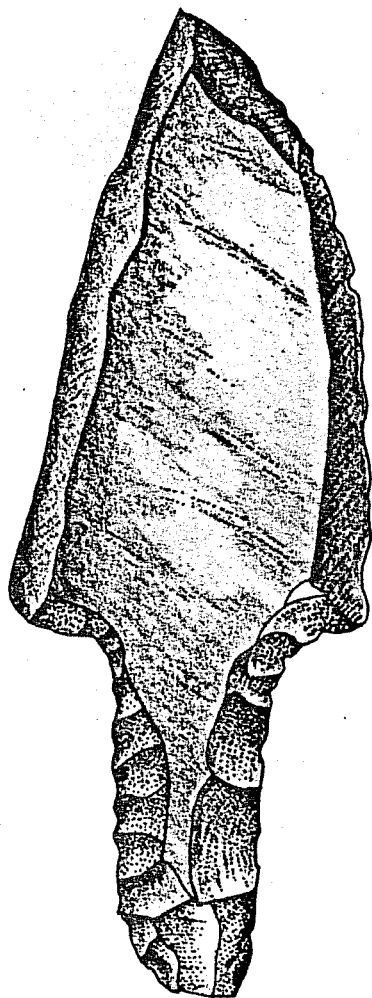


**MAYA LITHIC STUDIES:
PAPERS FROM THE 1976 BELIZE FIELD SYMPOSIUM**



Edited by

**Thomas R. Hester
and Norman Hammond**

**Special Report No. 4
Center for Archaeological Research
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- No. 6, Vol. 2 (1978) "The Mariposa Site: A Late Prehistoric Site on the Rio Grande Plain of Texas. Volume 2, Studies in the Archaeology of Chaparrosa Ranch" (By John Montgomery). (\$8.00 + .44 tax for Texas residents).

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The Center gratefully acknowledges the cooperation of the Department of Archaeology, Government of Belize (Joseph O. Palacio, Archaeological Commissioner) and the Centre for Latin American Studies, Cambridge University.

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PREFACE

As a result of intensified archaeological activity in northern Belize, and specifically the work of the joint British Museum-Cambridge University research project (directed by Norman Hammond), a variety of new data have been obtained on the prehistory of this region. Of the many sites that have been mapped, tested, or otherwise investigated in the past few years, one stands out as a major center of ancient Maya lithic technology. This is the site of Colha, located south of Orange Walk Town, along the highway between that town and Belize City. Personnel of the British Museum-Cambridge University Corozal Project began limited research at the site in 1973. As a result of efforts then and since, parts of this extensive site have been mapped, some stratigraphic tests have been made, and controlled surface sampling and lithic analysis have been initiated (the latter through the hard work of Richard Wilk). These investigations, although preliminary in nature, were sufficient to indicate that Colha had indeed been a significant center of stone tool production for the Maya, from Middle Preclassic through Postclassic times.

Conversations about the site, among Hammond, T. R. Hester, H. J. Shafer and R. Wilk during 1975, led to the formulation of plans to hold a "field symposium" in Belize, in which a number of persons interested in Mesoamerican lithic studies could be brought together. The purpose of the symposium was to be two-fold: (1) to make an on-site inspection of Colha, to view the chert-working loci and vast exposures of workshop debris, and (2) to present a series of papers, followed by extensive discussion, in which the status of lithic research in the region could be assessed.

Through the sponsorship of the Center for Archaeological Research at The University of Texas at San Antonio, the field symposium was held in Orange Walk Town, Belize during the period of April 16-20, 1976. The program was organized by Norman Hammond, a Faculty Associate of the Center, in collaboration with Thomas Hester, the Center's director. Formal sessions were held at the Hotel Nuevo Mi Amor, and we are grateful to the management (especially Sr. E. Urbina) for their assistance in providing a meeting room and appropriate refreshments. The participants included Don E. Crabtree, Norman Hammond, Thomas R. Hester, Jay K. Johnson, Joseph W. Michels, Arlene V. Miller, Hattula Moholy-Nagy, Harry J. Shafer, Payson D. Sheets and Richard Wilk; Irwin Rovner presented a paper *in absentia*. Each of the participants presented a formal paper, revised versions of which are published in this volume.*

During the three days of the symposium, part of each day was occupied by the presentation of papers, while the remainder was spent in visits to archaeological sites in the vicinity. Greatest emphasis was placed on

*Two papers dealing with Belize lithics have been submitted to the editors since the symposium. These contributions, by Ray Sidrys and John Andresen, are published here.

a full day inspection of the lithic workshops of Colha. While at the site, the symposium participants were able to examine a number of individual workshops and the wide variety of lithic debris exposed at these. Impromptu replicative experimentation utilizing nodules of the local chert exposed in a streambed was carried out by Crabtree, Sheets and Shafer. The participants also visited the ceremonial center of the site, and spent a good deal of time examining the extensive collection of stone tools belonging to John and Herbert Masson, the owners of the property on which Colha is situated. The Masson family was extremely gracious to the conference participants and we are very grateful for their hospitality, including a magnificent lunch.

Apart from the day spent at Colha, other sites visited during the conference included the Richmond Hill locality (about which the participants were collectively skeptical; see Miller's paper in this volume) and the Classic major center of El Pozito being excavated by the University of the Americas. An obsidian workshop had been discovered at El Pozito just prior to our visit and the materials from this workshop were examined. A paper has been written by Mary Neivens and David Libbey describing the workshop, and it is published in this volume. The Preclassic site of Cuello, being excavated by Hammond, was also visited, and lithics dating to 1000-2000 B.C. were examined.

The field symposium ended with a lengthy discussion of the status of Maya lithic studies, suggestions for a more unified approach and a more consistent terminology, and the identification of areas of knowledge, and similarly, areas of ignorance in the field of Maya lithics in terms of time, space, materials and technology. It was also agreed that the site of Colha deserved long-term, detailed research. Crabtree described the site as "one of the most important lithic sites in the world", and it was commonly felt by participants in the field symposium that research at this site would yield a wide variety of new insights into Maya lithic technology. A proposal for long-term research at Colha was being prepared at the time this volume went to press.

There are many to whom we are grateful for support and aid during and after the field symposium. We again thank Sr. Urbina of the Hotel Nuevo Mi Amor, and the Masson family, owners of the site of Colha. His Excellency the Governor of Belize, Mr. Richard Posnett, opened the conference and attended the session at Colha. Mr. Joseph Palacio, Archaeological Commissioner for the Government of Belize, provided the assistance of his office and welcomed participants. Belize Sugar Industries made available the swimming pool at Tower Hill, near Orange Walk Town, through the courtesy of Mr. F. J. C. Curtis, O.B.E. Norman Hammond's field crew at Cuello, with the generous aid of Harold B. Haley, provided the conference participants with a party on the last evening. Kathy McCauley, secretary for the Center for Archaeological Research, and Jeanette Burch, typist for the Center, helped in report preparation.

Persons attending the conference in addition to those participants listed above included: Evelyn Crabtree, Gabrielle Michels, Mary Neivens,

Juliette J. Cartwright, Peter R. A. Barron, Ginny Schneider, Harold B. Haley, Elizabeth Graham and Duncan Pring.

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As editors of this volume, and on behalf of the participants in the 1976 Belize field symposium, we respectfully dedicate this volume to Don E. Crabtree, in recognition of his outstanding contributions to the study of lithic technology.

ISLANDS OF LITHIC KNOWLEDGE AMID SEAS OF IGNORANCE IN THE MAYA AREA

Payson D. Sheets

INTRODUCTION

The purpose of this paper is to provide a brief summary of lithic analyses in the Maya area, noting "islands of knowledge" amid "seas of ignorance". I shall use a geographic organization, beginning in the northern Maya lowlands and ending in the southern highlands. Length limitations eliminate many topics such as assessing what we know and need to know about trace element attribution studies and prehistoric trade, general technological analyses and Paleo-Indian research.

SURVEY OF MAYAN LITHIC STUDIES

This overview of what areas are well or poorly known in terms of chipped stone artifacts ("artifacts" includes implements and debitage) begins in the Yucatan Peninsula, continues southward into the Classic Maya core area, then shifts westward to the Isthmus of Tehuantepec. From there we can move eastward, examining lithic knowledge in the Maya highlands of Chiapas-Guatemala-El Salvador as well as along the adjoining Pacific piedmont and coast.

The Maya Lowlands

A small area of northern Yucatan is fairly well known in terms of lithics, extending from Mayapan to Chichen Itza, from the work of Proskouriakoff (1962) and Rovner (1974b). As the Dzibilchaltun monographs are published by the Middle American Research Institute over the next few years, our knowledge of chipped stone in this small area will increase further. But, this island of knowledge is surrounded by a vast sea of lithic ignorance extending to the south, east, and west. As we travel south the first locality with some information available on stone artifacts is Becan (Stoltman 1975; Rovner 1974a), and this information may be expected to increase as the Becan publications also become available from the Middle American Research Institute.

Both the Mexican states of Campeche and Quintana Roo are lithic *terra incognita*. Moving southward and passing over the border into Guatemala, we find the situation greatly improved. Piedras Negras (W. Coe 1959) and Altar de Sacrificios (Willey 1972), both along the Usumacinta River in the western Peten, are quite well described and thoroughly illustrated. The Seibal artifact analysis will be available soon (G. Willey, personal communication 1975) and it will contribute considerable new information on the south-central Peten area. Jay Johnson's analysis of Palenque chipped stone is now available (1976), contributing considerable valuable information to our understanding of lithics in the extreme western portion of the Maya realm.

The seminal studies of Uaxactun chipped stone (Ricketson and Ricketson 1937; Kidder 1947) are the major landmarks of published lithic information for the central Peten area. However, the first Tikal lithic analyses are now beginning to appear (Moholy-Nagy 1975; see also O. Puleston 1969 and Becker 1973). With the final publication of the Tikal series, the central Peten should be one of the best understood areas in southern Mesoamerica.

Yaxha, to the southeast of Tikal, should become better known, from the lithic technological standpoint, as the lithic analyses of Ray Sidrys and Jay Johnson continue (N. Hellmuth, personal communication 1975).

The area to the east of Yaxha, central and northern Belize, is becoming one of the better understood areas. Willey's lithic analysis of the Barton Ramie artifacts is thorough and well illustrated (Willey *et al.* 1965). Northern Belize has received considerable attention as of late, particularly because of the efforts of Norman Hammond, Dennis Puleston, and their associates. Puleston (1975) has mentioned the *possibility* of Richmond Hill being a Paleo-Indian site, but this must remain only a possibility until detailed excavations, analyses, and chronometric dating have been conducted. Further studies of the calibre of Arlene Miller's (1975; see also this volume) examination of the Richmond Hill lithics are needed at this yet-enigmatic location.

The work of N. Hammond and associates in northern Belize are beginning to yield a clearer picture of lithic patterning and variability as well as pointing out areas of critically-needed research. R. Wilk (1975) has performed a preliminary reconnaissance and analysis on the massive chert manufacturing center of Colha, and J. Andresen (n.d.; see also this volume) has contributed an overview manuscript of northern Belize chert implements. The small lithic collections from Lubaantun in southern Belize have recently been published by Hammond (1975), and the material from Elizabeth Graham's project in Stann Creek District, central coast of Belize, is being analyzed by R. Wilk.

The southern Peten and southern Belize-eastern Guatemalan areas are poorly known (see Joyce 1932 for an early description of "eccentric" lithics from this area), but Copan, in the southeastern Maya area, is relatively well understood from the work of Longyear (1948, 1952). The current Copan project, directed by G. Willey, should yield a considerable increase in lithic information. The same applies to the current project at nearby Quirigua, under the direction of W. Coe and R. Sharer.

Southern Maya Area

This summary of lithic reports in the southern Maya area begins with the Isthmus of Tehuantepec and continues eastward through Pacific and highland Chiapas, Guatemala, and El Salvador. These southern Mayan projects/reports tend to be smaller but more numerous and somewhat more evenly distributed across the landscape than those summarized above for the lowlands.

The work of Wallrath (1967) and Lee (1969) have contributed to lithic

knowledge of lowland Oaxaca (Isthmus of Tehuantepec) and lowland Chiapas respectively. MacNeish and Peterson (1962) encountered early Archaic lithics in the Santa Marta Cave near Tuxtla Gutierrez, and reported them extensively. Other than these three studies, little is known until we reach the Guatemalan frontier.

Just inside the Guatemalan border, along the Pacific coast, is the Ocos-La Victoria area subjected to the ecologic scrutiny of M. Coe and Flannery (1967). Some mention of lithic artifacts is made by them. J. Graham's and R. Heizer's current work at Abaj Takalik on the Pacific piedmont 50 km east of Ocos should yield at least Preclassic lithic materials. Bilbao, similarly situated but farther east, yielded chipped stone implements which Parsons (1969) described briefly.

In the highlands of Guatemala, Woodbury and Trik (1953) provide us with an extensive analysis of Zaculeu lithic artifacts. Kidder analyzed the artifacts of Zacualpa (1948) and Nebaj (Smith and Kidder 1951), two highland sites east of Zaculeu.

The central Guatemalan highlands are quite well known, based on the work of Kidder at Kaminaljuyu (Kidder, Jennings and Shook 1946; Shook and Kidder 1952) and from the recently completed fieldwork of Sanders and Michels (also see Michels' article, this volume). M. Coe and Flannery (1964) presented a valuable description of the El Chayal obsidian outcrop just northeast of Kaminaljuyu (but see Sheets 1975a and Michels 1975 for comments on their interpretations). M. Coe (1960) also describes a Paleo-Indian point from San Rafael, near Guatemala City.

Sidrys *et al.* (1976) recently visited a number of obsidian outcrops and their associated workshops in the Maya highlands. Their locational, descriptive, and analytic data are a contribution to our understanding of aboriginal quarrying and trade.

An extensive analysis of the chipped stone from Beleh (Chinautla Viejo) is contributed by Hester (1975) as a portion of L. Feldman's research. Brief analyses of small lithic samples collected by Feldman along the Motagua River and in the southernmost corner of Guatemala were performed by Sheets (1975b, 1975d, n.d.).

The massive obsidian outcrop of Ixtepeque and the associated processing site of Papalhuapa were described by Graham and Heizer (1968) and more recently by Sidrys *et al.* (1976).

The Chalchuapa area is fairly well understood, both at the site of Chalchuapa itself (Sheets 1974, 1975c) and at the rural Bustamante Site (Sheets 1972). Chalchuapa area core-blade technology recently was found to be representative, in most respects, of lithic technology in the central and western areas of El Salvador (Sheets 1976:29-32). The investigations of E. W. Andrews V at Quelepa, in eastern El Salvador, will extend our lithic understanding into a poorly known area. The Quelepa report will be published soon in the Middle American Research Institute series from Tulane (Andrews, personal

communication 1976). The area of northern El Salvador and all of Honduras except Copan is virtually *terra incognita* as far as lithics are concerned.

Mention should be made in this brief review of the Mayan lithic literature of other summaries which are available. Woodbury (1965) and W. Coe (1965), in their reviews of highland and lowland Maya artifacts, do give brief attention to lithics. In an earlier article W. Coe (1955) reviewed the pitfalls inherent in Paleo-Indian research in the Maya area. Contemporary researchers would do well to carefully consider this caveat. Also, I recently reviewed the Southern Mesoamerican-Central American lithic literature on a topical basis, noting shortcomings and lacunae (Sheets 1977). Finally, typological summaries are available in the comparison sections of the major site reports mentioned above. Particularly extensive typological summaries can be found in Kidder (1947), Willey (1972), Willey *et al.* (1965), Sheets (1974), and W. Coe (1959).

NEEDS FOR FUTURE RESEARCH

The needs for future research are numerous; in fact the needs are so vast and varied as to be discouraging, were it not for the fact that lithic analysis is rapidly becoming an integral component of Mesoamerican research programs.

From this survey we can see a number of geographic gaps where lithic knowledge is weak or nonexistent. The most striking are Campeche, Quintana Roo, and southern and eastern Chiapas in Mexico, the southern Peten and Alta Verapaz in Guatemala, southern Belize, and virtually all of Honduras.

Topically, I believe the most underdeveloped approach of Mayan lithic studies at present is function. This is not surprising, given the size and condition of most lithic samples, the number of variables intervening between implement abandonment and archaeological recovery, and the rigorous demands of a sophisticated functional analysis (cf. Odell 1975).

Trace element analyses, which began in the 1960's, to attribute obsidian artifacts to sources, are contributing an important body of data which allow for reliable reconstruction of trade patterns. When combined with technological analyses yielding an understanding of what kind of exploitation and processing was occurring at what node along the manufacturing trajectory process, along with the changes which occurred through time, our knowledge of the processing and distribution of that valuable commodity will be greatly enhanced.

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BELIZE LITHICS: FORMS AND FUNCTIONS

Thomas R. Hester

INTRODUCTION

In the symposium, this paper was designed to orient and stimulate the discussions regarding Belize chert industries. It was originally presented in two parts: (1) a commentary on the status of lithic studies in Belize; (2) a series of specific observations on a collection of chert artifacts from the site of Colha, as analyzed by H. J. Shafer. For the purposes of the symposium volume, Shafer's paper has been printed separately.

It should be emphasized at the outset that the author's background in Maya lithic studies is very limited, having been confined up to this point to the areas of trace element and technological analyses of Maya obsidian (cf. Hester 1972, 1975; Graham *et al.* 1972). However, I have worked extensively with chipped stone industries in North America, particularly in Texas and in the Great Basin area. Lithic research has greatly expanded over the past few years, and it is now standard practice for most North American archaeologists to devote considerable attention to lithics from their sites. Analyses include wear pattern studies designed to provide data on actual tool function, debitage analysis which permits a better perspective on the lithic manufacturing process, and the utilization of data derived from both functional and technological studies in an attempt to learn more about site function and intrasite behavioral patterns (a bibliography of such lithic research is presented by Hester and Heizer 1973).

An intensified concern with lithics as a source of behavioral information is beginning to penetrate into Mesoamerican archaeological research, a fact reflected by the nature of the papers published in this volume. The past seven or eight years have seen a greatly accelerated effort on the part of many Mesoamerican specialists to provide more anthropologically-meaningful analyses of lithic samples (cf. Sheets 1975a). In particular, there have been numerous studies devoted to trace element analysis of obsidian, and the resulting data have made available new information on the nature of obsidian dispersion in Mesoamerica (a recently published synthesis of such studies can be found in Stross *et al.* 1976).

Still, Mesoamerica lags far behind North America in the quality of lithic analysis that is being done. One can argue that the highly complex sites of Mesoamerica offer a wide range of data for analysis, whereas many North American sites often yield little else than chipped stone. This is certainly true; however, I would counter that the integration of data derived from lithic analysis with that obtained through studies of architecture, monuments, ceramics, long distance trade, intensive agriculture, and the like, will eventually permit a fuller and more complete picture of ancient Mesoamerican life-styles.

LITHIC STUDIES IN BELIZE

Archaeological research in the Maya lowlands of Belize has tended to

neglect lithics and lithic studies. Early papers, like those of Franks (1877), Gray (1916) and Joyce (1932) were concerned with eccentrics or with individual specimens. This is a situation which has been considerably improved by the work of Willey and others in the Belize Valley (Willey *et al.* 1965), by N. Hammond's Corozal Project (particularly the work of R. Wilk at Colha; see this volume), and by the research of UCLA students in northern Belize (see the papers by Sidrys and Andresen in this volume).

An illustration of the paucity of information on chipped stone tools from the Maya lowlands is reflected in the scant five or six pages devoted to them in a synthesis of Maya lowland artifacts prepared by W. Coe (1965). As just stated above, more work has been done since then, but lithic studies in the lowland area remain in the embryonic stage.

A great deal more emphasis has been placed on the analysis of obsidian. Two major areas of research have been technological studies and trace element analysis. Work has been done by Rovner, Sheets, Michels, Moholy-Nagy, the author, and others. Concepts have been developed as to the process of obsidian tool production and distribution, the function of specific tool forms (cf. Hester 1975), the nature of activities at a site (Sheets 1975b; Michels 1975), and there has been particular success in defining and delimiting many of the significant obsidian sources in the Maya area (cf. Stross *et al.* 1976; Sidrys *et al.* 1976). Again, however, the area of Belize has not figured in most of this research (an exception is the work of Hammond 1972; see also this volume).

For the purposes of this symposium paper, it is perhaps most useful to restrict the discussion to implements fashioned from chert--the chipped stone artifacts of Belize and the adjacent Maya lowlands. Specifically, I would like to briefly examine (1) the problem of artifact description; (2) the need for functional analysis of lithic implements; (3) the need for studies of the lithic manufacturing process; (4) the necessity for intensive studies at sites specifically related to the lithic production process (also important in this regard is the relationship between the production site and the consumption/distribution of the products).

Early archaeological studies in Belize paid scant attention to lithic artifacts, although as I have previously noted, some exotic specimens were described and illustrated. There are, of course, a number of early reports which treat with stone implements in one fashion or another, but the general trend was to illustrate a few specimens and let it go with that (cf. Gann and Gann 1939; Ricketson 1929; Thompson 1939). In the report of Ricketson's (1929) research at Baking Pot, a number of eccentrically chipped chert artifacts are illustrated, along with large bifaces, discoid unifaces, and small bifaces that may be projectile points. None of these specimens was described in any detail.

The first really adequate descriptive studies of lowland Maya lithics came with the work of Kidder (1947) in his report on artifacts excavated some years earlier at Uaxactun. Kidder distinguished between artifacts of utilitarian and ceremonial functions. Within the utilitarian category,

further division was made on the basis of materials used in tool manufacture--"implements of white flint", "implements of dark flint", and "implements of obsidian". The implements of white flint consisted mainly of tools used in what he suggested were chopping, pecking, rubbing, perforating, and scraping functions, and these functional attributions were used in describing each form. The chopping tools were termed "general utility tools", with "standard" and other forms. Basic descriptive data and illustrations were provided. What I find significant about Kidder's treatment of the stone tools is his evident concern for substantive data related to function. He was not content to call a tool a "chopper" simply because it looked like what most archaeologists thought choppers ought to look like. Rather, he scrutinized the edges of these implements, as well as those of the other tool forms, for evidence of use-wear and for possible methods of prehension and/or hafting.

The descriptive categories set forth by Kidder in 1947 have generally been followed in studies published since that time. They have been elaborated upon and some new categories added; in particular, lengthy treatments of stone tools have been presented by Coe (1959, for Piedras Negras), Willey *et al.* (1965, for the Belize Valley), and Willey (1972, for the artifacts of Altar de Sacrificios).

By way of review, I want to very briefly examine those descriptive categories put forth by Willey *et al.* (1965) for the Belize Valley, confining these observations to what were termed "utilitarian implements of flint". Of the 524 specimens in this category, 6% were described as "knives or points", with stemmed, unstemmed, and notched variants; both bifacial and plano-convex examples were noted.

"Choppers or General Utility Tools" (following a classification originally proposed by Kidder) constituted 44% of the sample. These are large ovate bifaces, often bearing indications of wear on one end.

The rubric "chisel-like tools" was used to describe 6% of the assemblage, and includes "adzes or planes" (both bifacial and unifacial) "bifacial gouges", and "small bifacial chisels".

"Drills or punches" is a fourth category, representing 2% of the sample. Both "small" and "heavy" variants were reported.

"Scrapers" constituted 5% of the collection. These were subdivided into groups such as "triangular side-scrapers", "end and/or side scrapers" (with both large and small variants). "Prismatic end and side scrapers" were also described, and are made on blade-like chert flakes.

Other chipped stone tool categories include specimens which were either "choppers or cores" (19 of these showed wear evidence; 26 did not), a polyhedral chert core, unworked or slightly modified chert nodules, flake blades and flakes, rejects, and unidentifiable fragments.

In general, most of these categories evidence very good description, excellent illustrations, and contain comparative comments dealing with similar specimens elsewhere in the Maya area. There are no major criti-

cisms on my part as to the adequacy of the lithic descriptions; some categories, such as the flakes, are perhaps insufficiently treated, but the sample was small (and, to the authors' credit, they did carry out experiments in an effort to replicate the use-nicks observed on the flakes).

Thus, there are eight or nine major descriptive categories into which the Belize Valley lithics were sorted. Similar classifications were used earlier by Kidder, Coe and others, and in the subsequent Altar report by Willey (1972). All of these scholars seem to be talking about the same things when these various descriptive classifications are invoked. One could argue that these categories "communicate" well and that they have a respectable history of use among archaeologists working with lowland Maya artifactual remains.

Perhaps this is true, but it brings me to my second point. Do these descriptive terms have any substance, or do they reflect any sort of functional "reality"? Can these subjective terms be replaced by more meaningful labels reflecting the tool's actual use? Or, by the same token, can we provide better tests of the functional terms, such as "end and side scrapers", "chopper", etc., which currently exist in the literature?

The archaeologist now has available a series of research tools which would permit useful functional studies with Belize lithics. Paramount among these is wear pattern analysis, at both the macroscopic and microscopic levels. Such research can, and should, be combined with replicative experiments in which tool forms are used in certain tasks and the resulting wear patterns then observed and recorded for comparison with archaeological specimens.

Use-wear observations have already been made at the macroscopic level, beginning with the work of Kidder (1947) and amplified in the various publications of Willey (cf. Willey *et al.* 1965; Willey 1972). Wilk (n.d.a) has conducted microscopic wear pattern studies of artifacts from the site of Barton Ramie in Belize (see also Wilk's n.d.b, microwear research on the lithics of Seibal, Guatemala). The potential for functional analysis with Maya chert tools has already been demonstrated by similar studies with Maya obsidian industries. For example, at Beleh, Guatemala (Hester 1975), microscopic wear pattern studies revealed that thinned bifaces which might be called projectile points by some archaeologists actually functioned as cutting tools or knives. Similarly, in some Mexican obsidian assemblages, such as one I studied from Michoacan (Hester n.d.), there are unifacial implements which can be technologically classified as "end scrapers", but which wear analysis revealed to have been used on both the ends and sides, most probably used in a cutting, rather than in a scraping mode.

Practically all of the existing Belize lithic categories are ripe for functional analysis. The "general utility" bifaces, described by some as choppers or possibly hand-axes, often exhibit wear, either as battering on edges or as polish on or near working edges. Bullard (1965:53) uses the term "celt" for this tool form. He reports battering and use-polish on specimens from San Estevan in northern Belize. According to Bullard

the tool form is restricted to the Maya lowlands, and it is his belief that they were "primarily forest-clearing and wood-cutting tools" (probably hafted for such use). Bullard and Bullard (1965:28) present similar remarks. Significant samples of these tools need to be systematically studied for types and frequencies of wear patterns, and attempts should be made to replicate the wear evidence through controlled experimentation. The large, stemmed bifaces from Belize described by Willey *et al.* (1965) as "points or knives" should also undergo similar examination; a projectile point shape does not necessarily equate with function.

The so-called "chisels" or "gouges" show wear, but we have no concrete evidence as to their actual function. Specimens termed "scrapers" may well have served in that fashion, but wear pattern studies might lead to the establishment of useful subdivisions within this classification. Willey (1972), in his study of Altar de Sacrificios lithics, making the following observation about scrapers: "...they are not well reported, and it is possible that they have often been discarded as little more than odd flakes or scraps." (p. 178). He was referring to a particular unifacial form that has been noted at Barton Ramie, Tikal, Uaxactun, Piedras Negras, and other sites. However, terribly little has ever been written about this tool form.

Systematic functional research with Belize lithics would enable archaeologists to not only establish more realistic classifications, but to also use these meaningful categories in discussing the utilization of chert implements in Maya society. Such studies would be especially valuable in the interpretation of a production site like Colha. Wilk (1973) used both descriptive and morphological classifications in his studies of the lithics from that site, but repeatedly argued for wear pattern and functional research. Until such studies are done, it will be difficult to achieve the goals of explaining workshop activities, intra-site organization, and export mechanisms at the site.

A third area I have chosen for comment is the analysis of the lithic manufacturing process in Belize and lowland Maya chert industries. Here again, such studies have been carried out with obsidian assemblages, with the work done by Sheets (1972) serving as an excellent example. He has proposed a model which allows the archaeologist to evaluate obsidian specimens in terms of the sequence of manufacturing and use events--beginning with the quarrying phase, continuing through implement manufacture and utilization, and ending (usually) with the discard of the worn or broken tool.

No such model exists for the Belize chert industries (a post-symposium paper by Andresen presents a preliminary model; see this volume). In order to evaluate an industry or to develop a model to explicate it, one has to adequately sample and analyze flake debris, rejects, broken implements, etc., to record their provenience within a site, and, hopefully, to locate and study workshops and other functionally-specific areas within sites. In the past, flake debris has been consistently ignored at sites in Belize. Even those flakes used as tools have received rather cavalier treatment; e.g., Bullard's (1965:54) description of "worked flakes" at

San Estevan: "Irregular flakes showing use chipping on one or more edges were found sparingly in deposits of all periods." Willey (1972) notes that at Altar de Sacrificios, flakes were not saved except when they were found in caches (p. 180). He did report, however, that flakes were present in all parts of the site. At Barton Ramie, Belize, the "abundance of flint scrap and wastage" was reported, and an estimated 3000 specimens were tabulated but not analyzed. Willey *et al.* (1965:411) observed "... the presence of flint nodules in the house sites" and concluded that "these manufactures [of flint implements] were carried out at the Barton Ramie village" (*ibid.* 411). Obviously, the recovery and analysis of chert debris or debitage needs to be incorporated into future excavation projects. Some such studies have already been done. R. E. W. Adams (personal communication) informs me that James Stoltman has done a lithic debris analysis for the site of Becan in the Rio Bec area; Wilk (1973) has also provided cursory comments on lithic waste at Colha.

Similarly, tools broken during use, or those abandoned during the manufacturing process, need to be reported in order to establish the sequence of lithic tool utilization. Reports such as Barton Ramie (Willey *et al.* 1965) mention "uncompleted artifacts", but no descriptions are provided.

This brings me to a fourth and final point: we can perhaps best elucidate the lithic industries of Belize by beginning with the analysis of the production centers--the chert workshops. A number of such sites must be present in the Maya lowlands; for example, one workshop locality has been reported by Bullard (1960) near Santa Rosa on the Belize frontier. The participants in this field symposium will visit the site of Colha, where preliminary studies of a series of chert workshops has been initiated by R. Wilk (see this volume). To properly study a site as massive and as extensive as Colha will require a great deal of time, patience, and careful planning. Such an investment should be well worthwhile. The site has the potential to yield new and exciting data on the activities and organization of this major Maya chert-working center. Research at the site should also provide a better understanding of the manner through which the chert tools produced there were subsequently exported to Maya consumers.

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BELIZE LITHICS: "ORANGE PEEL" FLAKES AND ADZE MANUFACTURE

Harry J. Shafer

INTRODUCTION

The subject of my study is the technological analysis of a small sample (N=26) of chipped stone artifacts recovered from the surface of Structure 100 at Colha, Belize. The majority of the items are curious elongated, curved flakes exhibiting one unifacially retouched convex edge. Emphasis will be placed on describing the technology of production and exploring the functional implications of these flakes. These interesting artifacts have been described and termed "orange peels" by Wilk (1976:165-166). I will use the term "orange peel" flakes for the sake of continuity. In addition to the "orange peel" flakes, the sample contains five other artifacts which deserve special attention.

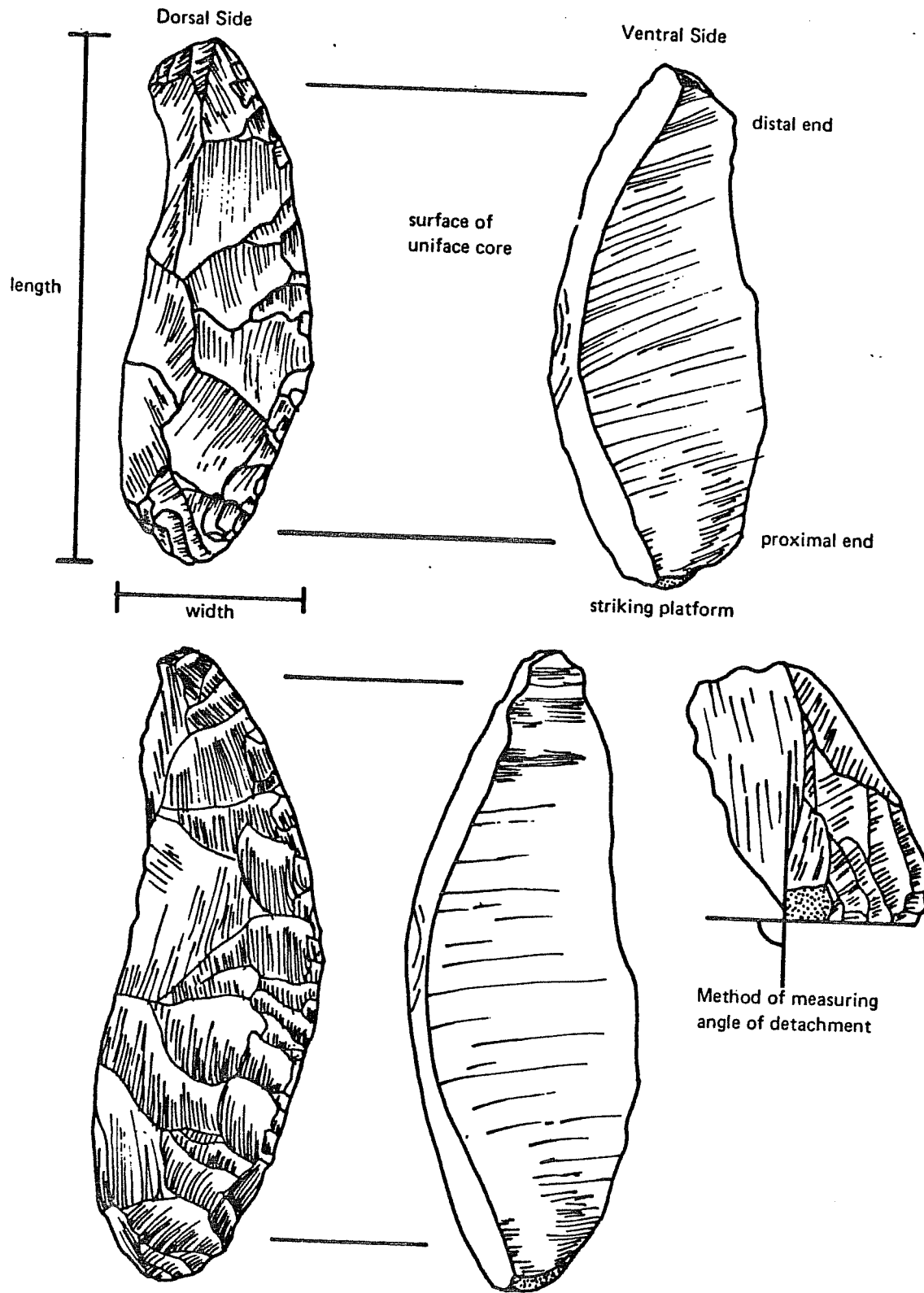
The major objectives of this brief study are (1) to provide a description of the sample; and (2) to provide a functional explanation of the "orange peel" artifacts. The descriptive work is accomplished by sorting the artifacts into morphological categories and providing a list of attributes used as sorting criteria. The second objective is accomplished by using the observed attributes of the "orange peel" flakes to hypothesize a reduction sequence which would explain the attribute patterns observed. This hypothesis was then tested in the field by searching for artifacts at several debitage mounds at Colha, which could either have served as cores or which would otherwise provide clues to the purposes of the "orange peel" flakes. In essence, the hypothesis is that the "orange peel" flakes are the debitage resulting from edge rejuvenation of large unifacial adze-like utilitarian (and probably hafted) tools. This hypothesis, if confirmed, would explain the apparent abundance of the "orange peel" specimens and the near absence of cores from which they were derived, since the hypothesized cores or tools, once rejuvenated, would be carried back to the area where they were to be used. An alternative hypothesis proposed by both Wilk (1976) and Crabtree (personal communication), that the "orange peels" could themselves be specialized tools, will also be considered.

THE SAMPLE

The artifacts were divided into two major categories: "orange peel" flakes and possible cores for "orange peel" flakes.

"Orange Peel" Flakes (N=22)

The sample of artifacts described under this heading was subdivided into four categories; three of these may have functional implications in that initial, secondary and tertiary uniface retouch steps appear to be represented. Measurements taken include the length of the retouch flake which would provide the maximum width of the core (Fig. 1). The width is calculated by measuring from the flat surface from which the retouch flakes along the worked edge were struck to the maximum width of the



Category 2 "orange peel" flakes illustrating method of orientation

Figure 1. Category 2 "orange peel" flakes illustrating method of orientation and measurement.

opposite edge (Fig. 1). This measurement will provide a minimum thickness of the core from which the "orange peel" flakes were derived. Edge angle measurements were made using a contact goniometer.

Category 1 (N=3; Fig. 2, top) Primary Removals: These are represented by three specimens; two of these exhibit all or significant portions of the bulb of force that resulted in the removal of the parent flake. Remnants of the weathered cortex surface are retained along the outer edge. However, much of this edge has been retouched, perhaps to establish a continuous ridge along the edge to direct the fracture path in order to insure a successful removal. Oriented with the bulbar end downward and with the original flake surface facing the viewer, the retouched edge is to the left on all three examples. Angles of the intersection of the ventral surface of the core and the flake facet are 118° , 120° and 121° . One specimen appears to have been thermally altered (reddish hue at bulbar end), but since the specimen is a surface find the thermal alteration is likely due to slash and burn clearing of the mound (Wilk 1976: 153). Length: 10.4 cm, 11.6 cm, 10.2 cm; height: 3.7 cm, 3.7 cm, 3.3 cm.

Category 2 (N=14; Fig. 1): The largest group of "orange peel" flakes was removed from artifacts that could have been repeatedly retouched by step flaking along the wider and convex end. The presumed working edges of the tools prior to retouch are steeply trimmed by step flaking and the edges are evenly convex. The edges clearly show dulling. The possible wear is not the kind expected if the specimens were tools used against hard materials. It is possible that the dulling is due to abrasive retouch rather than constituting actual wear. With the bulb of force oriented downward and the parent flake surface facing the viewer, the retouched edge is on the left on 13 examples and on the right on one. Four appear to have been thermally altered (one at the bulbar end). Edge angles vary from 85° - 121° . Dimensions: 7.0-12.4cm; height: 2.2-4.9 cm.

Category 3 (N=3; Fig. 2, lower): These are tertiary flakes in that they represent at least the second in a series of "orange peel" flakes from their respective cores. Two exhibit the characteristic step retouched edges since the previous "orange peel" removal. Both are quite thin, show the characteristic dulling observed on many category 2 examples, and are slightly burned. The third example is more complex in that a removal was attempted from one side but failed. The failure was partially corrected by another removal from the opposite side. Apparently still not satisfied, but now having a continuous outer edge to guide the fracture, a third and successful removal was struck from the striking platform where the original removal was attempted. Edge angles are 170° , 107° , and 106° . Dimensions: 8.1 cm, 9.8 cm, 9.6 cm; height: 3.2 cm, 3.9 cm, and 5.0 cm.

Category 4 (N=2) Fragments: One of these specimens is the distal end of an "orange peel". It would probably fit in the category 2 series had it been complete. It is broken at the proximal (bulbar) end by a thermal fracture. The second example is much more irregular in appearance than any other "orange peel" specimen. It, too, is the distal end,

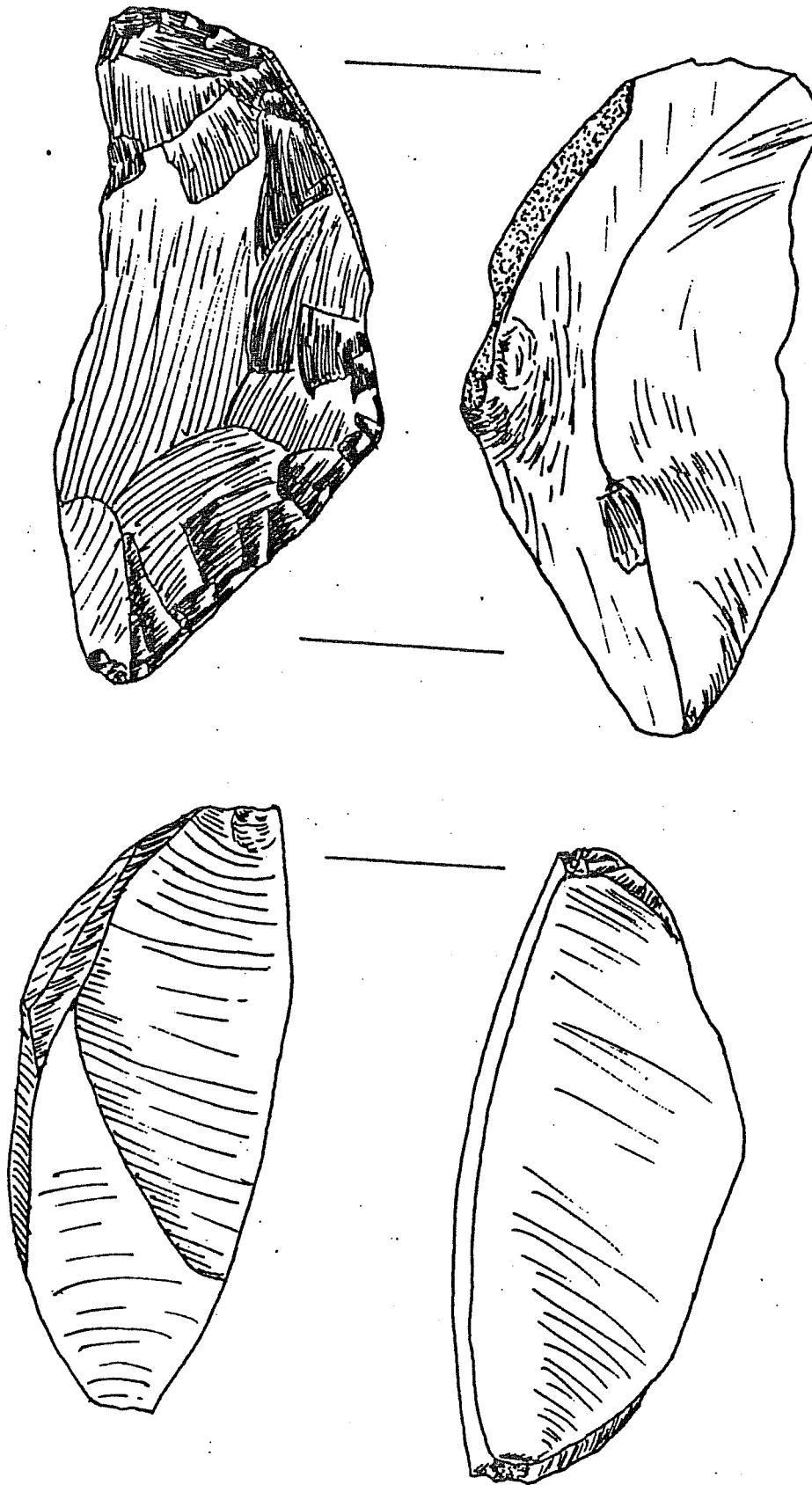


Figure 2. *Category 1 and Category 3 "orange peel" flakes.* Upper, Category 1 flake (both faces); Lower, Category 3 flake (both faces).

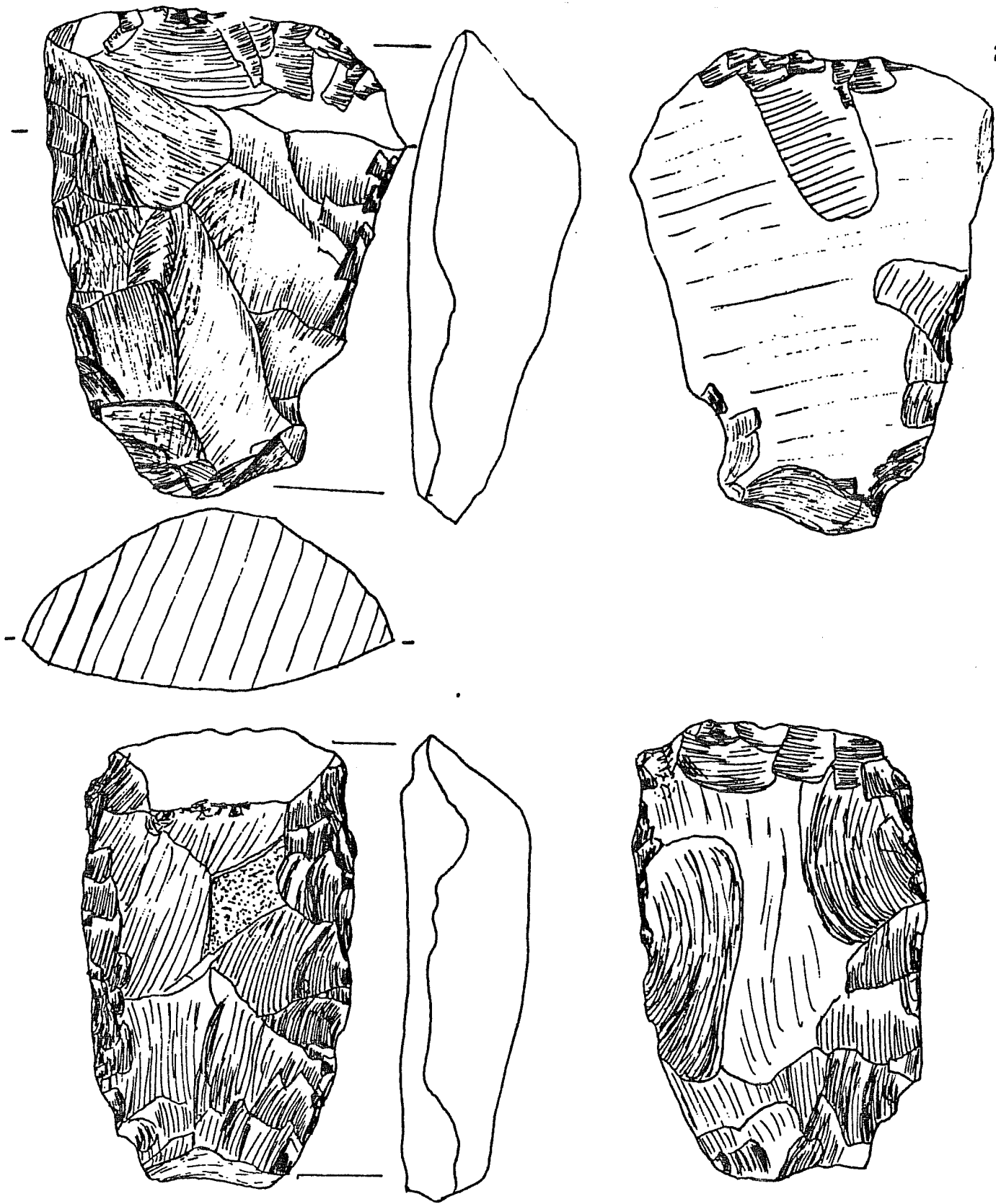


Figure 3. Possible cores for "orange peel" flakes. Adze-like tools exhibiting truncate retouch possibly resulting in "orange peel" flakes. Upper, specimen No. C72.17 (both faces, transverse and longitudinal sections shown); Lower, specimen No. C66.5 (both faces and longitudinal section shown).

having been snapped from the proximal end. Edge angles are 98° and 119° .

Discussion of the "Orange Peel" Flakes

Several general observations are worthy of comment. The striking platform on the flakes, for example, was prepared by extensively dulling and blunting one corner--with one exception, the same corner--of the parent core. This point of detachment was the upper right hand corner of the hypothesized adze-like plano-convex tool with the convex surface facing the viewer and the wider end oriented upward (see Fig. 4 C). It may have been necessary for the flintknapper to straighten the retouched or working edge of the core in order to insure a successful removal, but this cannot be demonstrated with certainty on category 2 specimens. I suspect, however, that was the reason for the unifacial retouch on the category 1 specimens.

Curiously, there are no obvious erailure scars (cf. Crabtree 1972:60) on the bulbar surfaces of any "orange peel" flakes. This, and the slight lipping effect observed at the striking platform area of several specimens, suggest to me that hardwood mallets may have been used in their removal.

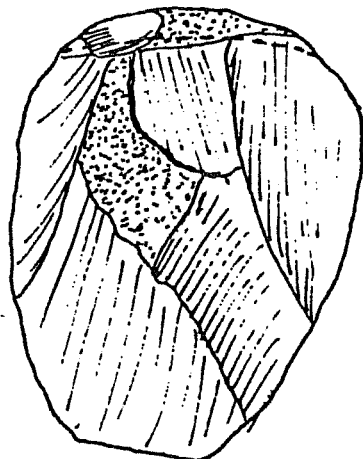
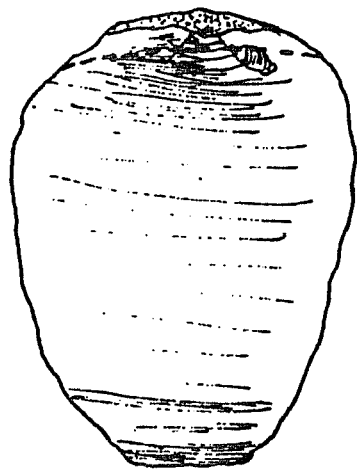
Of the 22 specimens examined, the angle of removal--that angle created by the plane surface of the parent core and the facet created by the specimen's removal--varies from 85° to 121° . The expected complementary angle on the core resulting from the "orange peel" flake removal would vary from about 60° to 105° . Interestingly, this angle range does not differ significantly from that projected for the angle of the step retouched edge (i.e., 80° - 100°). Assuming that these are rejuvenation flakes, the rounded, dulled and slightly smoothed retouched edge may have been more of a factor necessitating rejuvenation than an angle increase through retouch of the edge angle itself.

Possible Cores for "Orange Peel" Retouch

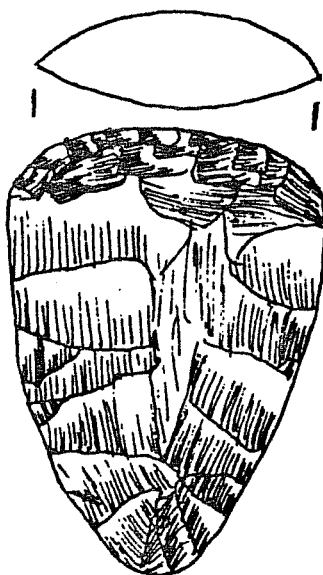
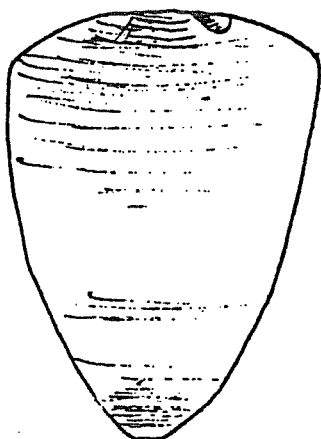
Wilk (1976:166; Fig. 9.28) describes and illustrates a specimen which he believes to be a possible core for "orange peel" flakes. This specimen was included in the shipment of artifacts to The University of Texas at San Antonio and eventually to Texas A & M University. The specimen is shown in Figure 5 A. Close examination revealed that the curvate fracture across the wider end thought by Wilk to be the scar from an "orange peel" flake removal was instead a thermal fracture. The wider end on this specimen was burned and the flint exhibits numerous internal fractures and some discoloration due to thermal potlidding. The specimen was much too thin at the wider end to have yielded an "orange peel" flake.

A search of the small sample of chipped stone artifacts accompanying the "orange peel" collection yielded four specimens of adze-like tools that appeared to have been retouched in a manner that would yield "orange peel"-like flakes. These specimens are described individually.

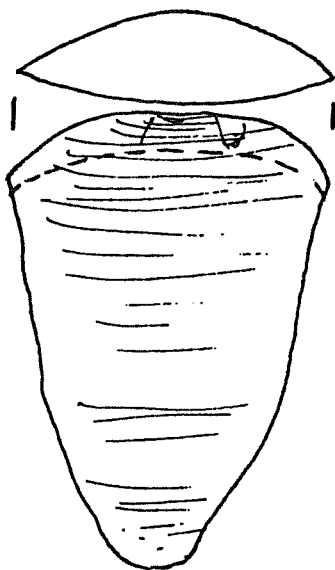
C72.17: This is a trapezoidal-shaped unifacially chipped tool made on a



A



B



C

Figure 4. Hypothesized sequence for manufacture and retouch of adze-like tools illustrating how "orange peel" flakes may have been produced during the course of edge refurbishing.

large, thick flake (Fig. 3; top). It is described by Wilk (1976:168; Fig. 9.32) as an adze. The broader end exhibits traces of a single flake facet that removed the entire edge from corner to corner; edge angle created by this removal was 71° . The removal was struck from the right corner, the same corner which all but one of the "orange peel" were struck. The broader end has been mostly unifacially retouched with some minor bifacial retouching near the center on the ventral side. Dimensions: length, 9.2 cm; width, 7.1 cm; thickness, 3.4 cm.

Comments: The size of the tool and character of the wider end plus subsequent alteration of this end suggests strongly that the beveled edge was created by a single flake removal; the resulting flake would have all of the characteristics of an "orange peel".

C82.2: This is a narrow, triangular-shaped artifact made from a large, thick flake which was shaped mostly by unifacial chipping. It is described by Wilk (1976:168; Fig. 9.31) as a chisel. The wider end has been truncated by a single flake removal, again originating from the upper right corner (with the specimen oriented with the wider end up and the dorsal side of the parent flake facing the viewer). The angle created by the removal is 77° . The resulting edge is sharp and unretouched--and indeed appears to have been unmodified. The specimen may have been discarded subsequent to retouching. Length: 9.2 cm; maximum width: 4.4 cm; thickness: 2.9 cm.

C66.5: This specimen is a subrectangular biface (Fig. 3, lower). It appears to have been fashioned from a large thick flake although it is difficult to ascertain this. Cross section is approximately plano-convex. One end is slightly wider and exhibits traces of a single truncated retouch flake having been removed from this end. The angle created by this removal is impossible to measure but is estimated to have been about 70° . Retouching of this and other edges was done mostly from the ventral or planar side. The specimen had undergone quite extensive retouch from both sides subsequent to the truncation. Length: 8.9 cm; width: 5.2 cm; thickness: 2.5 cm.

Comment: The history of this particular specimen is clearly complex and later retouch and modification mask many of the earlier attributes. This factor should be taken into consideration in the search for possible cores of the "orange peel" flakes and signals the need to examine a sample of all the tool and debitage categories during the course of a technological analysis. The adze-like tools, whatever they were, may have been retouched in several ways during the time they were used. This specimen exhibits two possible ways: removing the entire edge with one stroke, resulting in an "orange peel" flake; and retouching the acute edge by removing flakes from the ventral (plane) side of the tool.

C80.4: This is another elongated thick plano-convex artifact that is mostly bifacially chipped. It appears to have been fashioned from a thick flake. The wider, thicker end exhibits several interesting flake removals. The first truncated the thicker end but created an irregular, recurved edge of approximately 90° . A possible attempt to straighten

this edge resulted in the removal of a blade-like flake from the opposite edge. This flake made most of the edge obtuse (115° - 120°). Another flake struck from the dorsal side removed the striking platform of the second flake and may have destroyed any hope of recovering from previous mistakes. The dorsal surface exhibits a medial ridge created by the termination of flakes originating at each lateral edge. The highest point of the ridge near the presumed proximal end evidences scars resulting from battering. This battering is subsequent to the apparent retouch attempts previously described. The purpose of the battering is unknown, but again demonstrates the complexities of reconstructing the life history of these artifacts. Length: 9.9 cm; width: 5.5 cm; thickness: 3.3 cm.

Function of "Orange Peel" Flakes

Two hypotheses are proposed to explain the function of "orange peel" flakes. Hypothesis 1 is that the "orange peel" flakes were the by-products of edge rejuvenation of adze-like tools. This hypothesis was based on the author's experience with a strikingly similar (albeit smaller) pattern of uniface retouch debitage in west central Texas (Shafer 1970). The second hypothesis, proposed by Wilk, is that the "orange peel" flakes were specialized tools. These hypotheses are discussed in detail below.

The first hypothesis can best be presented by describing a reduction sequence for the "orange peel" flake cores based on the observations of various attributes in the sample. This sequence, illustrated in Figure 4, is as follows. A large, thick flake was selected (Fig. 4 A). The bulbar end was designated as the use end of the anticipated tool in order to take advantage of the curvature of the ventral flake surface due to the swollen bulb of force. The remainder of the flake was trimmed to an elongated triangular shape (Fig. 4 B). The bulbar end was either uniaxially retouched to a steep, convex edge for use or the striking platform remnant was removed in one blow usually struck from the right corner of the wider end (ventral side up). This single removal created an "orange peel" flake containing traces of the striking platform and bulb of force on the trimmed edge (Fig. 4 C). As the adze tools were used and perhaps retouched through step flaking, eventually edge wear and perhaps resin accumulation along the step fractures necessitated refurbishing. The rounded edge may have become too stepped or obtuse for additional step retouch that in order to continue using the tools, complete removal of the edges was necessary. The process of removal was accomplished by roughening one corner of the tool in preparation of a striking platform and, using the retouched edge to guide the fracture path, removing the entire edge with one blow. The technique is essentially that of blade production modified to produce a new working edge with an angle of approximately 60° - 80° . Critical to insure successful removal was achieving an even curvature of the retouched edge. This curvature was the surface or ridge that directed the fracture path.

Since the production and rejuvenation of the adze-like tools is one of reduction, mistakes can be expected at every step and exhausted examples should fossilize each critical step in the manufacturing sequence. Despite

the small sample, a model of virtually the entire sequence can be constructed. That the convex, retouched edge of the "orange peel" flakes originated from the bulbar end of large flakes is certain. Category 1 "orange peel" flakes may represent initial edge shaping for unifacial adze-like tools by removing the striking platform and creating a suitable working edge in a single removal. Category 2 flakes may represent the by-products of rejuvenating tools repaired or retouched by step flaking during the process of use. Two of the category 3 flakes may represent retouch debitage from tools that had previously been rejuvenated via the "orange peel" technique, retouched by stepped flaking, became dull through use, and retouched again by the "orange peel" technique. Three plano-convex adze-like tools exhibit traces of truncations across the wider end and the angle of this retouch conforms to the expected complementary angle of the "orange peel" flakes. Weighing the evidence in the small sample that agrees with the proposed reduction sequence of adze-like tools certainly provides a strong basis for the hypothesis that the "orange peel" flakes are uniface retouch debitage.

TESTING HYPOTHESIS 1

I anticipated having the opportunity to visit Colha and to examine several of the debitage mounds known to be present. The opportunity to collect selected artifacts from certain areas, however, was not anticipated and made possible a much more thorough analysis of the field collected sample. Collecting was indeed selective and most debitage specimens were collected from a bulldozed refuse mound southeast of Masson's house near the public road. The artifacts selected for collecting were those that represent either stages in adze manufacture or variations in "orange peel" flakes. Numerous examples of completed and exhausted adzes were seen in and near the ceremonial center and examples of these were collected. The initial intention was to use the artifacts as visual aids in the presentation of my paper on adze manufacture at the evening symposium at Orange Walk Town. The field collected sample caused me to rethink certain aspects of the adze manufacture and retouch sequence. In short, the original hypothesis was not altogether confirmed by the new data. Based on field examination of a massive quantity of debitage and a large sample of tools at Colha, I am currently of the opinion that the "orange peel" flakes are indeed debitage of adze manufacture but that the rejuvenation portion of the original hypothesis is in error. Figure 5 B-D illustrates three artifacts representing examples of steps in what I hypothesize the adze manufacturing sequence to be. In essence, this sequence can be described as follows:

1. A large flake was removed from a prepared core (Fig. 6 A). This flake was relatively thin in proportion to width and length and was longer (along the flake axis) than it was wide. A number of very large flakes which could have served as adze blanks were seen in several areas of Colha. One was collected and passed around at the symposium.

2. The striking platform of the large flake was retouched uniaxially to form an even convex edge and the lateral edges were trimmed to shape the specimen to a rough, triangular outline (Fig. 6 B).

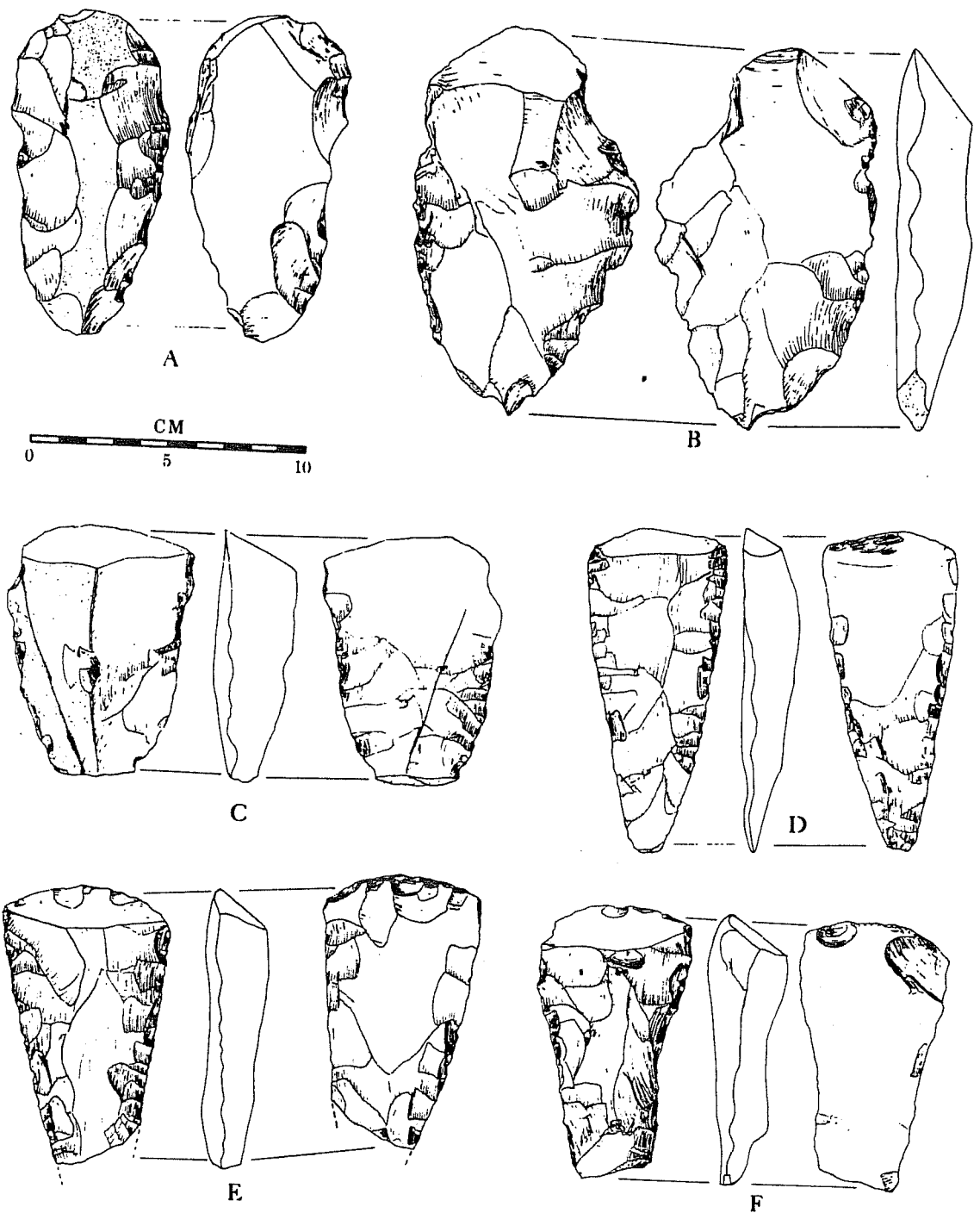


Figure 5. *Artifacts from Colha.* A, biface reported by Wilk as being possible "orange peel" core; B, rejected adze-preform after removal of "orange peel" flake; C, adze-preform; (B, C from bulldozed refuse mound); D-F, adzes collected from ceremonial center.

3. A broad notch (Fig. 5 B; Fig. 6 B) was prepared in one edge near the wider end. Orienting the specimen with the dorsal side facing the viewer and with the wider end placed upward, this notch is usually located in the upper right-hand corner. A striking platform was prepared on the corner of the notch with the intersecting convex edge. The first (and if successful, the only) "orange peel" flake was then removed, possibly with a soft hammer (but a hammer with considerable mass nonetheless), for the purpose of creating the edge angle and bit of the adze (Fig. 6 C).

4. The adze preform was then biface and thinned to the desired size and form (Fig. 5 D, E; Fig. 6 D). Debitage from the thinning process would include biface thinning flakes and preform failures due to thinning errors. Mistakes during the removal of "orange peel" flakes also occurred (Fig. 5 C) and these are manifested on both the flakes and cores. It should be pointed out that "orange peel" flakes will always be longer than the adzes are wide, due to subsequent reduction of the adze preform through final shaping. The later retouch often masks or removes negative features of "orange peel" flake scars. This, plus the fact that I could not find tools large enough to serve as retouched tools, finally led me to favor the notion that the "orange peel" flakes were produced during the initial step of adze manufacture rather than being a product of adze bit rejuvenation as proposed in the first hypothesis. And my continued reference to the tools as adzes is based on an inspection of numerous tools found lying in and around the ceremonial center at Colha. I collected one of these tools which showed an especially good example of wear. This specimen is shown in Figure 5 F along with other examples of adzes and adze failures (Fig. 5 B-E).

TESTING HYPOTHESIS 2

The second hypothesis is that the "orange peel" flakes were some kind of specialized tool as Wilk first assumed. The patterned production of the flakes, their apparent abundance at Structure 100, plus the curious shape and combination of attributes would indeed create suspicion that they were specialized tools. Two observations by Wilk, however, tend to weigh heavily against this hypothesis. First, he noted that most "orange peel" flakes were complete whereas other tools were mostly fragmentary. Second, only one possible candidate for an "orange peel" flake core was observed by him and this specimen has since been rejected as a possible core. If the items were used as tools which resulted in the extensive step fracturing, their delicacy could doubtfully withstand prolonged wear without breaking. Second, the opposite edge is indeed sharp and is usually unaltered. Also, my observation that four plano-convex tools in the initial study collection were retouched in a manner that would create flakes similar to "orange peels" indicates that such items could result fortuitously through systematic and patterned retouch. In short, I reject the second hypothesis on several grounds, but mainly because their attributes are best explained by the reduction sequence model and because their common occurrence and complete condition are more likely due to the fact that much manufacturing activity was conducted at Structure 100 and the flakes are by-products of tool production activities of specialists. The seeming paucity of cores could be due to skill of the artisans or to the difficulty

in recognizing the cores. My own feeling is that by placing attention on the truncating technique, "orange peel" flake cores will become more apparent and more easily recognized.

The refined model of adze manufacture and "orange peel" flake production has been presented. The debitage at Colha is enormous in quantity and the lithic specialization includes a broad range of tools. One technique of adze bit formation has been described and is based on the inspection of debitage, failures and end products. Because we know so little of the Colha lithic technology at this time, it would be naive to claim that the "orange peel" question has been resolved. Indeed, a technique so expedient as the "orange peel" or truncating method would have been used to either prepare working edges or ends to other specialized tools as well as a technique for edge rejuvenation which we have not yet recognized. In short, the "orange peel" flake method is one specialized technique used by the Mayan flintknappers at Colha; undoubtedly there are others, but these will become clear only after an intensive analysis of debitage and tools is carried out.

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WORK IN PROGRESS AT COLHA, BELIZE, 1976

Richard Wilk

Northern Belize is an area rich in archaeological resources, in which the Corozal Project has often found its efforts spread very thinly. The investigations at Colha have so far been managed as a small segment of the Corozal Project's general program in the Corozal and Orange Walk Districts, and thus the site has received much less attention than it deserves.

Colha is located on the farm of John and Herbert Masson, just north of the Orange Walk District's southern boundary (see Fig. 1). There is a minor ceremonial center, surrounded by many square kilometers (mostly unmapped and under forest cover) of house mounds and piles of chert artifacts and debitage which we have called workshops.

An effort was made this season to estimate the total area of the site by foot survey and the use of air photos. The eastern and western site boundaries are evident where the Northern Highway crosses them, but the other limits to the site are covered by thick bush, and are crossed only by a few trails. Along the highway the site stretches between 2.5 and 3 km; to the south dense mound concentrations are still encountered more than 1.5 km from the road, and may continue for more than another kilometer. To the north the site extends more than 2 km from the road and may continue to the edges of a large swamp, more than 3 km north of the road. A minimum site area is therefore 8.75 km^2 ; extrapolating from the areas already mapped, in which mound densities average to about 460 per km^2 (excluding the ceremonial center), the minimum number of structures present at the site is approximately 4,000.

It is worth pointing out that a density of 460 structures per km^2 is more than double the figure of 197 structures per km^2 given by Puleston for the combined residential areas of Tikal and Uaxactun (again excluding the ceremonial centers; Puleston 1974:308). On this basis alone, Colha is clearly an exceptional Maya site.

My first season at Colha was an all-too-short two weeks in the spring of 1973. Given the complexity and size of the site, an extensive survey program was ruled out, and excavations were limited to a single trench in a particularly enigmatic feature which turned out to be a chert-paved *sacbe* (reported in the Corozal Project 1973 interim report). The rest of my time was devoted to the intensive investigation of a single workshop mound, Structure 100 (Wilk 1976). Despite the problems of generalizing about other workshops on the basis of a single example, my work provided information on both technical problems of archaeology at Colha and the kinds of artifacts which were being produced at a single workshop.

Structure 100 was chosen because of accessibility and an apparent lack of any serious disturbance. I mapped all tools, took debitage samples, and attempted both distributional and technological analysis of the artifacts. Some of the artifacts have since been restudied by T. R. Hester and H. J. Shafer (see Shafer's paper in this volume) from a more strictly

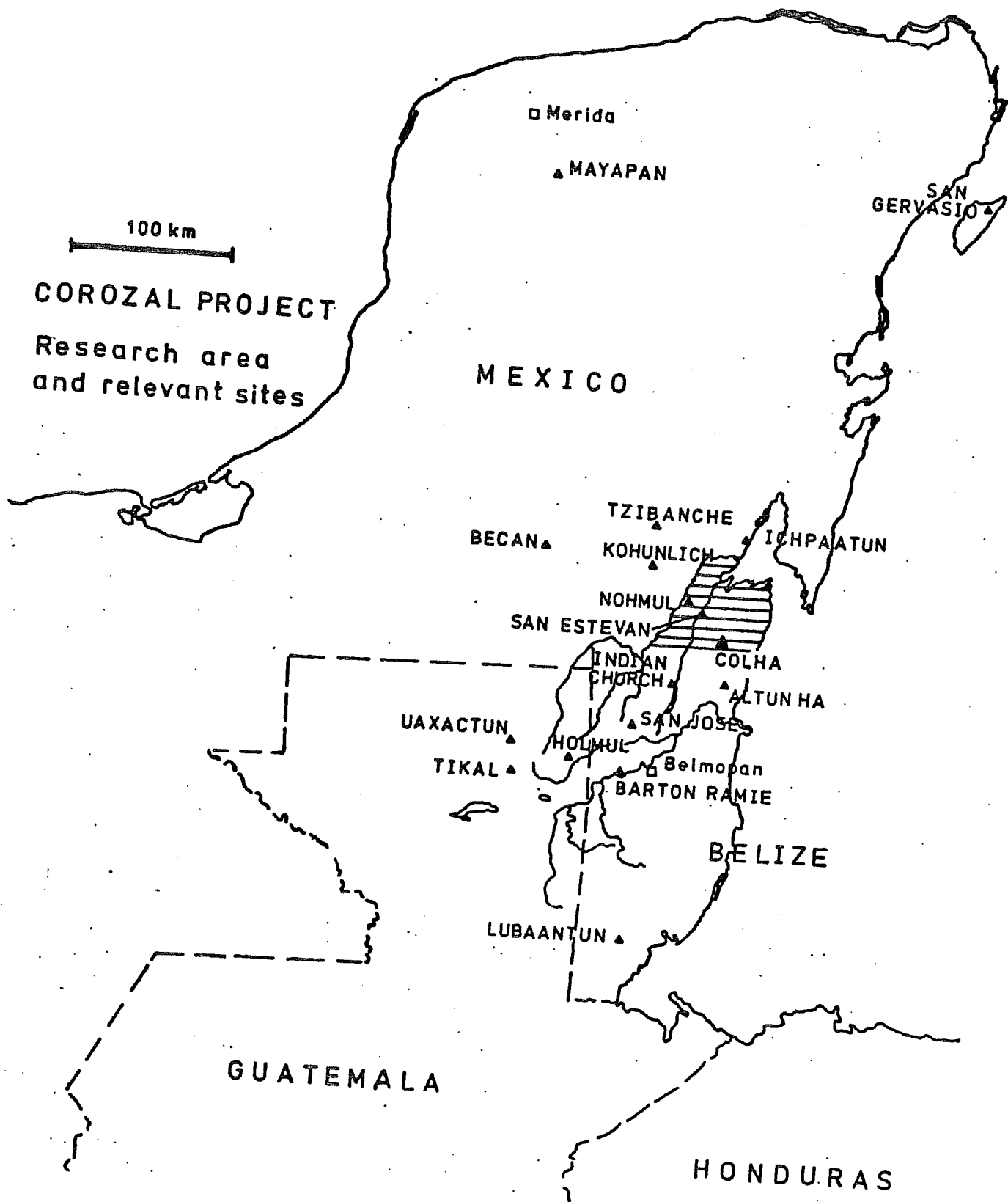


Figure 1. Location of Colha, Belize. The location of the site of Colha is shown in the shaded area of northern Belize.

technological point of view. Two very basic problems remain; delimiting the chronology of the workshops at the site, and determining the way in which production at Colha was organized.

Duncan Pring returned to Colha in 1975 and spent several weeks excavating within the ceremonial center. Though his work was mostly oriented towards ceramic chronology, several layers of workshop debris were excavated and sent back to England, to join the rest of the Corozal Project lithics, out of this investigator's present reach.

The ceramic sequence at Colha extends all the way from the Middle Preclassic to the Late Postclassic, some 2400 years (Pring 1976), though the excavated lithic debris dates to Late Classic and Postclassic times. Previous typological analysis of Colha material in the Masson collection has shown considerable similarities to the Postclassic lithics at Mayapan in Yucatan, and the Late Classic lithics from other sites in Belize, such as Nohmul, Barton Ramie and San Jose. An earlier dating for large scale lithic manufacture at Colha cannot be ruled out; the Corozal Project excavations in Early Preclassic levels at the site of Cuello turned up many artifacts which show similarities to Colha surface finds. In 1976, attention will be paid to ceramic remains from workshops, in an attempt to further clarify chronological problems, though excavation of workshops would be the ideal method.

The technical problems of excavating a deposit of solid artifacts and debitage are formidable. Hundreds or even thousands of kilograms of chert would have to be washed, sorted, counted and analyzed from just a single meter square test pit. Laboratory facilities on site would be an obvious necessity; specialized excavation and recording methods will also have to be developed.

Such an ambitious undertaking is beyond the limited available resources during 1976. The Masson family, with its characteristic generosity, has offered to provide accommodations and a pack horse for collecting artifacts; we will also have the Corozal Project survey and excavation equipment available. In addition, Texas A & M University has kindly provided funds for the shipping of artifacts back to the United States for analysis, under a permit provided by the Belizean government.

Given the vast size of the site, and our limited resources, a specific sampling strategy promises the largest possible information return. Though operations at Structure 100 disclosed a surprising variety of artifacts and production processes in a very small area, we have as yet no idea of the range of variability between workshops at the site. Are there patterns of organization at the site which are larger than the individual structure unit? This question has a wider relevance for Maya studies because it reflects upon the presently controversial nature of ancient Mayan social, political and economic organization? Various models are at hand which portray Classic Maya society as complex, hierarchical and based on specialized production and distribution of products, as opposed to the older theocratic state models which tended to stress religion and art at the expense of trade, politics and welfare. An important piece of ammunition in the hands of proponents of secular models is the increasing amount of evidence which suggests considerable

occupational specialization during the Late Classic, at least in the large ceremonial centers of the "core" zone. Marshall Becker's (ms.) work at Tikal has suggested to many that Classic centers had quite developed structures of complex craft specialization, perhaps on a clan basis, involved in a complex redistributive economy. Colha is not in the central Peten, nor is it a large ceremonial center; yet it seems to show the existence of *an entire site* with a single speciality-evidence that commercial structures existed at a much higher level than is presently accepted on the basis of intra-site evidence for specialization.

The tracing of the trade networks which distributed Colha artifacts will be a long and complex study. Neutron activation analysis of chert may be a necessity. But before the Colha workshops are fitted into a larger political and commercial network, we must have an accurate picture of how production *within* the site was organized; hopefully, this will be disclosed by distributional analysis.

Actual tactics in 1976 will be a variation of those used on Structure 100: extensive surface collection of artifacts and intensive localized sampling of debitage and debris. Operations will be limited to those mounds presently mapped which are clear of vegetation and have not been bulldozed by the Public Works Department. Two hundred fifty acres of land to the south of the creek have been cleared and burned this season, revealing several hundred new, unmapped mounds which we will not be able to get to in 1976.

Within our target population of 186 cleared, mapped structures (the ceremonial center has been excluded) there are enough gross morphological differences to allow stratification into three "types". First, there are earthen mounds which contain little flint debris or artifacts, much like the common house mounds at other sites in northern Belize. Then there is a large number (more than half the total) of mounds which consist mostly of flint nodules and limestone rubble, usually with a few artifacts scattered on the surface. The nature and function of these structures is still unknown, though it is unlikely that they are workshops considering the general lack of chipping debris or hammerstones. Finally is the group of structures, like Structure 100 (comprising about 13% of the total structures in the mapped area), which are largely covered with fine chipping debris, broken and discarded artifacts in all stages of manufacture, and large numbers of chert cores and nodules. Examination of bulldozer cuts and tree falls shows that these mounds are solid debris and artifacts rather than earthen platforms covered with sheet deposit. A variant of this kind of workshop is the eight large areas near the ceremonial center, where the artifacts and chipping debris are extensive, thin layers on the surface rather than piled up mounds. The fact that all three types of mound occur in close proximity to each other is a strong argument that the differences are due to more than differential erosion or preservation.

The first stage, just completed, involves the plotting of each type of mound on a master plan of the site, following intensive surface examination. Each stratum will now be random sampled; the sample size determined

by the limited amount of money available for shipping. Two by three meter squares will be laid out on each mound selected for sampling, and all artifacts enclosed, including preforms but excluding cores and debitage, will be collected. The location of the test squares will be determined by choosing the clearest and most easily collected area, rather than by any specifically randomized procedure.

One debitage sample will be taken from each mound from a 25 cm square located at random on the surface. This material is most important for efforts to reconstruct technological processes of tool production at each workshop.

Analysis will be carried out at the University of Arizona with the guidance of Dr. Arthur Jelinek. Artifacts will be sorted morphologically, as will the debitage, and the results will be coded for use with the University of Arizona CDC computer system, with the computer time provided by the Anthropology Department. Attention will be paid to the technological attributes of the artifacts and debitage in order to draw up more complete flow diagrams of the artifact reduction sequence than that proposed on the basis of the Structure 100 material (Wilk 1976: Fig. 9.34).

The general objective of the analysis of workshop artifacts is a set of statistics which describes the variability of the data in terms of indices of homogeneity and heterogeneity. A program for this has been developed at the University of Arizona, and has been used for the analysis of pottery distributions on Cozumel Island (Gordon Bronitsky, personal communication). There are three possible outcomes which would have clear implications for interpreting the productive organization of the site:

(1) High variability in the composition and output of workshop mounds with no significant clustering, a situation suggesting a large number of individual workshops conducting different operations or combinations of operations, with little central control or organization. An alternate explanation, verifiable only by excavation, would be that the surface remains sampled were mixed deposits from several phases, obscuring any meaningful variability.

(2) High variability between mounds with significant clustering, which I will call polytypism. The nature of the clusters would be the key to interpretation; they may have spatial correlates or temporal correlates, and will provide data for further stratification of the sample when test excavations become practical. If specific workshops tend to produce specific products or clusters of products, a degree of intra-site organization or control is implied. It is also hoped that significant clusters of artifact types will emerge, allowing the identification of tool kits and perhaps shedding light on the functions of some artifacts by association.

(3) A third outcome, that there is little variability between workshops, is very unlikely to occur. Preliminary observations show that there is a wealth of variation at the site.

Whatever the conclusions of the above analysis, it will provide a useful guide for further work at the site. A large, well-staffed program of mapping, geological survey, controlled surface sampling and excavation is the only way of approaching such a unique and important area. The work done in 1976 has been designed as a guide for this future research; it will provide the data necessary for coherent, large-scale work by allowing a further stratification of the mound population so that the test excavations will produce maximum data return. At the same time the program should produce data of more general interest to lithic specialists and Maya archaeologists.

ACKNOWLEDGEMENTS

I would like to acknowledge the interesting discussion of the field symposium participants, particularly for stimulating me to think more carefully about my work. I hope some of the members can return to Colha in the future to share the fascination of the site with me. Thanks are also due to the Masson family, protectors of the site, gifted "bush archaeologists" and providers of endless hospitality, as well as a good argument now and then.

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PRE-COLUMBIAN MAYA DEVELOPMENT OF UTILITARIAN LITHIC INDUSTRIES:

THE BROAD PERSPECTIVE FROM YUCATAN

Irwin Rovner

INTRODUCTION

The major lithic assemblages used in this study were obtained from excavations conducted by the Middle American Research Institute, Tulane University, at the northern Yucatan site of Dzibilchaltun and at the central lowlands sites of Becan and Chicanna in the Rio Bec. In both cases lithic phase assemblages were defined providing a sequence extending from Preclassic through the Postclassic periods. Comparison of these sequences yielded some similarity in their patterns of development as well as several significant differences due in part to marked differences in locally available lithic resources. This condition is typical of the entire Maya lowlands; namely, that no particular locality possessed the full range of lithic resources to fill completely their basic utilitarian needs through time, much less their ceremonial requirements.

Dzibilchaltun on the north coast of Yucatan, was almost totally devoid of good quality local lithic resources. Usable chert is not present and even the limestone of the area is of such a coarse, porous quality that the residents of Dzibilchaltun also engaged in importing utilitarian limestone implements during much of their history. The most common chert at Dzibilchaltun is a hazy gray-brown. The abundance of this chert at nearby Mayapan suggests that the source for this material is relatively close, possibly in or near the Puuc Hills which could have also supplied a better quality limestone to Dzibilchaltun. The central and southern lowlands shared similar lithic resources, good quality limestone and a mediocre quality grayish-white chert common to wide areas of the Peten, Rio Bec and Belize. This chert was used for a variety of common biface core tools--celts, picks, choppers, etc.,--found at sites in all three areas. Some moderately good quality chert cobbles were also available ranging in color from pinkish gray to yellowish brown. However, the high quality fine brown chert favored for Tepeu phase projectile points is rare to the point of essentially being absent in Yucatan, as are granite, basalt and obsidian. These resources were available variously from sources in Belize or the volcanic highland zones. In sum, lithic resource distribution clearly departs from the often-stated characterization of the Maya lowlands as "environmentally uniform". On the contrary, lithic resources which were basic to Maya economy and technology at the utilitarian level were quite diverse and divergent establishing many access gradients amenable to local industrial specialization, development of trade networks and competition for resources.

INDUSTRIAL DEVELOPMENT OF THE LATE PRECLASSIC

The Dzibilchaltun and Rio Bec Preclassic assemblages like many other Maya

Preclassic lithic assemblages show three diagnostic characteristics: (1) they are overwhelmingly reliant on local resources; (2) show no significant development of short distance exchange networks to exploit lithic resource diversity; and (3) an inexplicable, but clearly evident, absence of stone projectile points. These features existed over a broad area as indicated by reports of various Early to Late Preclassic lithic assemblages from Chiapa de Corzo, Chiapas (Lee 1969); La Victoria (Coe 1961) and Salinas La Blanca (Coe and Flannery 1967), Guatemala; Uaxactun (Rickertson and Rickertson 1937) and Altar de Sacrificios (Willey 1972) in the Peten; and Barton Ramie (Willey *et al.* 1965) and San Jose (Thompson 1939) in Belize. At Kaminaljuyu Shook and Kidder (1952) are quite explicit in stating that their excavations in Preclassic Miraflores phase deposits failed to produce a single projectile point in spite of the presence of a clearly well-developed obsidian industry.

The Late Preclassic assemblage from the Rio Bec consists entirely of locally available material with the exception of a sparse presence of imported obsidian. Ground stone implements were also sparse, most probably a result of collection bias in the field, and are non-descript domestic implements. A substantial chert industry is represented by two general, related classes of implements--bifacial core tools, mostly celts, and a variety of simple, unifacially modified flake tools. These flake tools have been classed variously as simple retouched flakes, graters, beaks, denticulates, and notches. Both cortex (decortication) flakes and percussion trimming flakes, probably no more than the by-products of biface celt manufacture, were selected without any apparent preference. These flake implements show no morphological characteristics to distinguish them from similar implements commonly found in other lithic phase assemblages.

The biface celts, while showing clear and significant morphological variation through time, are present throughout the Rio Bec sequence. These celts, along with the associated flake tools, represent a basic local lithic industrial tradition which the Rio Bec shared with similar local industries to the south and east. Biface celts are rare in the Dzibilchaltun collections appearing late in the sequence suggesting that the function of the biface celt was ecologically related; i.e., useful in the tropical forest of the Rio Bec and Peten, but not in the scrubland-chaparral of the north coast. Morphological variation in biface celt assemblages through time show several potentially significant features. The Preclassic celt assemblages show the least standardization of quality of manufacturing technique, techniques employed and range of morphological variation. Poorly executed, thick and asymmetric celts are characteristic, indeed, possibly diagnostic of the Preclassic assemblage. If they were merely rejects, they should be expected to occur with celts and celt manufacturing debitage common in later phase assemblages. However, they are virtually absent in every phase assemblage of Tzakol 3-equivalent age and later. An informal test of this was conducted in survey collections from several sites in the Rio Bec area south of Becan showing high correlation with sites yielding Preclassic ceramics. Paradoxically, the technologically best celts also appear to be diagnostic of the Preclassic period as exemplified by large, elongate, symmetric celts which show a carefully

executed fully-polished bit end. The bit-polishing technique is absent in the Tzakol 3 and Tepeu equivalent phases, reappearing as an Early Postclassic feature of a morphologically unrelated, bevel-nosed biface celt, a diagnostic artifact. Morphological variation, showing a decided aversion to clustering, of the admittedly limited Preclassic celt sample is unequalled in later phases. In terms of Maya Classic development, it is surely not insignificant that free-ranging variation in manufacturing technique, size and form gives way to marked standardization by the end of the Early Classic period.

The Formative lithic assemblage at Dzibilchaltun is similar to the contemporary Rio Bec assemblage only in the general characteristic of local resource exploitation with the single significant exception of the sparse presence of obsidian. Unlike the Rio Bec assemblage, chert is poorly represented appearing mostly in the form of small flakes, few showing even simple deliberate retouch. There is hardly a chert implement worthy of the name represented. On the other hand, ground stone implements are well represented in the form of various limestone implements which probably functioned as smoothers and manos. Manos and metates of this period are primarily from poorly dressed, poor quality limestone. The manos are porous and often contain readily discernable marine shell inclusions. Manos are typically flat faced providing the basis for characteristically angular cross sections. Tapered cylindrical forms with round cross sections become dominant later in the sequence.

The presence of obsidian in both assemblages is similarly sparse but nonetheless significant. It indicates that the importation of material over long distances had developed prior to the development of more local interaction with immediate neighbors. A rounded prismatic blade platform is diagnostic of the few proximal fragments in both assemblages which appears to be related technologically to highland Mexico rather than highland Maya obsidian sources (Rovner 1975:101-110). The obsidian collections from throughout the sequences in the Rio Bec and at Dzibilchaltun fail to show any substantial on-site manufacture. Primary core production debitage is totally absent while a very small number of flakes, none of which show features which could conclusively characterize them as core platform rejuvenation debitage (Rovner 1974), are insufficient to demonstrate any significant level of local secondary industry production at either site at any time during their respective histories.

INDUSTRIAL DEVELOPMENT OF THE EARLY CLASSIC

In sharp contrast to the general expectation of dynamic development marking the Early Classic period at most sites including Becan, Dzibilchaltun undergoes a substantial decline in population and resident activity during its contemporary Early Period I phase. The lithic assemblage for this phase is correspondingly meagre and of little further concern unless particular importance is given to two individual artifacts; a fragment of barkbeater and a narrow, elongate chert biface pick vaguely suggesting affinities with the south (Belize?). There is also a change in the meagre obsidian sample from the Formative diagnostic rounded prismatic

blade platform to a style showing much less ablation of the platform edge prior to blade removal resulting in the retention of a small planar portion of the core platform on the proximal end of the blade. A similar change in blade platform style does occur synchronously in the Rio Bec obsidian sequence.

The Early Classic period in the Rio Bec is ushered in with an enormous flurry of dynamic growth at Becan.

At some time during the second or third century A.D....the Becan site was fortified by means of an enormous dry moat and parapet system...(Also) over 500 square meters of plaster flooring, four well preserved platform units, and one structure exceeding ten meters in height... With one exception, all of this activity was concentrated within the defensive perimeter. Major excavations at Chicanna produced no indications of Preclassic structural activity...(Ball 1973:375-376).

The nature of the lithic evidence does provide a perspective on at least some significant aspects of the activity at Becan, particularly the fortifications. There is not a single shred of *lithic* evidence to suggest antecedent local conditions in the Late Preclassic which would develop into as massive an undertaking as the Becan ditch and parapet. In the absence of any critical natural lithic resources there is no development of a specialized lithic industrial complex, no evidence of developing trade networks with neighboring regions and a total absence of lithic weaponry. Furthermore, the limited sample of locally produced lithic implements dating to the post-fortress construction phase is disproportionately static, showing a direct continuation of Preclassic traits even to the presence of an elongate, polished-bit biface celt.

The only substantial change in the lithic collection, and substantial in the extreme, is a proliferation of the only non-local feature of the Preclassic assemblage--obsidian prismatic blades, a long-distance import item. In spite of considerably more extensive excavations in Late Classic and Early Postclassic units, more than 26% of the total Rio Bec obsidian collection, including the material from Chicanna, was recovered in Tzakol 1-2 equivalent Early Classic contexts at Becan, within the fortified zone. The highest density of obsidian was obtained from a context apparently representing an elite ceremonial cache of Tzakol 1-2 date which was badly disturbed during Tzakol 3-equivalent period modification and reconstruction of the extant structure (Ball 1973:205). The obsidian collection from this context includes eight prismatic blades of Pachuca green obsidian, material of clear Teotihuacan origin. Several additional pieces of green obsidian were recovered from further excavations in the same vicinity (Stoltman 1975). This provides two important correlations; a continuation of the apparent highland Mexico origin of Preclassic phase obsidian as indicated by its technological features, and a second instance of cached green obsidian in the Maya lowlands dating well before the fifth century to match discoveries at Altun Ha by Pendergast (1971). The first appearance of projectile points occurs even later in the Early Classic. All but one are made of non-local material with the locally-made exception showing

an anomalous manufacturing technique of probable foreign origin.

With the sum total of changes in the Early Classic lithic assemblages attributed to foreign influence synchronous with and subsequent to the construction of the Becan fortifications, all the lithic evidence points to foreign influence motivating its construction. It is obviously tempting to see that motivation originating from either Teotihuacan itself or an intermediate group linked to Teotihuacan. However, the only reported architectural antecedents are apparently located at Los Naranjos, Honduras (Baudez 1971). A massive ditch and parapet construction dates to the Eden phase which extends from 200 B.C. to A.D. 400 wholly overlapping the suggested time range for the building of the Becan fortifications. Indeed, in terms of antecedents, there is a large, but simple, ditch fortification construction dating to the earlier Jaral phase at Los Naranjos. Given the development of the Protoclassic Usulután sphere it becomes tempting to see the Honduras and the Rio Bec fortifications as frontier outposts of that sphere. However, this contradicts not only the suggested Highland Mexican influence at Becan, but even more cogent ceramic data to argue against the presence of significant Usulután sphere influence.

...it is noteworthy that defensive measures seem to have been undertaken just at that time when intrusive elements were pushing their way westward and northward into the Maya lowlands. No true Protoclassic stage material was encountered at Becan, despite its proximity to Holmul (less than 140 kilometers away). Usulután types, present 125 kilometers south of Becan at Uaxactun and 290 kilometers northeast on the coast at Tancah, have been neither at Becan nor inland to its north... It is difficult to believe that the absence of intrusive Protoclassic ceramics from Becan and that center's second through third century growth are not casually inter-related (Ball 1973:375-376).

Furthermore, the large, triangular bodied, unifacially retouched "dagger" with wide shoulders and bifacially flaked stem, distributed from Chalchuapa, Honduras, to Chiapa de Corzo, Chiapas, to Belize and the Peten, is absent in the Rio Bec collections. The glaring discrepancy between the architectural relationships and the ceramic and lithic evidence clearly demands resolution.

The fourth and fifth centuries of the Early Classic period mark the first phase of major activity at Chicanna. The earliest manifestation of activity comes from a buried soil beneath the initial major architectural construction at Chicanna but is not necessarily related to that construction. The buried soil yielded a concentration of over 1000 pieces of local chert debitage. In spite of the relatively mediocre quality of the local chert, more than 15% of the debitage shows characteristics of a percussion blade technology while two chert cores in the sample appear to be blade core rejects. In addition 39 simple unifacially retouched implements, mostly beaks and graters, were recovered, fully one-third of which were made on preforms classified as blades. There is no other significant incidence of chert blade production or selection of local chert blades as preforms for the manufacture of unifacially retouched implements anywhere

in the Rio Bec collections. It appears to be an intrusion of an alien technology into the Rio Bec near to, but outside, the fortified zone at Becan which was not incorporated into the subsequent chert industries either at Becan or at Chicanna. Although the retouched implements are superficially related to the flake beaks and gravers typical of the traditional local chert industry, there is also a clear differentiation in average size and size range of the implements in this anomalous Chicanna industry. The 39 Chicanna flake and blade implements, of comparable size to each other, are distinctively smaller than their flake counterparts in the rest of the Rio Bec assemblage. Although this anomalous occurrence of chert blade tools in a restricted Early Classic context is not unique, Kidder (1947:6) illustrates 10 implements which appear to be beaks-on-blade from a single restricted Early Classic context at Uaxactun; the area of origin for this industry is not apparent. Inasmuch as the Rio Bec ceramics show minor changes in the fourth and fifth centuries with affinities to ceramics from Belize (Ball 1973), I am inclined to place the origin of this industry in that general area which also contains native resources of quality chert which would foster development of a local chert blade technology.

The appearance of projectile points during the Early Classic has several implications for developments in the Rio Bec. The small sample size, only eleven, and all from Becan itself, does not reflect the significance they represent. Ten are bifacially flaked, of which five are made of obsidian, one gray and four Pachuca green. All 10 are fragments or are badly broken. None were found in cache or ceremonial context; indeed, three of the four green obsidian points are in contexts directly associated with the fortifications. Ball (1973) notes the possibility of a fifth century "downfall" of the Becan fortress to Teotihuacan and/or highland Mexico-allied forces are a prelude to the final phase of the Early Classic which shows substantial Teotihuacan influence in the ceramic assemblage. He further notes (Ball 1973:380) the presence of large quantities of scattered human bone in most pure deposits of this period. To further confuse the issue of who was competing with whom, if anyone, for control of Becan during the fifth century, the eleventh Early Classic point is a small, unifacially retouched, stemmed point-on-blade made of local chert. The technological affinities are clearly to the anomalous alien chert blade industry at Chicanna, but the point, perhaps not surprisingly, was recovered from a context in association with the Becan fortifications. The permutations of possible explanations given the incomplete evidence strain the imagination.

INDUSTRIAL DEVELOPMENT OF THE LATE CLASSIC

The Late Classic period comparison of the Dzibilchaltun and Rio Bec lithic developments continues the general pattern of distinctly opposite trends, but in this instance representing a reversal of the Early Classic pattern. Following the apparent demise of widespread Teotihuacan influence in the Maya region, the Rio Bec underwent an initial retrenchment to a markedly localized development. Ceramic ties to the Peten disappear while distinctive Chenes-Rio Bec architectural and ceramic styles develop directly out of antecedent Early Classic forms (Ball 1973). Virtually all of the

indications of disparate foreign influences in the Early Classic lithic assemblages are either substantially diminished or disappear entirely. In sharp contrast, Dzibilchaltun rises out of its doldrums to the peak of its development socially, architecturally, etc., (Andrew IV 1965) with evidence of substantial interaction with neighboring and distant groups readily apparent in the lithic collection.

The absence of local chert resources at Dzibilchaltun appears to have precluded development of any local lithic industrial development at the site. The chert debitage of this period of maximum development shows no change from the Preclassic pattern, no chert nodules, reject cores, decoration flakes or large trimming flakes occur in the collections. Indeed, there is not even a substantial change in absolute quantity of small flake debitage recovered as compared to the Preclassic (Formative) collection. Considering the more extensive excavations in units of this later phase, which included substantial testing of house mounds as well as exploration of elite precincts, it might be suggested that even less lithic production activity took place at the site than even the rather meagre level indicated for the Formative. Obsidian importation is at its peak; imported fine quality limestone implements clearly predominate at the expense of implements of porous local material; and chert projectile points make their initial appearance in the sequence. The few diagnostic points are simple lanceolates or ovals. Stemmed points appear toward the close of this period while notched points are clearly a Postclassic-equivalent period occurrence. In addition a cache containing a pair of large, bifacial daggers (i.e., ceremonial knives), one made of fine brown chert and the other of gray obsidian, date to this period. Dzibilchaltun necessarily relied almost entirely on foreign industry and exchange to provide for all its utilitarian and relevant ceremonial lithic requirements.

With the subsidence of Early Classic foreign activity in the Rio Bec, a return to manifestation of local lithic industries and industrial traditions dominates the collections. In the Tepeu 1-equivalent phase, obsidian is imported at substantially diminished levels and is once again the only apparent utilitarian lithic import. Not one example of the ceremonial chert and obsidian eccentrics which typify the Late Classic in the Peten and Belize was found in the Rio Bec. Green obsidian does not again appear in this sequence. Local chert is used to manufacture bifacial projectile points for the first time; but, coincidentally with the points from Dzibilchaltun, only simple lanceolates are produced. The earliest possible date for stemmed points is the Tepeu 2-equivalent phase, but invariably in deposits mixed with later material. It is very likely that stemmed points do not appear in the Rio Bec until the Terminal Classic. Biface celt and unifacial flake tool manufacture is once again the most prominent feature of the lithic assemblage. Whereas there is little to distinguish the flake tools of this period from their counterparts in the Preclassic, clear distinction is evidenced in the celt collection. The polishing finish technique is absent; size clusters in the short-broad range; elongate celts are absent; and morphological types cluster in the rounded cordiform to oval zone. The apparent uniformity to size and form is further enhanced by the absence of crudely flaked, irregular celts and

460).

The large number of specimens recovered from a two meter square test pit suggests a rapid accumulation of obsidian debitage from blade manufacture. It is conceivable that other such specialized activity areas exist within this same plazuela group or certainly within similar areas throughout the site environs. Careful analysis of these areas may shed more light on the larger questions of class or occupational stratification, population distribution, economic structure and trade affiliations.

ACKNOWLEDGEMENTS

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NOTES ON THE PRE-COLUMBIAN CHERT INDUSTRY OF NORTHERN BELIZE

John M. Andresen

INTRODUCTION

The 1974 UCLA survey of northern Belize produced a medium-sized collection of chert artifacts. This paper summarized the findings of the analysis and their implications for lowland Maya archaeology. The collection discussed here was obtained through excavations at 11 sites, most of them in the Corozal District of Belize (Fig. 1). The collection must be viewed in a regional framework. Intersite comparisons cannot be made because the sample from each site may not be fully representative. Fig. 2 gives the numerical breakdown of the collection by site. The bulk of the collection comes from the four sites of Aventura, Santa Rita, Chan Chen, and Patchchacan.

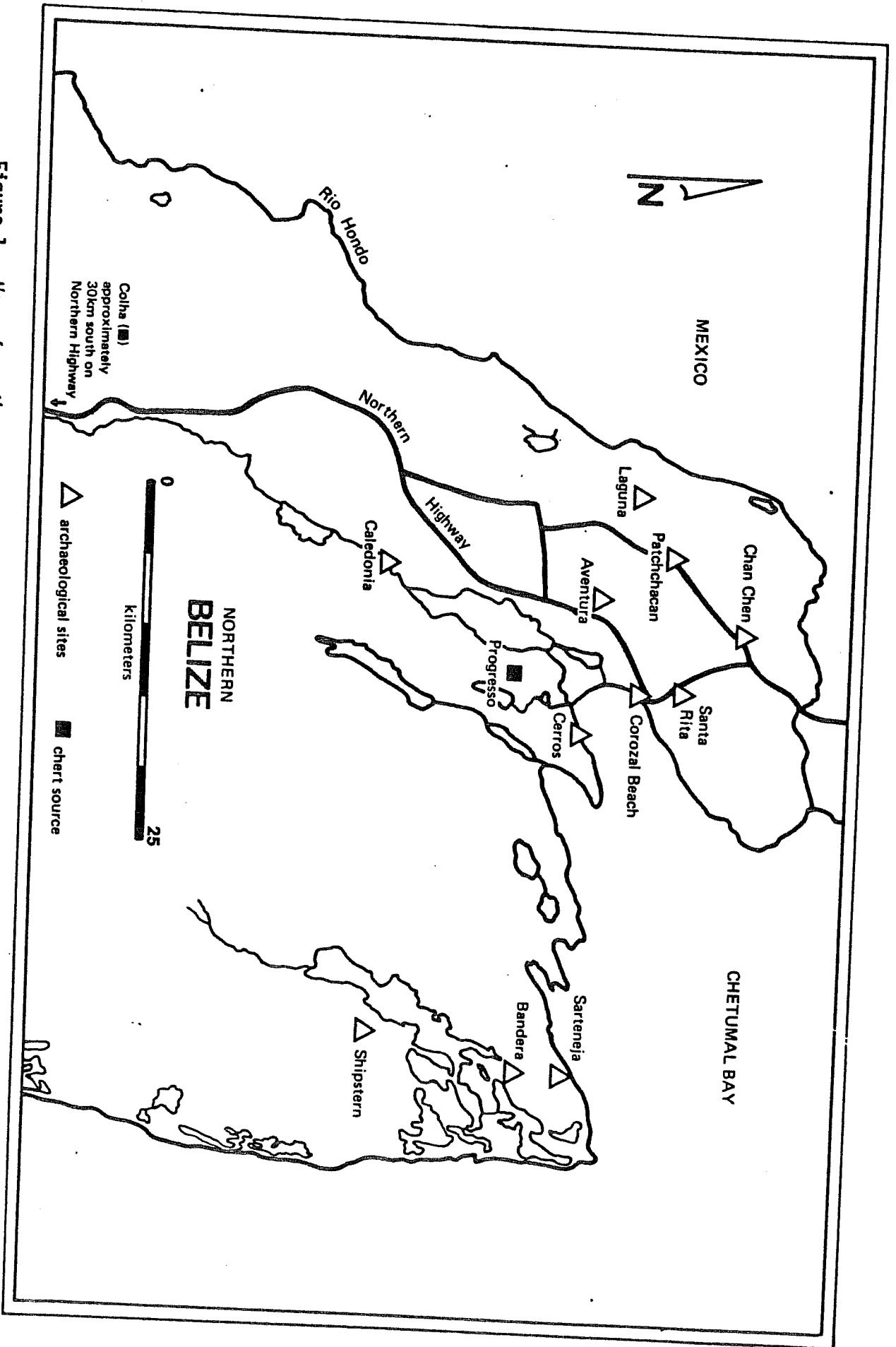
Each test pit at a site was numbered. Fig. 2 lists the test pit numbers and sites. Within every test pit, each stratigraphic layer is numbered consecutively. For example, the first layer of test pit four is Ex. 4-1, and the sixth layer in test pit 23 is numbered Ex. 23-6.

CLASSIFICATION AND TYPOLOGY

Willey completed the first major analysis of a chipped stone collection from the Belize area as part of his survey of the Belize Valley (Willey *et al.* 1965). Later analyses of chipped stone artifacts from Belize have been sporadic and incomplete. The lack of consistency in lithic analysis for the Maya lowlands in general has been discussed by Sheets (1975a). The approach to classification and typology taken here is a result of the need for more systematic analysis.

Two decades ago, Oswalt (1955) based a classification of stone tools from Alaska on the technological procedures involved in their manufacture. Oswalt's approach received little acceptance at that time (cf. Oswalt 1973: 2). However, within the past few years many lithic studies in the New World, particularly from Mesoamerica, have emphasized lithic technology and the manufacturing stages involved in stone tool production (Graham and Heizer 1968; Hester 1972, 1974; Sheets 1975b). The typology for the collection from northern Belize considers the technological stages of manufacture as well as the functions of the artifacts. The major divisions of the classification separate chert artifacts according to three stages of manufacture. The first major group includes the most crudely shaped tools produced by percussion techniques. These are such artifacts as flake cores, tool blanks, some debitage, and large blades. The term "large blade" is used here to mean large, parallel-sided flakes struck from a specially prepared core. These blades are triangular or trapezoidal in cross section and correspond to the obsidian macroblades described by Hester (1972) and large blades defined by Sheets (1975b:375). The core and blade technology of northern Belize is directly analogous to the core-blade technology well known at obsidian quarries in the Mesoamerican highlands.

Figure 1. Map of northern Belize showing the locations of the eleven sites listed in Fig. 2.



<u>SITE</u>	<u>COUNT</u>	<u>WEIGHT(KG.)</u>	<u>PERCENT BY COUNT</u>	<u>PERCENT BY WEIGHT</u>	<u>TEST PIT NUMBERS</u>
Aventura	305	10.7	18.0	31.8	1 thru 8
Patchchacan	169	2.9	9.9	8.7	9 thru 15
Caledonia	304	9.1	17.9	27.2	16 thru 22
Chan Chen	402	5.5	23.7	16.4	23 thru 33
Santa Rita	399	2.9	23.5	8.7	34 thru 42
Shipstern	10	0.2	0.6	0.5	43, 44
Sarteneja	91	1.5	5.4	4.4	45, 46
Surface Collections*	18	0.3	1.1	2.3	----
TOTALS	1,698	33.5	100.1**	100.0	

* Four sites yielded chert artifacts through surface collections: Bandera, Cerros Beach, Corozal Beach, and Laguna.

** All decimals were rounded to nearest tenth unit before inclusion in table. Inconsistencies are due to rounding.

Figure 2. Distribution of collection by site, with listing of test pit numbering sequence.

- 1) PRIMARY CATEGORY ARTIFACTS
Associated technological procedures: Core reduction and percussion detachment of Macroblades, production of large flakes and Tool Blanks.
 - A. Flake Cores
 - B. Tool Blanks and Large Blades
 - C. Hammerstones
 - D. Large Flakes to be reduced further
 - E. Residual Waste
- 2) SECONDARY CATEGORY ARTIFACTS
Associated technological procedures: continued reduction of cores and flakes by direct and indirect percussion, completion of crude tools.
 - A. Unifacial Scrapers
 - B. Crude, Unifacial Knives
 - C. Crude, Bifacial Scrapers and Knives
 - D. Partially Worked Tool Blanks
- 3) FINELY FINISHED ARTIFACTS
Associated technological procedures: final thinning of bifaces by pressure flaking, production of pressure-made waste flakes.
 - A. Drills, Gougers
 - B. Arrow Points
 - C. Fine, Bifacial Scrapers
 - D. Fine, Bifacial Knives or Points
 - E. Choppers and Pick-like Tools
 - F. Large, Stemmed Points
 - G. Ceremonial Implements
 - H. Burin Spalls and Prismatic Blades
 - J. Pressure Waste Flakes

Figure 3. Outline of the typology used in this report.

The second manufacturing category consists of flakes, tool blanks, and cores that have been further worked into crude knives or scrapers, and multi-purpose tools. They may be unifacial or bifacial and are characterized by the deep scars of percussion flaking. Tools in this category may be used, or they may be further worked in the third stage.

The last manufacturing category includes artifacts that have been carefully worked and finished by delicate pressure flaking. Prismatic blades, small arrow points, and ceremonial implements are examples of artifacts in this group.

The subdivisions within the technological categories are based on tool functions. Morphology, macroscopic traces of wear, and comparisons with other chert analyses aided in the functional assignments. However, no functional classification can be conclusively established since it is possible that a given tool had several uses. The 1700 chert specimens in the collection have been separated into 20 artifact types by this procedure. The lack of quarry and workshop data prevents a more detailed framework for analysis.

Epstein (1964:163) points out that tool manufacture relates to tool status. The analytic procedure outlined above makes a correlation between lithic manufacturing effort and the status of the finished item. This correlation applies to the Maya chert industry and should not be extended to other lithic industries. This model reflects the fact that hastily made cutting implements were low status tools, while carefully manufactured ceremonial blades and eccentrics were used for high status purposes.

THE COLLECTION

The collection was initially analyzed in the fall of 1974 (Andresen 1974). Nearly 1700 chert specimens (33.5 kg) were classified. Most of these are classified in non-tool groupings: flake cores, debitage, tool blanks, waste flakes and chunks, and unidentifiable fragments. These "marginal" types make up three-fourths of the collection, 67% by weight and 85% by count. A few of the types are represented by only one or two complete specimens (Fig. 5). The collection is permanently stored with the Department of Anthropology, University of Illinois, Urbana.

Twenty artifact types are described below. Within the descriptions of individual types, particular specimens are discussed. The dimensions of particular specimens are presented in a standardized format for descriptive efficiency. Dimensions are recorded in centimeters and enclosed in parenthesis, e.g. (10 x 5 x 1.5) represents length, width, and thickness in that order.

Flake Cores

Flake cores represent 3% of the collection by count and nearly one-third of the collection by weight. Forty-five flake cores are recorded; mean weight is 243 gm. These cores range in maximum dimensions from 4.5 cm to about 21 cm. Twenty-four show light to heavy battering while the rest show no macroscopic signs of secondary use. Both small and large cores

TYPE	COUNT	WEIGHT (gm)	COMPLETE	INCOMPLETE
Flake cores	45	10,931	-	0
Tool blanks	1	206	-	0
Residual waste	703	9,741	-	0
Hammerstones	7	418	2	5
Large blades	4	500	1	3
Unifacial scrapers	5	336	4	1
Unifacial knives	2	140	1	1
Crude, bifacial scrapers	29	1,692	6	23
Crude, bifacial knives	11	476	0	11
Fine, bifacial scrapers	24	1,732	5	19
Fine, bifacial knives or points	84	3,161	3	81
Drills, gougers	12	238	8	4
Choppers, axes	2	483	1	1
Pick-like tools	2	386	1	1
Arrow points	10	12	1	9
Knife or scraper fragments*	19	566	6	13
Large, stemmed points	2	104	-	-
Prismatic blades	24	189	1	23
Burin spalls	2	3	12	12
Ceremonial implements	12	529	2	10
Pressure-made waste flakes	698	1,699	4	8
TOTALS	1,698	33,544	58	175

* Not a "type".

Figure 5. Distribution of collection by type.

display battering. No cores had been specially prepared for the removal of chert prismatic blades.

Tool Blanks and Large Blades

An initial step in chert tool manufacture is the production of tool blanks. These are flakes that are suitable for working into a variety of tools. Some tool blanks can be put to use without further modification. Most of the tool blanks in the collection were manufactured by the blade-making process described by Bordes and Crabtree (1969:10). These specially detached tool blanks are classified as large blades.

The large blades in the collection (Fig. 6 b, d) resemble the "Prismatic Flake Blade, Large" described by Willey *et al.* (1965:441, Fig. 278d). Although only one of the large blades in the present collection is complete, all four are trapezoidal in cross section and were detached from a specially prepared core. In these respects they are analogous to the obsidian tool blanks from El Chayal described by Coe (1966:39, Fig. 4). One large blade (10.5 x 5.5 x 2.0) was recovered from Ex. 27-1. One edge retains the cortex and the other edge tapers to a thin blade that shows considerable use-nicking (Fig. 6 b). The two lateral edges are nearly parallel.

Another example (Fig. 6 d), also from Ex. 27-1, was detached from a specially prepared core. The medial flake scar, the nearly parallel sides, the trapezoidal cross section, and the small point of contact on the striking platform indicate that this specimen is a chert counterpart to the large obsidian blades found at obsidian quarries throughout the Mesoamerican highlands.

One tool blank does not result from the blade-making process. The artifact (Fig. 6 a) is from Ex. 9-1 and is rectangular in outline (11.0 x 6.5 x 2.8; 206 gm). One edge is thin, sharp and shows use in the form of tiny crushed spots. The rest of the specimen appears unaltered by use. This artifact represents one aspect of the initial stage of manufacture diagrammed in Fig. 4.

The production and transport of obsidian tool blanks and the utilization of unmodified tool blanks are described by Graham and Heizer (1968), Sheets (1975b), and Hester (1972, 1974). The artifacts classified as tool blanks or large blades in this collection suggest that chert technology in northern Belize involved analogous practices and manufacturing techniques.

Hammerstones

Percussion instruments are, of course, essential to any percussion approach to chertworking. Accordingly, the two complete and three incomplete hammerstones in the collection are classified as Primary Category Artifacts (see Fig. 3). These are waste chunks or nearly exhausted flake cores that were used to detach flakes from other specimens by percussion. The hammerstones show battering over all surfaces.

Unifacial Knives

Unifacial knives are large, unifacially modified flakes that bear at least one edge suitable for general cutting purposes. These artifacts were worked by direct, and possibly indirect, percussion techniques. Their surfaces exhibit large conchoidal flake scars; cross sections and irregular. A complete unifacial knife (Fig. 9 a) was recovered from the surface collection at Cerros Beach. One incomplete specimen is recorded from Ex. 20-B. These artifacts are in the second major manufacturing category (Fig. 3) and are considered finished artifacts. However, unifacial knives are morphologically general enough to serve as preforms for other tools. It is difficult to distinguish a discarded, slightly worked preform from a finished but unused Secondary Category artifact. Wilk has encountered the same problem in analyzing the chipped stone industry at Colha, Belize (Hammond 1973:59). Accordingly, the Secondary Category combines finished and unfinished artifacts.

Unifacial Scrapers

A unifacial scraper (8.0 x 3.0 x 1.7) obtained from Cerros Beach was manufactured from a large blade. The artifact (Fig. 7 a) is rectangular in outline, trapezoidal in transverse cross section, and slightly curved on the longitudinal axis. This specimen closely resembles the "Prismatic End- and Side-Scrapers" from Barton Ramie (Willey *et al.* 1965:437 and Fig. 274 h-k).

One incomplete and three complete unifacial scrapers are roughly circular in outline and bear deep flake scars (Fig. 7 b). These compare with one illustrated from Altar de Sacrificios (Willey 1972: Fig. 157 e) and another from Barton Ramie (Willey *et al.* 1965: Fig. 227 b). The unifacial scrapers in the present collection range in diameter from 4.7 to 5.2 cm and in thickness from 2.0 to 3.5 cm.

Crude, Bifacial Knives

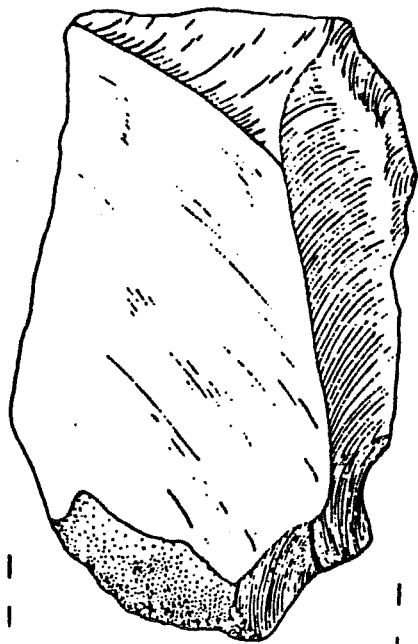
Crude, bifacial knives are the bifacial counterparts to unifacial knives described above. They are crudely manufactured and display large, deep flake scars on all surfaces. Eleven incomplete and nearly complete specimens are classified as crude, bifacial knives.

Proskouriakoff (1962:362) describes several "Asymmetrical Flints" that are equivalent to the crude, bifacial knives from northern Belize. Willey (1972:174) notes several "coarsely chipped Bi-pointed Knives" from Altar de Sacrificios that he describes as suitable for gouging or cutting. They are equivalent to the crude, bifacial knives in this collection. These artifacts were intended for the roughest tasks and were probably easily discarded. Some may have been intended for further reduction.

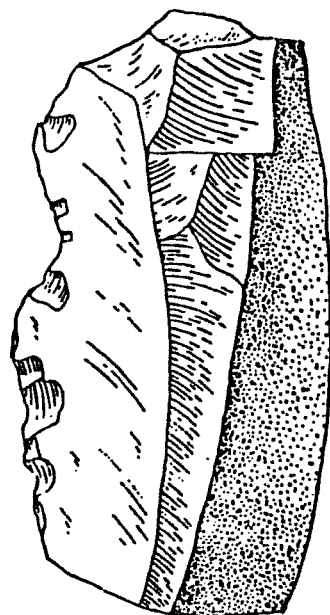
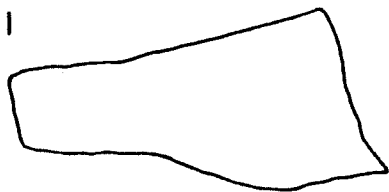
Crude, Bifacial Scrapers

Crude, bifacial scrapers exhibit crude, deep flaking and are suited to scraping functions though they may have also served some rough cutting functions. Outlines range from oval to circular and cross sections

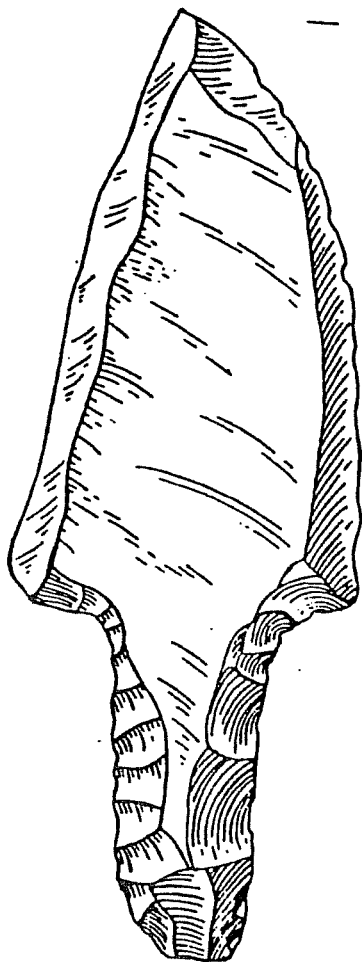
Figure 6. *Tool Blank and Macroblades.* a, Tool Blank from Ex. 9-1 (Patchchacan); b, Macroblade from Ex. 27-1 (Str. F-2, Chan Chen); c, Large, Stemmed Point made from a Macroblade, stem is bifacially worked, from Ex. 27-1 (Chan Chen); d, Macroblade from Ex. 27-1.



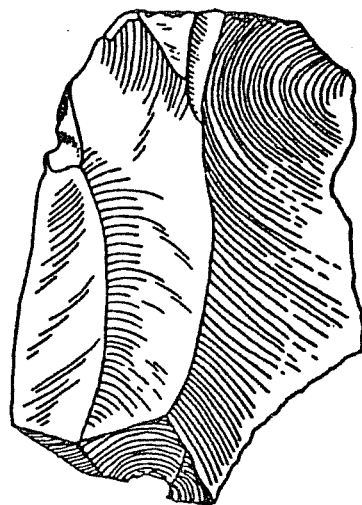
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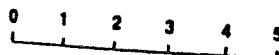
b



c



d



CMS

approach ellipses. There are six complete and 23 fragmentary artifacts recorded for this type. These range from 4.5 to 6.0 cm in diameter or length, with thicknesses between 1.7 and 2.8 cm. None of these specimens show evidence of final reduction, or "thinning", by pressure flaking.

Drills

Drills in this collection are essentially chips or thick flakes that have been modified by the removal of tiny flakes to form a sharp point suitable for boring, drilling, or gouging. A total of eight complete and four incomplete drills was recovered (Fig. 8 g, h).

Fine, Bifacial Scrapers

Fine, bifacial scrapers are elliptical in transverse cross section and in outline and have been thinned by pressure flaking (Fig. 7 c, d). Shallow flake scars on both faces are characteristic of this tool type. These artifacts correspond in function and description to the "Scrapers: Bifacial, Fine" from Altar de Sacrificios (Willey 1972:177). They are quite similar to some of the smaller examples of the "Hatchet-Form Flints" from Mayapan (Proskouriakoff 1962: Fig. 31 p-s). Five complete and 19 incomplete fine, bifacial scrapers range in length from 6.9 to 8.0 cm. Widths are 5.0 to 6.5 cm and thicknesses 2.0 to 3.0 cm. All of the scrapers in this group show light to medium wear along the lateral edges. Most are from Late Classic deposits.

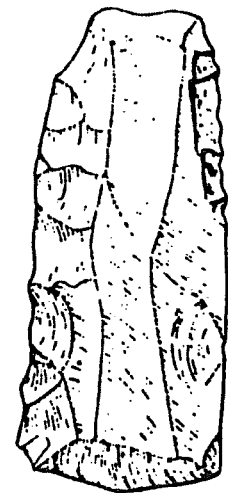
Arrow Points

Proskouriakoff (1962:360) establishes that these tiny, distinctive arrow points (Fig. 8) were introduced into northern Yucatan in "very late times". The arrow points described below come from definite Postclassic contexts. Arrow points are the most delicately pressure flaked tools in this collection. Like the arrow points from Mayapan, not one of these exceeds three gm. Six complete and nearly complete arrow points and four incomplete specimens were recovered.

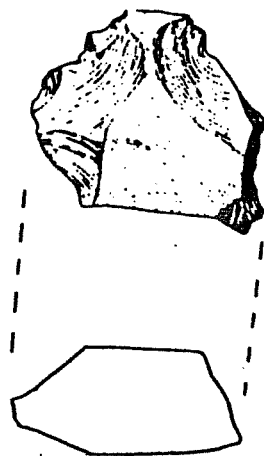
Following Proskouriakoff (1962:360), two arrow points are classified as Side-Notched, Straight Base. One of these (3.9 x 1.4 x 0.3; Fig. 8 d) is from Ex. 5-S. The other (4.2 x 1.2 x 0.3; Fig. 8 d) is from Corozal Beach. Two specimens are classified as Side-Notched, Round Base arrow points. One is complete (3.0 x 1.2 x 0.2; Fig. 8 f) and was recovered from Ex. 37-2. The other (3.0 x 1.6 x 0.4; Fig. 8 e) is nearly complete and was recovered from Ex. 40-S. Four nearly complete arrow points are Side-Notched with an undetermined base form (Fig. 8 a, c). Most of the arrow points in the collection were made from prismatic blades; all have been bifacially modified. This modification is minimal on some specimens.

Fine, Bifacial Knives or Points

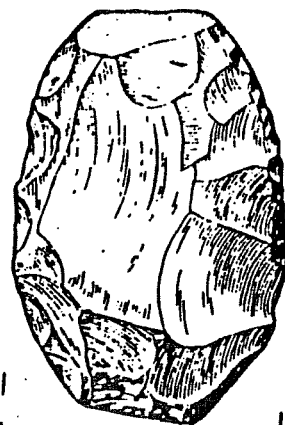
Three complete and 81 incomplete artifacts are classified as bifacial knives or points. Because this study lacks thorough use-wear examinations it is difficult to separate projectile points from bifacial knives. In some cases the distinction can be made on the basis of morphology. One complete fine, bifacial knife (7.5 x 4.7 x 2.1) from Ex. 9-1 is rectan-



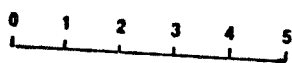
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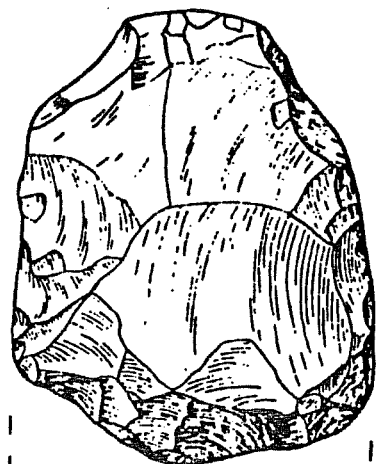
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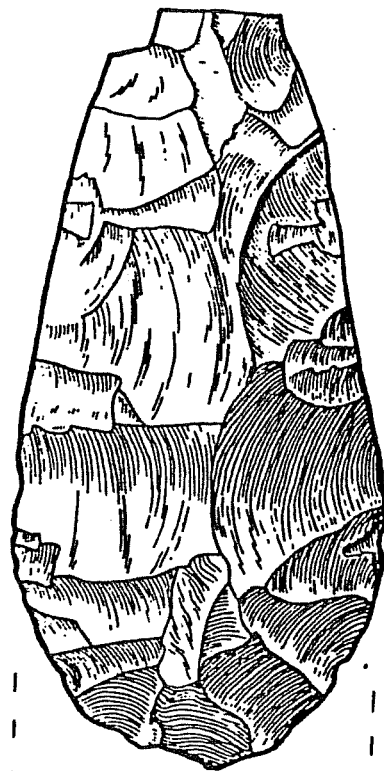
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e

Figure 7. *Scrapers and Chopper*. a, Unifacial Scraper made from a Macroblade; surface collection, Cerros Beach; b, Unifacial Scraper, Ex. 1-1 (Aventura); c, Fine, Bifacial Scraper from Ex. 1-1; d, Fine, Bifacial Scraper from CM-S, a surface collection at Aventura; e, Chopper from Ex. 27-1 (Str. F-2, Chan Chen).

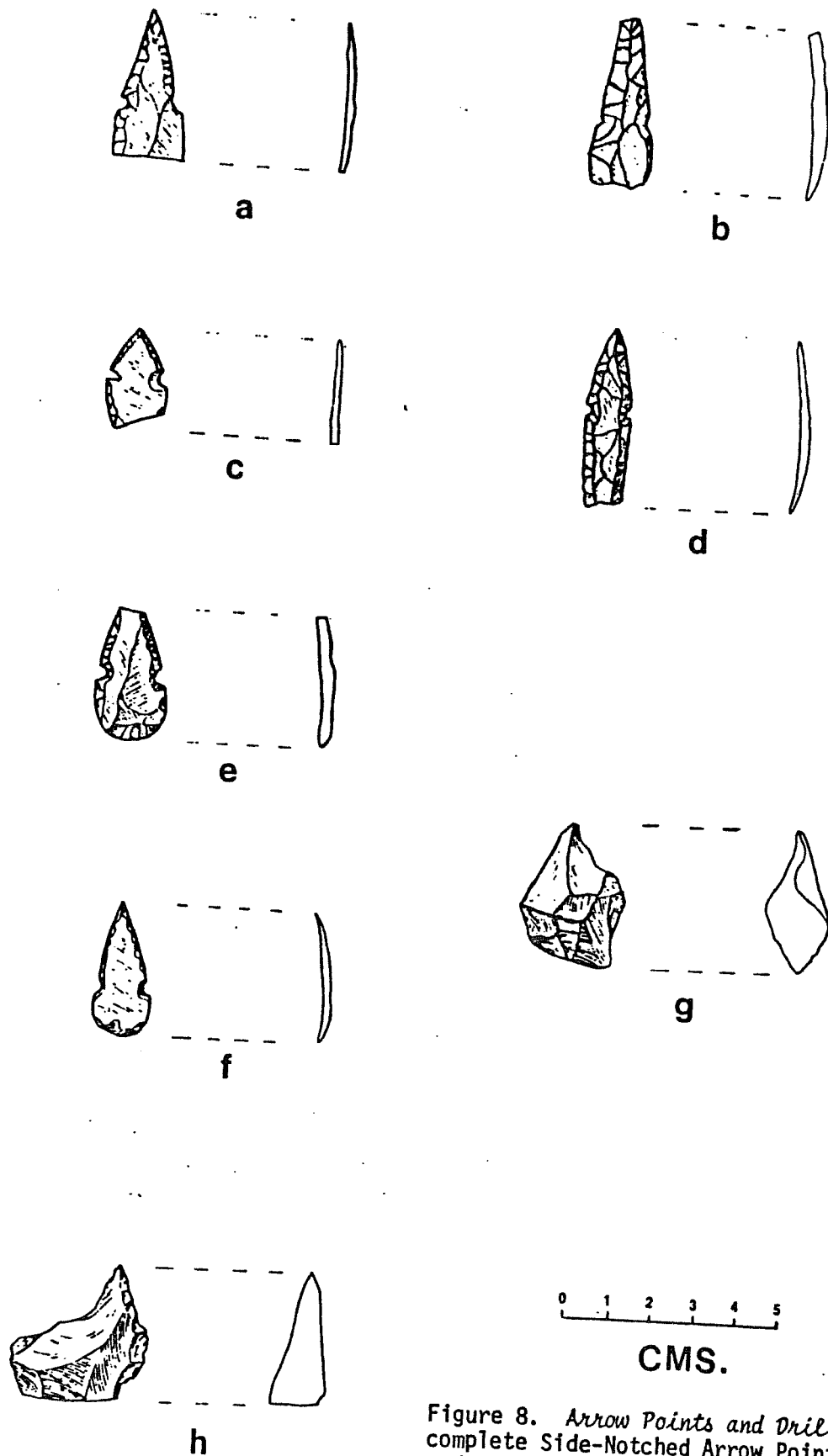


Figure 8. *Arrow Points and Drills.* a, Nearly complete Side-Notched Arrow Point, base from undetermined, Ex. 37-2 (Santa Rita); b, Side-Notched, Straight Base Arrow Point, surface collection, Ex. 37-2; c, Nearly complete Side-Notched Arrow Point, base form undetermined, Ex. 37-2; d, Side-Notched, Straight Base Arrow Point, base form undetermined, Ex. 5-S; e, Side-Notched, Round Base Arrow Point, 40-S (Santa Rita); f, Side-Notched, Round Base Arrow Point, Ex. 23 (Chan Chen); h, Drill, Ex. 37-2; g, Drill, Ex. 46 (Sarteneja).

gular in outline with two evenly chipped, sharp lateral edges. Cross section is plano-convex (Fig. 9 c). The slight polish on both faces of the butt end suggests this tool may have been hafted. However, it is suitable for hafted or hand-held use and the macroscopic traces of wear along all edges suggest it may have been used in a variety of positions.

Two incomplete artifacts classified as fine, bifacial knives or points were most likely used as knives (Fig. 9 b, d).

An incomplete artifact from Ex. 32-1 (Fig. 10 a) consists of the lower half of a stemmed projectile point. It measures 3.0 cm in width and 0.5 cm in thickness. This artifact resembles stemmed points reported from Barton Ramie (Willey *et al.* 1965:412, Fig. 261) and resembles more closely the points classified as "Straight Stem, Long Blade" from Altar de Sacrificios (Willey 1972:162). Two nearly complete projectile points are unstemmed and show fine bifacial working. Both are nearly 8 cm in length, 3 cm in thickness and 1.0 to 1.5 cm in thickness. They are identical to each other in style and proportions. One is from Ex. 9-1, the other from Ex. 27-3 (Fig. 10 b). The latter dates to the Late Preclassic Period.

The remaining specimens classified as knives or points are either cutting or piercing implements. These tools were all finished with a degree of pressure flaking, though a continuum in chipping quality is displayed. Cross sections range from triangular to elliptical with either converging or parallel lateral edges. Tips are rounded in most cases.

Knife or Scraper Fragments

Nineteen fragments are classified as either knives or scrapers. These were so badly fragmented that more precise identification is impossible. Most are bifacially worked and bear evidence of pressure flaking. Some may be Secondary Category artifacts.

Choppers or Axes

Heavy chopping tools must have played an important role in lowland Maya life. Agricultural land was cleared regularly and ancient Mayan workers needed chopping and cutting tools for the task. It is surprising that the 1974 UCLA survey found so few chopping and heavy cutting tools in northern Belize. Two artifacts, one whole and one fragmentary, are classified as choppers. These implements correspond to the "Chopping tools, standard form" from Uaxactun (Kidder 1947: Fig. 61), to the "Standard Choppers, Bifacial" from Barton Ramie (Willey *et al.* 1965:423), and to the "General Utility Form Choppers" from Altar de Sacrificios (Willey 1972:157). They resemble less closely the chopper from Mayapan (Proskouriakoff 1962: Fig. 32 v).

The whole chopper (13.5 x 6.4 x 2.6) in the collection was recovered from Ex. 27-1. Large shallow flake scars (Fig. 7 e) cover both faces, with no macroscopic evidence of use along the edges. The incomplete chopper is from Ex. 9-1, and is the same with respect to workmanship as the whole chopper. Full length is indeterminate. The lateral edges are crushed from use.

Large, Stemmed Points

Large, stemmed points are bifacially modified large blades. They are technologically identical to the large obsidian and chert "Lance Points" from Chiapa de Corzo (Lee 1969:154) and the three "Points or Knives: Stemmed, Plano-Convex" from Barton Ramie (Willey *et al.* 1965:412, 417). The complete specimen (17.4 x 6.5 x 1.5) is lenticular in transverse cross section at the proximal end, or stem. The blade is trapezoidal in transverse cross section and averages 0.4 cm in thickness (Fig. 6 c). The tip fragment of a large, stemmed point was recovered during a surface collection at Cerros Beach. It is triangular in cross section and displays slight bifacial retouch at the extreme tip. Willey notes fine retouch at the top of one of the three large, stemmed points in the Barton Ramie collection (Willey *et al.* 1965:412).

Pick-like Tools

One nearly complete pick-like tool (17.0 x 5.3 x 2.3) with a small bit of the tip broken was found in Ex. 15-1. This long, slender tool was carefully pressure-flaked over parts of both faces (Fig. 11 a). One incomplete specimen from 20-B is also classified as a pick-like tool. It is the mid-section of a large, bifacially pressure-flaked tool. The specific function of pick-like tools is unknown.

Ceremonial Implements

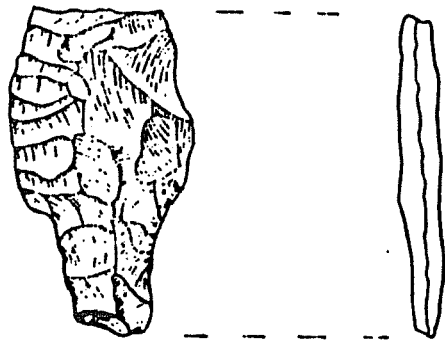
The high quality of chipping on ceremonial implements corresponds to the high status the artifacts had in ancient Maya society. The ceremonial implements are the most evenly chipped and most consistently pressure-flaked artifacts in the collection. One incomplete and four complete specimens were recovered in ritual contexts. Seven incomplete ceremonial implements were found in refuse deposits and fill.

One incomplete and three complete ceremonial implements were found with the stela in Group B, Chan Chen (Ex. 33-1). One of the complete examples (9.5 x 2.8 x 0.9) is bipointed with a triangular tip. An incomplete "ritual flint" from Mayapan has an identical tip and is classified as an eccentric (Proskouriakoff 1962: Fig. 27 j). The other two complete ceremonial implements from Ex. 33-1 are triangular in outline. One of these (9.2 x 5.5 x 1.0) is illustrated in Fig. 11 c. The other measures 8.0 by 5.3 by 1.1 cm; both are made of fine grained brown chert. The incomplete ceremonial implement from Ex. 33-1 (Fig. 11 b) is a laurel leaf blade with one tip missing. This specimen measures 4.8 cm in width and 0.7 cm in thickness.

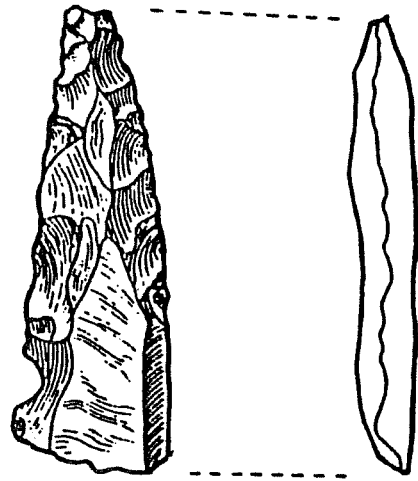
One complete laurel leaf blade (Fig. 11 d) was recovered during the excavation of Ex. 10-1, a Postclassic ceremonial deposit at Patchchacan (11.7 x 3.6 x 1.2).

Prismatic Blades

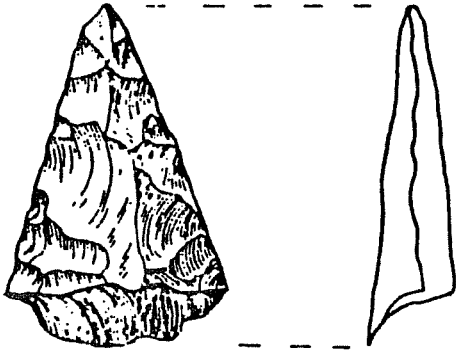
Chert prismatic blades correspond in method of production to the familiar obsidian prismatic blades common at archaeological sites throughout Mesoamerica. These artifacts are the result of a specialized pressure method



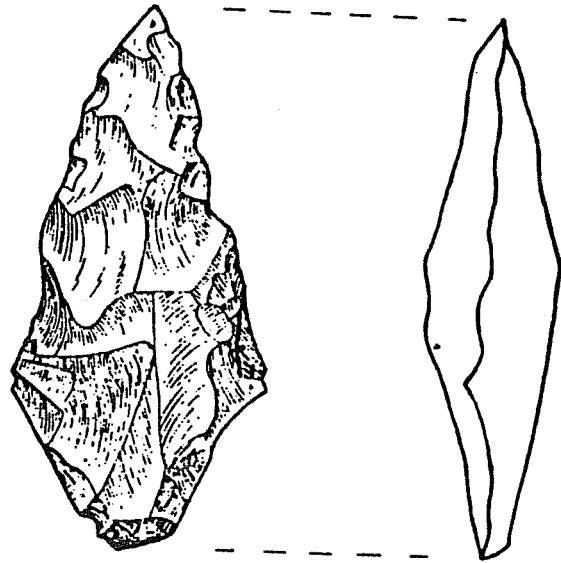
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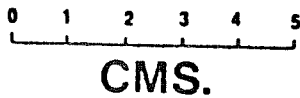
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Figure 10. *Fine, bifacial knives or points.* a, Base of a Stemmed Projectile Point, Ex. 32-1 (Str. A-1, Chan Chen); b, Nearly complete Projectile Point from Ex. 27-3 (Str. F-2, Chan Chen); c, Fragment of a Knife or Point, Ex. 20-B (Str. A-1, Caledonia); d, Complete Knife or Point from the Ex. 13 surface collection (Patchchacan).

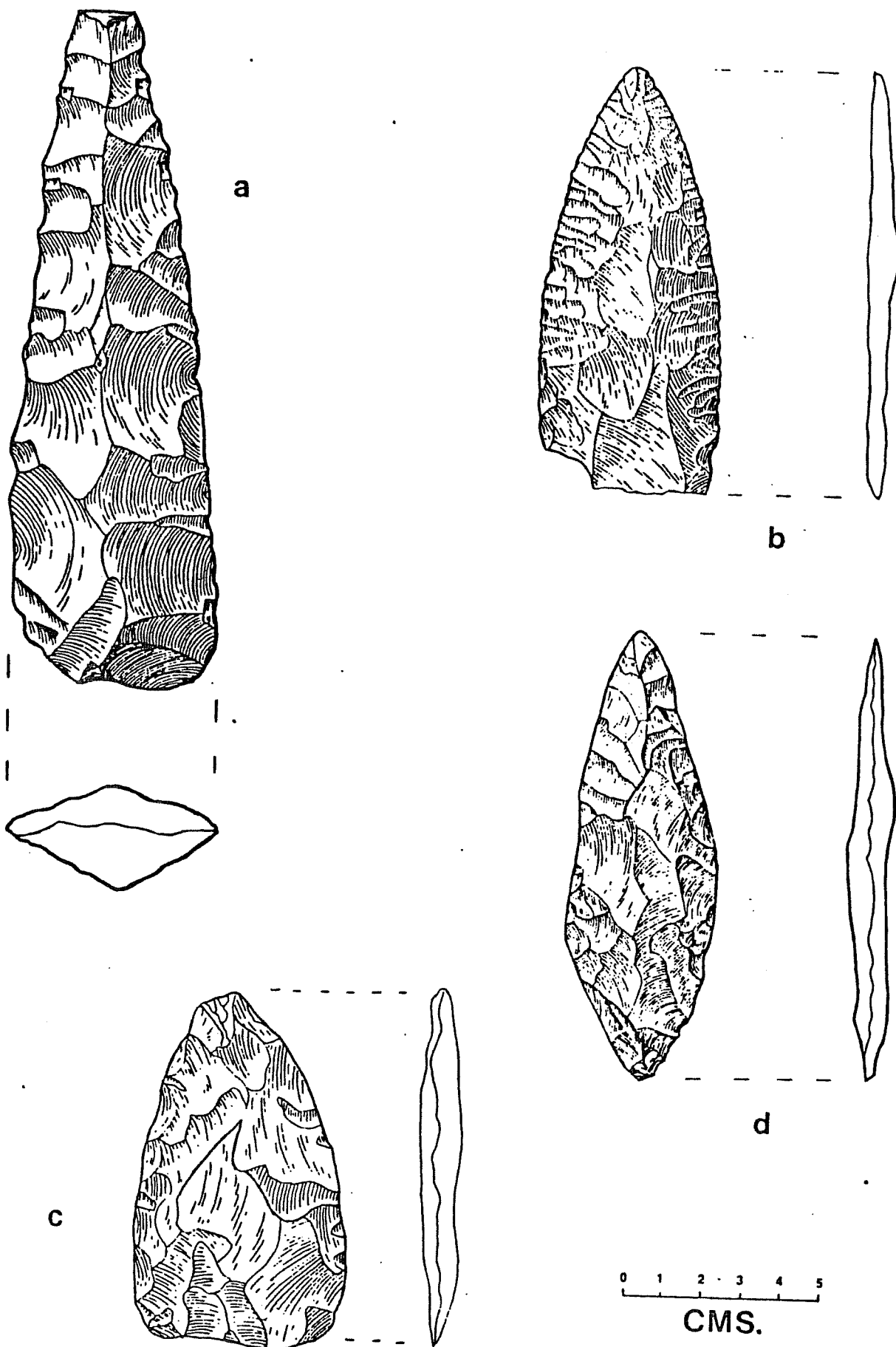


Figure 11. Pick-like tool and ceremonial implements. a, Pick-like Tool, Ex. 15-1 (Patchchacan); b, Ceremonial laurel leaf blade, Ex. 33-1 (Chan Chen); c, Complete triangular Ceremonial Implement from Ex. 33-1; d, Ceremonial Implement from 10-1, Late Postclassic ritual deposit (Patchchacan).

abundance of chert nodules in the vicinity.

One chert source is known to exist at Progresso. Hazelden (1973:77) reports grey, brown, and red cherts in the quarry. Progresso is centrally located with respect to the sites used in this analysis. In the same area chert boulders occur in beach deposits associated with the coastal strip.

Most of the specimens in the collection are classified in non-tool groups or types of marginal utility. Discarded tool blanks, flake cores, debitage, and residual waste constitute about three-fourths of the collection by count and weight. This indicates that some tool manufacturing took place at the habitation sites. It is difficult to determine what proportion of the chert assemblage was manufactured at quarry sites and what proportion was manufactured at living sites from tool blanks, large blades, and cores. However, it is clear that some core reduction and biface thinning took place at the habitation sites. The availability of local chert accounts for this. Future lithic studies in northern Belize should include visits to the chert sources in the area. More data is needed on the initial stages of tool manufacture as well as on the degree of localization and quality of exposed cherts.

Artifacts from quarry sites and workshop mounds are not included in this analysis. Of the 45 flake cores in the collection, no cores were found that had been specially prepared for the removal of large or prismatic blades. If blade-making activities were confined to quarries and workshops, then there may have been a degree of part-time specialization for chert workers in the area. Wilk (1975) has found evidence that there was a greater degree of craft specialization in Belize than previously believed. He has investigated a chert tool workshop at Colha containing artifacts in various stages of completion and an accumulation of chipping debris. Chopping tools were the most numerous tools found. The report makes no mention of blade-making. There may be technological differences between the Colha industry and that described here. However, it would be premature to make detailed comparisons. Neither industry is fully known. Future quarry surveys and workshop studies will increase our understanding of the relationships between sites and the distribution of resources.

REGIONAL PATTERNS AND LITHIC TRADE

The northern Belize collection includes several large, stemmed points. These distinctive artifacts were manufactured from large blades by modifying the proximal end into a tapered stem. Cross sections are triangular or trapezoidal as a result of their specialized detachment from prepared cores. These artifacts have a circum-Caribbean distribution and are particularly abundant in Belize (Coe 1957:280). Rovner (1975) has developed the concept of competing lithic exchange spheres in the Maya area. The distribution of these easily identifiable large, stemmed points defines the extent of Rovner's (1975:5) Protoclassic Southern Trade Sphere. It appears that Belize may have been a center of production and distribution for these artifacts.

A number of artifacts at several sites in the Maya lowlands, particularly at Rio Bec sites, are reported to be made of Belize chert (Rovner 1975:11).

Figures 3 and 4 summarized the brief description of the industry as presented above. There are several detailed behavioral models for some Mesoamerican lithic industries (Hester 1974; Sheets 1975b; Wilk 1975). The generalized model in Figs. 3 and 4 should not be compared to the more detailed behavioral models. The model presented here was developed only to aid in structuring the typology and not to thoroughly reconstruct the various paths a tool might take during production.

CONCLUSIONS

The purpose of the analysis of this collection is to provide a systematic description of chert artifacts from northern Belize and to outline the major aspects of the pre-Columbian industry of the area. There is a lack of behavioral and technological analyses of Maya chert industries. There are a number of such analyses of obsidian industries and this report has been influenced by these studies. It should, of course, be remembered that the problems encountered in working and using chert are not always the same as those encountered with obsidian.

Oswalt (1973:21) contends that man is basically a technological animal and that the major distinctions among cultures should be made on the basis of manufactured forms. Sheets (1975b:378) stresses that regional models of lithic industries should be developed. This paper is a start in that direction for Maya chert industries and I hope that future studies will improve on my methods and findings.

ACKNOWLEDGEMENTS

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METATE IMPORT IN NORTHERN BELIZE

Raymond Sidrys and John Andresen

INTRODUCTION

Grinding stone implements were necessary to every Mesoamerican household because of maize-dominated subsistence. Although manos and metates are commonly recovered in lowland Maya excavations, few studies have investigated the geographic and diachronic distribution of imported grinding stone. Such studies are valuable as they reveal the availability of a long distance trade good to the average Maya farmer.

This study reports on the geological sources of grinding stone artifacts from several sites in northern Belize. The findings are compared to other Maya lowland sites. The northern Belize material consists of 122 metate and 144 mano fragments found during the 1974 UCLA Corozal Survey. All of the grinding stone artifacts encountered in the survey came from utilitarian contexts such as surface locations, sherd dumps, middens or construction fill.

The grinding stone data were analyzed for the following variables: (1) temporal context, (2) general geological source area, (3) morphological form, and (4) physical dimensions. For future statistical permutations, the complete raw data can be found in Sidrys (1976: Fig. 83). Data lists of this sort, from all recent and on-going Mesoamerican excavations, should be compiled in a centralized computer data bank. This would facilitate future scholarly research through: (1) a greater availability of generally unpublished field data, and (2) the standardization of certain data classification methods. A regional data bank of this sort has already been established (SELGEM) by American archaeologists in the U.S. Southwest. In the Maya sphere, only the Pennsylvania State University Kaminaljuyu Project has established a computer data bank (Michels and Sanders 1973:6).

METHODOLOGY

The methodology of the study will be discussed prior to the presentation of the findings. Most of the ground stone was classified in the field laboratory and it is now stored in Belize. It should be noted that few complete metates were found, and that the largest fragment weighed only about 5 kg. The average fragment probably weighed less than .5 kg (the fragments were not weighed). The small size of the metate fragments, in some cases, caused ambiguity as to the morphological form. Accordingly, this variable is the weakest aspect of our metate classification scheme. Although few complete manos were found, most of the fragment sizes were sufficient for shape identification. The classification of metate and mano shapes generally followed the typologies used at Barton Ramie and Altar de Sacrificios (Willey *et al.* 1965:453-465; 1972:106-124). The five metate forms (Fig. 1) include the turtleback form with a rounded base (TB); the trough-shaped form with a flat base (TS); the thin-flat legless form (T); the thin-flat legged form (L); and the thin-flat grooved form

(G). It is possible that some of the fragments classified as the thin-flat legless form actually belong to the thin-flat legged form, as the leg evidence was occasionally ambiguous. The eight mano shapes (Fig. 2) include oval (O); circular (C); plano-convex (PC); rectangular (R); square (S); triangular (T); pentagonal (P); and overhand or knob-ended (OV). The shape determination was made primarily on the basis of transverse cross sections.

Qualitative size determinations (i.e., subdivision into large or small varieties) were not made for either manos or metates. Rather, a standardized series of measurements were taken on each fragment to allow quantitative size comparisons within and between types. For the metates the first measurement consisted of its thickness at a point about one-fourth of its transverse length, or its "end-thickness" (ET). The second measurement was the "middle-thickness" (MT), near the middle of its transverse length. To some degree these measurements merely reflect the variation in the depth of the grinding basin, which is substantial in the larger metates (Willey 1972:106-108). Nevertheless, they appear to be the best data that are available for small fragments. The mano measurements are more straightforward. They consist of the height (H) and width (W) of the transverse cross section. However, a slight measurement problem does exist as the cross section varies along the longitudinal axis between fragments.

Few conclusions could be drawn from either the metate or mano measurements (see Sidrys 1976: Figs. 77 and 79). The largest metate type was the trough-shaped form, followed by the thin-flat legged, the turtleback, and the thin-flat legless. The size variation within most of the metate and mano forms is quite large.

The ground stone fragments were assigned to five time periods. These include a Late Preclassic Period (1) at 300 B.C.-A.D. 250; an Early Classic Period (2) at A.D. 250-A.D. 600; a Full Classic context (3), A.D. 250-A.D. 900, for those fragments that could not be securely assigned to an Early or Late phase; a Late Classic context that probably extended into the Early Postclassic (4), roughly A.D. 600-A.D. 1250; and a Late Postclassic Period (5) at A.D. 1250-A.D. 1450. Many of the excavation levels were somewhat "mixed" in terms of ceramic phase. Accordingly, in some cases temporal context had to be assigned on the basis of the largest ceramic phase proportion present. Most of the ground stone dates to Period 4. The Late Preclassic sample includes only one metate and one mano.

Most of the simple geological characterization was done by the authors in the field laboratory. Chips of unidentified samples (c. 20) were brought back and examined under polarized light microscopes by several UCLA geologists. These individuals informed us that even their identifications are somewhat tentative as no definitive chemical analyses were performed. However, the prime objective of our geological characterization was simply to separate the ground stone into three general geological "sources" that were used by the Maya. Clearly, geological analyses of archaeological artifacts should have the goal of discriminating between Maya "emic" sources rather than producing "etic" geological

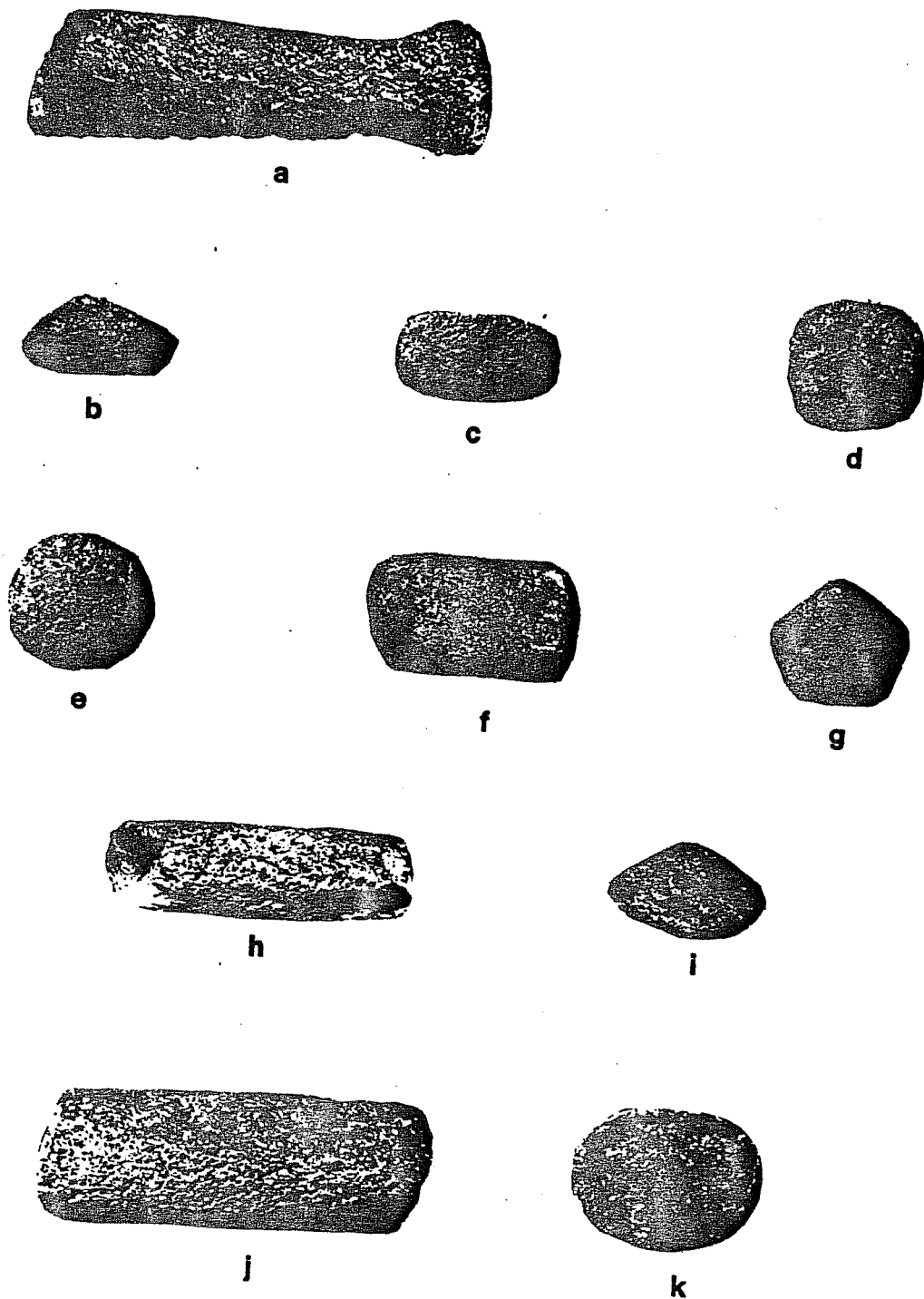


Figure 2. *Representative mano types.* (Not to scale). a, Overhang, longitudinal view, Ex. 3-2-1 at Aventura. b, Triangular, cross section, Ex. 9-2-2 at Patchchacan. c, Rectangular, cross section, Ex. 31-1-3 at Chan Chen. d, Square, cross section, Ex. 9-1-4 at Patchchacan. e, Circular, cross section, Ex. 13-S-5 at Patchchacan. f, Pentagonal, longitudinal view, Ex. 15-1-B-1 at Patchchacan. g, Pentagonal, cross section of f. h, Plano-Convex, longitudinal view, Ex. 5-2-1 at Aventura. i, Plano-Convex, cross section, Ex. 9-5-1 at Patchchacan. j, Oval, longitudinal view, Ex. 23-S at Chan Chen. k, Oval, cross section, Ex. GP-S-1 at Aventura.

categories. Of course, a comprehensive geological characterization of an artifact will be useful in the future for more precise outcrop localization (and should be done whenever possible). We wish to stress, however, that the type of geological "sourcing" analysis that is presently most useful to Mayan field archaeologists is not very complex (recognition of basic types can be learned in about an hour in a geology laboratory).

An awareness of one particular concept is critical. The classic three geological divisions of rock are sedimentary, metamorphic and igneous. Within the lowland Maya sphere the categorization of a rock artifact as either sedimentary or metamorphic is generally adequate. However, igneous rocks can be either intrusive or extrusive. Whereas igneous extrusives are those discharged by a volcano or a vent, igneous intrusives are forced into another subterranean stratum and are not ejected onto the surface. Since igneous intrusives are found in the Maya Mountains, all use of the term igneous should be specified as to *extrusive* (synonymous with volcanic) or *intrusive* variety. One well-known trade study that emphasized lowland metate import failed to make this distinction. This led the author to apply the term "volcanic stone" to granite metates found near the Maya Mountains, which is in error since granite is an intrusive rather than an extrusive rock. In the same study, reference was made to "quartzite and other igneous materials", which also is misleading, as quartzite is a metamorphic rather than an igneous rock. While the existence of such errors is understandable, their frequent occurrence could distort the final summary.

For the most part, a classification of the geological sources for grinding stone artifacts in the Maya sphere will do best by making reference to a geological source region, rather than to the three classic geological types. Accordingly, the first source (L) is the "local sedimentary rock" that occurs in northern Belize (see Hazelden 1973) as well as throughout most of the Maya lowlands. All limestone rock, some of it in varying light-colors or degrees of hardness, was placed in this category, together with some sandstone, conglomerates and shales (as well as specular hematite and iron pyrite). It should be noted that nearly all of the limestone metates found by the survey were of sub-crystalline limestone. This finding refutes an earlier statement that such metates "are rarely found since natural limestone is too soft to be efficient" (Rathje 1972: 388).

The second source (M) is the metamorphic and igneous intrusive region of the Maya Mountains (Dixon 1955:35-48) in central and western Belize that is located at a minimum linear distance of 150 km from Aventura. All metamorphic ground stone artifacts such as gneiss, quartzite, slate and schist, as well as such igneous intrusives as granite and porphyry were assumed to have been imported from this region. Thompson (1970:140) has presented some evidence of serpentine deposits in the Maya Mountains but this is uncertain. The third source (V) is the volcanic highlands of southern Guatemala at a minimum linear distance of 400 km from Aventura. The extrusive volcanics imported from this area include basalt, vesicular lava, and pumiceous or andesitic tuff (serpentine, obsidian and jade also derive from this area). Note that small blocks of pumice do occur

at the Barrier Reef, and the inhabitants of San Pedro regularly sell them for use as abraders in laundry work. These very light low-density cobbles should not be confused with the heavier fragments of imported pumiceous tuff.

It should be understood that the assignation of an artifact to one of these three sources is not incontrovertible. It assumes a primary reliance on the nearest available resource. For example, a limestone metate designated to be of local derivation could theoretically have been imported from a distance of several hundred kilometers (of course this is unlikely). Furthermore, all of the metamorphic and igneous rocks found in the Maya Mountains are very likely to also occur near the volcanic highlands. The only certain assignation is in the category of extrusive volcanics.

The compiled ground stone data were run on standard "package" programs (SPSS, SAS) for numerous permutations of descriptive statistics and chi-square association tests. These permutations included source vs. time, form and site; time vs. form; form per site; size per site; etc. The most important results are discussed in the following sections.

Metates: Geologic Sources

A 3 x 3 contingency table ($n = 94$) compared the use of the three geological sources between the Late Preclassic-Early Classic, the Late Classic-Early Postclassic, and the Late Postclassic. The χ^2 was significant at the .05 level and indicated that, in general, the use of some geologic sources is related to different time periods. Interestingly, source use does not seem to be appreciably different between the Late Preclassic-Early Classic and the Late Classic-Early Postclassic, as their association was not significantly different ($\chi^2 = 3.1$) at the .1 level of confidence. However, a substantial change in source use does seem to occur between the Late Classic-Early Postclassic and the Late Postclassic (the χ^2 of 5.8 is significant at the .1 level). Specifically this change consists of a radical increase (by a factor of 2.2) in the use of volcanic sources during the Late Postclassic, together with a substantial increase in the use of the Maya Mountains (see Table 1). The gradual increase in the import of long-distance volcanic stone (from the Early Classic onwards), together with the large decrease in use of the local stone during the Late Postclassic may reflect an evolutionary trend in the mechanics of long-distance exchange: better sea-going canoes, establishment of ports-of-trade, entrepreneurial alliances, etc.

The finding that long-distance volcanic import in the northern Belize area increased through time is also reflected in the source breakdown per site in Table 2. The three metate collections with the highest volcanic metate percentages are at Sarteneja, with a known full Postclassic occupation; Aventura, with a strong late Late Classic-early Early Postclassic population; and Sta. Rita, with a strong full Postclassic occupation. Caledonia and Chan Chen, both with strong Late Preclassic-Early Classic populations, follow in the sequence with volcanic percentages that are less than one-half those of the first three sites.

TABLE 1.

Geologic Sources of Metates in Northern Belize through Time

Time Period	Sample Size (N)	Local Source %	Maya Mts. %	Volcanic Source %
0 - 600 A.D.	17	64.7	29.4	5.9
600 A.D. - 1250 A.D.	58	67.2	13.8	19.0
1250 A.D. - 1450 A.D.	19	36.8	21.0	42.1

Patchchacan's position in last place is somewhat anomalous as it is fully contemporaneous with Aventura. However, as a small hamlet it may not have had the resources to participate in long-distance trade.

The regional Corozal metate data are now compared with similar data from other lowland sites (see Table 2). It is significant that the average percentage of volcanic rock among the metate collections from the six Corozal region sites is double that of the seven sites in the Peten area/Usumacinta-Pasion area (18.6% vs. 9.4%). As the latter group of sites range 155-320 km in linear distance from the volcanic highlands whereas the Corozal sites are at a 388-413 km range, it is apparent that some significant factor (perhaps direct seaborne transport) more than offset the distance disadvantage for the Corozal sites. The site of Chichen Itza also appears to have had a very significant trade with the volcanic highlands, especially in consideration of its 700 km source distance (Proskouriakoff 1962:337-348, 410-416). The marked disparity between its trade in volcanic rock and that of Mayapan (also a regional capital) should be noted.

While the metate collections of the Corozal region do appear to show high percentages of volcanic rock (c. 20%) relative to other regions in the Maya lowlands, usage of the other two geologic sources must also be compared. The Corozal sites range from 141-166 km in linear distance from the known quartzite and granite deposits in the Maya Mountains. These deposits were not heavily exploited, as they account for only about 20% of the metates in the Corozal region. In sum, the Corozal Maya (through time) relied upon local sedimentary rock to produce about 60% of their metates.

In contrast, the majority of metates in the Peten area were of stone imported from the Maya Mountains. Granite and quartzite were primarily used, usually one being present almost exclusively. Tikal (n = 48) used 71% quartzite and 12% granite (Haviland 1963:450-451). Similarly, Yaxha (in excavations conducted by the senior author in 1971) had a quartzite:granite ratio of 4:1, while Barton Ramie (n = 108) had only 2% quartzite and 94% granite. One source of quartzite is at Baldy Beacon in the Maya Mountains of Belize (Dixon 1955:20), at a linear distance of 94 km from Tikal. It is unknown whether this represents the closest source to Tikal. Thompson (1939:173) writes that quartzite is abundant about 55 km south-east of San Jose, which would also be about 90 km from Tikal and may represent the same source. The nearest granite source to Tikal is probably the Granite Basin west of the Bald Hills, at a linear distance of 72 km. Medium-grained biotite granite is visible to depths over 50 feet here in road cuts from Mai to Augustine (Furley 1968:42-46). Barton Ramie is only some 20 km from granite outcrops.

It is difficult to compare the energy costs of the metate import systems of the Peten and Corozal areas. The Peten area received large numbers of metates imported at a moderate distance (<100 km), while the Corozal area imported relatively small numbers of metates at a large distance (c. 400 km). It is clear, however, that the average Corozal Maya had less access to imported grinding stone than did his Peten counterpart.

TABLE 2.
Geologic Sources of Metates in the Maya Lowlands

Site	Sample Size(N)	Local (%)	Maya Mts. (%)	Volcanic (%)	Linear Dist. From Volcan. Zone
Usumacinta Peten Area					
Altar	375	c.90?	<10?2	.5	155
Piedras Negras	20	85	0	15	220
Yaxha	14.66kg ¹	<5	>95	0	260
Barton Ramie	108	0	100	0	280
Tikal	>2000	c.15	c.80?	"some"	285
Uaxactun	13	33.3	403	26.7	305
San Jose	14	7.1	78.63	14.3	320
Northern Belize Region					
Sarteneja	7	42.9	28.6		
Aventura	42	64.3	7.1	28.6	405
Sta. Rita	29	58.6	13.8	28.6	400
Caledonia	8	62.5	25.0	27.6	408
Chan Chen	10	70	20	12.5	388
Patchchacan	23	73.9	21.7	10	413
North Yucatan					
Mayapan	747	97.2	0.4	2.4	680
Chichen Itza	42	85.7	0	14.3	700

- 1 Most of the grinding stone fragments (n<100) excavated at Yaxha by the senior author were very small and were recorded by mass. Some of these fragments may represent manos as well.
- 2 The small percentage of quartzite found at Altar may have come from a closer highland source rather than the Maya Mountains.
- 3 The sandstone metates at Uaxactun and San Jose were classified as from the Maya Mountains.

TABLE 3.
Geologic Sources of Manos in the Maya Lowlands

Site	Sample Size(N)	Local (%)	Maya Mts. (%)	Volcanic (%)
Usumacinta-Peten Area				
Altar	542	c. 90?	<10?	0
Piedras Negras	9	"some"	"some"	0
Barton Ramie	249	0	100	0
Tikal	49	14.3	83.7	0
Uaxactun	56	66	32	0
San Jose	13	38	62	2
				0
Northern Belize Region				
Sta. Rita	24	87.5	4.2	8.3
Aventura	65	95.4	3.1	1.5
Sarteneja	6	67	34.0	0
Patchchacan	29	93.1	6.9	0
Chan Chen	15	100	0	0
North Yucatan				
Mayapan	54	85.2	0	14.8
Chichen Itza	227	98.2	0.4	1.3

Metates: Forms

In the total collection (n = 110) the turtleback form appeared to be the most common (45%), closely followed by the thin-flat legless form (41%), with the thin-flat legged form (10%), the trough-shaped form (3%) and thin-flat grooved form (2%) appearing in small quantities. One should note that some of the T fragments may belong to the L category. Because of this factor, as well as the insufficient sample size in two of the groups, the χ^2 results in the TypexTime permutations were not used. However, comparative observations in the literature show that the thin-flat legless form is not frequently present in the lowlands, but that it does seem to appear at the Tabasco region, Palenque, and San Jose at a Late Classic or Terminal Classic date (Willey 1972:115). Half of our thin-flat legless sample (n = 38) also date to this period. However, they appear to have been commonly used during other time periods as well. Since the TB form is the "overwhelmingly common metate type in the Peten" and the TS and L forms are more common in north and west Yucatan (Willey 1972:115), the metate distribution in northern Belize appears to share the Peten tradition more so than that of north Yucatan.

Metate form appeared to be related to geological source. This is indicated by a 3 x 5 contingency table of sources and types (n = 110) which gave a significant χ^2 at the .05 level. It is presumably metate size, as related to metate form, that is the actual factor involved here. It is clear that the smallest and lightest morphological forms, such as the T or L form, would have been the most economically desirable for long-distance transport.

The largest metates found were of the TS form, and all three of these were of local limestone. The TB form averaged the second largest, and was the most common mode for local stone (TB form comprised 44% of the L source) as well as for stone from the Maya Mountains (83% of the M source). Volcanic stone was principally used for the lighter T form (T form comprised 58% of V source) and although some volcanic stone did appear in the TB form (28% of V source) at least half of this sample had been quarried from a lightweight andesitic or pumiceous tuff. Finally, it should be noted that the L form had a nearly identical geological source breakdown to the T form. This suggests, as previously mentioned, that some fragments within these two categories were not correctly sorted.

Manos

In comparison with metate trade, there was very little long-distance import of manos in northern Belize (contrast Tables 2 and 3). More than 90% of the manos at each site were of local limestone; only 10 imported manos were found. As the same three sites, Sta. Rita, Aventura, and Sarteneja, had both the highest metate and mano import frequencies it is likely that imported manos were simply fashioned from discarded imported metates. Sta. Rita appeared as the leader in mano import with one basaltic tuff mano (37-2-5), one vesicular lava (FE2-S), and one quartzite (35-4-1). Aventura had one volcanic tuff (2-6-1), one of grey quartzite

(1-1-11), and one sandstone (3-S-7); Sarteneja had one of white granite (Sart-B-2) and one black granite (Sart-B-3); and Patchchacan had one of white granite (10-2-1) and one of brown quartzite (15-1-B-3). Other lowland sites share the same pattern: relative to volcanic metates there is very little volcanic mano import. The sole exception is Mayapan where 15% of the mano collection was volcanic stone (note that five lava pounding stones found at that site were not included with the mano total).

The mano total (n = 125) from five Belizean sites shows the following cross sectional shape frequencies: Oval (28%), Circular (22.4%), Rectangular (21.6%), Square (9.6%), Plano-convex (8%), Overhand (4%), Pentagonal (4%), Triangular (2.4%). The Oval form was the most common at Aventura (36.9% of site total) and at Sarteneja (50%). The Rectangular form occurred most frequently at Sta. Rita (25%), Patchchacan (20.7%) and Chan Chen (33.7%). Since shape determination is partially an arbitrary process we are unsure of the significance of the shape frequencies, especially in regard to intersite comparisons or chronological evolution. For example, a "square" form is occasionally nearly indistinguishable from an "oval" or a "rectangle" (Willey *et al.* 1965:462-465 have remarked on similar difficulties).

During the Early Classic (n = 11) the Rectangular form was the most common (55%). The Late Classic-Early Postclassic (n = 68) appeared to indicate a shift to the Oval and Circular forms (each with 31%), but the Late Postclassic (n = 19) once again had the Rectangular form (48%) as the most common mano shape. Willey (1965:465, 1972:124) has noted somewhat of a trend in the Late Classic in the replacement of circular, oval and flattish mano forms with rectangular or square sectional forms. Clearly the temporal pattern from the present study does not fit this trend.

In one sense the mano shape frequencies appeared to corroborate well with the metate type frequencies. One would expect a curvilinear cross-sectional mano shape to be associated with a curvilinear grinding trough (e.g. TB), and the polygonal cross sectional mano shapes to be associated with the flatter grinding troughs (e.g. L or T). We found that the frequency of TB + TS curvilinear troughs (48% of total metates) does compare favorably with the Oval + Circular mano frequency (50% of total manos). Likewise the T+L+G flat grinding trough frequency (52%) compared favorably with the frequency (50%) of those manos with at least one planar surface, the R+S+P+T+Ov+P-C forms. Finally, the occurrence of the Overhang mano form, which is specialized for a thin-flat legged metate (Willey 1972:124) compared well (4%) with the frequency of the L metate form (10%). However, these good correspondences may be coincidental as Willey (1972:124) has noted that at Altar almost all mano shapes (excluding Ov) could have been used with the TB+TS curvilinear troughs.

In summary, the metate collections of several sites in the Corozal District of northern Belize show some of the highest percentages of volcanic metates in the Maya lowlands. The import of volcanic rock in the area increased through time and reached its peak during the Late Postclassic. The Corozal Maya, however, did rely upon local sedimentary rock to produce about 60% of their metates. In contrast, the Peten Maya imported the

majority of their metates, although from a lesser distance (<100 km). While the energy costs of the two import systems are difficult to compare, it seems that the average Corozal Maya had less access to imported grinding stone than did a Tikal Maya.

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