Adaptive Radiations in Prehistoric Panama

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Stone Tools from the Rio Chiriqui Shelters

A. J. RANERE

INTRODUCTION

The four rock shelters I excavated in 1971 in the upper Rio Chiriqui drainage in the province of Chiriqui, Panama (Ranere 1972b), are all located near the bottom of the Rio Chiriqui canyon at elevations between 645 meters and 900 meters. Eight kilometers to the north, the continental divide rises to an average elevation of 2,000 meters (see section 3.2 for a description of the region). All four rock shelters are small, none containing more than 30 square meters of protected living space.

Casita de Piedra contained preceramic deposits to a depth of 1.4 meters. Six radiocarbon dates, ranging from 4610 B.C. to 940 B.C., fix the time of its occupation. The Trapiche Shelter contained 1.2 meters of predominantly preceramic deposits. Four radiocarbon dates place its preceramic occupation between 3900 B.C. and 350 B.C. The Horacio Gonzales site (undated) contains both preceramic and ceramic components in its shallow deposits. From the fourth site, the Zarsiadero Shelter, we recovered both preceramic and ceramic materials in 70 centimeters of somewhat disturbed cultural deposits. Ten square meters of the first site, twelve square meters of the second, five square meters of the third, and a 1 x 2-meter pit in the fourth site were excavated. This report concerns the more than 45,000 stone flakes and tools recovered from these four shelters.

THE APPROACH TO THE ANALYSIS

The analysis of the lithic assemblages from the Rio Chiriqui shelters presented a number of problems, in part due to the large numbers of specimens that had to be processed but in the main due to the nature of the tool assemblages themselves. The preceramic chipped stone assemblages from the Rio Chiriqui sites differ considerably from those found in North America, the Andean area, and even in the ceramic horizons of Central America. Moreover, while it is quite probable that other sites within the tropical forested regions of South America have similar assemblages, none are adequately described (the problem of comparing the Rio Chiriqui assemblages with others in South America is dealt with elsewhere).

Tool categories such as projectile points, bifacially flaked knives, drills, and blades are either nonexistent in the Rio Chiriqui stone tool inventory or are applied only at the risk of distorting the true nature of the inventory. Forcing chipped stone tools into familiar predefined categories is not only tempting but almost unavoidable in a first encounter with a strange assemblage. Consequently, during the excavation of Casita de Piedra and the other shelters, my impression, as the tools were being found, was that a number of parallels to North American and Andean tool types could be drawn even though some important differences certainly existed. It was on this basis that I first discussed the Rio Chiriqui tools in a preliminary fashion (Linares and Ranere 1971). Unfortunately, first impressions are not always reliable, for, in this case, I overestimated the importance of the few pieces which resembled burins and blades, while underestimating the importance of small wedges which occurred by the dozens, but which were tools unfamiliar to me.

Rather than use categories of tools designed to describe the more familiar kinds of New World assemblages, it was decided to define new tool types based on a study of the Rio Chiriqui materials themselves. Therefore, the first step in the analysis was to examine every flake in the collections, separating out for individual cataloguing those pieces which were tools or tool fragments or which showed any sign of human modification other than the single blow which detached the flake from its parent block. During this initial sorting operation, no attempt was made to separate pieces into categories beyond the distinction between "unmodified, unused flakes" and "all others." Throughout this rather lengthy process, a stereoscopic microscope was used regularly to look for signs of wear, which could indicate how the tool was used, and for evidences of the manufacturing or flintknapping techniques employed in making the tools. When the patterns of tool form, function, and manufacturing techniques began to emerge, I initiated a series of experiments in an attempt to replicate the forms and technological characteristics of tools in the collections. The tools made in these experiments were then used to perform a variety of tasks in an attempt to replicate the wear patterns observed under the microscope. Additional experiments in lithic technology were carried out in order to reproduce the range of flakes found in the sites and thus to identify stoneworking techniques known to the prehistoric inhabitants of the Rio Chiriqui valley (see Ranere 1975 for a lengthier discussion of the replicative experiments).

By the end of the initial sorting, and after a number of experiments, I was considerably more aware of the kinds of tools and stoneworking techniques represented in the collections. From this relatively knowledgeable position, the entire collection was reexamined. All chipped stone from a single occupation layer was laid out on the laboratory tables, and tools (including tool fragments) were separated once again from "unmodified unused flakes," correcting the identifications made during the initial examination where necessary. Also, at this time attempts were made to match artifact fragments, flakes with their cores, and flakes with flakes, with modest success.

Finally, all tools and tool fragments from each individual site were grouped together, then classified without regard to layer provenience. It was at this stage of the analysis that artifact categories were first formally defined. Tools from all sites were laid out on tables at the same time, and every precaution was taken to insure that artifact categories were consistent from site to site as well as from layer to layer.

A similar procedure was followed in the classification of nonchipped stone tools, but one made simpler because of the fewer numbers of tools to consider. All artifacts from one site made on pebbles, cobbles, and boulders, whether purposely manufactured or shaped through use, were put out together on the laboratory tables and sorted into categories. Again, replicative experiments were carried out in order to better understand the function of the tools and the techniques of manufacture. As with the chipped stone tools, the cobblestone tools were classified without regard to layer provenience, and the categories are considered to be consistent from site to site.

The artifacts were divided into major groups based on the final method of manufacture (e.g., chipped stone, ground and polished stone). Within these groups, artifact types are defined primarily in functional terms and only secondarily in terms of form. In large measure, the emphasis on function in defining artifact types reflects the nature of the stone assemblages themselves. Form seems to be important only in those characteristics that directly affect function (for example, large bifacial wedges have straight bits and taper gradually to a thick body; choppers are large enough and heavy enough to use for chopping). The technological repertoire represented in the assemblages was simple but effective; it appears that as little work as possible went into making a functional tool. Almost all the nonchipped stone tools were not purposefully shaped at all but were suitably sized cobbles or boulders which could be used as found. The modification of these cobbles into recognizable (and classifiable) forms came about only through use.

DESCRIPTION OF ARTIFACTS

A word of caution must be introduced here before going on with the tool descriptions. A great many tools from these shelters consist of flakes, spalls, cobbles, and so forth, used without modification. Identification of these specimens as tools depends on the analyst's ability to detect evidence of their use. In order to do this, the wear patterns on the working surfaces of the tool must be preserved reasonably intact after the tool has been discarded. Unfortunately, some of the rocks used for tools in the Rio Chiriqui sites weather rapidly when a fresh surface is exposed. Most of the andesite used for chipped stone tools and the granite cobbles used for grinding and mashing are included in this category. The weathering of some andesite pieces is so great that evidence for use retouch would not be preserved. Other andesite specimens are not so heavily weathered and use retouch can be detected, although wear polish and striations cannot. As figures 8/1 and 8/2 indicate, andesite accounts for between 48 percent and 96 percent of the chipped stone found in major stratigraphic units. Therefore, a considerable number of tools, particularly those modified only through use, have necessarily gone unrecognized. Flake knives, flake scrapers, and

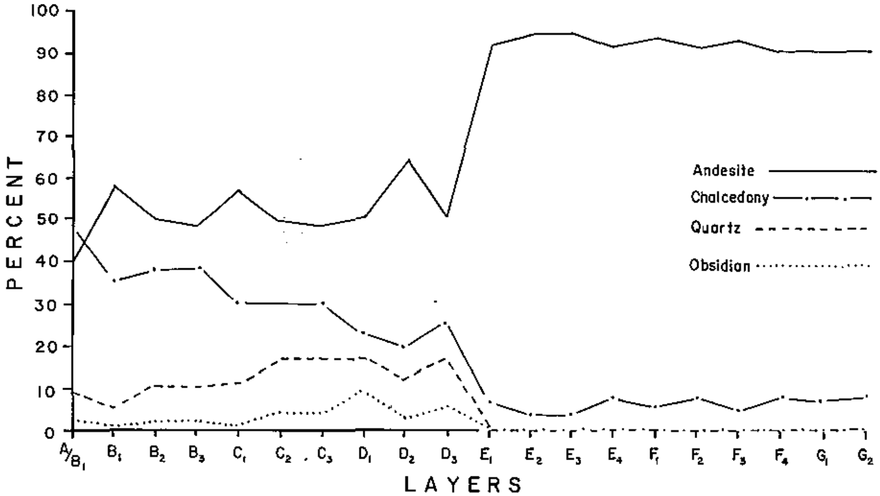

Figure 8/1: Percent of andesite, chalcedony, quartz, and obsidian chipped stone by layer in Casita de Piedra

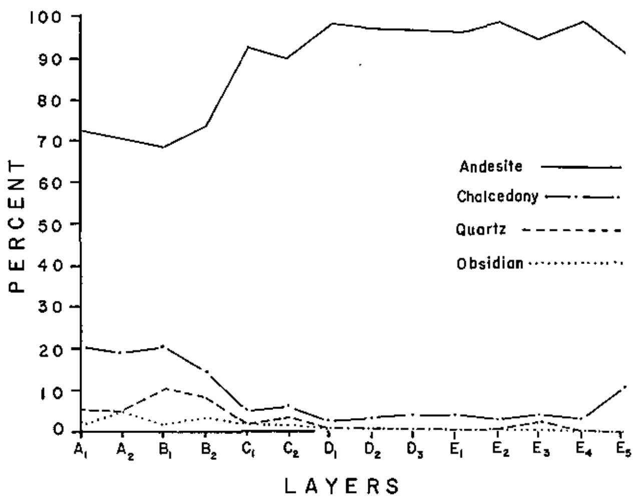

Figure 8/2: Percent of andesite, chalcedony, quartz, and obsidian chipped stone by layer in the Trapiche Shelter.

gravers, in particular, are certainly more common than is indicated in the discussion to follow.

I. *Chipped Stone*

In this section, the major classes of chipped stone artifacts (e.g., scrapers, choppers, wedges) are subdivided into different varieties (e.g., steep scrapers, concave scrapers), and these form the basic descriptive unit. The method of manufacture and probable use of the tool types are included in the description, as is the description of the tools by site and layers. Distributions of artifacts are further broken down to sublayers in each of the sites and recorded in tables 1–4. Dimensions are given for the largest and smallest artifact in each category and for the artifact in the median position (having a like number of objects larger and smaller than itself). Providing measurements for individual specimens rather than listing maximum-minimum values for each dimension may convey a better picture of tool proportion (that is, the relationship between its length, width, and thickness). Distinctions made in the raw materials used in tool manufacturing were limited to five: andesite, chalcedony (which includes other cryptocrystalines such as jasper and agate), quartz, obsidian, and "other" (primarily coarse-grained volcanic and metamorphic rocks).

A. Cores

1. Conical cores (fig. 8/3 j-l). These have a single striking platform from which flakes have been detached. Negative flake scars extend completely around the perimeter on most specimens and more than halfway on the remainder. The cores are not supported on an anvil; therefore, the flakes curve underneath the core on detachment, giving the distinctive conical shape. Most of these small cores were simply discarded as exhausted. However, some of the specimens considered as scraper-planes may have been made on conical cores. One unusually large specimen made on a small boulder produced flakes large enough to be used as choppers.

Dimensions: largest, 21.0 x 13.5 x 7.4 cm; smallest, 2.6 x 1.6 x 1.4 cm; median, 4.2 x 4.1 x 2.9 cm. Material: At Casita de Piedra, 5 andesite, 1 other (total 6); at Trapiche Shelter, 3 andesite. Distribution: At Casita de Piedra, 1 in layer E, 3 in F, 2 in G (disturbed); at Trapiche Shelter, 1 in B, 2 in E.

2. Bifacial cores (fig. 8/3 p,q). Several bifacially flaked objects in the collections appeared to serve no purpose other than as cores for removal of flakes. Instead of having a flat striking platform, these cores have an edge functioning as the striking platform with flakes removed in two directions. One of these bifacial cores is made on a small boulder and has flakes removed on alternate sides along one edge. The smaller cores tend to be disk-shaped or round, and biconvex in cross section; the perimeter of the disk is the striking platform and the flakes terminate at the center of the two opposing faces. None of the specimens show evidence of having been used as a chopper or wedge. Furthermore, they are not the proper shape to be considered blanks or preforms for bifacially flaked wedges.

Dimensions: largest, 15.4 x 14.4 x 8.2 cm; smallest, 5.0 x 4.9 x 2.3 cm; median, 6.7 x 5.5 x 3.0 cm. Material: Casita de Piedra, 2 andesite, 1 other (total 3); Trapiche Shelter, 2 andesite, 3 chalcedony (total 5); Zarsiadero Shelter, 1 chalcedony. Distribution: Casita de Piedra, 2 in layer C, 1 in E; Trapiche Shelter, 1 in A, 1 in B, 3 in D; Zarsiadero Shelter, 1 in B.

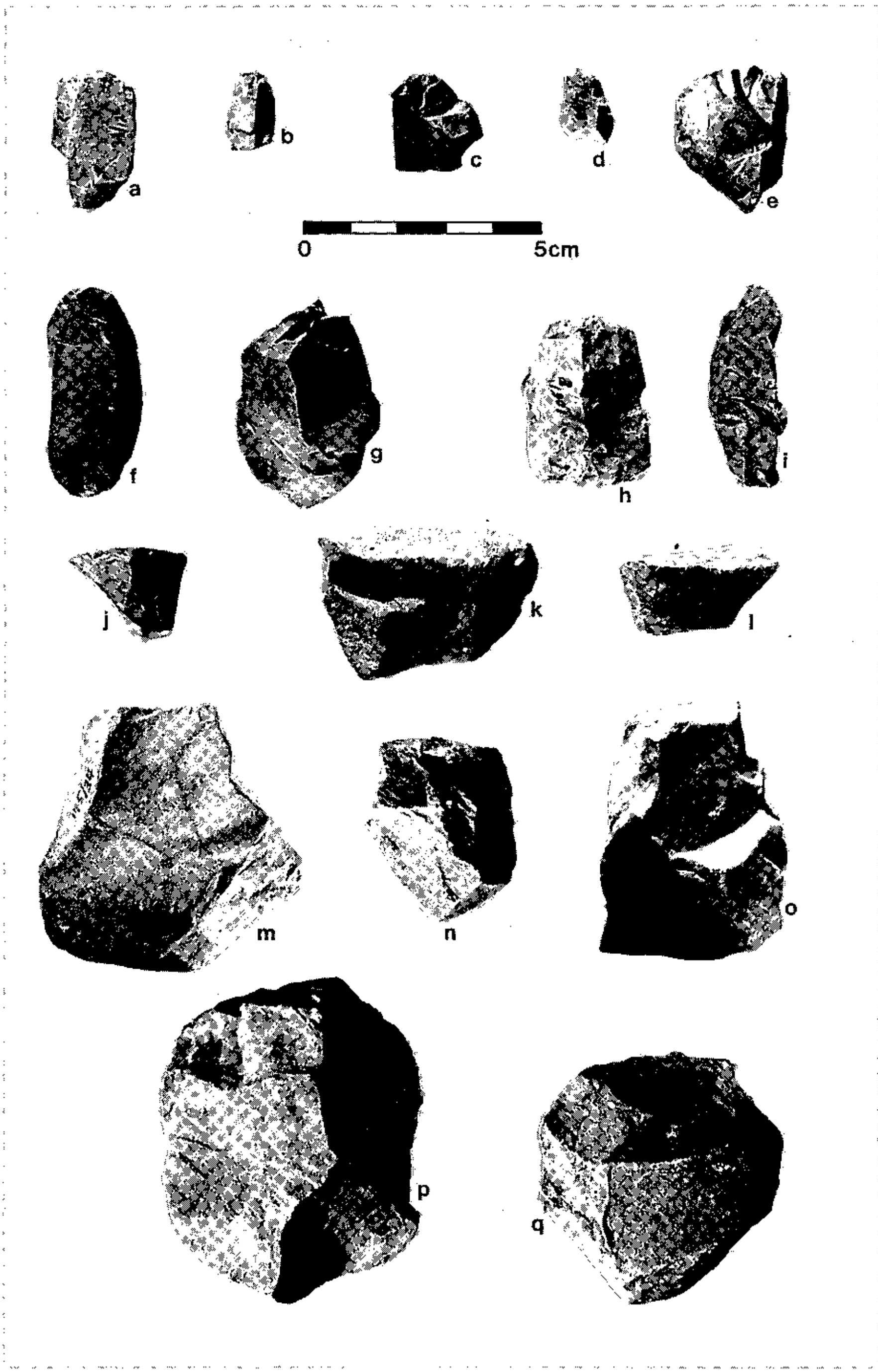

Figure 8/3: a-i. Bipolar cores; j-l. conical cores; m-o. irregular cores; p,q. bifacial cores.

3. Bipolar cores (fig. 8/3 a-i). Included here are cores, core remnants, or fragments which have negative flake scars originating at opposite ends of the specimen. This indicates that an anvil was used in the flake removal process. Such a method of flake detachment is called the bipolar flaking technique, since a single blow from a hammer results in force being applied simultaneously to both distal and proximal ends; that is, at the point of contact between the core and the hammer and at the point of contact between the core and the anvil. In the Rio Chiriqui sites, small rounded pebbles were supported on a stone anvil and struck by a hard stone hammer. Although the bipolar flaking technique lacks precision (cf. Sollberger and Patterson 1976), it is an efficient way to reduce small pebbles into usable flakes. With force being applied simultaneously at both ends of the core, flakes cannot "curve under" the distal end of the core and are therefore quite straight. Core remnants themselves are often straight, parallel-sided tabular pieces. Both flakes and core remnants produced by the bipolar flaking technique are ideal for use as small wedges. Numerous specimens classified as tabular and broadbased wedges are bipolar cores which show subsequent flake removal and polish, having been used as wedges or chisels. Specimens listed below do not show any additional evidence of use other than as cores.

Dimensions: largest, 3.8 x 3.5 x 1.4 cm; smallest, 0.9 x 0.7 x 0.6 cm; median, 2.5 x 1.2 x 0.8 cm. Material: Casita de Piedra, 97 chalcedony, 3 quartz, 1 obsidian, 2 andesite (total 103); Trapiche Shelter, 25 chalcedony, 2 quartz (total 27); Zarsiadero Shelter, 5 chalcedony. Distribution: Casita de Piedra, 9 in layer A/B, 8 in B, 26 in C, 19 in D, 31 in E, 4 in F, 1 in G (disturbed), 5 in ABC; Trapiche Shelter, 6 in A, 8 in B, 4 in C, 7 in D, 2 in E; Horacio Gonzales Site, 3 in C; Zarsiadero Shelter, 1 in B, 1 in B/C, 3 in C.

4. Irregular cores (fig. 8/3 m-o). Blocks of material which have had flakes removed in a random manner are grouped together as irregular cores. Some are exhausted cores from which further flake removal is impossible. Others have very few flakes removed and seem to have been abandoned because the material was not suitable for flaking. None of the pieces included in this category appears to have been used after functioning as a core.

Dimensions: largest, 16.4 x 9.7 x 8.9 cm; smallest, 2.2 x 1.6 x 1.2 cm; median, 3.8 x 2.8 x 2.6 cm. Material: Casita de Piedra, 14 chalcedony, 10 andesite, 2 quartz (total 26); Trapiche Shelter, 1 chalcedony, 8 andesite, 1 obsidian (total 10); Zarsiadero Shelter, 1 chalcedony, 1 andesite, 1 quartz (total 3). Distribution: Casita de Piedra, 2 in layer A/B, 5 in B, 7 in C, 3 in D, 6 in E, 1 in F, 2 in G (disturbed); Trapiche Shelter, 2 in A, 1 in B, 5 in C, 1 in D, 1 in E; Zarsiadero Shelter, 1 in A, 1 in B, 1 in C.

B. *Large Wedges*

1. Bifacial wedges (fig. 8/4 a-f, k). These are large, bifacially flaked implements which have celtlike forms; that is, they are long and thick bodied. They were not hafted either as axes or adzes, but were used as wedges or chisels. The bit end on complete specimens was carefully flaked to a sharp,

Figure 8/4: a-f, k. Bifacial wedges; g-j. irregular bifacial wedges.

relatively straight edge. It tapers gradually back to the thick, center section of the tool at about a 45° angle. Wedges which have been resharpened depart from these ideal characteristics, more or less depending on the success of the resharpening. Often the resharpened bit may be straight and sharp, but hinging of the resharpened flakes increases the angle and the smoothness of the taper. The butt end of these wedges almost always has an area of heavy battering slightly offset from the long axis of the tool. Frequently the battering occurs on a small portion of cortex which seems to have been purposely left intact in shaping the wedge. This would be reasonable since the cortex of the andesite blocks is stronger than the freshly exposed rock and can withstand more hammering. The bit is more heavily worn on the corner directly opposite the battered portion of the butt than in any other place. Wear polish, which also extends for three-fourths of the length of the tool on the high spots, is more heavily developed on the most convex side of the tool (the cross sections of the wedges tend to be plano-convex). Striations visible in the polished areas run at an angle of ca. 30° from the long axis of the tool. The lateral edges of the tools are usually blunted. These various wear patterns and manufacturing characteristics strongly suggest that these tools were handheld at a 30° angle (more or less) to the wood being split or chiseled, and driven in with a mallet of hard wood or perhaps stone.

In experiments, I replicated several of these wedges using only a hammerstone to remove flakes. One of these I used repeatedly in splitting wood blocks, holding the tool at an angle and driving it with a hard wooden mallet. As a result, wear patterns virtually identical to those on the archaeological specimens were produced.

Many of the specimens had been resharpened, and others had been broken in the resharpening attempt. A series of flakes that carried off the worn bit end of these wedges were recovered. These flakes show that the tool length was reduced at least 7 to 10 mm during each resharpening. This suggests that some of the wedges in the collection were resharpened several times before being discarded. One of these wedges (from layer E in Casita de Piedra) was reused as a hammerstone after several resharpenings (it is short relative to its width and thickness). It has blunted lateral edges and heavy wear polish on its faces, but it has a battered, rounded end where the bit should be.

Dimensions: largest, 12.0 x 4.1 x 3.4 cm; smallest, 7.0 x 3.3 x 1.6 cm; median, 9.3 x 3.9 x 2.3 cm. Average weight: 150 gm. Material: Casita de Piedra, 14 andesite; Trapiche Shelter, 28 andesite, 1 chalcedony (total 29); Zarsiadero Shelter, 11 andesite. Distribution: Casita de Piedra, 11 in layer E, 3 in F; Trapiche Shelter, 2 in B, 2 in C, 20 in D, 5 in E; Zarsiadero Shelter, 5 in B, 3 in B/C, 3 in C.

2. Irregular bifacial wedges (fig. 8/4 g-j). These tools appeared to function as wedges or chisels in the same way as the celtlike wedges. They differ in that they are made on cobbles and large flakes with a minimum of shaping by bifacial flaking. Most have wear polish on the bit edge and on the faces of the tools, most noticeably on the more convex side. Most also have a battered area at the butt end.

Dimensions: largest, 11.5 x 4.6 x 3.6 cm; smallest, 4.9 x 2.9 x 2.4 cm; median, 7.0 x 5.6 x 2.1 cm. Materials: Casita de Piedra, 6 andesite; Trapiche Shelter, 6 andesite. Distribution: Casita de Piedra, 5 in layer E, 1 in F; Trapiche Shelter, 5 in D, 1 in E.

3. Biface fragments. Most specimens are probably bifacial wedge fragments, since this is the most common bifacially worked artifact type found at the shelters. However, a few pieces may be from bifacial cores or bifacial choppers.

Material: Casita de Piedra, 31 andesite, 2 chalcedony (total 33); Trapiche Shelter, 29 andesite; Horacio Gonzales, 1 andesite; Zarsiadero Shelter, 5 andesite. Distribution: Casita de Piedra, 1 in layer A/B, 4 in B, 4 in C, 18 in E, 5 in F, 1 in ABC; Trapiche Shelter, 1 in A, 2 in B, 6 in C, 19 in D, 1 in E.

C. *Small Wedges*

1. Tabular wedges (fig. 8/5 a-y). These are small tools generally made on a flake, but are also made on core remnants. They average about 2.0 centimeters in length and weigh approximately 20 grams. Flakes are removed from opposite ends of the artifact and from both faces, creating a wedge- or chisel-shaped edge at one or both ends of the artifact. These edges have a series of small, generally hinged, use flakes evident. Some of these tabular wedges exhibit wear polish on the bit edge and on the high spots of both faces. Striations visible in the polished areas indicate that the tool was

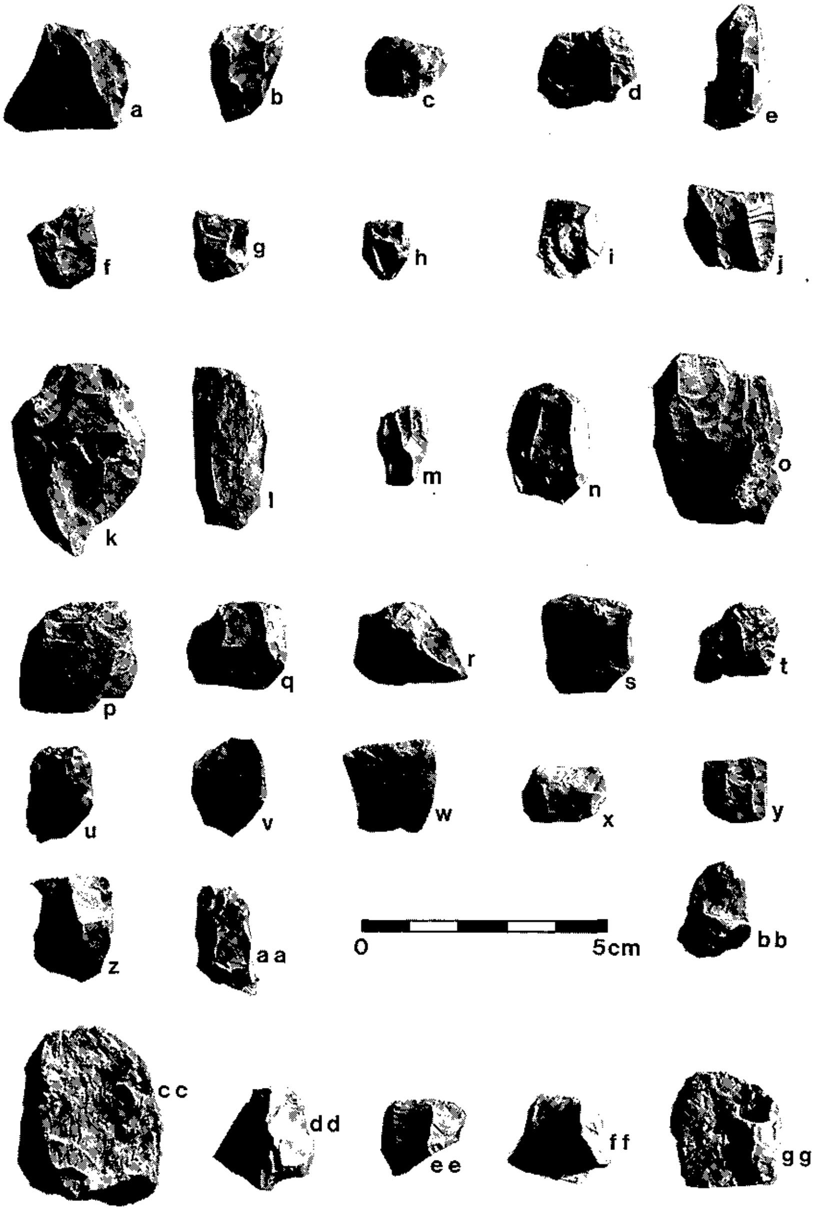

Figure 8/5: a-y. Tabular wedges; z-gg. broad-based wedges.

driven directly into the material being worked (probably wood) since they parallel the working axis of the tool. In some cases, sets of striations perpendicular to each other can be observed, indicating that the tool had two different and adjacent bits. More often, if a wedge had more than one edge used as a bit, the two edges were opposite each other. Occasionally, flake scars will extend the length of the wedge, giving it a "fluted" appearance. The fluting occurs quite naturally when a wedge is deeply embedded in wood, and therefore rigidly supported, and meets resistance when an attempt is made to drive it further into the wood. I produced several such fluted specimens during the course of my experiments. The maximum dimension of the tool can be either parallel or perpendicular to the working axis of the tool; many are approximately square.

Some wedges seemed to have been intentionally shaped for use, others simply shaped by use. In most cases, this distinction could not easily be made. By hitting straight down with a hammerstone on a flake or core remnant on a stone anvil (bipolar flaking), quite regularly formed double-bitted wedges could be produced. On the other hand, by driving a previously unmodified flake or core remnant into a block of wood and reversing the direction of the wedge occasionally, nearly identical forms result. Once the purposefully manufactured wedge has been used long enough to acquire wear characteristics, it becomes indistinguishable from the wedge formed solely through use.

In the experiments, these tools worked quite well as wedges, and could split sizable pieces of wood if several were used at a time. I have also used these tools as chisels; in fact, the decision to call them wedges instead of chisels was purely arbitrary. In my experiments, a limb section of hard wood was used as a mallet to drive the unhafted wedges into wooden blocks. These replicated wedges were identical to the archaeological specimens in form, in the use flakes removed from the bit end, in the crushing and use flakes removed from the butt end, and in the wear polish on the faces.

Some of the wedges are quite small (many being less than 1.5 centimeters in length); too small to be held between the fingers and hit with a mallet without endangering your fingers. They may have been used by holding them with something like a doubled green twig — a kind of primitive pliers. Alternately, they may have been hafted in wood, bone, or antler and thus have been bits in a composite splitting or chiseling tool. I have used a small wedge hafted in antler as a wood-splitting implement and found it to be very effective. I hasten to point out that the extension of wear polish, the length of some archaeological specimens, and the heavy battering of the butt ends seem to argue against the hafting of the tools. It is possible, however, that these wedges were reversed or turned sideways in their haft when the original bit became damaged or dulled.

Dimensions: largest, 5.6 x 3.0 x 1.5 cm; smallest, 1.1 x 0.9 x 0.5 cm; median, 2.1 x 1.5 x 0.5 cm. Material: Casita de Piedra, 110 chalcedony, 57 quartz, 17 obsidian, 2 andesite (total 186); Trapiche Shelter, 32 chalcedony, 17 quartz, 11 obsidian, 2 andesite (total 62); Horacio Gonzales Site, 14 chalcedony, 1 quartz (total 15); Zarsiadero Shelter, 14 chalcedony, 1 obsidian, 1 andesite (total 16). Distribution: Casita de Piedra, 15 in layer A/B, 37 in B, 73 in C, 40 in D, 9 in E, 1 in G, 11 in ABC; Trapiche Shelter, 23 in A, 32 in B, 3 in C, 3 in D, 1 in E; Horacio Gonzales Site, 1 in A/B, 13 in C, 1 in D; Zarsiadero Shelter, 5 in A, 7 in B, 4 in B/C.

2. Broad-based wedges (fig. 8/5 z-gg). The description of this artifact type closely follows that given for the tabular wedges except that the bit is opposed by a broad flat platform instead of a narrow one. Thus, whereas the tabular wedges could be and often were reversed when being used, the broad-based wedges could be oriented only one way, having a bit end distinct from the butt end. The bases of these wedges generally show crushing and small, hinged, use flakes around the periphery as a result of being pounded by a mallet. Broad-based and tabular wedges seem to be functional equivalents although the more blocky shape of the broad-based variety makes it a somewhat stronger tool; it can be driven with more force without fracturing.

Dimensions: largest, 3.7 x 2.4 x 1.9 cm; smallest, 1.0 x 0.9 x 1.4 cm; median, 1.8 x 1.5 x 1.4 cm. Material: Casita de Piedra, 18 chalcedony, 4 quartz (total 22); Trapiche Shelter, 4 chalcedony, 3 quartz (total 7); Horacio Gonales Site, 1 chalcedony; Zarsiadero Shelter, 4 chalcedony. Distribution: Casita de Piedra, 2 in layer A/B, 10 in B, 6 in C, 2 in D, 1 in E, 1 in F; Trapiche Shelter, 2 in A, 5 in B; Horacio Gonzales Site, 1 in C; Zarsiadero Shelter, 2 in A, 1 in B/C, 1 in C.

3. Probable small wedges. This is not a third distinct wedge variety, but simply a category including all those specimens which appear to have been used as wedges or chisels but which either lack some diagnostic characteristic or else are too fragmentary to be positively identified as wedges. It was often the case in my experiments that flakes used as wedges did not develop the pattern of use flakes described for tabular and broad-based wedges. This was particularly true for wedges made from "brittle" material which tended to snap at the point where the wedge entered the wood rather than having use flakes removed along the edge of the bit. Thus, it is my feeling that all specimens in this category can be considered wedges even though this cannot be demonstrated as convincingly as for the tabular and broad-based wedges.

Dimensions: largest, 3.2 x 2.6 x 0.9 cm; smallest, 1.0 x 1.0 x 0.3 cm; median, 2.2 x 1.5 x 0.6 cm. Material: Casita de Piedra, 89 chalcedony, 32 quartz, 3 obsidian (total 124); Trapiche Shelter, 27 chalcedony, 11 quartz, 5 obsidian (total 43); Horacio Gonzales Site, 6 chalcedony; Zarsiadero Shelter, 4 chalcedony, 3 quartz (total 7). Distribution: Casita de Piedra, 6 in layer A/B, 42 in B, 42 in C, 24 in D, 6 in E, 4 in ABC; Trapiche Shelter, 14 in A, 23 in B, 3 in C, 3 in D; Horacio Gonzales Site, 5 in C, 1 in D; Zarsiadero Shelter, 6 in B, 1 in C.

D. Choppers

1. Bifacial choppers (fig. 8/6 i-k). A few chopping tools in the collections had bifacially flaked edges. These were large heavy cobbles flaked completely around the periphery with one edge battered. Most of the specimens are fragmentary.

Dimensions: largest, ? x 6.5 x 3.5 cm; single complete specimen, 7.0 x 6.3 x 3.1 cm. Material: Casita de Piedra, 4 andesite; Trapiche Shelter, 1 andesite; Zarsiadero Shelter, 2 andesite. Distribution: Casita de Piedra, 1 in layer B, 3

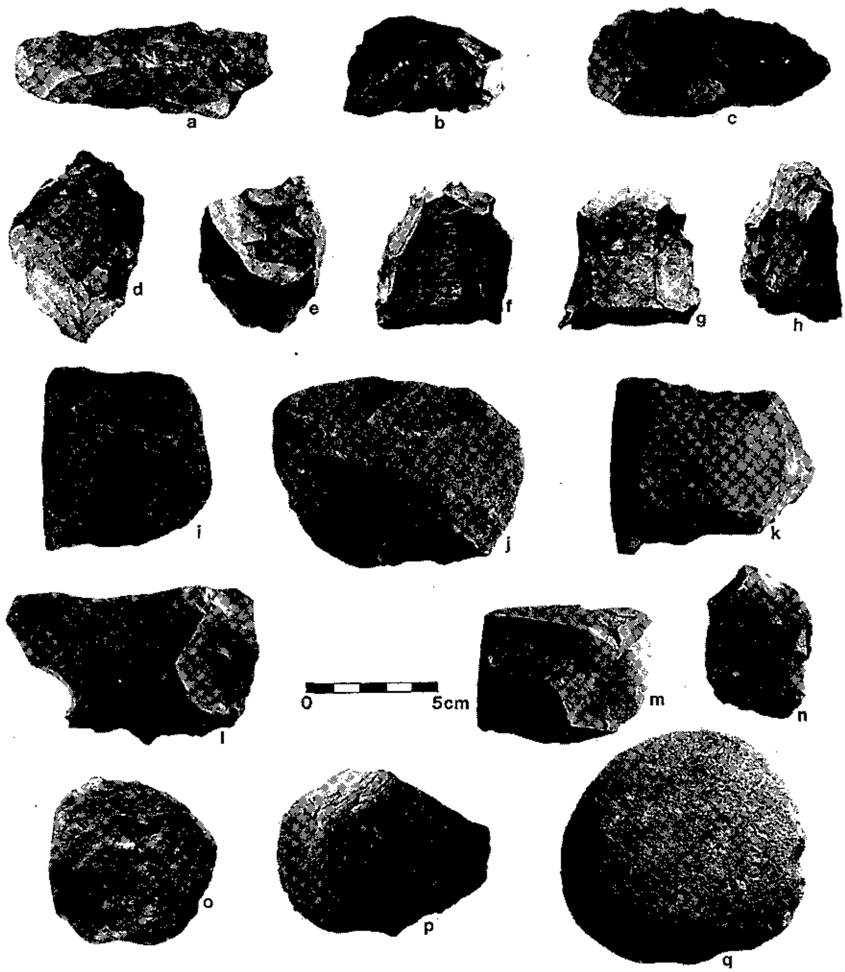

Figure 8/6: a-h. Scraper-planes; i-k. bifacial choppers; l-n. flake choppers; o-q. cobble spall choppers.

in E; Trapiche Shelter, 1 in C; Zarsiadero Shelter, 1 in B, 1 in B/C.

2. Cobble spall choppers (fig. 8/6 o-q). These large flakes or spalls have been detached from rounded cobbles. The flakes are generally round and flat with one edge showing battering or removal of use flakes or both.

Dimensions: largest, 10.5 x 8.9 x 2.8 cm; smallest, 6.5 x 6.0 x 1.2 cm; median, 8.8 x 7.5 x 2.1 cm. Material: Casita de Piedra, 4 andesite, 1 other (total 5); Trapiche Shelter, 4 andesite; Zarsiadero Shelter, 2 andesite. Distribution: Casita de Piedra, 3 in layer C, 1 in D, 1 in G (disturbed); Trapiche Shelter, 1 in A, 1 in C, 2 in D; Zarsiadero Shelter, 1 in B, 1 in C.

3. Flake choppers (fig. 8/6 l-n). The specimens in this category are very much like cobble spall choppers but are made on large flakes struck from

andesite cores. Some show intentional bifacial flaking, but most of the flake removal can be attributed to use of the tools in chopping. A few of these tools may have been used as large splitting wedges.

Dimensions: largest, 8.8 x 7.5 x 3.1 cm; smallest, 3.8 x 3.5 x 0.7 cm; median, 6.2 x 4.6 x 1.6 cm. Material: Casita de Piedra, 11 andesite; Trapiche Shelter, 8 andesite; Horacio Gonzales Site, 1 andesite. Distribution: Casita de Piedra, 4 in layer C, 2 in D, 3 in E, 1 in F, 1 in ABC; Trapiche Shelter, 1 in A, 1 in C, 5 in D, 1 in E; Horacio Gonzales Site, 1 in C.

E. Scraper-planes (fig. 8/6 a-h)

Scraper-planes are heavy tools which have been unifacially flaked around their entire perimeter (with a few exceptions). A number of them are made on thick flakes and are domed or keeled. Working edges can be straight, "toothed," or (rarely) concave. Edge angles are most commonly between 60° and 70°, but range between 45° and 95°. Wear polish occurs on the edges and occasionally along the high spots on the adjacent ventral surface. On some specimens, use flakes are found on the ventral surface as well. Replicated scraper-planes, when used against wood with the ventral surface down, develop the same wear patterns as those observed on the archaeological specimens. These tools are all large enough to be used without hafting. On the other hand, replicas of the smaller specimens were much more effective when hafted. Such hafted tools bear a strong resemblance to the hafted "adze flakes" used by Australian aborigines (Gould et al. 1971). I could not determine from an examination of the archaeological specimens whether or not any had been hafted. (See Hester and Heizer 1972 for a discussion of other uses for scraper-planes.)

Dimensions: largest, 10.7 x 7.5 x 5.2 cm; smallest, 4.1 x 3.1 x 2.1 cm; median, 6.4 x 3.2 x 1.1 cm. Material: Casita de Piedra, 13 andesite; Trapiche Shelter, 22 andesite; Horacio Gonzales Site, 1 andesite; Zarsiadero Shelter, 1 andesite. Distribution: Casita de Piedra, 3 in layer B, 2 in C, 1 in D, 3 in E, 4 in F; Trapiche Shelter, 3 in B, 1 in C, 11 in D, 7 in E; Horacio Gonzales Site, 1 in A/B; Zarsiadero Shelter, 1 in B.

F. Scrapers

1. Steep scrapers (fig. 8/7 f-m). One edge of these flakes has been purposely chipped to form a steep-angled scraping edge. The angle of the working edge varies from 70° to 90°. Five of the scrapers had the working edge on the distal end of a short wide flake. Several were quite small (maximum length 3 cm) and had carefully flaked and rounded scraping edges.

Most of the wear polish on steep scrapers extends from the working edge back along the ventral surface, indicating that these tools were used as planes. Some of the heaviest wear occurred on the smallest specimens. I could not exert enough force to replicate the heavy wear polish or use flakes on experimental specimens without hafting them. A simple socket haft greatly increased the amount of force which could be applied when planing wood with these small tools.

A few specimens had light polish extending from the working edge onto the protruding ridges left by flake scars on the dorsal surface. Rather than being used as planes, these tools were drawn across the surface of the material being worked (probably wood) with the dorsal face downward.

Dimensions: largest, 7.9 x 6.1 x 1.2 cm; smallest, 1.4 x 1.0 x 0.9 cm; median, 2.8 x 2.5 x 0.8 cm. Material: Casita de Piedra, 31 andesite, 4 chalcedony (total 35); Trapiche Shelter, 12 andesite, 3 chalcedony; Zarsiadero Shelter, 6 andesite, 1 chalcedony. Distribution: Casita de Piedra, 2 in layer B, 1 in C, 3 in D, 22 in E, 7 in F; Trapiche Shelter, 4 in A, 2 in C, 7 in D, 2 in E; Zarsiadero Shelter, 4 in B, 2 in B/C, 1 in C.

2. Concave scrapers (spokeshaves) (fig. 8/7 a-e). All scrapers with one or more concave scraping edges were placed in this category. The scrapers were made on a variety of flakes. The diameter of the concavity or notch varies from 1.8 cm to 0.4 cm with no noticeable clustering. A number of these specimens have convex or straight scraping edges as well as a concave scraping edge.

Wear polish occurs most commonly on the concave working edge, occasionally extending a short distance back along the flake scar ridges on the dorsal surface (where edge angles are steep). Use flakes most often occur on the dorsal face as well. This wear pattern can be duplicated by drawing a spokeshave along a wooden shaft with the ventral surface facing the direction of motion. Use flakes occur less frequently on the ventral surface of spokeshaves (sometimes occurring together with use flakes on the dorsal surface). This suggests that sometimes the tools were used with the dorsal surface facing the direction of motion.

Dimensions: largest, 8.0 x 5.7 x 3.1 cm; smallest, 1.4 x 1.1 x 0.3 cm; median, 3.6 x 2.5 x 1.1 cm. Material: Casita de Piedra, 40 andesite, 26 chalcedony, 1 quartz (total 67); Trapiche Shelter, 40 andesite, 24 chalcedony, 1 quartz (total 65); Horacio Gonzales Site, 5 andesite; Zarsiadero Shelter, 8 andesite, 4 chalcedony. Distribution: Casita de Piedra, 2 in layer A/B, 5 in B, 9 in C, 9 in D, 31 in E, 10 in F, 1 in G (disturbed); Trapiche Shelter, 2 in A, 8 in B, 9 in C, 35 in D, 10 in E, 1 on surface; Horacio Gonzales Site, 5 in A/B; Zarsiadero Shelter, 1 in A, 6 in B, 5 in B/C.

3. Flake scrapers (fig. 8/7 n-t). This is a category of flakes and spalls which shows unifacial use retouch on at least one edge. The scraping edges are generally convex but can be straight. The angle of the working edge varies enormously, as does the size and the shape of the flake or spall which has been used for scraping. A few of the specimens show heavy wear polish on the flat, unretouched side, showing that they were used as scraping planes or push planes. Sixteen flake scrapers have a rounded scraping edge formed at one corner of a generally large flake. Otherwise, there is no particular pattern shown by the tools in this category. These tools were not intentionally manufactured, and it would appear that any flake which had a serviceable working edge was a candidate for scraping.

Dimensions: largest, 10.0 x 7.6 x 1.7 cm; smallest, 1.4 x 0.8 x 0.4 cm;

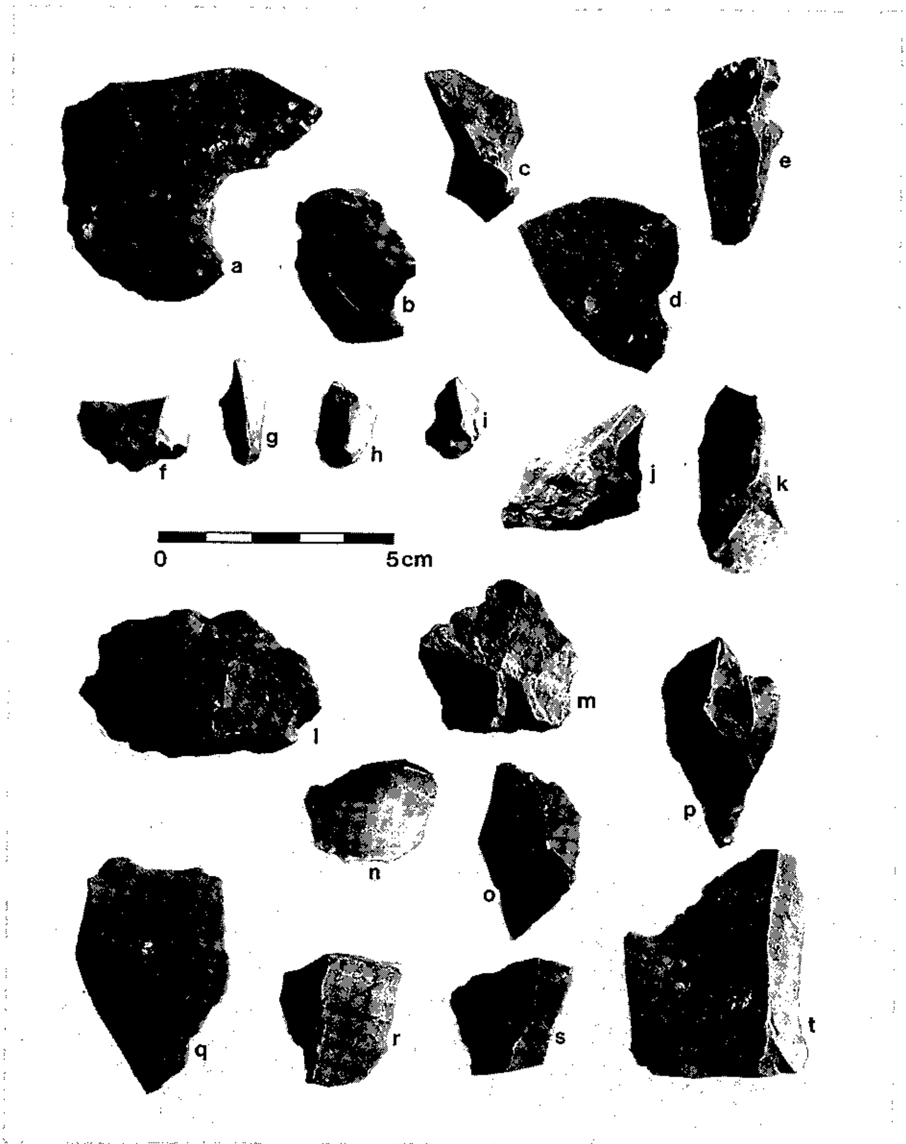

Figure 8/7: a-e. Concave scrapers; f-m. steep scrapers; n-t. flake scrapers.

median, 4.1 x 2.9 x 0.7 cm. Material: Casita de Piedra, 96 chalcedony, 73 andesite, 1 quartz (total 170); Trapiche Shelter, 27 chalcedony, 30 andesite (total 57); Horacio Gonzales Site, 2 chalcedony, 4 andesite (total 6); Zarsiadero Shelter, 9 chalcedony, 8 andesite (total 17). Distribution: Casita de Piedra, 7 in layer A/B, 14 in B, 24 in C, 17 in D, 70 in E, 31 in F, 2 in G (disturbed), 5 in ABC; Trapiche Shelter, 8 in A, 8 in B, 8 in C, 24 in D, 9 in E; Horacio Gonzales Site, 3 in A/B, 3 in C; Zarsiadero Shelter, 6 in A, 2 in B, 6 in B/C, 3 in C.

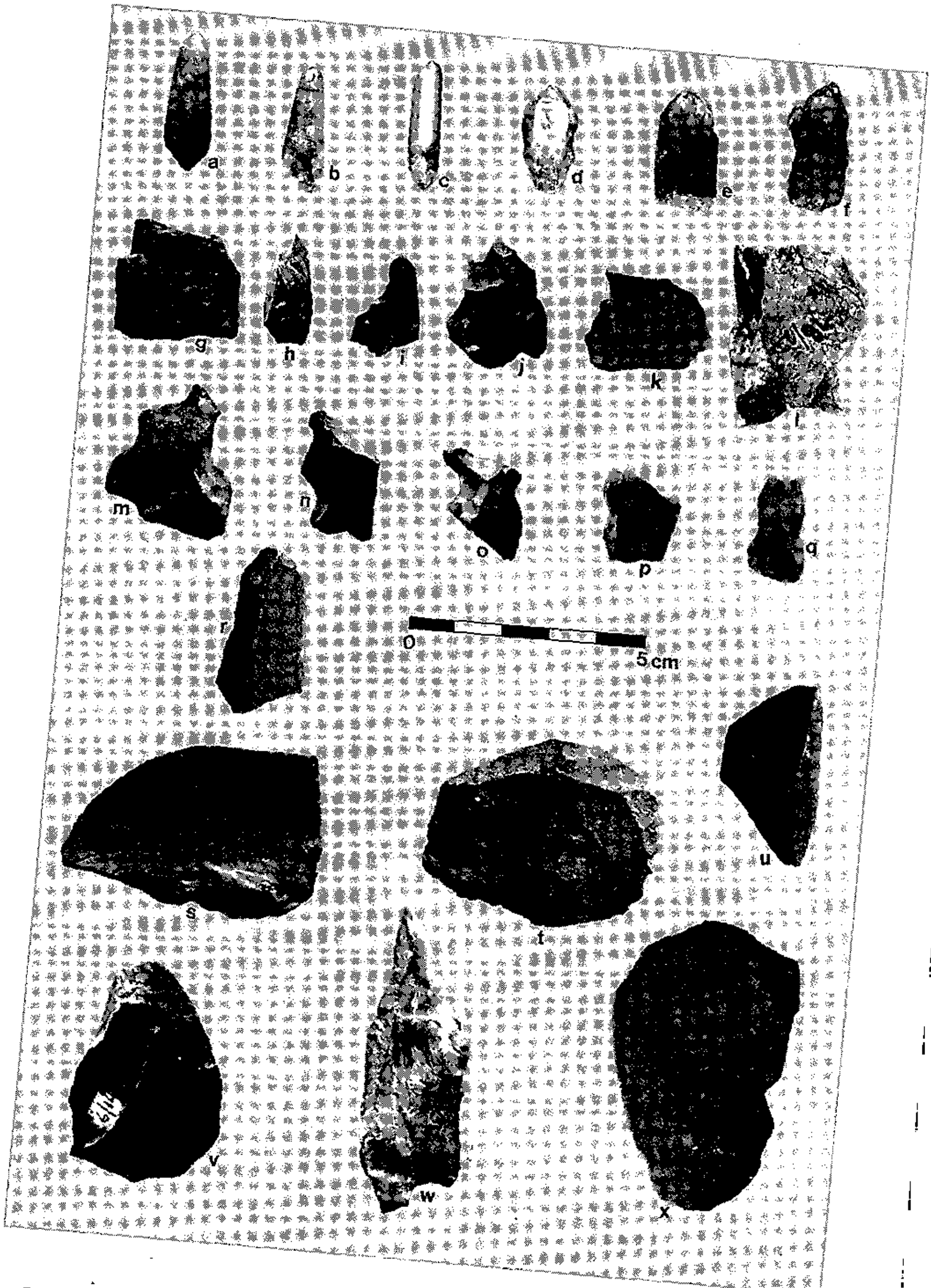

Figure 8/8: a-f. Used quartz crystals; g-l. burins; m-q. gravers; r-x. flake knives.

G. *Flake Knives*

Flake knives (fig. 8/8 r-x) are not intentionally manufactured tools, but they have use retouch or wear polish along one edge, indicating that they functioned as cutting tools. The working edge is generally straight and thin, an edge angle of less than 45° being most common. On most specimens, small flakes have been removed from both sides of the cutting edge. These use flakes are short and usually end in hinges or step fractures indicating that force was applied directly into the body of the tool. This pattern of use flakes contrasts with that found on flake scrapers where force is applied at an angle to the axis of the tool. Edge retouch on scrapers is unifacial, and the small flakes terminate smoothly rather than in step fractures. Flake knives with bifacial use retouch were probably used to cut hard materials, such as wood. In attempting to reproduce the pattern of use flake removal seen on archaeological specimens, I was most successful when using hafted flakes against hard wood. Knives with heavy use polish and no use flakes were probably used to cut meat and other soft materials.

Dimensions: largest, 6.9 x 4.0 x 1.9 cm; smallest, 2.4 x 1.5 x 0.3 cm; median, 4.6 x 3.1 x 0.8 cm. Material: Casita de Piedra, 49 andesite, 3 chalcedony (total 52); Trapiche Shelter, 24 andesite, 5 chalcedony (total 29); Horacio Gonzales Site, 5 andesite; Zarsiadero Shelter, 4 andesite. Distribution: Casita de Piedra, 1 in layer A/B, 1 in B, 8 in C, 8 in D, 25 in E, 7 in F, 1 in G (disturbed), 1 in ABC; Trapiche Shelter, 1 in A, 5 in B, 10 in C, 10 in D, 3 in E; Horacio Gonzales Site, 3 in A/B, 2 in C; Zarsiadero Shelter, 3 in B, 1 in B/C.

H. *Engraving Tools*

1. Burins (fig. 8/8 g-l). The strong, chisellike engraving end of a burin is formed by one or more blows directed perpendicular to the face of the stone being worked. Such a blow removes a burin spall or microblade from along one edge of the stone, leaving it with a squared-off or truncated edge. Two such truncations intersect to form the bit of the burin. Or, if a natural truncation was already present on the stone, the intersection of this truncation with one produced by a burin blow forms the bit of the tool. Numerous specimens in the Rio Chiriqui collections exhibit this specialized truncation or "burin facet." However, most are accidental by-products of the bipolar flaking technique or of breakage of small wedges while being used. The only specimens recorded as burins are those which are not obviously formed by accident. My feeling is that there is no strong burin industry represented in the Rio Chiriqui collections. Nonetheless, the specimens listed below do appear to be purposefully produced burins. Some have small flakes removed from their bits, showing that tools were used.

Dimensions: largest, 4.6 x 2.6 x 0.8 cm; smallest, 1.5 x 0.9 x 0.4 cm; median, 2.8 x 2.4 x 0.6 cm. Material: Casita de Piedra, 7 chalcedony, 3 andesite (total 10); Trapiche Shelter, 2 chalcedony, 2 andesite (total 4); Horacio Gonzales Site, 1 chalcedony; Zarsiadero Shelter, 1 chalcedony, 2 andesite (total 3). Distribution: Casita de Piedra, 1 in layer B, 5 in E, 3 in F, 1 in G; Trapiche Shelter, 2 in A, 2 in C; Horacio Gonzales Site, 1 in C; Zarsiadero Shelter, 1 in B, 2 in B/C.

2. Gravers (fig. 8/8 m-q). These tools have short projections or spurs which exhibit heavy use. On some, the spurs are isolated by fine unifacial retouch. The concavities which result from this retouch look like concave scraping edges (spokeshaves). However, microscopic examination indicates that wear occurs only on the spurs, not on the concavities. Some specimens are simply fortuitously pointed flakes which have been used without modification. All of these gravers have heavy use polish on the tip, and most have small use flakes removed from the tip's ventral surface.

Dimensions: largest, 4.9 x 2.5 x 0.9 cm; smallest, 2.2 x 1.3 x 0.6 cm; median, 3.4 x 1.9 x 1.0 cm. Material: Casita de Piedra, 4 chalcedony, 3 andesite (total 7); Trapiche Shelter, 1 andesite; Horacio Gonzales Site, 1 chalcedony; Zarsiadero Shelter, 1 chalcedony. Distribution: Casita de Piedra, 2 in layer B, 3 in E, 2 in F; Trapiche Shelter, 1 in B; Horacio Gonzales Site, 1 in C; Zarsiadero Shelter, 1 in B.

I. Used Quartz Crystals (fig. 8/8 a-f)

Evidence of wear is shown on the chisel-shaped point at the end of the crystal. Often the opposite end shows the effects of battering. These tools probably functioned as chisels or wedges.

Dimensions: largest, 2.8 x 1.2 x 1.1 cm; smallest, 1.4 x 0.5 x 0.4 cm; median, 2.1 x 1.2 x 1.0 cm. Distribution: Casita de Piedra, 3 in layer B, 1 in C, 3 in D, 1 in ABC; Trapiche Shelter, 5 in B.

J. Blades

Blades can be defined as parallel-sided flakes which are twice as long as they are wide. The striking platform is perpendicular, and the direction of applied force parallel, to the long axis of the blade. True blades are detached from prepared cores. Nonetheless, flakes having all the proper characteristics of blades can be produced accidentally in the process of manufacturing tools such as bifacial wedges, scraper-planes, and choppers. I doubt that blades were purposely produced tools in the Rio Chiriqui sites, since no blade cores were recovered. Instead, all cores were designed to produce short, wide, thin flakes, although bladelike flakes might have been detached in preparation of the core. In an experimental replication of a flake core, where short, wide flakes were the desired end-product, 5 out of 162 flakes could be considered blades. In a similar experiment to reproduce a celtlike wedge, 8 out of 205 flakes could be considered blades. Therefore, it is not at all unreasonable to suggest that the 79 blades recorded in the Rio Chiriqui collection of more than 45,000 stone flakes were accidentally produced. The fact that none of the blades exhibited use flakes or wear polish supports this position.

Dimensions: largest, 15.3 x 3.5 x 1.7 cm; smallest, 2.0 x 0.9 x 0.2 cm; median, 3.8 x 1.7 x 0.5 cm. Material: Casita de Piedra, 23 andesite, 8 chalcedony, 2 quartz (total 33); Trapiche Shelter, 31 andesite, 1 chalcedony

TABLE 1 DISTRIBUTION OF CHIPPED STONE IN CASITA DE PIEDRA

	Conical cores	*Bifacial cores*	*Bipolar cores*	*Irregular cores*	*Bifacial wedges*	*Irregular bifacial wedges*	*Biface fragments*	*Tabular wedges*	*Broad-based wedges*	*Probable small wedges*	*Bifacial choppers*	*Cobble spall choppers*	*Flake choppers*	*Scraper-planes*	*Steep scrapers*	*Concave scrapers*	*Flake scrapers*	*Flake knives*	*Burins*	*Gravers*	*Used quartz crystals*	*Blades*	*Totals (tools)*	*Flakes*
A, B_1			9	2			1	15	2	6						2	7	1				2	47	485
B_1			1				1	3	1	7					1	2							16	220
B_2			2	4				14	5	19	1			2	1	3	6		1	1	1		60	945
B_3			5	1			1	20	4	16				1			6	1		1	2	4	62	889
C_1			8	3			2	23	2	13			2	1		3	10	3				1	71	1,085
C_2		1	6	2				32	1	12		2		1		3	5	3			1		69	1,251
C_3		1	12	2			2	18	3	17		1	2		1	3	9	2				1	74	990
D_1			5					12		3				1			3	2			1		27	404
D_2			12	2				16	1	11		1	2		3	8	7	2			1		66	1,587
D_3			2	1				12	1	10						1	7	4			1	1	40	401
E_1			9							1			1		6	2	9	4	1	1		2	36	1,156
E_2	1		18	4	3	3	7	5	1	1	2		2	1	8	16	30	7	2	1		2	114	5,194
E_3		1	3	2	6	2	9	1		1				2	6	9	25	11	1	1		11	91	3,918
E_4			1		2		2			1	1				2	2	5	3	1			1	21	696
F_1			2													1	2						5	279
F_2																2	3	1					6	443
F_3	2		2	1	3	1	4		1				1	1	4	5	16	5	2	1		2	51	2,016
F_4	1		1				1							3	3	1	9	1	1			5	26	966
G_1								1											1				2	16
$G_{dis.}$	2		2	2								1				1	2	1				1	11	316
$E_{dis.}$								3		2													5	488
A, B, C							1	11		4			1				5	1			1		29	428
Totals	6	3	103	26	14	6	31	186	22	124	4	5	11	13	35	64	166	52	10	7	8	33	929	24,173

TABLE 2 DISTRIBUTION OF CHIPPED STONE IN THE TRAPICHE SHELTER

	Conical cores	*Bifacial cores*	*Bipolar cores*	*Irregular cores*	*Bifacial wedges*	*Irregular bifacial wedges*	*Biface fragments*	*Tabular wedges*	*Broad-based wedges*	*Probable small wedges*	*Bifacial choppers*	*Cobble spall choppers*	*Flake choppers*	*Scraper-planes*	*Steep scrapers*	*Concave scrapers*	*Flake scrapers*	*Flake knives*	*Burins*	*Gravers*	*Used quartz crystals*	*Blades*	*Totals (tools)*	*Flakes*
A_1			4	1				12	2	7					1		5	1	1			4	38	838
A_2		1	2	1			1	11		7		1	1		3	2	3		1				34	1,033
B_1	1		6					9	3	9				1		3	3	2			2	2	41	1,044
B_2		1	2	1	2		2	23	2	14				2		5	4	3		1	3	2	67	2,051
C_1			4	5			5	3		1	1			1	2	6	7	8	2			4	47	1,898
C_2					2		1			2		1	1			3	1	2				1	16	505
D_1		1	1		10	2	9	1		1		1	2	4	4	10	9	3				4	62	3,251
D_2		2	4	1	8	2	10	2		2		1	2	7	2	16	7	6				6	78	3,256
D_3			2		3	1							1		1	9	8	1				6	31	1,941
E_1			2	1	2	1	1							2	2	6	5	2				2	26	1,263
E_2	2				2			1					1	3		2	3						14	928
E_3					1									2		2	1	1				1	8	298
Totals	3	5	27	10	29	6	29	62	7	43	1	4	8	22	15	64	56	29	4	1	5	32	462	18,306

TABLE 3 DISTRIBUTION OF CHIPPED STONE IN THE HORACIO GONZALES SITE

	Bipolar cores	Irregular bifacial wedges	Tabular wedges	Broad-based wedges	Probable small wedges	Flake choppers	Scraper-planes	Concave scrapers	Flake scrapers	Flake knives	Burins	Gravers	Blades	Totals (tools)	Flakes
A, B		1	1				1	5	5	3				16	729
C_1			4		4				3	1		1	2	15	1,587
C_2	3		9	1	1	1			1	1	1		2	20	446
D			1		1									2	55
Totals	3	1	15	1	6	1	1	5	9	5	1	1	4	53	2,817

TABLE 4 DISTRIBUTION OF CHIPPED STONE IN THE ZARSIADERO SHELTER

	Bifacial cores	Bipolar cores	Irregular cores	Bifacial wedges	Biface fragments	Tabular wedges	Broad-based wedges	Probable small wedges	Bifacial choppers	Cobble spall choppers	Scraper-planes	Steep scrapers	Concave scrapers	Flake scrapers	Flake knives	Burins	Gravers	Blades	Totals (tools)	Flakes
A			1		1	5	2						1	6					16	306
B	1	1	1	5	2	7		6	1	1	1	4	6	2	3	1	1	4	47	1,765
B/C		1		3	3	4	1		1			2	5	6	1	2		2	31	787
C		3	1	3			1	1		1		1		3				6	20	631
Totals	1	5	3	11	6	16	4	7	2	2	1	7	12	17	4	3	1	12	114	3,489

(total 32); Horacio Gonzales Site, 2 andesite; Zarsiadero Shelter, 12 andesite. Distribution: Casita de Pedra, 2 in layer A/B, 4 in B, 2 in C, 1 in D, 16 in E, 7 in F, 1 in G (disturbed); Trapiche Shelter, 4 in A, 4 in B, 5 in C, 16 in D, 3 in E; Horacio Gonzales Site, 2 in C; Zarsiadero Shelter, 4 in B, 2 in B/C, 6 in C.

K. Waste Flakes

Nearly 45,000 apparently unmodified and unused flakes were recovered from the Rio Chiriqui excavations. Most were by-products of tool manufacture. However, an indeterminant number of these flakes must have seen some use. The extreme weathering of some of the andesite used so extensively in the shelters would have destroyed any wear patterns that might once have existed on flakes of this material. Other indications of wear undoubtedly went undetected. Still, the great majority of these flakes can be considered manufacturing debris. They clearly document the fact that these shelters did function as lithic workshops.

II. Ground and Polished Stone

These are nonchipped tools made on pebbles, cobbles, and boulders, either purposefully manufactured or shaped through use.

A. Grooved Stone Axe

A single specimen (fig. 8/9 h) was recovered from layer C_1 near the rear wall of Casita de Piedra. The surface is badly eroded; therefore, no wear patterns were visible. The bit edge is convex and asymmetrical. The axe is completely encircled by a broad (ca. 2.0 cm), shallow (0.2–0.6 cm) groove to facilitate hafting. Dimensions: length 7.8 cm, width of bit 6.3 cm, width of butt 4.6 cm, width at groove 4.1 cm, maximum thickness 2.6 cm.

B. Polished Celts

A bit fragment of a polished celt (fig. 8/9 d) was recovered from the upper part (layers A, B, and C) of Casita de Piedra. The fragment came from the top 50 centimeters of a balk separating blocks 2 and 5. Striations from shaping the celt are clearly visible. They run parallel to the front edge of the beveled faces which form the bit. Dimensions: 3.5 x 1.0 x 1.4 cm.

A second bit fragment came from layer A in the Zarsiadero Shelter (fig. 8/9 e). This small fragment (3.0 x 1.6 x 0.8 cm), from a polished celt or chisel, tapers from a relatively wide, thick body to a narrow bit. The faces of the bit are polished; striations run parallel to the long axis of the tool. The beveled edges below the faces are ground but not polished.

A complete (?) polished stone celt was left in the wall of the excavation at the Zarsiadero Shelter. It remains 18 cm below the surface in layer B. The tool, approximately 4–5 cm wide and 2–5.3 cm thick, was plano-convex in cross section. About 7 cm of the tool projected from the wall, and the complete specimen probably measured about 12 cm in length.

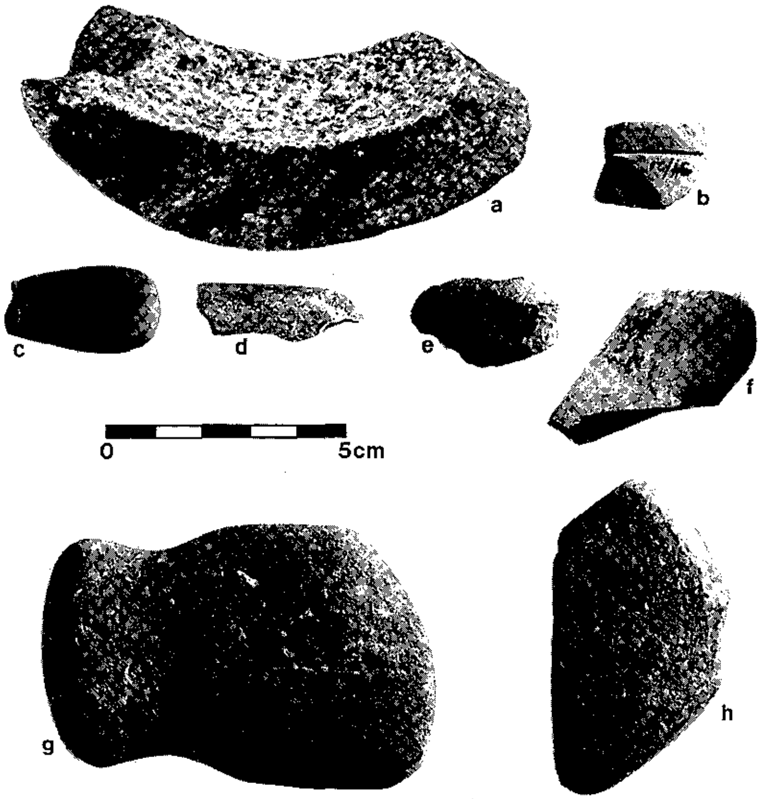

Figure 8/9: a. Stone bowl fragment; b. stone bowl sherd; c. polished stone chisel bit; d. polished stone celt fragment; e. polished stone celt bit; f. beveled ground stone fragment; g. grooved stone axe; h. grooved ground stone fragment.

C. *Polished Stone Adze or Chisel*

The specimen (fig. 8/9 c), which came from layer B_3 in Casita de Piedra, was snapped at the middle by pressure exerted perpendicular to the face of the bit. Only this bit end was found. Two sets of parallel striations resulting from the manufacturing process run diagonally across the faces of the stone and cross each other at right angles. Two incised lines encircle the tool almost at the point where it snapped. The lines were formed as the tool rubbed against its haft. The fragment measures 3.3 x 1.6 x 0.5 cm.

III. *Pecked, Ground, or Battered Stone (tables 5 and 6)*

A. *Handstones*

1. Edge-ground cobbles (fig. 8/10 a-f). These tools have their working facet on the side or edge of the cobble rather than on the face as is common

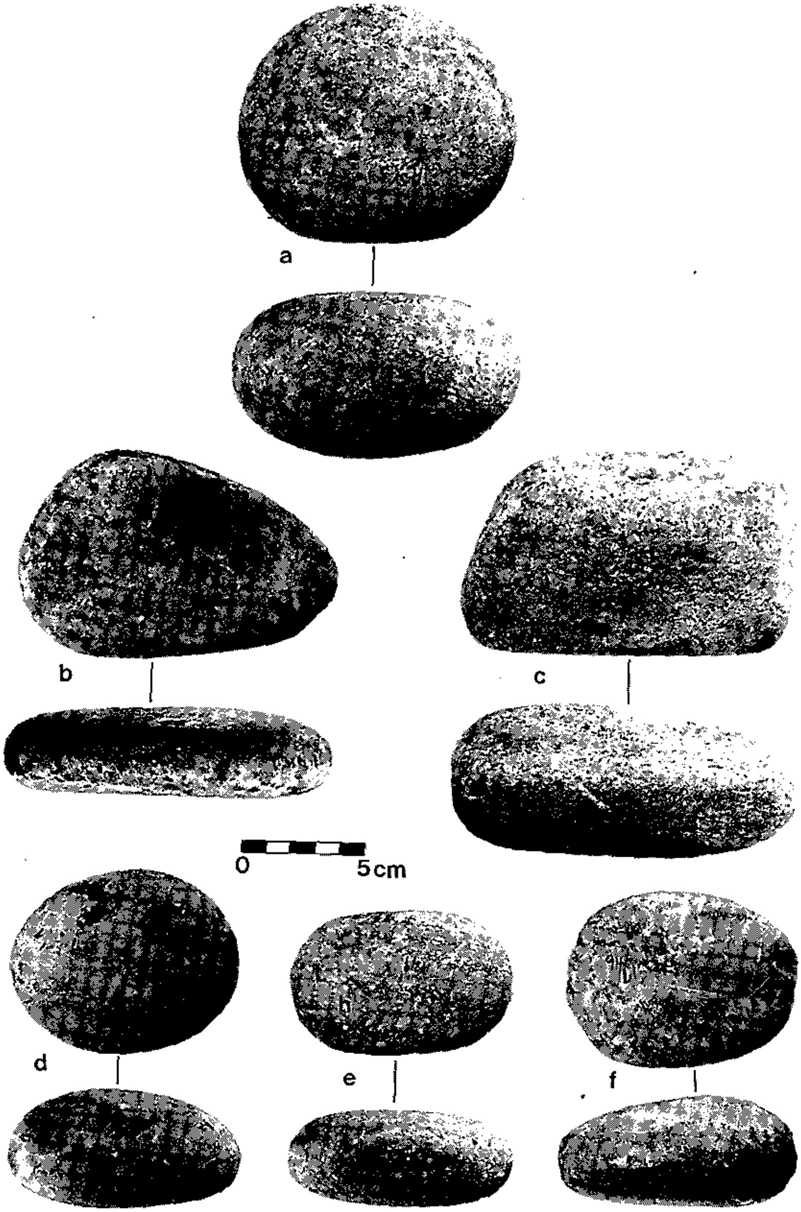

Figure 8/10: Edge-ground cobbles.

with most handstones or manos. The working surface may extend nearly the length of the tool. The working surfaces are quite smooth and regular. Facets are slightly convex along the short axis and vary from quite convex to almost straight along the long axis. The cross sections of the cobbles themselves range from rectangular to oval to triangular, with the first being the most common. These tools have been called "pebble grinders," "edge grinders," and "chopper-grinders" (Willey and McGimsey 1954; McGimsey 1956; Willey 1971). They presumably were used in the Rio Chiriqui region with boulder milling stone bases. The two tool types have similar distributions in the sites' deposits. I have suggested that these tools were used in grinding or mashing root crops (Ranere 1972, 1975). Experiments using intially unmodified cobbles to mash manioc on a flat boulder did produce edge-ground cobbles (and milling stones) similar to the archaeological specimens. Any number of other substances could have been substituted for manioc and produced the same result, since it is the action of the cobble handstone against the boulder base that causes the wear (see Sims 1971 for further discussion on "edged" cobbles).

Dimensions: largest, 13.8 x 11.5 x 8.0 cm; smallest, 7.3 x 5.8 x 3.6 cm; median, 10.8 x 6.8 x 5.0 cm. Distribution: Casita de Piedra, 3 in layer A/B, 6 in C, 1 in D, 10 in E, 2 in F, 1 in ABC (total 23); Trapiche Shelter, 1 in A, 6 in B, 4 in C, 14 in D, 1 in E (total 26); Horacio Gonzales Site, 1 in A/B, 6 in C (total 7); Zarsiadero Shelter, 1 in B.

2. Rectangular handstones or manos (fig. 8/11 a,b). At Casita de Piedra, two formed rectangular grinding stones were recovered together in layer C near the rear wall of the shelter. These tools may have functioned as hammers, as well as manos, for the ends are battered. Grinding surfaces occur on the other four facets of the cobbles. Dimensions: 11.4 x 5.8 x 4.2 cm and 10.8 x 5.8 x 4.6 cm.

3. Cobbles with offset grinding facets (fig. 8/11 c,d). A few grinding stones had facets which were neither on the face of the cobble nor on the side, but in some intermediate position. In three of four specimens, these facets occurred in combination with side facets (that is, on edge-ground cobbles). The offset surfaces appear to have been made by pecking and are rougher than those on either the edge-ground cobbles or manos.

Dimensions for the three whole specimens: 13.8 x 11.5 x 8.0 cm, 13.7 x 8.8 x 5.4 cm, and 10.1 x 9.6 x 4.2 cm. Distribution: Casita de Piedra, 2 in C, 1 in ABC; Zarsiadero Shelter, 1 in B.

B. *Milling Stone Bases*

These tools (fig. 8/12) consisted of large boulders with one flat surface, sometimes with a slight concavity. In the best specimen (and the only example packed out of the Rio Chiriqui valley), the shallow depression is circular, 13 cm in diameter and 0.3 cm deep. In specimens having no depression, the surface of the boulder is ground smooth.

Dimensions: largest, 46 x 30 x 17 cm; smallest, 23 x 21 x 8 cm; median, 34 x

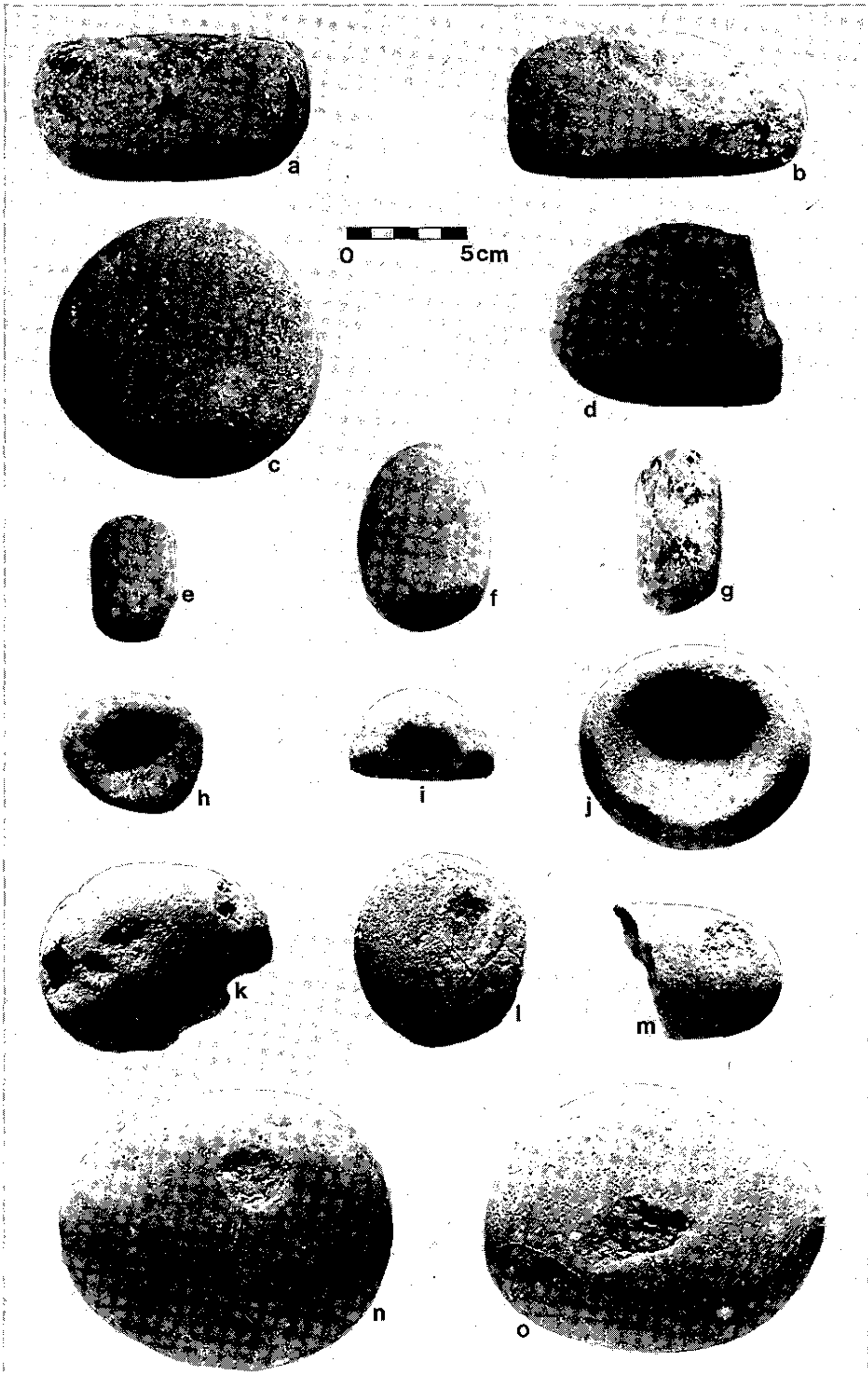

Figure 8/11: a,b. Rectangular handstones; c,d. cobbles with offset grinding facets; e-g. pestles; h-j. mortars; k-o. nutting stones.

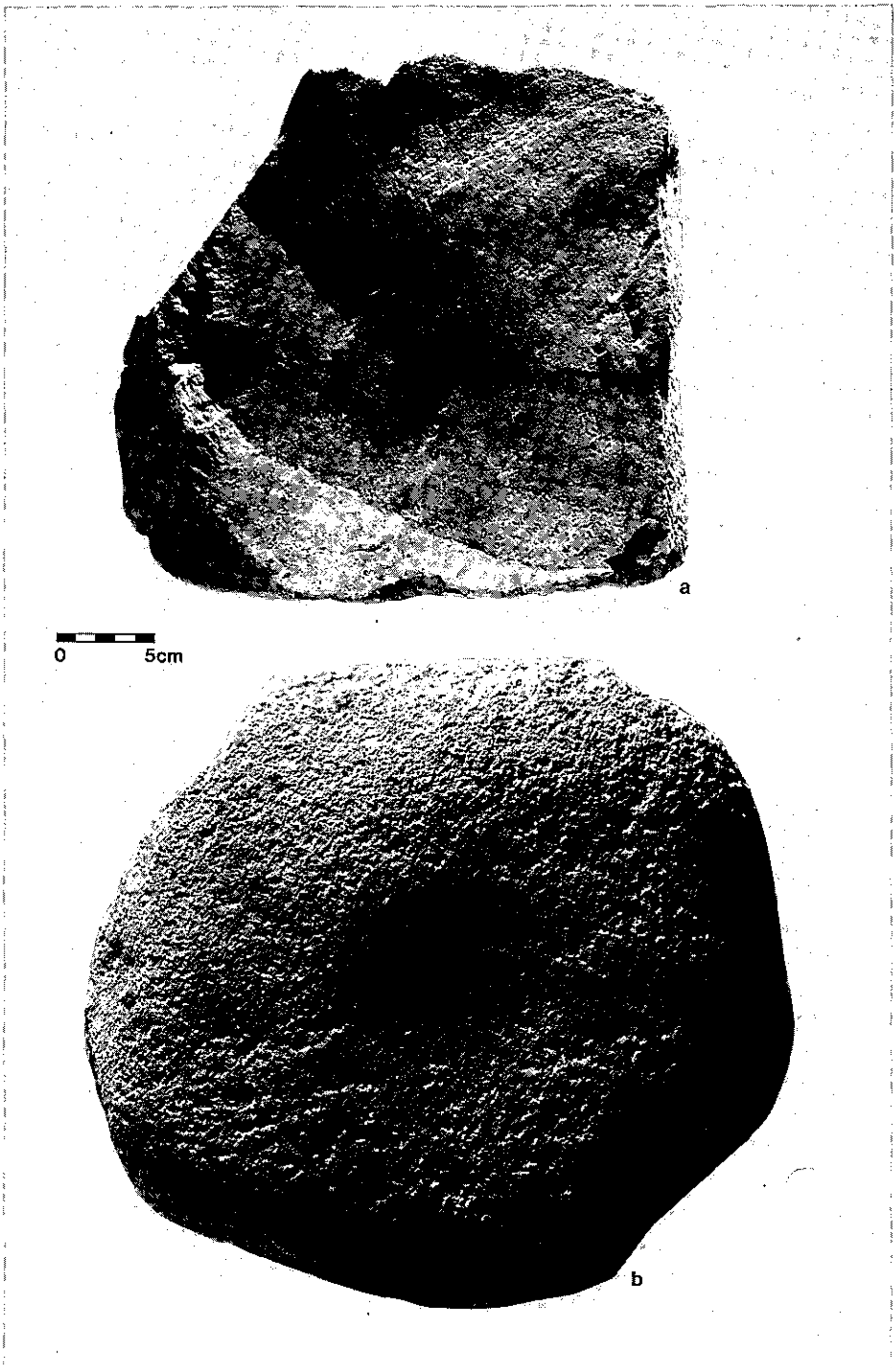

Figure 8/12: Milling stone bases.

33 x 15 cm. Distribution: Casita de Piedra, 1 in layer B, 2 in C, 5 in E; Trapiche Shelter, 2 in layer D.

C. *Pestles*

These tools (fig. 8/11 e-g) were recovered only in the upper two layers in Casita de Piedra. The working surface is shaped like the gable on a house; the two facets join at an angle of ca. 120°. Either one or both ends of the pestle have this faceted surface. When in use, the tool was apparently held at an angle of approximately 60° to the mortar or milling stone base but not rotated in the hand (which would produce a rounded rather than a faceted working surface).

This type of tool was termed a "pestle" because specimens were made on elongated pebbles and cobbles. However, the working surfaces might as easily have been formed through use of the specimens as pecking hammers.

Dimensions: largest, 18.0 x 8.5 x 6.9 cm; smallest, 5.6 x 3.9 x 2.2 cm; median, 7.6 x 5.5 x 4.3 cm. Distribution: Casita de Piedra, 3 in layer A/B, 2 in C.

D. *Nutting Stones*

These tools (fig. 8/11 k-o) have one or more small (ca. 2–3 cm in diameter) pits pecked into their surface to a maximum depth of one centimeter. Such stones were presumably used in cracking nutshells; the nut being placed in the depression and hit with a stone hammer.

Dimensions: largest, 14.6 x 11.2 x 6.1 cm; smallest, 5.2 x 4.5 x 3.6 cm; median, 10.8 x 7.3 x 4.2 cm. Distribution: Casita de Piedra, 1 in layer B, 1 in F, 1 in ABC; Trapiche Shelter, 1 in A, 2 in B, 3 in C, 1 in D; Horacio Gonzales Site, 1 in C.

E. *Hammers*

1. Battered choppers/hammers (fig. 8/13e). Included in this category are bifacially flaked cobbles which have been heavily battered, so much so that broad facets characteristic of hammerstones occur along at least one section of the periphery and, on some specimens, around the entire periphery. The tools seem to have been originally manufactured and used as choppers, and later, after the edges had been so battered that they no longer served this function, they were used as hammerstones. In final appearance, these tools resemble the category "edge-battered cobbles."

Dimensions: largest, 10.5 x 10.0 x 4.7 cm; smallest, 3.9 x 3.1 x 2.4 cm; median, 7.0 x 5.6 x 2.1 cm. Material: Casita de Piedra, 8 andesite; Trapiche Shelter, 5 andesite, 2 chalcedony (total 7); Zarsiadero Shelter, 1 andesite. Distribution: Casita de Piedra, 1 in layer C, 1 in D, 4 in E, 1 in F, 1 in G (disturbed); Trapiche Shelter, 1 in A, 3 in B, 2 in D, 1 in E; Zarsiadero Shelter, 1 in B.

2. Edge-battered cobbles (fig. 8/13 g-i). Part or all of the cobble's circumference has been modified by hammering or battering. In the case of a few heavily used specimens, very broad, gently convex, hammering facets ring the cobble.

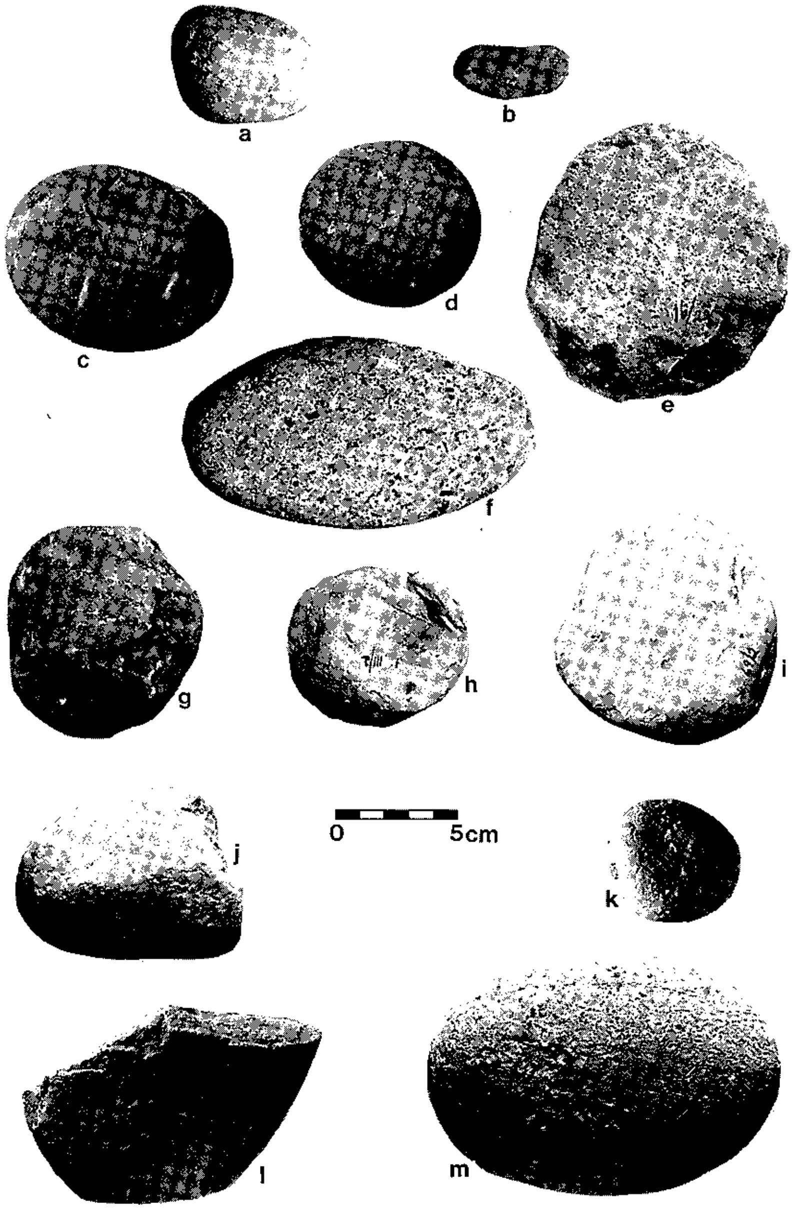

Figure 8/13: a-d, f. End-battered hammers; e. battered chopper/hammer; g-i. edge-battered hammers; j-m. anvils.

Dimensions: largest; 9.0 x 8.7 x 3.0 cm; smallest, 4.6 x 3.8 x 3.2 cm; median, 7.3 x 6.5 x 4.3 cm. Distribution: Casita de Piedra, 1 in layer A/B, 6 in B, 3 in C; Trapiche Shelter, 2 in A, 1 in B, 1 in D; Horacio Gonzales Site, 1 in C.

TABLE 5 DISTRIBUTION OF PECKED, GROUND, AND BATTERED TOOLS IN CASITA DE PIEDRA

	Edge-ground cobbles	*Rectangular handstones*	*Faceted handstones*	*Milling-stone bases*	*Pestles*	*Nutting stones*	*Battered choppers/hammers*	*Edge-battered cobbles*	*End-battered hammers*	*Anvils*	*Miscellaneous*	*Totals*
ABC	1		1			1			2		1	6
AB_1	2				1			1		1	1	6
B_1						1			1			2
B_2								1	5			6
B_3	1			1	2			5	2	1	1	13
C_1	2	2	2	1			1	1	1	1	3	14
C_2	3			1	1			2	2		4	13
C_3	1				1				2	1	1	6
D_1												
D_2	1								1			2
D_3							1					1
E_1	2										1	3
E_2	4			4			2				1	11
E_3	4			1			2					7
E_4												
F_1												
F_2									1			1
F_3	2					1	1		1		1	6
F_4									1			1
G dist							1					1
Totals	23	2	3	8	5	3	8	10	19	4	14	99

3. End-battered hammers (fig. 8/13a-d, f). These elongated cobbles and pebbles are modified by hammering at one or both ends, but do not show evidence of heavy use. They were probably used in flintknapping, and so were discarded when the end of the tool became too blunted to accurately strike the implement being flaked.

Dimensions: largest, 13.9 x 8.0 x 4.3 cm; smallest, 3.6 x 2.4 x 1.2 cm; median, 9.9 x 7.0 x 4.6 cm. Distribution: Casita de Piedra, 8 in layer B, 5 in C, 1 in D, 3 in F, 2 in ABC; Trapiche Shelter, 2 in A, 4 in B, 2 in C, 6 in D; Horacio Gonzales Site, 2 in C.

F. *Anvils (fig. 8/13j-m)*

These cobbles and boulders have pitted surfaces on one or both faces where a chipped stone core has been supported during the process of flake

TABLE 6 DISTRIBUTION OF PECKED, GROUND, AND BATTERED TOOLS IN THE TRAPICHE SHELTER

	Edge-ground cobbles	*Milling-stone bases*	*Nutting stones*	*Battered choppers/hammers*	*Edge-battered cobbles*	*Edge-battered hammers*	*Anvils*	*Miscellaneous*	*Totals*
A_1			1		2			3	6
A_2	1			1		2	1	1	6
B_1			1	1		1			3
B_2	6		1	2	1	3			13
C_1	1		2						3
C_2	3		1			2	1		7
D_1	5	1			1	6	1		14
D_2	6	1		2			1		10
D_3	3		1						4
E_1	1			1			1		3
E_2								1	1
E_3									
Totals	26	2	7	7	4	14	5	5	70

removal. Such anvils are necessary to produce the bipolar cores found so abundantly in the Rio Chiriqui collections.

Dimensions: largest, 22.0 x 10.4 x 9.3 cm; smallest, 5.4 x 4.9 x 3.3 cm; median, 12.3 x 6.5 x 4.5 cm. Distribution: Casita de Piedra, 1 in A/B, 1 in B, 2 in C; Trapiche Shelter, 1 in A, 1 in C, 2 in D, 1 in E.

G. Miscellaneous Artifacts

1. Stone mortars (fig. 8/11 h-j). One complete stone bowl or mortar, one fragment of a mortar, and one possible mortar came from Casita de Piedra (the first from layer C, the last two from layer E). The complete specimen, slightly oblong, had its surface entirely eroded away. Outside dimensions: length 8.7 cm, width 7.7 cm, depth 5.4 cm. Inside dimensions: length 6.5 cm, width 5.8 cm, depth 1.8 cm. The fragment was much like the complete specimen although smaller (outside ? x 5.4 x 3.1 cm, inside ? x 3.1 x 0.7 cm). The third specimen had a highly eroded surface and slightly irregular shape, making it doubly difficult to determine if it was made or used by man. The outside measurements: 5.4 x 4.6 x 3.0 cm; inside measurements: 4.1 x 3.6 x 0.5 cm.

2. Stone bowl (fig. 8/9 b). A single sherd, which appeared to be from the base and side of a stone bowl, was recovered from the Trapiche Shelter in layer E_2. Both inside and outside surfaces are smooth and regular. The

thickness varies from 2.0 cm near the base to a maximum of 2.2 cm, then tapers to 1.2 cm toward the rim of the bowl. Dimensions of the sherd are 9.5 x 5.7 cm.

3. Beveled, ground fragment (fig. 8/9 f). The entire surface of this fragment has been shaped, as striations are everywhere visible. Along one edge, where the specimen is intact, there is a polished concave section, suggesting that the specimen was once drilled. Opposite the concavity, the edge has been beveled to a thickness of 0.2 cm. Dimensions: 4.8 x 3.0 x 1.0 cm. Provenience: Casita de Piedra, layer C_2.

4. Pecked and ground stone tool fragment (fig. 8/9h). This small fragment, made on a flat rounded pebble, has been pecked and ground on both faces. A shallow notch has also been pecked into the edge. Dimensions: 7.4 x 3.6 x 1.4 cm. Provenience: Horacio Gonzales Site, layer C.

5. Pebble fragments with ground facets. Three specimens are very much alike, with ground opposing faces that taper to a rounded edge. Since much of the tool is missing in all cases, we can do no more than to suggest that they may have been fragments of manos. One fragment (dimensions 4.1 x 6.2 x 3.0 cm) came from layer A/B in Casita de Piedra, and two (dimensions 8.5 x 7.5 x 3.3 cm and 6.1 x 6.1 x 1.8 cm) from layer A in the Trapiche Shelter.

6. Grinding stone fragment (?). A small fragment of vesicular lava was recovered from the Trapiche Shelter, layer A. It shows no definite evidence of wear, but such evidence might easily go unrecognized on such a small fragment. Dimensions: 6.2 x 3.1 x 3.4 cm.

7. Small, flat, pointed pebbles. Two fragments of pebbles, both from layer C in Casita de Piedra, have ends ground to a rounded point. Although heavily eroded, worn facets are visible on the spatulalike ends. Dimensions: 3.1 x 3.1 x 0.6 cm; 3.1 x 2.5 x 1.2 cm.

8. Pebbles with striations. Several small specimens occur with striations visible on one or more surfaces. These may have served as abrading stones. Dimensions: 6.1 x 4.8 x 1.4 cm; 4.8 x 2.2 x 1.5 cm; 4.5 x 2.9 x 2.0 cm. Distribution: Casita de Piedra, 2 in layer C; Trapiche Shelter, 1 in layer A.

9. Whetstone (?). A flat, tabular piece of andesite that has both polishing and striations visible on one face. The piece came from layer F in Casita de Piedra. Dimensions: 4.8 x 3.6 x 1.2 cm.

10. Triangular polished stone. This small (2.5 x 1.6 x 0.3 cm) piece of stone is smoothed on all surfaces and quite even. It could be an unmodified piece, but the triangular or wedgelike appearance is unusual.

TECHNOLOGY

In spite of the enormous quantities of flakes and stone tools recovered from the Rio Chiriqui sites, the chipped stone industry is not a complicated one. The amount of chipping debris in the deposits reflects the fact that Casita de Piedra, the Trapiche Shelter, and the Zarsiadero Shelter were, in part, workshop sites. Lithic material, including obsidian, was plentiful within a kilometer or two of each site, and most kinds could be gathered from andesite outcrops or stream gravels less than 200 meters away from the overhangs. The range of tools produced throughout the sequence is quite limited, and the techniques used to produce them are simple. Moreover, very little change takes place in any aspect of the stone industry during the 4,500-year span of preceramic occupation of the valley. The conservative nature of the stone industry is a predictable consequence of the tropical forest adaptive pattern which emphasizes the use of other materials, principally tropical hardwoods, in manufacturing tools. Stone is simply not the important medium here, as it is in other preceramic patterns; thus, the stimulus to improve the technology was largely absent.

Stoneworking techniques represented in the Rio Chiriqui assemblages were simple but functional. All manufacturing was done by direct percussion, and hammerstones were probably the only flaking implements. Hardwood or bone billets may have been used also, but the flaking characteristics on the tools and discarded flakes can be accounted for by stone-hammer percussion only. Within the stone-hammer category itself, however, a wide range of sizes, hardness, and shapes is represented.

Two percussion-flaking techniques were used, depending largely on the characteristics of the material being flaked. Chalcedony (and other cryptocrystaline rocks like jasper, chert, and agate), obsidian, and quartz generally occurred as small nodules. These were broken up by using the "bipolar" flaking technique whereby a nodule or core is placed on a stone anvil for support and hit on the top surface with a hard hammerstone. For the chalcedony and quartz nodules, which are tough rocks to fracture, the use of an anvil greatly improves the ease with which flakes can be removed from a core. In addition, with the force being applied to the core simultaneously from the anvil as well as from the hammerstone, the detached flakes tend to be quite straight in profile. Often such flakes make suitable small wedges without further retouch. Use of the bipolar technique is documented for the entire preceramic sequence but is more common in the Boquete phase where 30 percent to 50 percent of the lithic material is chalcedony, quartz, and obsidian (figs. 8/1, 8/2). These materials account for less than 10 percent of the lithic specimens present in the preceding Talamanca phase.

Andesite can be found in large blocks in the immediate vicinity of all sites. The large andesite cores were not supported on an anvil, but were held free in the flaking procedure. Andesite flakes do not have the straight profile of the bipolarly flaked chalcedony ones; instead they curve underneath the core when being detached. This percussion technique, in which the core is not supported, was used more extensively in the Talamanca phase, where over 90 percent of the lithic material was andesite and from 30 percent to 55 percent of the tools were scrapers.

The lithic techniques represented in the Rio Chiriqui sites can be fairly characterized as being directed toward producing a serviceable tool with the least amount of work. This characterization holds true even for the celtlike wedge, the most sophisticated chipped stone tool in the preceramic period, ground and polished stone tools excepted. The category "irregular bifacial wedges" consists primarily of andesite flakes and spalls which were naturally wedgelike and needed little retouch to become functional tools. Celtlike wedges themselves take very little time to make. In experiments conducted to replicate the Rio Chiriqui tool types, I could produce a reasonable celtlike wedge in ten to fifteen minutes. All other tool types can be replicated in less than five minutes.

The ground and polished stone industry is represented by fewer than half a dozen specimens in the preceramic period, all found in Boquete phase contexts. The axe, celt fragments, and chisel bit found in Casita de Piedra represent the work of skilled craftsmen. With so few specimens present, it is not possible to say whether or not they were made at the site or imported. Still, the presence of a ground and polished stone industry in the Boquete phase represents a significant addition to the stoneworking repertoire of the Rio Chiriqui preceramic population.

Most of the other tools (i.e., those not made by chipping or by grinding and polishing) were not manufactured at all, but were simply suitably shaped cobbles and boulders formed through use. The only ones purposefully manufactured were two rectangular handstones (manos) from Boquete phase deposits in Casita de Piedra, plus three mortars and miscellaneous fragments from both Boquete and Talamanca phase deposits. In contrast to this small number of shaped tools, edge-ground cobbles, faceted grinding stones, milling stone bases, pestles, nutting stones, battered choppers/hammers, edge-battered cobbles, end-battered hammers, and anvils (over 150 tools) were shaped only through use. Moreover, these tool types occur throughout the preceramic sequence with even less change in frequencies than is the case for the chipped stone tools.

In summary, strong technological continuities exist between the Talamanca and Boquete phases in the Rio Chiriqui sequence. The only technological changes are the increase in the use of the bipolar flaking technique in the later phase, and the concurrent introduction of grinding and polishing stone as a method of forming axes, celts, and chisels.

TOOL USE

Throughout the preceramic sequence, stone tools were used in four activities: manufacturing stone tools, working wood, processing plant food, and processing animal products. In the first category are stone tools that were used for making other stone tools. These anvils and a variety of hammerstones (end-battered hammers, edge-battered cobbles, and battered chopper/hammers) are present in both the Talamanca and Boquete phases in roughly equal numbers. Also a part of the stoneworking complex are the various cores identified in the assemblages. Irregular cores and bifacial cores are equally represented in both preceramic phases while bipolar cores become more frequent in the later Boquete phase. Although few in number (seven), the clustering of conical cores at the base of the Talamanca phase deposits helps to distinguish it from the succeeding phases.

Woodworking tools are the most common tool types throughout the Rio

Chiriqui sequence. The large bifacial wedges have very distinctive technological and functional attributes which leave little doubt as to how the tools were manufactured and used (see description of bifacial wedges). This tool type is found only in Talamanca phase contexts and is its most diagnostic artifact. The small tabular and broad-based wedges are also quite clearly used as wedges or chisels in woodworking. These small wedges are best considered to be restricted to Boquete phase deposits. Of 277 small wedges recovered in Casita de Piedra and the Trapiche Shelter, all but 16 came from the upper depositional unit (Boquete occupations), and 10 of these 16 came from the upper sublayer in the lower depositional unit. The 10 found in this upper sublayer probably got there through mixing of deposits either before or during excavation. The remaining 6 are likely to have been misidentified, since the tools are simple ones, and in appearance very much like some of the bipolar core remnants. At any rate, the tools dominate the Boquete phase assemblages and are either absent or a very minor element in the Talamanca phase assemblages. Small wedges are not a part of the Burica-Aguas Buenas stone industry, either in the Rio Chiriqui valley (only 1 of the 22 small wedges found in the Horacio Gonzales Site came from the ceramic layer, and it is considered to be intrusive), or at other occupation sites in the province (Shelton Einhaus, report no. 15; Ranere and Rosenthal, report no. 16; Sheets, Rosenthal, and Ranere, report no. 14).

Other tools seem associated with woodworking tool kits, based on replicative experiments and microscopic analysis of wear patterns (Ranere 1975). A number of the scraper-planes show wear polish extending from the tool edge back along the ventral surface. A few of the large flake scrapers and steep scrapers exhibit the same wear. This pattern of wear has been duplicated experimentally by pushing these tools along the surface of the wood to remove shavings. Concave scrapers or spokeshaves also appear to be woodworking tools based on replicative experiments and wear pattern analysis. All of these tool types (scraper-planes, flake scrapers, steep scrapers, and spokeshaves) occur in larger numbers during the Talamanca phase than in the following Boquete phase.

The engraving tools found in the Rio Chiriqui shelters may well have been woodworking tools (they could have been used on bone as well or instead). Burins characteristically occur in Talamanca phase deposits, while gravers are found throughout the preceramic (and ceramic) sequence.

One final chipped-stone tool type appears to hold woodworking tools: flake knives. A number of these knives have bifacial use retouch, which I was able to replicate by using hafted specimens for whittling wood. Other unyielding materials, like bone, seem likely to produce the same wear.

An entirely new set of woodworking tools, the polished stone axes and celts, appear in the Boquete phase and continue into the ceramic phases. The single grooved stone axe was obviously hafted with the bit edge parallel to the handle and used in the same manner as modern axes. The polished stone celt left in the wall of the excavation at the Zarsiadero Shelter was plano-convex in cross section and tapered toward the butt end. It was probably hafted as an adze blade with the bit edge perpendicular to the handle. A much smaller bit from Casita de Piedra was similarly hafted and used as an adze or chisel. The two additional celt fragments were too small to indicate hafting methods, but both seemed to have adzelike or chisellike bits. Although only five polished stone tools were recovered, they document an important advance in the manufacturing of woodworking tools in the Rio Chiriqui sequence introduced during the Boquete phase.

Edge-ground cobbles and milling stone bases, with which they are almost certainly associated, dominate the tool kit used in the preparation of plant foods. The edge-ground cobbles and their bases might better be thought of as mashing implements used in processing starchy roots (both wild and cultivated), rather than as seed-grinding implements as has been suggested for similar tools found at Cerro Mangote and Monagrillo in central Panama (Willey and McGimsey 1954; McGimsey 1956; Willey 1971). There are several reasons for suggesting this. First, the narrow edge on these cobbles seems better suited for pounding or mashing than for grinding of seeds (or so our experiments indicated). Second, the use of roots as a food source is more characteristic of tropical forest cultural patterns than the use of seeds. Finally, edge-ground cobbles or "edge-grinders" never have been associated with the grinding of seeds, but they are associated with processing roots (*camus* bulbs) in the Pacific Northwest region of North America (Butler 1962; Sims 1971). Edge-ground cobbles and their bases occur in approximately equal numbers in the two preceramic phases in the Rio Chiriqui sequence, and are absent from the ceramic phases.

Nutting stones are presumed to have been used in cracking nutshells, perhaps from the Corozo palm. Similar stones are used today for this purpose by local residents of the province. These stones occur in small numbers throughout the Rio Chiriqui sequence.

Added to the food-processing tool inventory during the Boquete phase are rectangular grinding stones (manos) and offset faceted grinding stones, elsewhere commonly associated with seed grinding. Pestles are similarly restricted to the Boquete phase. However, of the three mortars recovered, two came from Talamanca phase contexts, indicating that the grinding or pulverizing function implied for mortars and pestles (presumably for foodstuffs, but possibly not) was a feature common to both preceramic phases.

The stone assemblages from the Rio Chiriqui shelters dimly reflect the hunting and processing of animals (butchering, hide preparation, and working of bone), which must have been an important aspect of the economy. Although not directly used as hunting implements, woodworking tools, particularly spokeshaves, were undoubtedly used to make spear shafts and wooden projectile points. Other stone tools may have been directly used in butchering, dressing hides, and working bone. Cobble spall and flake choppers are possibly butchering tools. (Although far removed from Panama, identical tools were used in the northern Rockies for fleshing hides by the Northern Shoshoni — see Swanson and Sneed 1966; Ranere 1971.) Flake knives may also have been used in butchering, since the pattern of edge polish on some specimens suggests that they were used on a soft, pliable substance like meat or hides.

SUMMARY

In summary, distinctions between the two preceramic phases can be made on the following bases: (1) over 90 percent of the chipped stone in the Talamanca phase was andesite, while in the Boquete phase, chalcedony, quartz, and obsidian accounted for at least 25 percent and up to 50 percent of the chipped stone; (2) bifacial wedges were restricted to the Talamanca phase deposits, whereas small tabular and broad-based wedges were restricted (in all probability) to the Boquete phase where they accounted for up to 50 percent of the tools recovered; (3) scrapers make up from 30 percent to 55 percent of the chipped stone tool inventory in the Talamanca phase, 11 percent to 22 percent in the Boquete phase; (4) choppers and flake knives were more common in the Talamanca phase than in the Boquete phase; (5) blades and burins were both more numerous in the earlier Talamanca phase; (6) conical cores, with one exception, were found only in Talamanca phase deposits; (7) restricted to the Boquete phase were used quartz crystals, manos, faceted grinding stones, pestles, polished stone celts, polished stone axes, and (with one exception) edge-battered cobbles. Recovered in approximately equal numbers in both preceramic phases were edge-ground cobbles, grinding stone bases, end-battered hammers, anvils, nutting stones, irregular cores, and bifacial cores.

The stone tool assemblages for the ceramic phase can only be described as impoverished in comparison to the preceramic assemblages. Even beyond the obvious fact that the Late Bugaba and Chiriqui Classic phases have pottery, and the Talamanca and Boquete phases do not, the contrast between ceramic and preceramic occupations is striking.

Report Number 9

Ceramic Classes from the Volcan Baru Sites

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INTRODUCTION

This report is little more than a description of the ceramic classes that make up what we have called the Bugaba style. This style (Sackett 1977) dominated the highlands in the centuries between A.D. 200 and 600 (section 7.4). In order to facilitate statistical comparisons, we classified the collections in terms of several different criteria. First we sorted the pottery according to seven easily distinguished wares "defined solely on the basis of paste and surface finish" (Drennen 1976, p. 21). Then we used vessel forms, which we classified into three large groups: jars, closed bowls, and open bowls. The