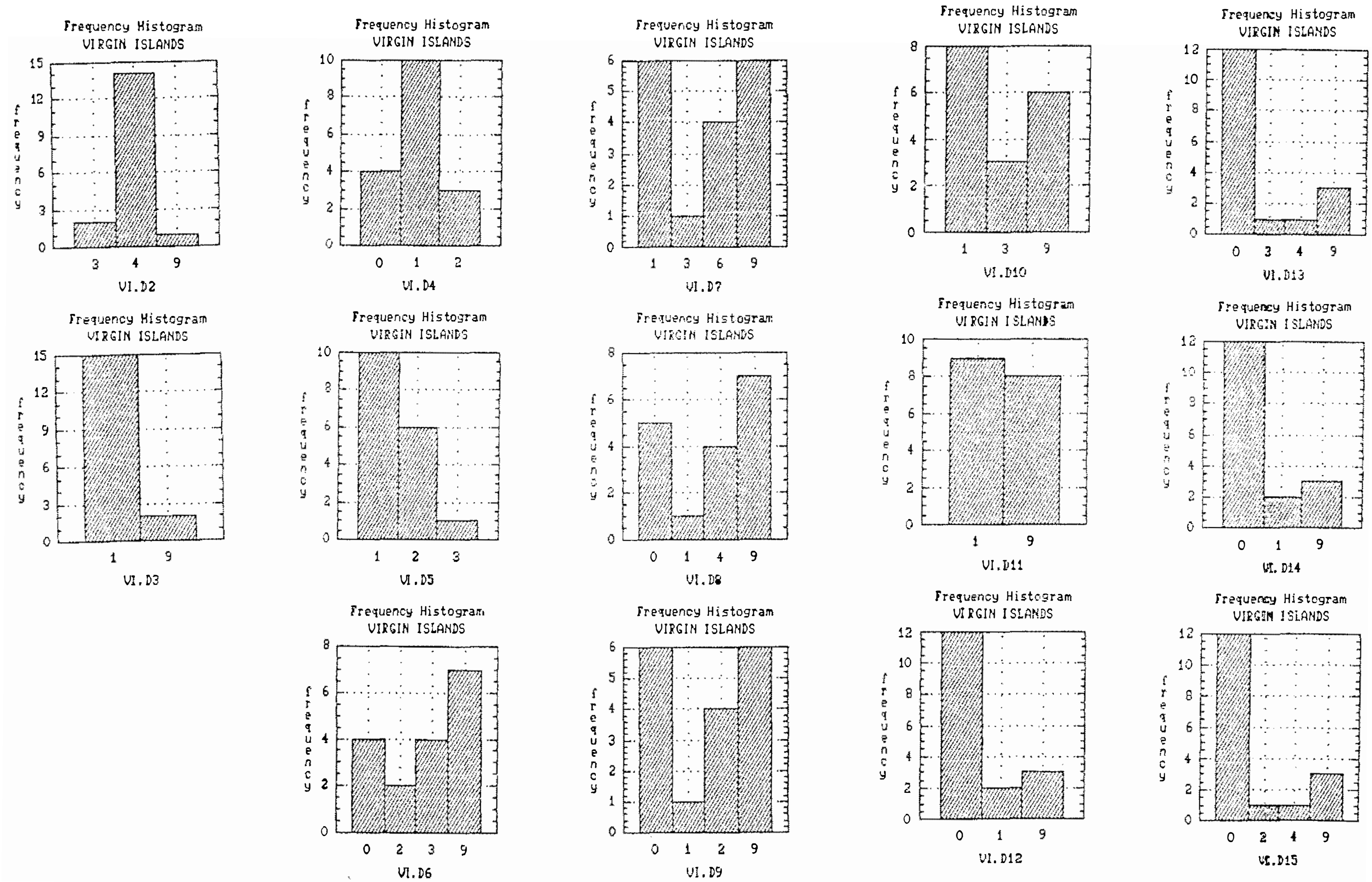

Figure B-6. Frequency histograms of all dimensions and modes for the Virgin Islands.

APPENDIX C

FREQUENCY HISTOGRAMS FOR DIMENSIONS 2-15

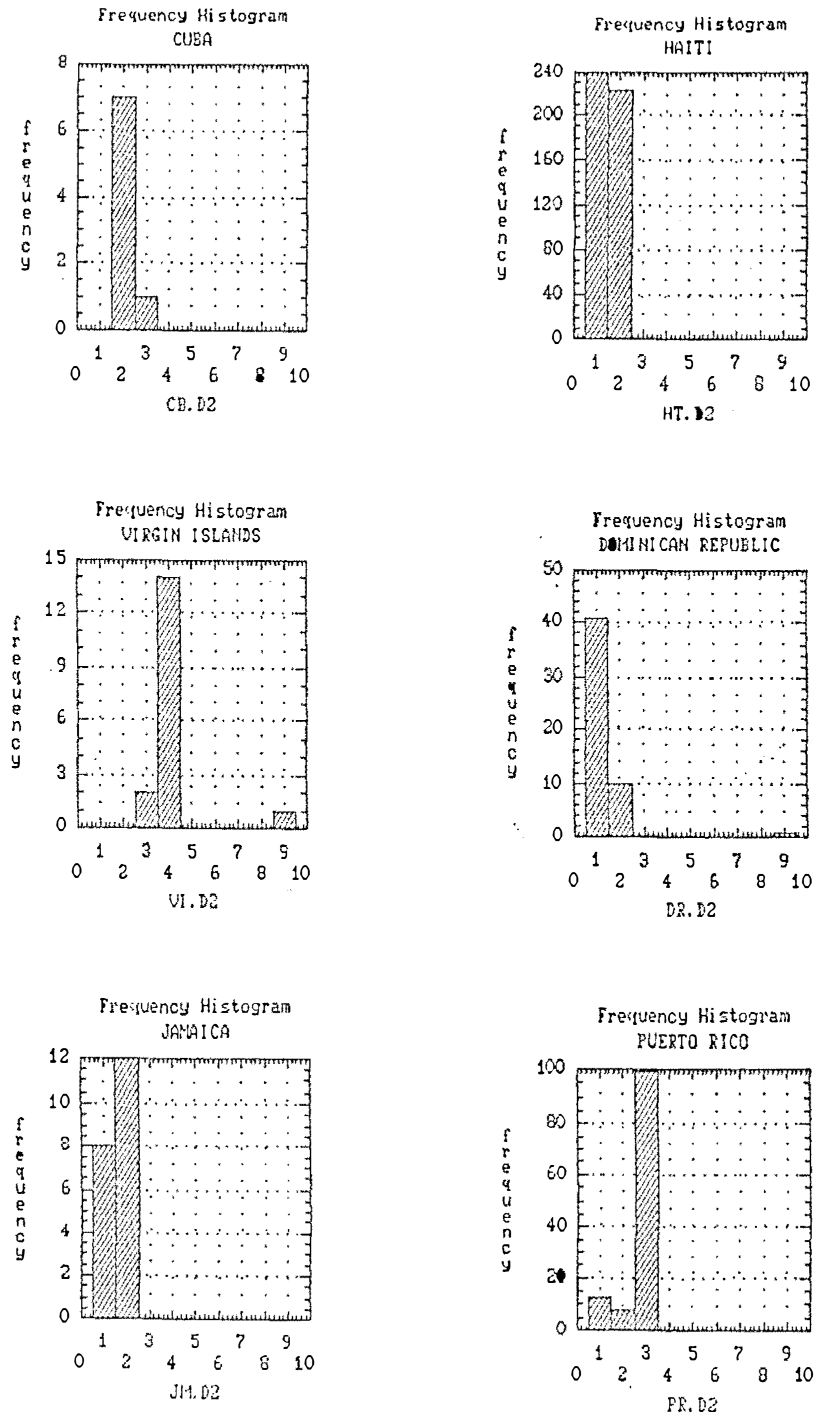

Figure C-1. Frequency histograms showing modes of geologic types (DM2) for each island.

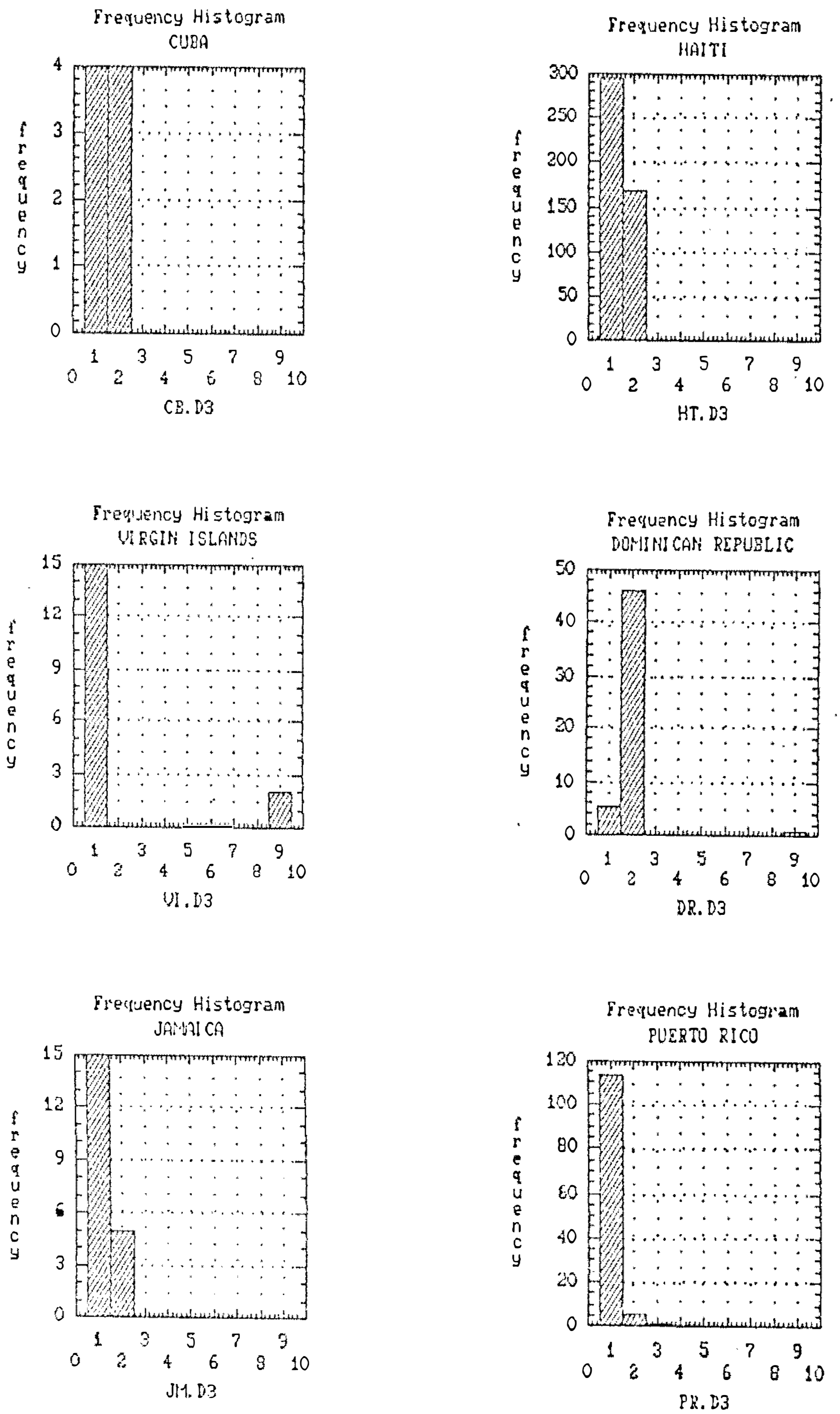

Figure C-2. Frequency histograms showing modes of size potential of the raw material (DM3) for each island.

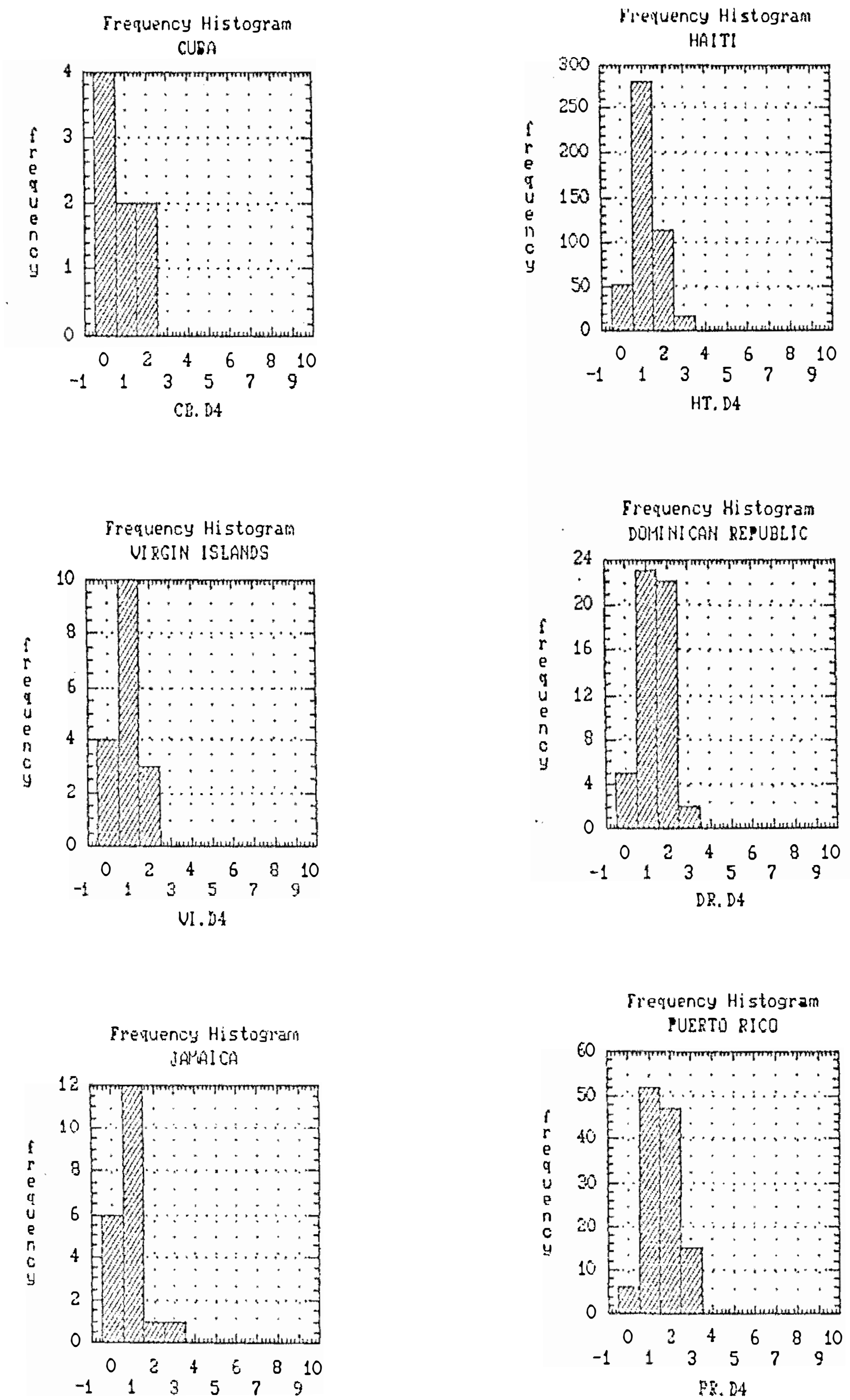

Figure C-3. Frequency histograms showing modes of inclusions in raw material (DM4) for each island.

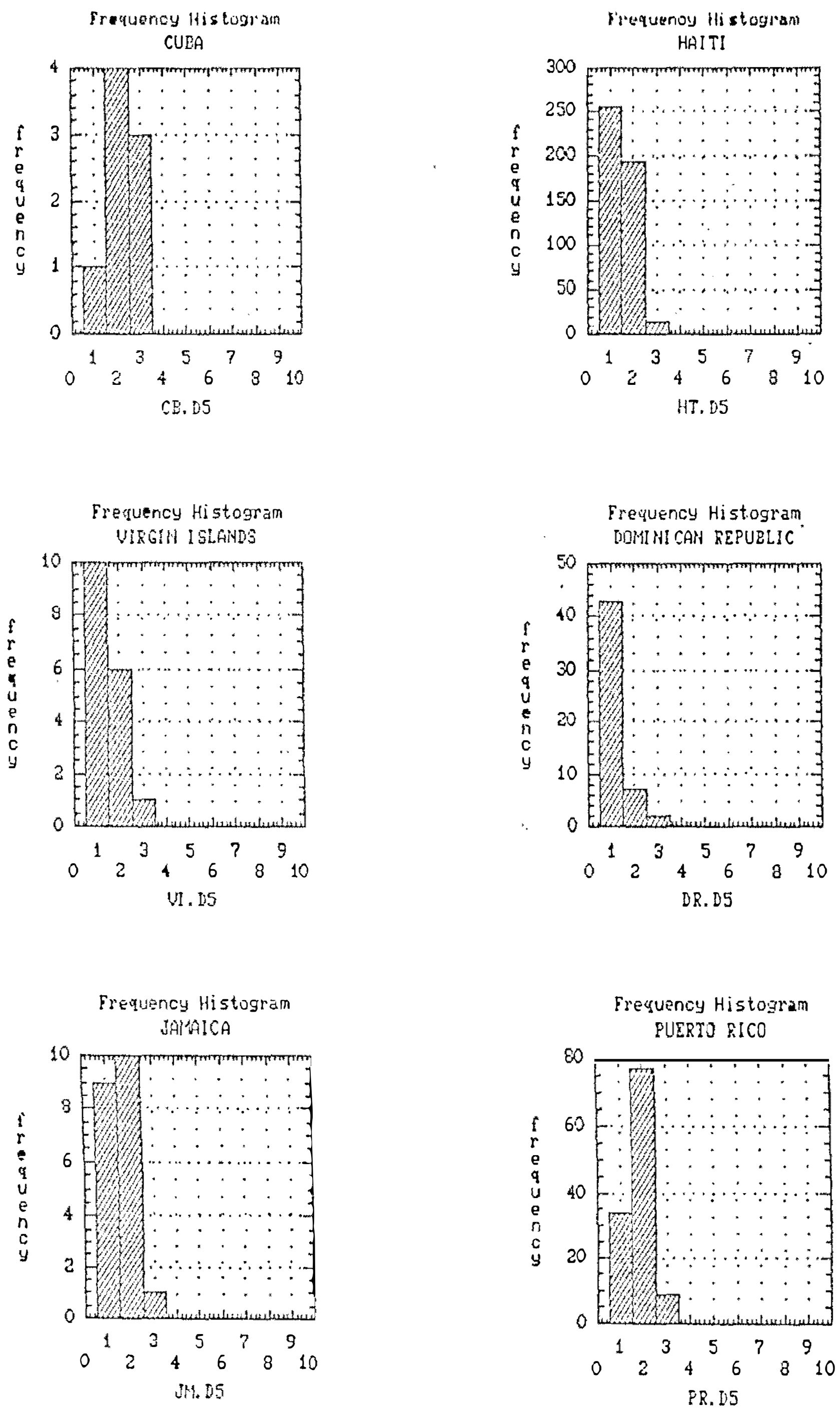

Figure C-4. Frequency histograms showing modes of grain (DM5) for each island.

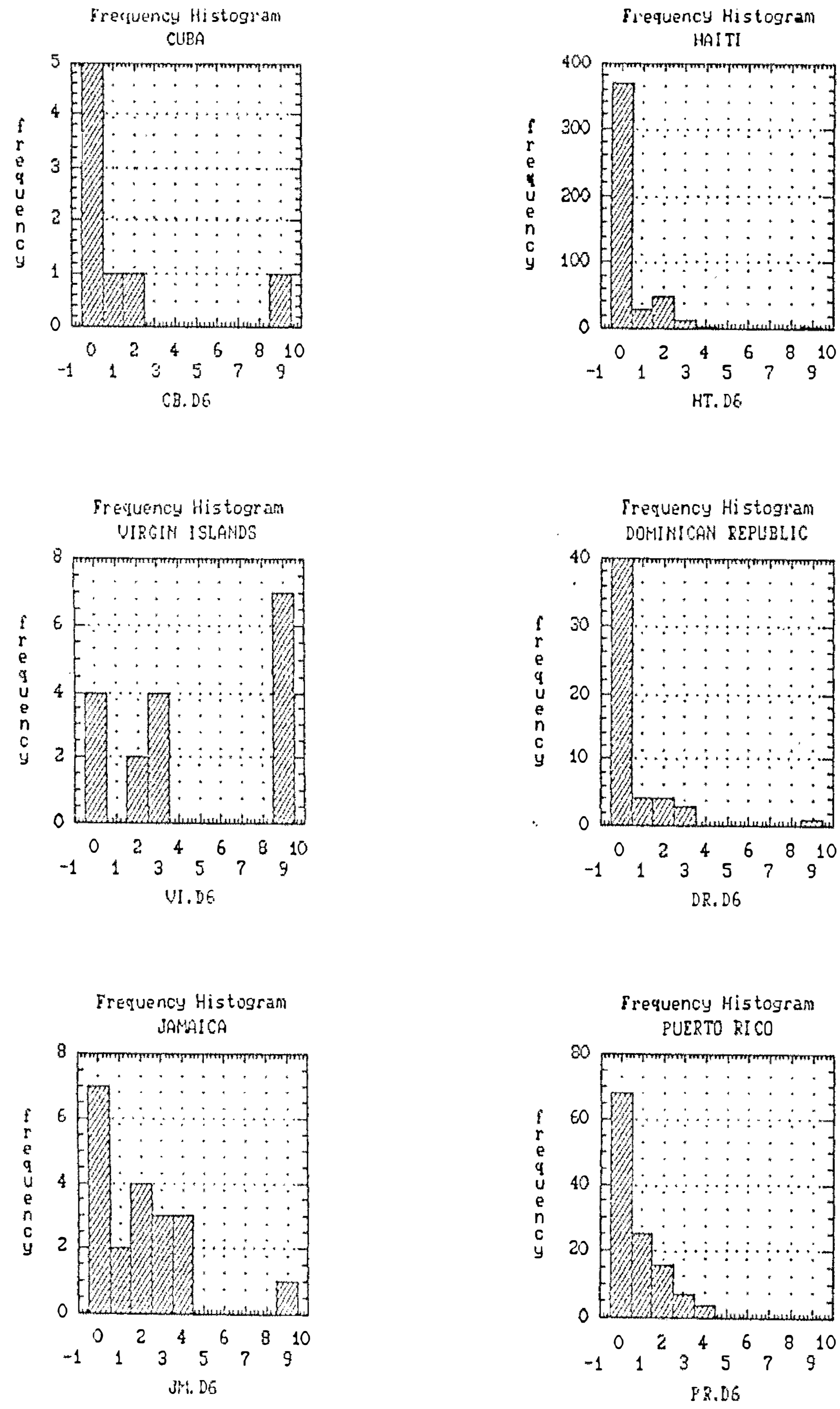

Figure C-5. Frequency histograms showing modes of degree of cortex (DM6) for each island.

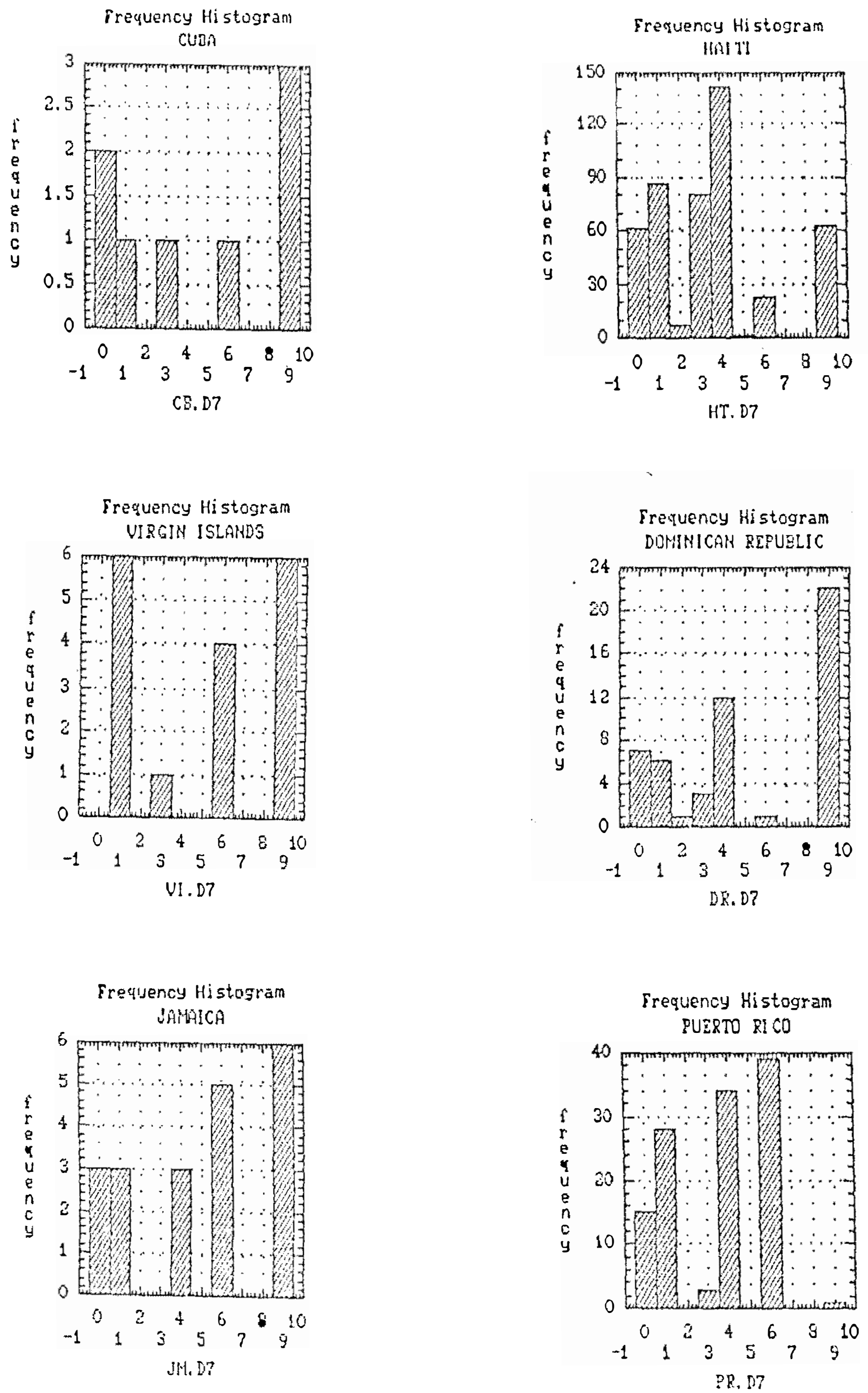

Figure C-6. Frequency histograms showing modes of bulbs of percussion (DM7) for each island.

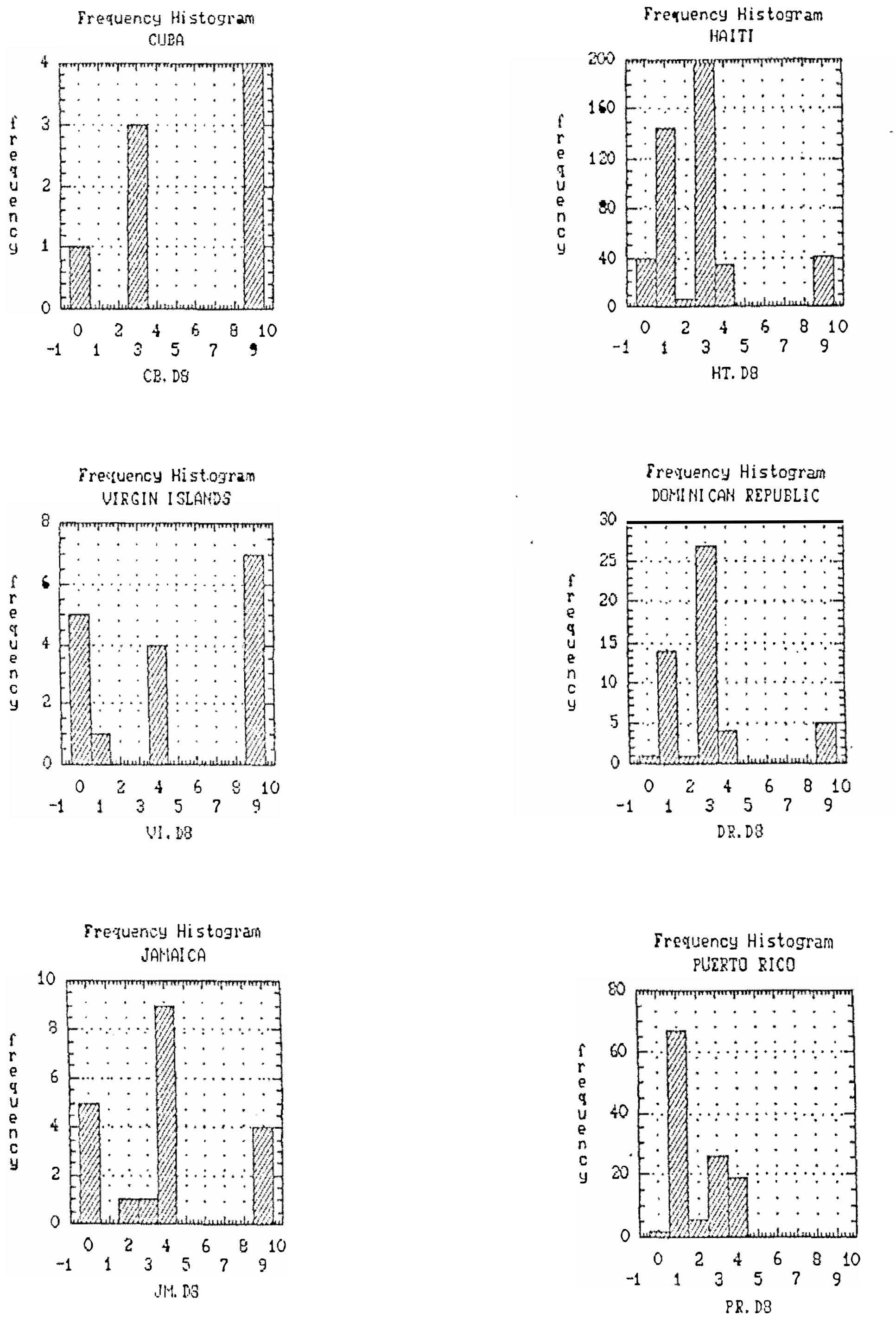

Figure C-7. Frequency histograms showing modes of the direction of primary flake scars (DM8) for each island.

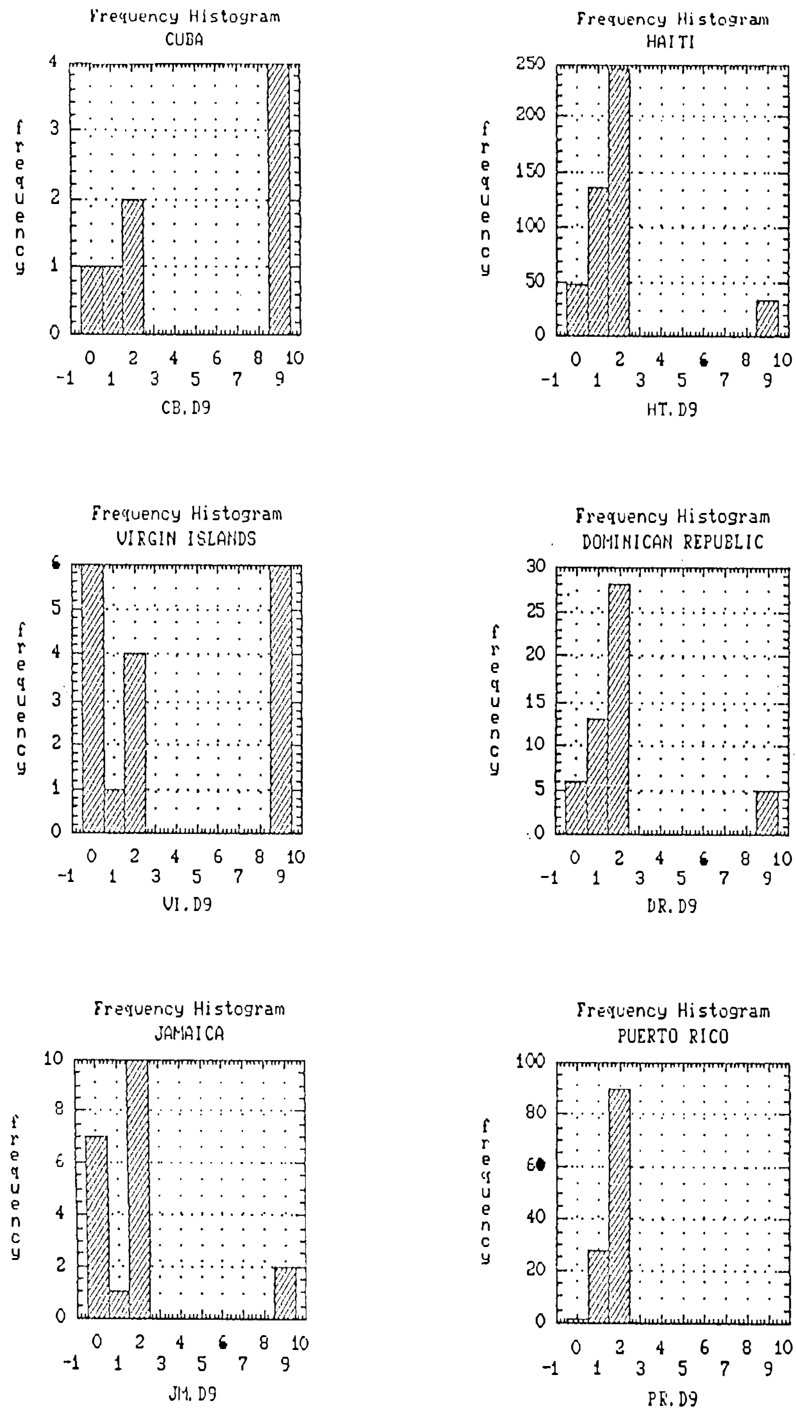

Figure C-8. Frequency histograms showing modes of the number of primary flake scars (DM9) for each island.

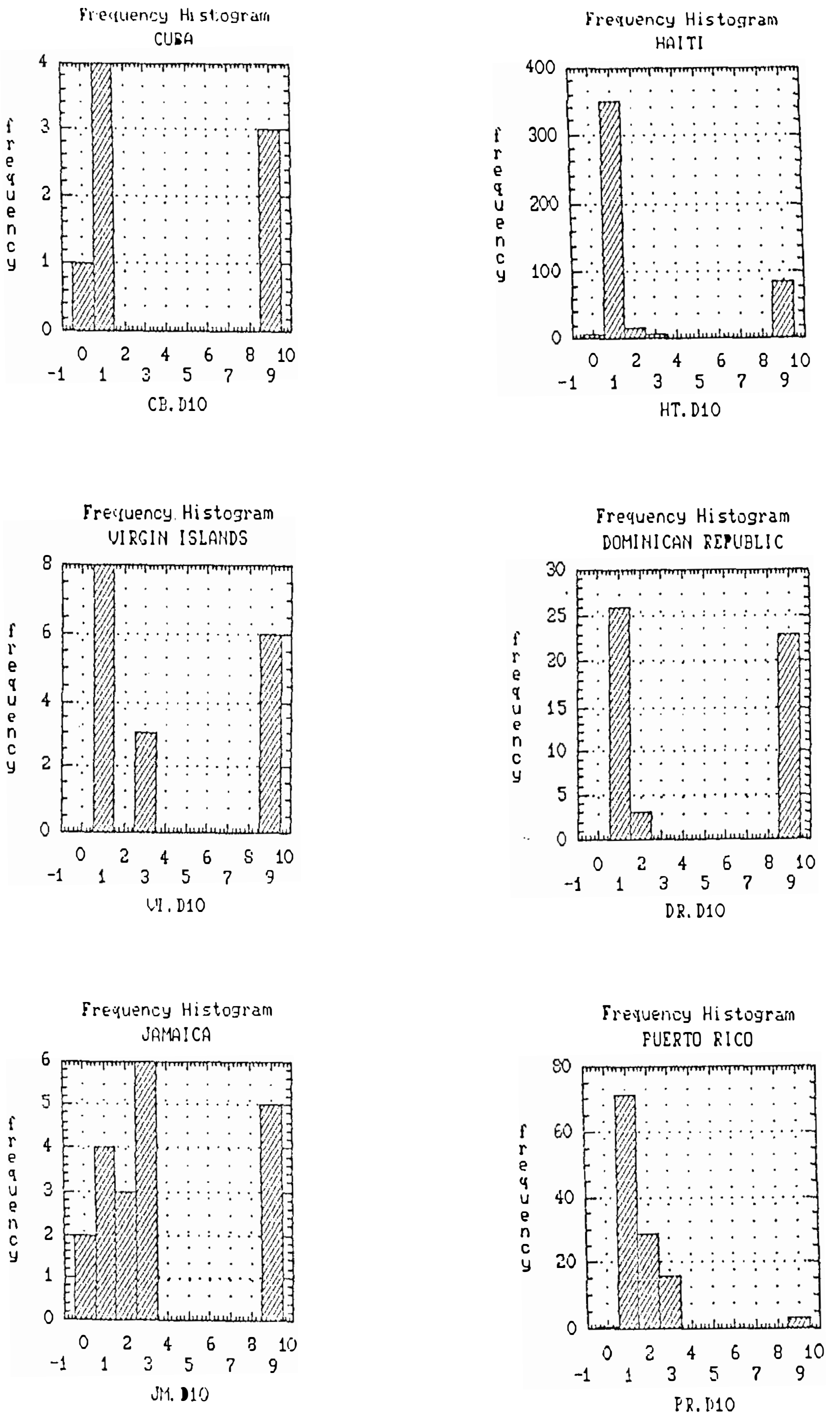

Figure C-9. Frequency histograms showing modes of the number of primary platforms (DM10) for each island.

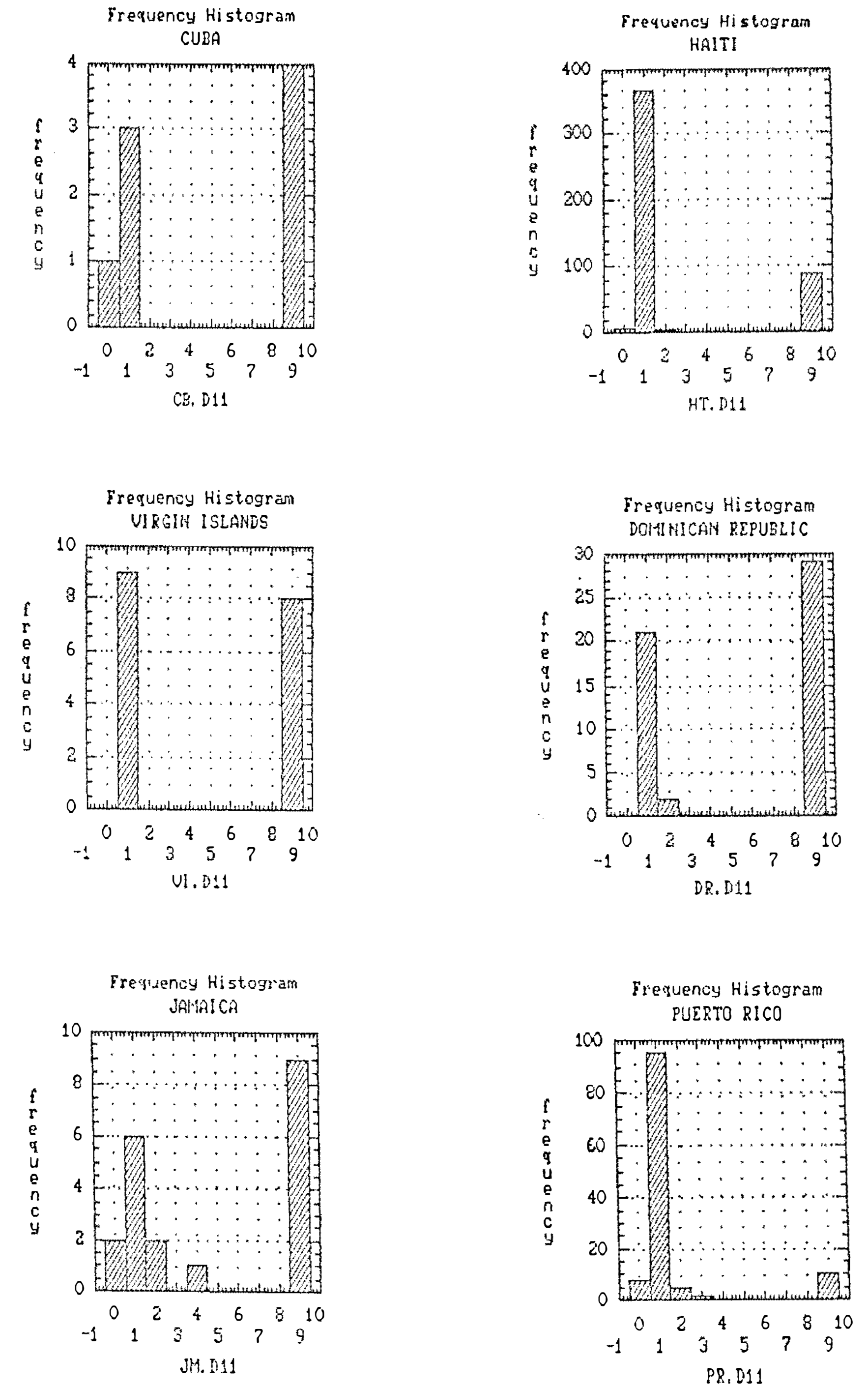

Figure C-10. Frequency histograms showing modes of the dominant angle(s) of primary platform(s) (DM11) for each island.

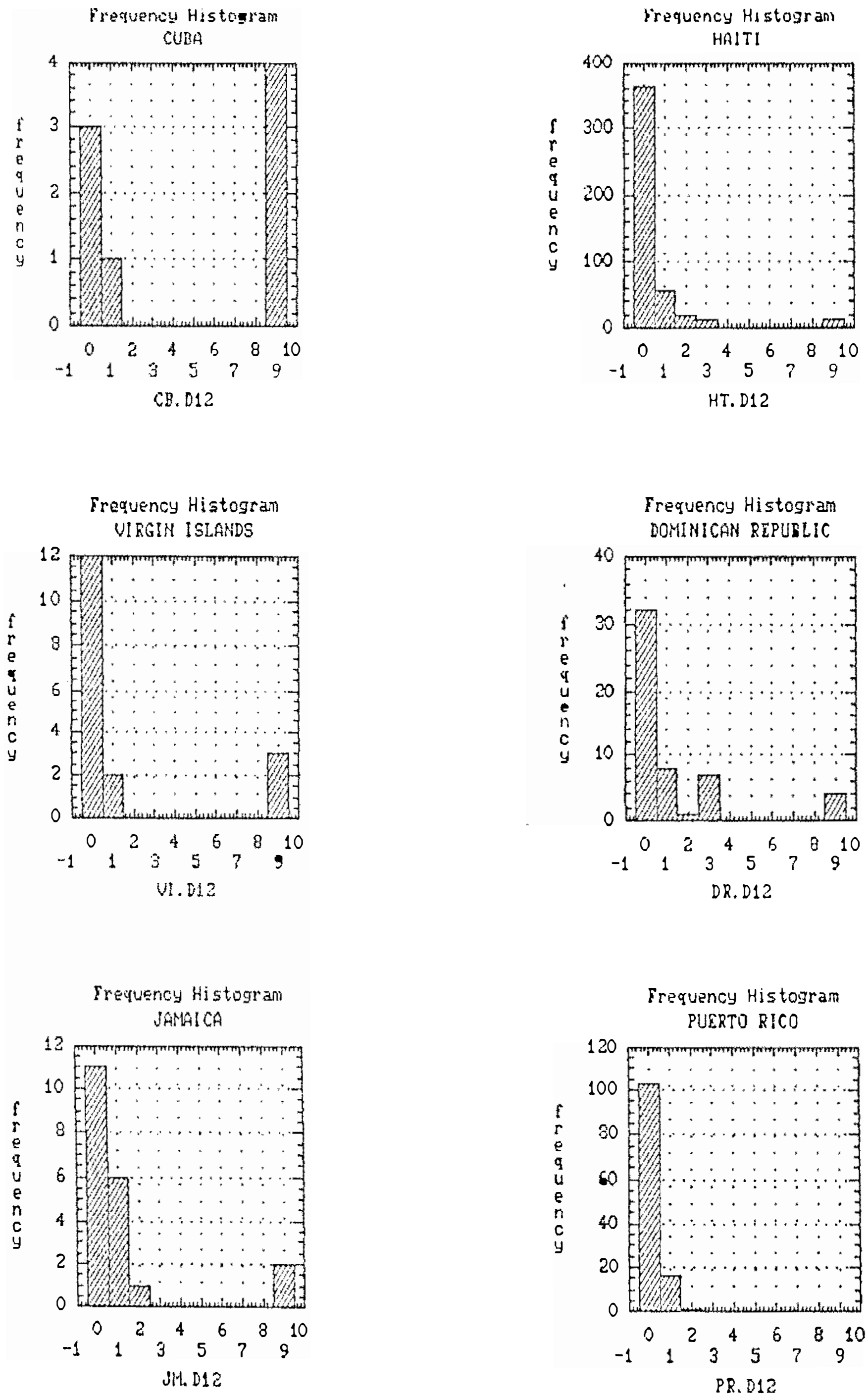

Figure C-11. Frequency histograms showing modes of the number of secondary flake scars (DM12) for each island.

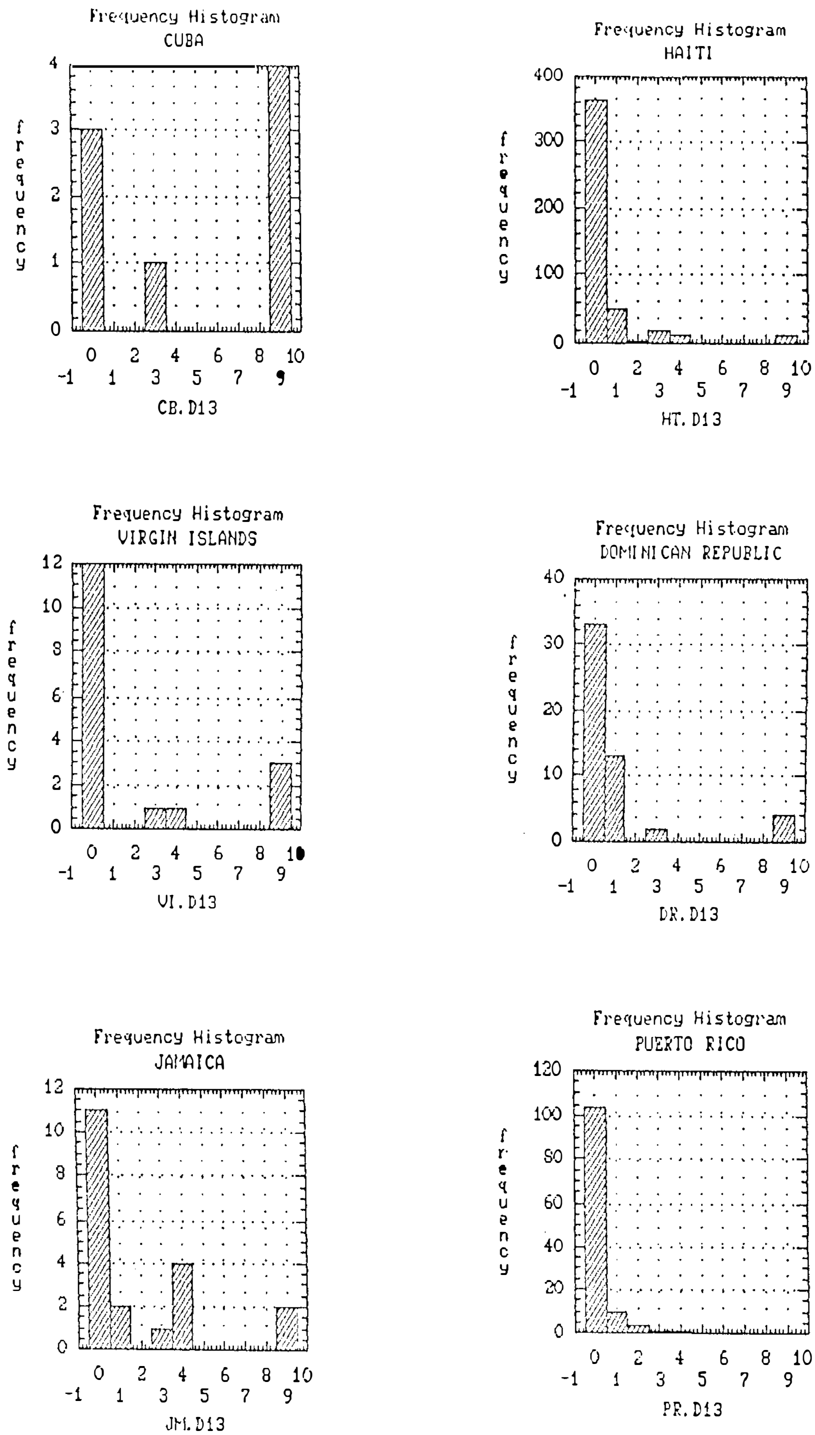

Figure C-12. Frequency histograms showing modes of the direction of secondary flake scars (DM13) for each island.

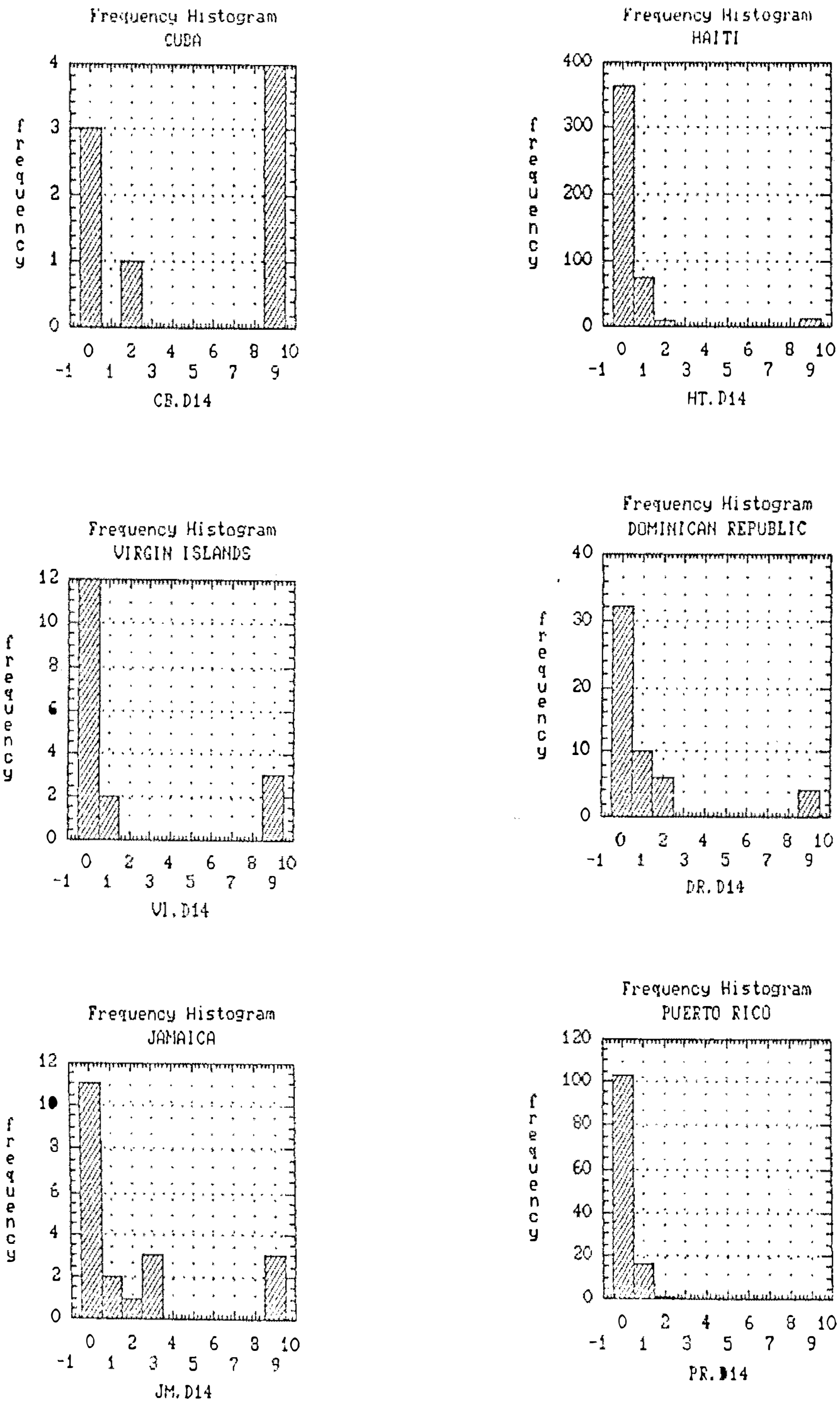

Figure C-13. Frequency histograms showing modes of the number of secondary platforms (DM14) for each island.

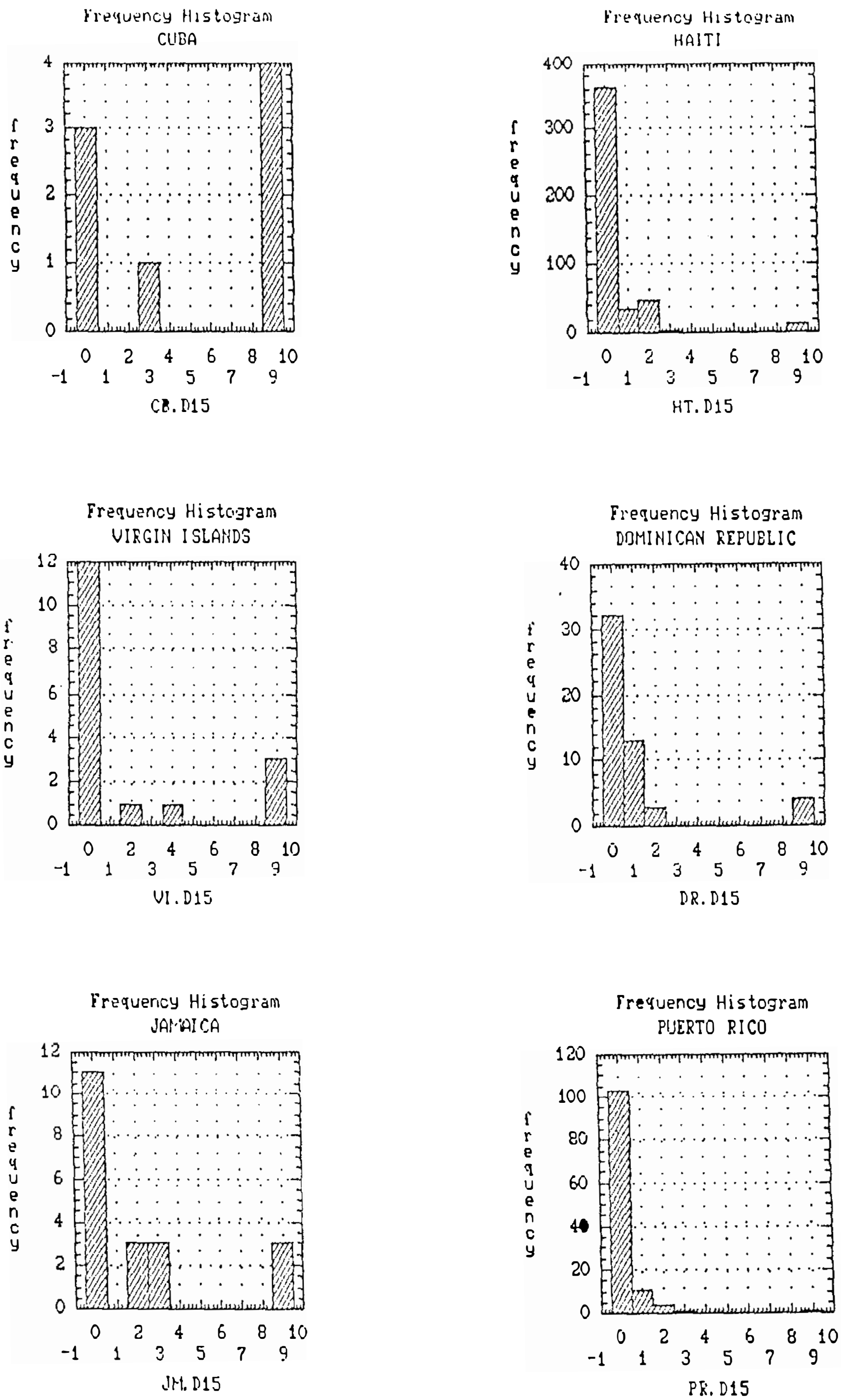

Figure C-14. Frequency histograms showing modes of the dominant angle(s) of secondary platform(s) (DM15) for each island.

APPENDIX D

STATISTICAL DATA OF PARADIGMATIC COMPARISONS

D-1 Classes (DM6-15) correlated by Island (DM1). Showing class in first column, number of artifacts in second column and highest relative percentages in third column.

CLASS BY ISLAND

CUBA (DM1.1)

(all equal)

JAMAICA (DM1.2)

(all equal)

HAITI (DM1.3)

0432110000	30	6.5%
0431110000	27	5.8%
0412110000	26	5.6%
0999990000	18	3.9%
0332110000	16	3.4%
0312110000	15	3.2%
0311110000	10	2.2%
0331110000	10	2.2%

Constants: Dimensions 6, 10*. 11*, 12-15
Variants: Dimensions 7, 8, 9, 10

DOMINICAN REPUBLIC (DM1.4)

0432110000	5	9.6%
0911990000	4	7.7%
0010993121	2	3.8%
0030993121	2	3.8%
0132110000	2	3.8%
0412110000	2	3.8%
0932990000	2	3.8%
0932991111	2	3.8%
0942990000	2	3.8%
3931190000	2	3.8%

Constants: Dimensions 10*, 11*, 13, 15
Variants: Dimensions 6, 7, 8, 9, 12, 14

PUERTO RICO (DM1.5)

0412110000	8	6.7%
0412210000	8	6.7%
0112110000	6	5.0%
0642310000	5	4.2%
0131110000	4	3.3%
0432110000	4	3.3%
1111110000	4	3.3%
2612110000	4	3.3%

Constants: Dimensions 11, 12-15
Variants: Dimensions 6, 7, 8, 9, 10

VIRGIN ISLANDS (DM1.6)

3100110000	2	11.8%
0999990000	2	11.8%
0999999999	2	11.8%

Constants: Dimensions 7*, 8*, 9*, 10*, 11*, 12-15

Variants: Dimension 6

D-2 Islands (DM1) correlated with Chert (DM2) and Class (DM6-15).

ISLAND / CHERT/ CLASS

CUBA (DM1.1) (all equal)

With Barrera Mordan Chert (DM2.2) (all equal)

With Cerrillo Chalcedony (DM2.3) (all equal)

JAMAICA (DM1.2) (all equal)

With Hispaniola Flint (DM2.1) (all equal)

With Barrera Mordan Chert (DM2.2) (all equal)

HAITI (DM1.3)

With Hispaniola Flint (DM2.1)

0432110000	16	6.7%
0431110000	13	5.4%
0412110000	12	5.0%
0332110000	7	2.9%
0999990000	7	2.9%
0311110000	6	2.5%
0312110000	6	2.5%
0131110000	5	2.1%
0331110000	5	2.1%
0411110000	4	1.7%

Constants: Dimensions 6, 10*, 11*, 12-15
Variants: Dimensions 7, 8, 9

With Barrera Mordan Chert (DM2.2)

0412110000	14	6.3%
0431110000	14	6.3%
0432110000	14	6.3%
0999990000	11	4.9%
0312110000	9	4.0%
0332110000	9	4.0%
0100110000	5	2.2%
0132110000	5	2.2%
0331110000	5	2.2%

Constants: Dimensions 6, 10*, 11*, 12-15
Variants: Dimensions 7, 8, 9

With Cerrillo Chalcedony (DM2.3) (only 1)

DOMINICAN REPUBLIC (DM1.4)

With Hispaniola Flint (DM2.1)

0911990000	4	9.8%
0432110000	3	7.3%
0010993121	2	4.9%
0030993121	2	4.9%
0132110000	2	4.9%
3931190000	2	4.9%

Constants: Dimensions 10*, 11*
Variants: Dimensions 6, 7, 8, 9, 12-15

With Barrera Mordan Chert (DM2.2)

0942990000	2	20.0%

With Cerrillo Chalcedony (DM2.3) (only 1 example)

PUERTO RICO (DM1.5)

With Hispaniola Flint (DM2.1)

0642310000	2	15.4%

With Barrera Mordan Chert (DM2.2)

0131110000	2	25.0%

With Cerrillo Chalcedony (DM2.3)

0412210000	7	7.1%
0412110000	6	6.1%
0112110000	5	5.1%
1111110000	4	4.0%
2612110000	4	4.0%
0432110000	3	3.0%
0642310000	3	3.0%
1411110000	3	3.0%
1642310000	3	3.0%
2612210000	3	3.0%

Constants: Dimensions 11, 12-15
Variants: Dimensions 6, 7, 8, 9, 10

VIRGIN ISLANDS (DM1.6)

With Cerrillo Chalcedony (DM2.3) (all equal)

With Virgin Islands Basalt (DM2.4)

3100110000	2	14.3%
0999990000	2	14.3%

D-3 Chert (DM2) correlated with Class (DM6-15). Size (DM3) correlated with Class.

CHERT / CLASS

Hispaniola Flint (DM2.1)

0432110000 19 6.3%
0412110000 14 4.6%
0431110000 14 4.6%

Constants: Dimensions 6, 7, 10, 11, 12-15
Variants: Dimensions 8, 9

Barrera-Mordan Chert (DM2.2)

0412110000 16 6.2%
0432110000 16 6.2%
0431110000 14 5.4%
0999990000 11 4.2%

Constants: Dimensions 6, 7, 10, 11, 12-15
Variants: Dimensions 8,9

Cerrillo Chalcedony (DM2.3) (DM2.3)

0412210000 7 6.8%
0412110000 6 5.8%
0112110000 5 4.9%
1111110000 4 3.9%
2612110000 4 3.9%

Constants: Dimensions 8,11,12-15
Variants: Dimensions 6,7,9,10

Virgin Islands Basalt (DM2.4)

3100110000 2 14.3%

SIZE / CLASS:

Cobbles (DM3.1):

0412110000 25 5.6%
0432110000 20 4.5%
0999990000 18 4.0%
0431110000 17 3.8%
0131110000 10 2.2%
0312110000 10 2.2%
0112110000 9 2.0%
0332110000 7 1.6%

Constants: Dimensions 6, 10*, 11*, 12-15
Variants: Dimensions 7, 8, 9

Boulders (DM3.2):

0432110000 17 7.4%
0412110000 11 4.8%
0431110000 11 4.8%
0332110000 8 3.5%
0312110000 6 2.6%
0132110000 5 2.2%
0331110000 4 1.7%

Constants: Dimensions 6, 10, 11, 12-15
Variants: Dimensions 7, 8, 9

D-4 Inclusions (DM4) correlated with Class (DM6-15). Grain (DM5) correlated with Class.

INCLUSIONS / CLASS

No Inclusions (DM4.1)

0312110000 4 5.2%
0432110000 4 5.2%
0332110000 3 3.9%
0412110000 3 3.9%

Constants: Dimensions 6, 9 10, 11, 12-15
Variants: Dimensions 7, 8

<10% Inclusions (DM4.1)

0432110000 24 6.3%
0412110000 19 5.0%
0431110000 16 4.2%
0332110000 10 2.6%
0999990000 10 2.6%

Constants: Dimensions 6, 10, 11, 12-15
Variants: Dimensions 7,8,9

10-50% Inclusions (DM4.2)

0412110000 12 6.3%
0432110000 10 5.3%
0431110000 9 5.3%

Constants: Dimensions 6, 7, 10, 11, 12-15
Variants: Dimensions 8, 9

>50% Inclusions (DM4.3)

2612110000 3 8.8%
2612210000 2 5.9%
3311110000 2 5.9%

Constants: Dimensions 8, 11, 12-15
Variants: Dimensions 6, 7, 9, 10

GRAIN / CLASS

Fine Grain (DM5.1)

0432110000 20 5.7%
0412110000 18 5.1%
0431110000 17 4.8%
0999990000 12 3.4%
0332110000 9 2.6%

Constants: Dimensions 6, 10, 11, 12-15
Variants: Dimensions 7, 8, 9

Medium Grain (DM5.2)

0412110000 17 5.7%
0432110000 17 5.7%
0431110000 11 3.7%
0312110000 9 3.0%

Constants: Dimensions 6, 10, 11, 12-15
Variants: Dimensions 7, 8, 9

Coarse Grain (DM5.3)

0432110000 2 6.5%
0942990000 2 6.5%
2612110000 2 6.5%

Constants: Dimensions 9, 10?, 11?, 12-15
Variants: Dimensions 6, 7, 8

D-5 Highest frequencies of Technology (DM6-11) for entire sample and Technology by Island (DM1).

TECHNOLOGY FREQUENCY

043211	57	8.4%
041211	41	6.0%
043111	31	4.6%
099999	29	2.9%
033211	20	2.9%
013111	18	2.6%

Constants: Dimensions 6, 10, 11
Variants: Dimensions 7, 8, 9

TECHNOLOGY / ISLAND

CUBA (DM1.1) (all equal)
Constants: Dimensions 10*, 11*

JAMAICA (DM1.2)

044231	2	10.0%

HAITI (DM1.3)

043211	45	9.7%
041211	31	6.7%
043111	30	6.5%
099999	22	4.7%
033211	19	4.1%
031211	16	3.4%
013111	14	3.0%
013211	11	2.4%
010011	10	2.2%
031111	10	2.2%
033111	10	2.2%

Constants: Dimensions 6, 10*, 11*
Variants: Dimensions 7, 8, 9

DOMINICAN REPUBLIC (DM1.4)

043211	8	15.4%
093299	5	9.6%
091199	4	7.7%
094299	4	7.7%
001099	2	3.8%
003099	2	3.8%
013211	2	3.8%
041211	2	3.8%
099999	2	3.8%
393119	2	3.8%

Constants: Dimensions 10*, 11*
Variants: Dimensions 6, 7, 8, 9

PUERTO RICO (DM1.5)

041221	9	7.5%
041211	8	6.7%
001211	6	5.0%
064231	5	4.2%
111111	5	4.2%
013111	4	3.3%
043211	4	3.3%
061211	4	3.3%
261211	4	3.3%

Constants: Dimension 11
Variants: Dimensions 6, 7, 8, 9, 10

VIRGIN ISLANDS (DM1.6)

099999	4	23.5%
310011	3	17.6%
910001	2	11.8%

Constants: Dimensions 7*, 8*, 9*, 10*, 11*
Variants: Dimension 6

D-6 Islands (DM1) correlated by Chert (DM2) and Technology (DM6-11).

ISLAND / CHERT / TECHNOLOGY

CUBA (DM1.1)

With Barrera Mordan Chert (DM2.2)
(Technologies different)

With Cerrillo Chalcedony (DM2.3) (only 1 example)

JAMAICA (DM1.2)

With Hispaniola Flint (DM2.1) (Technologies different)

With Barrera Mordan Chert (DM2.2)

044231	2	16.7%

HAITI (DM1.3)

With Hispaniola Flint (DM2.1)

043211	21	8.8%
041211	15	6.3%
043111	15	6.3%
013111	10	4.2%
099999	10	4.2%
031211	7	2.9%
033211	7	2.9%
031111	6	2.5%
210011	6	2.5%

Constants: Dimensions 10*, 11*
Variants: Dimensions 6, 7, 8, 9

With Barrera Mordan Chert (DM2.2)

043211	24	10.8%
041211	16	7.2%
043111	15	6.7%
033211	12	5.4%
099999	12	5.4%
031211	9	4.0%
013211	8	3.6%
010011	6	2.7%

Constants: Dimensions 6, 10*, 11*
Variants: Dimensions 7, 8, 9

With Cerrrillo Chalcedony (DM2.3) (only 1 specimen)

DOMINICAN REPUBLIC (DM1.4)

With Hispaniola Flint (DM2.1)

043211	5	12.2%
091199	4	9.8%
093299	3	7.3%
001099	2	4.9%
003099	2	4.9%
013211	2	4.9%
094299	2	4.9%
099999	2	4.9%
393119	2	4.9%

Constants: Dimensions 10*, 11*
Variants: Dimensions 6, 7, 8, 9

With Barrera Mordan Chert (DM2.2)

043211	2	20.0%
093299	2	20.0%
094299	2	20.0%

Constants: Dimensions 6, 7*, 9 10*, 11*
Variants: Dimension 8

PUERTO RICO (DM1.5)

With Hispaniola Flint (DM2.1)

064231	2	15.4%

With Barrera Mordan Chert (DM2.2)

013111	2	25.0%

With Cerrillo Chalcedony (DM2.3)

041221	8	8.1%
041211	6	6.1%
011211	5	5.1%
111111	5	5.1%
261211	4	4.0%
043211	3	3.0%
061211	3	3.0%
064231	3	3.0%
141111	3	3.0%
164231	3	3.0%
261221	3	3.0%

Constants: Dimension 11
Variants: Dimensions 6, 7, 8, 9, 10

VIRGIN ISLANDS (DM1.6)

With Cerrillo Chalcedony (DM2.3) (all equal)

With Virgin Islands Basalt (DM2.4)

310011	3	21.4%
099999	3	21.4%
910001	2	14.3%

D-7 Chert (DM2) correlated with Technology (DM6-11). Size (DM3) correleated with Technology.

CHERT / TECHNOLOGY

Hispaniola Flint (DM2.1)

043211	26	8.6%
041211	17	5.6%
043111	16	5.3%
099999	12	4.0%
013111	10	3.3%

Constants: Dimensions 6, 10, 11
Variants: Dimensions 7, 8, 9

Barrera-Mordan Chert (DM2.2)

043211	27	10.4%
041211	18	6.9%
043111	15	5.8%
099999	13	5.0%
033211	12	4.6%

Constants: Dimensions 6, 10, 11
Variants: Dimensions 7, 8, 9

Cerillo Chalcedony (DM2.3)

041221	8	7.8%
041211	6	5.8%
011211	5	4.9%
111111	5	4.9%

Constants: Dimensions 8, 11
Variants: Dimensions 6, 7, 9, 10

Virgin Islands Basalt (DM2.4)

310011	3	21.4%
099999	3	21.4%
910011	2	14.3%

Constants: Dimensions 7?, 8?, 9?, 10?, 11?
Variants: Dimension 6

SIZE / TECHNOLOGY

Cobbles (DM3.1):

014121	27	6.1%
043211	25	5.6%
099999	21	4.7%
043111	19	4.3%
011211	12	2.7%
013111	11	2.5%
031211	11	2.5%
033211	11	2.5%
010011	8	1.8%
041221	8	1.8%

Constants: Dimensions 6, 11*
Variants: Dimensions 7, 8, 9,10

Boulders (DM3.2):

043211	30	13.1%
041211	14	6.1%
043111	12	5.2%
033211	9	3.9%
013211	8	3.5%
013111	7	3.1%
031211	6	2.6%
099999	6	2.6%

Constants: Dimensions 6, 10*, 11*
Variants: Dimensions 7, 8, 9

SIZE / TECHNOLOGY

			Cobbles	Boulders
043211	15	11.45%	3	12
013111	6	4.58%	1	5
210011	6	4.58%	5	1
011111	5	3.82%	1	4
000019	4	3.05%	1	3
010011	4	3.05%	2	2
013211	4	3.05%	3	1
310011	4	3.05%	4	0
			--	--
			20(42%)	28(58%)

D-8 Inclusions (DM4) correlated with Technology (DM6-11).
Grain (DM5) correlated with Technology.

INCLUSIONS / TECHNOLOGY

No Inclusions (DM4.1)

043211	6	7.7%
031211	4	5.2%
099999	4	5.2%

Constants: Dimensions 6, 9, 10, 11
Variants: Dimensions 7, 8

>10% Inclusions

043211	37	9.7%
041211	22	5.8%
043111	18	4.7%
099999	14	3.7%

Constants: Dimensions 6, 7, 10, 11
Variants: Dimensions 8, 9

10-50% Inclusions (DM4.2)

041211	13	6.9%
043211	12	6.3%
043111	9	4.8%
099999	9	4.8%

Constants: Dimensions 6, 7?, 10?, 11?
Variants: Dimensions 8?, 9?

>50% Inclusions (DM4.3)

261211	3	8.8%
041211	2	5.9%
043211	2	5.9%
099999	2	5.9%
331111	2	5.9%

Constants: Dimensions 10, 11
Variants: Dimensions 6, 7, 8, 9

GRAIN / TECHNOLOGY

Fine Grain (DM5.1)

043211	28	8.0%
041211	21	6.0%
043111	20	5.7%

Constants: Dimensions 6, 7, 10, 11
Variants: Dimensions 8, 9

Medium Grain (DM5.2)

043211	26	8.7%
041211	19	6.4%
043111	11	3.7%
031211	10	3.4%
033211	10	3.4%

Constants: Dimensions 6, 10, 11
Variants: Dimensions 7, 8, 9

Coarse Grain (DM5.3)

043211	3	9.7%
011111	2	6.5%
094299	2	6.5%
099999	2	6.5%
261211	2	6.5%

Constants: Dimensions 10?, 11?
Variants: Dimensions 7, 8, 9

D-9 Overall frequency of Retouch (DM12-15) for entire sample. Island (DM1) correlated with Retouch.

RETOUCH FREQUENCY

0000	523	76.8%
9999	27	4.0%
1111	25	3.7%
1112	18	2.6%
1312	14	2.1%

Constants: Dimension 12
Variants: Dimensions 13, 14, 15

ISLAND / RETOUCH

CUBA (DM1.1)

9999	4	50.0%
0000	3	37.5%

JAMAICA (DM1.2)

0000	11	55.0%
9999	2	10.0%

HAITI (DM1.3)

0000	362	78.0%
1112	14	3.0%
9999	14	3.8%
1312	13	2.8%
1111	12	2.6%

DOMINICAN REPUBLIC (DM1.4)

0000	32	61.5%
3121	6	11.5%
1111	5	9.6%
9999	4	7.7%

PUERTO RICO (DM1.5)

0000	103	85.8%
1111	8	6.7%
1112	2	1.7%

VIRGIN ISLANDS (DM1.6)

0000	12	70.6%
9999	3	17.6%

D-10 Islands (DM1) correlated with Chert (DM2) and with Retouch (DM12-15).

ISLAND / CHERT / RETOUCH

CUBA (DM1.1)

With Barrera Mordan Chert (DM2.2)

0000	3	42.9%
9999	3	42.9%

With Cerrillo Chalcedony (DM2.3) (only 1 specimen)

JAMAICA (DM1.2)

With Hispaniola Flint (DM2.1)

0000	5	62.5%

With Barrera Mordan Chert (DM2.2)

0000	6	50.0%

HAITI (DM1.3)

With Hispaniola Flint (DM2.1) (7.5%)

0000	185	77.1%
1312	10	4.2%
9999	10	4.2%
1112	8	3.3%

With Barrera Mordan Chert (DM2.2) (10.7%)

0000	176	78.9%
1111	8	3.6%
1112	6	2.7%
2111	5	2.2%
3112	5	2.2%

With Cerrillo Chalcedony (DM2.3) (only one example)

DOMINICAN REPUBLIC (DM1.4)

With Hispaniola Flint (DM2.1) (19.5%)

0000	24	58.5%
3121	6	14.6%
9999	4	9.8%
1111	2	4.9%

With Barrera Mordan Chert (DM2.2) (30%)

0000	7	70.0%
1111	3	30.0%

PUERTO RICO (DM1.5)

With Hispaniola Flint (DM2.1)

0000	13	100.0%

With Barrera Mordan Chert (DM2.2)

0000	8	100.0%

With Cerrillo Chalcedony (DM2.3) (10.1%)

0000	82	82.8%
1111	8	8.1%
1112	2	2.0%

VIRGIN ISLANDS (DM1.6)

With Cerrillo Chalcedony (DM2.3) (equal 0's and 9's) (1 each)

With Virgin Islands Basalt (DM2.4)

0000	11	78.6%

D-11 Chert (DM2) correlated with Retouch (DM12-15). Size (DM3) correlated with Retouch.

CHERT / RETOUCH

Hispaniola Flint (DM2.1)

0000	227	75.2%
9999	15	5.0%
1312	10	3.3%
1112	9	3.0%
3121	7	2.3%

Constants:
Variants: Dimensions 12, 13, 14, 15

Barrera-Mordan Chert (DM2.2)

0000	200	76.9%
1111	11	4.2%
9999	8	3.1%
1112	7	2.7%

Constants: Dimensions 12, 12, 14
Variants: Dimension 15

Cerrillo Chalcedony (DM2.3)

0000	84	81.6%
1111	8	7.8%

Virgin Islands Basalt (DM2.4)

0000	11	78.6%

SIZE / RETOUCH

Cobbles (DM3.1):

0000	370	83.0%
1111	13	2.9%
1112	12	2.7%
9999	11	2.5%
1312	9	2.0%

Constants: Dimensions 12**, 14**
Variants: Dimensions 13, 15

Boulders (DM3.2):

0000	149	65.1%
9999	14	6.1%
1111	12	5.2%
3121	7	3.1%
1112	6	2.6%
3112	6	2.6%

Constants: Dimension 13**
Variants: Dimensions 12, 14, 15

RETOUCH

(19.24% of entire sample is retouched)

			Cobbles	Boulders
1111	25	19.08%	13	12
1112	18	13.74%	12	6
1312	14	10.69%	9	5
2112	7	5.34%	4	3
3121	7	5.34%	0	7
1412	6	4.58%	4	2
3112	6	4.58%	0	6
1311	5	3.82%	4	1
2111	5	3.82%	0	5
			---	---
			46	47

D-12 Inclusions (DM4) correlated with Retouch (DM12-15). Grain (DM5) correlated with Retouch.

INCLUSIONS / RETOUCH

No Inclusions (DM4.1)

0000	54	70.1%
9999	5	6.5%
3121	4	5.2%

Constants: Dimensions
Variants: Dimensions

<10% Inclusions (DM4.1)

0000	300	78.9%
1112	13	3.4%
9999	13	3.4%
1111	12	3.2%

Constants: Dimensions 12, 13, 14
Variants: Dimension 15

10-50% Inclusions (DM4.2)

0000	140	74.1%
1111	12	6.3%
9999	6	3.2%
1312	5	2.6%

Constants: Dimensions 12, 14
Variants: Dimensions 13, 15

>50% Inclusions (DM4.3)

0000	28	82.4%
9999	3	8.8%
1111	1	2.9%
1199	1	2.9%
1412	1	2.9%

Constants: Dimensions 12,14?
Variants: Dimensions 13,15

GRAIN / RETOUCH

Fine Grain (DM5.1)

0000	268	76.4%
9999	18	5.1%
1111	9	2.6%
1112	9	2.6%
1312	8	2.3%

Constants: Dimensions 12, 14
Variants: Dimensions 13, 15

Medium Grain (DM5.2)

0000	235	78.9%
1111	13	4.4%
1112	9	3.0%
1312	6	2.0%
9999	6	2.0%

Constants: Dimensions 12, 14
Variants: Dimensions 13, 15

Coarse Grain (DM5.3)

0000	19	61.3%
1111	3	9.7%
9999	3	9.7%
2111	2	6.5%
3112	2	6.5%

Constants: Dimensions 13, 14
Variants: Dimensions 12, 15

D-13 Relative frequencies of correlations between Size (DM3) with Chert (DM2), with Inclusions (DM4), and with Grain (DM5).

SIZE:	Cobble (DM3.1)		Boulder (DM3.2)	
	446	66.5%	229	33.6%
CHERT / SIZE				
Hispaniola Flint (DM2.1):	125	41.4%	175	57.9%
Barrera Mordan Chert (DM2.2):	206	79.2%	53	20.4%
Cerrillo Chalcedony (DM2.3):	102	99.0%	0	
Virgin Islands Basalt (DM2.4):	13	92.9%	0	
INCLUSION / SIZE				
No Inclusions: (DM4.0)	37	48.1%	40	51.9%
<10% Inclusions: (DM4.1)	249	65.5%	128	33.7%
10-50% Inclusions: (DM4.2)	133	70.4%	53	28.0%
>50% Inclusions: (DM4.3)	26	76.5%	0	
GRAIN / SIZE:				
Fine Grain (DM5.1):	161	45.9%	187	53.3%
Medium Grain (DM5.2):	263	88.3%	34	11.4%
Coarse Grain (DM5.3):	22	71.0%	7	22.6%

VITA

Agamemnon Gus Pantel is a Greek-American born in Middletown, Ohio on September 6, 1947. After attending primary and secondary schools in Middletown, he attended the University of Athens in Greece for a year. Upon returning to the United States he attended Miami University in Oxford, Ohio where he received a Bachelors of Arts degree in 1970 and in 1974 received a Master of Arts degree in Anthropology. He received the Doctor of Philosophy degree with a major in Anthropology from the University of Tennessee, Knoxville, in 1987.

From 1972 until the present he has lived and worked in Puerto Rico. In 1976 he received a Smithsonian Institution Predoctoral Fellowship, in 1980 a Fellowship to the Education Policy Fellowship Program from George Washington University, and in 1984 was selected by the U.S. I.C.C.R.O.M. Committee as a U.S. participant to UNESCO's International Center for the Study of the Conservation and Restoration of Cultural Patrimony in Rome, Italy.

The author served as Deputy State Historic Preservation Officer for Puerto Rico, State Archaeologist for Puerto Rico, and Lecturer at the University of Puerto Rico, Rio Piedras Campus in San Juan. His field work in the Caribbean has included Puerto Rico, the Dominican Republic, Haiti, St. Kitts, Venezuela and Columbia.

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