ARTICLE 10: CHIPPED STONE ARTIFACTS FROM THE CORDILLERA DE TILARAN

PAYSON D. SHEETS

ABSTRACT

A total of 2304 lithic artifacts were collected and analyzed during the 1984 field season of the Proyecto Prehistórico Arenal. A large number of boiling stones, both fragmentary and complete, were found, surprising for a pottery-making society. A core–flake industry was predominant in chipped stone tool manufacture, followed by bifacial manufacture of celts and knives. The core–flake industry developed early, and remained largely unchanged during the prehistoric occupation of the cordillera. Only a few categories of chipped stone implements were found to be sensitive temporal indicators.

Department of Anthropology
University of Colorado

INTRODUCTION

The principal objective of this article is to describe and interpret the 16 categories of lithics found in survey and excavation operations in the Cordillera de Tilarán during research conducted by the Proyecto Prehistórico Arenal in 1984. Two types are not commonly found in lithic sections of research reports in Central America: boiling stones, and thermally fractured debitage. Other, more conventional categories are also presented, including bifaces, biface manufacturing and resharpening flakes, celts, celt flakes, and general lithic wastage.

The methods used in analysis are straightforward. A sample consisting of 600 lithic artifacts was subjected to a preliminary analysis, to determine the categories of lithics present, and to see the range of variation within categories, within the entire collection, and in materials used. These categories were designed to be comparable with types already described from other Central American sites, insofar as possible. All lots, whether from survey or excavation, were subjected to a 'lot readout', i.e. a detailed analysis and classification of each artifact into one of the 16 categories. Thus, each of 2304 lithic artifacts is tabulated by type and by excavated lot, of which 200 contained lithic artifacts. This resulted in a large table with 3200 cells, which is difficult to handle on paper, let alone to conceptualize and use efficiently. To facilitate data processing, all lithic data was entered into the computer, using Lotus 1-2-3. Also tabulated on the computer were data on hinge fractures in the debitage, and the frequency of chalcedony, petrified wood, porphyry, rhyolite, jasper, and quartzite. All retouched artifacts, and samples of the debitage were weighed, measured, described, and photographically recorded in color and in black-and-white.

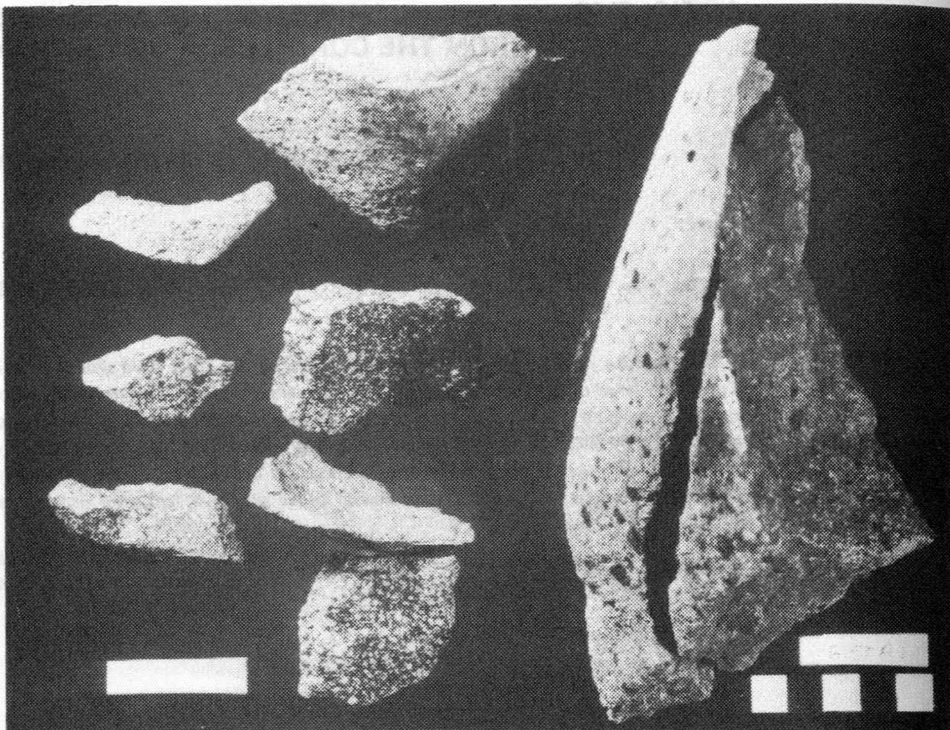

Figure 1. Thermally Fractured Debitage. This is a representative sample, from G–150. Note lack of attributes of percussion fracture. Normal range of size on left, extra–large specimens that fit together on the right. Note granularity of material. Scale in cm.

CHIPPED STONE ARTIFACTS: TYPES

Each type of chipped stone artifact is presented in this section with its name, followed by the total artifact count from the 1984 research, and the figure in which it is illustrated. Each is then described and compared with similar specimens in Costa Rica and elsewhere in Central America.

Thermally Fractured Debitage (669) (Fig. 1)

These are portions of stones fractured by the stresses generated by extreme temperature changes. The fracture surfaces are rough, irregular, lack the single point of force application of chipped stone artifacts, and they lack the attributes of pressure or percussion flaking (bulbs, bulbar lips, radial fissures, gull wings, ripple marks, or specific terminations). Their outsides are often oxidized in a thin zone to as much as 5 or even 10 mm in depth. Generally, these thermally fractured stones can be distinguished from the chemically-eroded spalls and rinds on naturally-weathering stones. Weathering results in smoother surfaces, and the chemically-weathered rinds are much softer. Oxidation is minimal or nonexistant.

The material consistently used for these stones is a plutonic rock: a highly crystalline (phyric) andesite. This is a poor material from which to manufacture flaked stone artifacts, given large grain size. It is not particularly refractory (Melson, personal communication 1984), and thus is not the ideal choice to resist temperature stresses. However, it is the most common stone around, and thus is eminently replaceable when it fractures.

During a brief experiment with 6 stones of the same andesite collected from the Riò Santa Rosa near G–154, it became clear that the degree of weathering of the andesite collected is an important factor. The stones were repeatedly heated in a fire and then placed in 3 liters of water. The weathered andesite began fracturing after only 2 heat-cool cycles, whereas the relatively unweathered andesite was unfractured after 10 cycles. The efficiency of stone boiling is demonstrated by the raising of water temperature from 23.3 degrees C (74 degrees F) to 43.3 degrees C (110 degrees F) in three minutes. The more weathered stones began fragmenting both while being heated in the fire and while cooling in the water, and would suffice to boil only an estimated 50 liters of water. The fresher stone, I estimate, could serve for perhaps 100 heat-cool cycles. Thus, 2 kilos of fresher stone could boil at least 300 liters of water. The most rapid boiling is achieved with two sets of rocks being heated in the fire while a third set is heating the water. These figures allow for a very rough calculation of the minimum volume boiled at a given site. For instance, 258 pieces of thermally fractured debitage were collected from G–150. The mean weight per piece is 110 g. This figure excludes the occasional large stone that probably was a hearth stone. The total is 28,380 liters of water. Because perhaps half of of the thermally fractured debitage was collected, the true total for our sample probably is on the order of 60,000 liters. Because our sample represents less than 1°/o of the site total, the site total could be 6,000,000 liters, or, assuming 3 centuries of use, about 20,000 liters per year. Of course, these figures cannot be taken literally, but they serve to give an impression of the magnitude of that activity at the cemetery.

These artifacts are found in sites of all time periods, and at domestic and funerary sites. There does seem to be an increase in their frequency, at least through the Middle Polychrome Period.

Boiling Stones (19)

A total of 11 boiling stones were selected for typological analysis. These are the complete versions of the Thermally Fractured Debitage. They average 382 grams, and range from 60 to 1560 grams. Average diameter is 6 cm. They are rounded to oval in shape. Three have some thermal fracturing, and they may have been discarded for that reason. They derive from all periods, and from funerary and habitation sites. All have some oxidation on their exteriors, ranging from a very thin and discontinuous zone to a thick (8 mm) and continuous zone. Only a small fraction of the boiling stones found on survey or during excavations were collected, but their numbers were recorded. For instance, 3 boiling stones were collected out of 56 observed at G–156. Using the above figures, all these stones could have boiled 3000 litres of water. The fraction of the site represented by our survey is unknown, so extrapolations to the full site are not possible.

The large numbers of whole and fragmentary thermally-altered stones in these sedentary, pottery-producing sites, is surprising. Stone boiling is common among migratory hunter-gatherers, or sedentary non-ceramic peoples (e.g. California Indians), but it is unusual among sedentary agricultural societies.

Large Bifacil Trimming Flakes (19)

Six large bifacial trimming flakes were chosen from the 19 collected. They average 119 grams, and range from 10 to 440 g. Their average lengths and thicknesses are 7.2 and 1.7 cm, with ranges from 5.6 to 11 cm and from .6 to 3 cm. All are of a fine-grained dacite, and all bear the flakes scars on their dorsal surfaces of multiple flakes. This is a conservative category, in that only the specimens which clearly were bifacial wastage are included. I agree with Ranere (Linares and Ranere 1980) that bifacial manufacture actually yields very few flakes that are clearly identifiable as deriving from biface manufacture. Thus, the low figure of 19 should not be interpreted as indicating a paucity of bifacial manufacture in the cordillera.

All these flakes evidently derive from the early stages of bifacial flaking, and most apparently are the wastage in bifacial celt manufacture rather than wastage from manufacture of the finer stemmed points. Most bear at least some cortex. They come from a variety of contexts. Fully 58% of the specimens derive from the relatively small excavations at sites G–151 and G–152, the laja repositories probably associated with the large graveyard (G–150). Another 21% came from that graveyard, indicating that a very high proportion of the chipped stone celt manufacture and probably use is cemetery-associated. It is important that the sole flaked andesite celt derived from G–152. Chipped stone axes are easier to make than groundstone axes, but hold up less well under the stresses of use. The tradeoff of manufacturing ease and durability is here interpreted as these being expedient tools, to be made rapidly when the need arises, from available materials obtained from laja repositories, and discarded when no longer needed.

Chronologically, the large bifacial trimming flakes are predominantly or exclusively late. The bulk (79%) derived from Late Period V or VI contexts. Some from survey might be earlier. No specimens are yet known from definite early contexts.

Small Bifacil Trimming Flakes (32) (cf. Fig. 8)

The arbitrary threshold used here to separate large from small biface trimming flakes is 4 cm in length. The average weight of a sample of 14 chosen for analysis is 3.7 g and their average length is 1.8 cm. They range from .9 to 3.9 cm. They clearly represent the later stages of biface manufacture. All have multiple flake scars on their dorsal surfaces which derived from previous flake removals. Materials are dominated by dacite and chalcedony, with an occasional flake of jasper or other microcrystalline silicates. One small chalcedony flake, from G–154 I, bears evidence of heat treatment. The ventral side has a markedly increased luster. Evidently heat treatment occurred late in the manufacturing sequence. If our sample is reliable, there is a marked increase in fine bifacial flaking in Period VI. Site G–154 had 13, and 12 came from the G–151/G–152/G–153 funerary complex, thus representing 78% of the total.

Celt Flakes (8) (Fig. 2)

These are the flakes that derived from celt resharpening or from celt abuse. Thus, some are deliberate and some are accidental. In composite, they average 6 grams, and 3 cm in length. The materials match the celts described by Chenault (Article 11), as would be expected.

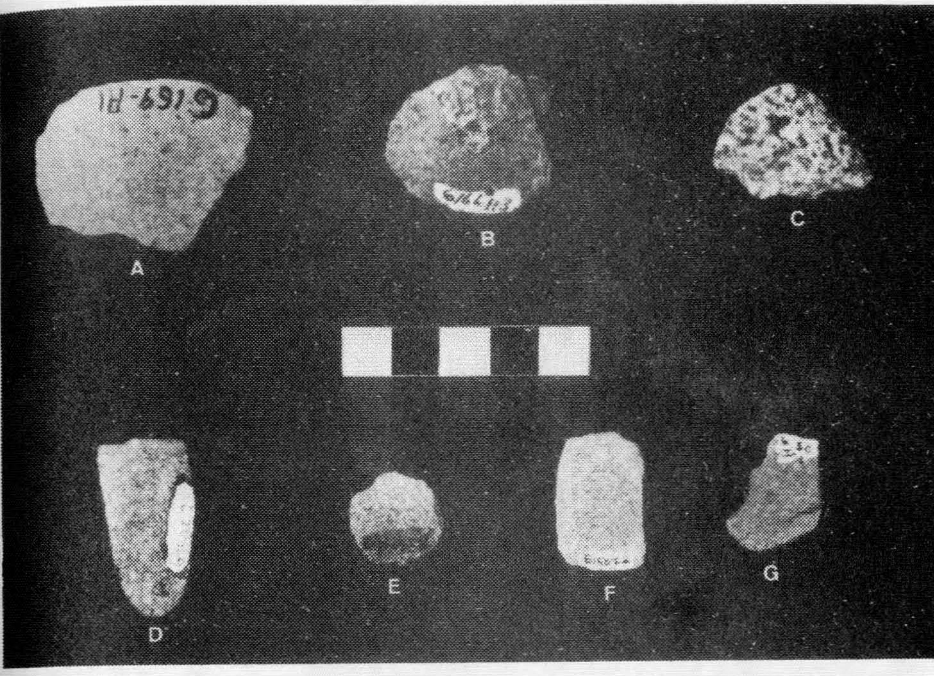

Figure 2. Celt Flakes. These derive from resharpening or from abuse of groundstone celts. These are illustrated with the platforms at the top, dorsal side showing. The dorsal side carries the ground surface of the celt. A: G–169A1. B: G–166A3. C: G–175B1. D: G–150C2. E: G–150C2. F: G–150I2. G: G–150I1. Scale in cm.

Fortunately, the two varieties can often be distinguished. Known celt resharpening flakes (Sheets, Rosenthal, and Ranere 1980) tend to be thin, and often carry a small portion of the rounded or damaged bit end with them as their platforms. On the other hand, a drastic misuse of a celt can detach a large part of the bit, or a corner of the bit. Such criteria allow for distinguishing the resharpening variety from the abuse variety.

The resharpening flakes are small, thin, and all weigh less than 2 g each. It is possible that some are from misuse, but, given their strong similarities with known Panamanian resharpening flakes, they are classified as probably resharpening. They average 2.1 cm in length, but only one is complete, and average length probably was over 3 cm. It is significant that all but one derives from the G–150 graveyard. The large graveyard witnessed considerable groundstone celt use, as well as the expedient chipped stone celt manufacture and use, probably when a groundstone celt was not available. The other flake was found in G–169, the Period V habitation site. Thus, all are within the same period.

The three celt abuse flakes are longer (average 3.8 cm), thicker (ave. 1 cm), and heavier (ave. 13 g) than the other celt flakes. One removed the entire corner of the bit. Another removed a large portion of the central portion of the bit. The other carries no platform, because the flake snapped laterally. It appears to have been flaked from the bit, based on dorsal morphology. All three were surface finds, and are not well-dated. One probably is late Period IV, and the others probably are late Period IV or V.

Polished Flakes (5)

These five stones were tabulated on the lot readouts as general flakes, because they are wastage in chipped stone implement manufacture. Four are chalcedony and one is petrified wood. Instead of simply becoming lithic wastage, they were polished on all surfaces, as if subjected to lapidary polishing. It is conceivable that prehistoric techniques existed for polishing flakes, but inadvertent polishing of flakes by tumbling on a fine-sand beach is also possible. A likely location is on the old shore of Laguna Arenal. If they were shore polished, then the finding of two at the Silencio graveyard indicates at least some visitation of that graveyard from the east. However, as noted by Marilynn Mueller (personal communication 1984), beach polishing rarely results in such a vitreous luster. I think the flakes probably were deliberately polished. The two from G–150 are very small; they average only 1 cm in length. Both probably are wastage from bifacial manufacture.

The three larger polished flakes all come from the Joluvi site (2 from G–169G2 and one from B4). They average 2.2 cm in length.

General Flakes (1101)

General flakes are the "undiagnostic body sherds" of lithics. These are the miscellaneous wastage of a variety of manufacturing procedures, including biface manufacture, uniface manufacture, core-flake technology, and perhaps others. Some of these flakes probably derived from misuse of chipped stone celts, unifaces, fragmenting hammerstones and wedges. The bulk of these probably derive from cutting flake manufacture, followed by biface and celt manufacture.

The general flakes from G–150C2 are used here as an illustrative sample. Some are complete, but many are shatter. They are not thermally fractured, but rather they clearly derive from controlled fracturing. They average 7.5 g in weight, and have mean lengths, widths, and thicknesses of 3, 2.8, and .7 cm respectively. These flakes are technologically representative of the entire collection, but, in terms of materials, they are not representative. The general flakes from other sites have much higher percentages of chalcedony and other microcrystalline silicates. Fully 93% of these flakes are dacite and only 7% are microcrystalline silicates, whereas most other sites have 1/3 to over 1/2 microcrystallines. This indicates selection of materials for tools with specific uses in the graveyard, probably for harsher use with less sharp edges. Only 2% of the debitage had hinge fractures, which is here interpreted as quite skilled manufacture.

Other (363)

The lithic category "other" is a residual category. It is what is left over, after all the other artifacts have been assigned to other categories. These are artifacts, because they are broken stones that do not occur naturally in a soil that is building up, over the centuries, from airfall volcanic ash deposits. They were brought to sites by people, but they are so nondescript or fragmentary that further classification was not possible. Pro-

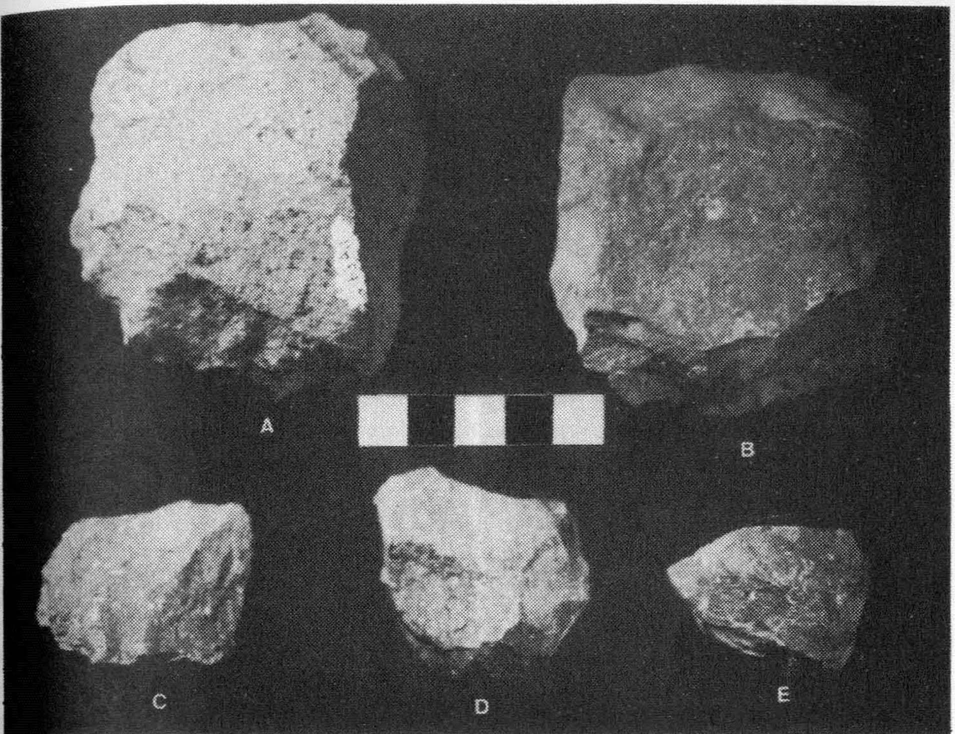

Figure 3. Unifacially Flaked Implements. Most probably were used as scrapers. A: G–163A1. B: G–163A1. C: G–152A1. D: G–176A1. E: G–156A1. Scale in cm.

bably most could have been classified as general flakes, or as thermally fractured debitage, if they were in better condition.

Utilized Flakes (6)

It is tempting, in a lithic collection, to pick out large numbers of flakes with tiny nicks or flakes removed from their edges and call them utilized flakes. However, flakes on the surface of an occupied site are subject to edge damage after discard by trampling and a variety of other causes. Thus, these are very conservatively classified; only those flakes which clearly have edge attrition from use are included. The six utilized flakes have a mean weight of 13 g, and a mean length of 4 cm. Three exhibit a fine polishing kind of wear along an edge, two by motion parallel to the edge and one with a motion perpendicular to the edge. One has a dull attritional wear from motion parallel to the edge, and one has tiny but systematically removed flakes along the distal end of the flake.

Two came from the Silencio graveyard, two were from the early G–161 habitation site, and two were from G–169. Thus, there is no apparent pattern by chronology or by site function.

Unifacially Flaked Implements (6) (Fig. 3)

These implements need to meet two criteria to be included here: steep unifacial retouching (i.e., 50-90 degrees) and some evidence of use-wear. In all cases where directionality was determined, it was perpendicular to the edge, making the term "scraper" appropriate for these implements. Mean weight is 114 g, and mean diameter and thickness are 6.2 and 2.2 cm.

Chronologically, these scrapers extend from earliest to latest. They are found exclusively in habitation sites and in G–152, a laja repository. None were from graveyards. Half are of dacite and half are of andesite.

Bifacially Flaked Implements (6) (Fig. 4)

A total of six bifacially flaked projectile points or knives were found. Four of the six are typologically identifiable. The other two are small fragments, one from G–161A3 and one from G–176A1. Both small fragments appear to have broken in manufacture. One is rhyolite and one is chalcedony.

One finely-flaked stemmed biface of black, fine-grained dacite was found at the island cemetery (G–166). Two smaller fragments of the same type were found at G–150, in B2 and C2. Private collections in the area commonly contain these implements from graves. Complete specimens generally are stemmed, with rounded bases, and total lengths from 10 to 15 cm. Estimated lengths are 13 cm, thicknesses are 1.3 cm, and widths are 2.9 and 3 cm. These characteristically are thick, with accentuated midlines. They are very similar to the late stemmed, rounded base bifaces from Nicaragua and somewhat like the Late Classic and Postclassic specimens from the Maya area. They are similar to the tanged points from the Stone Cist Period in the Atlantic area, which date to A.D. 1000 to 1500 (Snarskis 1978:270). The type is chronologically and functionally "tight"; that is, all come from graveyards and all probably are from Period V. Flaking is fairly good, but is not the highly controlled, flat, patterned flaking of PaleoIndian or Archaic Periods. Each face has 2 to 5 step or hinge fractures, which contributes to the prominent medial ridge. These may have been projectile points, or, more likely, hafted knives.

A complete bifacially flaked point was found on the Aguacate surface at G–163, and it may date to the Archaic. It is made of dacite, and is highly weathered to the point of obscuring many flake scars. The phenocrysts have weathered out of the surface, indicating greater age than other implements in the collection. It is deeply and broadly corner-notched, with a flat bottomed, short stem. The stem is slightly asymmetric. It measures 5.5 x 2.9 x .6 cm. The flaking was well-controlled, and only one flake step-fractured. The result is a very thin biface, an Archaic characteristic (Snarskis, personal communication 1984). This probably is the oldest artifact encountered during the 1984 season.

Wedges (2)

Two wedges were found, one from G–153 and one from G–177. Both are of andesite, one fine grained and one medium grained. Both are made from rather thick flakes (2.8 and 2 cm) and both are 6.5 cm long. They average 90 g. Both exhibit some battering at one end and some wear at the sharper, flaked end. They probably were used to split

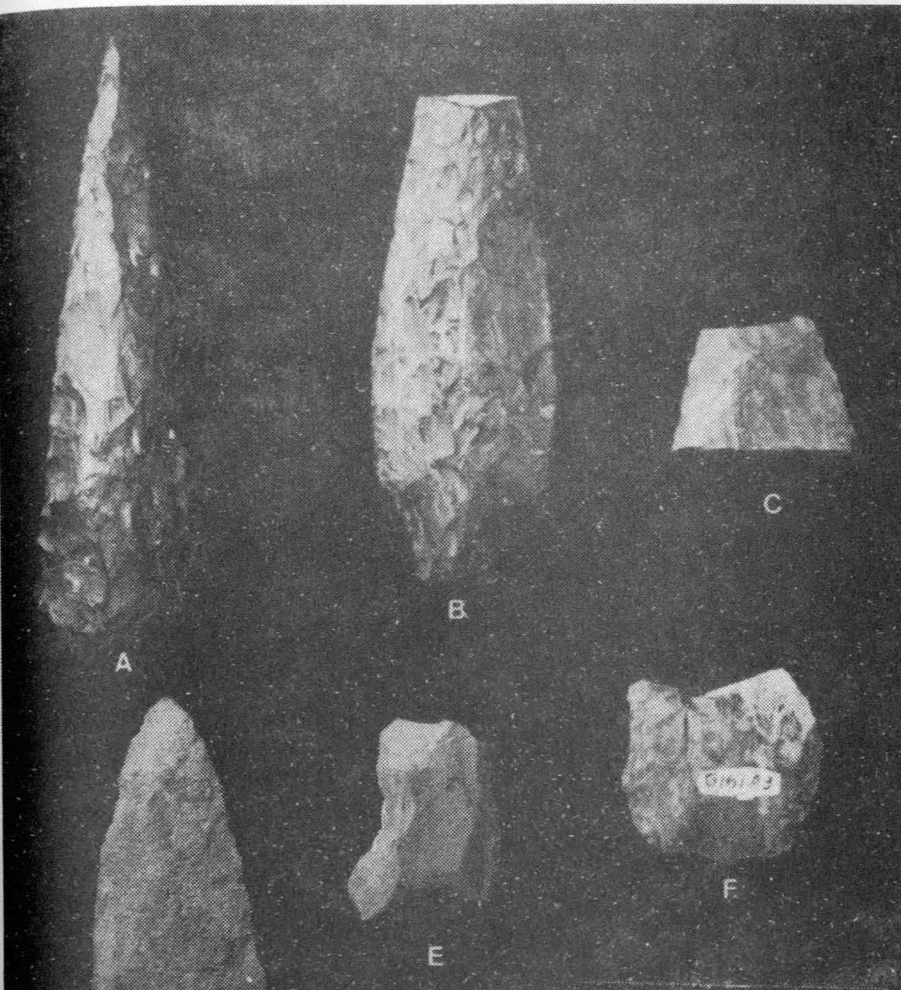

Figure 4. Bifacially Flaked Implements. Projectile Points or Knives. A and B are stemmed, rounded–based bifaces that probably date to Period V. D is a probable Archaic point; note the highly–weathered surface, with phenocrysts weathered out. A: G–150 B2. B: G–166A2. C: G–150C2. D: G–163A1. E: G–176A1. F: G–161A3. Scale in cm.

wood. These are intermediate in size between Ranere's large and small wedges (Linares and Ranere 1980:322-327). The Panamanian wedges were much more used than these.

Celt Blank (1)

The basal portion of one chipped stone celt blank, broken by end-shock during manufacture and discarded, was found at G–150E2. It measures 7 x 5.5 x 2.5 cm. Most

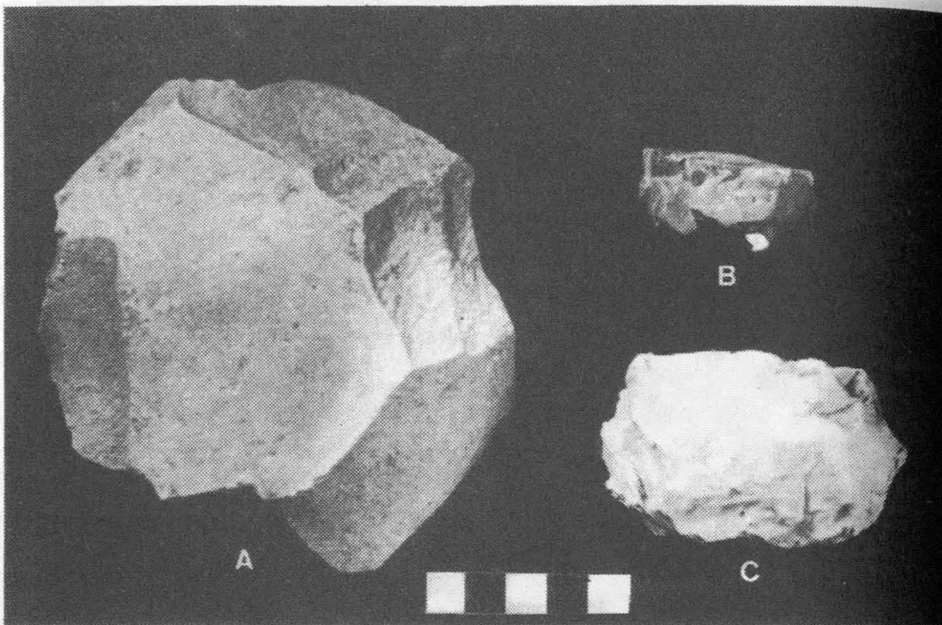

Figure 5. Flake Cores. All are informal cores; large discoidal core on left, two small flake cores on right. A: G–150G1. B: G–175A1. C: G–156A1. Scale in cm.

of the cortex had been removed from one surface, and all from the other. The material is a fine grained dacite. It is a failed attempt at expedient manufacture of a chipped stone celt.

Hammerstones (18)

These average 194 grams, and have mean diameters of 5.6 cm, with a range from 3.6 to 7.5 cm. Materials are andesite, dacite, and chalcedony. All exhibit the pecking-battering that derives from use in chipped stone manufacture, in pecking groundstone implements during manufacture or for roughening, or other uses. Ten came from the G–150/G–151/G–152 funerary complex, and others came from habitation sites around the lake. Although they are found in all periods, they are most commonly found in later times, particularly in Period V.

Flake Cores (43) (Fig. 5)

Core-flake technology is the single most widespread technology in the area. It begins with our earliest sites, and continues to our latest. It is found in both funerary and habitation sites. It is an informal, cottage industry showing considerable variation in raw materials, skill, and in core shaping and reduction. It is an expedient technology, in that flakes were made when and where needed, used, and then discarded.

The cores average 222 g in weight, 5 cm in diameter, and 3.5 cm in thickness. Diameter and thickness ranges are 3.3 to 14 cm, and 2 to 6.6 cm. Not surprisingly, the dacite: microcrystalline rations match the materials in general flakes. Here, 20% are chalcedony and 6% are jasper, with the rest dacite.

Some cores are unidirectional, some are bidirectional, and some are multidirectional. Some are conical, some are discoidal, and many are irregular. Cores are shaped only insofar as it aids the next flake removal. There is no formal manufacturing stage of core shaping, as exists in other areas.

Percussion Blades (9) (Fig. 6)

These percussion blades are not the product of an organized blade industry. Rather, they appear to be incidental by-products of core-flake technology which happened to be elongated, with relatively parallel edges. They average 92 grams, and have mean lengths of 10.5 cm, widths of 4.4 cm, and thicknesses of 2 cm. The shortest is 9.4 cm,

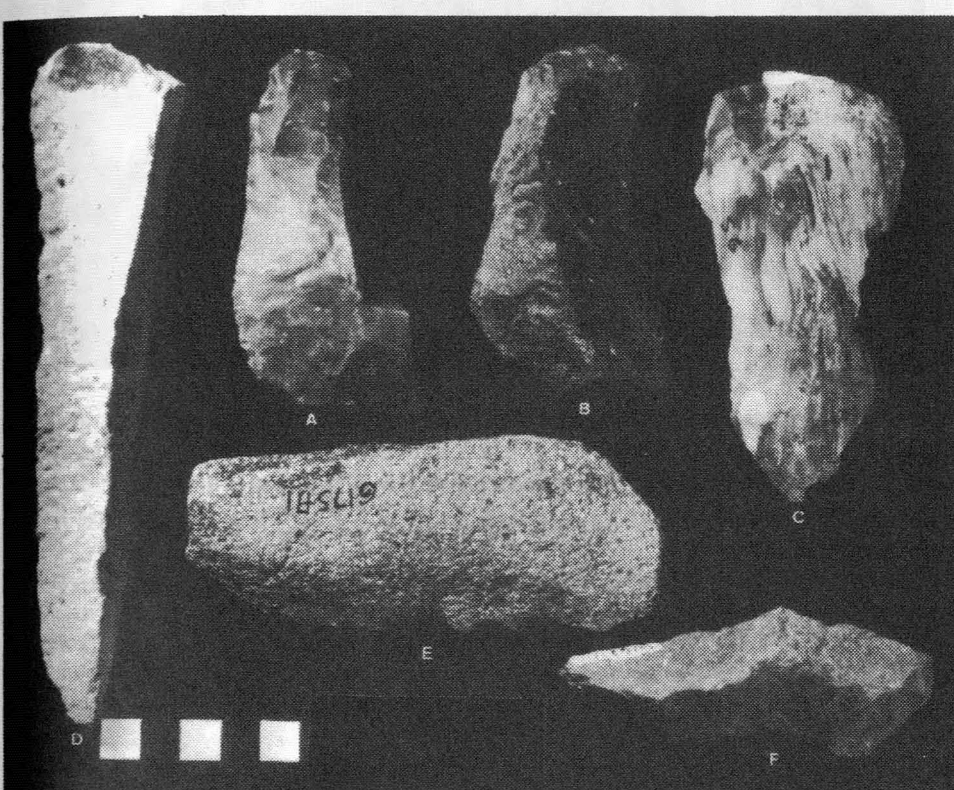

Figure 6. Percussion Blades. These are "fortuitous" blades, thus they are not a component of a formal blade industry. A: IF13, note retouch on left margin, made of a fine quality porphryry. B: G–152A4. C: S6, of petrified wood, perhaps from the Venado area source. D: G–150A. E: G–175A1. F: G–163A1. Scale in cm.

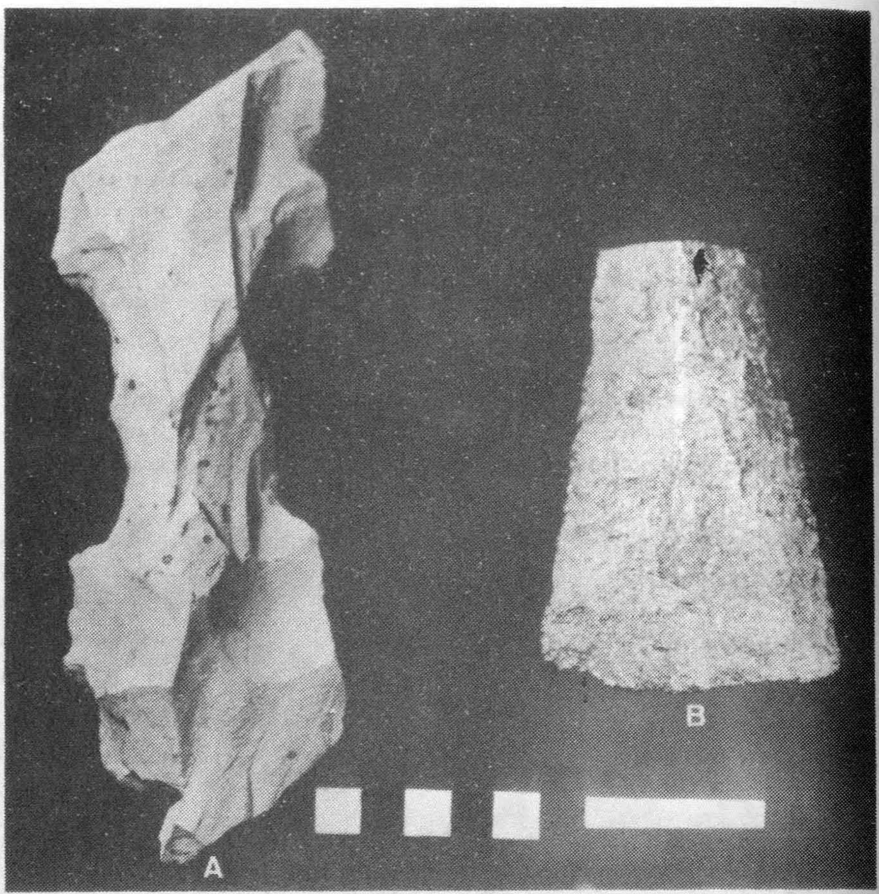

Figure 7. Chipped Stone Celts. A: G–156A1, a double–bitted, waisted axe, apparently damaged in manufacture and never finished. B: G–152A2, a chipped stone axe of dacite from the laja repository near the high status graveyard. The working and the lateral edges were lightly ground, for unknown reasons. Scale in cm.

and the longest is 18 cm long. Three are andesite, one is dacite, one is porphyry, and one is petrified wood. The porphyry blade was finely retouched along its outside margin, probably to sharpen and strengthen the edge. No others were retouched or show use wear.

Chronologically, there is no clear patterning, as they run throughout the sequence, and they are found at funerary and habitation sites.

Chipped Stone Celts (2) (Fig. 7)

These chipped stone celts are distinguished from groundstone celts by the lack of pecking and extensive grinding. They do share the early shaping stage of percussion flaking, and they probably were used for many of the same cutting and chopping tasks as groundstone celts.

A dacite chipped stone celt was found at G–152, along with much lithic wastage, indicating that chipped stone celt manufacture occurred there. It is only missing 2 or 3 cm of its poll end. Thus, its original length would have been 12 or 13 cm. Its width is 6.6 cm, and its thickness is 2 cm. It weighs 151 g. Interestingly, it is lightly ground along both sides and at the bit end, in a narrow zone 1 to 2 mm wide. It is not use wear, but is a manufacturing phenomenon. Its effect on the bit end would be to dull the edge somewhat, but it would have strengthened the edge significantly. The reason for grinding both edges is not known. It was used after the bit was ground, as use had detached a few flakes, leaving only about 1/3 of the bit length with the ground surface.

A double-bitted, waisted axe was found at G–156. It is missing portions of both bits, and appears to have broken in manufacture. It is of andesite, and it weighs 282 g. It is 20 cm long, 6.6 cm wide, and 2.7 cm thick. It was not carefully made, as hinge fractures abound, and the "waisting" or medial constriction is composed of a welter of small hinge and step fractures. A flaw in the material, a hidden natural fissure, was encountered at one end, and surely contributed to its premature abandonment. Similar specimens are extremely common in Atlantic Costa Rica during the first millenium A.D. Snarskis (1978:153) reports large numbers of them, of fine dark shale, chipped and then usually ground, from cemeteries and from some habitation sites.

ASPECTS OF THE COLLECTION

Some aspects of the collection need special mention. Lithic workshops were encountered at a few sites, and some of these have been described above, including the manufacture of dacite chipped stone celts and andesite general utility flakes.

Obsidian Flake

A tiny (5 x 4 x 2 mm) obsidian flake was found in Burial 1 at the Silencio graveyard, G–150B5. It was close to, and probably associated with, the gold pendant. It is a fragment of a small percussion or pressure flake. It is very poor quality obsidian, and it would be difficult to make a usable artifact from it, even a simple cutting flake. It has a large pumiceous inclusion in the middle, but the rest is a smoky transparent obsidian. It may be a local, Costa Rican obsidian, or it may have come from the sources of small nodular obsidian located east of Lake Managua in Nicaragua. It is the sole obsidian artifact, out of 2304 lithic artifacts collected.

Bifacial Workshop at G–154 (Fig. 8)

Fine screening with a 1/8-inch mesh of operation G–154I, at the Period VI site, yielded 185 small flakes of dacite and chalcedony. Most flakes are less than one centimeter long, and less than 1.5 mm thick. Although only 13 can unequivocally be identified as bifacial trimming flakes, it is clear the primary, if not sole, objective was manufacture and maintenance of bifaces. Most of the chalcedony flakes were from primary manufacture, but five had platforms taken from used bifacial knives. Each carried abrasion on its platform; the flake's removal left a sharpened edge. Four of the black dacite flakes

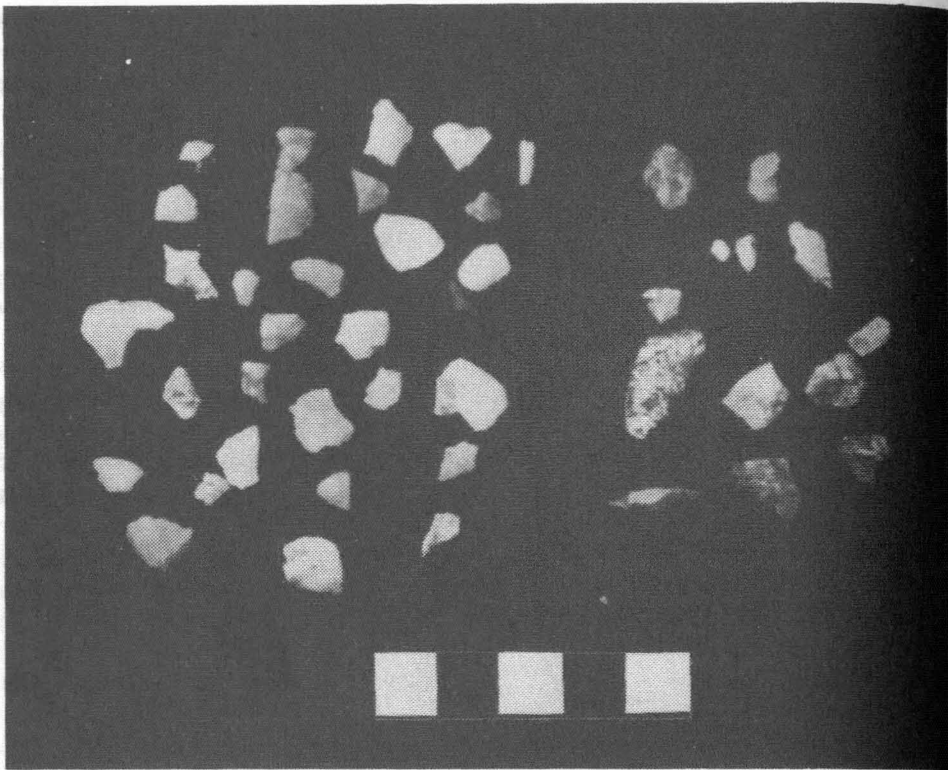

Figure 8. Small Bifacial Trimming Flakes, from the G–154I workshop, Period VI (Tilarán Phase). Flakes on the left are of chalcedony, others are dacite. Platforms at top, ventral sides visible. Scale in cm.

likewise carry an abraded platform, and indicate maintenance activities. Thus the main activity was manufacture of dacite and chalcedony knives, but some effort was also devoted to resharpening.

Bifacial Workshops at G–151 and G–152

Two bifacial workshops that appear very similar to each other were found at these two laja repositories to the west of the big Silencio graveyard. They are almost entirely composed of flakes from a dark dacite. These flakes represent the full manufacturing sequence from cortex removal and early shaping to the final edge trimming.

G–169 Site Assemblage

The Joluvi site is unusual for its concentration of lithics, and for the lack of much variation within it. Although only a small volume of the site was excavated, a total of 484 lithic artifacts was recovered. This is the second highest site total; G–150 had more lithic artifacts, but much more volume was excavated at G–150. Six boiling stones and 141 pieces of thermally fractured debitage indicate great amounts of boiling at the site. A small flake from a groundstone celt indicates possession of celts by inhabitants of the site. A bifacial trimming flake does indicate bifacial manufacture at the site, but what is notable is how little bifacial manufacture was done, compared with flake manufacture.

The predominant lithic activity was core–flake technology. The total for general flakes, 276, is a large one, and it is largely composed of flakes manufactured for domestic consumption. The hinge fracture rate, 3.3% , is high relative to many sites in the cuenca, and is additional evidence for household, not specialist, production. The percentage of microcrystalline materials, 13% , is surprisingly low. They evidently favored the immediately available andesite and dacite over the more rare chalcedony that probably required more effort to obtain, either by longer–distance travel or through an exchange system. Also notable for their absence in such a large collection are unifacial implements, bifacial implements, and chipped stone celts. The site lithics give the impression of a mundane, domestic, local cutting flake assemblage with few frills.

Lithics: Chronology

Using stratigraphy, and particularly the associated ceramics, the lithics from four time spans were compared (Table 1). The time spans correspond to the four ceramic phases. A total of 1633 chipped stone artifacts were so used; the remainder came from mixed lots or multicomponent sites without clear separations and thus they were not used. Lithic tables were prepared on Lotus 1–2–3 for each component, and then compared. Because each phase has a different total number of artifacts, the percentages of each type within its total per phase is used for comparison, instead of the raw frequencies.

The percentages of thermally fractured debitage do not vary markedly through time, although there is an increase in the Silencio Phase and a drop in the Tilarán Phase. Bifacial flaking is found in all phases, and it increases somewhat through time. The evidence is in the relative frequencies of implements and debitage. The increase in general flakes in the Tilarán Phase may be partially explained by an increase in bifacial flaking, because bifacial technology has a much higher ratio of wastage to implements than core–flake or unifacial manufacture. The percentage of flake cores remained constant, between 2 and 3% , indicating a high degree of stability for at least two millenia.

Hinge fracture percentages, computed as a percentage of general flakes, do show variation through time. The highest percentages, 4% , are earliest and latest, with a drop to 3% in the Arenal Phase and a remarkable drop to only 1% in the Silencio Phase. Four percent is not a very high hinge fracture rate, speaking in general terms, at least it is not so high as to significantly inhibit lithic manufacture, especially of flake tools from simple cores. However, the 1% figure is notably low and needs explanation. The Silencio Phase lithics derive from three sites, G–150, G–151, and G–152. These are the elite graveyard, and the two associated laja repositories. I interpret this as markedly more skilled manufacture, in general. Core-flake technology was performed at G–150, for miscellaneous cutting tools, but the percentage of skilled manufacture is higher at these sites, resulting in a lower error rate. The most likely explanation is specialization, that a higher percentage of the lithic manufacture at these sites was performed by specialists, or at least by part–time occupational specialists. That is a characteristic of a nonegalitarian society, and in this case, a chiefdom or ranked society is a possible interpretation.

A large amount of variation in materials is notable through time. Chalcedony rises

Table 1. Summary of Chipped Stone Artifacts by Phase and by Site Type.
The six columns on the right give material breakdowns by phase and by type of site.

	Thermally Fractured	Small Biface Flakes	Large Biface Flakes	Celt Flakes	General Flakes	Other	Uniface	Biface	Wedge	Hammerstone	Flake Cores	Perc. Blade	Boiling Stone	Celt Blanks	Ch. Celt	TOTAL	Hinges	Chalcedony	Petrified Wood	Porphyry	Jasper	Quartzite
Tilarán Phase No.	63	14	1		216	38	1	1		1	8	1	4			350	9	121	4		7	1
°/o	18	4			62	11					2		1				4	56	2		3	
Silencio Phase No.	292	10	11	4	325	119	1	2	1	10	16		4	1	1		4	15	1	1	1	
°/o	36	1	1		41	15				1	2						1	1/2				
Arenal Phase No.	83	3	4	3	166	86	1	2	1	5	10	2	2			368	5	43	3		2	
°/o	23	1	1	1	45	23				1	3	1	1				3	26	2		1	
Tronadora Phase No.	29	1			50	25	2	1			2	2				113	2	10			2	
°/o	25	1			44	22	2				2	2					4	20			4	
TOTALS	467	28	16	7	757	268	5	5	2	16	36	5	10	1	1	1632	20	189	8	1	12	1
Habitations No.	354	20	4	3	734	198	5	3	2	8	25	6	15		1	1382	24	213	16	1	12	1
°/o	26	1			53	14				1	1	1	1				3	29	2		2	
Cementeries No.	287	12	15	4	340	126	1	2		10	16	2	4	1	1	823	5	15	1	1		
°/o	35	1	1		41	15				1	1						1	4				

from 20% to 26%, and then drops down to 1/2%, and then rises up to 56%. The notable drop to almost nothing in the Silencio Phase may or may not indicate a society– wide decline in chalcedony use. It does indicate that very little chalcedony was used in cemeteries. Until Silencio Phase habitations are explored we will not known how much chalcedony was used in everyday activities. The rise in chalcedony to 56% is also notable, and in part derives from the fine–screened bifacial workshop at the G–154 habitation site. Chalcedony edges are sharper, and seem to have been favored at habitation sites for some uses.

Lithics by Site Type

Lotus 1–2–3 tables were prepared for the lithics from cemeteries versus lithics from habitation sites. These are summarized in Table 1. The most striking result is that there is considerable overlap. There is not a crisp demarcation, at least in most categories, between habitation assemblages and graveyard assemblages. I suspect that the graveyards were turned into temporary residences for sufficiently extended periods to introduce a lot of habitation lithic artifacts into cemetery areas.

Some differences can be seen. The percentage of thermally fractured debitage is higher at cemeteries than in habitations. This may be due to the difficulty of transporting bulky and fragile large ceramic cooking vessels for many kilometers. It many have been easier, in many cases, to use wooden, hide, or basketry containers, with stone boiling, for cooking at the graveyard. The fact that relatively more general flakes were found at habitations than cemeteries is not surprising.

The difference in hinge fractures, noted above in discussing chronology, is clear in the habitation: funerary discrimination. The cemeteries are consistently low in hinge fractures, evidently due to a higher level of skill in manufacture. A very strong difference is noted in the rarity of chalcedony (4%) and other microcrystalline rocks in the graveyard, versus an abundance of chalcedony (29%), petrified wood, and jasper in habitation sites. The chalcedony is available in the area, and there is a good source of petrified wood in the Venado area (Tosi 1980:2–129). Evidently the range of needs was greater in habitations, from needing the sharper but more fragile edges of chalcedony and the other microcrystallines, to the tougher but duller edges on fractured andesite and dacite. Graveyards apparently witnessed a lot of woodworking, as evidenced by celts, celt flakes, and some wear on dacite flakes. This probably included tree and branch cutting and trimming, firewood cutting, digging stick manufacture and maintenance, temporary shelter construction and maintenance, and vine cutting.

CONCLUSIONS

The single most notable aspect of the cordillera lithics collected in 1984 is their conservatism. Chipped stone tool manufacture is dominated by core–flake technology from its inception about 1000 B.C., and it continues virtually unchanged until about A.D. 1500. One way of viewing this is stasis, that they became stuck in their lithic ways and refused to change and keep up with their neighbors to the north. However, another view is that a successful means of generating a variety of cutting edges for various uses in adapting to a tropical rainforest environment was achieved early, and there was no need to change a technological system that was so successful. It was a simple system, probably performed within each household, yet with variation in raw materials and in edge shapes and lengths, the cutting needs of households could be met easily. Highly skilled items were not needed, allowing the household to maintain self–sufficiency and avoid the economic and social compromises that derive from reliance on a centralized economy. Certainly, they avoided being brought into reliance upon long–distance traded obsidian, in contrast to societies in Nicaragua, El Salvador, and Honduras. Their avoidance of an economy of dependence should be viewed as a positive achievement, not as a "lack of progress."

Of interest is the high frequency of thermally fractured stones, along with occasional complete boiling stones. This probably is a hold–over from preceramic times, when stone boiling was the easiest way to cook food in wooden or hide containers. It remained surprisingly common throughout our sequence, and was strikingly common at the large graveyard.

Bifacial and unifacial flaking were rare at all times, but occurred during all phases. One of the rare chronologically sensitive types of chipped stone is the stemmed, rounded base biface, of which three were found. They consistently are Late Classic to Postclassic in the north, and are Period V or later in northwestern Costa Rica and Nicaragua. At the other end of the sequence is the probable Archaic point found at G–163. This likely is the oldest artifact collected during 1984.

In summary, then, the chipped stone industry as a whole is a successful complex of knowledge, materials, techniques, and uses that provided cutting edges for households for many centuries in the Cuenca de Arenal area. It is a strong local tradition, only occasionally affected by lithic developments from outside.