

# SPATIAL DISTRIBUTION OF FLINT AND OBSIDIAN ARTIFACTS AT

## TIKAL, GUATEMALA

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### INTRODUCTION

Larger lowland Maya sites are characterized by architectural heterogeneity and the clustering of structures around plazas to form definable groups (Bullard 1960; Becker 1973). Yet in spite of the fact that archaeological excavations typically are oriented towards particular structures or structure groups, most Maya area artifactual studies tend to ignore intrasite provenience.

Provenience-oriented studies have produced very interesting results, for example, at Teotihuacan (Spence 1974) and in the United States Southwest (Hill 1968; Longacre 1968). But to date only a few such artifact studies have been undertaken in the lowland Maya area. Becker (1973) and Haviland (1974) have studied the association of material culture with site provenience and produced evidence of occupational specialization at Tikal. Haviland (Tikal Report No. 20; personal communication) is studying the artifacts associated with residential groups in an attempt to learn what activities took place in such groups, to try to identify a basic household inventory of tools, and to get data for the reconstruction of kinship organization. Stoltman (1975) has analyzed flint and obsidian artifacts from inside and outside the fortifications at Becan and has found evidence for functional differences between different parts of the site.

### A TRIAL ANALYSIS

An analysis was undertaken of the flint and obsidian artifacts associated with different kinds of structures and groups excavated at Tikal. One objective was to see if the artifact distributions correlated in any way with the structural types, whether different kinds of loci might have distinctive artifact "profiles". Another objective was to see if the artifacts indicated anything about ancient activities associated with various loci.

The artifact classification used was based loosely on Kidder's (1947) for Uaxactun. A preliminary classification of structures and groups was formulated for the purposes of this analysis. It grew out of one formulated by Haviland for his study of Tikal burials in which he used architectural form, structure and group size, construction methods, and associated monuments, chultuns, and special deposits as distinguishing criteria. Functional terms were successfully avoided except in the case of "temple", where no satisfactory substitute could be found.

The preliminary classification includes (Fig. 1):

1. Temple Groups, such as the North Acropolis
2. Twin-Pyramid Groups, of which nine are known at Tikal

3. Range Structure (RS) Groups, such as the Central Acropolis
4. Intermediate Structure Groups (ISGs)
5. Smaller Structure Groups (SSGs)

It is here assumed that groups of structures indicate some kind of ancient functional unity.

From the criteria mentioned above, it was hypothesized that the Temple and Twin-Pyramid Groups were ceremonial in function (Coe 1967:41-50; Jones 1969). Some Range Structures may have been elite residences (Harrison 1970). Others such as those associated with Twin-Pyramid Groups, were evidently not residential. Intermediate Structure Groups (Becker 1971, 1973) and Smaller Structure Groups (Haviland 1963, 1974, Tikal Report No. 20) were mainly residential. Presumably the occupants of the ISGs ranked lower than those of the RSGs, but enjoyed a higher social status than the occupants of the SSGs.

Eleven loci were selected from the approximately 690 architectural groups (Becker 1973:397-398) identified at Tikal to date. These represented types in the five-part classification given above. The sample was composed of one Temple Group, the North Acropolis; one Twin-Pyramid Group, Group 4E-4; three Range Structures, Structures 4E-31, 5D-15; and 5D-46; three Intermediate Structure Groups, Groups 7F-1, 4H-1, and 6E-2; and three Smaller Structure Groups, Groups 4F-2, 6E-1, and 2G-1. The first column on Table 1 gives figures for Central Tikal as a whole.

Range Structures rather than RSGs were selected because of the more manageable sample size. Haviland, the excavator of RS 4E-31, feels it was not a residence (Tikal Report No. 21). I feel that present evidence suggests it had the same function as the other two RSs in the sample, 5D-15 and 5D-46, and that this function probably was residential.

For this trial analysis, proveniences were chosen primarily for size of excavated sample rather than representativeness of Tikal as a whole. Therefore, all pertain to the 16-square-kilometer Central Tikal Area (Fig. 1; Carr and Hazard 1961). The reason for choosing large individual samples was that results could be presented in terms of percentages and ratios. Another consideration in selecting loci was approximate equivalence in time. All were in use during the Late Classic Period and most of them had their heaviest occupation at that time. Artifacts from Terminal Classic Period lots (Eznab ceramic complex) were not included in the analysis. Because artifacts found in construction fill may be mixed, not only in date but very likely also in provenience, artifacts from those lots designated as construction fill by the excavators were also omitted. Concentrating upon artifacts from undisturbed occupation debris would undoubtedly have been less complicated and would have given better results, but at this stage of analysis of Tikal materials, this information is not yet available for most loci. Archaeological context was broadly divided into special deposits (burials, caches, and deposits of problematical nature) and general excavations (all other contexts except construction fill). This distinction is important in that material found in general excavations would have been available to the users of a particular locus, while material in special deposits on the whole would not have been.

Flint and obsidian artifacts from each locus were analyzed with regard to each other, that is, in terms of percentage of the locus total or in proportion of occurrence to each other. There were two reasons for this: to try to measure the relative importance of artifacts and kinds of stone and, especially, because no other satisfactory yardstick was available. In a recent paper, Sidrys (1974) raised objections to comparing artifacts with each other. I feel they are well taken, but that it is possible to mitigate all of them by careful excavation and detailed reporting. On the other hand, Sidrys' suggested standard, volume of excavation, is very difficult to calculate (except in those rare cases where the artifact analyst and the excavator are the same person), does not take into account the differing abilities of excavators to recover materials (suggested by N. Hammond), and leaves surface finds in limbo (Johnson 1976).

The figures on Table 1 are preliminary in that not all have been checked against the lot cards, which list all materials found in a given excavation. Therefore, they may differ from figures given by other Tikal authors or from those to be published in the final Tikal artifact report.

A comment on terminology also seems in order here. Researchers working with Maya stone artifacts do not yet have a generally agreed upon terminology, either for kind of stone or for artifact type. Therefore, for want of anything better, I have continued to use most of A. V. Kidder's (1947) functional terms here. "Pebble/core choppers" is modified from Willey (Willey *et al.* 1965:438-440, Fig. 277, i,j). "Point-knife" is a contraction of "projectile point or knife" and is taken from Spence and Wiegand (1968). Non-functional terms have been used for some types which did not occur at Uaxactun or which were not recognized there. These are ultimately derived from a classification formulated by Karl G. Heider for Tikal artifacts in 1960.

## RESULTS AND COMMENTS

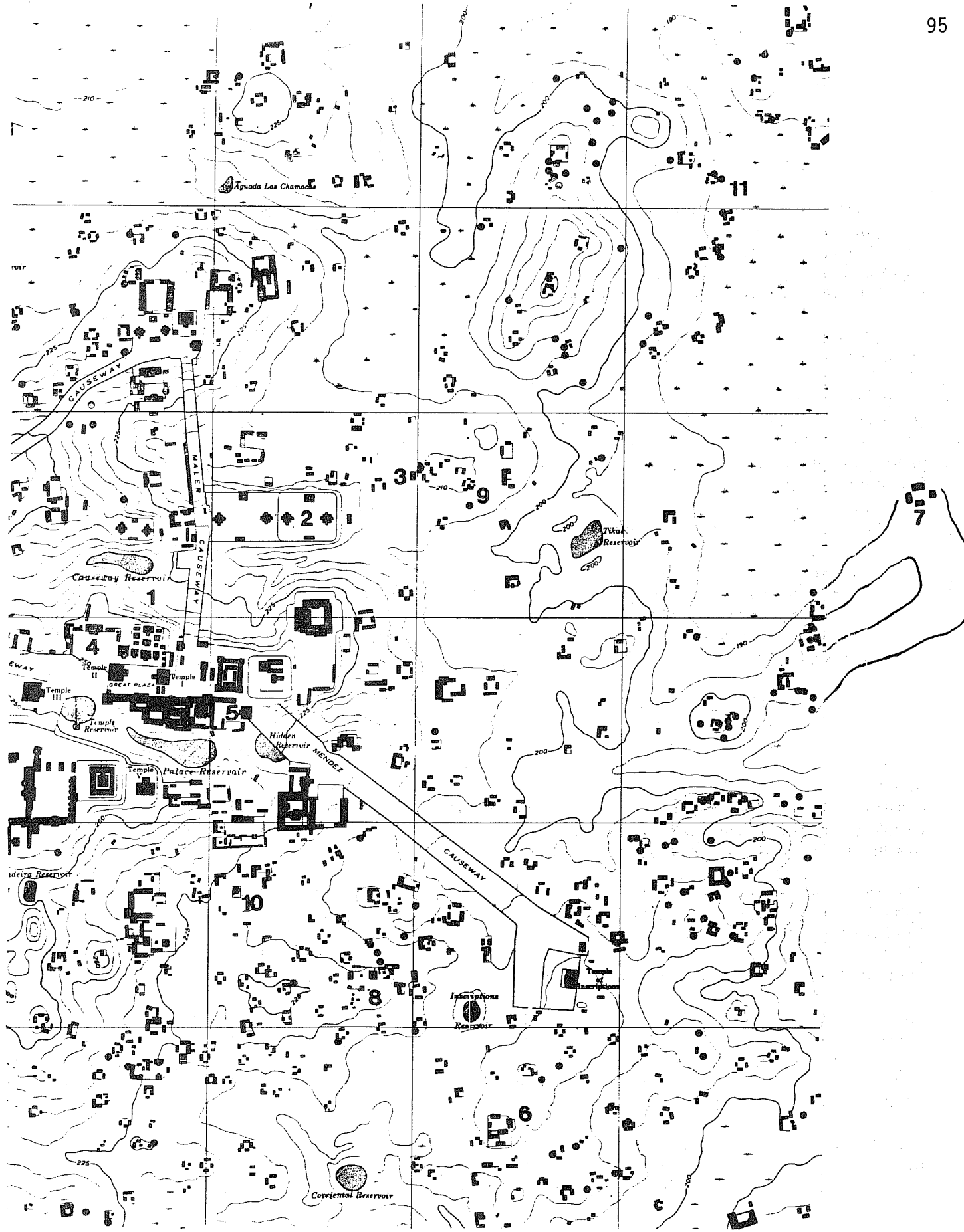
The results of this trial analysis are summarized in Table 1. Some of them, along with additional comments on Tikal flint and obsidian, are discussed here.

Artifacts were classified into three broad material categories: local flint, imported flint, and obsidian. Of interest is the circumstance that over 83.9% of all obsidian recovered from Central Tikal came from special deposits. Yet it was also present at all of the analyzed loci, where it comprised from 5.6 to 42.9% of all the chipped stone artifacts from general excavations alone. This suggests that during the Classic it was probably widely distributed throughout Central Tikal. However, the two loci with the lowest relative amount of obsidian, SSG 2G-1 and ISG 4H-1, were also the two loci farthest away from the Great Plaza-North Acropolis center.

In an initial analysis which included both Eznab deposits and construction fill, green obsidian was widely distributed. It occurred at all loci except SSG 2G-1, and comprised between 0.2% and 8.1% of the total obsidian.

Figure 1. *Map of Tikal*

1. North Acropolis
2. Twin-Pyramid Group 4E-4
3. Range Structure 4E-31
4. Range Structure 5D-15
5. Range Structure 5D-46
6. Intermediate Structure Group 7F-1
7. Intermediate Structure Group 4H-1
8. Intermediate Structure Group 6E-2
9. Smaller Structure Group 4F-2
10. Smaller Structure Group 6E-1
11. Smaller Structure Group 2G-1



Eliminating Eznab deposits and construction fill greatly reduced the green obsidian sample. It no longer appeared among the artifacts from RS 4E-31, RS 5D-15, ISG 4H-1, and SSG 6E-1, where its occurrence had been restricted to construction fill. As suggested previously (Moholy-Nagy 1975), the distribution of green obsidian at Tikal seems more influenced by time--with a maximum use in the Early Classic--than by social status. Furthermore, even after green obsidian began to be imported in quantity sometime during the Early Classic, grey obsidian was still preferred for special deposits.

In the absence of any other identified Mesoamerican source, green obsidian found in Maya lowland sites is generally assumed to have come from the Central Mexican source near Pachuca, Hidalgo (cf. Sheets 1975). All grey obsidian identified from Tikal to date came from highland Guatemalan sources (Moholy-Nagy 1975: Table 1). However, Pires-Ferreira (1975:30) mentions a green obsidian of unknown source but possibly from Oaxaca, and a few of the green obsidian samples from Tikal could not be identified as to source. Although it is possible that this unknown green obsidian source could be a product of analytical procedures, it might be well to regard green obsidian more critically. I also suspect on chronological and typological grounds (cf. Tolstoy 1971: Figs. 2 and 3) that most, if not all, of the stemmed grey and green obsidian point-knives found at Tikal and elsewhere in the Maya lowlands came ready-made from the Mexican highlands. In spite of many years of analyzing for obsidian source, apparently no data yet exist for secondarily worked artifact types such as point-knives, eccentrics, or incised obsidians. Hopefully, this gap in knowledge can be filled soon.

Two kinds of imported, fine-textured flint can be readily distinguished at Tikal. Of minor importance is a banded tan flint, which may have been imported only in the form of daggers (Coe 1957) during the Late Preclassic. Of more common occurrence during the Classic Period is an unbanded tan, brown, or dark brown flint, which occurs primarily as point-knives, and occasionally as eccentrics, flakes, and nodules. Superficially, both kinds of flint appear identical to nodules from the site of Colha, near Orange Walk, Belize (Wilk 1976:152-173).

RSs had the highest percentage of imported flint--never more than 3.6% with ISGs next, and SSGs with the lowest. The amount of imported flint is directly related to the number of point-knives recovered from the particular locus. The exception is the North Acropolis, where imported flint occurred primarily in the form of eccentrics.

The materials found in general excavations are here considered as having been available to all of the occupants or users of a locus. Therefore, the counts from general excavations have been given more emphasis on Table 1. These counts do show some correlations and lack of correlation with group or structure type.

Regarding artifact types, generally RSs and ISGs produced higher percentages of bifacially worked artifacts than SSGs. RSs had slightly more point-knives than ISGs, and ISGs had noticeably more than SSGs. Point-knives may

TABLE 1. FLINT AND OBSIDIAN ARTIFACT COMPARISONS ( ) - incomplete count

	CENTRAL TICAL TOTAL			NORTH ACROPOLIS			TWIN PYRAMID GROUP 4E-4			RANGE STRUCTURES			INTERMEDIATE STRUCTURE GROUPS			SMALLER STRUCTURE GROUPS		
	Gn Ex %	Sp Dp %	no.	Gn Ex %	Sp Dp %	no.	Gn Ex %	Sp Dp %	no.	STR. 4E-31	STR. 5D-15	STR. 5D-46	GROUP 7F-1	GROUP 4H-1	GROUP 6E-2	GROUP 4F-2	GROUP 6E-1	GROUP 2G-1
Local flint %	99.3			99.4	99.5	99.4	99.4	99.4	99.4	96.4	96.4	97.5	97.3	98.2	97.7	98.6	100.0	99.0
Imported %	0.6			0.6	0.5	0.6	0.6	0.6	0.6	3.6	3.6	2.5	2.7	1.8	2.3	1.4	-	1.0
Unstudied %	0.1			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All flint:Gn Ex %	52.3			90.0	6.1	90.0	90.0	90.0	90.0	100.0	97.3	36.1	42.5	84.4	96.6	100.0	99.7	100.0
Sp Dp %	(47.7)			10.0	(83.1)	10.0	10.0	10.0	10.0	2.7	63.9		58.5	15.6	3.4	-	0.3	-
Loc flint:Gn Ex %	52.0			90.6	6.1	90.6	90.6	90.6	90.6	100.0	97.2	34.5	41.9	84.1	98.8	100.0	99.7	100.0
Sp Dp %	(48.0)			9.4	(93.9)	9.4	9.4	9.4	9.4	2.8	65.5		59.1	15.9	1.2	-	0.3	-
Imp flint:Gn Ex %	86.5			100.0	3.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	33.3	100.0	100.0	100.0
Sp Dp %	(13.5)			-	(96.6)	-	-	-	-	-	-	-	-	-	66.7	-	-	-
Grey obsidian %	(99.0)			99.3	99.5	99.3	99.3	99.3	99.3	100.0	100.0	97.4	99.7	100.0	95.5	99.2	100.0	97.7
Green obsidian %	1.0			0.7	0.5	0.7	0.7	0.7	0.7	-	-	2.6	0.2	-	5.0	0.8	-	-
Red/Black obs. no.	8			-	1	-	-	-	-	-	-	-	1	-	-	-	-	1
All obsidian:Gn Ex %	17.0			19.6	1.1	19.6	19.6	19.6	19.6	100.0	2.1	57.9	5.2	86.5	90.0	100.0	96.6	100.0
Sp Dp %	(83.0)			80.4	(98.9)	80.4	80.4	80.4	80.4	-	97.9	42.1	94.8	13.5	10.0	-	3.4	-
Grey obs:Gn Ex %	16.1			18.9	10.0	18.9	18.9	18.9	18.9	100.0	2.1	55.3	5.2	86.5	89.5	100.0	96.6	100.0
Sp Dp %	(83.9)			81.9	(90.0)	81.9	81.9	81.9	81.9	-	97.9	44.7	94.8	13.5	10.5	-	3.4	-
Green obs:Gn Ex %	69.6			100.0	30.0	100.0	100.0	100.0	100.0	-	-	100.0	-	-	100.0	100.0	-	-
Sp Dp %	30.4			-	70.0	-	-	-	-	-	-	-	100.0	-	-	-	-	-
Obs:Flint-Total	(1.5)			1.3	(0.5)	1.3	1.3	1.3	1.3	8.8	0.1	3.6	0.4	10.4	4.4	1.3	9.6	16.9
-Gn Ex %	4.5			6.0	2.7	6.0	6.0	6.0	6.0	8.8	4.9	2.3	3.2	10.1	4.8	1.3	9.9	16.9
-Sp Dp %	(0.8)			0.2	(0.5)	0.2	0.2	0.2	0.2	-	-0.1	5.8	0.2	12.0	1.5	-	1.0	-

(Continued)

Gn Ex:Local flint	81.0	72.5	85.1	86.6	79.6	64.9	71.2	89.0	80.8	56.3	90.8	93.5
Imptd flint	0.9	0.2	0.5	3.2	3.0	4.8	4.8	2.0	1.9	0.8	-	0.9
Obsidian	18.1	27.3	14.4	10.2	17.4	30.3	23.9	9.0	17.3	42.9	9.2	5.6
Flint:Gn Ex	44,039+	699	155	141	109	101	127	325	86	3,273+	286	727
Choppers	3.0	4.0	9.0	5.7	8.2	3.0	13.4	11.7	9.3	2.5	3.8	3.6
Elongates	1.4	1.9	0.6	2.8	2.7	5.0	7.1	2.1	4.6	1.0	1.4	0.7
All Bif-R/0s	0.9	2.3	0.6	-	2.7	1.0	3.9	0.9	-	0.6	1.4	-
P/C Choppers	0.3	1.0	-	0.7	-	1.0	1.6	-	1.2	0.1	1.0	0.3
Point-knives	1.3	0.9	1.9	4.2	3.7	7.0	5.5	3.7	3.5	1.9	0.3	1.0
Scrapers	2.3	3.0	3.9	0.7	4.6	3.0	2.4	1.5	8.1	1.1	1.4	1.1
Drills	0.8	0.7	0.6	0.7	2.7	1.0	0.8	0.9	2.3	0.4	1.0	0.4
Flake-blades	1.1	1.0	-	-	-	1.0	2.4	0.9	1.2	0.2	1.4	0.4
Flake cores	3.9	13.3	17.4	2.1	5.5	8.0	7.9	2.5	15.1	5.5	0.7	1.1
Unret. flakes	83.8	69.5	65.8	82.8	68.8	75.0	52.7	74.8	52.3	86.1	88.5	91.3
Cores:Flakes	21.5	5.2	3.8	39.0	12.5	9.4	6.7	30.4	3.5	15.6	126.5	83.0
Obsidian:Gn Ex	9,705+	262	26	16	23	44	40	32	18	2,457	29	43
Point-knives	2.2	3.8	3.8	6.2	8.7	6.8	5.0	6.2	11.1	0.4	3.4	2.3
Flake-blades	79.4	88.2	65.4	81.2	73.9	70.4	75.0	75.0	83.3	77.1	93.1	88.4
F-b cores & fr	3.6	0.8	7.7	12.5	-	9.1	7.5	-	5.5	2.0	-	2.3
Flakes (all)	14.2	5.0	23.1	-	17.4	11.4	12.5	18.7	-	20.3	3.4	4.6
Grey obs.cores:flake blades-Total	(15.8)	(19.8)	13.2	6.5	-	10.0	9.8	-	-	37.9	-	38.0
-Gn Ex	22.1	111.5	8.5	6.5	-	10.0	10.0	-	-	37.9	-	38.0
-Sp Dp	(14.2)	(14.5)	18.0	-	-	-	9.8	-	-	-	-	-
Flake-Blades-Flint:	(51.2)	(239.5)	-	-	-	17.3	110.5	7.0	17.0	315.8	7.0	12.7
Obsidian-Total	16.5	33.0	-	-	-	31.0	10.0	8.0	15.0	315.8	6.7	12.7
-Gn Ex	(264.9)	(284.0)	-	-	-	10.5	412.0	4.0	-	-	-	-
-Sp Dp												

TABLE 1. FLINT AND OBSIDIAN ARTIFACT COMPARISONS - concluded



have been status symbols (suggested by Joseph Michels). Usually the ISGs had more bifacially worked artifacts than either RSs or SSGs. Choppers were relatively much more common in IGs than anywhere else.

Unretouched flint flakes were the most common artifact type at all loci, comprising from 52.3 to 91.3% of the sample considered. However, they are consistently most numerous in the SSGs, thereby lowering the percentages of secondarily shaped artifacts which were also invariably present. For example, SSG 4F-2 produced 82 choppers, many of them whole. But the percentage of choppers is only 2.5% due to the presence of over 2818 unretouched flint flakes. If unretouched flint flakes and flake cores are subtracted from the flint found in general excavations, more overlap occurs in the distributions of various types of secondarily worked artifacts. Yet point-knives are still proportionately more frequent in RSs and choppers are still more frequent in the ISGs.

Why the SSGs produced so many unretouched flint flakes is difficult to answer now. Unfortunately, at the time of excavation little attention was directed towards distinguishing usable flakes from debitage. The ratio of flake cores to unretouched flakes is too variable to be helpful here. A high ratio of cores to flakes might indicate a workshop situation. A low ratio might indicate that flakes were being used as tools in some activity. However, the possibility that cores might have been further utilized, perhaps as chopping-tools or hammerstones, and therefore not classified as cores, also comes to mind. A study underway by Lilita Bergs may shed light on this problem.

Most of the obsidian found at Tikal was in the form of flake-blades. The percentage of obsidian flake-blades in general excavations was somewhat higher in SSGs than in ISGs, and lowest in RSs. A lower percentage of flake-blades is usually associated with a higher percentage of flakes, suggesting a possible classification problem during the early years of excavation at Tikal. Most of the obsidian flakes studied and catalogued in later years were small and irregular, and were probably debitage. In contrast to flint flakes, larger flakes of obsidian showing signs of edge use, or retouched into scrapers, were uncommon.

Distribution of obsidian flake-blade cores and fragments was spotty. The highest percentage was in RSs (but none occurred in RS 5D-15) and ISGs had more than SSGs (but none occurred in ISG 4H-1).

The grey obsidian core: flake-blade ratio was equally random. Even SSG 4F-2 with its obsidian workshop had proportionately fewer flake-blade cores or fragments. Complete cores were also very rare; not only in the studied sample but in Tikal as a whole (135 of 1807 cores and fragments). Apparently few exhausted cores were simply discarded. Most seem to have been reworked. Many were broken into pieces, deliberately, as indicated by the standardized forms of the fragments. Many were reworked into eccentrics. In addition, many exhausted cores and identifiable core fragments were specially deposited, and account for the somewhat higher proportion of cores and core fragments in special deposits.

The studied sample included the debris left by at least two obsidian workshops (Table 2). Localized workshop debris of Ik ceramic complex date

(Tepeu 1) was discovered in SSG 4F-2 (lot 20A/14) and redeposited workshop debris associated with Late Preclassic, Early Classic, and Ik complex sherds turned up in construction fill of Str. 5D-33 on the North Acropolis (lot 12L/28). Not included in this sample was a third, probably redeposited workshop of Early Classic date associated with Str. SE-454 (Op. 132F) in the Peripheral Area of Tikal (Becker 1973: 399), and a fourth, redeposited workshop associated with Late Preclassic and Early Classic sherds at the Str. 6C-60 locus (Op. 66D). Of these four, all but the redeposited workshop on the North Acropolis were associated with SSGs. No artifacts identifiable as stone-knapping tools, either of stone, bone, or antler, were associated with any of these workshop concentrations.

The redeposited debris of yet another obsidian workshop may be present in ISG 7F-1 (Haviland, Tikal Report No. 22). The limestone block fill of Str. 7F-30 included pockets of material which considered together look like workshop debris (Coe and Broman 1958:32): many small, probably percussion-struck flake-blades, pressure flake-blade fragments, many flakes, several with patches of cortex, and 11 polyhedral core fragments. This material was designated Problematical Deposit 37 and had been specially deposited during the time of use of the Ik ceramic complex.

ISG 7F-1 came into existence during the latter part of the Early Classic Period. Haviland (Tikal Report No. 22) suggests that the obsidian workshop may have predated the founding group.

If the contents of Problematical Deposit 37 are indeed the remains of an obsidian workshop, then a possible explanation of the scarcity of such workshops in a site as large and as extensively excavated as Tikal is suggested. Perhaps many of them were redeposited in the large caches and exterior burial offerings (a change of opinion from that expressed in Moholy-Nagy 1975:518). Although none of these special deposits has been carefully studied in its entirety, most of them appear to be heterogeneous, including flakes, percussion and pressure flake-blades, and core fragments. Possibly the proportion of neatly-made polyhedral core fragments would distinguish redeposited workshop debris from a specially-produced offering. Perhaps percussion-struck flakes and flake-blades were specially produced to augment redeposited workshop debris. At any rate, this point obviously needs more study.

Flint flake-blade: obsidian flake-blade ratios for general excavations do not correlate well with locus type. However, there does seem to be a loose, inverse correlation with general excavation obsidian:flint ratios. It will be especially interesting to see if this tendency persists in a larger sample.

One of the more interesting results of this trial analysis was the poor correlation of general excavations obsidian:flint ratios with locus type. Averaged out, the ISGs had proportionately more obsidian than the RSs, which in turn had more than the SSGs. But there was considerable overlapping. SSG 4F-2 with its workshop had the highest proportion of obsidian

of all loci. Even after subtracting the workshop debris (Table 2), the ratio was 1:3.0, surpassed only by RS 5D-46 with 1:2.3. Although sociotechnic and ideotechnic usage of obsidian appears to relate directly to social status, technomic usage may not. Although Rathje (1972) mentions the abundance of obsidian in lowland Maya sites, other researchers like Sidrys (1974) and Stoltman (1975) feel its use was restricted to the elite. But it would seem that at least in Central Tikal (and perhaps only in Central Tikal?), obsidian was being widely distributed among all social groups.

With regard to total counts at individual loci, it is clear that special deposits, particularly structure caches and problematical deposits, greatly affected percentages and ratios. For example, loci with high total obsidian:flint ratios all had special deposits including a great deal of obsidian (except for SSG 4F-2 which had the workshop). Among the RSs, the locus counts from RS 4E-31 which had no flint- or obsidian-bearing special deposits more closely resemble those from SSGs than from the other two RSs considered here.

Flint and obsidian are rarely associated with burials in SSGs. They are often present in some ISG burials, for example in ISG 4H-1, but not in others. This suggests local variation on traditional Tikal burial customs. Two burials in ISG 7F-1 included flint and obsidian eccentrics within the graves, the only known instances at Tikal.

The masses of flint and obsidian flakes and flake-blades deposited as exterior offerings to North Acropolis tomb burials indicates a ranked society (Fried 1967:109). In view of the large quantity of local flint and imported obsidian involved, as well as the labor involved in chipping all that stone into useless little pieces, a true stratified society (Fried 1967:186) seems plausible.

In his study of Smaller Structure Groups, Haviland (Tikal Report No. 22) has identified a basic, invariably present, artifactual assemblage of ten types. Three of these are not included in this study (pottery figurines, group stone manos and metates) and two have been merged (used and unmodified flint flakes). All six of the other basic artifact types occurred in all of the analyzed loci (flint choppers, elongates, scrapers, flakes, and flake cores, and obsidian flake-blades). Of these six types, I feel that at least three were probably produced by specialists (choppers, elongates, and obsidian flake-blades). They show a high degree of standardization of form and competent workmanship. If they were made by specialists, then their wide distribution would indicate close socio-economic integration in the Central part of Tikal during the Late Classic Period. As mentioned above, the large percentages of unretouched flakes associated with the SSGs is hard to interpret without more detailed technical data. However, together with the circumstance that three of the four known obsidian workshops were associated with SSGs, the high percentage of flint flakes suggests that the hypothetical flint-knapping specialists may also have lived and worked in the SSGs.

TABLE 2 - OBSIDIAN WORKSHOP ARTIFACT COUNTS

All grey obsidian

	Group 4F-2 Lot 20A/14	Str. SE-454 Op. 132F (redeposited)	Str. 5D-33 Lot 12L/28 (redeposited)	Str. 6C-60 locus Op. 66D (redeposited)	Group 7F-1 Problematical Deposit 37 (possible redeposited workshop debris)
Flake-blades	955	135	327	40	371
Flakes	376	12+	122	11	219
Cores & fragments	20	7	20	6	11
TOTAL	1,351	154	469	57	601

A redistributive type of economy (Sahlins 1974:189) is usually assumed for the Classic lowland Maya (cf. Culbert 1973). If this was the case in Central Tikal, then even the inhabitants of the SSGs had good connections with the redistributive node, whoever that was. Through the node they could have distributed the products of their flint and obsidian workshops to the RSGs and the ISGs. From the node they could have received imported raw obsidian and fine flint, as well as finished products of these materials.

Furthermore, the high proportion of obsidian:flint for Central Tikal as a whole (ca. 1:1.5) indicates Tikal itself was an important redistributive node in a lowland Maya obsidian network, confirming suggestions by Adams (1973:154) and others. The proportion of obsidian to flint at any given lowland Maya site appears more influenced by the size and kind of site than by the site's distance from the obsidian source (see also Johnson 1976). That lowland Maya settlement pattern was hierarchic is clear (Bullard 1960), even though the causes for this arrangement may be in dispute (Marcus 1973; Hammond 1974). A direct correlation between proportion of obsidian and size and type of site is in contrast to the situation in presumably more egalitarian societies, such as the Neolithic Near East (Dixon, Cann, and Renfrew 1968) and perhaps Formative Highland Mesoamerica (Pires-Ferreira 1975:20-24), where distance from source seems to be more significant.

In view of the variability in quantity and proportion of obsidian in lowland Maya sites, and even differences at different times during the occupation of the same site, it would seem that Rathje's (1972) characterization of obsidian as a basic resource ought to be modified. Rather than a *basic* resource, it was probably regarded and sought as a *preferred* choice for cutting tools and ceremonial deposits.

#### CONCLUSIONS

A few correlations between locus type and the occurrence of flint and obsidian artifacts were brought out by this trial analysis:

The three RSs were characterized by the highest percentages of point-knives, and, accordingly, of imported flint. The percentages of other secondarily worked flint and obsidian artifacts in general excavations generally trailed slightly behind those of the ISGs. RSs tended to have larger flint- and obsidian-bearing special deposits than ISGs and SSGs, and this is reflected in the total counts for the locus. For example, the counts from RS 4E-31, without such special deposits, differed somewhat from the other two RSs.

The three ISGs had the highest percentages of secondarily worked artifacts, except point-knives. ISG 4H-1 had rather low percentages of imported flint and obsidian, which may be related to its peripheral position.

Unretouched flint flakes and obsidian flake-blades were numerous at all loci. However, they comprised the highest percentages of flint and obsidian recovered from general excavations in SSGs. It is probable that specialized obsidian workers lived in SSGs; perhaps specialized flint

workers did, too. In addition--or alternatively, given our present state of knowledge--certain processing or manufacturing activities involving the use of flint flakes may have been carried out in SSGs. Caches do not occur with SSGs at Tikal and the amount of flint and obsidian deposited with burials and problematical deposits is comparatively small.

The Temple Group and Twin-Pyramid Group did now show any distinctive correlations. They are included in Table 1 for comparative purposes.

The distribution of obsidian within the studied sample indicated a close economic integration of Central Tikal during the Late Classic Period. This integration was reflected not only by the presence of obsidian at each locus, but also by the remains of at least two workshops indicating obsidian-working specialists. The presence of flint-working specialists is suggested but not established.

It cannot be said that the results of this trial analysis produced new information on ancient activities associated with each locus. Nevertheless, it produced a few correlations which may prove to be characteristic of certain structure and group types once a larger sample is analyzed.

Future research is planned which will also take into account all portable artifacts and ecofacts, not just flint and obsidian. If an overview of all of the surviving materials from a given locus could be achieved--if we could lay out all the remaining puzzle pieces on the same table--the chances of deducing the activities that once took place at that locus would be greatly improved.

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## SOME SOCIOLOGICAL OBSERVATIONS ON OBSIDIAN PRODUCTION

## AT KAMINALJUYU, GUATEMALA

Joseph W. Michels

## INTRODUCTION

Ninety-five percent of all obsidian found at Kaminaljuyu comes from the El Chayal Magma located approximately 20 km to the northeast (Hurtado de Mendoza 1973:48). On-site inspection at one of the principal chipping stations (the El Chayal site) indicates that quarry-centered operations involved the production of blade cores (Michels 1975:103). Prodigious quantities of large blades and large flakes were produced as by-products, and were used *in situ* for the operation of heavy-duty woodworking industry (*ibid.*). The finished blade cores were transported elsewhere for blade production.

From the beginning of the Late Formative (500 B.C.) to the end of the late Late Classic (A.D. 1000) Kaminaljuyu was a principal center of both blade production and blade consumption. This is understandable since the El Chayal magma is located in territory controlled by Kaminaljuyu, and all quarried extrusion points of the magma would be subject to Kaminaljuyu administration.

Yet Kaminaljuyu appears to be only one of three major political entities that share common frontiers within the Valley of Guatemala. The southern end of the valley and the uplands to the southeast comprise an autonomous political unit called the Amatitlan chiefdom (Brown 1975). The upper portion of the western slopes of the valley and adjacent Sacatepequez-Chimaltenango uplands comprise a second autonomous political unit, which I call the Chimaltenango chiefdom. The Kaminaljuyu chiefdom, itself, consists of the northern half of the valley and the topographically rugged drainage system to the northeast. Studies conducted by both Brown (1975) and myself (Michels n.d.) would seem to indicate that these three contiguous chiefdoms coexisted, autonomously, ever since their emergence in the Late Formative.

There are several economically strategic features located within Kaminaljuyu territory. The territory includes the major access routes connecting the Valley of Guatemala with the Matagua Valley--a principal artery of Meso-american inter-regional commerce. In addition, as mentioned earlier, the El Chayal obsidian region is located within the territory. Finally, the famous Chinautla clays are mined here; clays which were used in the production of fine ceramic vessels from very early in the occupational history of Kaminaljuyu right up to the present day (Rice 1976).

## THE SOCIAL ORGANIZATION OF KAMINALJUYU

Kaminaljuyu is a conical clan chiefdom that consists of five sub-chiefdoms that collectively occupy an area of approximately 150 square km, forming the immediate sustaining area of the site of Kaminaljuyu. In addition, Kaminaljuyu administers extensive dependent territories north and northeast of the immediate sustaining area. Provisional demographic reconstruction

suggests that the immediate sustaining area and the site of Kaminaljuyu, combined, had a Formative Period population that grew from 4,000 to 10,000 persons, and a Classic Period population that reached a height of about 22,000 persons.

The site of Kaminaljuyu, itself, occupies 7.5 square km, and is divided into five local lineage precincts of roughly equal area. Each precinct accommodates the residential and ceremonial needs of the paramount lineage of one of the five sub-chiefdoms. Each sub-chiefdom, and the Kaminaljuyu precinct with which it is connected, is named after a principal modern town located within its area. Starting from the north and moving in a clockwise manner they are the El Incienso, the Santa Rosita, the Caterina Pinula, the San Carlos, and the Mixco sub-chiefdoms. The paramount lineages of the five sub-chiefdoms are ranked, and although during specific phases there are exceptions, generally speaking they have a long-term rank order that conforms with the sequence in which I named them above. That is, the El Incienso lineage ranks highest and the Mixco lineage ranks lowest. The El Incienso lineage chief is therefore the paramount political and religious leader of the Kaminaljuyu chiefdom. The Acropolis and Palangana which form the well-known Acropolis Complex (Cheek 1976), with its Teotihuacan-style architecture, represents the ceremonial and residential center of the El Incienso lineage during the Middle Classic and early Late Classic phases.

By the Middle Classic phase an intermediate subdivision emerges that causes the five sub-chiefdoms to be grouped into two organizational entities, which I have called *districts*. The El Incienso and Santa Rosita sub-chiefdoms (ranked I and II respectively) form the Northeast district. And the Caterina Pinula, San Carlos and Mixco lineages (ranked III, IV, and V respectively) form the Southwest district. As might be expected from the internal ranking of the grouped lineages, the two districts are themselves ranked; with the Northeast district of higher rank than the Southwest district. District ranking can be explained by the fact that all economically strategic resources of the chiefdom are located in dependent territories administered by the Northeast district. The El Incienso sub-chiefdom appears to control the northern access routes as well as the Chinautla pottery-making communities. The Santa Rosita sub-chiefdom, on the other hand, seems to control the obsidian producing hamlets of the El Chayal region. In fact, the Southwest district sub-chiefdoms are effectively deprived of extensive dependent territories since their lands abut almost directly upon the frontiers of the Amatitlan and Chimaltenango chiefdoms.

Each of the five paramount, but ranked, lineages that reside at Kaminaljuyu and that form the ruling elite of the Kaminaljuyu chiefdom is characterized by dual organization. The dual organization does not achieve institutional expression until the beginning of the Late Terminal Formative phase, but once manifested it maintains an institutional presence until the end of the early Late Classic phase. I have named the organizational entities resulting from dual organization *moiety*s. Architectural manifestation of moiety units demonstrates that each lineage precinct can be divided into moiety *sectors*. These sectors appear to be more or less stable over a five

phase trajectory (1000 years). That moiety sector of each lineage precinct in which the sub-chieftdom's elaborate Early Terminal Formative ceremonial complex was located is designated Moiety A. The remaining sector is designated Moiety B. Moiety A and B sectors of each lineage precinct possess roughly comparable architectural complexes. Despite this, however, the moieties are of unequal rank. Moiety A tends to rank higher than Moiety B for all lineages and for all seven phases for which comparisons could be made.

Cutting across the organizational structure summarized above is a class hierarchy that divides the population of Kaminaljuyu into four basic strata. Rank I households constitute a paramount elite. Rank II households represent a secondary elite. Rank III households, on the other hand, are moderately affluent commoners. And Rank IV households constitute the low status retainer or peasant stratum of society.

The evidence supporting the sociopolitical reconstruction of Kaminaljuyu given in this paper will be published in detail by me in a book currently being prepared for publication (Michels n.d.). My summary here is intended to serve as a sociological framework within which I can make a series of observations regarding obsidian production at Kaminaljuyu.

#### OBSIDIAN PRODUCTION

Using the distribution of exhausted polyhedral cores as a principal indicator, I can report that almost one-quarter (23%) of the 512 households studied at Kaminaljuyu within a seven phase (1500 year) time frame were involved in obsidian blade production. How that percentage was distributed with respect to district, lineage, moiety, and social class subdivisions, and how that distribution changes over time, is the subject of this part of the paper.

#### The Late Formative Phase (500 B.C.-200 B.C.)

Overall, 21% of the 28 Late Formative households sampled were involved in blade production. By sub-chieftdom precinct, the percentage of households involved in blade production is:

El Incienso - 20%	San Carlos - 75%
Santa Rosita - 7%	Mixco - 0%
Caterina Pinula - 25%	

Two of these figures are especially noteworthy. The fact that Santa Rosita had only 7% of its households involved, yet is believed to be in political control of the El Chayal obsidian hamlets, would suggest that a deliberate policy of redistribution not only deprives it of a monopoly on blade production comparable to its purported monopoly on core production but mitigates against its participation in this aspect of the industry on an equitable basis. The fact that San Carlos, on the other hand, had 75% of its households involved suggests, furthermore, that the latter was a privileged recipient of the output of El Chayal blade cores. San Carlos may, on the basis of the lopsided percentage figures, be thought of as having an industrial focus on the manufacture of prismatic blades.

During the Late Formative dual organization had not yet been institutionalized, and moiety sectors must be extrapolated backward in time on the basis of patterning in subsequent phases. On that basis, however, all blade production can be associated with households located in Moiety A sectors of the sub-chiefdom precincts.

On examination of the distribution of blade production along social class lines, one finds that 33% of blade producing households belong to the paramount elite, while 67% belongs to the class of low ranked commoners. This disparity in favor of non-elite households is unique among the seven phases for which adequate data is available. What is interesting is that the disparity is associated with district divisions. That is, all obsidian producing households in the Northeast district belong to the paramount elite, while all of the obsidian producing households in the Southwest district belong among low ranked commoners.

#### The Early Terminal Formative Phase (200 B.C.-A.D. 0)

For this phase 39% of the 44 households sampled were involved in blade production. By sub-chiefdom precinct, the percentage of households involved in blade production is:

El Incienso - 31%	San Carlos - 50%
Santa Rosita - 50%	Mixco - 37%
Caterina Pinula - 20%	

Again, we may usefully single out the Santa Rosita and San Carlos precincts. Both exhibit very high percentages, suggesting that one out of every two households in the precincts are involved in blade production. The industrial focus identified for the San Carlos precinct during the Late Formative appears to continue. However, the redistribution policy that seemed to adversely affect the Santa Rosita lineage during the Late Formative appears to no longer be in effect, since the precinct exhibits an industrial focus on blade production fully comparable to that of San Carlos.

During the Early Terminal Formative dual organization still had not yet been institutionalized, and moiety sectors must be extrapolated. On that basis, however, blade production can now be observed in both Moiety A and Moiety B sectors. Although there is a tendency for blade production to continue to be more heavily represented in Moiety A sectors of the site, its representation in Moiety B sectors is substantial and may prefigure the architectural manifestation of dual organization that occurs during the next phase.

On examination of the distribution of blade production along social class lines, one finds that 76% of blade producing households belong to the paramount elite, 18% to the secondary elite, and 6% to the class of low ranked commoners. This is in sharp contrast with the distribution reported for the Late Formative. Now, a full 94% of the blade producing households are elite, while only 6% are commoners. No significant variation can be discerned along district lines.

It should be noted that a secondary elite type household emerges for the

first time at Kaminaljuyu during this phase. What is interesting is that although it is only modestly associated with blade production it is universally associated with some type of craft specialization.

#### The Late Terminal Formative Phase (A.D. 0-A.D. 200)

Overall, 23% of the 65 Late Terminal Formative households sampled were involved in blade production. By sub-chieftdom precinct, the percentage of households involved in blade production is:

El Incienso - 29%	San Carlos - 33%
Santa Rosita - 0%	Mixco - 28%
Caterina Pinula - 0%	

Once again, a stringent policy of redistribution appears to adversely affect the Santa Rosita lineage's ability to maintain an industrial focus upon blade production. And although the figures listed above suggest a rough parity in blade production among three sub-chieftdom precincts, in fact the San Carlos lineage continues to dominate; as evidenced by the prodigious quantities of workshop debris concentrated in an area which can usefully be referred to as a *factory site* (46-32-239). The sharp drop in the number of Kaminaljuyu households involved in blade production (from 39% in the Early Terminal Formative to 23% here) might be explained by the appearance of factory-level concentrations of obsidian production in specific barrios.

Another concomitant factor is the institutionalized expression of dual organization, in the form of separate but equal ceremonial complexes within each lineage precinct, that first manifests itself during this phase. However, moiety divisions do not significantly affect the distribution of blade producing households at Kaminaljuyu during this phase. In those precincts which have such households, they are almost equally apportioned along moiety lines.

On examination of the distribution of blade production by social class, one finds that 80% of blade producing households are elite, while only 20% are non-elite. Among elite households blade production is evenly distributed between paramount and secondary elite.

A new class category makes its first appearance at Kaminaljuyu during this phase--the Rank III commoner. It is only modestly involved in blade production; accounting for no more than 7% while the low ranked commoner accounts for 13% of such households.

When district divisions are superimposed upon class divisions one notes that there is considerably more variability in class among blade producing households of the Southwest district than among those of the Northeast district. While only the two elite classes are represented among such households in the Northeast district, all four classes are represented in the Southwest district. Furthermore, the contrast in distribution appears to be significant. Obsidian producing households in the Southwest district

are distributed as follows: paramount elite, 30%; secondary elite, 40%; Rank III commoner, 10%; low ranked commoner, 20%. While in the Northeast district the distribution is: paramount elite, 60%; secondary elite, 40%. It certainly seems as if, at least in the Southwest district, the locus of blade production is being cautiously divorced from its invariant association with elite residential compounds; enabling it to begin to take on the form of a cottage industry.

#### The Early Classic Phase (A.D. 200-A.D. 400)

Of the 104 Early Classic households sampled, 28% were involved in blade production. By sub-chieftdom precinct, the percentage of households involved in blade production is:

El Incienso - 25%	San Carlos - 46%
Santa Rosita - 20%	Mixco - 18%
Caterina Pinula - 27%	

The figures reveal that four of the precincts have percentages that approximate the average for Kaminaljuyu (23%), and may therefore denote a policy of equitable distribution of El Chayal blade cores among the lineage chiefs. However, San Carlos stands out conspicuously; having almost one out of every two households involved in blade production. Once again, it seems as if San Carlos is continuing a tradition of possessing an industrial focus with respect to the obsidian working craft. Not only is there a high percentage of households involved, but also the factory-like concentrations of workshop debris continue on from the Late Terminal Formative.

An inspection of blade producing households broken down by moiety tends to reinforce the impression that the San Carlos precinct possesses a barrio of obsidian workers. For all other precincts there is no noteworthy difference in the distribution of blade producing households by moiety sector. Yet, in San Carlos 66% of all households in the Moiety B sector are engaged in blade production, compared with only 29% in the Moiety A sector. The Moiety B sector is also the locus of the factory-level concentrations of obsidian workshop debris. We may therefore conclude that Moiety B of the San Carlos precinct constitutes a barrio of obsidian workers during the Early Classic phase.

On examination of the distribution of blade production along social class lines, one finds that 69% of blade producing households are elite (66% and 3% paramount and secondary elite respectively), and 31% are non-elite (14% and 17% Rank III and low ranked commoners respectively). This seems to suggest that the process of divorcing the locus of blade production from its association with elite residences, glimpsed in the Late Terminal Formative, has not advanced significantly; stabilizing at a 2:1 ratio of elite to non-elite. This impression is reinforced when one examines the breakdown by district. No detectable difference in the household rank composition of blade producers exists between the Southwest and Northeast districts.



### The Middle Classic Phase (A.D. 400-A.D. 600)

Overall, 23% of the 66 Middle Classic households sampled were involved in blade production. By sub-chiefdom precinct, the percentage of households involved in blade production is

El Incienso - 15%	San Carlos - 21%
Santa Rosita - 55%	Mixco - 8%
Caterina Pinula - 25%	

For the first time the Santa Rosita sub-chiefdom, which is believed to control the El Chayal obsidian quarries, has achieved a partial monopoly on the obsidian industry--dominating both its mining and its manufacture. The San Carlos lineage, which has consistently possessed a manufacturing focus in all previous phases, now exhibits only an average complement of blade producing households. The obsidian workers' barrio of San Carlos Moiety B has disappeared, and along with it the Moiety B ceremonial complex.

A new obsidian workers' barrio emerges in the Santa Rosita precinct. For all other precincts, including San Carlos, there is no noteworthy difference in the distribution of blade producing households by moiety sector. But in Santa Rosita 71% of all households in the Moiety A sector are engaged in blade production, compared with only 25% in the Moiety B sector.

On examination of the distribution of blade production along social class lines, one finds that 87% of blade producing households are elite (40% and 47% paramount and secondary elite respectively), and only 13% are those of low ranked commoners. The very modest tendency towards transforming blade production into a cottage industry, first glimpsed in the Late Terminal Formative, is effectively reversed--the association of obsidian working with elite residence is almost as pervasive as it was in the Early Terminal Formative. This holds true when broken down by district. Household rank composition of blade producers in the Northeast and Southwest districts is virtually identical (89% and 84% elite respectively).

### The Early Late Classic Phase (A.D. 600-A.D. 800)

Of the 113 Early Late Classic households sampled 18% were involved in blade production. By sub-chiefdom precinct, the percentage of households involved in blade production is:

El Incienso - 4%	San Carlos - 38%
Santa Rosita - 21%	Mixco - 15%
Caterina Pinula - 12%	

The preeminence of the Santa Rosita lineage with respect to blade production was short-lived, since we observe that San Carlos resumes its traditional importance during this phase. This time, however, no single moiety sector stands out as an obsidian workers' barrio. No variation in the percentage of blade producing households per moiety sector for any of the lineage precincts, including San Carlos, appears to be significant.

On examination of the distribution of blade production along social class

lines, one finds that 80% of blade producing households are elite (65% and 15% paramount and secondary elite respectively), while only 20% were non-elite (Rank IV commoners). As in the case of the Middle Classic, household rank composition of blade producers in the Northeast and Southwest districts is virtually identical.

#### The Late Late Classic Phase (A.D. 800-A.D. 1000)

For this phase, 20% of the 69 households sampled were involved in blade production. By sub-chieftdom precinct, the percentage of households involved in blade production is:

El Incienso - 30%	San Carlos - 13%
Santa Rosita - 11%	Mixco - 27%
Caterina Pinula - 15%	

All precincts exhibit average or below average obsidian working activity, suggesting that no single lineage precinct had a special industrial focus upon blade production. The El Chayal blade cores underwent a more or less equitable redistribution among the five lineage chiefs. This fact may suggest that the industrial focus of blade production may have shifted away from the site of Kaminaljuyu to some other center. The most promising candidate would be the site of Azacualpilla (24-22-010), located right in the heart of the El Chayal region. Ball court alignment (Brown 1973:440) and obsidian dates indicate that Azacualpilla was initially built during the Middle Classic. Yet obsidian dates also make it clear that fully half of the occupational time frame for the site falls within the late Late Classic and the early part of the early Post Classic (A.D. 800-A.D. 1100) (see Table 1). One implication of this would be that the power of the Kaminaljuyu chieftdom was on the decline, enabling dependent territories, such as that which Azacualpilla controlled, to assert their independence. Blade production for purposes of long distance trade may therefore have effectively bypassed Kaminaljuyu beginning in this phase.

A concomitant feature was the disappearance of virtually all monumental architecture from Kaminaljuyu, and the simultaneous construction of "moiety-scale" civic centers within the northern, northwestern and northeastern peripheral segments of the Kaminaljuyu's immediate sustaining area.

Perhaps most striking of all, is the observation that the distribution of blade production along class lines is altered significantly. For the first time since the Late Formative there is a breakdown in the tenacious association of blade production with elite status. Just as many blade producing households are now non-elite as are elite (50% and 50% respectively). This is an important symptom of the dislocations that marked the Kaminaljuyu chieftdom during this phase. By the end of the late Late Classic Kaminaljuyu, as a political, economic and religious center, ceases to exist. All that remains in the Early Post Classic is a population slightly larger than that of the Middle Formative, consisting of Rank II and Rank IV households.

## CONCLUSIONS

The sociology of blade production at Kaminaljuyu reveals that all structural components of Kaminaljuyu society, at one time or another, impinge upon the industry. District, lineage, moiety, and social class divisions have all proved to be determinants of the distribution of this industry among the inhabitants of the site. Similarly, the transformational sequence represented by the seven phase time frame within which the study was undertaken demonstrates that blade production as an industry is affected by overall systemic change affecting the Kaminaljuyu chiefdom.

Much of the sociology of blade production, and its change through time, should become understandable in the context of how the full economic subsystem operates. This is especially true concerning the policy underlying blade core redistribution. Towards this end, some progress has been made in the analysis of "exotica" craft industries, that supply the needs of the Rank I households as well as much of the sumptuous mortuary furnishings to be found in Kaminaljuyu tombs. Preliminary findings would suggest that such industries were often responsible for heavy consumption of prismatic blades. This may imply that blade production within the site of Kaminaljuyu was intended almost exclusively for local consumption. And that, especially from Middle Classic times on, factory sites which produced blades for export remain to be found outside Kaminaljuyu, in the north-eastern dependent territories.

A chipping station that can serve as a model for this type of satellite factory site is located within the village of Las Animas, Jutiapa. The site is within quick walking distance of the slopes of obsidian rich Cerro Ixtepeque. I conducted a survey of the site in 1971 and discovered prodigious quantities of exhausted polyhedral cores and very fine prismatic blade detritus. Not a single large flake or large blade, nor a single unused blade core was to be found. Las Animas is in close proximity to the site of Papalhuapa, with its monumental architecture. Las Animas is probably only one of a number of blade producing hamlets that are administered by Papalhuapa in connection with long distance trade of obsidian blades into the Peten.

The Papalhuapa-Las Animas model may apply to the El Chayal region during the Classic Period. Quarry-centered sites, such as El Chayal (25-00-249) extract the obsidian and manufacture blade cores. Blade cores intended to supply the needs of long distance trade are routed to blade producing hamlets located in the vicinity of Azacualpilla (24-22-010). The finished prismatic blades are then brought to Azacualpilla for eventual shipment. At the same time Azacualpilla directs a portion of blade cores to Kaminaljuyu as tribute. The Santa Rosita sub-chiefdom is the direct recipient, and it, in turn, redistributes the blade cores by some formula among the lineage chiefs. They, in turn, distribute them among elite households where they finally undergo reduction. An in-depth study of this hypothesis is currently being undertaken by Luis Hurtado de Mendoza as part of his doctoral research.

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## ARTI-FACT OR FICTION?: THE LITHIC OBJECTS

FROM RICHMOND HILL, BELIZE

Arlene V. Miller

## INTRODUCTION

The site of Richmond Hill is located in a bajo or seasonal swamp in the Orange Walk District of northern Belize. In an area dominated archaeologically by Classic Maya debris, not a single Maya-like implement was recorded at Richmond Hill, nor were there any evidences of ceramic sherds. The lithic objects recovered were thick in cross section, often with oblique edge angles. The problem remains as to whether these lithic materials are artifacts or naturally formed geofacts. Assuming that Richmond Hill is in fact an archaeological site, one must then determine whether it represents a pre-ceramic occupation or if the artifacts constitute a phase of Classic Maya lithic technology previously unrecognized by archaeologists.

The goal of this paper is to answer the following question: can the lithic objects from the site of Richmond Hill, Belize be classified as artifacts of human manufacture and use, or were natural agents responsible for the flaking, striations and other observed modifications characterizing this collection? It is well known that certain lithic objects, undergoing natural geologic processes, can exhibit morphological features which closely resemble artifacts of human manufacture. The problem of determining whether a given stone object is truly an artifact or naturally formed has been discussed by many authors (e.g., Barnes 1939, Carter 1967, Harner 1956, Rose 1968) and several criteria have been utilized that aid in separating true artifacts from geofacts. These include (1) investigation of the cultural and/or geological context from which the stones were derived (Clark 1958:76; Heider 1960); (2) examination of related collections with a known cultural context for implements of similar morphology and lithic material (Rose 1968:240); (3) investigation of the mechanics involved in producing the type of fractures which created the morphology of the stones (Rose 1968:243; Clark 1958:76), and (4) determining if certain regularities in the patterns of flaking are the same as those which would be expected from flaking patterns found on artifacts (Carter 1967:4).

In the specific case of the lithic objects from Richmond Hill, evidence can be presented which supports both sides of this problem. The aim of this paper is to test the different explanations for the origin of the alterations found on the Richmond Hill lithic materials in order to propose the most likely explanation.

The features which lead one to believe that the samples may be geofacts include (1) a lack of technological complexity; (2) the wide spatial distribution of the cert over a 5 km area and (3) a lack of positively identified and associated cultural materials from the test pits, although this could be the result of limited site sampling.

The major factors supporting the hypothesis that the lithic materials are

artifacts include (1) the lack of evidence for a high energy environment in the vicinity, other than human force, that can account for the various types of fractures and striations found on the lithic objects; and (2) the patterns of breakage, polish and striations are similar to those often found on lithic artifacts and are not expected to appear on naturally fractured geofacts.

Three steps were taken in attempting to solve this problem. The first step was to reconstruct the past geological and weathering environments of the area. This step was directed at discovering evidence for and against a natural high energy environment, powerful enough to have produced the extreme flaking found on some samples of the collection. Fluvial action would have been the most likely of these processes, although heat fracturing causing spalling is another possibility. The second step was to describe and categorize the kinds of alterations observed on the lithic collection, and the third step was a statistical analysis to determine if patterns of the alterations might be similar to those patterns which could be expected to appear on artifacts of human manufacture and use.

#### SITE DESCRIPTION

The site of Richmond Hill occurs on a flat stretch of land which was, until 1972, completely covered by tropical forest vegetation. The chert deposits extend for at least five kilometers in diameter in a noncontinuous surface distribution (Puleston 1975:3). However, my concern here is with one small area which I will refer to as the site of Richmond Hill.

The site was first discovered by David Penn, an agronomist and pasture development officer for the Belizean government who was inspecting some newly cleared land late in 1972. He reported his find to Dr. Dennis Puleston who was working in the area on a survey of early Maya riverine agriculture. Puleston was able to examine the site in 1973. He paced out the site's boundaries, collected a surface sample, and excavated a one meter test pit. In August of 1974, he excavated another one meter test pit 25 cm north of the first.

Normally, spatial distribution should be an important factor in the consideration of whether a collection of lithics are truly human artifacts. In the case of Richmond Hill, however, it is possible that the original spatial orientation has been changed through time. The distribution of the lithic materials throughout the stratigraphic profile exhibits a pattern of small flakes and nodules at the top of the profile with larger ones below. This can be explained in terms of natural processes when considering the high shrink-swell capacity of clayey soils. During repeated wetting and drying throughout the tropical year, shrinking and swelling can cause an upward movement of solid materials, as has been shown in cases where fence posts have been pushed upward and out of line (Soil Survey Staff 1960:124). It is my opinion that the smaller materials such as chert flakes would, over a period of time, have been moved upward more rapidly than larger heavier stone materials. The larger stones from the test pits were from lower levels, and the same situation was true for a small post hole sample taken from the flat surface below the knoll. There-

fore, the present stratigraphy may not be directly reflective of the depositional history of this area.

#### GEOLOGIC BACKGROUND

A brief discussion of the deposition of the Richmond Hill lithic materials and the Pleistocene geology of northern Belize is necessary. This consideration will aid in explaining the possible natural forces that could have been the cause of the morphological modifications exhibited by the lithic objects.

During the Cretaceous period, deep layers of white limestone were deposited throughout the area of northern Belize. Much of the chert from this area formed within pockets in these limestone deposits (Flores 1952:408). During the Pleistocene, sea levels rose again in the area (Wright *et al.* 1959:24) and submerged almost the entire region. The possibility was explored that rivers flowing to the sea at this time could have transported chert nodules to the Richmond Hill area. In their publication called "Land in British Honduras", Wright *et al.* wrote that rivers draining from the southern highlands deposited a narrow strip of gravel and chert along the re-entrant bay immediately north of the Maya Mountains. However, this is still too far south to account for the occurrence of the chert in the Richmond Hill area. The only river mentioned by Wright as flowing from the northern area is the Rio Hondo which is described as "...a deep, rather sluggish river draining a limestone watershed. It has probably never carried much sediment" (*ibid.*:25). Therefore, it is unlikely that the Rio Hondo was the cause of chert deposition in the northern regions. This consequently excludes a potential source of fluvial action.

During later times faulting of the coastal shelf caused the uplifting of limestone ridges in the northern areas. These formed troughs which became areas of water collection creating seasonal swamps, and thick deposits of gray clays were accumulated (*ibid.*).

The possible origins of bajo sediments are discussed by Cowgill and Hutchinson (1963:38) in their work done at Bajo de Santa Fe in the Peten, Guatemala. After determining the chemical composition of the bajo clays and comparing them with residue from the limestone of the surrounding hills, they concluded that the residue from the eroding upland limestone slowly moved onto the valley floor creating the bajo clays. They also found chert nodules which were described as unsorted and unwaterworn (*ibid.*:38). These, they postulated, originated in the upland areas and eroded from the limestone when the first occupants arrived and cleared the forest cover, about 3000 B.P.

In keeping with the interpretation of Cowgill and Hutchinson, the Richmond Hill bajo chert could have been secondarily deposited after erosion from a limestone source on the uplands, and subsequent slow movement downhill along with other colluvium. This hypothesis is favored over that of fluvial deposition on the basis of (1) the lack of direct evidence for river action in the immediate area; (2) the widespread occurrence of

chert on the uplands similar to those in the bajo, which would not be expected if rivers were the cause of deposition; (3) the lack of significant water rounding on the lithic objects themselves and (4) their depositional situation within a colluvial soil matrix.

A possible explanation for the stratigraphic appearance of larger stones in the lower portions of the soil profile with the smaller stones near the surface is that the original deposition of chert occurred at a time corresponding to the lower levels of the test pit where the larger stones now occur. According to the model of Cowgill and Hutchinson it would follow that this would have occurred during the period when people were deforesting the upland areas. Deforestation would have enhanced erosion and the chert concretions would have been detached from their source and redeposited with other colluvium in the bajo area. Such easily obtainable chert would have been an attractive resource for flint workers. Following reforestation, intensive erosion would have ceased and a slower rate of colluvial accumulation would have prevailed. More recent colluvium would have eventually covered the deposits of chert leaving the larger ones, which move more slowly, nearest the bottom. This of course is speculative and many test situations must be devised before definite conclusions can be reached. These would involve finding the chert source on the uplands, discovering evidences of burning for deforestation at an early date and investigation of the capacity of the Richmond Hill bajo soils to selectively move objects upwards through the solum.

#### DESCRIPTION OF THE LITHIC COLLECTION

The lithic objects from Richmond Hill consist, for the most part of a translucent reddish brown to gray chert, and are in some cases fossiliferous. They range from about six grams to 900 grams in weight. Most of the stones are nodular in form and many have a thick cortex. The lithic material includes (1) nodules from which a series of flakes were removed; (2) stones from which all of the cortex was removed leaving flake scars over the entire surface; (3) a few primary flakes and (4) some secondary flakes. Sample specimens are shown in Figs. 1-3.

The collection was examined by Washington State University geologists Dr. A. John Watkinson, Dr. H. Len Vacher and Dr. W. Frank Scott. They reported that most of the nodules had probably not been moved far from their source by natural forces. The evidence for this was (1) their angularity of shape; (2) the thick cortex; (3) the appearance of surface fossil indentations and (4) the surface areas exhibiting tiny bubbles of chert which formed during solidification. Most of these features would have been altered during any substantial transport. Nevertheless some of the stones did have small areas of water smoothing.

Many of the stones have thick patination, and almost all of them exhibit a very high degree of external gloss on areas not covered by cortex. The cause of the gloss was investigated in order to discover clues the weathering environments which have affected the collection, and the possible relationship between such environments and the more pronounced



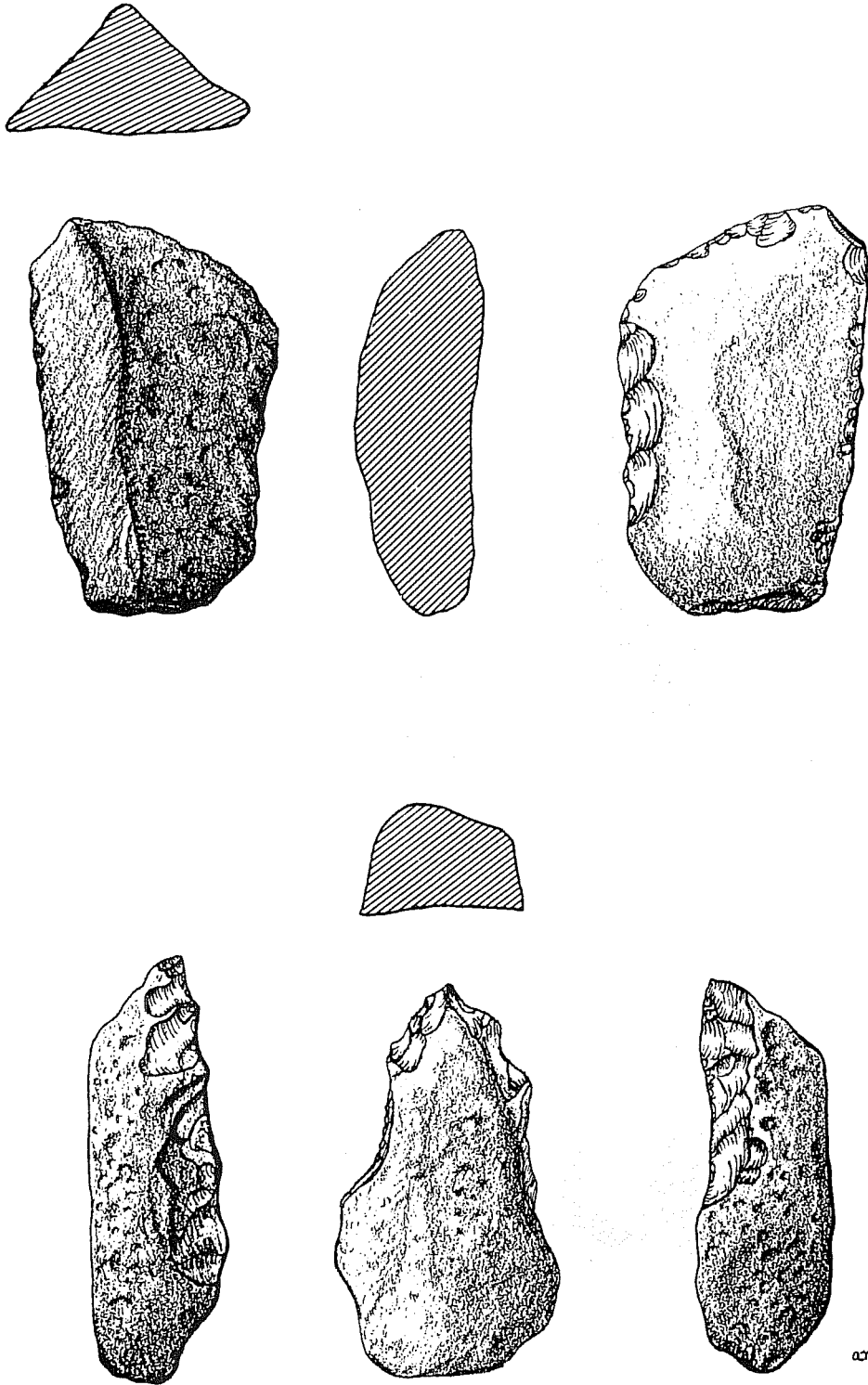


Figure 1. Possible stone artifacts from the site of Richmond Hill (Scale 1:1).

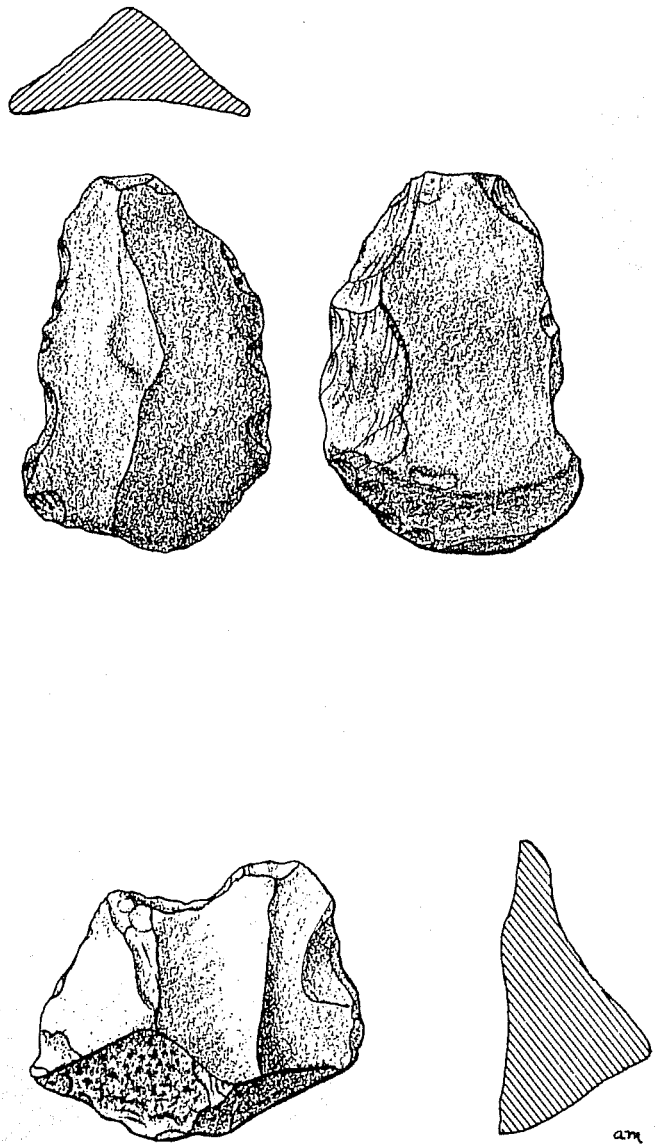


Figure 2. Possible stone artifacts from Richmond Hill. (Scale 1:1).

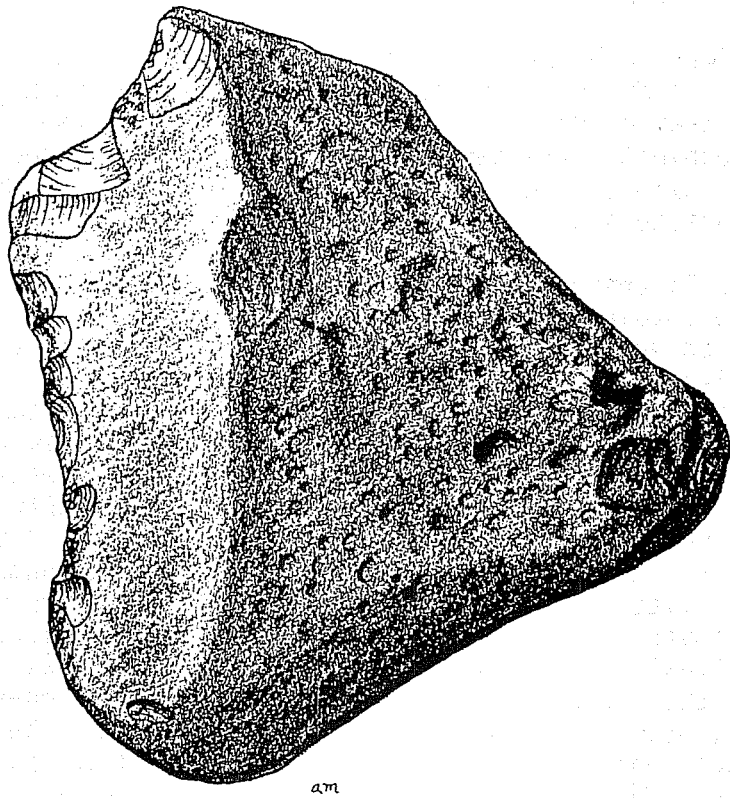
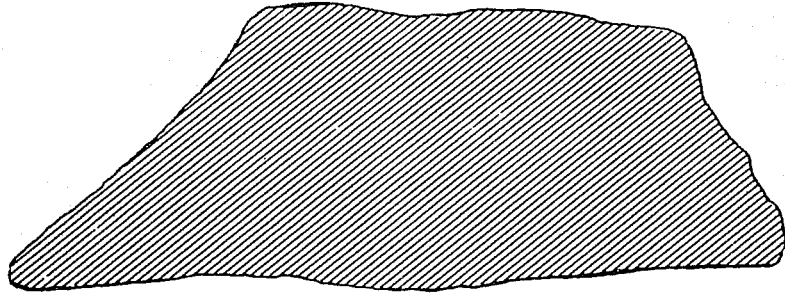


Figure 3. Possible stone artifact from Richmond Hill. (Scale 1:1).

modifications such as flaking.

This was accomplished with the aid of the scanning electron microscope (SEM). A series of photomicrographs were taken (6000x) of surfaces with gloss ranging in intensity from mildly vitreous to areas of heavily concentrated resinous gloss, or polish. In all cases the results were very much the same. Even at 6000x there were large areas of smooth surfaces intermixed with areas of rounded pitting (Miller 1975: Figs. 6 and 7).

The gloss was first believed to have been the result of extreme heating of the materials such as would happen during a forest fire. A macroscopic vitreousness was achieved on a sample of the same material through heat treatment. The external surface of the stones appeared unchanged in texture but much whiter in color. When flaked, however, the interior exhibited a high degree of vitrification. The opposite is true with the Richmond Hill lithic materials as the interior displays a coarse surface in contrast to the glossy exterior. This gloss also appears on small areas interspersed within the cortex which could not have resulted from flaked exposures.

The SEM photomicrographs of the interior portion of the heat treated materials show a flatter relief than the freshly flaked non-heated materials, but they do not have the large surfaces of smoothing that the natural gloss exhibits. Evidence will be discussed below which suggests these materials were in fact heated. However, this was probably not the cause of the surface gloss.

A review of the literature has revealed comparative samples from geological studies. These studies have investigated the different microscopic surface features found on quartz sand grains which had been subjected to various weathering environments. Since chert has some properties similar to those of quartz such as silica content and hardness, the comparisons are in part justified. Various authors have studied these features, but the work of Krinsley and Funnell (1965) is especially useful as it contains the results of a systematic study of the surfaces of quartz sand grains, utilizing SEM photomicrographs. Their results show that distinct surface patterns are related to different depositional and environmental conditions (e.g., glacial, littoral, aeolian, and diagenesis in which chemical etching predominates). Through the comparison of photomicrographs it was discovered that the chemical etching pattern alone has a striking resemblance to the surface texture of the Richmond Hill chert. According to the authors, quartz dissolves as silicic acid and may be redeposited as colloidal gel, opal, or crystalline quartz depending upon concentration, pH, temperature, and pressure. This causes a wavy etched pattern and a worn, low relief on the surface of the stones, appearing as a gloss macroscopically. Thus, it is probable that the vitreousness observed on the Richmond Hill samples is a result of the present situation within a seasonal swamp. Possibly, periodic water saturation causes the generation of silicic acid and etching, and upon dehydration there is a redeposition of siliceous materials causing the smoothing or gloss.

The occurrence of round spalls or potlids provides evidence suggesting that heating of these stone materials did take place at one time. It is interesting to note that the surfaces of the potlid cavities are all well glossed indicating that heating of the materials occurred before the glossing. This would tend to support the hypothesis of the burning of the upland forest and subsequent deposition of lithic materials within the bajo below. It is unknown whether the heating was caused by natural or human factors but it seems unreasonable that heat spalling alone could account for all of the kinds of alterations including striations, serial chipping, cores with long flake scars over the entire surface, etc.

### Analysis of Alterations

In order to better understand the causes contributing to the alteration of the Richmond Hill lithic assemblage, a statistical study was conducted to determine which, if any, characteristics of these modifications interrelate with one another in a significantly patterned manner. It is the assumption here that certain patterns could not be expected to occur consistently in nature. This would provide further support for the hypothesis that at least some of the lithic objects were of human manufacture. There were 34 different characteristics noted for each damage unit (Miller 1975:24-28). A damage unit may be defined as a discrete area such as an edge, face, ridge, tip, etc., which has undergone stresses that have altered the original form of the stone at that location. A single stone may have from one to five such units. Only a few of these characteristics were found to be significantly related.

The basic assumption of this analysis was that alterations to the lithic objects would be in the form of clusters of characteristics which could be attributed to specific causes. For example, a given task, tool modification technique, or weathering environment would consistently leave specific groups of characteristics. If groups of these characteristics could be recognized in an assemblage, perhaps then, it would be possible to narrow down the types of activities which had caused these groups. Assuming that all members of the collection were exposed to equal weathering environments under natural conditions, the null hypothesis was that all characteristics of alteration occur on the samples with equal frequencies due to the uniform effect of environmental variables.

The sample consisted of 86 individual stones, and from this 224 damage units were recorded. Most of the statistical tests were run on the damage units considering them as single entities independent of the whole stone. Of the 34 characteristics tested, only those of polish, stria, and retouch were found to be significantly related. These were perhaps the most objectively defined categories of stone modification.

Chi-square tests were run to investigate the co-occurrence of specific characteristics. The test on the presence or absence of polish and striae on the 86 individual stones demonstrated their common occurrence at the .01 level of probability (Table 1). This relationship could indicate human use as the agency which modified the stones. Both polish and striations often occur together in tool use with concentrated pressure and small quartz grains which come between the working surface of the

stone and the object being processed (Semenov 1964:84; Wilmsen 1970:71).

Another statistical relationship which presents evidence against solely natural causes of alteration was the direction of the striae (parallel, perpendicular, multidirectional, etc., in relation to the nearest edge) and its occurrence on only one face as opposed to various faces (Table 2). Assuming that all faces of a given stone, under purely natural conditions, were equally subjected to stresses causing striations, one would expect the same frequencies of occurrence for the different directions as found on multisurfaces. This, however, is not the case with the Richmond Hill materials. A chi-square test run with the variables unidirectional or multidirectional, on one face or two faces, was significant at the .02 level of probability indicating a non-random relationship with unidirectional striations more common on one face rather than on multiple faces. This could also be indicative of human use (Tringham *et al.* 1974:188-189, 192).

When striae and retouch were found together in association on one damage unit, the retouch was most often on the lateral surface with the striations most often on the ventral face. This is also a common situation on lithic implements since retouching may be used to dull the lateral surface so that the tool can be easily held when using a portion of the ventral face as the working surface (Semenov 1964:64; Wilmsen 1970:70). A chi-square test considering all locations of striae and all locations of retouch resulted in a .05 level of significance for this correlation (Table 3). The number of damage units which have both striae and retouch was only 17, and therefore may not be a reliable sample, nevertheless the results do merit cautious speculation.

When the retouch was located on the lateral surface, the striations were found to be mostly oriented toward the damage units in multidirectional and perpendicular directions. This correlation was significant with a .005 level of probability when tested using chi-square (Table 4). Striations perpendicular to the edge indicate a single direction of movement as might be expected on end scrapers, or for an adzing activity (Wilmsen 1970:74). Multidirectional striations are often found on scraping tools (Semenov 1964:83).

These tests, although somewhat limited and unsupported by replicative experiments, serve to question the null hypothesis that damage characteristics are equally distributed on these lithic objects and therefore lend support to the belief that some of the Richmond Hill samples are, in fact, artifacts.

		POLISH		Row Total
		+	-	
Stria	+	29	5	34
	-	30	22	54
Column Total		59	27	86

Chi-Square = 7.279 with 1 degree of freedom. Probability = .01  
 +, presence  
 -, absence

Table 1. Chi-square table correlating the presence of polish with the presence of striae on all of the individual stones (Miller 1975).

		STRIA DIRECTION		Row Total
		unidirec- tional	multidirec- tional	
STRIA LOCATION	On One Face	11	6	17
	On Two Faces	2	9	11
Column Total		13	15	28

Chi-Square = 5.425 with 1 degree of freedom. Probability = .02

Table 2. Chi-square table correlating the direction of striae with location for all individual stones possessing stria (Miller 1975).

	ventral	dorsal	ventral and dorsal	one face	two faces	lateral	ROW TOTAL
on ventral	0	0	2	0	0	5	7
on dorsal	0	0	0	0	0	1	1
on lateral	0	0	0	1	1	0	2
on face	0	0	1	0	1	1	3
on flake scar	0	0	1	0	0	0	1
on lateral	1	0	0	0	0	1	2
presence suspected	0	1	0	0	0	0	1
COLUMN TOTAL	1	1	4	1	2	8	17

STRIA LOCATION

Chi-Square = 43.66360 with 30 degrees of freedom. Probability = .05

Table 3. Chi-square table correlating the location of retouch with the location of striae as they occur together on individual stones (Miller 1975).



RETOUCH LOCATION

STRIA DIRECTION	RETOUCH LOCATION							ROW TOTAL
	ventral	dorsal	ventral and dorsal	one face	two faces	lateral		
diagonal	0	0	0	0	1	1	2	
parallel	0	0	0	1	0	0	1	
perpendicular	0	0	2	0	0	3	5	
multidirectional	0	0	0	0	1	3	4	
wrinkling	0	0	1	0	0	1	2	
presence suspected	0	1	0	0	0	0	1	
perpendicular and diagonal	1	0	0	0	0	0	1	
perpendicular and parallel	0	0	1	0	0	0	1	
COLUMN TOTAL	1	1	4	1	2	8	17	

Chi-Square = 60.88107 with 35 degrees of freedom. Probability = .005  
 Table 4. Chi-square table correlating the location of retouch with the direction of striae relative to an individual edge (Miller 1975).

STRIA DIRECTION

## CONCLUSION

It has been the aim of this paper to determine whether the formal alterations exhibited by the Richmond Hill lithic objects were caused by human manufacture and use as implements. It is argued here that the data presented supports this possibility.

Fluvial action as a cause of damage was rejected as there is no evidence for sediment-carrying rivers in this area from Pliocene to recent times. Also, there are few macroscopic properties indicating water transport over long distances. In addition, microscopic examination of the glossy surface texture on the stones did not show the type of scarring expected to occur in a fluvial environment. Heat spalling, although present, was rejected as a major cause of alteration since it could not account for all varieties of modification, and in particular striations.

Stratigraphic and depositional positioning should be an important factor in determining human presence archaeologically. However, it was demonstrated here by a discussion of the stratigraphy and soil matrix that the original deposition may have been disturbed by the seasonal expanding and contracting of clayey soils. It was suggested that these processes were probably also responsible for creating the knolls found at the site.

Characteristics of the damage features on the stones were noted, and chi-square tests were run to determine if these characteristics related to one another in a patterned manner which would be similar to common patterns found on lithic artifacts. Of all 34 characteristics only those of polish, striae, and retouch were found to be significantly related. These are probably the most distinct and objective of all the categories.

The above investigations have led to the following interpretation of the depositional history and alterations of the lithic objects of Richmond Hill: the lithic materials originally formed as chert deposits within limestone, near the area of the present site, sometime before the Pliocene. During the Pleistocene, coastal faulting caused the uplifting of the chert bearing limestone creating depressions and seasonal swamps below. The natural forest cover on the uplands kept erosion to a minimum. When the first human populations arrived, the forest was burned to create agricultural land. This resulted in the heat spalling of the lithic materials which were situated close to the surface. Continuous clearing of the upland forest would have caused rapid erosion of the normally thin soil under the heavy tropical rains. Erosion of soil, and the naturally soft limestone beneath it, would have freed the chert from its parent rock and allowed it to wash down the slopes along with other colluvium to the bajo below.

This concentration of easily attainable fine grained lithic material would have attracted flint workers to the bajo areas in order to manufacture and use implements from this material. Perhaps the implements were used in the harvesting of some other bajo resources as well.

At least two explanations are possible for the lithic depositional sequence in which the large stones are located deep within the profile, and the small stones are near the surface. First, all of the stones were initially deposited together after erosion from the same general source. After reforestation of the uplands, colluvial deposits consisted of only clay sediments which built up over the original level. Over time, the shrink-swell action of the accumulated bajo clays moved the lithic materials upwards towards the surface with the smaller stones moving the fastest and consequently occupying the upper portions of the stratigraphic profile. A second explanation could be that since shifting agriculture on the uplands caused burning and deforestation in many different places, several different chert sources were exposed and washed down the slopes at different times. The lower profile then would correspond to a source of large nodules and the upper portion to a source of small nodules. Support for one of these explanations might be gained with the use of neutron activation analysis in an attempt to pinpoint the lithic material to one or several sources.

To test all of the above interpretations several steps should be taken. These include:

- 1) a search for primary chert sources on the upland areas
- 2) find evidence for early extensive burnings on the uplands
- 3) check the topography for evidence of rapid erosion at one point in time
- 4) survey for other sites on the uplands which relate to the Richmond Hill site in the bajo
- 5) examine the tiny chips of chert not previously recovered at the bajo site for evidence of detritus from implement manufacture
- 6) test the shrink-swell capacity of the bajo soil and its ability to move objects upwards in the profile.

In conclusion, it is probable that the Richmond Hill lithic objects were not naturally fractured, and may instead be either a feature of the Classic Maya lithic technology, or the remains of some of the earlier inhabitants of the tropical lowlands of Central America. Very little is known about early populations in this area and their relationship to other early inhabitants of Mesoamerica. Therefore, the Richmond Hill site needs to be further and systematically investigated.

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## AN OBSIDIAN WORKSHOP AT EL POZITO, NORTHERN BELIZE

Mary Neivens and David Libbey

## INTRODUCTION

In recent years in Mesoamerican archaeology there has been a growing concern with craft specialization, evidenced by such papers as those of Adams (1970), Becker (1973) and Millon (1970). In view of such concern we are providing this report of our discovery during the 1976 field season of an obsidian workshop at El Pozito, the first such workshop to be found in Belize.

El Pozito (Fig. 1) is a large ceremonial center (Bullard 1960:360) with a predominantly Late Classic component. The site is composed of two ceremonial precincts with several hundred surrounding house mounds. The 1976 field season was the third season of excavations. The primary goal in excavation of the site has been to determine the subsistence-settlement pattern with a view to incorporating it into the regional studies that are now being carried on in northern Belize (see Hammond 1973, 1974 and Siemens 1974). The program at El Pozito is being carried out in two major categories. The first is an extensive mapping of the man-made structures and topography in the area of the settlement that is connected to the ceremonial precincts. At present the areal extent covers nine square kilometers. The second is an excavation program that has concentrated on test pitting for a chronological sequence encompassing both the ceremonial areas and the house mounds as well as a search for activity areas. The principal findings of the first two seasons indicate that El Pozito was a large regional center during the Late Classic Period. Over 90% of the house mounds that were tested or surface collected were occupied during the Late Classic. The excavations of the 1976 season were concentrated on a randomly selected sample of domestic structures within several prominent plazuela groups to further our understanding of the population distribution. It was in one such randomly selected structure--a long, low mound forming part of a group to the northwest of the main ceremonial center--that the remains of an obsidian workshop were found (Fig. 2).

## EXCAVATION

The remains of the obsidian workshop were discovered in Level 2 of a two meter square test pit, between two parallel walls which may or may not have belonged to the same structure (Fig. 3). The top of the first wall lay along the south face of the pit on an axis of S75°E; the upper portion of its vertical face was plastered. The second wall uncovered along the north face of the excavation was also plastered on the upper portion of its vertical face. After the walls were exposed, the excavation was narrowed to the space confined by them. Between the walls, obsidian debitage began at 18 cm below the ground surface in the eastern half of the pit. A 1/16 inch mesh screen was set up for complete recovery. The debitage increased in density as the excavation continued, and it formed a distinct concentration at 50 cm below ground surface. Along the west face of the excavation marl blocks rested on the uneven sascab (a natural lime cement)

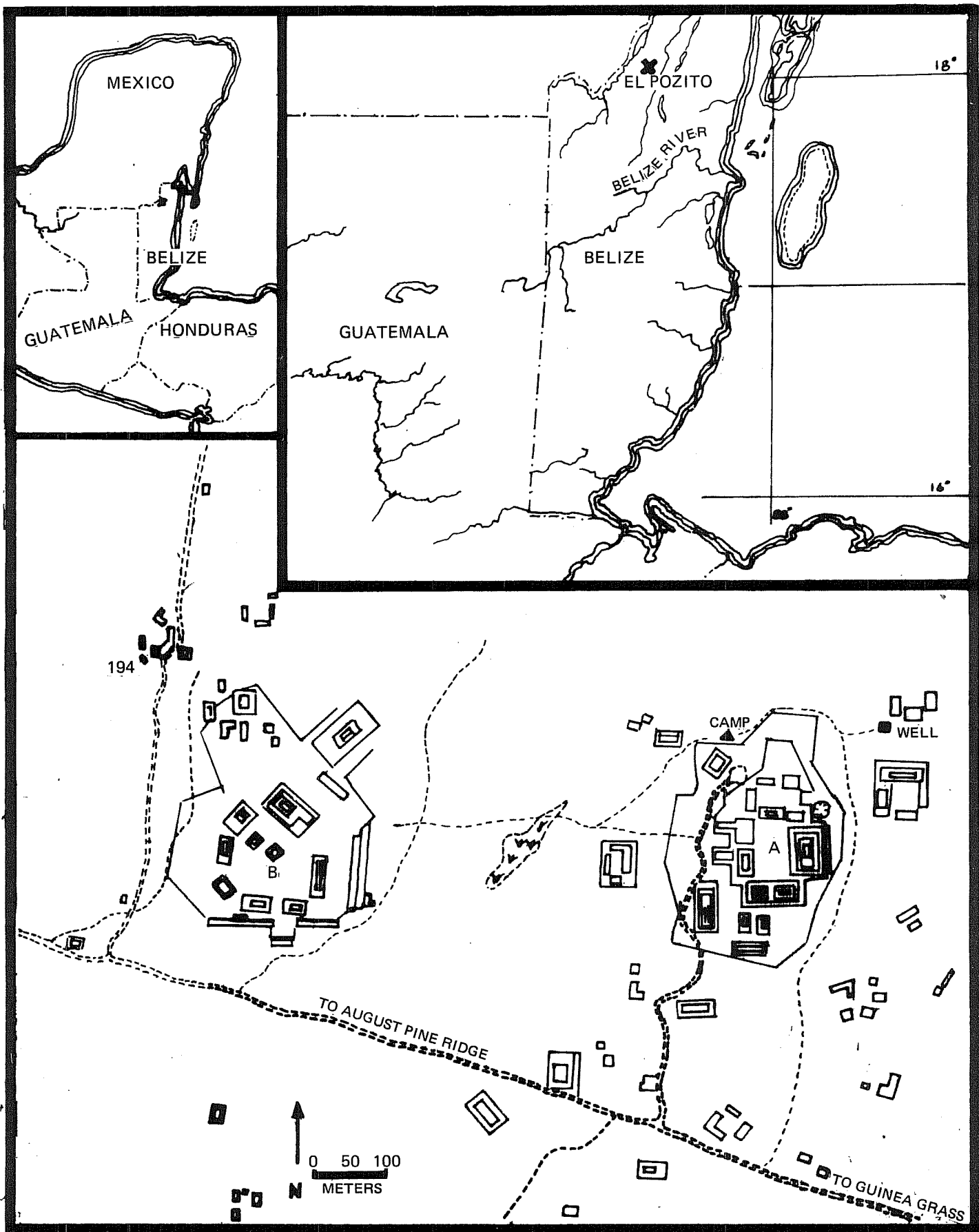


Figure 1. Sketch map showing the relationship of Mound 194 to the ceremonial precincts. Insets show location of El Pozito and Belize.



## EL POZITO PLAZUELA GROUP

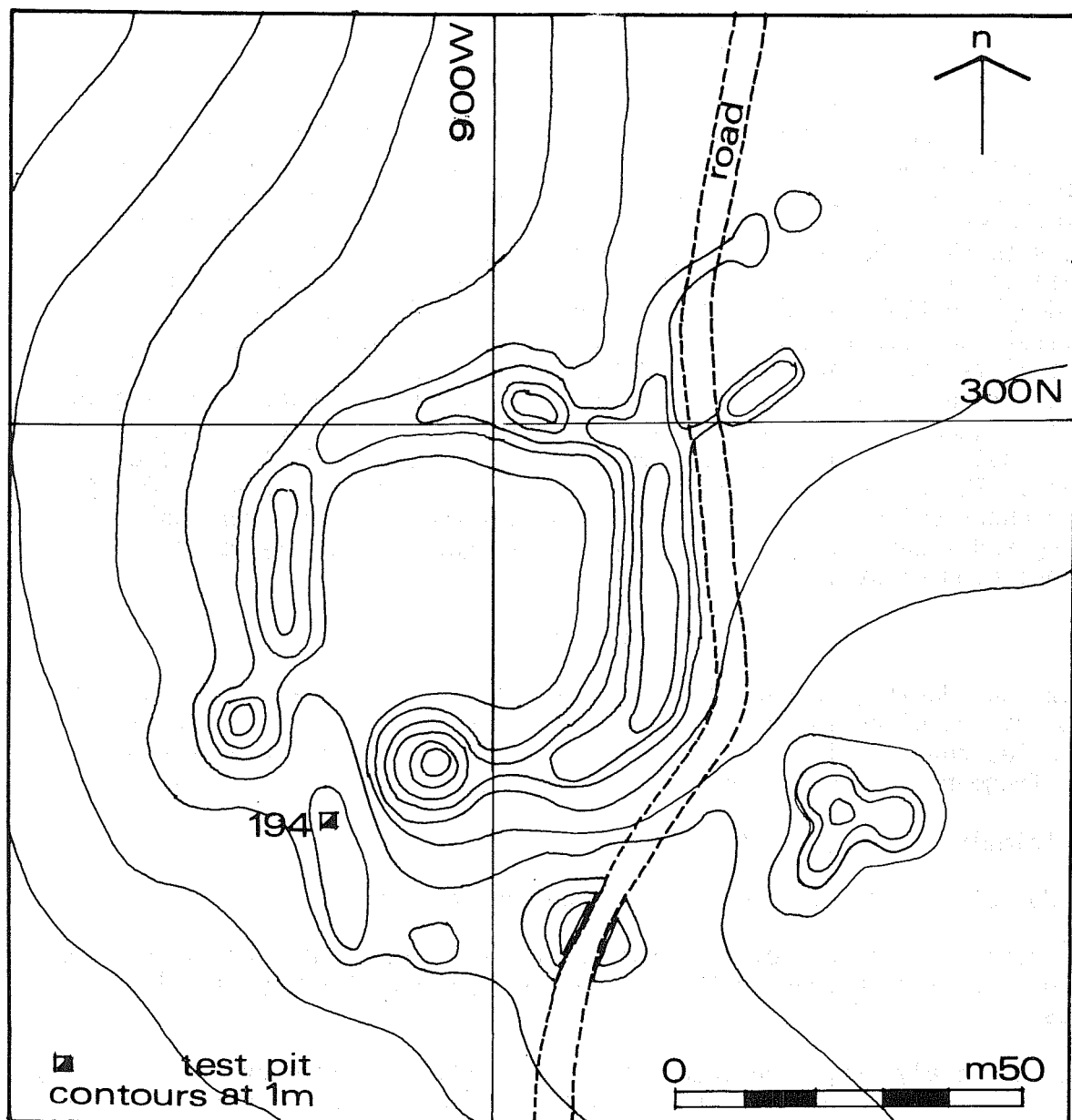


Figure 2. Topographic map of the plazuela group with the obsidian workshop.

surface of Level 3. The plaster on the sides of the walls terminated at Level 3. The packed sascab extended to Level 4 or the base of the two walls. The concentration of obsidian had begun to dwindle with Level 3, and in the upper portion of Level 4, a well-consolidated white marl, the last of the obsidian debitage occurred. Level 5, a dark organic layer, was the original ground surface, underlain by the limestone bedrock that is predominant in the area.

#### ASSOCIATED ARTIFACTS

With the obsidian debitage were found a chert chisel (Object 6), stone fragments (Objects 2, 4 and 5), a large pottery sherd (Object 3), and a deteriorated bone (not illustrated) which may have been a flaking tool, possibly a punch (Fig. 4). Object 1 (not illustrated), a fine grained polishing stone, was found very near the surface and not in direct association with the other tools. Object 2 is a portion of a metate found in two pieces with Object 3 sandwiched between them. The metate fragment is of a deeply pitted coarse-grained igneous rock. Deterioration made it impossible to determine any wear pattern on its surface. Between the two pieces of metate a large rim sherd (Object 3) from a polychrome round sided bowl was found. The edges of the sherd are smoothed. Object 4 is a granite metate fragment. It did not show the highly polished surface of Object 1 and 5. Object 5 is a fine grain volcanic stone with a highly polished surface. The center of the stone shows a concave honing surface. Object 6, the chert chisel, is similar to examples from Tikal that were used for cutting and shaping limestone or marl blocks (Hattula Moholy-Nagy, personal communication).

#### DEBITAGE ANALYSIS

In size the debitage ranges from 60 mm pieces to 3 mm flakes. A total of 12,082 pieces of obsidian was recovered in the excavation. The debitage categories consist of polyhedral core fragments, prismatic blades and blade fragments, retouched blades and flakes.

##### Core Trimming and Rejuvenation Flakes

No. of specimens: 180; 1.5% of the sample (Fig. 5)

These flakes resulted from the removal of protruding lumps and ridges from the core, a step in shaping the core prior to the continued removal of blades.

These relatively large and chunky flakes are characterized by well-developed bulbs of percussion on the ventral surface. On the dorsal surface, flake scar ridges extend along the long axis of the flake. On some of the examples these side ridges alternate from one side to the other as they move down the central axis (Fig. 5 a-c); some of these specimens may be crested, or ridge, blades.

The flakes range in size from 20 mm long by 7 mm wide by 4 mm thick (at the thickest point along the medial ridge and the ventral side) to 49 mm

## EL POZITO 194 EAST SECTION

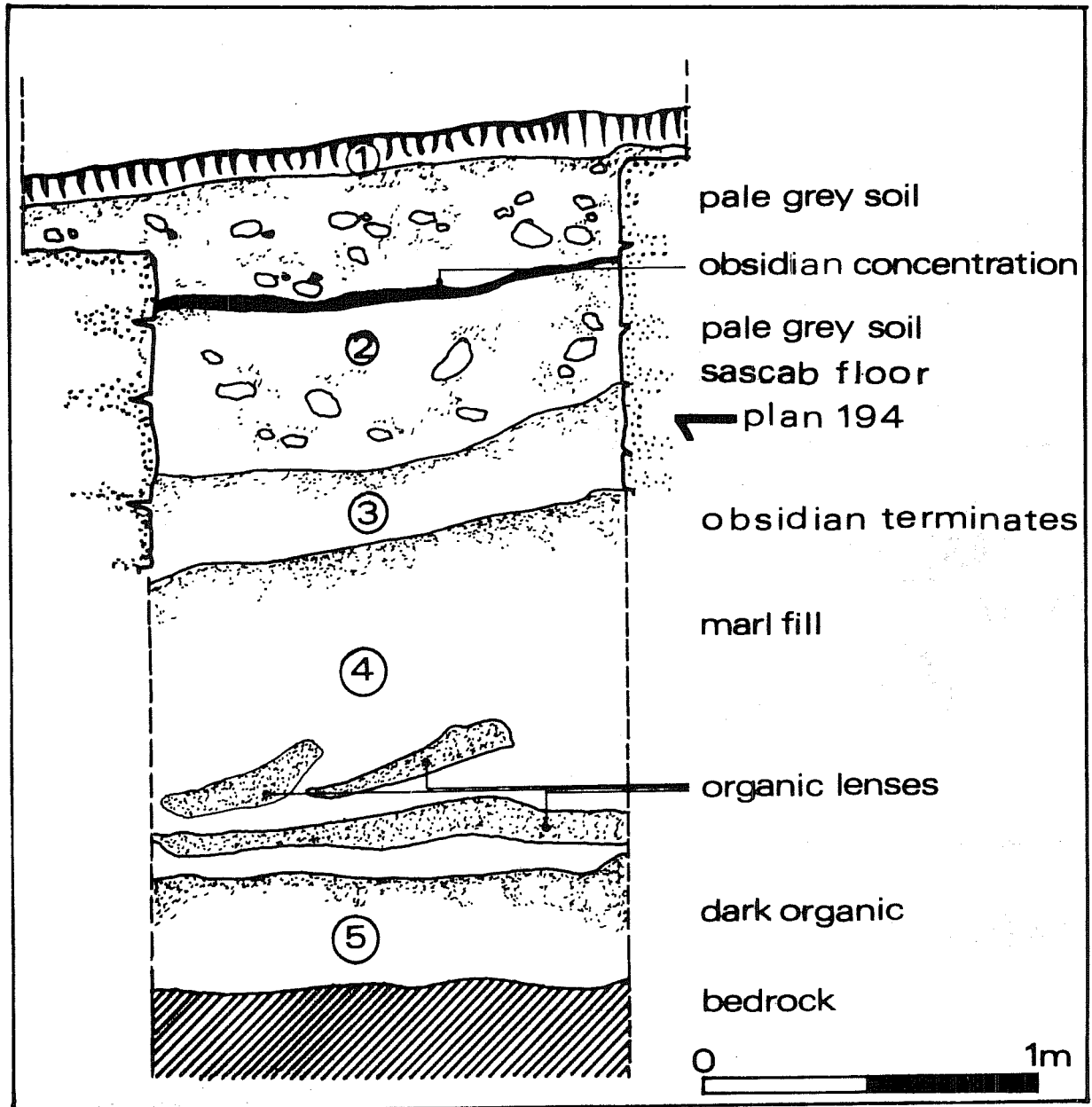
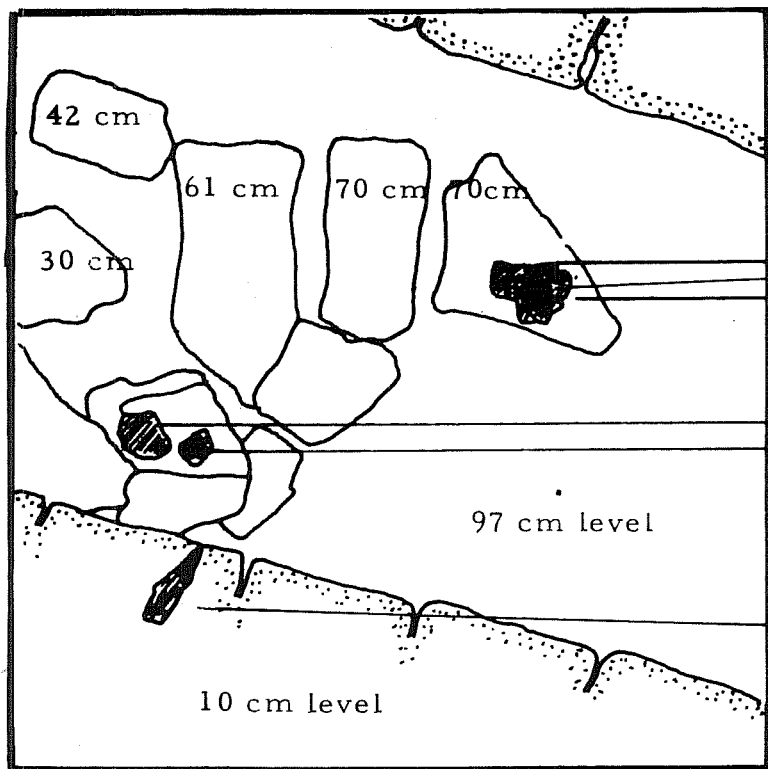


Figure 3. East section through test pit, Mound 194.

### EL POZITO 194 PLAN



- Stone Object 2
- Pottery Object 3
- Stone Object 4
- Honing stone Object 5
- Chisel Object 6

### MASONRY WALLS AND TOOLS

#### LEGEND



-  Marl Blocks
-  Tools



Figure 4. A plan of the obsidian workshop in Mound 194.

long by 29 mm wide by 7 mm thick.

Many of these flakes show crushing along the ridges, the result of percussion removal (Fig. 5 d). Eighty-four specimens show erailure flake scars (Fig. 5 b-c) on the ventral side of the bulb, another result of percussion removal. One hundred eleven examples have grinding along the dorsal ridge, evidence of wear during transport, or possibly use. One example is notched, with flake removal from the dorsal side.

#### Erailure Flakes

No. of specimens: 69; .6% of the sample (Fig. 6)

These flakes are apparently the remains of a bulbar scar (Crabtree 1972: 60). They seem to represent the residue that falls away from a percussion flake during its removal. Relatively small plano-convex flakes, they are generally circular to oval, tapering to a sharp edge around the circumference (Fig. 6 f-h). Some have the appearance of a contact lens. They are characterized by compression rings on the ventral (concave) surface. They range in size from 30 mm to 13 mm in diameter.

#### Core Fragments

No. of specimens: 24; .2% of the sample (Fig. 6)

Of these fragments 17 are proximal ends. Twelve of the proximal ends are side angle platform rejuvenation flakes. This rejuvenation is necessary when the core has become constricted or nearly exhausted (Crabtree 1968: 457; Hester, Jack, and Heizer 1971:76). For additional blade removal a larger platform must be made. In this technique, force is applied to the side of the core platform parallel with and about 2 or 3 mm below the surface of the platform perpendicular to the long axis. If one blow does not clear the platform, then two strokes, one from each side, would remove the old platform and with subsequent grinding and flattening a new platform for continued blade removal would emerge. Only two of the proximal core truncations show efficient clearing of the entire platform, yielding a core tablet (Fig. 6 b). The smallest was approximately 15 mm in diameter.

Five of the proximal fragments have striations across the edge of the platform for gripping the blade removal tool (in all cases the striations form a triangle with its apex at the ridge formed by the scars from two previous blade removals).

There are seven terminal ends of which two are recovery flakes with step fractures (Fig. 6 a); two were removed with blades; two have bulbs of percussion and so were probably removed purposely; and one is indeterminate.

#### Blade Fragments

No. of specimens: 11,815; 99% of the sample (Figs. 5 and 6)

Only three complete blades were recovered. In Fig. 6,c the dorsal view shows the nearly parallel ridges and the negative compression rings along

the scars from previous blade removals. The ventral view shows the concave-convex form of the blade. All three blades are similar in length and are "prismatic" with parallel edges and a medial ridge.

The blade fragments are relatively long and thin and broken sometimes with irregular sharp edges (Fig. 5 e-g). 5,162 are broken so that they lack bulbs and platforms. Those flakes with a platform have a poorly developed bulb and exhibit a triangular or trapezoidal cross section. A number of the platforms exhibit abrasion or dulling along the edge. 607 examples have fine grinding on the dorsal ridge. Some of these fragments may be the result of core modification rather than the production of an imperfect blade. The smallest of these flakes is 8 mm long by 16 mm wide and the largest is 60 mm long by 11 mm wide.

#### Strangulated (Notched) Blades

No. of specimens: 22; slightly less than .2% of the sample (Fig. 6)

These tools were all made on the bulbar end of blade fragments. The European term "strangulated" is applied here for the flaking occurs directly opposite on both margins making a constriction (Crabtree 1972:93). The technique of removing the flakes is characteristic of the tranchet blow whereby the "blow is struck obliquely to the marginal edge to remove a flake crosswise and at right angles to the main axis of the tool, leaving a sharp transverse edge" (Crabtree 1972:95). The notching is done from alternate sides (Fig. 6 d,e) with flakes removed from one margin on the dorsal side and from one margin of the ventral side. Twenty-one blades have this kind of alternate notching, while one example displays two pairs of notches on each side. One blade shows dorsal flaking on both margins on the same side. All of the notched blades have been broken off below the notches at the distal end. The smallest strangulated blade is 7 mm long by 10 mm wide (across the bulb). The largest one is 22 mm long by 10 mm wide.

#### Other Retouched Specimens

No. of specimens: 2; less than .1% of the sample

Of the two pieces showing retouch, one is a broken triangular blade with dorsal flaking retouch around the bulbar end. The other is a core rejuvenation flake with ventral flaking along one margin.

#### CERAMIC ANALYSIS

The levels of the test pit in which obsidian was found produced Late Classic sherds. A substantial portion of the monochromes are of the dark red slip (Munsell 7.5YR 4/8). The polychromes are also Late Classic characterized at El Pozito by a matte finish in red-and-black on orange. These polychromes occur in the simple silhouette dishes with and without a lateral ridge that compare to San Jose III (Thompson 1939:100). A large rim sherd reported in the excavation (Fig. 4, Object 3) manifests this polychrome treatment with the matte finish that is so abundant at

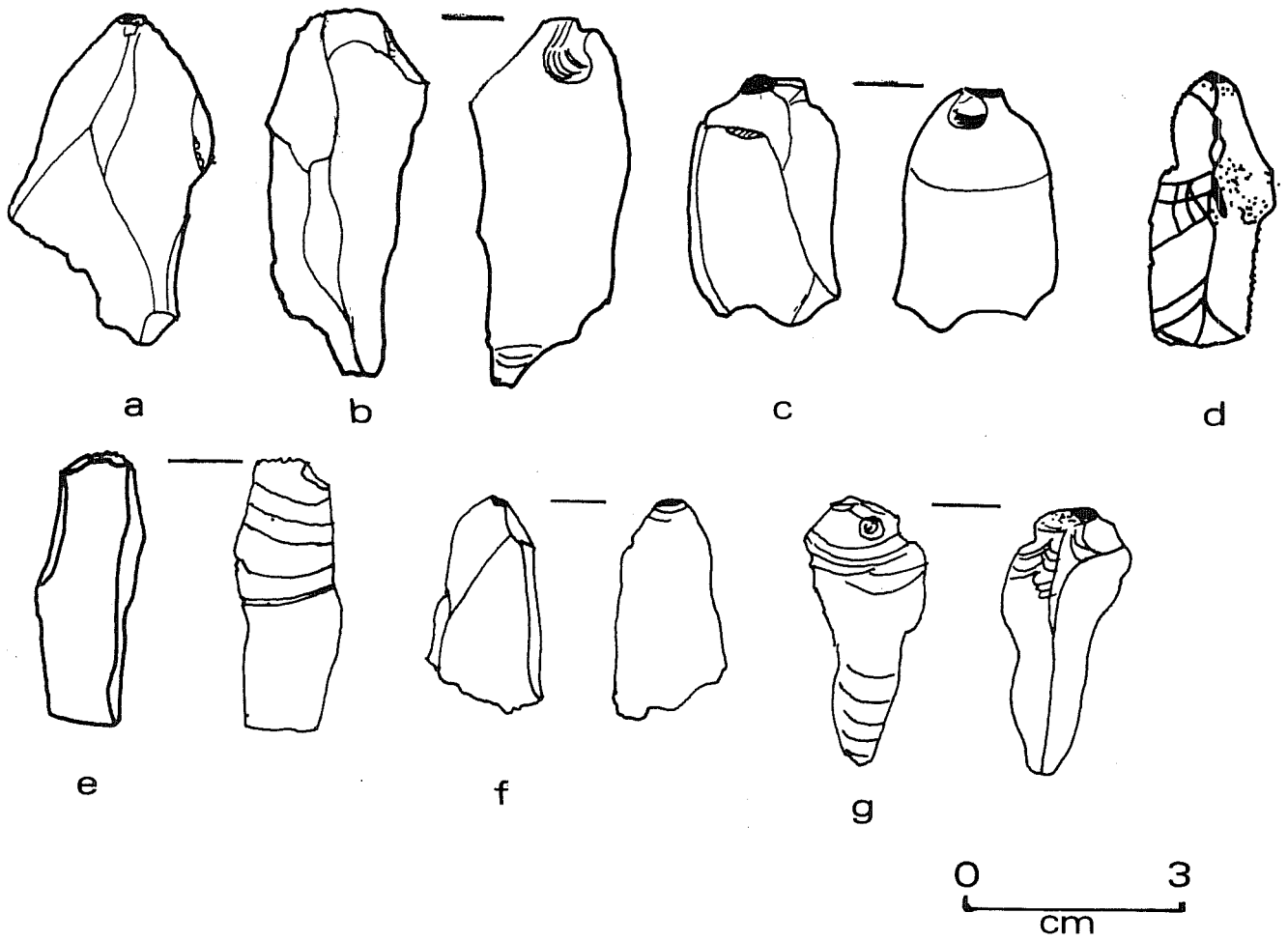


Figure 5. *Obsidian debitage from El Pozito.* a-d, core trimming and rejuvenation flakes; e-g, blade fragments.

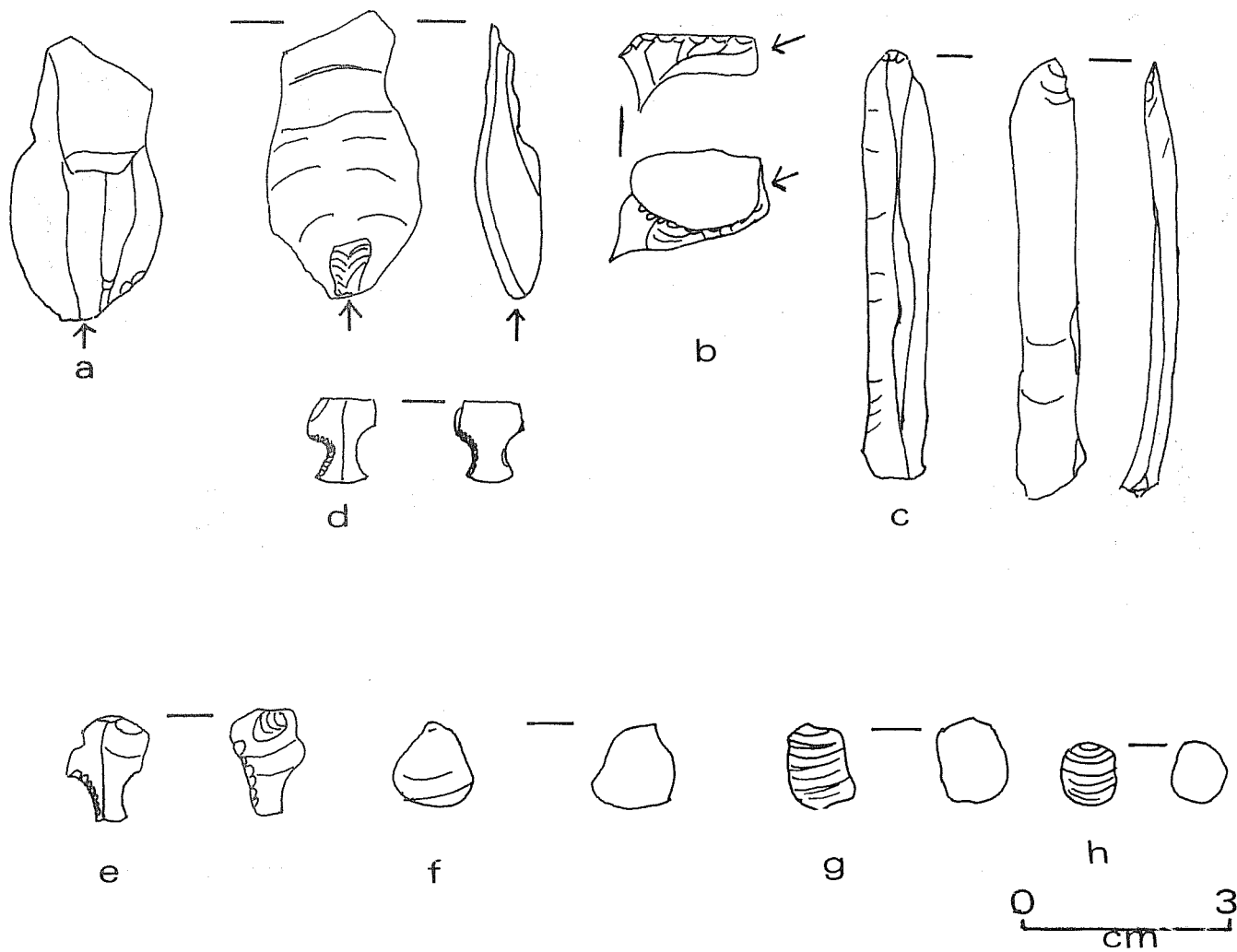


Figure 6. *Obsidian debitage from El Pozito.* a, Rejuvenation flake showing hinge fracture scar; b, core tablet; c, prismatic blade; d-e, strangulated blades; f-h, erailure flakes.



El Pozito. In this case the vessel was a large round-sided bowl with an eroded exterior design of geometric form. Another dish of the Late Classic is a shallow redware plate with slightly outflaring rim. In the unslipped ware, storage jars with outflaring rims and triangular bolsters were present. These compare to San Jose IV (Thompson 1939:126). Below the obsidian and the sascab floor, the sherds were mixed with examples from the Early and Late Classic and Late Preclassic Chicanel. Basal flanges and Early Classic polychromes were present.

### CONCLUSIONS

These writers envisage an obsidian workshop set up for rather limited production of obsidian blades. This workshop is situated between two walls and features low stone stools the knappers could sit on (more or less in the position of a cow-milking stance). From this position it would have been easy to lean forward and apply pressure to a chest crutch. The soft sascab floor is thus covered with debris from this operation.

An obsidian workshop is indicated by the presence of manufactured blades, blade fragments, and core and platform rejuvenation and trimming flakes. Ceramic analysis indicates that the workshop activity occurred during the Late Classic Period. The presence of small erailure flakes in nearly equal quantity (69 examples) to percussion flakes exhibiting erailure flake scars (84 examples) is strong evidence that the debitage was produced *in situ*. Most of the debitage consists of discarded blades that were not acceptable as tools. There is even a shortage of expended cores. (In a tomb excavated during 1975 over 40 expended cores had been used as grave goods.) Therefore any valuable blades, tools or expended cores were distributed with the results that residue on the workshop floor were for the most part unusable or undesirable pieces. The absence of cortex fragments and "large blades" from the beginning stages indicates the cores were preformed elsewhere and blades were struck off with subsequent core rejuvenation and modification.

Crabtree (1968) describes a method for striking off prismatic blades. The description is taken from his own experiences with making blades and compared to the recorded literature at the time of the Spanish Conquest. The knapper first places the preformed core within a vise which can be a simple A-frame of wood. The knapper then applies pressure with the chest crutch and the blades snap off the core. Although Crabtree finds a standing position more effective some of the accounts suggest that the knapper sits. Crabtree (1968:448) finds the sitting position impossible for himself but concedes that a seated position on a stone or immovable object would be advantageous. A look at Fig. 4 shows stones in a very good position for sitting and striking off blades. A hard plaster floor would tend to dull the delicate edges of the blades as they fly from the core. Several of the stone objects are smoothed as if used for honing. These could have been used for sharpening the tip of the chest crutch which would have been replaceable. Various woods of Belize, such as *lignum vitae* (*Guaiacum sanctum*) and iron wood (*Dialium guianense*), are ideal as a crutch tip being some of the hardest woods known. The stone objects would also be used for scratching or grinding the platforms (Crabtree 1968:

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 ones 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

We wish to thank Don Crabtree for his helpful comments and encouragement.

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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 summarizes 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.

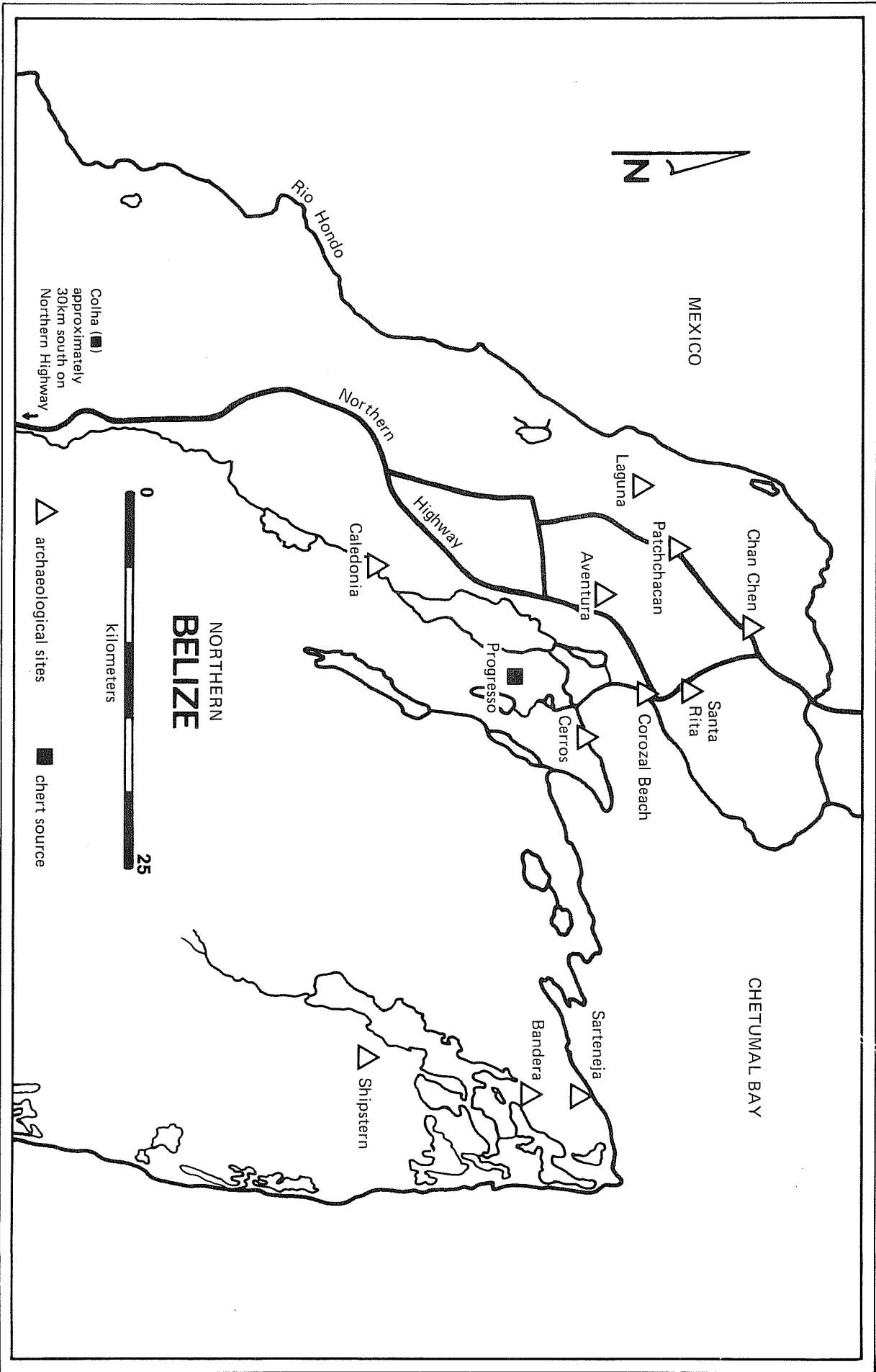
Each test pit at a site was numbered. Fig. 2 lists the test pit numbers and sites. Within every test pit, each stratigraphic layer is numbered consecutively. For example, the first layer of test pit four is Ex. 4-1, and the sixth layer in test pit 23 is numbered Ex. 23-6.

## 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
Patchacan	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.*



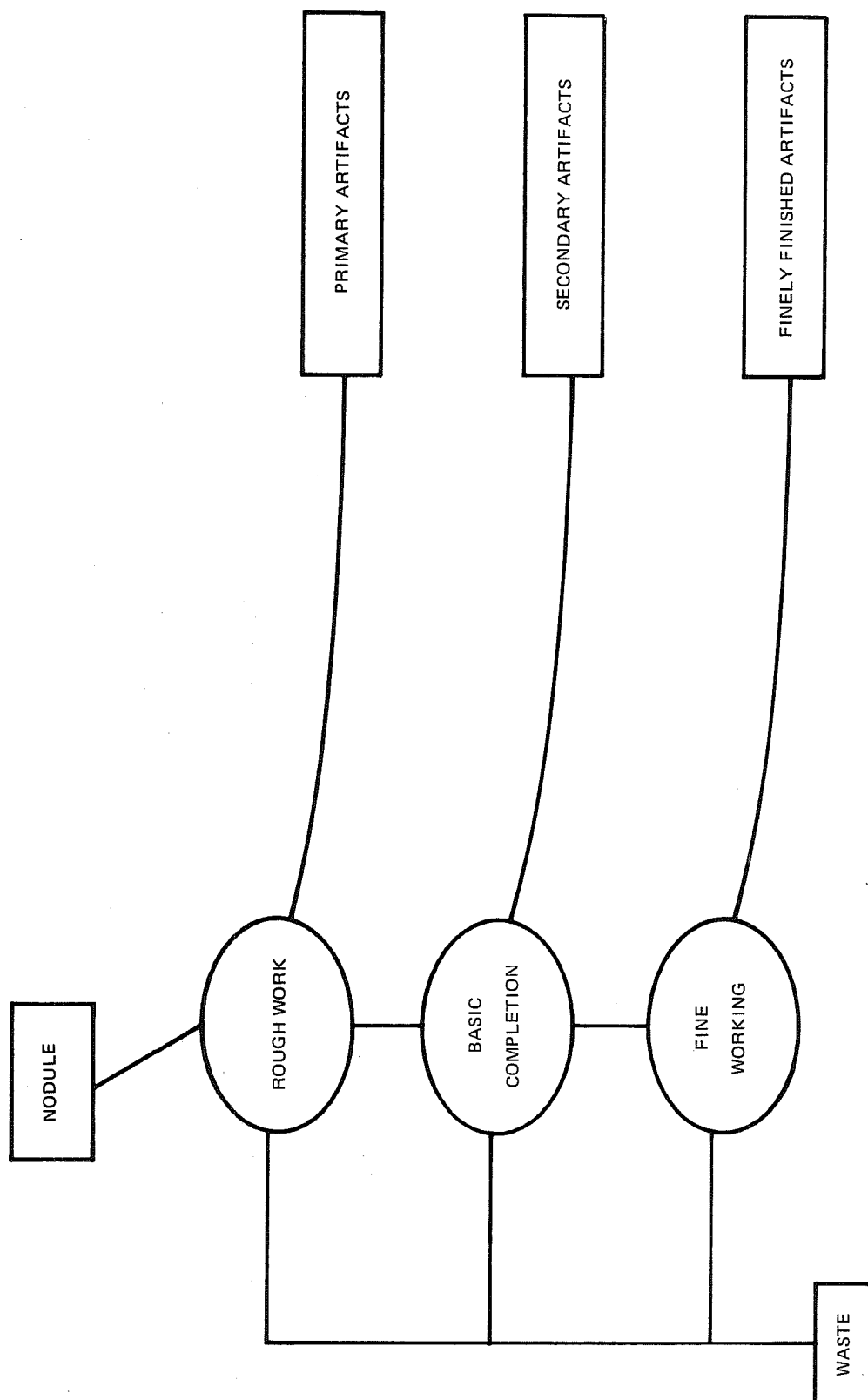


Figure 4. Diagram showing the relationships between three major stages of chert tool manufacture and their products.

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	-	-
Tool blanks	1	206	1	0
Residual waste	703	9,741	-	-
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	6	4
Knife or scraper fragments*	19	566	-	-
Large, stemmed points	2	104	1	1
Prismatic blades	24	189	12	12
Burin spalls	2	3	2	0
Ceremonial implements	12	529	4	8
Pressure-made waste flakes	698	1,699	-	-
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 Meso-american 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.

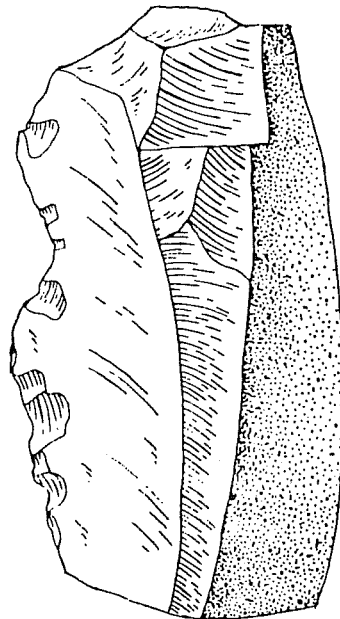
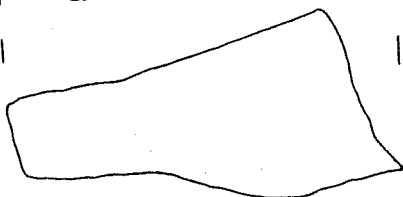
## Crude, Bifacial Scrapers

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

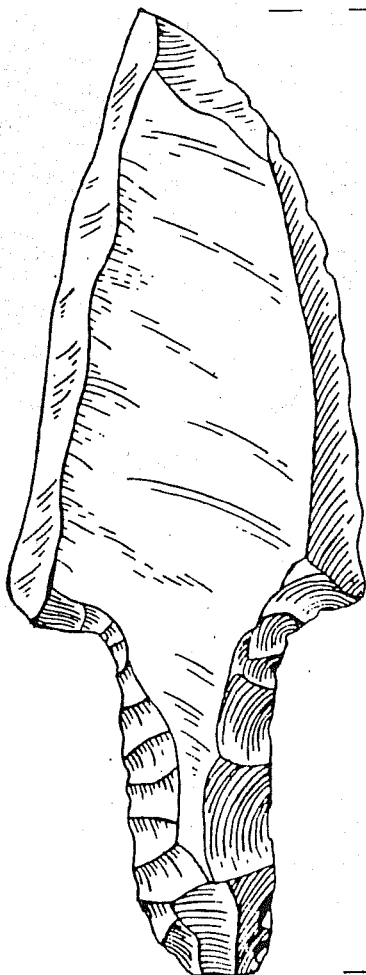
Figure 6. *Tool Blank and Macroblades.* a, Tool Blank from Ex. 9-1 (Patchchacan); b, Macroblade from Ex. 27-1 (Str. F-2, Chan Chen); c, Large, Stemmed Point made from a Macroblade, stem is bifacially worked, from Ex. 27-1 (Chan Chen); d, Macroblade from Ex. 27-1.



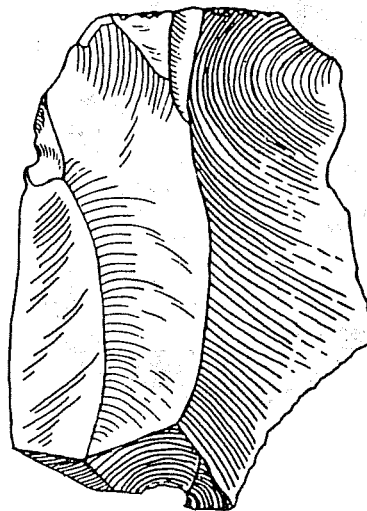
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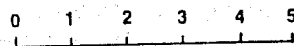
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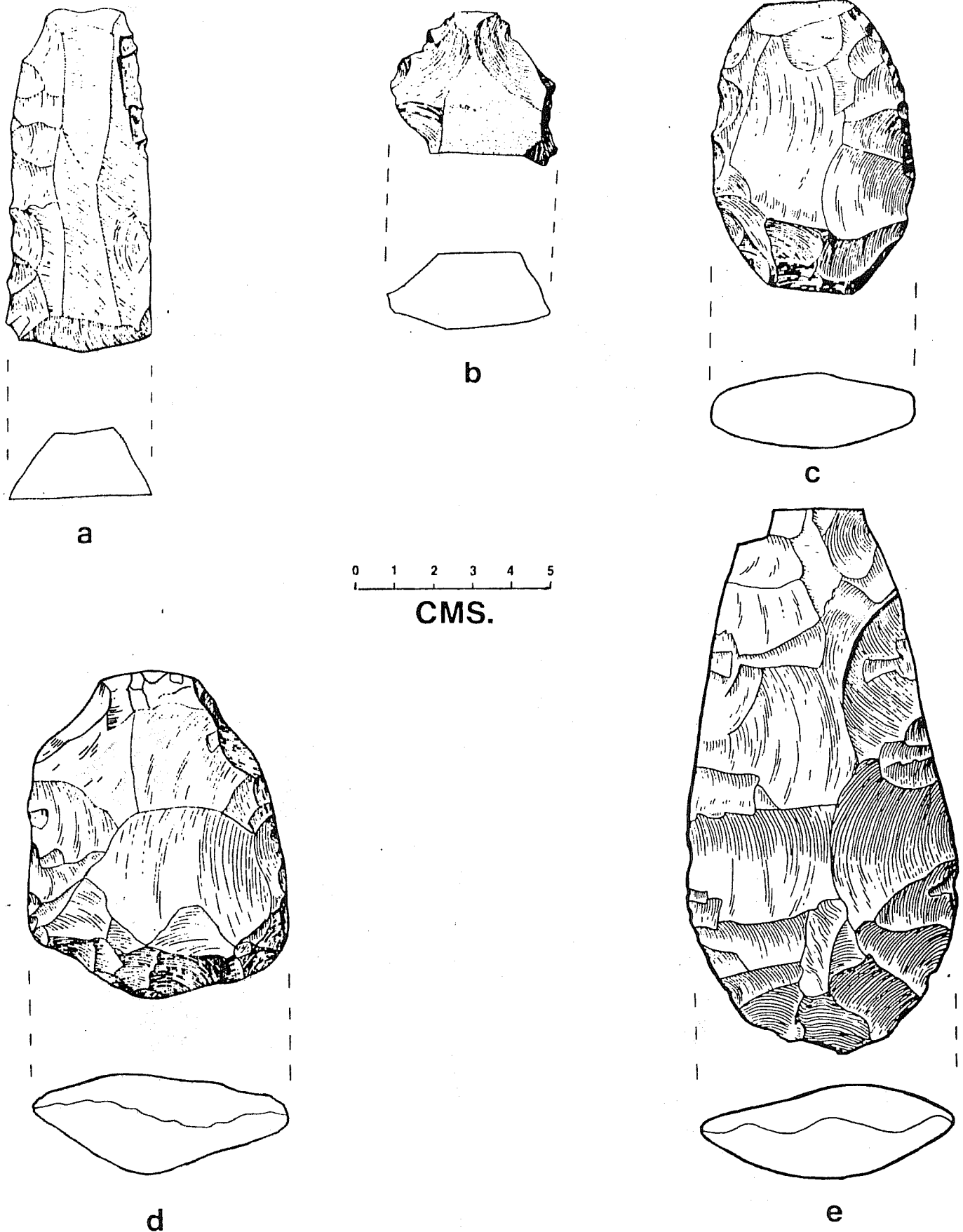


Figure 7. *Scrapers and Chopper.* a, Unifacial Scraper made from a Macroblade; surface collection, Cerros Beach; b, Unifacial Scraper, Ex. 1-1 (Aventura); c, Fine, Bifacial Scraper from Ex. 1-1; d, Fine, Bifacial Scraper from CM-S, a surface collection at Aventura; e, Chopper from Ex. 27-1 (Str. F-2,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



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-

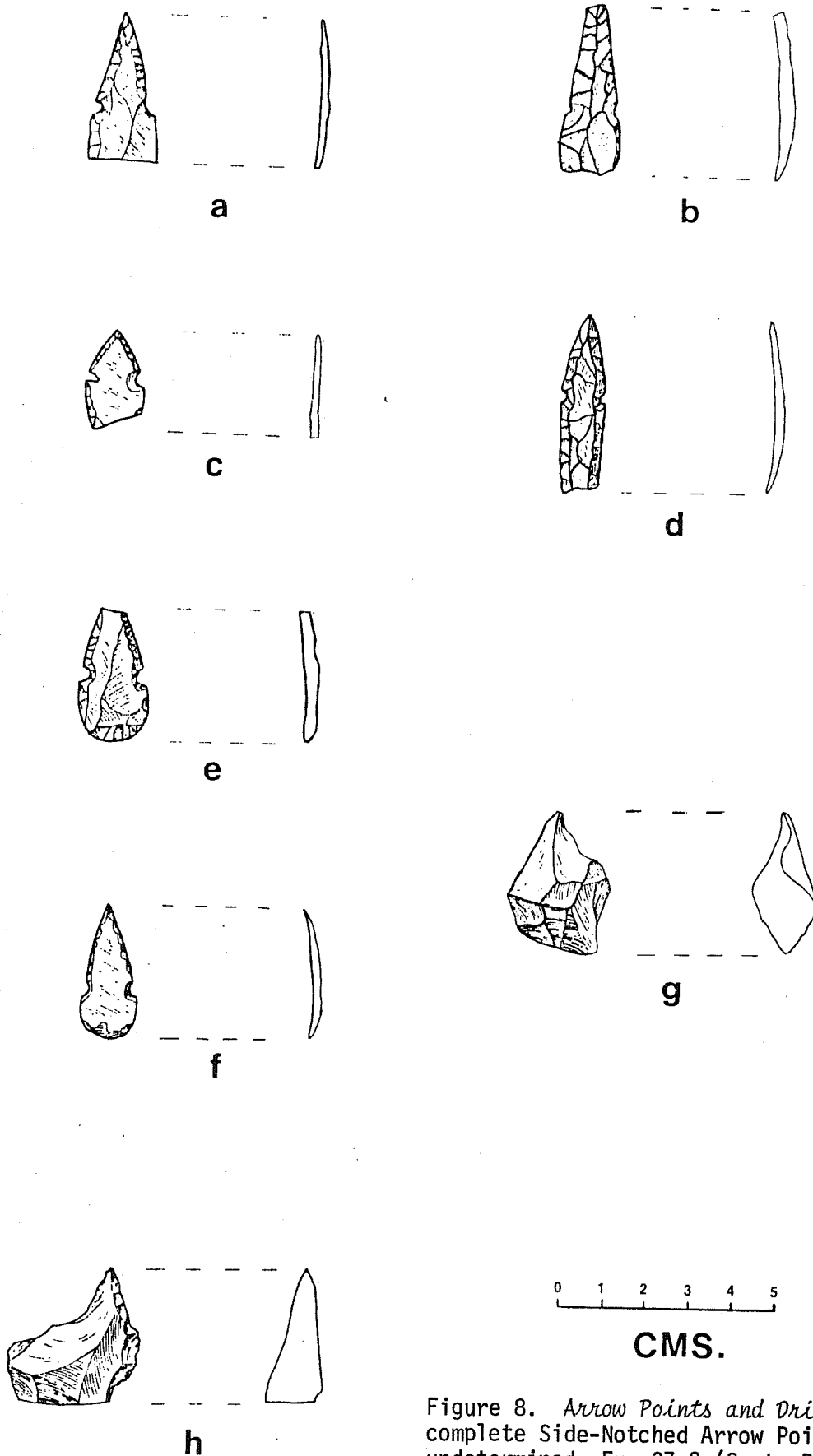
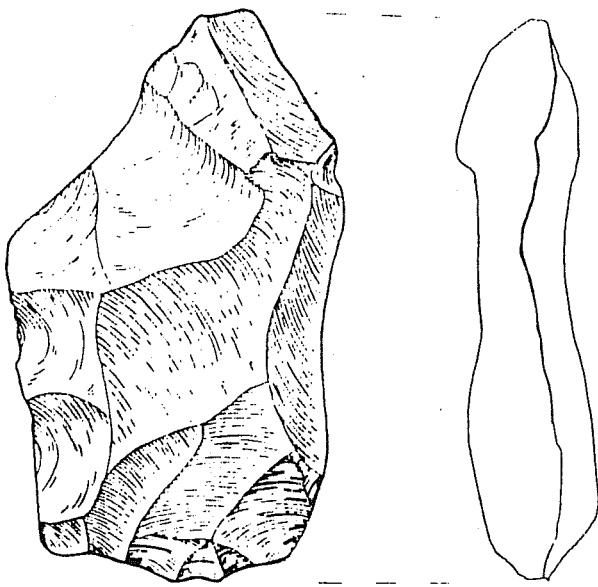
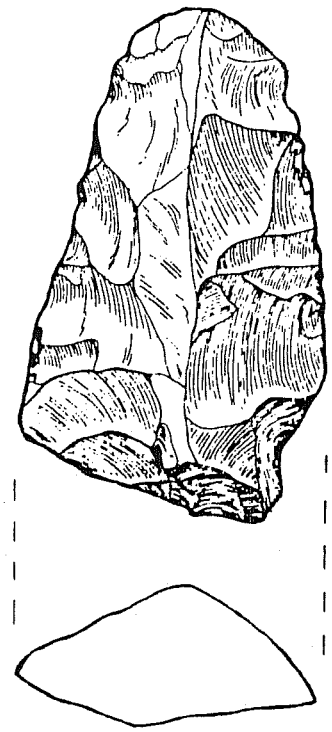


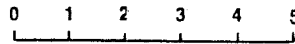
Figure 8. *Arrow Points and Drills.* a, Nearly complete Side-Notched Arrow Point, base from undetermined, Ex. 37-2 (Santa Rita); b, Side-Notched, Straight Base Arrow Point, surface collection, Corozal Beach; c, Nearly complete Side-Notched Arrow Point, base form undetermined, Ex. 37-2; d, Side-Notched,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



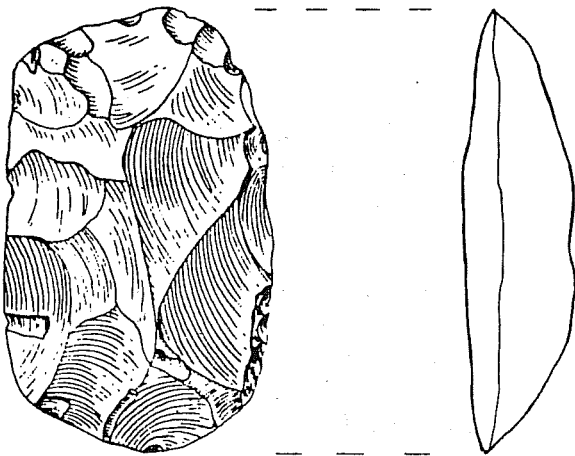
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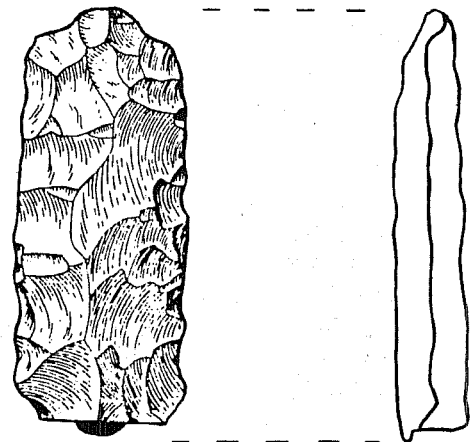
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Figure 9. *Knives*. a, Unifacial Knife from the Cerros Beach surface collection; b, Fine, Bifacial Knife fragment with rounded tip, Ex. 1-1; c, Fine, Bifacial Knife from Ex. 9-1 (Patchchacan); d, This Fine, Bifacial Knife fragment was recovered from 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

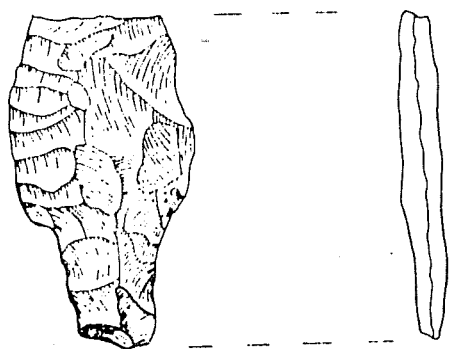
The high quality of chipping on ceremonial implements corresponds to the high status the artifacts had in ancient Maya society. The ceremonial implements are the most evenly chipped and most consistently pressure-flaked artifacts in the collection. One incomplete and four complete specimens were recovered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

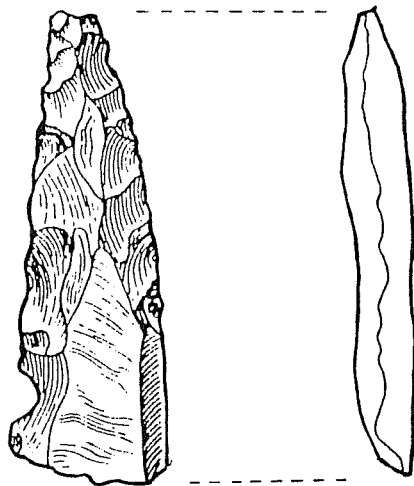
One complete laurel leaf blade (Fig. 11 d) was recovered during the excavation of Ex. 10-1, a Postclassic ceremonial deposit at Patchchacan (11.7 x 3.6 x 1.2).

### Prismatic Blades

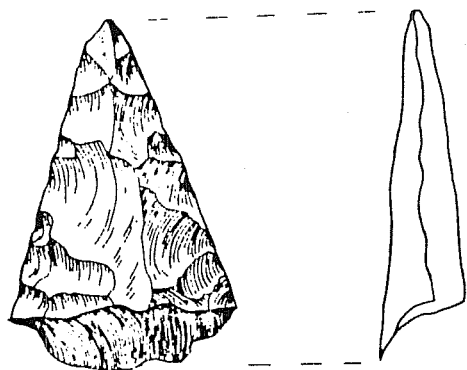
Chert prismatic blades correspond in method of production to the familiar obsidian prismatic blades common at archaeological sites throughout Mesoamerica. These artifacts are the result of a specialized pressure method



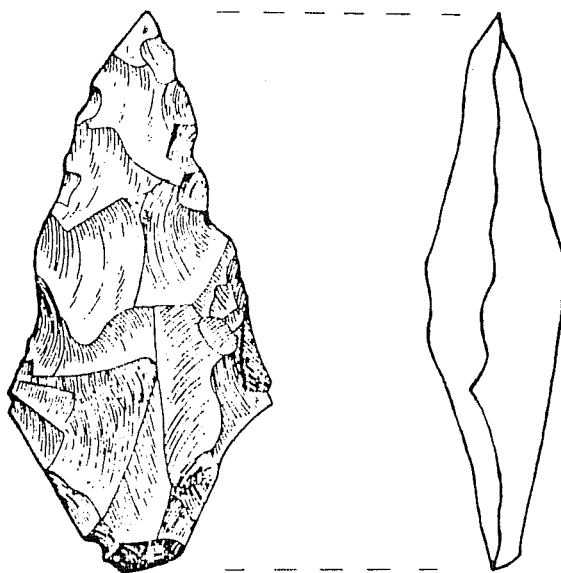
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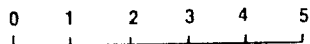
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Figure 10. *Fine, bifacial knives or points.* a, Base of a Stemmed Projectile Point, Ex. 32-1 (Str. A-1, Chan Chen); b, Nearly complete Projectile Point from Ex. 27-3 (Str. F-2, Chan Chen); c, Fragment of a Knife or Point, Ex. 20-B (Str. A-1, Caledonia);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

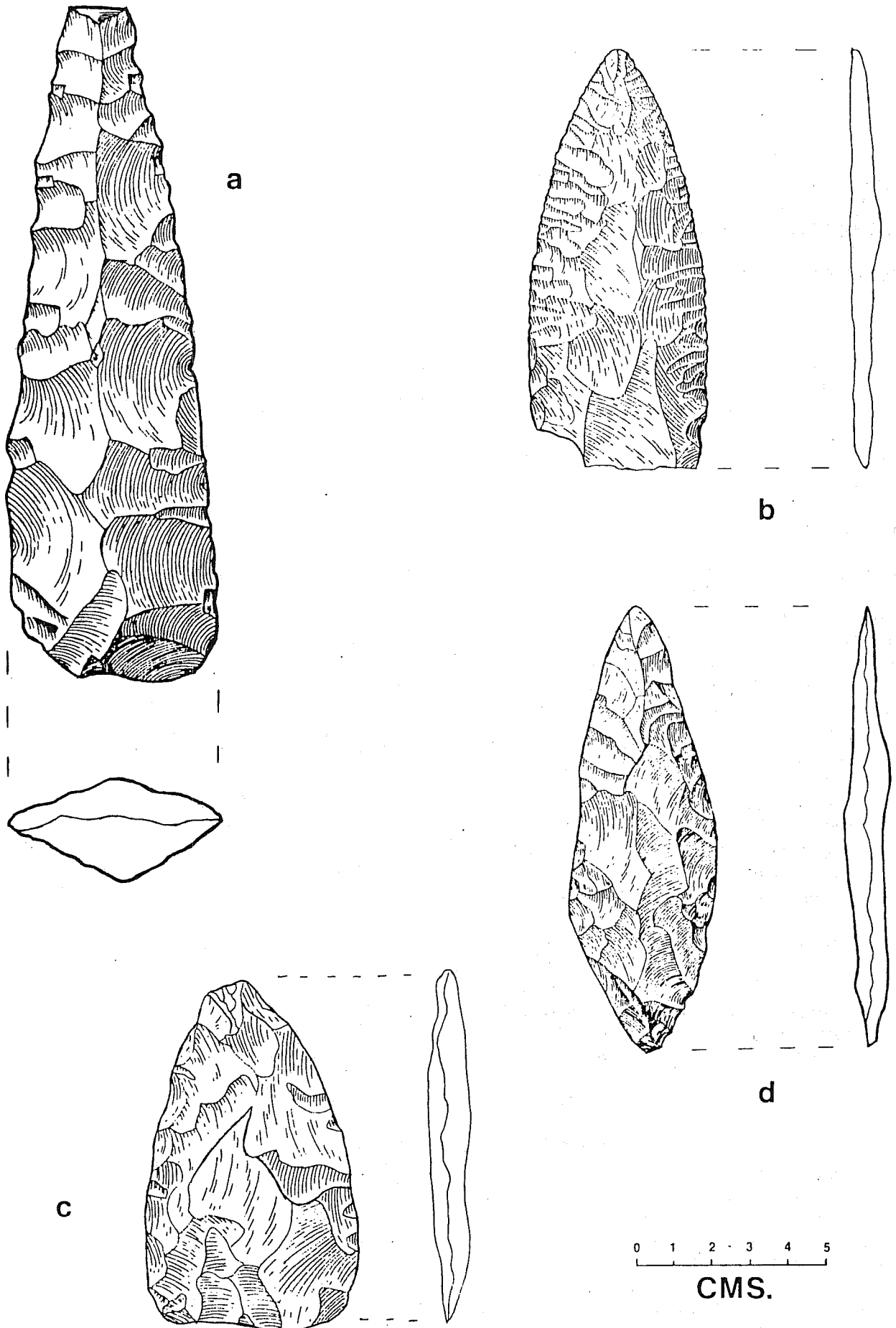


Figure 11. *Pick-like tool and ceremonial implements.* a, Pick-like Tool, Ex. 15-1 (Patchchacan); b, Ceremonial laurel leaf blade, Ex. 33-1 (Chan Chen); c, Complete triangular Ceremonial Implement from Ex. 33-1; d, Ceremonial Implement from 10-1, Late Postclassic ritual deposit (Patchchacan).

of detachment fully described by Crabtree (1968). The chert versions have been found at other lowland sites including Tikal (Haviland 1963:428) and Barton Ramie (Willey *et al.* 1965:440). There are 12 complete and 12 incomplete specimens in the present collection which range in length, for the complete blades, from 5.0 to 7.1 cm. These blades are all triangular or trapezoidal in cross section and have nearly parallel sides.

### Burin Spalls

Burin spalls are the by-products of trimming and finishing activities and are therefore included in the third manufacturing category. These specialized flakes are discussed by Semenov (1964:55; Fig. 17-5) who describes the burin blow process as intermediate between percussion and pressure. Two burin spalls were recovered, one from Ex. 33-1 and the other from Ex. 40-S.

### Pressure Flakes

Bordes and Crabtree (1969:11-12) describe the manufacturing stages in the reduction and thinning of bifaces: direct percussion, indirect percussion, and pressure. No doubt there is some overlap in the morphology of the flakes produced by these techniques. However, nearly 700 flakes have been identified as the by-products of final pressure flaking of finely finished artifacts. These pressure-made waste flakes are thin, flat, and display little or no bulb of force. The count given here may not be precise because of the difficulty in distinguishing pressure flakes from other waste flakes. Borderline cases were not included in this category.

Pressure flakes comprise 41% of the collection by count and 12% of the collection by weight. Of the 698 pressure flakes recorded, 102 show macroscopic signs of wear. This figure may not indicate the proportion of utilized pressure flakes. Brose (1975) has found that certain cutting tasks leave no traces of wear on experimentally utilized flakes.

### Residual Waste

The residual waste category consists of chips, chunks, amorphous fragments, and unidentified waste. Any chert specimens not described in the preceding descriptions are tabulated in this section. Residual waste accounts for about 42% of the collection by count and 29% by weight.

## CHERT SOURCES

Basic to any lithic industry is a supply of suitable raw materials. Deposits of good quality chert are not distributed evenly in the Maya lowlands. The pre-Columbian stone worker in Belize was fortunate to have an abundant local supply of good to fine quality chert. One chert source is reported near Altun Ha, at Km 24 just off the Northern Highway out of Belize City.

Colha, immediately northwest of Rancho Creek, is the location of another chert source in the northern Belize area. Hammond (1973:57) attributes the existence of the Colha ceremonial center and workshops to the



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).

More precise sourcing will have to be done before this is certain. Yet, there is a strong suggestion that the chert industry of Belize influenced the lithics of other regions.

#### SUMMARY OF THE INDUSTRY

Scraping and light cutting tools are the most common tool types in the present collection. In contrast, chopping tools are more common at other lowland sites such as Tikal, Altar de Sacrificios, Uaxactun, and Barton Ramie. Chopping and heavy cutting tools are rare in the northern Belize collection. This may be the result of the small sample size, in view of the number of chopping tools found at Colha, only 30 kilometers to the southeast. However, Proskouriakoff (1962:418-419) notes a similar rarity of chopping tools at Mayapan. In addition, the distinctive arrow points of the Postclassic Period are common to both Mayapan and northern Belize. Lithic similarities between Mayapan and northern Belize suggest an exchange of influence or similar technological circumstances. This should be tested with larger collections in future studies.

The arrow points in the Postclassic component of this collection were manufactured from prismatic blades. Identical points have been found in the Maya area as far south as Chalchuapa, El Salvador (Sheets 1975b:337) and as far north as Mayapan (Proskouriakoff 1962:360, 369). In all cases, these arrow points are dated to the Postclassic Period.

The availability of local chert permitted a chert industry to operate without a reliance upon long distance trade for raw lithic material. Initial core reduction and production of tool blanks probably took place at the quarries. It is clear that further working of some of the chert took place at the quarries while some tool blanks, flake cores, and large blades were distributed to non-quarry sites.

The first stage of manufacture involves the preparation and reduction of cores. This activity produces large blades, large flakes, and tool blanks. Some of these are worked further, or they are transported or used without modification.

The products of the first stage of manufacture are worked in the second stage into tools of crude or intentionally general form. It may be that these tools were intended for the least specialized tasks. The by-products of this second stage of manufacture are used or worked into finer, more specialized tools. The third manufacturing category embraces those tools that are carefully finished. Tools in this category could become broken and reworked into other tools, or they could become dull and rejuvenated. But for the purposes of the typology used in this analysis the third manufacturing category includes only those tools that display chipping of high quality, usually the result of pressure flaking, and that have taken on a specific form. Thus, large bifacial choppers and tiny arrow points are the products of the same stage of manufacture. Temporal and spatial changes in the industry are difficult to recognize. A larger sample will allow a more detailed analysis of the industry.

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

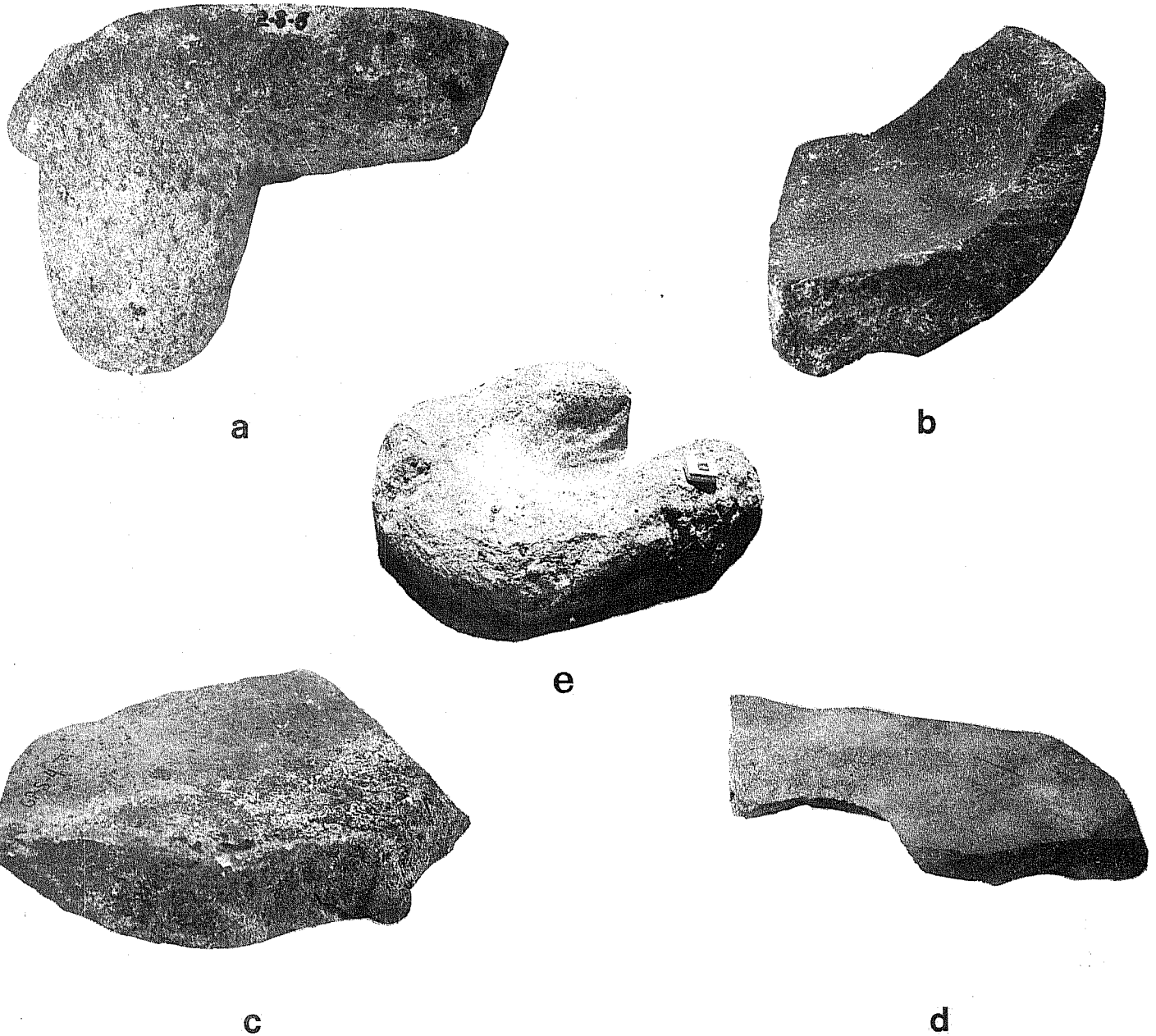


Figure 1. *Representative metate types.* (Not to scale). a, Thin-legged (L), Ex. 2-S-5 at Aventura. b, Turtleback (TB), Ex. 6-2-2 at Aventura. c, Thin-Flat (T), Ex. GP-S-4 (TS), Ex. 41-S at Sta. Rita Corozal; d,e, other metate forms.



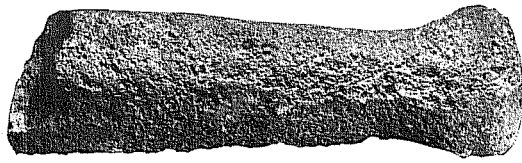
(G). It is possible that some of the fragments classified as the thin-flat legless form actually belong to the thin-flat legged form, as the leg evidence was occasionally ambiguous. The eight mano shapes (Fig. 2) include oval (O); circular (C); plano-convex (PC); rectangular (R); square (S); triangular (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



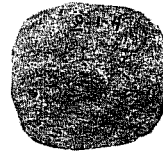
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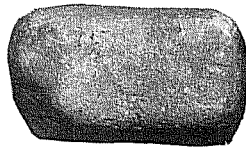
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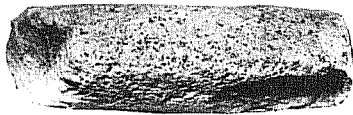
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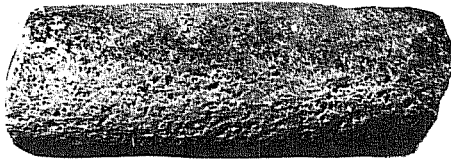
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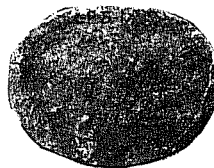
h



i



j



k

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. -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 f 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 extrusive 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  $\chi^2$  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  $\chi^2$  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? <sup>2</sup>	.5	155
Piedras Negras	20	85	0	15	220
Yaxha	14.66kg <sup>1</sup>	<5	>95	0	260
Barton Ramie	108	0	100	0	280
Tikal	>2000	c.15	c.80?	"some"	285
Uaxactun	13	33.3	40 <sup>3</sup>	26.7	305
San Jose	14	7.1	78.6 <sup>3</sup>	14.3	320
Northern Belize Region					
Sarteneja	7	42.9	28.6	28.6	405
Aventura	42	64.3	7.1	28.6	400
Sta. Rita	29	58.6	13.8	27.6	408
Caledonia	8	62.5	25.0	12.5	388
Chan Chen	10	70	20	10	413
Patchchacan	23	73.9	21.7	4.3	410
North Yucatan					
Mayapan	747	97.2	0.4	2.4	680
Chichen Itza	42	85.7	0	14.3	700

<sup>1</sup> 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.

<sup>2</sup> The small percentage of quartzite found at Altar may have come from a closer highland source rather than the Maya Mountains.

<sup>3</sup> 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	2
San Jose	13	38	62	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  $\chi^2$  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  $\chi^2$  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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