Adaptive Radiations in Prehistoric Panama

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Report Number 15

Stone Tools from La Pitahaya (IS-3)

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INTRODUCTION

The 1971 excavations at La Pitahaya (IS-3) yielded approximately 2,000 lithic specimens produced and/or used by man. Of this total approximately one half, or 1,000, are tools; the others are by-products of tool manufacture.

Tools have been divided into categories on the basis of final method of manufacture, if manufacturing took place. We felt that such a descriptive typology would be more useful than others (e.g., a functional typology) for comparing the different sites we excavated in western Panama. Although functional interpretations of tools are of great interest to this study, in the current state of affairs they would be subject to almost constant revision. Furthermore, functional interpretations rely to a large extent on the study of wear patterns. Some tool uses leave no apparent wear; postdepositional weathering of tool surfaces often obliterates wear patterns; and replicative experiments on a very large scale are necessary to approach accuracy of explanation in functional analyses. Hence, the possible functions of IS-3 tools have simply been proposed as subcategories of the technological divisions.

The multiple wear displayed by these tools proved both informative and troublesome. It was informative because it emphasized the fact that at Palenque some kinds of stone were apparently more easily procured than others. Many of the materials used in the tools resemble the beach cobbles found on this peninsula today. Other materials must have come from the mainland, possibly from riverbeds, from the highlands, or from as far away as the Azuero Peninsula. Those materials that were not available locally appear to have been more highly valued, if extensive reuse can be taken as an indication of value. Multiple use also implies a certain lack of specialization in the assemblage. Finally, tools showing multiple usage present obvious problems in classification, in that there may be no way to distinguish which was the most important kind of wear, or if one kind of wear was equal to another.

Three avenues of investigation were pursued in identifying tool function: (1) microwear analysis, (2) ethnographic analogy, and (3) experimental replications. Microscopic analysis of wear patterns aids in identifying tool usage and in understanding variation in the macromorphology of tools (cf. Tringham et al. 1974, p. 195; Wilmsen 1968, 1970). Although archaeologists will not be able to discern every use to which every tool was ever put, wear patterns will teach them a great deal about specific sites and about the activities performed there.

Some tools from IS-3 so closely resemble ethnographic or historic ones that analogy seems justified, especially if corroborative evidence can be provided. Thus, manos and metates are considered by analogy to be maize-grinding implements, a fact corroborated by the recovery of maize kernels, cobs, and pollen from Isla Palenque.

A number of experiments were undertaken using raw materials from the site, from other areas of Panama, plus a few similar materials from the Philadelphia, Pa. area. These experiments reproduced and used tools similar to the excavated ones. As many archaeologists have pointed out (Coles 1973, pp. 15–18; Keeley 1974, p. 329; Odell 1975, p. 234), tool replication experiments do not tell us definitively what past use was made of excavated tools. They do, however, narrow the range of possible functional interpretations.

THE CLASSIFICATION

This typology divides artifacts into categories based on the final method of manufacture, where manufacture took place. It is an essentially descriptive typology that may be skipped over lightly by the nonspecialists. Subcategories within these groupings are based on inferred tool use and may be of more general interest.

Tables 1, 2, and 3 show the occurrence of each tool type by trench, block, and layer. These totals include some large artifacts that were not removed from the site. In table 4 tools showing clear evidence of more than one use have been listed, first according to the primary or heaviest kind of usage, then according to their secondary use. Artifacts photographed and discarded at the site have been included in the totals for table 3 and noted in the text, but omitted from table 4.

I. Chipped Stone

On the whole the IS-3 chipped stone industry does not appear to have been particularly well developed or complex. The most carefully made chipped stone artifacts, points and blades, are found in other Panamanian sites as well. These points are triangular in cross section and are known from other sites in the Chiriqui Gulf region (Linares 1968b) and from Sitio Conte and Nata in the other central provinces (Lothrop 1937; Cooke 1976a and personal communication). Stems from two large blades also resemble those from whole blades known from Cerro Brujo (see report no. 6) and from several sites in central Panama, including Sitio Sierra (Cooke 1976, personal communication).

Chipped stone tools were made of several varieties of chalcedony, as well as quartz and agate.

Chipping waste includes waste flakes, identified by such criteria as bulbs, striking platforms, *éraillure* scars and ripple marks, and shatter, resulting from the intentional breakdown of cores and flakes but not clearly exhibiting the above criteria. A flake with these identifying marks removed is thus classified as shatter. Waste flakes and shatter constitute the largest number (803 specimens) of chipped stone artifacts at La Pitahaya.

A. Core and Core Tools (table 1, fig. 15/1)

The principal materials for cores are a green or red chalcedony (jasper), a crystalline quartz sometimes combined with chert in the same specimen, white to gray cherts and white quartz. Of the 33 cores in the sample, eight are jasper and the remaining are gray cherts and quartzite.

1. Bipolar cores (fig. 15/1 a-c). At least 13 cores in the sample were flaked using a bipolar technique. This technique leaves crushing marks on the platform at two opposite ends of the core as a result of placing the core on a supporting anvil stone while it is being struck. The same technique also gives a flattened or straight-sided appearance to many flake scars, which is unusual in materials that break with concoidal fracture. Most of the bipolar cores are made of chert and quartz and exhibit nearly straight-sided breaks. Some of the quartz cores are under 2 centimeters in height, so small that support on an anvil might be necessary for flake detachment. The use of the bipolar technique can also aid in the flaking of larger cores of quartz, a material notable for its hardness. In the laboratory it was found that a supporting anvil was useful in anchoring the stone so that it could be smashed with a blow hard enough to break it.

2. Multidirectional, unidirectional, and other cores (fig. 15/1 d-f). None of the cores were flaked multidirectionally, that is, from more than one direction but not bipolarly. This group includes a few cores flaked in two directions. There are also 10 or possibly 11 unidirectionally flaked cores in this sample. Eighteen miscellaneous cores are listed under other cores in table 1.

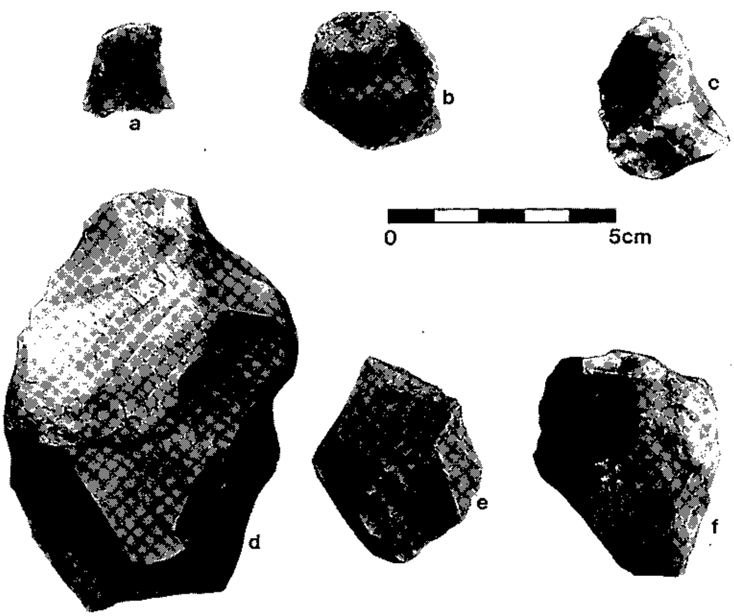

Figure 15/1: a-c. Bipolar cores: d-f. multidirectional (irregular) cores.

TABLE 1 CHIPPED STONE FROM ISLA PALENQUE

Provenience and Types

Layer or cms below surface	Cores				Used flakes	Perforators	Possible grater chips	Unmodified blades	Stemmed blades	Points on blades	Trifacial points	Waste flakes	Shatter	Total
	Unidirectional	Bipolar	Multidirectional	Other										
TRENCH I														
BLOCK 1														
Surface	–	–	–	–	–	–	–	–	1	–	–	3	–	4
A+B	1	1	–	–	5	–	11	1	–	–	3	46 (6)[a]	4	78
C	–	2	2	–	3	–	2	–	–	–	–	56 (8)	12	85
D+E	–	–	–	–	1	2	–	1	–	–	–	29(5)	4(3)	45
Block 1 Subtotal	1	3	2	–	9	2	13	2	1	–	3	134(19)	20(3)	212
BLOCK 2														
Surface	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A+B	1	–	–	1	–	–	1	–	–	–	–	3	1(1)	8
C	1	1	1	–	2	2	3	1	–	–	–	24(13)	24(4)	76
D+E	1	2	–	1(BL)[b]	11	1	22	1	1	–	3	121(18)	50(3)	235
Block 2 Subtotal	3	3	1	2	13	3	26	1	1	–	3	149(31)	75(8)	319
BLOCK 3														
Surface	–	1	1	1	1	–	–	–	–	–	–	3	–	7
A+B	2	–	–	–	1	–	3	1	–	–	2	24(4)[a]	4(1)	42
C	1	2	1	5	8	1	6	–	–	2	–	67(10)	10(4)	117
D+E	–	1	–	2	4	–	3	1	–	–	2	45(6)	11(2)	77
Block 3 Subtotal	3	4	2	8	14	1	12	2	–	2	4	139(20)	25(7)	243

Layer or cms below surface	*Cores*				*Used flakes*	*Perforators*	*Possible grater chips*	*Unmodified blades*	*Stemmed blades*	*Points on blades*	*Trifacial points*	*Waste flakes*	*Shatter*	*Total*
	Unidirectional	*Bipolar*	*Multidirectional*	*Other*										
TRENCH II														
BLOCK 1														
Surface	—	—	—	1	—	—	—	—	—	—	—	1	—	2
A+B	1	—	—	—	—	—	4	1	—	1	1	30(5)	8	51
C	2	—	—	2	3	—	1	2	—	—	3	17(2)	3(1)	36
D+E	—	2	—	—	2	—	—	—	—	—	1	5(3)	1	14
Block 1 Subtotal	3	2	—	3	5	—	5	3	—	1	5	53(10	12(1)	103
BLOCK 2														
Surface	—	—	—	—	1	—	—	—	—	—	—	4(1)	—	6
A+B	1	—	3	—	6	2	7	1	—	1	4	28(11)	14(4)	82
C	—	(1)	—	2	1	—	—	—	—	—	1	6(3)	(1)	15
D+E	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Block 2 Subtotal	1	(1)	3	2	8	2	7	1	—	1	5	40(15)	14(5)	105
TRENCH III														
0–50	—	—	1	—	1	2	—	1	—	—	2	1(2)	—	8
50–100	—	—	—	—	—	—	—	—	—	—	—	2	—	4
100–sterile	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	1	—	1	2	—	1—	—	—	2	3(2)	—	12

TRENCH IV - none

TABLE 1 continued

Layer or cms below surface	Cores: Uni-directional	Cores: Bipolar	Cores: Multi-directional	Cores: Other	Used flakes	Perfo-rators	Possible grater chips	Unmodi-fied blades	Stemmed blades	Points on blades	Tri-facial points	Waste flakes	Shatter	Total
TRENCH V														
Surface	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
B	–	–	–	2	–	–	–	–	–	–	1	4	1	8
C	–	–	–	–	1	–	–	–	–	1	1	3	–	6
D	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Subtotal	–	–	–	2	1	–	–	–	–	1	2	7	1	14
TRENCH VI - None														
TRENCH VII														
A(Surface)	–	–	–	–	–	–	–	–	–	–	–	2	–	2
B	–	–	–	1(BL)	–	–	–	–	–	–	–	–	–	1
C	–	–	–	–	1	–	–	1	–	–	2	(1)	(1)	6
C?	–	–	–	–	1	–	–	–	–	–	–	1	2	4
D+E	–	–	–	–	–	–	–	–	–	–	–	2(1)	–	3
Subtotal	–	–	–	1(BL)	2	–	–	1	–	–	2	5(2)	2(1)	16
TRENCH VIII - none														
Artifact totals	11	13	9	18	53	10	63	11	2	5	26	530(99)	149(25)	1,024

[a]( ) = possible specimen.

[b]BL = blade.

TABLE 2 GROUND AND POLISHED STONE FROM ISLA PALENQUE

Layer or cms below surface	*Axe*	*Celt type* *A*	*B*	*C*	*Adzes*	*Chisels*	*Flakes of celt material*	*Flakes with polish or pecking*	*Celt fragments*	*Totals*
TRENCH I										
BLOCK 1										
Surface	—	—	3	—	—	—	—	—	1	4
A+B	—	—	4	—	1	—	1	11	11	28
C	—	1	1	1	—	—	—	17	3	23
D+E	—	—	—	—	—	—	1	6	—	7
Subtotal Block 1	—	1	8	1	1	—	2	34	15	62
BLOCK 2										
Surface	—	—	—	—	—	—	—	—	—	—
A+B	—	2	6	1	—	—	—	1	3	13
C	—	2	4	—	1	—	1	8	6	21
D+E	—	—	1	—	—	—	5	43(1)[a]	7	56(1)
Subtotal Block 2	—	4	11	1	1	—	6	52(1)	16	91(1)
BLOCK 3										
Surface	—	1	2	—	—	1 butt	—	4	1	9
A+B	—	—	2	—	—	1	—	10(1)	17	30(1)
C	—	—	—	—	—	—	6	18	9	33
D+E	—	—	—	—	—	—	3	18	5	26
Subtotal Block 3	—	1	4	—	—	2	9	50(1)	32	98(1)

TABLE 2 continued

Layer or cms below surface	Axe	Celt type A	Celt type B	Celt type C	Adzes	Chisels	Flakes of celt material	Flakes with polish or pecking[a]	Celt fragments	Totals
TRENCH II										
BLOCK 1										
Surface	—	—	—	—	—	—	—	—	—	—
A+B	—	—	1	1	—	—	—	6	4	12
C	—	—	1	1	—	—	—	12	12	26
D+E	—	—	2	—	—	—	1	1	2	6
Subtotal Block 1	—	—	4	2	—	—	1	19	18	44
BLOCK 2										
Surface	—	—	—	—	—	—	—	1	4	5
A+B	—	—	1	—	—	—	—	10	5	16
C	—	1	1	1	—	—	—	5	3	11
D+E	—	—	—	—	—	—	—	1	—	1
Subtotal Block 2	—	1	2	1	—	—	—	17	12	33
TRENCH III										
0–50	—	5	3	1	—	—	—	2	19	30
50–100	—	—	—	—	—	—	—	1	—	1
100–sterile	—	—	—	—	—	—	—	—	—	—
Total	—	5	3	1	—	—	—	3	19	31
TRENCH IV										
0–100	1	1	6	1	1	1	—	—	3	14
100–sterile	—	—	—	—	—	—	—	—	1	1
Total	1	1	6	1	1	1	—	—	4	15

Layer or cms below surface	*Axe*	*Celt type*			*Adzes*	*Chisels*	*Flakes of celt material*	*Flakes with polish or pecking*[a]	*Celt fragments*	*Totals*
		A	*B*	*C*						
TRENCH V										
Surface	–	–	–	–	–	–	–	–	–	–
A	–	–	–	–	–	–	–	–	–	–
B	–	–	–	–	–	–	–	3	3	6
C	–	–	–	–	–	–	1	4	3	8
D	–	–	–	–	–	–	–	–	–	–
Total	–	–	–	–	–	–	1	7	6	14
TRENCH VI - none										
TRENCH VII										
A(Surface)	–	–	–	–	–	–	–	–	1	1
B	–	1	1	–	–	–	–	–	5	7
C	–	–	1	–	–	–	–	3	1	5
C?	–	–	–	–	–	–	–	3	2	5
D+E	–	–	–	–	–	–	–	1	–	1
Total	–	1	2	–	–	–	–	7	9	19
TRENCH VIII - none										
Totals	1	14	40	7	3	3	19	189(2)	131	407(2)

[a]( ) = possible specimens.

TABLE 3 ARTIFACT TOTALS – GROUNDSTONE, COBBLE, AND MISCELLANEOUS ARTIFACTS FROM ISLA PALENQUE

Layer or cms below surface	*Metates or milling stones*	*Manos and hand-stones*	*Hammers*	*Pounding-mashing stones*	*Anvils*	*Nutters*	*Notched stones*	*Grooved stones*	*Miscellaneous*	*Totals*
TRENCH I										
BLOCK 1										
Surface	2	–	–	1	1	1	2	1	(1 sculpture)[a]	8(1)
A+B	7	5	5	5	4	2	3	–	(1 sculpture)	31(1)
C	3	3	6	–	1	3	6	1	–	23
D+E	–	–	2	–	–	–	–	–	–	2
Block 1 Subtotal	12	8	13	6	6	6	11	2	(2)	64+(2)
BLOCK 2										
Surface	–	–	–	–	–	–	–	–	–	–
A+B	17	20	9	2	1	5	6	1	1 grinding fragment	63
C	7	6	13	–	–	2	12	4	1 rasp 1 sculpture	46
D+E	4	2	17	1	1	–	11	1	2 rasps 4 grinding 2 grinding fragments[b]	45
Block 2 Subtotal	28	28	39	3	2	7	29	7	11	154
BLOCK 3										
Surface	8	3	7	4	3	4	3	–	–	32
A+B	–	6	13	2	5	5	12	–	1 rasp	44
C	3	3	9	–	3	1	6	1	1 polisher	27
D+E	1	1	2	–	1	–	1	–	–	6
Block 3 Subtotal	12	13	31	6	12	10	22	1	2	109

Layer or cms below surface	*Metates or milling stones*	*Manos and hand-stones*	*Hammers*	*Pounding-mashing stones*	*Anvils*	*Nutters*	*Notched stoned*	*Grooved stones*	*Miscellaneous*	*Totals*
TRENCH II										
BLOCK 1										
Surface	—	—	—	—	—	—	—	—	—	—
A+B	—	—	14	—	1	1	10	1	3 rasps 1 whetstone	31
C	3[c]	8[d]	8	—	—	2	25	1	1 sculpture 1 whetstone	49
D+E	1	2[d]	3	—	—	1	12	1	—	20
Block 1 Subtotal	4[c]	10	25	—	1	4	47	3	6	100
BLOCK 2										
Surface	1	3	1	—	—	—	1	—	1 bead	7
A+B	—	—	7	2	1	3	5	—	1 geode 1 sculpture	20
C	2	1	2	—	—	1	17	2	—	25
D+E	—	—	—	—	—	—	4	—	—	4
Block 2 Subtotal	3	4	10	2	1	4	27	2	3	56
TRENCH III										
0–50	2	5	18	—	5	5	26	2	—	63
50–100	—	—	—	—	—	—	—	—	—	—
100–sterile	—	—	—	—	—	—	—	—	—	—
Total	2	5	18	—	5	5	26	2	—	63
TRENCH IV										
0–100	—	—	—	—	—	—	2	1	—	3
100–sterile	—	—	3	1	—	—	2	1	—	7
Total	—	—	3	1	—	—	4	2	—	10

TABLE 3 continued

Layer or cms below surface	*Metates or milling stones*	*Manos and hand-stones*	*Hammers*	*Pounding-mashing stones*	*Anvils*	*Nutters*	*Notched stoned*	*Grooved stones*	*Miscellaneous*	*Totals*
TRENCH V										
Surface	–	–	–	–	–	–	–	–	–	–
A	–	–	–	–	–	–	–	–	–	–
B	1	1	1	1	–	1	14	–	–	19
C	2	1	–	–	–	–	6	–	–	9
D	–	–	–	–	–	–	–	–	–	–
Total	3	2	1	1	–	1	20	–	–	28
TRENCH VI – none										
TRENCH VII										
A (Surface)	–	1	–	–	–	–	–	–	–	1
B	2	2	2	–	2	1	2	1	–	12
C	–	–	–	–	–	–	4	1	–	5
D+E	–	–	–	–	–	–	–	1	–	1
Total	2	3	2	–	2	1	6	3	–	19
TRENCH VIII – none										
Artifact totals	66	73	142	19	29	38	192	22	22(2)	603(2)
Percentage of total	10.9%	12.1%	23.5%	3.1%	4.8%	6.3%	31.7%	3.6%	4.0%	100%

a = possible specimens in parentheses.

b = 2 pieces of same stone in different levels, counted twice.

c = additional fragments discarded at the site.

d = two fragments of the same piece in separate layers, counted twice.

TABLE 4 USE ON GROUNDSTONE, COBBLES, AND MISCELLANEOUS TOOLS FROM ISLA PALENQUE

Layer or cms below surface	*Metates and milling stones*	*Handstones and manos*	*Reused as handstones or manos*	*Hammers*	*Reused as hammers*	*Pounding-mashing stones*	*Reused as pounding-mashing*	*Edge-used*	*Anvils*	*Reused as anvils*	*Nutting stones*	*Reused as nutting stones*	*Notched stones*	*Other use with notches*	*Grooved stones*	*Other Use*	*Total*
TRENCH I																	
BLOCK 1																	
Surface	2	—	1	—	—	1	—	—	1	—	1	1	2	—	1	(1 sculpture)[a]	
A+B	2	4	—	5	2	5	1	1	4	—	2	5	3	—	—	(1 sculpture)	
C	—	—	—	4	2	—	—	—	1	—	2	—	6	—	1	—	
D+E	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	
Block 1 Subtotal	4	4	1	11	4	6	1	1	6	—	5	6	11	—	2	(2)	62+ (2)
BLOCK 2																	
Surface	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
A+B	—	2	—	2	1	—	—	—	1	1	1	1	2	—	2	—	
C	—	—	—	1	—	—	—	—	—	—	1	—	5	—	4	1 rasp, 1 sculpture	
D+E	—	—	—	1	—	—	—	—	1	—	—	—	—	—	1	2 rasps	
Block 2 Subtotal	—	2	—	4	1	—	—	—	2	1	2	1	7	—	7	4	31
BLOCK 3																	
Surface	7	3	1	7	3	4	—	3	3	1	2	4	3	—	—	—	
A+B	—	6	1	12	7	2	—	2	5	2	5	2	12	—	—	1 rasp	
C	1	1	—	8	3	—	—	1	3	3	1	—	6	—	1	1 polishing stone	
D+E	1	1	—	2	1	—	—	—	1	—	—	—	1	—	—	—	
Block 3 Subtotal	9	11	2	29	14	6	—	6	12	6	8	6	22	—	1	2	134

TABLE 4 continued

Layer or cms below surface	Metates and milling stones	Handstones and manos	Reused as handstones or manos	Hammers	Reused as hammers	Pounding-mashing stones	Reused as pounding-mashing	Edge-used	Anvils	Reused as anvils	Nutting stones	Reused as nutting stones	Notched stones	Other use with notches	Grooved stones	Other Use	Total
TRENCH II																	
BLOCK 1																	
Surface	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	
A+B	—	—	—	13	1	—	—	—	1	2	1	—	10	—	1	3 rasps, 1 whetstone	
C	3	3	—	8	—	—	—	—	—	1	2	1	24	—	—	2 sculptures,* 1 whetstone	
D+E	1	2[b]	—	3	—	—	—	—	—	—	1	—	12	—	—	1	
Block 1 Subtotal	4	5	—	25	1	—	—	—	1	3	4	1	46	—	3	8	101
BLOCK 2																	
Surface	—	—	—	1	—	—	—	—	—	—	—	—	1	1	—	—	
A+B	—	—	—	5	1	1	—	—	1	—	3	—	5	1	—	1 sculpture	
C	2	1	—	2	—	—	—	—	—	—	1	—	17	—	2	—	
D+E	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	
Block 2 Subtotal	2	1	—	8	1	1	—	—	1	—	4	—	27	2	2	1	50
TRENCH III																	
0–50	2	5	—	18	5	—	—	—	5	2	5	2	26	2	2	—	
50–100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
100–sterile	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Total	2	5	—	18	5	—	—	—	5	2	5	2	26	2	2	—	74
TRENCH IV																	
0–100	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	
100–sterile	—	—	—	3	—	1	—	—	—	—	—	—	2	—	1	—	
Total	—	—	—	3	—	1	—	—	—	—	—	—	4	—	2	—	10

Layer or cms below surface	Metates and milling stones	Handstones and manos	Reused as hand-stones or manos	Hammers	Reused as hammers	Pounding-mashing stones	Reused as pounding-mashing	Edge-used	Anvils	Reused as anvils	Nutting stones	Reused as nutting stones	Notched stones	Other use with notches	Grooved stones	Other Use	Total
TRENCH V																	
Surface	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
B	—	—	—	1	—	—	—	—	—	—	1	—	14	—	—	—	
C	1	1	—	—	—	—	—	—	—	—	—	—	6	—	—	—	
D	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Total	1	1	—	1	—	—	—	—	—	—	1	—	20	—	—		24
TRENCH VI - none																	
TRENCH VII																	
A(Surface)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
B	2	1	—	2	2	—	—	—	2	—	1	—	3	—	—	—	
C	—	—	—	—	—	—	—	—	—	—	—	1	3	—	—	1	
C?	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	
D+E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	
Total	2	1	—	2	2	—	—	—	2	—	1	1	6	1	—	3	21
TRENCH VIII - none																	
Total Use	24	30	3	101	28	14	1	7	29	12	30	17	169	19	18	13(2)	507+(2)

a = possible specimens in parentheses.

b = in two parts, with 2 numbers.

*One of these is on a metate.

B. Flake Tools

These are flakes with nibbling, crushing, unifacial retouch, or bifacial retouch on one or more edges. They may be divided into three categories, according to probable function (table 1).

1. Used flakes (fig. 15/2 oo-vv). Fifty-three flakes in our sample were probably used as scrapers, planes, and similar tools. Some cannot be assigned a special function but are included because of crushing, nibbling, retouch, or other indications of use. There was little or no polish visible on artifact edges under low magnifications. Forty-eight artifacts clearly show transverse or lateral retouch. One appears to be a spokeshave, three may have been used as knives. The majority are made of chalcedonies and quartz, the same materials as the cores from the site. Used flakes make up 5.2 percent of the chipped stone assemblages.

2. Perforators (fig. 15/2 hh-nn). Although usually associated with cores, waste flakes, and shatter, the ten quartz perforators in our sample differ from the latter in having sharply pointed ends showing crushing on the tips. They also tend to be larger than most quartz shatter and waste flakes. Perforators came from trenches I and II and make up 1 percent of the stone tools.

3. Possible grater chips (fig. 15/2 a-gg). These small flakes, mainly of quartz, were apparently detached from bipolar cores. There are 63 in the excavated sample.

Shapes are somewhat irregular, but tend to be thicker and blunter at one end and sharp at the other. The naturally rough cortex at one end gives an edge that holds up well, while the thickness provides added strength.

These flakes bear some resemblance to specimens classified elsewhere as insets for manioc grating boards, that is as grater chips. DeBoer (1975, pp. 419–433) notes a study by Barricklo giving modal dimensions for manioc grater chips in the collection of the American Museum of Natural History. These were: length 8 mm, width 6 mm, and thickness 2–3 mm. The grating edge was from 1–3 mm long. The modes for our sample of 63 chips were as follows: length 14 mm, width 5 mm, thickness 4 mm. Thus they were somewhat longer and only slightly thicker than the museum sample. The presence of thin cores and the regularity of our small chips suggest they were purposely manufactured to grate some product by setting them into wood. This product need not have been manioc, or other tubers, but possibly something completely different, like the kernel of the "corozo" fruit, from which oil is extracted today by boiling the pulp after it is grated. As Smith (section 10.5) has noted, this palm may have been under cultivation at IS-3. Fifty-one of the 63 chips were excavated from trench I, the remainder from trench II. They total 6.2 percent of the chipped stone.

C. Blades (fig. 15/3 a-f)

A blade is a flake twice as long as it is wide on which the direction of force is parallel to the long axis. There are 13 whole or partial specimens known from IS-3.

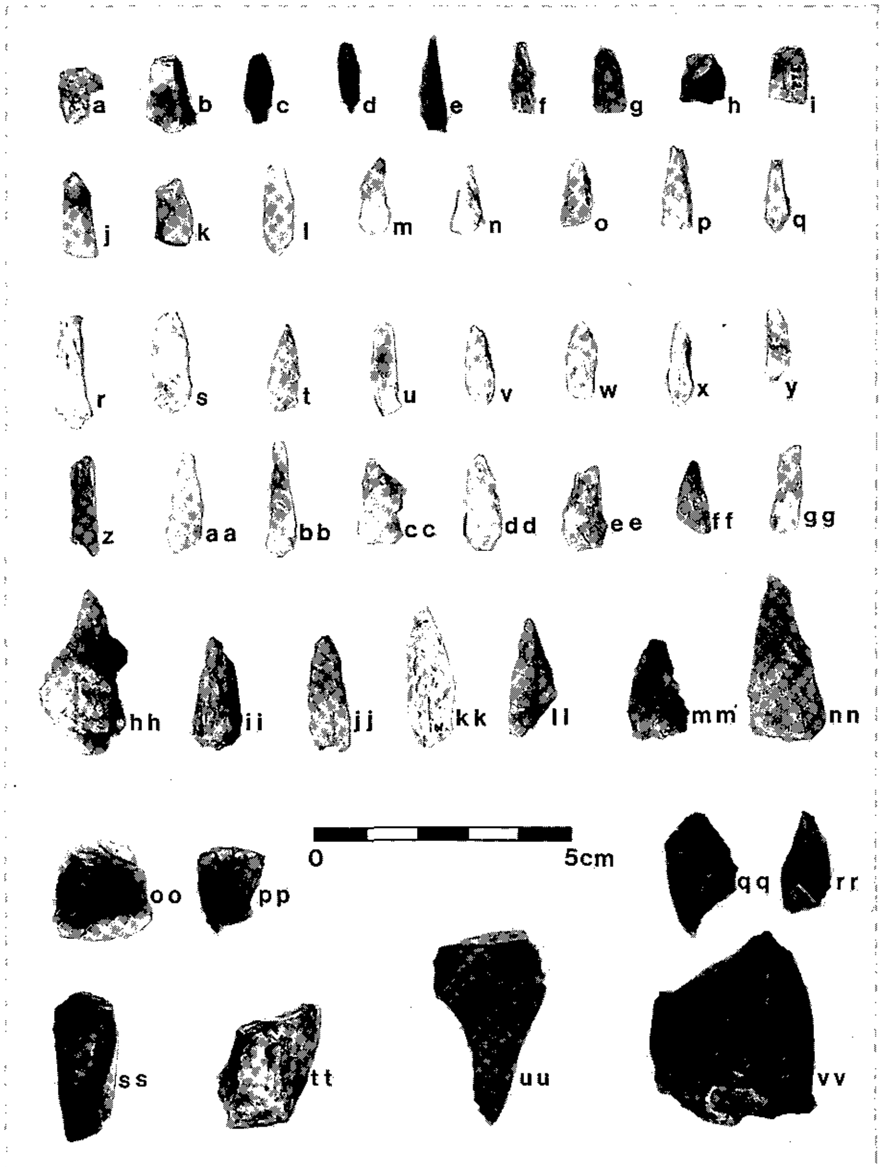

Figure 15/2: a-gg. Possible grater chips; hh-nn. perforators; oo-vv. used flakes.

Two large basal fragments of retouched blades were found at this site with their platform ends modified into stems for hafting (fig. 15/3 g,h).

On the smaller specimens evidence of use is found mostly along one or both edges or the tip and consists of use flakes or in one case polish. Six of these blades are ridged, four are backed, six show use on one edge, and three show use on both edges. In addition two blade specimens show wear on the tip, and one also has edge polish. One of the blades was unused,

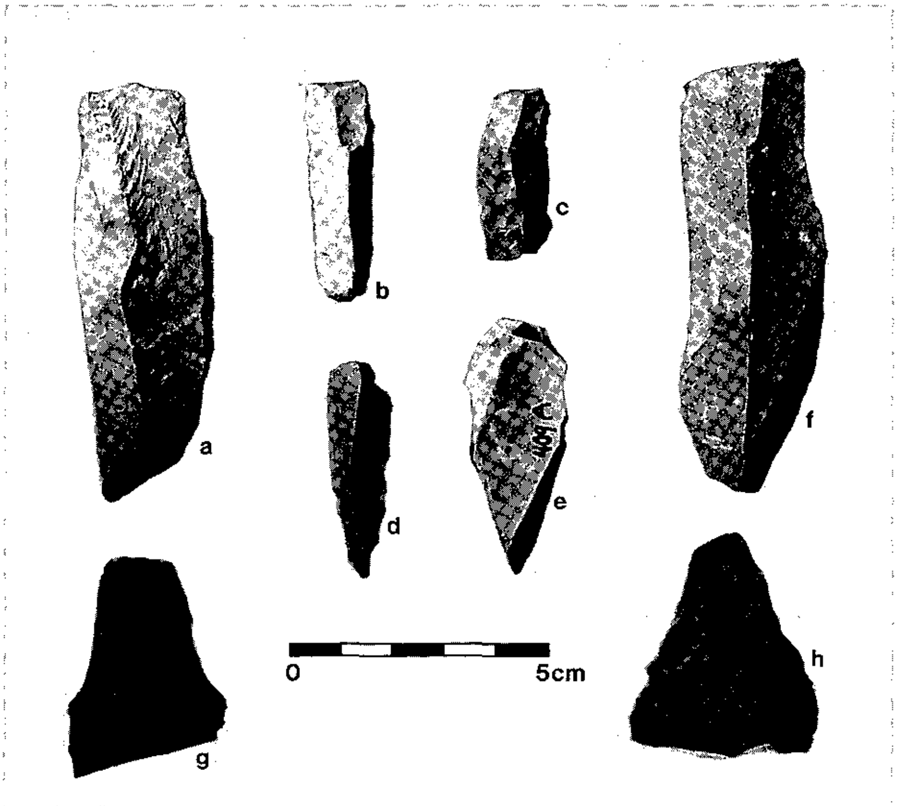

Figure 15/3: a-f. Blades; g,h. basal fragments of stemmed or tanged blades.

while wear patterns on the others suggest they were used for cutting.

One blade is of celtlike material, others are of chalcedony and a gray material, probably andesite. Blades were found in trenches I, II, III, and VIII. They make up 1.6 percent of the chipped stone sample.

D. *Points (fig. 15/4 q-w)*

1. Points made on blades. Five small, thin-stemmed points made on blades are unifacially worked with steep retouch. The platform end is shaped into a stem, and the ventral or inner surface is left more or less flat and unworked, while dorsal surfaces have ridges resulting from previous blade removal. They are made of a fine-grained gray material. All are broken, but length on complete specimens is estimated to vary from 3.5 to approximately 6 centimeters. These specimens must have been hafted, perhaps as projectile points. Other points like these were found by Linares in earlier survey work in the area and are illustrated in Linares (1968b, plate 20:a, c and description, p. 62). These points were excavated from trenches I, II, and V. They make up 0.2 percent of the chipped stone.

2. Trifaces (fig. 15/4 a-p). Twenty-six points with three faces and triangular cross sections are known from this site. On some specimens only two

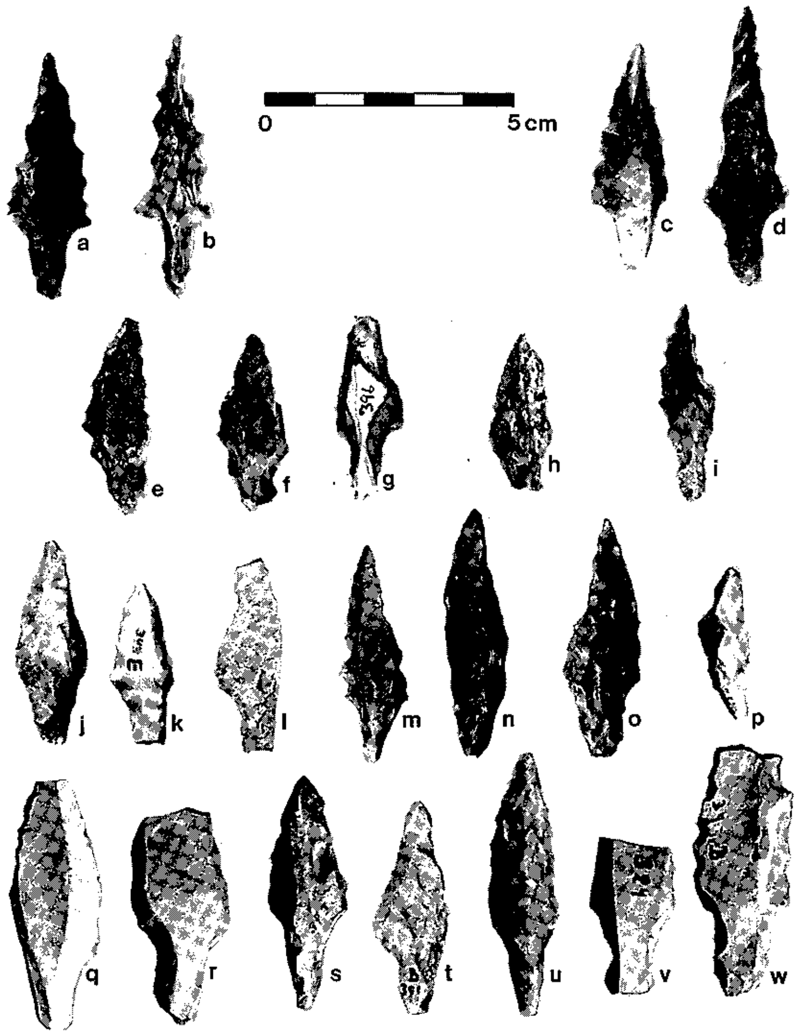

Figure 15/4: a-p. Trifaces; q-w. points made on blades.

faces are retouched or flaked while the third or ventral surface of the point is unmodified. The edges appear somewhat serrated.

At IS-3 the color range is wider for these chalcedony artifacts than for other cryptocrystalline artifacts. Many are in the tan-red-brown color range, which is not well represented in chipping debris at the site, raising the possibility that these points were imported, already made, from the mainland. They are known as far east as Veraguas and Cocle, where they are well documented (Lothrop 1937, 1950; Cooke 1972). Linares also found them in another nearby Chiriqui site (1968b, p. 62).

The inner or ventral surface of these points is usually nearly flat, although occasionally it is curved. On some examples there is polish on the edges where the midsection suddenly narrows to form the top of the base, possibly as a result of hafting.

They were excavated from trenches I, II, III, V, and VIII, making up 2.5 percent of the chipped stone sample.

E. *Waste Flakes and Shatter*

Waste flakes are frequently of the same materials as the used flakes, blades, etc. (Flakes made of celt materials have been placed in the section describing ground and polished stone.)

Flake size is variable, while platforms tend to be narrow and bulbs constricted. There are some *éraillure* scars. All these factors indicate that much of the percussion work at this site was probably done using hard hammer percussion techniques, as is also indicated by the large number of stone hammers.

There are approximately 800 waste flakes and pieces of shatter in the excavated sample from IS-3. Waste flakes and possible waste flakes number 629, while shatter and possible shatter number 174. Together they make up 78.5 percent of the chipped stone, of which the waste flakes form 61.5 percent and the shatter 17 percent.

II. *Ground and Polished Stone Tools*

These tools were made primarily on cobbles, usually flaked, then subsequently pecked, ground, and polished. At IS-3 the original working edge, a sharp bit, has been obliterated in many specimens by extensive reuse and breakdown, making description of them difficult, especially as the use sequence is not always clear.

Tools hafted with the bit parallel to the handle are commonly called axes when they are grooved, and celts when they are ungrooved (cf. Willoughby 1907). Tools whose bits form an acute angle with the haft are adzes. Axes and celts that are used for chopping tend to be symmetrical in cross section, while tools that are used in adzing or planing tend to be asymmetrical. The direction of use marks on a polished bit also aids in distinguishing adzes from axes and celts. Semenov (1964, p. 129) describes adze wear as being on the convex side of the bit as "grooves, thicker at the bottom and narrowing to fine lines. As a rule the striations lie along the axis of the tool more or less parallel to each other." In contrast axe wear shows up on both bit surfaces as diagonal striations.

Only 64 (27 percent) out of 236 ground and polished stone tool specimens preserved enough identifying characteristics to be included in the following typology. Most of these were complete or nearly complete specimens. However, the bits and edges were so battered that only three adzes were clearly recognizable from the excavations. Except for three chisels, the other polished tools having identifiable bits and more or less symmetrical cross sections have been designated as celts. Celts have been subdivided into three groups (A, B, and C), according to the shape of the celt and the length and curvature of the cutting edge.

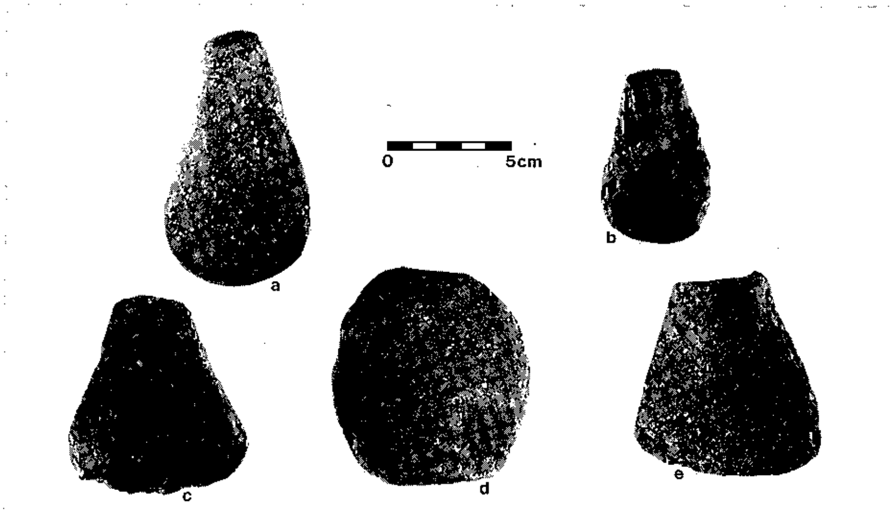

Figure 15/5: Celt Type A.

Many of the bitted tools have lopsided bits, indicating heavier wear at one end than at the other. This can occur when tools are used either as choppers or as adzes; thus a lopsided bit is not diagnostic of any particular use (Semenov 1964, p. 130).

An additional tool included in the ground and polished category is the chisel, which though only half as wide as a celt, is biconvex in cross section, like a celt. Only one complete and two broken specimens occur in the collection.

A. Axe (fig. 15/7 i)

One fragment of an IS-3 specimen having the bit missing is constricted in the midsection like an axe. The remaining section has very smooth and polished surfaces. The butt is larger and flatter on the end than those of celts, adzes, or chisels. Edges and butt are somewhat battered, probably from reuse. This fragment comes from trench IV and measures 7.3 x 5.8 x 3.8 cm.

B. Celts (fig. 15/5)

1. Type A celts (13 in total) have an extended or "parabolic" bit, which is larger than that of the other celts described below, and a short butt. Their shape resembles a pear (see Lothrop 1937). Some pear-shaped celts were probably hafted, if roughening of the edge where the constriction occurs is an indication of hafting. These celts are biconvex in cross section.

In all but one specimen, celt bit angles are unreconstructable, being battered or having large flakes and chunks missing. Other celts were purposefully battered, probably by hammering or pecking, to produce a broad smooth facet replacing the sharp bit. The butts on all Type A celts are short and sometimes battered or partly broken off. In smaller specimens the butts

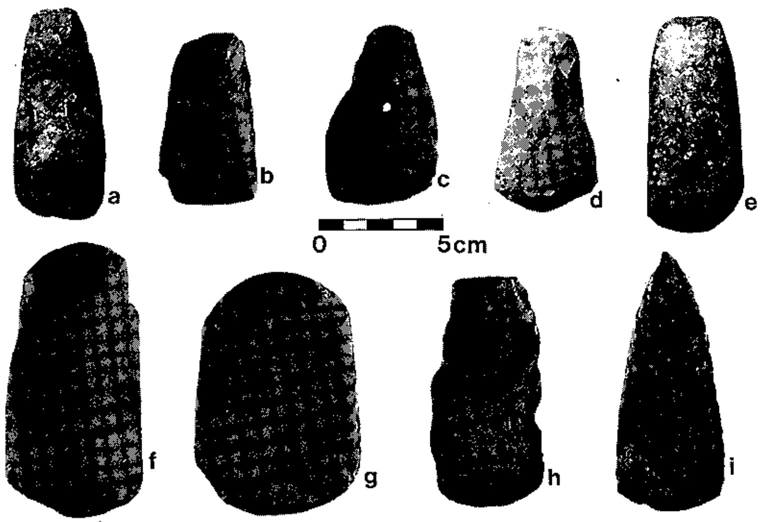

Figure 15/6: Celt Type B.

are proportionally larger than those of larger celts, suggesting that they may in fact be smaller because they have been extensively resharpened. Several breaks seem to have occurred at the point where the celts would enter the haft, if in fact these celts were hafted. On some celts the side edges remain smooth but on most they are heavily chipped.

Most Type A celts appear to have been polished from the bit edge to the constriction where the butt begins, though, on some celts polish may have stopped in the midsection. One small celt was clearly polished all over.

2. Type B celts (38 in total) constitute by far the most numerous of the celt categories (fig. 15/6). Their bits make a sharp, angular junction with the sides, while the butts may be pointed or blunted. Some are almost rectangular in shape, while others are roughly triangular. In the latter, some of the taper from bit to butt may be the result of chipping and resharpening.

Most Type B celts are roughly chipped, lack polish, and appear to have been battered as a result of hafting or other wear. When viewed from the bit end, their cross sections vary from biconvex to diamond and hexagonal as a result of having surfaces beveled. However, some celts have two curved surfaces, others a curved surface and a ridged one, and still others a ridge or bevel near the center of both surfaces.

The edges along the sides vary from roughly chipped to smoothly polished. Beveled specimens have retained smoother edges than most others.

The Type B celts are on the average longer and thicker than other celts. The majority were probably hafted, as is indicated by having been polished from bit end to midsection only, with the rest roughly chipped or pecked. Several specimens also have scars in the midsection.

Figure 15/7: a,b. Celt Type C; c-e. chisels; f-h. adzes; i. axe.

3. Type C celts (seven in total) are generally smaller and less numerous than those in Types A and B (fig. 15/7 a-b). They may also have been formed from large flakes rather than from pebbles or cobbles. Type C celts also tend to be much thinner and have less curving surfaces, appearing to be almost flat rather than curved or beveled. Many are almost triangular in outline, with the bit forming the shortest side of the triangle. The butt is usually a thin oval in cross section. Proportionally more celts of this type have retained bits with sharp angles than those that are identifiably Type A or B.

C. *Adzes (?) (fig. 15/7 f-h)*

Three plano-convex tools, asymmetrical in cross section, may have served as adzes. However, they do not show wear-striations even though the bits have been chipped and worn. Hence, it is not clear how or if they were hafted. One specimen is broken in the midsection, another resembles a pear-shaped celt, and the third looks like Type B celts.

D. *Chisels (fig. 15/7 c-e)*

Three polished stone fragments are classified as chisels even though not confirmed experimentally. However, similar artifacts have been described elsewhere (McEwen 1946).

The single complete specimen in the collection measured 13.4 cm long, 2.9 cm wide, and 2.0 thick and was polished from the end of the bit to about 3 cm behind the bit. No wear striations were visible. Its bit angle measured 62°. Chisels are biconvex in cross section, resembling very narrow celts.

E. Celt Fragments

Celt fragments of various kinds, 131 in all, occur in the collection. Fourteen are nearly whole specimens, 37 are bits and bit ends, 38 are center sections, and 42 are celt butts. The large bit and butt sections may have broken off while the tool was being used. Most of the large fragments, excluding butts, appear battered and/or chipped.

F. Celt Flakes

In an attempt to determine whether or not celts were manufactured at the site, we isolated those flakes without polish or pecking that were made of the same materials as the celts. Only 19 flakes (9 percent) fit this description. Hence, it seems likely that celts were not manufactured at IS-3. In fact, the majority of the celt flakes (191; 91 percent) show polishing or pecking marks somewhere on the surface, as if they had broken off from finished or at least partially finished celts. This would have happened while the celt was being used as a tool or reused as a hammer, or while the celt was being re-sharpened by flaking.

III. Pecked and Ground Stone Tools

This group includes metates and milling stones as well as manos and other handstones. Metates were pecked into shape from large pieces of quarried stone, while barlike manos may also have been shaped by pecking. Nonetheless the ground-down surfaces of these tools resulted principally from use, even though some pecking or grinding may have occasionally been done to rejuvenate the surfaces. Other handstones are not visibly pecked as are the manos, but they are also ground down from usage.

A. Metates (fig. 15/8)

Four possible and 24 identifiable metate fragments were removed from the site. Approximately 37 other large fragments were left at the site.

All but a few metates removed from the site appear to be made of a stone having large phenocrysts, unlike the other types of artifacts that were made of more variable kinds of material. Semenov (1964, p. 69), describing the quality of sandstone grinding surface, notes that it is a "rock in which the grains are held together by a clay cement." On this surface the friction of an abrasive agent "destroys the links between its grains by the friction of the object against it, so that the blunted grains fall out, only to be replaced by new sharp grains from the agent." This appears to be the way metate surfaces were ground-down and rejuvenated during use at La Pitahaya, although the material is a large-grained igneous rock (probably porphyritic andesite) rather than sandstone. Such a metate surface becomes concave with wear.

The stone for the metates was first shaped by pecking it into a slab with tapered legs as supports. The slab was slightly concave to begin with and

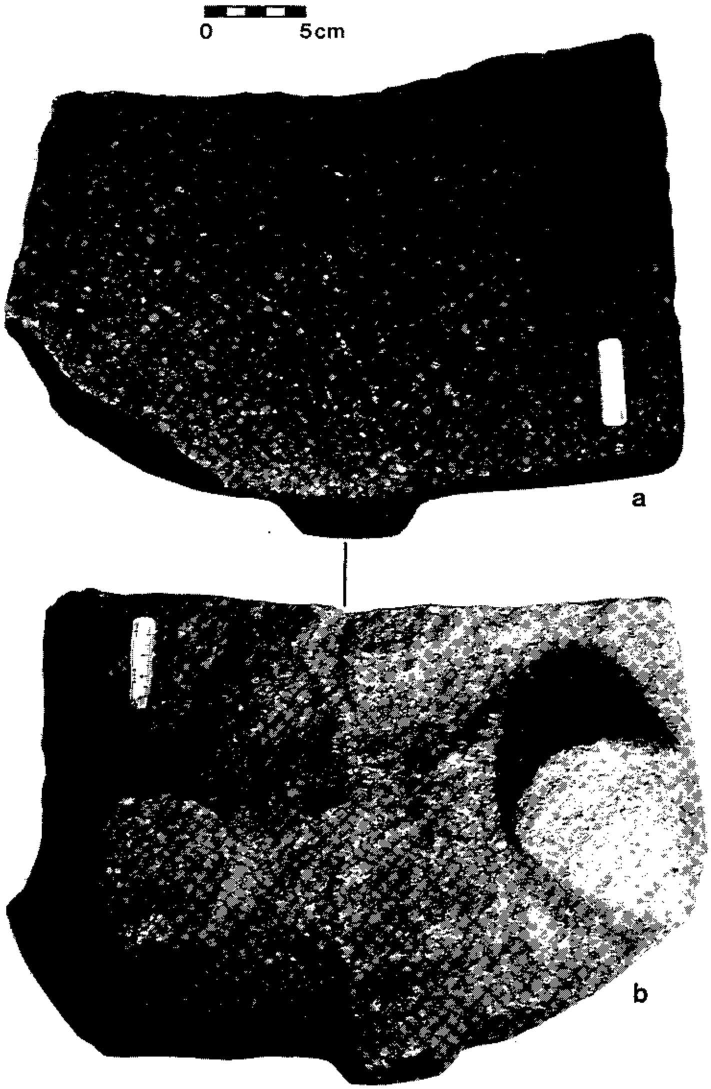

Figure 15/8: Legged metate fragment.

becomes more so with use. On many metates there is a narrow, smooth band or raised rim around the top edge of the grinding table, probably to hold in whatever substance was being ground. The outer sides and legs of the metate are usually rough and weathered. Some unattached legs show secondary use as nutting stones.

All that remains of the larger metates are either the legs, or segments of slabs with legs attached. The height from the bottom of the leg to the rim varies from 11.8 cm to 19.4 cm for those specimens which could be measured. Some of the outer edges of the metate may have borne elaborate sculpture, but the only remaining sculpture is a plain lug. The largest remnant of a metate removed from this site measures 30 cm (the original width) and the legs are broken. The thinnest part of the basin is only 3 cm, while the thickest is 4 cm. (For similar metates, cf. MacCurdy 1911, figs. 18 and 30; Lothrop 1950, fig. 32, and 1937, fig. 50 a-f, fig. 62 a,b.)

B. *Milling Stones*

Milling stones are thick-walled basins without legs, deeper than metates. They are also made of a somewhat denser material.

Two fragments from the surface of trench I, block 3 at IS-3 have been tentatively classified as milling stones because they have thick-walled basins, even though it is unclear whether they were used with a circular grinding motion as were those in the highlands (report no. 14).

C. *Bar Manos (fig. 15/9 a-e)*

Eleven of the 30 grinding stones removed from IS-3 are or were originally barlike in shape. Two of these fragments are part of the same mano, although one section comes from a depth of 80–90 cm and the other from 140 cm, in trench II, cut 1 (see note b, table 4). Many of these faceted handstones were made of the same material with the large phenocrysts and self-sharpening qualities as the metates. They have grinding surfaces and broken or roughly pecked ends. Presumably they were used, together with metates, for grinding maize, but they could also have been used for grinding other substances such as pigments, spices, or other foodstuffs.

Only one of the manos in this group has just one grinding surface, while seven have two used surfaces and three have three grinding facets. The ends of most are broken off so that the original size is not clear.

D. *Handstones*

Handstones, like manos, frequently have smoother surfaces near the edges and roughened areas in the center of the grinding surface. Also the surface frequently curves outward so that it is thinner at the sides than in the center, which is the opposite of a metate basin.

1. Ovoid handstones (fig. 15/9 f-i) constitute a highly variable category, for some are true ovals, almost loaflike in appearance, while others are more irregular. Six specimens out of a total of 15 were ground on only one surface; the rest were ground on two or more surfaces. One specimen was pitted, suggesting use as an anvil, while another may have been used as a nutting stone, for it has a deep central depression. Some smaller fragments known from the site may have been originally parts of grinding stones.

The raw materials out of which handstones were made could not be identified easily without costly thin-sectioning. However, several different stones seem to have been used in their manufacture.

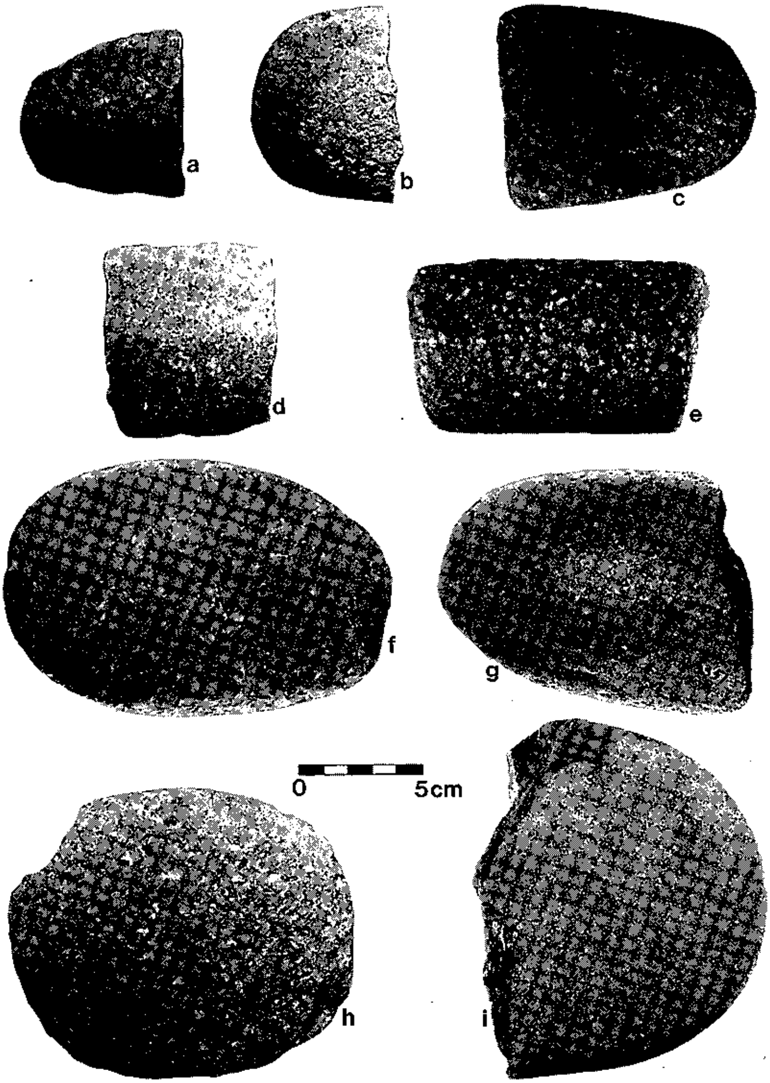

Figure 15/9: a-e. Bar or cylindrical manos; f-i. ovoid handstones.

2. Angular handstones (four specimens). These may have been more rectangular originally. In fact, one may be a reused metate leg, while another may have been used as an anvil. All of the specimens have only one ground edge. Measurements are not included because of the fragmentary nature of the specimens.

IV. *Cobble Tools*

Cobbles not clearly modified, except in minor ways, were selected according to their size and shape to make such tools as hammerstones (except for those made of reused celts), pebble polishers, anvils, and pounding-mashing stones. Many of these tools are made from stones similar to those found now on the beach at Isla Palenque.

A. *Hammerstones (fig. 15/10)*

Hammerstones vary greatly in shape. Most are end-battered, with only a few showing wear all around the edges.

Hammers were no doubt used for chipping and pecking stone. The part used (such as a tip) is more restricted than the broadly flattened ends of the pounding-mashing stones. Thus, hammerstones were apparently being selected for their narrower, pointed ends. They are also small enough to be held in one hand. The use varies from light, just barely noticeable, to heavy, where the shape of the cobble's surface appears changed. Edge-used hammers with central depressions are good examples of heavy use. Their original irregular shape was smoothed out through use, while their surfaces show irregularities and roughened surfaces.

Most hammers are made of compact dense stone that breaks down slowly. The lighter the wear the more variable the materials out of which they were made. A few siltstone ones could only have been very lightly used.

B. *Pebble Polishers or Polished Pebbles (fig. 15/13 b-d)*

A number of small stones from IS-3 were probably used for polishing pottery or for burnishing polished celt surfaces. They are 3 cm or bigger in size and are of brown- or greenstone with quartz inclusions. Although it is difficult to tell which pebbles were actually used, as very few show striation marks, they must in any case have been carried inland from the beach.

C. *Pounding-Mashing Stones (fig. 15/11 g-i)*

These large, fine-grained cobbles, which are battered at one or both ends, tend to be thick ovals in cross section. A depression near the center of one surface may indicate that some specimens were used as nutting stones, as anvils, or even as special pounding stones with thumb-holding depressions to prevent the hand from slipping. The ends seem to be gradually worn away, being broad and flat, unlike the pointed ends of hammers. Pounding-mashing stones are also bigger and heavier than most hammers, presumably because they were used differently. A few may have been used for grinding, as they are unnaturally smoothed. In some the edges exhibit pitting, battering, or faceting. One artifact is partially fire-cracked.

D. *Anvils (fig. 15/11 d-f)*

Cobbles and boulders with irregularly pitted surfaces were probably used as supports during stone tool manufacture. Some of these anvils must

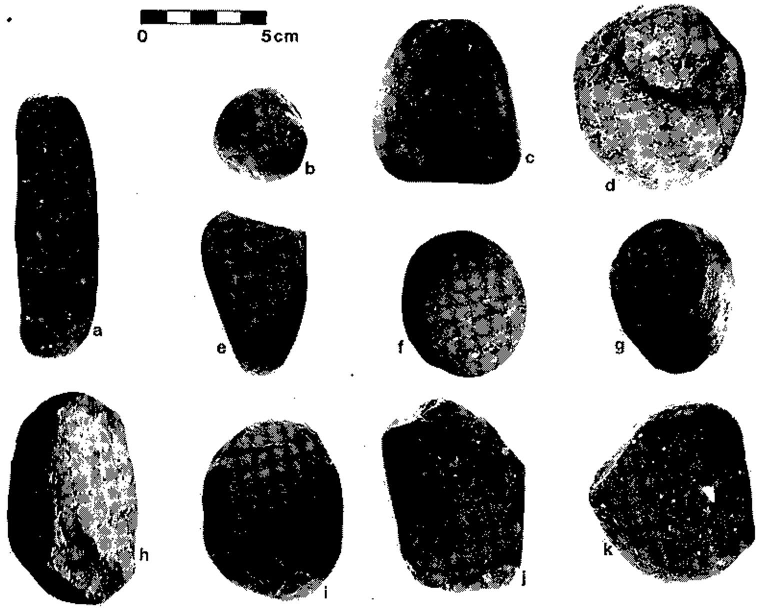

Figure 15/10: a-f. Hammerstones; g-k. celts reused as hammers.

have undoubtedly been employed in bipolar flaking, a technique responsible for producing between a quarter and a half of the chipping debris at the site. The size of the anvils varies considerably, as do their shapes.

Many anvils show marks of battering on the ends, indicating that they were also used as hammers. Pitting is frequently found on the center of the surface, probably as a reflection of use with a bipolar core.

V. Worked Cobbles

These tools were made on cobbles modified somewhat before being used.

A. Nutting Stones (fig. 15/11 a-c)

These were usually made of a soft green siltstone like the one used for notched and grooved stones described below, only nutting stones are generally much larger and thicker. They have small holes in the center of one or two surfaces where a palm fruit kernel or nut could be placed and cracked with a light blow from another stone. Because siltstone will crack if pounded hard, the force used to open nuts or other food could not have been very great. The holes range from being rather shallow (about 1 mm) up to 8 mm deep. Some are quite wide (as much as 4.5 x 4.5 cm). The holes were apparently made by gouging with a sharp tool. A piece of flint worked nicely when used on this kind of stone in the laboratory, producing holes much like those on the excavated specimens from the site.

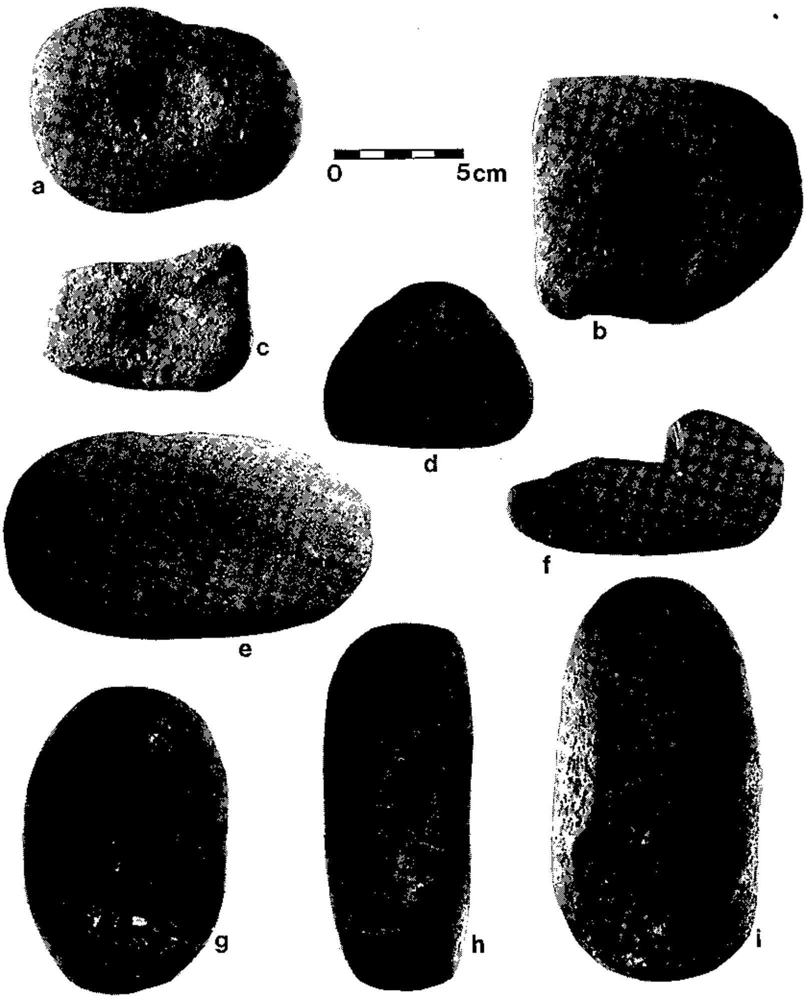

Figure 15/11: a-c. Nutting stones; d-f. anvils; g-i. pounding/mashing stones.

Often the area around the small holes is pitted and some nutting stones have battered edges. Some of the larger nutting stones are very thick, resembling thick bricks. Not all are large and bricklike, however. Some are quite small and irregular, others are oval, and still others are loaf shaped. A few nutting stones have split at the point where a hole occurred, suggesting that repeated blows, or even a single hard blow, split the stone in two. Occasionally nutting stones show some evidence of notching.

A number of pounding-mashing stones also show pitting in the center of one surface. Even though some are much larger than nutting stones, they are often found close enough to the latter to have been used with them, perhaps as the pounding stone for the nut.

Figure 15/12: a-d. Grooved stones; e-k. notched stones.

B. *Notched Stones (fig. 15/12 e-k)*

They are the largest category (192 specimens) of complete artifacts recovered from the site. The majority are made of green siltstone, though some are made of a somewhat denser, grayish-white stone. Their function seems to have been to weigh down nets or lines used in fishing.

Beach pebbles chosen to be flaked on the edges in order to form notches varied tremendously in shape. The notches themselves vary from slight indentations to deep scars extending onto the surfaces and part way around the pebble. They may be symmetrically placed on opposite sides of the artifact, or placed diagonally at different heights. A few specimens are notched on only one edge, while others are notched on three edges.

Many notched stones show evidence of having been roughly battered, probably as a result of their use as weights. It is unlikely that they could have served as hammerstones since the materials out of which they are made tend to crack and crumble easily if used with very much force. A few (four) specimens have holes in the center of their surfaces, as if they had also been used as nutting stones.

C. *Grooved Stones (fig. 15/12 a-d)*

These are small pebbles (22 specimens) with one or more incised grooves encircling them in the midsection. Most are very small, almost ovoid. Only a few resemble the notched stones in the larger size and irregularity of shape. A few of the grooves are as wide as 3 mm, but most are quite narrow. Some are continuous, others not. In some cases grooving is found on only one surface. The narrower grooves are found on smaller specimens, while the broader, bandlike marks, occur on larger stones. Almost all were made of the same green siltstone used for the notched stones. Whether or not they were used for the same purposes is difficult to say.

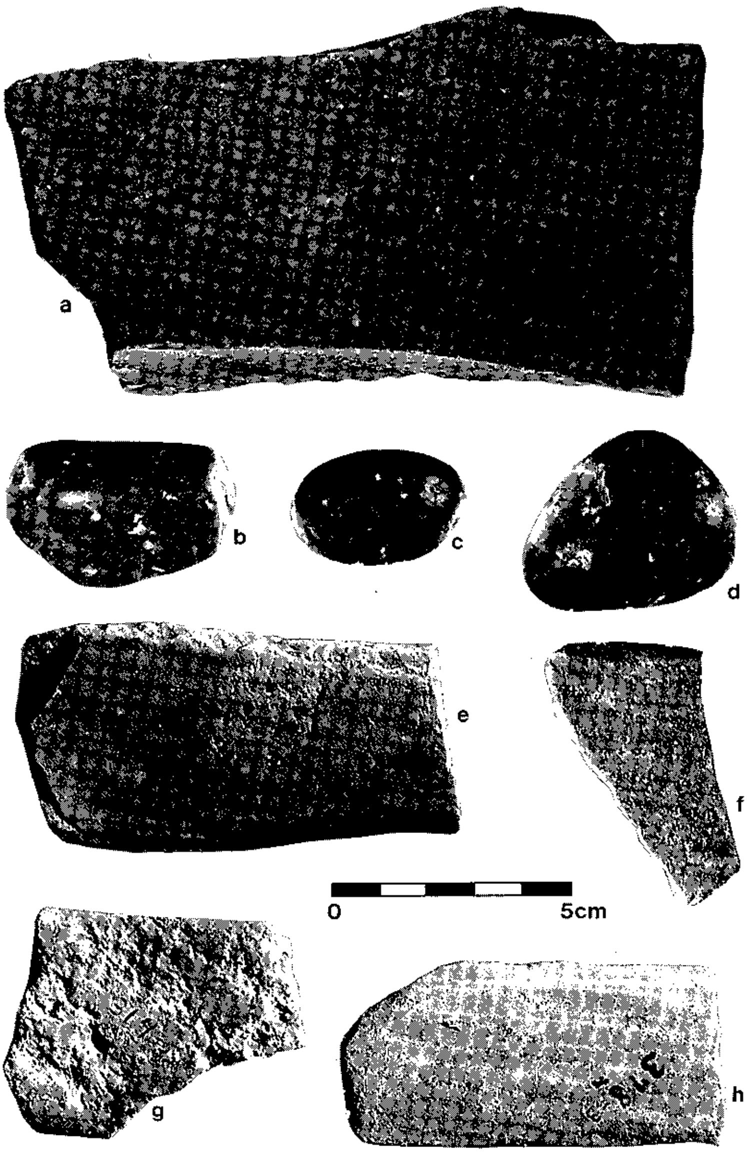

Figure 15/13: a. Whetstone; b-d. pebble polishers; e-h. rasps.

VI. Miscellaneous Stones

This category includes rasps, whetstones, fragments of sculpture, as well as assorted beach cobbles showing no obvious wear but having been brought to the site from a distance of almost a mile.

A. Rasps (fig. 15/13 e-h)

Seven rasps, also called sandstone saws, were found at the site. They may have been used for cutting shell. The only complete specimen is 11.8 cm long, 4 cm wide, and 0.6 cm thick. It has almost parallel sides, and it is beveled on both surfaces, on each side. The edges resemble those of a worn emery board or file, with a sloping band that is hardly noticeable at one end, but gradually broadens out as it goes down the length of the artifact. The other specimens are sections of rasps showing wear patterns similar to the complete specimen, although none shows use on both sides of two edges. Two specimens are waterworn. They may have been ground prior to use or the bevels could have resulted simply from use. Rasps were made from some kind of lightweight and somewhat grainy sandstone.

B. Whetstones (fig. 15/13 a)

Only two specimens were found. One is concave on all four sides, as well as on one end, and is made of lightweight coarse stone. It was probably used with water and sand as an abrasive to resharpen slightly blunted celts, or celts in final stages of manufacture. It measures 5.3 x 5.3 x 3.4 cm and weighs 4.8 oz. The other, a fragment, seems originally to have been part of a much larger slab. One end is smoothed and has what appears to be a polish on it. The thicker end, like the reverse surface, is somewhat rough. It is made of a greenstone that is probably found naturally in tabular form.

A similar stone was chosen in the laboratory to conduct a celt grinding experiment. The slab was submerged in water, coarse sand was sprinkled on it to act as an abrasive agent, and the celt was rubbed back and forth across the surface. The smoothed and polished surface that was formed on the experimental whetstone duplicates the one on the excavated fragment.

C. Sculptural Fragments

Five detached fragments of sculpture, as well as part of a large metate with a lug on one end, were found in the excavations. Four of these specimens are made of a fine-grained greenstone similar to the one used for notched stones.

D. Beach Cobbles

Several hundred cobbles with no apparent use marks were recovered in the excavations. Presumably, they were hauled to the site from the beaches on the island. Their use remains unknown.

RAW MATERIALS

Material is one of the most important factors in determining how a stone was used. The type of material puts certain constraints on the use of the stone. For example, a piece of siltstone (quartz and mica) does not work well as a hammer for use on chalcedony. The chalcedony is harder and it is likely to break the hammer, rather than the reverse. However, the siltstone will work well as a hammer for cracking palm nuts. Similarly, an implement destined for heavy use, such as a celt, is usually made of a tough resilient stone.

At Isla Palenque some artifacts, for example manos and metates, were made on only one kind of material (an igneous rock) while others, such as hammers, were made of several different materials. An igneous rock was also used for tools such as pounding-mashing stones, handstones, hammers, anvils, and most celts. Metamorphic rock was used for some celts and some hammers. Metaigneous rock was used for notched and grooved stones, and nutting stones. Sedimentary rock was used for rasps. Both metamorphic milky quartz and sedimentary chalcedonies were used for chipped stone artifacts. Both these materials fracture concoidally and both give strong, sharp edges. Some andesite may have also been used.

Celts tend to be of hard, dense, and durable stones like andesites, diorites, rhyolites, and basalts. When polished, these stones hold up well under repeated blows from being used as cutting and perhaps planing instruments. However, the evidence indicates that they eventually wore down and/or broke, and were discarded. Thin sections were made from three celts at IS-3 and are described in Shelton Einhaus (ms. 1976, pp. 68–69).

Another specimen, one of the notched stone fragments, was also thin-sectioned. It is a volcanic tuff with fragments of mica, feldspar, clay, and quartz.

Pounding-mashing stones are heavy, dense stones, often very fine-grained, that do not seem to crack easily. Their strength was a necessary prerequisite for the repeated pounding and mashing action that has been attributed to them. The broad, flatly battered ends are evidence that the stone wears away evenly with this kind of usage, rather than chipping and breaking as lighter stones might do.

Anvils were also made of similar materials, but in some cases less fine-grained and dense stones were used.

Grinding stones or handstones, like manos and metates, were made of brittle stones, having the "self-sharpening" characteristics referred to previously in the artifact descriptions. A likely candidate is an andesite with large phenocrysts in a soft matrix.

The igneous materials out of which notched and grooved stones and nutting stones were made can be easily marked with a sharp implement such as a sharply chipped chalcedony flake; thus these stones could be quickly and easily shaped with such a tool. The light blows required for breaking palm nuts would not shatter the material as rapidly as hammer usage would.

Rasps were made of what appears to be slabs of water-smoothed sandstone, a material that is light and can be easily shaped by use, or so it seems. The small whetstone is a stone with larger phenocrysts, coarser than rasps in appearance.

William H. Bishop (ms. 1961) notes that lithic materials from the area around the city of David, and from the dikes farther north, are of igneous origin. Bishop also notes that on the mainland, in the area around San

Lorenzo, there are mountains of igneous material. Either of these sources could have supplied the materials for the IS-3 tools made of igneous stone.

The principal chipped stone materials — metamorphic quartz and sedimentary chalcedonies, particularly a green variety — were apparently available on or near the island. However, the red and yellow-brown jasper used in making trifacial points was not found locally; but it is known to occur both in the highlands of Chiriqui and in the central provinces and may have come from either region.

Celt materials probably came from mainland quarries or from gravels in major stream valleys. Beach cobbles as large as the pounding-mashing stones or anvils are not found now on Isla Palenque. Thus, large cobbles, like celt materials, may have been imported to the island. The igneous rocks used for manos and metates were not observed on the island and almost certainly came from the mainland, although the exact location of their source is not known.

Many of the materials used for hammers, and for grooved and notched stones, are available on the beach at IS-3 and probably on other nearby islands.

Thus, it seems clear that a wide variety of stone is represented in the tools found at this site and it is likely to have come from several different areas of Panama. The majority of the stone, however, is of volcanic origin.

TOOL REPLICATION AND WEAR STUDY

A number of experiments were carried out in an attempt to solve some of the questions posed by the artifacts recovered from IS-3. Some experiments were done early on as an aid to formulating a tool typology. These experiments involved method of manufacture and possible uses for the various artifacts.

A celt with a chipped bit from the surface of IS-3 was resharpened in order to observe the manufacturing and resharpening marks resulting from pecking and grinding the surface. This pointed up necessary revisions in existing descriptions of pecking hammers from this site. Since the celts are made of very hard, dense materials, only materials as hard or harder could have been used to peck them (e.g., broken celts and pebbles). Softer, oblong stones, previously classified as pecking hammers, would have crumbled rather than powdering the celt surface. By pecking the chipped bit with a hard stone hammer and then grinding the celt on a whetstone, using wet sand as an abrasive, it was possible to produce a surface resembling the polished ones on the excavated samples. Resharpening is a slow process; in the experiment it took approximately three hours to repair a small area of damage on a slightly blunted celt.

Experiments were also carried out to observe the results of tool use. The tool with the resharpened bit was hand-held and used as a plane. After two hundred strokes of this use, striations were visible microscopically. A pear-shaped celt from IS-3 with a sharp bit was also used to sever the head of a duck, following Lothrop's (1937) suggestion that such celts were used for butchering. For the experiment the tool was hand-held and the extended bit was used with both rotating and chopping motions.

Materials like those out of which the manos and metates were made were not obtained for experimentation. However, manos and metates are regularly used now by the Guaymí (Bort and Young, personal communication). Other evidence of grinding found on cobbles from IS-3 was thought to result from grinding foods and plants other than maize.

A large, dense anvil stone with a smooth and slightly hollowed surface was used in the lab in experiments involving the grinding of root crops. A cobble from IS-3 was used to mash and pulverize several manioc tubers. The edge of the cobble proved useful for smashing the tuber lengthwise, along its long fibers, while the smaller end of the ovoid stone was more useful for pulverizing the fleshy root. The ovoid stone used in the lab showed flattening of the end, much like the excavated pounding-mashing stones. The edge showed a slight facet, resulting from processing several pounds of manioc. Similar edge wear was noted on a few of the excavated tools. We do not mean to imply that manioc was the only foodstuff mashed or ground by these cobbles, or even that manioc was necessarily processed in this manner. A number of other food items could have been prepared by mashing and pounding. For example, Bort reports (personal communication) that pepper corns, garlic, and coffee are ground by modern Guaymí with stone manos and metates. These are all post-Contact additions to the diet, but presumably native foods would have been similarly processed in the past. Today Guaymí also make *chichas* out of mashed and chewed green corn (Young 1971, p. 205), or out of the peach palm which has been boiled, pitted, peeled, and pulped on a metate (J. Bort, personal communication, 1975).

Attempts to replicate line sinkers were also carried out in the lab. A small green siltstone pebble from the site was etched with a sharp flake of jasper to produce a groove around the stone. Going over and over the groove several times with the jasper flake rapidly produced a stone very similar to the grooved artifacts. The same piece of soft siltstone was also used to replicate a nutting stone, although it is somewhat smaller than the nutting stones from IS-3. The same sharp pointed jasper flake was used to hollow out a depression in the center of one surface, using a back and forth and a circular motion. Within five minutes a hole much like those on nutting stones was produced. A larger pebble of greenstone was also chosen to make a nutting stone replica, but it proved more resistant as it was much harder, and the work progressed more slowly.

We were particularly interested to know whether breaking down various kinds of stone on an anvil using bipolar flaking techniques would produce a large number of what I have suggested were grater chips at this site. One or two such flakes did result when a large chalcedony core was broken down in this manner. However, it is not clear whether all of those in the excavated assemblage from IS-3 were produced as by-products or as desired results of the bipolar technique. There are several small cores known from the excavation which could provide only small flakes, suggesting that such flakes were being intentionally produced, if not for grater insets then for some other as yet undetermined use.

Other experiments with chipped stone involved the production and use of trifacial points like those excavated at the IS-3 site. The most satisfactory technique employed was first to produce thick blades as blanks and then to trim these by steep unifacial retouch, using small pointed hammerstones with an anvil rest. Alternatively, a bifacially flaked ridge was made on a thin core, then removed by a blow in much the same manner as detaching a burin spall. The minimal retouch necessary to form the point and tang of the implement was done with a small pointed hammerstone on an anvil rest. A number of these points were socket hafted into the tips of hollow reeds which were then surrounded with tar and wound with cord, for use as drills (Emmert, personal communication). Microscopic examination of the trifacial points in our sample showed wear suggesting such a use in the form of smoothed-out flake scars near the tip, and somewhat crushed, snapped off, or chipped tips. Some smoothing of flake scars just behind the widened area of the tip could also indicate hafting.

SUMMARY

The stone tools recovered from La Pitahaya (IS-3) show a variety of manufacturing techniques. The techniques frequently employed were percussion flaking, pecking, grinding, polishing, and grooving. The majority of the chipped stone tools are quite simple and their manufacture required little skill, with the notable exceptions of trifacial points and blades, which would have required skill on the part of the maker. However, these tools are comparatively rare. The scarcity of chalcedony chipping debris of the same material raises the possibility that the points were not actually produced at the site, but were in fact, manufactured elsewhere and imported. The same types of points and blades are known from other areas of Panama.

The problem of which finished objects were being imported to the site is also raised by the stone sculpture and basalt columns found at the site. A very small number of chisels was recovered in the collections, suggesting the possibility that the sculpture was carved in situ. However, the materials used for the sculpture, as well as for the polished stone tools, manos, metates, blades, and possibly some of the trifacial points, were imported to the site. Hence, some of these objects were probably manufactured elsewhere, then imported.

Clearly, some of the artifacts found at the site required skilled workmanship. This is true for chipped stone as well as for polished tools such as celts, adzes, and chisels. Ethnographic descriptions and experiments with pecking, grinding, and polishing show this to be a long process requiring expertise. A bad blow can split a tool on which considerable effort has been expended. Cooke's recent work in central Panama (Cooke 1978) suggests that some stone workers were indeed specialists, although we have no way of knowing if this was true at Isla Palenque as well, as none of the burials found there contained stone-making kits.

The bipolar technique commonly employed in chipped stone working at Isla Palenque was known as early as preceramic times in the rock shelters of western Panama (section 3.5); hence, it does not represent a new technique at the much more recent IS-3 site.

CONCLUSIONS: TOOL USES AND IMPLICATIONS FOR SUBSISTENCE

The large number of metates and manos found at IS-3 suggests a heavy reliance on maize agriculture. Other tools thought to have been used in food processing and procurement are pounding-mashing stones, nutting stones, and both notched and grooved stones. Of these the notched stones are by far the most numerous. In turn, nutting stones are more numerous than pounding-mashing stones. Nutting stones may have been used for cracking nuts of the corozo palm thought by C.E. Smith (section 10.5) to have been probably under cultivation at IS-3. Pounding-mashing stones were probably used for crushing seeds, root crops, and/or spices of some kind.

Changes in the frequency of cobble tools in different layers may be particularly important in making inferences about subsistence, as nutting stones, pounding-mashing stones, and edge-used cobbles increase significantly through time. The evidence for metates and manos is not so clear, but in trench I, the most rich in artifacts, there does appear to be an increase in these artifacts in the top layers A and B. This evidence may indicate increased food-processing activities in response to increased population at the site. The diversity of food-processing tools in the top levels suggests a diversity of food resources, among these a growing use of nuts and root crops. Some of the stone tools at the site are indirect but essential parts of subsistence pursuits. For example, celts were probably used in land clearance or for other woodworking tasks like cutting wood for house posts, canoes, and for hafting other stone tools as well.

To conclude, tools are an indispensable part of all human cultural activities. Because they preserve well, they often make up a major segment of the archaeological materials recoverable from a site. The tools from IS-3 have provided valuable information about the activities of the prehistoric inhabitants at the site. However, many problems concerning the pattern of tool distribution are left unanswered, in large part due to the nature of the sample. Five of the eight trenches were placed on the highest parts of the site, on mounds built up by refuse accumulation. The absence of tools in trench VI probably indicates a specialized area of some kind. Trench I had the greatest density of tools and probably was built up by garbage accumulation. No house floors or workshop areas were located in the excavations with the possible exception of trench I, blocks 2 and 3, whose tool density may indicate a specialized area. It is hoped that additional excavations aimed at finding such specialized areas can be carried out at IS-3 sometime in the future.