

UNIFACES IN EARLY ANDEAN CULTURE HISTORY: THE NANCHOC LITHIC TRADITION OF NORTHERN PERU

Jack Rossen

Ithaca College & University of Kentucky

Introduction

This paper describes and discusses a lithic industry of northern Peru that has been studied for several years. The Nanchoc Lithic Tradition (NLT) is associated with sites on the forested western slopes of the upper Zaña Valley dating to the Middle Preceramic IV Period (8000-6200 B.P.). The chipped lithics described here were recovered from a series of residential sites in a lateral *quebrada* or side canyon of the valley with alluvial fans (the Quebrada de Las Pircas). The sites are characterized by intact midden and features, including *quincha* (wattle-and-daub) hut floors, burials, and a variety of activity areas (Dillehay *et al.* 1989; Rossen 1989, 1991). Other artifact assemblages such as ground stone, faunal remains, marine shell, daub, and botanical remains were also recovered and have been described in these sources and elsewhere (*e.g.*, Rossen *et al.* 1996).

Chipped lithics are the focus of this paper for several reasons. Foremost, lithics are usually the dominant assemblage in South American Preceramic sites, and thus lithic traditions have come to be strongly identified with those cultures. Lithics also provide the broadest basis for comparing Preceramic Andean cultures, many of which (such as the Paiján complex of northern Peru) have been defined primarily on the basis of surface-collected sites with minimal context or few non-lithic assemblages (see Chauchat 1988). In addition, there have been conceptual advances in the study of lithic technologies that allow examination of organizational implications of lithic assemblages (Binford 1987). In this regard, archaeological correlates have been developed to match different types of lithic assemblages with cultural traits such as (1) varying degree of group mobility or sedentism, (2) generalized versus specialized economies, and (3) long- versus

short-term tool use (Henry and Odell 1989; Johnson and Morrow 1987; Torrence 1989). A basic premise of this paper is that these conceptual advances in the study of lithics offer means to produce new insights into early Andean culture history.

The widespread presence of unifacial preceramic lithic traditions in northern Peru and southern Ecuador has been interpreted in a number of ways. As examples, unifacial industries have been viewed as indicative of the presence of dispersed, related social groups (Malpass 1983; n.d. [c. 1984]), as repetitive, independent adaptations to similar environments and resources (Richardson 1978:280), and as representative of more plant-oriented and woodworking functions (Ranere 1975; Richardson 1981). This analysis of the Nanchoc Lithic Tradition (NLT) adds detailed contextual data to the analysis. It will be argued that, in this case, unifacial lithics represent a shift toward a more diversified economy favoring plant exploitation, a low-mobility localized permanence, and the subtle beginnings of intensification. Here, intensification means a social reorganization or shift toward the potential to produce more, coupled with a commitment to change; specifically, an irreversible move toward sedentism, food-production, and group-level integration (Bender 1978). Lithic technology is but one of several data sets that led to this conclusion (Rossen 1991). However, because lithics constitute the largest data set of the Nanchoc sites, and because lithic contexts were documented in detail, it is useful to examine these unifaces in their own right. This article thus aims to characterize the lithic industry and touch on some related issues of how lithic technology may relate to economy and culture change in the forested slopes of Middle Preceramic northern Peru. Considerations of space preclude any detailed incorporation and discus-

sion of the smaller supporting associated assemblages such as faunal and floral remains (see Rossen *et al.* 1996).

The organization of this paper is as follows. First, the research area of the upper Zaña Valley will be described, along with a summary of the twenty-one-year history of the Zaña-Niepos Archaeological Project. A background section provides a broader context of the problems and hypotheses within which the Zaña Valley research has been conducted. The NLT is then described in terms of its stages of reduction, attribute-variables, formal tool typology, and site contexts. The final section discusses some conceptual and cultural historical issues related to the NLT, including the possibility of the existence of an Andean-Panamanian Unifacial Complex (Malpass n.d. [c. 1984]) and the possibility that Middle Pre-ceramic unifacial industries signal changes in social organization, economy, and a new direction in cultural evolution.

The Upper Zaña Valley

The Zaña Valley, in terms of water carried and arable land, is the sixth largest of Peru's north coastal valleys (Moseley 1983:785). It is situated parallel to, and immediately to the north of, the Jequetepeque Valley (Figure 1). The valley has two branches, with the Zaña Valley proper being the northern branch and the Nanchoc River the southern branch. These two branches have their confluence near the town of Oyotún, at what is considered to be the boundary between the middle and upper valleys. Today, the upper valley contains a string of small towns of maize farmers and herders. Other valley inhabitants live in dispersed homesteads on hill spurs and flats above the valley floor.

The valley is ecologically unique and important. It is situated at one of the lowest points of the Andes chain, and contains Peru's closest juxtaposition of coast, sierra, and tropical forest. The valley ecology includes a relict tropical montane forest on its western, uppermost slopes (Craig 1985; Dillehay and Netherly 1983; Dillehay *et al.* 1989:734-736; Koepcke 1954; Koepcke and Koepcke 1958;

Weberbauer 1945:27, 47, 444-446, 465-471). This forest is a remnant of a once-continuous band of tropical forest that crossed several northern valleys of Peru (Simpson 1975; Vuilleumier 1971).

The conquistador Francisco Pizarro travelled up the Zaña Valley on his way to Cajamarca in 1532, stopping to rest at an Inca administrative site at Nanchoc for several days (Trujillo 1948 [1571], discussed in Hyslop 1984:66). The valley and its vegetation was described by the Italian naturalist Antonio Raimondi, who visited the upper valley in 1868 (Raimondi 1940 [1874]:262-263). Raimondi noted that the forest stretched from the top of the valley at 3500 m down to Nanchoc, then an hacienda, located at only 360 m in elevation and 80 km from the coast. Even then, hacienda Indians were cutting trees for export to the coast. In 1905, and again in 1934, the region was visited by the German botanist Augusto Weberbauer, who described the forest as reaching down to about 5 km above Nanchoc (Weberbauer 1945:27, 47, 444-6). By the 1950s, when the region was again described by Hans and María Koepcke, the remaining forest ended 15 km above Nanchoc (Koepcke 1954; Koepcke and Koepcke 1958). The densest remaining pocket of this forest is located on the Zaña side of the valley near Taulis. At present, this surviving pocket of western slope tropical forest, located approximately from 1300-2400 masl grades into a humid, ceiba (*Ceiba* sp.) forest at elevations of about 800-1300 masl, and then into a semi-arid thorn forest that covers the lower portion of the upper valley (500-800 masl) including what are now the towns of Nanchoc, Bolivar and Carahuasi (Dillehay and Netherly 1983; Dillehay *et al.* 1989:734-736).

The present-day vegetation of the Nanchoc area is a mixture of semi-arid and temperate species, including various types of columnar cactus (*Cereus* sp. and *Cephalocereus* sp.) together with small trees and shrubs (*Bombax discolor*, *Puya* sp., and *Deuterocohnia* sp.). Along watercourses are temperate trees (*Celtis* sp. and *Myrica pubescens*). This portion of the valley (ca. 80 km from the coast) is characterized by a series of branching, lateral que-

brada and alluvial fan networks that contain access routes to the tropical forest above and the arid middle valley and coastal plain below (Figure 2).

Previous Research

Throughout the history of the Zaña-Niepos Project (now encompassing nine field seasons) the ecology and archaeology of the Zaña Valley has offered new insights into the cultural developments of the Middle and Late Preceramic Period in northern Peru. Prior to the 1987 research, four field seasons directed by Tom D. Dillehay and Patricia J. Netherly (1976, 1978, 1981, 1984-85) provided an initial understanding of the complex ecology, geology, and archaeological potential of the valley. Their research laid the foundation for further, specific investigations by locating and test excavating numerous sites and defining a localized chronology (Dillehay 1985; Dillehay and Netherly 1983, 1985; Dillehay *et al.* 1989; Netherly and Dillehay 1985, 1986).

Dillehay and Netherly's early surveys indicated a substantial Preceramic habitation in the upper Zaña Valley. In particular, surveys conducted in 1984-5 succeeded in locating sixty-two such sites, of which forty-eight are concentrated in a ceiba montane and arid thorn forest ecotone of the Nanchoc area. Within that ecotone, the sites are further clustered in 10 square kilometers of elevated alluvial fans near stream headwaters in the upper portions of the lateral *quebradas* (Figure 2).

The location of dense clusters of Preceramic sites on selected alluvial fans in side canyons well above the valley floor, and the total absence of overlying ceramic occupations were considered conspicuous and significant features of the Zaña Valley's archaeology. Although clustered, these sites appeared to represent an intact relict of a dispersed settlement pattern of many small sites, which tended to segment activities. From these features, Dillehay and Netherly (1985) hypothesized that earlier Preceramic populations were concentrated high in the lateral *quebradas* on alluvial fans, and that, through time, they gradually migrated toward the main

valley floor as agriculture intensified during the Formative Period, requiring more cultivable land and water. Also suggested was that important advances of the Preceramic Period, such as adoption of cultigens, sedentism, and clear separation of domestic and non-domestic space, originally occurred above the main valley floors, in narrow side *quebradas* that had received little archaeological attention (Dillehay and Netherly 1985; Dillehay *et al.* 1989).

Among many results, Dillehay and Netherly's research (1) provided evidence from a small Middle Preceramic public site (the Cementerio de Nanchoc Site [CA09-04]) and (2) defined many habitation middens, including at least two with intact subsurface deposits, and suggestive evidence of complex internal structure and activity areas. Although not segmented in the classic crafts specialization sense (Flannery 1969), there existed specialized, separated public activity and segmentation in terms of the dispersed settlement pattern. The Dillehay-Netherly hypotheses presented elements of an alternative model of the circumstances surrounding Preceramic subsistence intensification, including the possible adoption of plant cultivation, and the subsequent development of early complex society in northern Peru. The author's 1987 research was designed to follow-up with an intensive investigation of a related series of one *quebrada's* habitation middens in order to (1) define Middle Preceramic domestic activities and lifeway, (2) evaluate and further develop Dillehay and Netherly's localized model of cultural development, and ultimately (3) relate the findings to broad conceptual and theoretical debates concerning intensification and cultural evolution. A few of these issues will be explored as they specifically relate to the chipped stone industry.

The Quebrada de Las Pircas

Today the lateral *quebradas* of the Nanchoc area are semi-dry to dry, with only a few widely-scattered springs, and are uninhabited on a permanent basis. The *quebradas* are only sporadically utilized, for hunting, except during years with heavier-than-normal rainy sea-

sons (December to April) like 1986-87, when the area is used for foraging herds. Of the many *quebradas* in the Nanchoc region, the Quebrada de Las Pircas was a natural choice for intensive research because (1) it was the largest, most geologically developed *quebrada* and alluvial fan system in total area surveyed during the 1984-85 field season, (2) its Preceramic sites were more numerous and intact than those in other *quebradas*, and (3) test excavations at two sites in 1985 revealed intact deposits and Middle Preceramic radiocarbon dates (Dillehay *et al.* 1989).

A 1969 air photo of the southwest to northeast sloping Quebrada de Las Pircas depicts a sinuous dry streambed flowing through a canyon with little vegetative cover or zonation (Figure 3). This rocky dry bed that is up to 10-15 m deep runs along the southern foot of the hill, Cerro Tingues. During the 1985-87 investigations, the *quebrada* had much heavier vegetation, and a major curve in the dry streambed depicted in the air photo was straightened by the 1982-83 El Niño rains. This change in stream course is depicted by a dotted line in Figure 4. A lower pampa with dense undergrowth, passable by only two footpaths, opens into a higher, less vegetated, more dissected pampa containing alluvial fans, dissected alluvial fan remnants, and hill spurs. At its top, the *quebrada* is enclosed by three long hills, Cerro Tingues, Cerro Taza, and Cerro Conquis, which range in height from 1000 to 1200 m.

South American Unifacial Lithic Industries

As a unifacial lithic industry, the Nanchoc Tradition must be conceptualized in a different manner than bifacial industries. There are several examples of primarily or exclusively unifacial lithic industries in lower Central America and the Andes, some of which are briefly listed below from north to south with their locations, environmental reconstructions, and approximate dates:

Chiriqui (Ranere 1972, 1975; Linares and Ranere 1980):

location: western Panama, Pacific side

environment: semi-evergreen seasonal forest

date: 6500-5000 B.P.

economy: advanced hunting-gathering, incipient gardening?

Aguazuque (Correal 1989):

location: Cundinamarca Dept., central Colombia

environment: dry low montane forest

date: ca. 4000 B.P.

economy: advanced hunting-gathering and gardening

Las Vegas (Stothert 1974, 1985, 1988):

location: Santa Elena Peninsula, southwestern Ecuador

environment: mangrove swamp, thornscrub with woodland and thicket patches

date: 10,000-6600 B.P.

economy: hunting-gathering, incipient gardening

Sangay (Porrás 1988):

location: eastern Andean slopes, southeastern Ecuador

environment: tropical montane forest

date: ca. 5000-4000 B.P.

economy: horticulture-agriculture

Cubilán (Temme 1982):

location: eastern cordillera, southern Ecuador

environment: tropical montane forest

date: unknown

economy: hunting-gathering?

Siches (Richardson 1969, 1978, 1981):

location: Talara, far northern coastal Peru

environment: mangrove swamp, savanna woodland, savanna with extensive riparian forests

date: 8000-5000 B.P.

economy: hunting-gathering, gardening at end of sequence?

Mongoncillo (Malpass 1983):

location: lower Casma Valley, central coastal Peru

environment: open park forest, coastal valley

date: ca. 9000-8000 B.P.
economy: hunting-gathering

In considering this list, it should be noted that unifacial lithic industries related to forested environments have also been documented in other areas of South America, particularly Brazil (see Dillehay *et al.* 1992; Schmitz 1987 for general discussions). Also, South American unifacial lithic industries are not limited to the Preceramic Periods. For example, a coastal split-pebble tradition noted on the Peruvian north coastline in the Zaña and Jequetepeque Valleys continued until Inca times (Dillehay *et al.* 1990). The above list is given merely to highlight examples of some industries that are closer to the Nanchoc study area and/or have been well-documented. Of these, the works of Ranere, Richardson, Malpass, and Stothert constitute the most extensive analyses. In comparing these industries, two important similarities may be noted:

1. Many unifacial industries are associated with forested environments. These are regions where plant and wood exploitation would be expected to be important. Conversely, hunting (with associated bifacial lithics) would be a more important subsistence activity in less forested, more open environments where animals might be more accessible.
2. Many (but not all) tools in these industries are thought to have been used to make primary tools of wood or other perishable material, rather than having been primary tools themselves (Richardson 1969, 1978).

When the north-central Andes (particularly Peru and Ecuador) are specifically considered, there are currently two perspectives on the series of unifacial lithic industries that have been recorded. The first perspective is that these industries represent independent adaptations to similar environments and resources (Richardson 1978:280). The second perspective is that these industries are genetically related and represent actual intergroup contacts (Malpass 1983; n.d. [c. 1984]:3). Under this second perspective, the various industries are

grouped together into a "Unifacial Complex" (*ibid.*).

In discussing these concepts and perspectives on unifacial lithic industries, it is first important to emphasize that the NLT is not an anomalous phenomenon, but is instead one of several Preceramic unifacial industries located throughout forested or semi-forested zones of tropical America. Second, it will be argued that despite broad similarities with other unifacial industries, specific traits of the NLT differentiate it from other known unifacial industries. Three particular examples are (1) the presence of recurring formal tool types, (2) the amount of edge trimming and modification, and (3) the substantial amount of associated ground stone. Because of the above distinctions, a slightly different perspective is taken here: that the various unifacial industries of Ecuador and Peru represent industries associated with less mobile groups and primarily plant-oriented economic strategies. In part, this perspective recognizes that (1) great variation may exist between unifacial industries, and (2) unifacial lithics represent part of a plant-oriented economy rather than a cultural anomaly requiring the genetic linking of widely-distributed human groups. That is, this perspective suggests that unifacial lithics are part of an adaptive option related to emphasis on plant subsistence, woodworking, and in the particular case of the NLT, subsistence intensification in the form of a diversified economy emphasizing plants and perhaps gardening.

NLT Site Descriptions

Controlled surface collection and multiple block excavation were performed at three Nanchoc-area sites (CA09-27, CA09-28, CA09-52) and supplementary limited test excavation was performed at three other sites (CA09-85, CA09-86, CA09-87) (Figure 5). Lateral *quebrada* Preceramic sites in the Nanchoc area tend to be quite small (with a few exceptions), often under 1000 m² in total area. This can be a research advantage, in that block excavations can examine a substantial percentage of a site to sample its activities and contents reliably (Mueller 1976). The three sites chosen for intensive investigation were

documented during survey in 1985 (Dillehay and Netherly 1985), while the three sites chosen for limited test excavation, located in the upper reaches of the *quebrada*, were documented during the 1987 field season (Rossen 1988). All sites but CA09-86 and CA09-87 consisted of moderate to dense lithic scatters with occasional ground stone present. Those sites contained from 30 to 60 cm of intact midden and included subsurface features such as a *quincha* (cane and mud) hut floor with surrounding post holes, and both intact and fragmented human burials. Site CA09-86 was a light lithic scatter without underlying midden and site CA09-87 was a modified outcrop and heavy scatter of deep violet-colored quartzite. These sites were designated as follows:

- CA09-27 - Quebrada de Las Pircas 1
- CA09-28 - Quebrada de Las Pircas 2
- CA09-52 - Quebrada de Las Pircas 3
- CA09-85 - Quebrada de Las Pircas 4
- CA09-86 - Quebrada de Las Pircas 5
- CA09-87 - Quebrada de Las Pircas 6

Site Stratigraphy and Integrity

Multiple block excavation at three sites (CA09-27, 28, and 52) and test excavation at two other sites (CA09-85 and 86) conducted in 1987 produced consistent stratigraphic profiles of eolian (wind-blown) midden deposits sandwiched above the hard alluvial fan subsoil and below a thin (5-8 cm) hard cap of colluvium (Figure 6). The hard cap is attributed to seasonal rains and the resulting surface deflation, discussed briefly below. Regardless of depth of deposits, which, similar to the 1985 testing phase, ranged from 30 to 60 cm below surface, this general "stratigraphic sandwich" was present throughout the 120 square meters of excavation. Furthermore, all subsurface features, ranging from a *quincha* (wattle and daub) hut floor and post holes to a small stone structure and partial and complete human burials, began in a narrow range of approximately 22 to 28 cm below the modern surface. That is, all features appear to be interrelated within the same subsurface midden zone without crowding or overlap, giving the impression at each site of a single major occupational

episode (Figure 7). All excavations thus produced evidence of relatively shallow middens with simple stratigraphy and apparently inter-related, well-spaced features.

A recognition that all sites are disturbed to one degree or another, and a discussion of that disturbance is crucial to evaluating all archaeological evidence (Hassan 1987; Nash and Petraglia 1987; Schiffer 1987). In the Quebrada de Las Pircas, site disturbance was considered in terms of (1) the extent of surface versus subsurface deposits at these small sites, (2) surface artifact frequencies and lengths located within versus outside the boundaries of subsurface deposits, and (3) artifact frequencies and lengths in various 10 cm subsurface levels.

The detailed analyses of the sites' integrity and its experimental correlates (*sensu* Petraglia and Nash 1987; Schick 1987) have been presented elsewhere (Rossen 1991:103-125). The results of those analyses appear to indicate that the Nanchoc sites experienced only a low level of disturbance, consisting of surface deflation and downslope horizontal "smearing" of surface artifacts. Consistent means, modes and standard deviations of artifact size, both horizontally and vertically, suggest that more damaging post-depositional processes such as "size winnowing" of artifacts that remove selective portions of assemblages or vertical displacement are not major factors at these sites. Stylistic consistency of artifacts at all levels of individual sites and between different sites in the QLP suggest that all site deposits are related to the same occupation, or at least the same cultural stock (*ibid.*:153-155).

Radiocarbon Dates

A series of fourteen radiocarbon dates has thus far been received. Table 1 presents the ten accepted dates and their contexts. The four problematic dates are discussed in Rossen *et al.* (1996). The samples of aggregate wood charcoal were submitted from the best contexts of the sites, including the *quincha* hut floor (depth 25 cm from ground surface), a narrow midden level just beneath that floor (depth 32 cm) and an articulated burial (depth

36 cm). Nine of these ten samples produced Middle Preceramic Period dates. The acceptable dates (that is, dates that match the evidence of artifacts, stratigraphy, and previous project data) range from 7630 B.P. $\pm$ 80 (Beta-30778) on the hut floor of site CA09-27 to 8410 B.P. $\pm$ 140 (Beta-33526) from a test unit of site CA09-85, high in the *quebrada*. As may be noted in Table 1, three dates with acceptable results were processed on the extended count method that assures greater accuracy for small samples. Wood charcoal samples were also examined for possible contamination by carbonates and none were found (Murray Tamers, personal communication, 1989). An unacceptable date of 2270 B.P. $\pm$ 140, from wood charcoal of level 4, site CA09-52, would relate to the Late Formative Period. The absence of ceramics or other artifacts of this period at these sites suggests this date represents either charcoal from a root burned after the site occupation, sample contamination, or another unspecified problem. Other problematic radiocarbon dates, run on botanical remains using the Accelerator Mass Spectrometer (AMS) method, are not relevant to a discussion of the lithics and have been discussed in detail elsewhere (Rossen 1991:149-153, 517-528; Rossen *et al.* 1996).

Interrelated, Single Component Sites

In summary, six sites were investigated in the Quebrada de Las Pircas, one of several lateral canyons and alluvial fans located throughout the Nanchoc branch of the upper Zaña Valley. This series of sites was investigated both (1) as a continuation of the long-term research founded and nurtured by Dillehay and Netherly's Zaña-Niepos Archaeological Project (Dillehay and Netherly 1983, 1985; Dillehay *et al.* 1989) and (2) as an independent research project with somewhat different conceptual and theoretical goals, including an emphasis on past subsistence intensification activities (Rossen 1991). A total of 120 m² was excavated.

One of the more important results of the 1987 research was the recovery of a large collection of lithics from intact subsurface deposits, house floors, and other features of the

five sites. Each site appears stratigraphically to consist of a single component, representing occupation by a single group with a consistent material culture. Furthermore, the QLP sites appear to be culturally interrelated by their similar artifacts, stratigraphy, and spatial proximity. As subsequent field seasons refined the broad Preceramic sequence of the Nanchoc area, the interrelatedness of the QLP sites was further reinforced (Rossen and Dillehay 1994). The lithics recovered from these sites may thus be discussed as representative of a single stone-working tradition. It is further believed that these data may represent a broad, valley-wide cultural pattern of the Middle Preceramic Period (Dillehay *et al.* 1990).

ANALYSIS FRAMEWORK

The chipped stone collection (n=35,537) was analyzed from both more traditional perspectives such as reduction sequencing (Bradley 1972; Collins 1975; Schiffer 1976), attribute-variable analysis, and formal morphological typology (Brew 1946; Ford 1954; Krieger 1944; Rouse 1939, 1960), as well as from the perspectives of microscopic use-wear (performed by Dillehay) and spatial analyses to define the basic lithic tradition elements and to assign functions. Due to space limitations, only the reduction sequence and certain aspects of the attribute-variable and typological analyses are presented. An effort was made to present portions of the analysis that broadly define the characteristics of the NLT. Analyses that are not discussed here either generally corroborated the data presented (such as micro-wear analysis) or were oriented toward defining activity areas at individual sites.

In addition to the above-listed traditional forms of lithic analysis, newer concepts and archaeological correlates have been developed to match different types of lithic assemblages with such cultural traits as varying degree of group mobility or sedentism, generalized versus specialized economies, and long versus short-term tool use (Henry and Odell 1989; Johnson and Morrow 1987; Torrence 1989). Organizationally-oriented studies are based on conceptual dichotomies that apply to lithic

assemblages in their entirety. Of these, Binford's (1977, 1979, 1987) expedient versus curated industries dichotomy is most relevant to the NLT. Expedient industries contain tools that are manufactured, used, and discarded according to momentary needs, while curated industries contain tools that are manufactured in anticipation of future use, are maintained, transported, and often recycled or rejuvenated (*ibid.*; Bamforth 1986). In the classic sense of this conceptual dichotomy, expedient tools are technologically simpler and morphologically less-patterned than more technologically sophisticated and formally distinct curated tools (Bamforth 1986). The essential difference is one between an industry geared toward immediacy, a wider variety of tasks, utilization of resources on an encounter basis, and a generalized economy (expedient), versus an industry oriented toward logistical planning and more specialized tasks and economies (curated) (Binford 1980, 1987).

Related to this dichotomy is another conceptual dichotomy, that of embeddedness versus trade (Binford 1979). The concept of embeddedness is essentially that exotic raw material may be procured in the natural course of hunting or other mobile economic strategies, even for basically sedentary groups (*e.g.*, Morrow and Jefferies 1989). Embedded procurement of non-local material may then be low in cost. The archaeological correlate of this would be whether non-local (exotic) raw material occurs in a more reduced state than local material at a site (reflecting exchange), or whether both local and non-local raw materials are treated the same in reduction terms (reflecting embedded procurement) (Torrence 1989:30). Thus, at a series of interrelated sites such as the QLP sites, where local versus non-local materials are easily distinguished, analysis related to raw material types can be utilized to infer degree of embeddedness, mobility, and economic generalization or specialization of the group. Of course, in the broader research milieu, other site assemblages were utilized to support the observations based on these lithic conceptual dichotomies, and the realities of analysis produced a result more complicated than simple dichotomies allow. However, these new conceptual trends in lithic

analysis produce interesting supplemental information to the traditional analyses of reductive stage, attribute-variables, and formal tool typology.

Before discussing preceramic Andean lithic industries, it is important to note the variety of analytical terminology and methodology that is present in the literature. Terminologies utilized in connection with unifacial industries range from several variations on simple descriptive terms (*e.g.*, Malpass 1983; Richardson 1969) to an emphasis on flake production technique and flake shapes (Stothert 1974, 1988). These differences reflect differences in the excavation contexts and morphological characteristics among unifacial industries. The present terminology employed differs somewhat from those previously utilized for the same reasons the previous analyses differ from each other. The combination of attribute-variable analysis with formal typology and reductive stage compilations in part represents an attempt to minimize comparison problems between industries.

The present analysis differs even more from the terminology and style used to examine bifacial preceramic lithics of northern Peru. The Paiján industry, the latter portion of which slightly predates the NLT, is defined by its elongated bifacial prepared cores and stemmed projectile points (Chauchat 1975, 1978; Uceda 1986, 1987). There is no doubt that the Paiján industry represents a hunting economy, mobile settlement system, and bifacial lithic technology that are fundamentally different than those related to the NLT. The Paiján lithic studies placed an emphasis on morphological description and functional typology and heavily deemphasized attribute and contextual analyses, partly because the assemblages were collected from surface sites with poor contexts (for a more complete discussion, see Rossen 1991:172-174, 656-657). Supporting microscopic use-wear analysis was not conducted. The present analysis differs greatly in analytical terminology and emphasis from the Paiján studies because of the fundamental differences between unifacial and bifacial industries, and because of differing analysis philosophies (Adams and Adams 1991).

Stages of Reduction

The stage of reduction concept was originally developed and utilized to better understand manufacturing reduction of bifacial lithic industries (Bradley 1972; Collins 1975; Schiffer 1976). Other specialists consider lithic reduction to be a behavioral continuum, of which a series of stages is an inadequate representation (e.g., Flenniken 1985). The approach taken here is to consider the NLT as a behavioral reduction continuum within which stages of reduction can be isolated and examined. Bifacial industries to which the reduction stage concept has been applied are commonly characterized in five to six distinctive stages of reduction (e.g., Boisvert *et al.* 1979:60-62). In the present case of a unifacial industry, only three stages of reduction were isolated (Figure 8). Stage 1 is represented by blocky, angular cores chipped from nodules and boulders, primarily collected in the rocky *quebrada* floors adjacent to the research sites. Stage 2 consists of secondary flake tool types that have not been further shaped, trimmed, or thinned. Stage 3 consists of secondary flake tool types that have been shaped, trimmed, or thinned into what are considered here to be recurring formal tool types.

Figure 8 also illustrates both products and by-products of reduction within the NLT. That is, stages of reduction are defined in terms of production goals (cores, secondary flakes, and worked secondary flakes), but the lithic assemblage also contains by-products of the reduction process (primary flakes, exhausted cores, and tertiary flakes). Primary flakes are defined as flakes containing cobble cortex. Exhausted cores are cores too small for further removal of flakes. Tertiary flakes are flakes without platforms or bulbs of percussion that are smaller than 1.5 cm in their largest dimension. In terms of artifact use or consumption, tools exhibit little retouch and no rejuvenation (that is, reworking and reshaping of worn-out tools for different functions). Thus, tool consumption figures as only a minor component of this reduction sequence.

Although formulated for complex bifacial industries, the stage of reduction concept is

useful in this case to demonstrate the relative simplicity of this unifacial industry in terms of manufacturing reduction. The complexity of the NLT lies not in its principles of reduction, but in the variety of tool shapes and recurring formal types that exist within the Stage 3 (modified secondary flake) level. The NLT contains an extensive, proliferated Stage 3 instead of additional lower stages of reduction.

In his writings on lithics, the master flintknapper Don E. Crabtree emphasized the importance of the quality of available raw material above all other factors in characterizing and understanding a lithic industry reduction sequence (Crabtree 1973). In the NLT, the relatively brittle nature (compared to silexes) of the most common materials in the collection (basalt, tuff, diorite, andesite, and rhyolite) may help account for the attenuated series of reduction stages and the relatively great amount of tertiary flakes. But even the Nanchoc lithics with their generally coarse raw materials differ substantially from the Las Vegas, Ecuador lithics, where low quality raw material was considered an important reason for the preponderance of irregular small flakes, unprepared cores, and lack of formal tools (Stothert 1974, 1988). In another case, comparison of Nanchoc lithics with contemporary Junín puna Preceramic lithics of central Peru, made of much harder, finer raw materials such as silex, indicate that the Junín lithics have more reduction stages (including substantial retouch and rejuvenation) and fewer tertiary flakes (LaVallee *et al.* 1985; Matos 1975; Rick 1980; Matos, personal communication 1987). Despite the undeniable effect of raw material quality on a lithic industry, the position taken here is that the type of economy represented by the industry and thus, the intended functions of the produced tools, is a more important factor than raw material quality in explaining the reduction sequence of an industry. It will be argued that this unifacial industry with its three reductive stages is primarily related to procurement, production, and processing of vegetal products in the forest setting.

Attribute-Variables

A long list of attribute-variables were recorded and processed. For the purposes of this abbreviated description, the most important attribute variables are raw material type, tool angle (the angle of the general tool body, indicating acuteness of tool shape away from the use edge), use edge angle, length, width, thickness, core type, core shape, and degree of core exhaustion.

Formal Tool Typology

Morphological descriptions were utilized in the analysis, while functional descriptions were avoided as misleading and oversimplifying. A more polythetic, visually-based classification approach was taken (Adams and Adams 1991; Gardin 1984), with a formal tool typology based on easily recognizable characteristics utilized alongside a detailed attribute analysis. Formal type definition was in part based on observations and aggregations of the attribute lists of Tom Dillehay, developed for the Zaña-Niepos Project. In other words, a classification scheme was adopted that stresses human definition and recognition of types independent of and parallel to attribute analysis, leaving computers relegated to compilation and statistical tasks.

Type definitions were thus constructed on the basis of simple visual traits such as form and size. For example, distinctive, recurring rectangular, pentagonal, semi-lunar, and triangular flake tools were recognized during analysis. These tools were produced by a non-marginal percussion technique that was apparently designed to produce repetitive flake shapes with specific use-edge characteristics in terms of configuration and edge angle (Ahler 1989; Speth 1972). Within the NLT, the presence of recurring, simple, unifacial flake tools in particular forms suggested a simple formal tool typology (Table 2).

Rather than representing various stages of reduction, formal tool types all belong to the proliferated Stage 3 (trimmed secondary flakes) of the reductive sequence presented above, with two exceptions. The rare core

tools belong to Stage 1 (cores), and the common unmodified utilized flakes belong to Stage 2 (unmodified secondary flakes). The formal tool typology was constructed on the basis of four principles. First, basic shape or outline when viewing the dorsal surface is the most important visual characteristic for defining a formal type. Second, size differences in forms that appear to be morphologically similar often indicate tools of different functions (Stockton 1977:341). Third, relative steepness of tool and edge angles was viewed as an important characteristic in describing types and ultimately, in differentiating functions (e.g., Gould *et al.* 1971).

The strength of norms, or degree of standardization within a type varies considerably between types. Tool types with curved use-edges generally exhibit less standardization than types with straight use-edge types. In some cases, the lower standard deviations on metrics of the straight use-edge types (versus curved use-edge types) also indicate the greater strength of their norms. Other types are more generally-defined, and encompass a greater variety of specimens.

The strength of type boundaries also varies greatly. Boundaries are relatively poorly-defined between types with similar morphologies that were separated by size, such as the quadrilateral types (1-3), semilunar types (4-7), and triangular types (17-19). However, as morphological subgroupings, their boundaries are well-defined and easily recognizable. Certain types may have considerable variation within the type, but also have relatively well-defined boundaries because of their fairly complex morphologies.

ANALYSIS RESULTS

Computerized analyses of the NLT illustrate the variability within this unifacial industry and demonstrate how complexity may be hidden within apparent simplicity. In this instance, the term complexity refers to the variety of recurring, trimmed flake tool types. Complexity was also expressed in other ways not discussed here, as in the spatial relationships of particular tool types with other as-

semblages within discrete activity areas (e.g., Price 1981; White *et al.* 1977). Analyses were performed on an IBM 3090-600J mainframe at the University of Kentucky Center for Computational Sciences. The principle statistics program utilized was SPSSX. In the course of this descriptive analysis, attribute tendencies and modes, particularly related to edge angle, edge angle mode, and tool edge type, are defined and utilized as descriptive attributes of individual formal tool types. Some formal types are described as (1) generalized or specialized, (2) for fine or heavy use, and (3) as apparently related to specific actions such as slicing, cutting, scraping, and planing. Formal types are also referred to as expedient or curated (Binford 1977, 1979), based on whether the type is haphazardly-made and lightly-used (expedient) or carefully-made and heavily-used (curated). These are merely general and inexact distinctions that aid in categorizing and understanding diversity within the industry. Some of these assumptions and generalizations were further tested and corroborated by microscopic use-wear analysis (Rossen 1991:446-483).

Descriptive Analysis

Some basic compilations show the general nature of the NLT. Black basalt is by far the most common raw material type (46.5%) (Table 3). Other important material types are diorite (15.7%), tuff (12.9%), limestone (7.8%), andesite (7.5%), and rhyolite (6.5%). The tuff is a gray, veined material that was examined in thin-section by Charlotte Allen of the University of Kentucky Department of Geology. She wrote:

"The material is an altered lappilli tuff. The word lappilli refers to particle size, with the thin-section having "spots" of equal size. This material was the air fall part of a silicic volcanic eruption that was laid down, and altered by hot water flowing through it and depositing silica in it. The result is a hard, fine-grained, flinty rock" (Charlotte Allen, personal communication, letter, 1990).

Together, the six primary raw material types comprise 96.9% of all lithics. They are all locally available as alluvial gravels in the rocky stream beds adjacent to or near the sites. A series of non-local silexes, jaspers and quartzes comprise only 1.1% of the assemblage. Exotic silexes were recovered in a variety of colors and color combinations: cream, coffee, dark green, black, black with coffee, gray, gray with red streaks, maroon, black with yellow, and banded. Jaspers were black with red streaks and cream, black, and red. Highly translucent crystalline quartz was also recovered. These materials, with the exception of crystalline quartz, are all more fine-grained than locally available materials. If the collections in the Museo Nacional de Antropología, Arqueología e Historia in Lima are representative of the locations of lithic raw materials in northern Peru, it is most likely that many of these materials came from the Cajamarca highland area, approximately 100 km southeast of (up-valley from) Nanchoc. In comparison, silexes in coastal collections often exhibit a dull red color, such as a single Paiján point base specimen that was recovered from site CA09-27.

Tools of the industry (Table 4) may be discussed in three categories: (1) unmodified utilized flakes, (2) common tool types, and (3) uncommon tool types. Unmodified utilized flakes comprise nearly half the tools (49.0%). Unmodified utilized flakes are flakes that have not been trimmed through non-marginal percussion, and thus modification refers to the tool manufacturing process following detachment of the secondary flake. These tools are thus distinguished from the so-called "modified" types where trimming (such as removal of the dorsal ridge and non-marginal edge shaping) occurred (Speth 1972). Despite the presence of recurring tool forms with non-marginal edge trimming, one-half the tools used were merely unshaped flakes. The high percentage of these unmodified utilized flakes is characteristic of an expedient industry, because they reflect quickly-made, lightly-used tools made for immediate use and rapid discard.

Figures 9-16 illustrate representative formal tool types of the NLT. Common tool types consist of recurring, non-marginally edge-trimmed forms that include more than fifty specimens (Table 4). Types 2 (medium-sized quadrilaterals), 5 (medium-sized semi-lunars), 7 (thick semi-lunars), 12 (pentagonals), 13 (incurved edges), 15 (blocky tools with pentagonal cross sections), and 26 (long-handled, short use-edge forms) are the common types of the assemblage. Uncommon tool types recur in form but are not present in great frequency (Table 4). These include the large and small variants of quadrilateral (Types 1 and 3) and semi-lunar forms (Types 4 and 6), the triangular forms (Types 18, 19, 20), and heavier tool types such as thick rectangulars (Type 16) and thick pentagonals (Type 17). Pointed forms (Types 8 and 9) are present but rare ($n=12$). Uncommon tool types are important to understanding site activities despite their low frequencies. For example, only eight large core tools (Type 10) are present, but these distinctive specimens appear to be related to heavy woodworking and plant processing, two important activities. Once worn out, these tools were further reduced to produce flake tools instead of having been discarded. Thus, these relatively large tools may be underrepresented in the assemblage.

The compilation of tool types thus depicts a varied industry (Table 4). Approximately half the specimens are hurriedly made, unmodified (that is, untrimmed) utilized flakes (Type 14). These flakes represent expediency in the industry. Within the formal tools, there are frequently made, non-marginally worked recurring types that differ from flakes in having been trimmed to particular shapes, especially quadrilateral, semi-lunar, and pentagonal forms. These common tools probably represent intermediacy between expediency and curation, in that they have been shaped, and some specimens show heavy, repeated use-wear patterns on their edges. Some of these tools are made by striking only four to six blows along the edges of a flake. Others, including some pentagonal specimens, have many more flakes removed along their edges.

Third, there are some low frequency tool types, including pointed tools (Types 8 and 9) and large core tools (Type 10), that may be underrepresented in the assemblage. These tools are relatively well-made and heavily used, and represent a curated element in the industry. The implications of this mixture of expedient and curated tools will be discussed in the conclusions of this article. Recently, the concepts of expediency and curation have come to focus on reduction sequence and particularly on amount of exhaustion (Henry and Odell 1989; Johnson and Morrow 1987; Torrence 1989). In this sense, expediency is viewed as wasteful, while curation is more conservative of raw material. Expedient industries should thus (1) be associated with regions that contain an abundance of suitable raw material, and (2) be relatively less reduced or exhausted. It has already been stated that the Nanchoc region has an apparent abundance of locally-available raw material. Despite this, the NLT displays high rates of raw material exhaustion.

Core type is the best single measure of relative amount of exhaustion in a lithic industry. Table 5 describes 772 recovered cores in terms of both exhaustion and percentage of cortex remaining. Exhausted cores were defined as cores that do not contain platforms and/or dimensions suitable to further removal of 3 cm long flakes. (In final analysis, the average size of small Type 14 utilized flakes was slightly smaller, 2.6 cm). Because most raw material is in the form of streambed cobbles, lower percentages of remaining cortex also indicate more complete use (that is, greater exhaustion) of material. A large majority of cores, 79.3%, are exhausted, with the largest single category being exhausted cores with less than 10% cortex (48.7%).

When core type is crosstabulated with material type, it is apparent that all major material types are highly exhausted (Table 6). Basalt, the most common material in the assemblage as well as the most locally abundant, has only 19.8% non-exhausted cores. Other local materials such as rhyolite and diorite are also heavily exhausted. The least exhausted major material type, tuff, has 27.6% non-

exhausted cores. All 15 cores of exotic silexes are exhausted. In this case, local material abundance, general industry expediency, and lack of material conservation appear to not be associated. Prior to the general discussion below, it may be stated that our concepts of either abundance or expediency may be refined in order to understand this unexpected combination of industry characteristics.

A further examination of cores and their forms (Table 7) adds detail to our understanding of industry reduction and exhaustion. Most core forms, particularly trapezoidal, subtriangular, and rectangular cores, are heavily exhausted. One relatively uncommon core form, spherical cores, and one extremely rare form, conical cores, display high percentages (48.4% and 100%, respectively) of non-exhaustion. These two core forms tend to contain few acute angles, making detachment of suitable flakes for tools more difficult. This suggests that spherical and conical cores were undesirable core forms. There may thus be a technological/morphological reason for the non-exhaustion of some cores that further emphasizes the overall exhaustion and material conservation of this industry.

Also noteworthy in Table 7 is the ability to place most cores within a fundamental form category. The core form categories utilized here denote core form as it is viewed towards its dorsal surface. Only 11.4% of all cores were classified as "amorphous", while trapezoidal, pentagonal, sub-triangular, and rectangular core forms together comprise 73.0% of all cores. While these are not prepared cores in the classic sense (*e.g.*, Johnson and Morrow 1987), there are still preferred, blocky angular core types that facilitate removal of flakes for tools and may be better reduced to exhaustion.

Recent publications have increasingly linked expedient, including unifacial, industries with "amorphous core technology" (see several articles in Henry and Odell 1989; Johnson and Morrow 1987; Torrence 1989). The basic premise in doing so is that expedient tools are quickly made with little thought to core preparation, and thus the end result of lithic reduction is an amorphous core. How-

ever, this strict dichotomy between prepared and unprepared cores omits the possibility that multiple, angular, blocky core forms may be present in expedient industries. In this sense, perhaps the term "multiple form" is sometimes preferable to "amorphous" in describing the cores of generally expedient industries.

Exotic Lithic Materials

All non-local silexes and quartzes are lumped together under the term "exotics" to facilitate a comparative discussion between local and non-local lithic resources. Though still a small sample ($n=446$), the lumped exotic material type specimens are important because of their relatively distant sources (Table 8). Most lithic studies treat non-local materials as inherently valuable, and expect them to have been treated, distributed, and reduced differently than locally available materials. The concept of embeddedness challenges that fundamental notion in some cases by including the collection of at least a portion of a group's exotic materials within a suite of procurement activities conducted by the home group (Binford 1977, 1979). This removes some non-local goods from the necessity of having been procured through exchange and other external relationships and thus reduces their value.

A summary of the reduction of non-local lithic materials shows them to have a pattern of reduction similar to the dominant local materials (Table 8). The percentage of tools is higher among non-local materials, but this appears to be a function of the unusually high percentage of non-local material tools (12.6%) at one site (CA09-28) associated with specialized mortuary activities. At other sites, the percentage of tools made of non-local materials (5.0%) is much closer to the percentage of tools made of local materials (3.7%). It is noteworthy that the specialized activities of site CA09-28 apparently produced skewing in many categories of lithic data, and thus, despite containing all the basic aspects of the NLT, this site is less useful in statistically analyzing the basic characteristics of the industry. For example, the relatively high proportion of exotic tools at site CA09-28 occurs

where exotic material is also the lowest percentage (1.8%) of utilized unmodified flakes. It thus appears that there was more manufacture of exotic material tools, and more exotic material conservation in conjunction with mortuary activities.

These data show that despite their possible association with special activities, exotic materials were generally treated much like local materials in terms of reduction and conservation. That is, both local and exotic materials have similar reduction sequence proportions and even when lithic reductive proportions vary between sites, these differences are equally expressed in both local and exotic materials. This pattern suggests that exotic materials may have been at least partially "embedded" within the general lithic industry. This observation does not deny the probable role of sporadic trade and exchange in procuring non-local materials, but instead suggests one possible explanation of why exotic lithic materials, despite their scarcity, do not display archaeological patterns indicative of greater value or utility than local materials. That is, exotic materials may have been sometimes procured by the local group themselves during forays for other resources (quartz crystals, shells, etc.) as well as having been received through trade or exchange.

Edge Angles, Tool Angles, and Tool Edge Types

Edge angles, tool angles, and tool edge types also provide important insights into the NLT. These attributes aid in differentiating at the morphological level slicing and cutting functions that require low edge angles from scraping and planing functions that utilize higher angles (Vaughan 1985:59-63; White *et al.* 1977). Tool edge type is determined from the relationship between edge and tool angles. When edge angle is greater than tool angle, a strong edge is formed that allows heavier tasks to be performed with the tool. When edge angle is lower than tool angle, a finer edge is formed that allows use for more delicate and precise tasks (Figure 17). As a combination of two attributes, tool edge type aids in differentiating heavier edges, required for use on

harder materials, from finer edges used on softer materials. In general, analysis of these attributes contributes to a depiction of a versatile industry associated with a diverse economy requiring manipulation of a wide variety of materials. Specifically, slicing and cutting action on softer materials, probably plants, is common (Rossen 1991: Chapter 5). Certain tool types have narrow ranges for these three attributes, while others show wide ranges or multiple peaks in attribute values suggestive of multiple-function implements.

Figure 18 displays the frequencies of edge angles of the NLT. Two peaks exist, one at 30 and one at 40 degrees. A significant decline or valley is present at 35 degrees, between the two frequency peaks. This may represent two different types of fine cutting or slicing, or the working of different materials that require slightly different edge angles. Despite the presence of substantial frequencies of tools at high edge angles, the industry emphasis is clearly on relatively low edge angles probably related to slicing and cutting actions. The same conclusion is drawn from the mean edge angle of 38.755 and the mode edge angle of 30. Diversity and versatility in the industry is reflected by a large standard deviation, 16.25, nearly one-half the mean.

A different way of representing this is by plotting edge angles against tool types. Figure 19 has a cutpoint of five, meaning that one to five cases equals one, six to ten cases equals two, and so forth. Unmodified utilized flakes have been omitted. This figure shows that some tool types have a wide, equally distributed range of edge angles, while other types have one or two clearly defined edge angle modes. Note that Types 6 (small semi-lunar forms), 7 (thick semi-lunar forms), 16 (thick rectangular forms), 21 (the amorphous edge-trimmed category), and 26 (long-handled, short use-edge forms) all display regular normal curves with single, clearly-defined modes as follows:

<i>Tool Type</i>	<i>Edge Angle Mode (degrees)</i>
Type 6	35
Type 7	30
Type 16	35-40
Type 21	30-35
Type 26	40-45

Tool types 2 (medium quadrilateral forms), 12 (pentagonal forms), 13 (incurved edges), and 15 (blocky forms with pentagonal cross-sections) have multiple edge angle modes:

<i>Tool Type</i>	<i>Edge Angle Modes (degrees)</i>
Type 2	20, 40
Type 12	20, 40
Type 13	40, 50
Type 15	60, 75

Figure 19 thus allows a preliminary basis for separating relatively specialized forms from more generalized, presumably multi-purpose forms. With the exception of Type 15, with its unusually high edge angles, tool forms that display multiple edge angle modes generally have a much wider range of edge angles than those whose edge angles distribute more like normal curves with single peaks. Tool forms such as thick and long-handled types, which tend to have substantial edge-trimming, have single edge angle modes. There thus appears to be a trend for more finely-worked tools to have relatively specific edge angles and, presumably, functions.

Another, slightly different way to display edge angle data is to divide edge angles into increments and crosstabulate the resulting edge angle groupings with formal tool types. In Table 9, 15 degree increments were chosen. Instead of differentiating single peak and bimodal distributions, this table tends to mask bimodal edge-angle distributions. Instead, however, an incremental cross-tabulation effectively displays the more general, relative edge-angle tendencies of particular types.

Some general observations related to Table 9 are as follows: A majority of tool types ($n=12$) concentrate in the 31-45 degree edge angle increment. A few tool types, considered relatively finely-made and specialized by

other measures, such as Type 6 (small semi-lunar forms) and Type 7 (thick semi-lunar forms), concentrate in the lower 16-30 degree edge-angle increment. Unmodified utilized flakes (Type 14) also concentrate in this same low edge-angle increment, distinguishing them from a majority of formal tool types. This suggests a curious combination of the most general, expedient lithics and the most specialized, curated lithics as both having relatively lower edge angles than the majority of tool types. Thus, on the basis of edge angle tendency, expedient utilized flakes may have had somewhat different functions than the majority of formal tool types.

Tool types that have similar forms, but were differentiated only by overall size, also may be differentiated by edge angle increments. Type 1 tools (large quadrilateral forms) concentrate in a lower edge angle increment than Type 2 (medium quadrilateral forms) and Type 3 tools (small quadrilateral forms). Type 5 tools (medium semi-lunar forms) concentrate in a different edge-angle increment than Type 6 tools (small semi-lunar forms). This suggests that functional differences as well as size differences separate these size-graded varieties of tools with similar forms.

Type 15 (blocky forms with pentagonal cross-sections) is the only type that concentrates in the high edge angle increment of 46-60 degrees. These are relatively well-made tools whose function, probably wood-working, perhaps could not be served by casually-made, more expedient tools or unmodified flakes.

The cutpoint used in Figure 19 obscures patterns among rarer tool types, and negated consideration of their relationships within the overall industry. Conversely, although edge angle increments (Table 9) obscure the bimodal edge-angle distributions of some tool types, some characteristics of rare tool types are more clearly represented. Types 18, 19, and 20 (small, medium, and large triangular forms, respectively) all concentrate strongly in the 31-45 degree edge angle increment. These types, along with Type 1 (large quadrilateral

forms) specimens, could not be characterized in terms of edge angle tendency until the data were placed into increments.

Edge angles, whether examined through cutpoint scatterplots or incremental cross-tabulations, do not help characterize some tool types. Types 4 (large semi-lunar forms), 8 (faceted pointed forms), 9 (non-faceted pointed forms), 10 (large core tools), and 17 (thick pentagonal forms) are all rare tool types with a wide diversity of edge angles that display no modes from either type of analysis. Because of their edge diversity and relatively well-made forms, including much shaping and trimming, these five types are viewed on a morphological basis as multiple-function, relatively curated tools.

Tool angle, or the angle of the main portion of the stone that supports the edge, is an important attribute, particularly for its relationship to edge angle. Figure 20 plots this general relationship. While this figure refers to all lithics as an assemblage and not to actual relationships within individual tools, it does show a general trend where, below the 35 degree threshold, edge angles are associated with higher tool angles. Above that 35 degree threshold, edge angles are associated with lower tool angles. The two frequency peaks at 30 and 40 degrees are on opposite sides of this threshold. Examination of the relationship between the two lines in Figure 20 suggests that two high frequency clusters of artifacts exist, one group with lower edge angles associated with relatively higher tool angles, oriented to cutting and slicing, and a second group with higher edge angles and relatively lower tool angles, oriented more to scraping and planing.

In order to further investigate this dichotomy and the relationship between edge and tool angles in the industry, the combination attribute "tool edge type" was computed. Tool edge type is a direct measure of the relationship between edge and tool angles at the individual artifact level. Because it combines aspects of the lithic edge with the supporting structure of the tool, it potentially can aid in separating tools used for heavier versus lighter

tasks, providing another means of cross-checking conjectures on tool function made from general morphology and lithic use-wear analysis. Five tool edge types were defined. An edge is considered "very heavy" when the edge angle measurement is at least 10 degrees greater than the tool angle. An edge is "heavy" when the edge angle is from 1 to 9 degrees greater than the tool angle. "Medium edges" denote tools where the two measurements are equal. A "fine edge" is when the edge angle is 1 to 9 degrees lower than the tool angle. Finally, a "very fine" edge denotes a tool where the edge angle is 10 degrees or more lower than the corresponding tool angle.

Fine edges would presumably be used for cutting and slicing tasks (such as food preparation), while heavy edges would be oriented toward scraping, planing, and adzing tasks (such as woodworking). The degree to which a tool type tends to a particular tool edge type may thus suggest whether the type was more generalized or specialized in its use. That is, a tool type with a relatively even distribution of fine, medium, and heavy tool edge types would be considered more generalized than a tool type with a strong tendency toward one tool edge type.

Table 10 is a cross-tabulation of tool edge type with tool type. There is a general tendency for formal, edge-trimmed tools to have heavier edge types, regardless of whether their edge angles are generally high or low. Unmodified utilized flakes are dominated by medium edges. This contrast indicates a basic difference in edge characteristics between unmodified flakes and edge-trimmed flakes. Edge trimming tends to produce a stronger edge. Seven formal tool types that show clear tendencies toward heavier tool edge types are Types 1 (large quadrilateral forms), 3 (small quadrilateral forms), 5 (medium semi-lunar forms), 6 (small semi-lunar forms), 13 (incurved use edges), 15 (blocky forms with pentagonal cross-sections), and 26 (long-handled, short use-edge forms). Three additional tool types display weaker tendencies toward heavy tool edge types. Types 2 (medium quadrilateral forms), 4 (large semi-lunar forms), and 7 (thick semi-lunar forms) show a wider range

of tool edge types, although there are still more heavy and medium tool edges in these categories.

Two rare tool types, Types 16 (thick rectangular forms) and 17 (thick pentagonal forms) display strong dominance of medium tool edge types. Type 12, the distinctive pentagonal form, is unique among common tool types in displaying an almost even distribution of heavy, medium, and fine tool type edges. On the basis of this combination attribute, Type 12 tools may be considered multifunctional. Three rare tool types, Types 18, 19, and 20 (small, medium, and large triangular forms, respectively) also display an even distribution of heavy, medium, and fine tool edge types. These triangular forms, which are usually less edge-trimmed than other formal types, may also have had more general, multiple functions.

Debitage Analysis

Other extensive analyses of unifacial industries have not separated tool forms and have instead concentrated on detailed analysis of debitage, the waste flake by-products of tool production (*e.g.*, Stothert 1974). In contrast, a basic premise of this analysis has been that formal types may be extracted based on edge trimming and flake shaping. The analysis presented here has thus concentrated on key attributes of flake tool forms. However, a large collection of debitage ($n=32,215$) was also recovered. The primary analytical use of debitage here is to utilize total frequencies as percentage components of the reduction sequence, in order to demonstrate the general intersite consistency of reduction, and to further relate the sites into the same cultural system. A few summary tables (Tables 11, 12) of debitage (with all sites lumped) add further insights into the non-randomness of this unifacial industry. These patterns are similar at the individual site level.

Figure 21 shows the computer-scaled histograms of flake length and width with superimposed normal curves. These two dimensions all show relatively high concentrations, compared to a normal curve, of flake dimen-

sions around specific millimeter values. It has often been stated that more expedient lithic industries based on unifaces are amorphous and thus more randomly (less systematically) worked than more curated industry types, particularly those based on bifacial reduction (Bamforth 1986; Binford 1979; Henry and Odell 1989; Johnson and Morrow 1987; Torrence 1989). In terms of Andean unifacial industries, this point was most strongly stressed by Stothert (1974, 1988). Despite this, the present analysis, including this debitage figure, suggests a relatively systematic lithic reduction technology to the point of producing debitage that concentrates around specific dimensional modes.

The observation that debitage does not distribute randomly in terms of dimensions may be related to the earlier observation that cores are not "amorphous" but "multiple form" in character. This statement was meant to explain that, although not prepared in the classic sense, cores are not totally amorphous and random when subjected to detailed analysis. In terms of both cores and debitage, this unifacial lithic industry is relatively systematic in reducing cores, usually to exhaustion, and producing recurring tool flake forms and relatively uniform debitage. One way to further explore the above observation in regard to debitage is to examine flake type, an attribute based on the relationship between flake length (as measured from the platform or bulb of percussion) and flake width (as measured perpendicularly to flake length). Table 11 quantifies an observation made during analysis, that an unusually high percentage of debitage (31.7%) has larger flake widths than flake lengths. Short, wide flakes are struck in order to control the distant edge angle and form, while long, thin flakes are struck for control of lateral edges (Speth 1972). The relatively high percentage of short, wide flakes thus indicates concern for control of the reduction process and production of particular edge angles on flake tools. Table 12, a crosstabulation of flake type with material type, shows that this concern with edge angle control occurs within most major material types. Among the four most common material types, basalt, diorite, tuff, and rhyolite, the percentage of short,

wide flakes only varies from 28.4% to 34.2% of the total debitage. Flake type, in terms of relative length and width, provides another expression of the relatively careful nature of lithic tool production in the NLT despite its unifacial nature.

DISCUSSION

Characteristics of the Nanchoc Lithic Tradition

It is possible to outline some of the important defining characteristics of the NLT. Table 13 is a summary of the descriptive analysis, in terms of traits assigned to the various formal tool types. A quick perusal of this table illustrates the mixture of common versus rare, expedient versus curated, and generalized versus specialized tools present in the industry. Variation in edge angle mode, edge angle trend, and tool edge type tendency is also presented. This table serves to display concisely the hidden complexity present in this apparently simple, unifacial lithic industry. In conceptual terms, the NLT may be generalized and summarized in four ways:

1. *Relative morphological stability and consistency*

The most important attribute-variables of the NLT, including stage of reduction, material type, and tool type display general consistency when compared across sites and levels. When crosstabulated, stable relationships exist between attribute-variables in terms of relative percentages, tendencies, and modes. This consistency and stability extends to both frequent and rare tool and material types. Previous analyses have depicted unifacial lithic industries as amorphous, irregular, and unsystematic instead of consistent, regular, and systematic. It appears that the NLT is more regular and systematic than other analyzed Andean unifacial industries such as Mongoncillo, Siches, and Las Vegas (Dillehay *et al.* 1992; Malpass 1983; Richardson 1978; Stothert 1974, 1988). Despite this relative regularity, it must still be recognized that almost half of all recovered utilized lithics are unmodified flakes that were probably briefly

used and discarded. Even formal tool types have been loosely defined on the basis of form (and sometimes, size) and a substantial amount of variability is present within types. Furthermore, despite trends in edge angles of particular types, there is continually a 20% to 30% minority of specimens in a given type that do not conform to the edge angle tendency. It is thus appropriate to refer to the NLT as being relatively morphologically stable and consistent (especially for a unifacial industry) but certainly not as standardized in the sense of containing extremely exact replication of tool types and edges (Laville *et al.* 1980).

2. *Expediency*

The NLT contains traits of both expedient and curated lithic industries. However, in general, this industry better fits the conceptual characterization of an expedient industry. Traits such as (1) its exclusively unifacial character, (2) the local abundance of raw materials, (3) the lack of tool retouch and rejuvenation, and (4) the high percentage of simple utilized flakes all fit the classic definition of expedient industries (Binford 1977, 1979). Additionally, expediency in lithics is often associated with semi- or total sedentism, which is probable at these sites, given the type of dwelling construction and other artifactual data such as the heavy presence of ground stone and perhaps the botanical remains (*e.g.*, Binford 1990; Parry and Kelly 1987; Yerkes 1989:184).

Other industry traits such as (1) edge-trimmed tool types with recurring forms, (2) exhaustion of most cores, and (3) cores having recurring multiple forms instead of being amorphous do not fit the classic criteria of expediency. A few heavily used, relatively finely-made tool types, although a minority of this industry, are more curated than other industry tool types. This industry thus may not be as purely expedient as other unifacial industries previously described in the literature.

In terms of the expedient-curated dichotomy, the greatest paradox in the NLT is the apparent combination of highly exhausted

cores and material conservation with local abundance of raw material. Dillehay has suggested that the present-day abundance of basalt cobbles in the steep, dry creek beds adjacent to the research sites presents a false illusion of past abundance. He suggested that the heavy vegetation and flowing water that were present during the sites' occupation period produced a lower real availability (Dillehay, personal communication 1990). Even with this caveat considered, the Nanchoc area also contained boulder outcrops of the most commonly used lithic materials, and must have been moderately abundant in raw material.

Experiments with locally available materials revealed that it is very difficult to remove flakes from streambed cobbles, which must first be thoroughly sun-dried for at least two days (Dillehay, personal communication 1994). The absence of cobble cortex in the NLT indicates that the apparent abundance of streambed material was not utilized, but instead, reduced chunks were brought to the sites from boulder fields a few kilometers away. Thus, while raw material was abundant, it was not plentiful in the sense of immediate availability that encouraged total expediency. In the cultural situation being described here, people utilized various environmental zones and engaged in subsistence intensification while selectively accepting and rejecting outside influences. In such a situation, a lithic technology with traits of both expediency and curation, not totally conforming to simplistic conceptual dichotomies, should be expected.

The concepts of expediency and curation, each with its own lithic, economic, and environmental implications, must be refined through further evaluation against other large archaeological collections. While the term "expediency" is a generally useful concept for characterizing this industry, the exceptions to the classic criteria demonstrate the need for flexibility within the expedient-curated conceptual dichotomy. In the case of the NLT, expediency and curation are relative terms instead of an absolute dichotomy, and the true degree of expediency in the industry depends on what comparison is being made.

3. Localization, Embeddedness, and Sporadic Exchange

Abundant local materials, especially basalt and tuff, have very consistent patterns in terms of stage of reduction, distribution, and tool and edge characteristics. Other local materials such as diorite and rhyolite are slightly more reduced. As a lumped group, exotic materials are a very small percentage of the overall industry (1.1%) and this low percentage maintains remarkable consistency across different sites and stages of reduction. These exotic materials were treated, in terms of reduction sequence, similarly to local materials and are rather evenly distributed across sites despite the presence of intersite activity differences.

While it is probable that some non-local lithic material was procured through sporadic trade or exchange, it is possible that some exotic silexes and quartzes exhibit a pattern of "embeddedness" or "embedded procurement", if Binford's criteria for that process are accepted (Bamforth 1986; Binford 1979). That is, some exotic materials may have been procured by sending out individuals or small groups to collect them, or materials were procured incidentally or opportunistically in the course of other travel-related procurement. This is opposed to receiving exotic goods in well-organized trade or exchange, where the exotic material is expected to be more reduced in a site and is thus more valuable than local materials, as well as associated more with particular tool types and activities (*ibid.*). The possible combination of embedded contacts and sporadic exchange to procure a relatively small amount of non-local lithic material reinforces a characterization of the Nanchoc Culture as locally developed with relatively few outside contacts (Dillehay *et al.* 1989, 1992). From the perspective of chipped stone artifacts, the Nanchoc Culture cannot be viewed as one of cultural mediators, large-scale exchangers, or seasonally mobile or transhumant people.

4. *More distinct from the North-Central Andean-Panamanian "Unifacial Complex" than in conformity with it*

When comparing the NLT with other industries of the so-called Andean-Panamanian "Unifacial Complex" such as Chiriqui, Aguazuque, Las Vegas, Sangay, Cubilán, Siches, and Mongoncillo, important differences appear under the scrutiny of detailed analysis (Ranere 1975; Linares and Ranere 1980; Correal 1989; Stothert 1974, 1988; Porras 1988; Temme 1982; Richardson 1969; and Malpass 1983 respectively). Some of these industries are similar in that they appear to be associated with forested environments (with Mongoncillo being the possible exception, although Malpass [1983:38] believes that the lower Casma Valley was also forested). Many of these industries may have been associated with woodworking and diverse, generalized economies. A few may also have been associated with at least partly horticultural lifestyles (e.g., Pearsall 1994; Piperno 1990; Richardson 1969:115; Stothert 1988), although the presence and relative importance of gardening in each case has not been established. Despite the similarities, important morphological lithic differences exist in terms of stage of reduction, tool morphology (especially trimming and shaping), amount of ground stone present, and relative morphological consistency of the industries.

Other researchers have been generally frustrated in their attempts to find consistency within individual "Unifacial Complex" industries. Richardson (1969) came closest with his notched and denticulate tool varieties of the Siches Industry, although these were loosely defined in terms of edge characteristics and accorded great morphological variability within types. Stothert (1974, 1988) was furthest from finding consistency, and instead emphasized flake attributes, the lack of prepared cores, and industry irregularity within Las Vegas and other, later unifacial industries of the Santa Elena Peninsula of Ecuador. Malpass' (1983; n.d. [c. 1984]) formulation of the concept of a "Unifacial Complex" of genetically-related though spatially discontinuous industries drew heavily on the studies of

these and other industries (e.g., Linares and Ranere 1980; Ranere 1975). The result was a generalized characterization of unifacial lithic industries as (1) morphologically inconsistent and amorphous, (2) lacking specialized forms, especially edge-trimmed tools, and (3) lacking internal complexity. As a case study, the NLT provides an exception to these generalizations, perhaps because of intergroup differences in economic and social organization.

CONCLUSIONS

Unifacial tools were characterized by Binford (1977, 1979) as expedient, in being quickly made and discarded, as opposed to curated tools that were carefully-made, maintained and rejuvenated through longer uses. However, detailed analyses of the NLT suggest that this unifacial industry contained both relatively expedient and curated tools for both generalized and specialized purposes.

Many unifacial industries are associated with forested or semi-forested environments, and with some level of emphasis on plant exploitation. Some are associated with at least incipient levels of plant cultivation, if only, as in Panama, as a supplement to a continuing hunting-gathering lifeway. However, the question of whether there is a true "Unifacial Complex" of industries spread throughout tropical America (Malpass n.d. [c. 1984]) remains unanswered for several reasons. Primarily, the industries have been analyzed from varying levels of systematic detail, and very few have been analyzed in terms of their spatial distribution and associations with other artifact assemblages. Certainly, there are superficial similarities inherent in their very existence as unifacial industries, sometimes within similar montane forests and often having Preceramic Period dates ranging from 9000-5000 B.P. Yet, under close scrutiny, these industries appear to be as different as a group of bifacial industries might be in a similarly-sized region such as the Archaic Period eastern United States (Jennings 1978). For example, some trimming has been described for the Siches Industry of far northern coastal Peru (Richardson 1969, 1978), but published and unpublished descriptions of the

industry, along with personal examination of Siches collections housed at the Museo Nacional de Antropología, Arqueología e Historia, Lima, have satisfied me that Siches tools are larger, bulkier, and less carefully-shaped, with more denticulate forms and much less removal of dorsal ridges than are characteristic of the NLT. Other unifacial industries such as Las Vegas of coastal Ecuador and Cerro Mangote of Panama have been described as heavily dominated by small, crude, irregular, unshaped flakes and highly amorphous cores (McGimsey *et al.* 1986-87; Stothert 1988). In contrast, the NLT is presented here as a relatively morphologically systematic. Based on the emerging data, Malpass has backed away from the idea of the unifacial complex and a single cultural distinctiveness of preceramic Andean unifacial industries (Michael Malpass, personal communication 1995).

Another broad issue involving the NLT and its relationships may be mentioned. Are unifacial industries truly discontinuous in space? Malpass (1983) and Richardson (1969) suggested that they were widely-spaced, but this may be a function of where detailed research has occurred. Investigation of other areas of South America increasingly suggests that unifacial industries are much more widespread than previously supposed (Correal 1989; Porras 1988; Schmitz 1987).

Unifacial Lithics and Cultural Evolution

A central issue is whether unifacial industries are part of a general trend away from hunting-oriented economies with bifacial projectiles like Paiján in northern Peru (Chauchat 1988), toward greater economic diversity, localized permanence, and in some areas, intensification. That is, may unifacial industries be considered an archaeological indicator of intensification, or at least the shift toward different kinds of human-plant relationships which eventually led to food production in some areas? In this regard, the NLT only represents a single case study of perhaps an atypically complex unifacial industry. Researchers, however, have increasingly begun to describe similar associations between unifacial lithics and resource diversification and intensifica-

tion. In particular, the associations between unifacial lithics and corn pollen in Panama (Smith 1980) and incipient horticulture in Ecuador (Stothert 1988) support the findings at Nanchoc. Stothert, in her most extensive statement on the Las Vegas lithics, has also taken a social relations approach to early intensification that would push the concept back to the Preceramic Period based on technological indicators, including unifacial lithics (Stothert 1988:254-255). This potential relationship between unifacial industries and early intensification should be monitored in the course of future research. Unifacial lithic industries can be designed as part of a shift to a more plant-oriented economy. Detailed analysis may isolate technological diversity in these industries that reflects the activity diversity of broad-spectrum economies that often appear during the transition to food production (Piperno 1989).

It has been argued elsewhere in detail that the NLT represents one line of evidence of the subtle beginnings of localized intensification during the Middle Preceramic Period (Rossen 1991:667-674). The totality of this argument depends on local paleoenvironmental reconstruction and non-lithic data collected over the course of the Zaña-Niepos Project, including ground stone, faunal, human remains, entomological, ethnohistoric, and to a lesser extent botanical and pollen data. These data strongly suggest that the Middle Preceramic people of Nanchoc resided in an ecotone between semi-arid, brushy, and tropical rain forest zones and exploited a wide variety of plants and animals (Dillehay and Netherly 1985; Dillehay *et al.* 1989; Koepcke and Koepcke 1958; Rossen 1991: Chapter 6; Raimondi 1940 [1874]; Simpson 1975; Vuilleumier 1971; Weberbauer 1945). The variety of the unifacial lithic tools in the NLT (and associated non-lithic assemblages) suggests a shift toward a diversifying economy, while the dominance of local lithic materials, midden development, structures, and burials at the sites suggest a localized permanence of settlement (Rossen 1991:648-654).

Andeanists studying the Preceramic Period have long noted the rapid cultural changes of

the Late Preceramic Period, with its advent of large ceremonial architecture, based on maritime and agricultural sedentism (Quilter 1991). In some cases, it has also been suggested that the origins of the intensification process must have occurred in subtler technological shifts of the preceding Middle Preceramic Period (e.g., Quilter *et al.* 1991). Bender (1978) has asserted that the process of intensification begins with the addition of more versatile technologies and new dietary options, together representing an increased "productivity", or the potential to produce more even if increased production per land unit is not achieved. If Bender's premise is accepted, then the Nanchoc sites with their varied unifaces, diversified economy, and localized permanence appear to represent one cultural situation where an early subtle form of intensification foreshadowed the more dramatic cultural changes of the Late Preceramic Period.

Acknowledgements

This paper builds on some twenty-five years of research in the Zaña Valley by the Zaña-Niepos Project, founded and nurtured by Tom D. Dillehay and Patricia J. Netherly. The paper benefitted from numerous discussions with Tom, Patricia, William Y. Adams, Ramiro Matos, Duccio Bonavia, and Peter Kaulicke. The thoughtful review comments of Karen E. Stothert were greatly appreciated. The lithics were drawn by Jimmy A. Railey. Analysis of the Nanchoc lithics was supported by a National Science Foundation dissertation improvement grant and the University of Kentucky Center for Computational Science.

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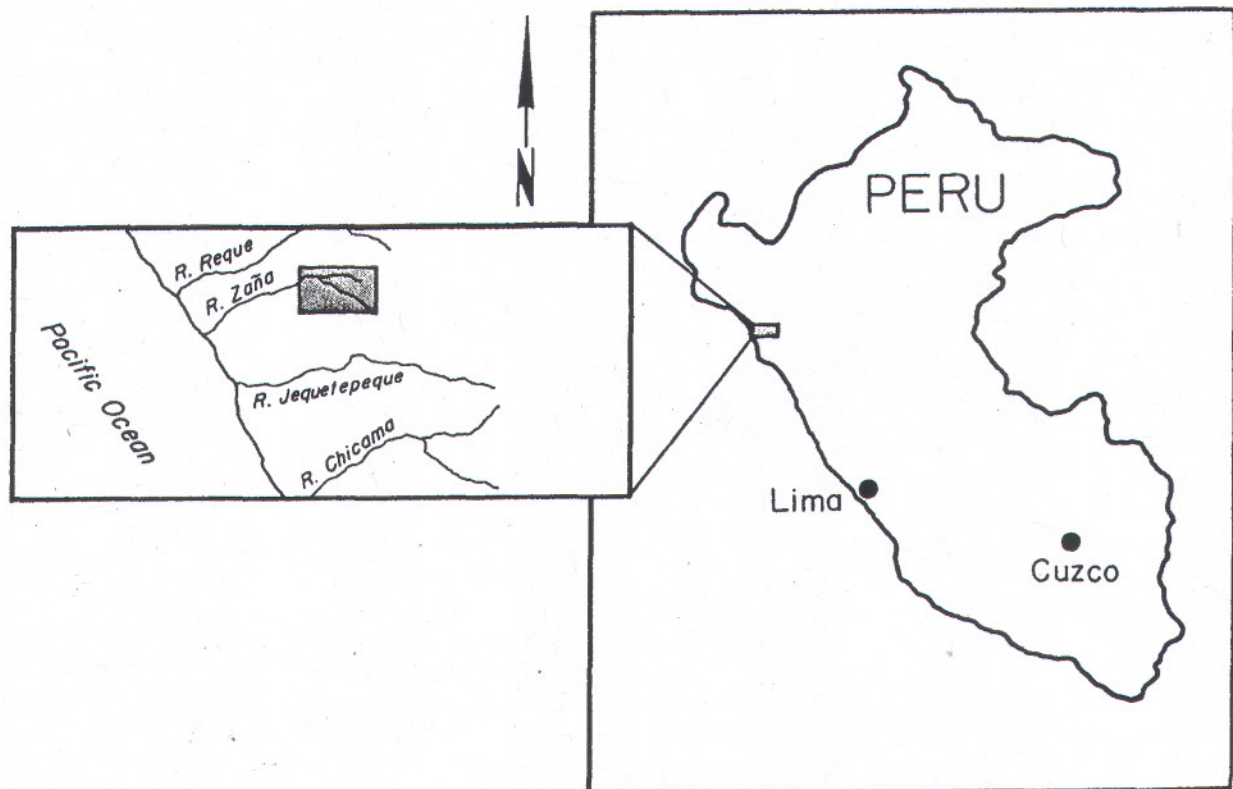


Figure 1. Location of upper Zaña Valley, northern Peru (after Dillehay *et al.* 1989).

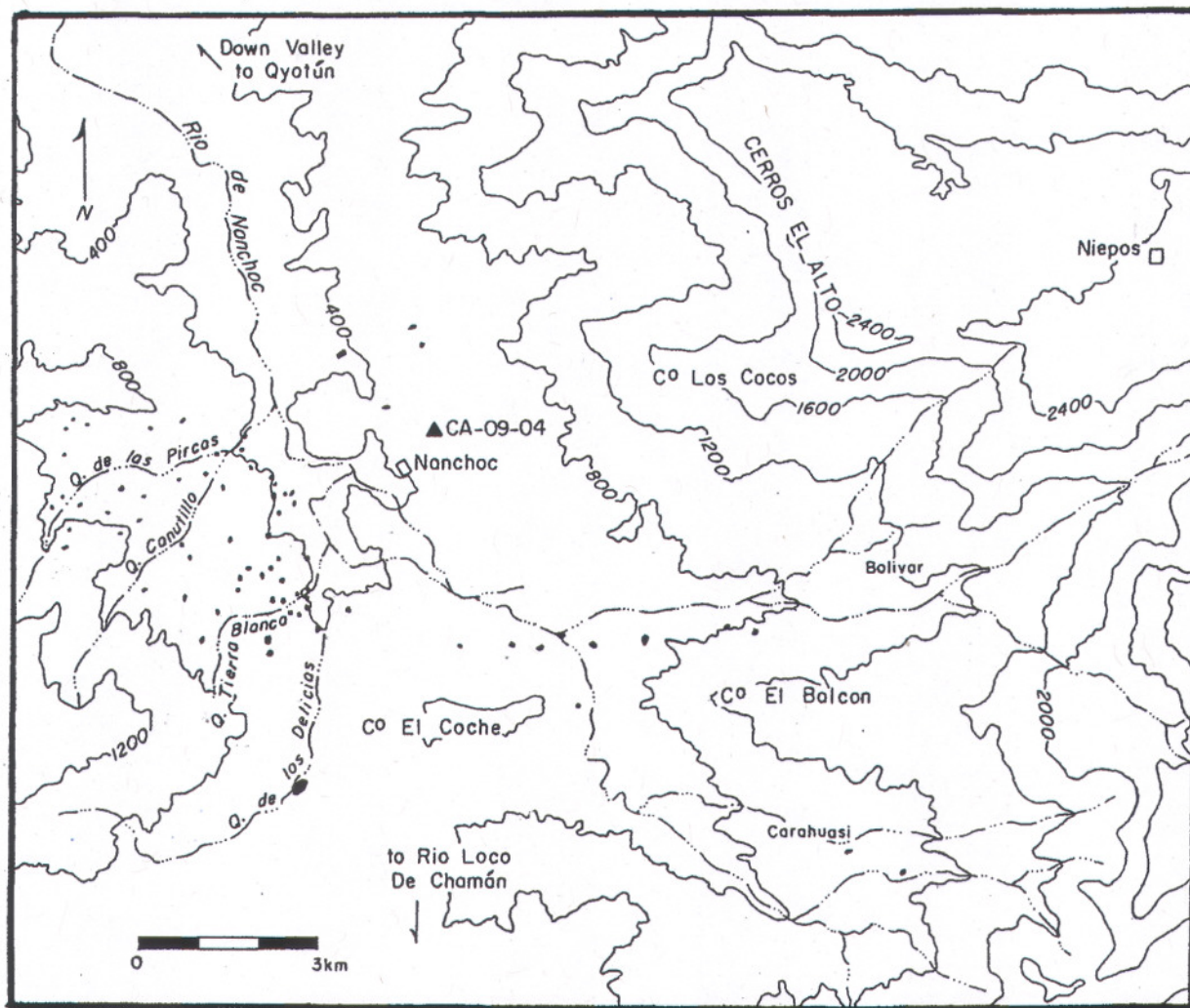


Figure 2. Map of Nanchoc area, showing south bank lateral quebradas. Dots represent Pre-ceramic sites. Site CA09-04 is Cementerio de Nanchoc site, across river from Quebrada de Las Pircas (after Dillehay *et al.* 1989).



Figure 3. October 1969 (dry season) air photo of a portion of the Nanchoc Valley, including the (outlined) Quebrada de Las Pircas. (Photo courtesy Servicio Aerofotográfico Nacional [SAN].)

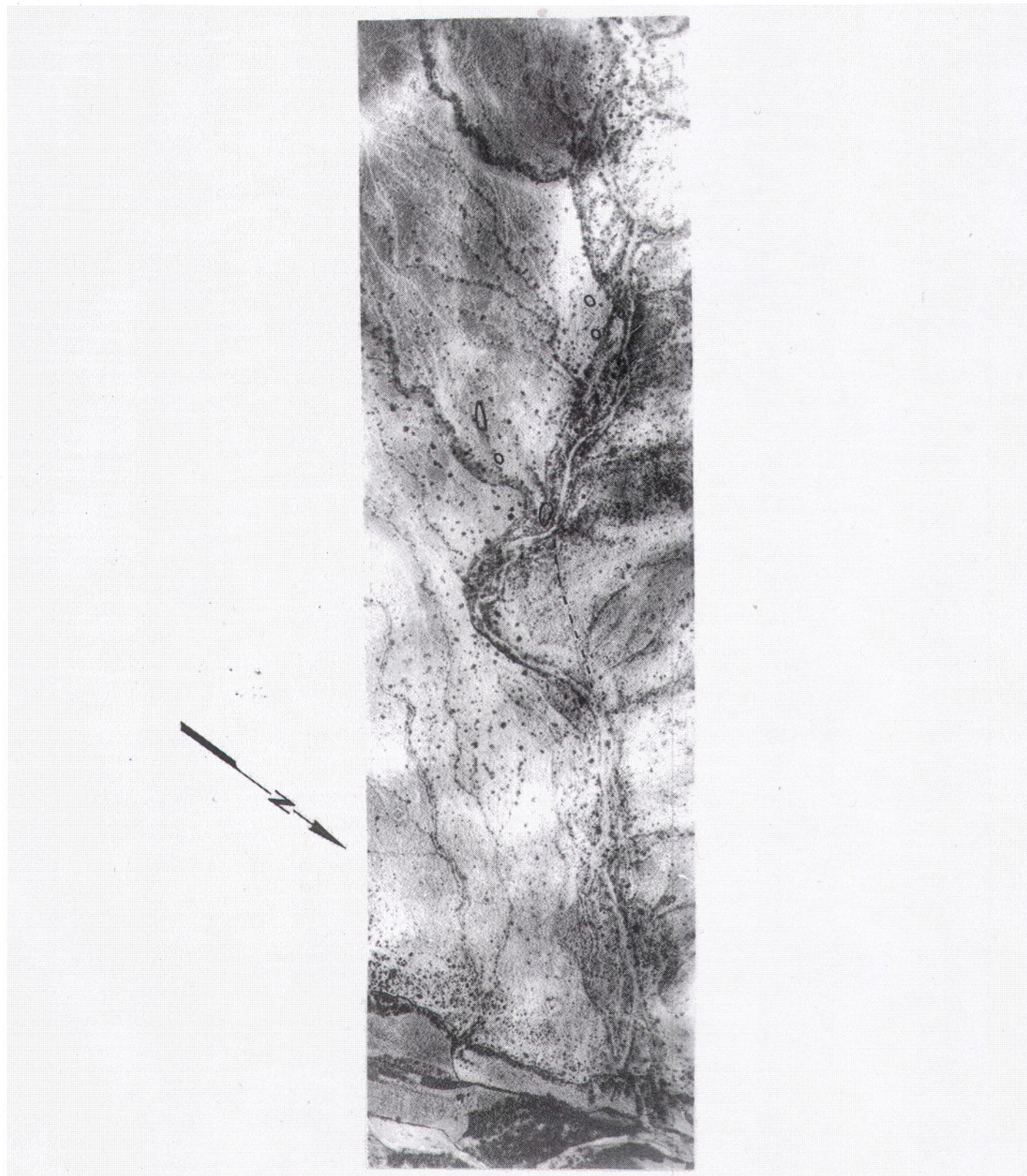


Figure 4. Blow-up of outlined area in figure 3, showing October 1969 (dry season) air photo of the Quebrada de Las Pircas. Note the Nanchoc Valley floor at bottom of photo. Circles denote the locations of investigated sites. Dotted line denotes rechanneling of main rocky streambed due to heavy El Niño rains of 1983-1984 (Photo courtesy of SAN).

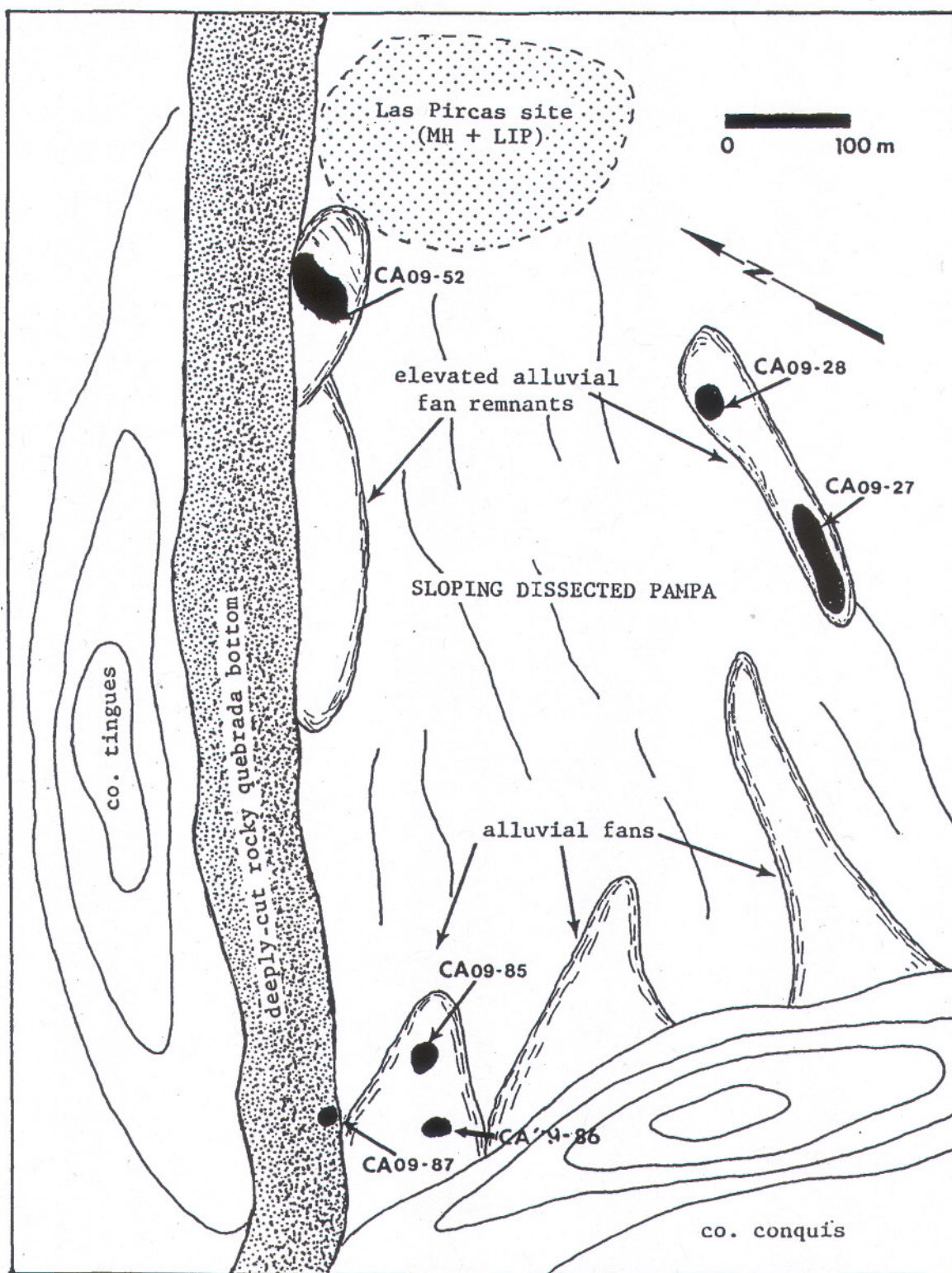


Figure 5. Schematic diagram of the Quebrada de Las Pircas, with relative locations of the investigated sites.

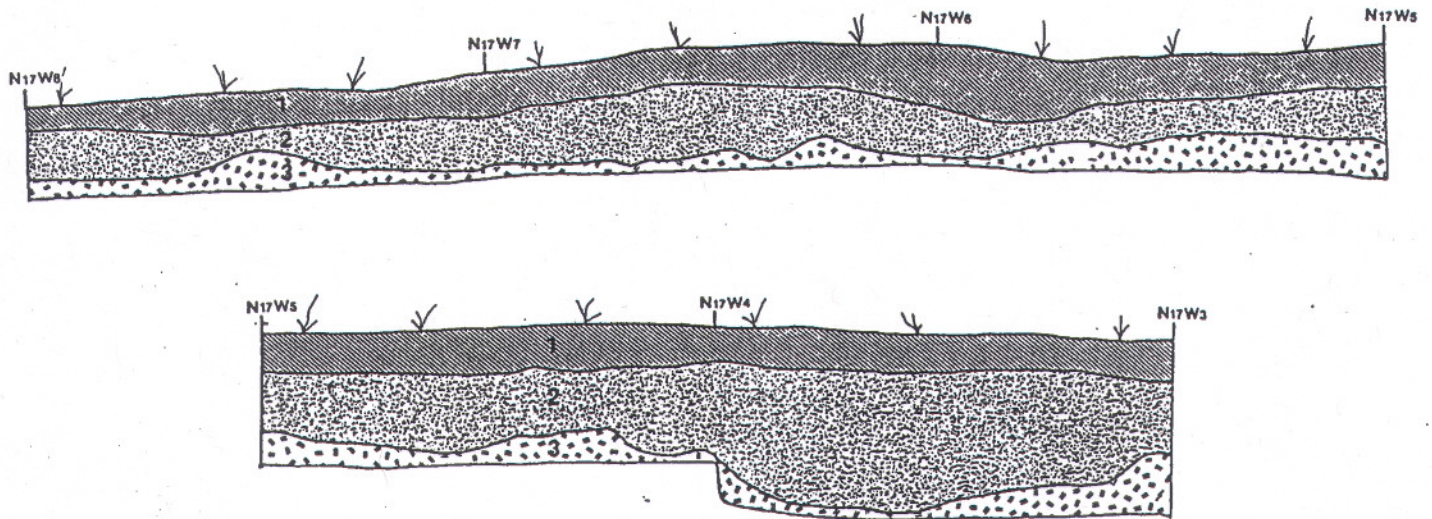


Figure 6. North wall profile of North Block, site CA09. Note the increasing depth of eolian deposits on block's eastern side, toward the center of the site. Numbers denote the stratigraphy of (1) hard colluvial cap, (2) soft eolian deposits, and (3) sterile alluvial subsoil.

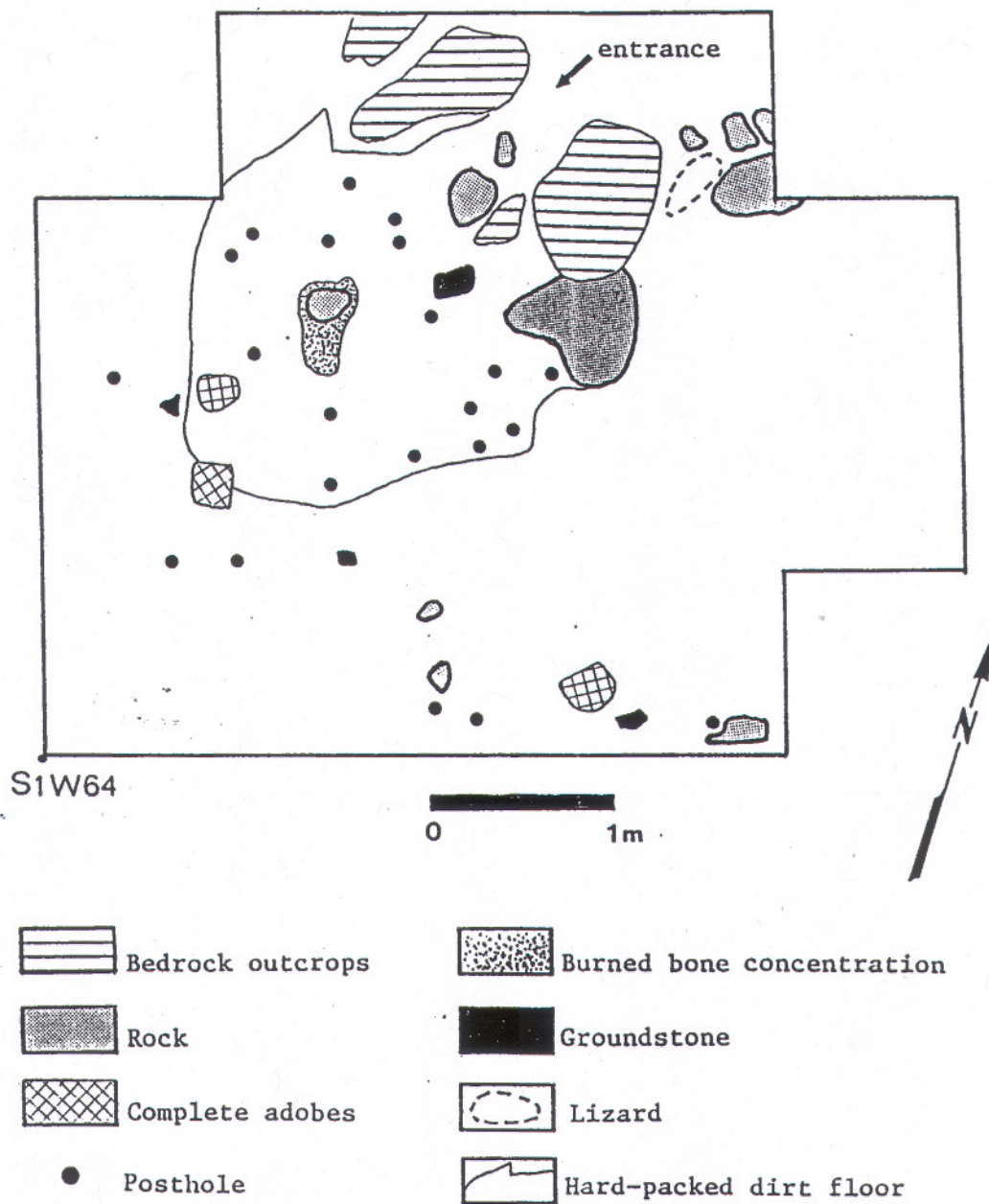


Figure 7. Quincha hut of site CA09-27.

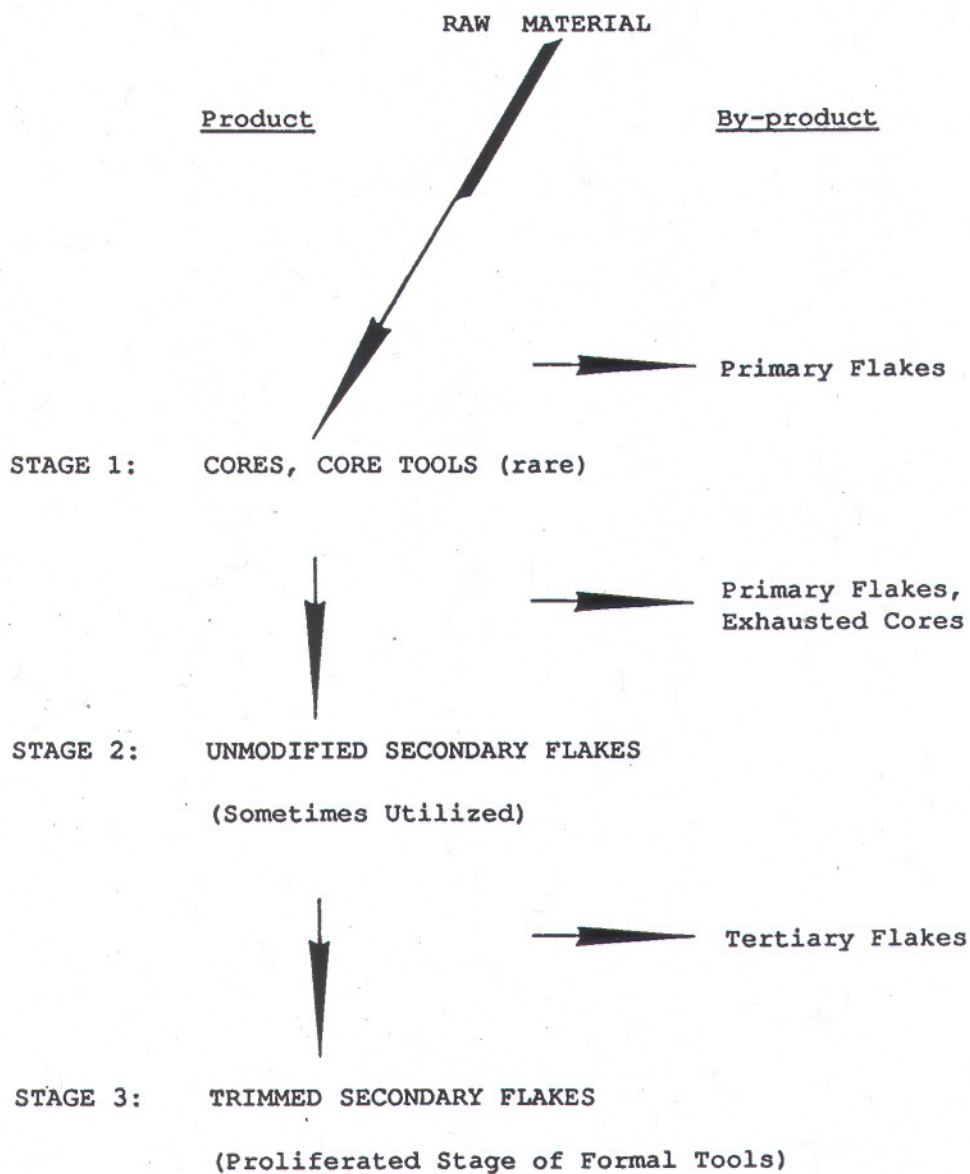


Figure 8. Schematic representation of the Nanchoc Lithic Tradition (NLT) reduction sequence.

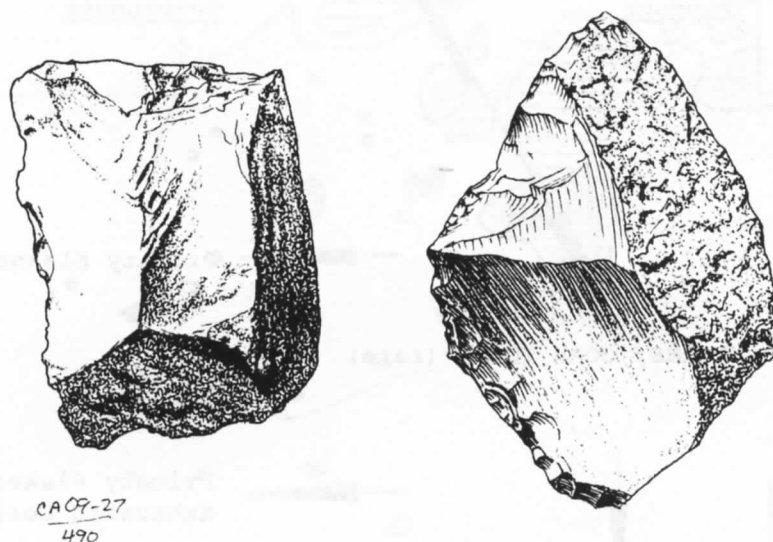
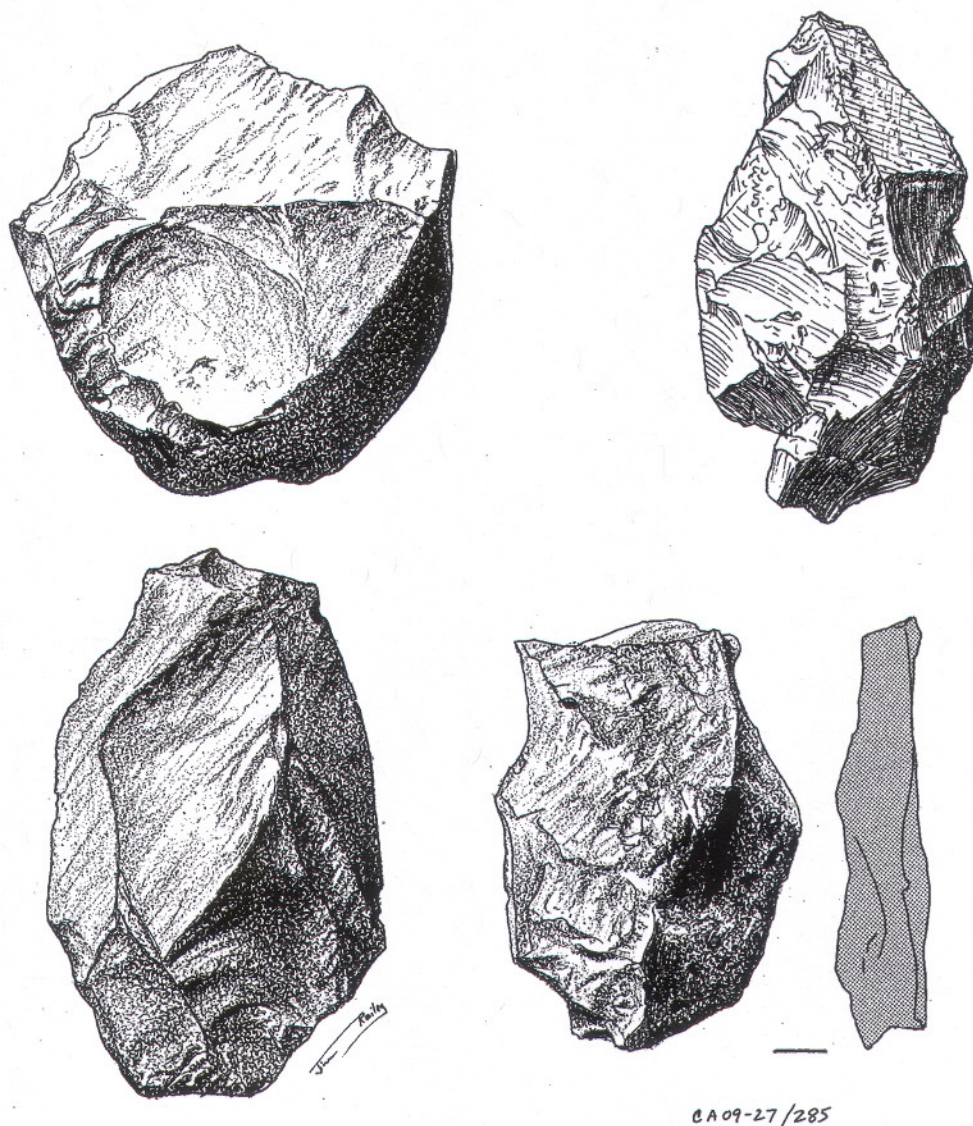


Figure 9. Type 1: Large Quadrilateral Secondary Flake Tools (n=25)

- ▶ quadrilateral or nearly quadrilateral form, often with sharp corners, sometimes pentagonal with quadrilateral scar where dorsal ridge was removed.
- ▶ very straight use-edge(s).
- ▶ use-edge usually along longer side(s) of quadrilateral.
- ▶ often parallel flakes removed along work edge(s).
- ▶ often dorsal ridge removed by single thinning flake.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	48.7	49	8.4
Width	39.1	33	8.8
Thickness	14.4	10	3.9



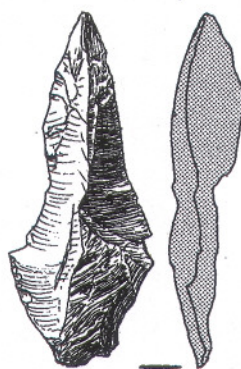
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Figure 10. Type 7: Thick semi-lunar Flake Tools (n=57)

- ▶ larger than Type 4 tools.
- ▶ made of large secondary and occasionally primary flakes.
- ▶ parallel thinning flakes sometimes removed along dorsal surface.
- ▶ relatively steep tool and edge angles.
- ▶ sometimes broken work edge indicates heavy-duty use.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	49.9	43	9.9
Width	29.6	22	8.4
Thickness	12.2	10	3.2



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Figure 11. Type 8: multi-faceted pointed secondary flake tools (n=4)

- ▶ rare.
- ▶ pointed form with relatively thick, diamond-shaped, multi-faceted point (thicker than remainder of tool).
- ▶ point shows pronounced wear.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	41.5	--	14.1
Width	29.6	--	8.8
Thickness	12.2	--	4.0

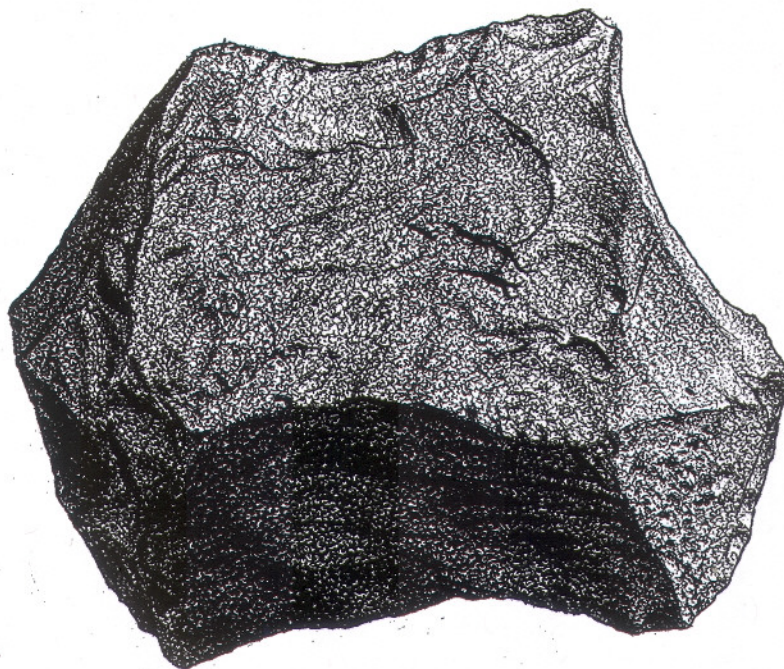


Figure 12. Type 10: core tools (n=8)

- ▶ forms range from simple quadrilateral blocks with one or a few primary flakes removed to more complex forms with several secondary flakes removed.
- ▶ often with long, even pointed edge.
- ▶ has several use-edges.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	102.1	102	19.9
Width	56.6	--	31.0
Thickness	40.0	--	9.9

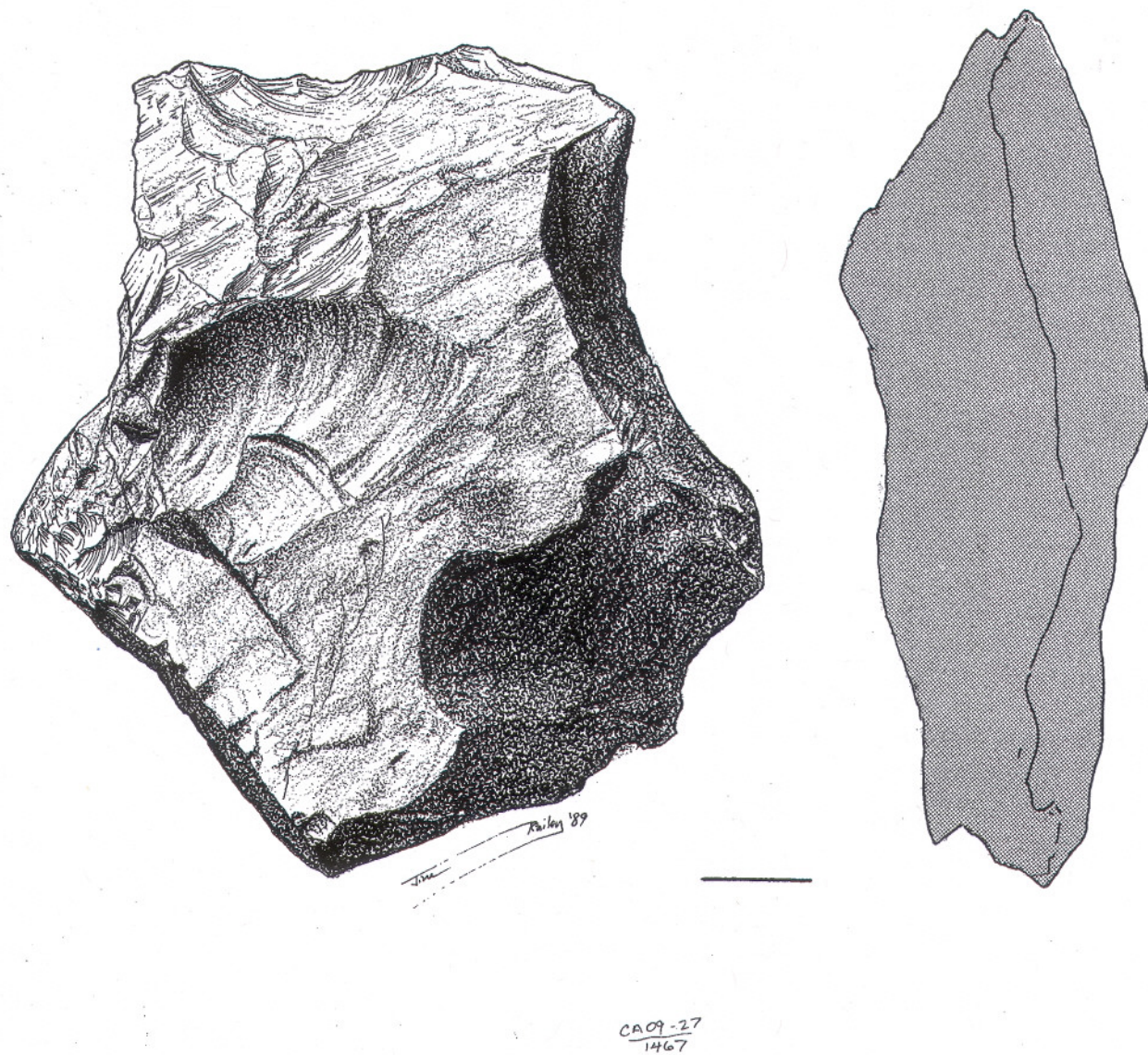


Figure 13. Type 10 core tool.

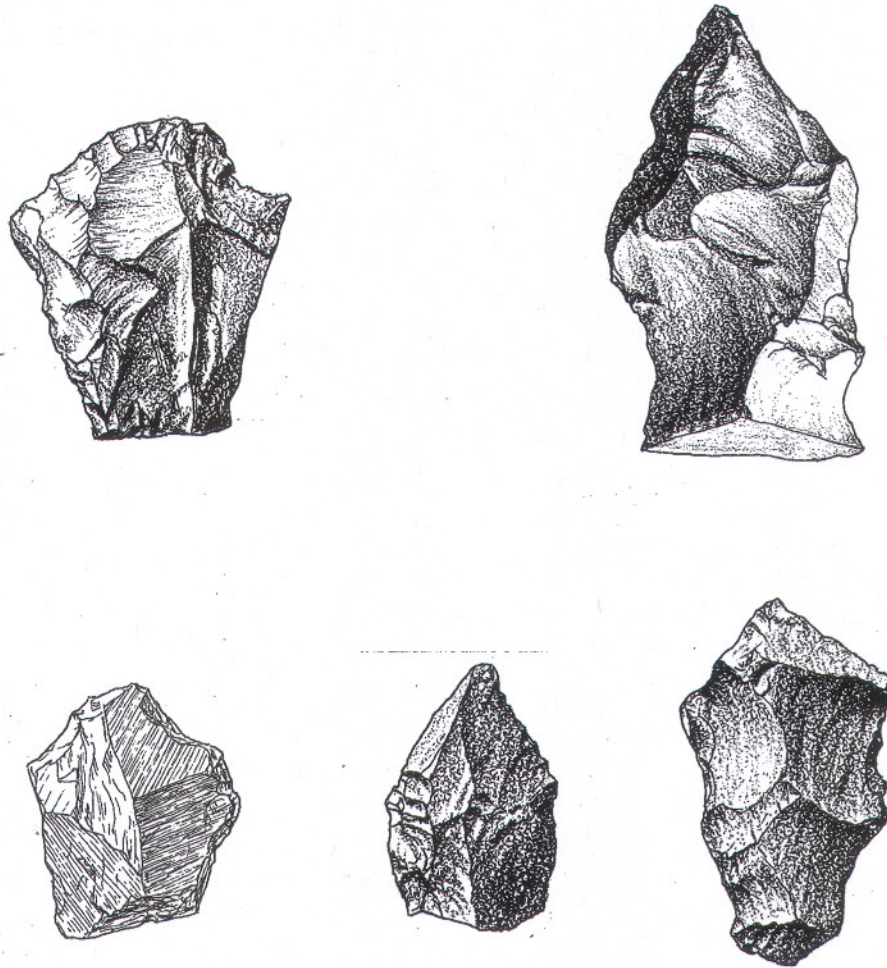


Figure 14. Type 12: pentagonal secondary flake tools (n=131)

- ▶ distinctive pentagonal outline, often elongated.
- ▶ shaped by removing flakes along two to three edges, including both use and non-use edges (this distinguishes this type from pentagonal variant of Types 1 to 3, along with use-edge location).
- ▶ use-edge usually on upper left side of pentagon; (dorsal side up, striking platform at bottom).
- ▶ shallow edge angles.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	38.4	34	8.1
Width	29.2	26	6.2
Thickness	10.7	10	3.5

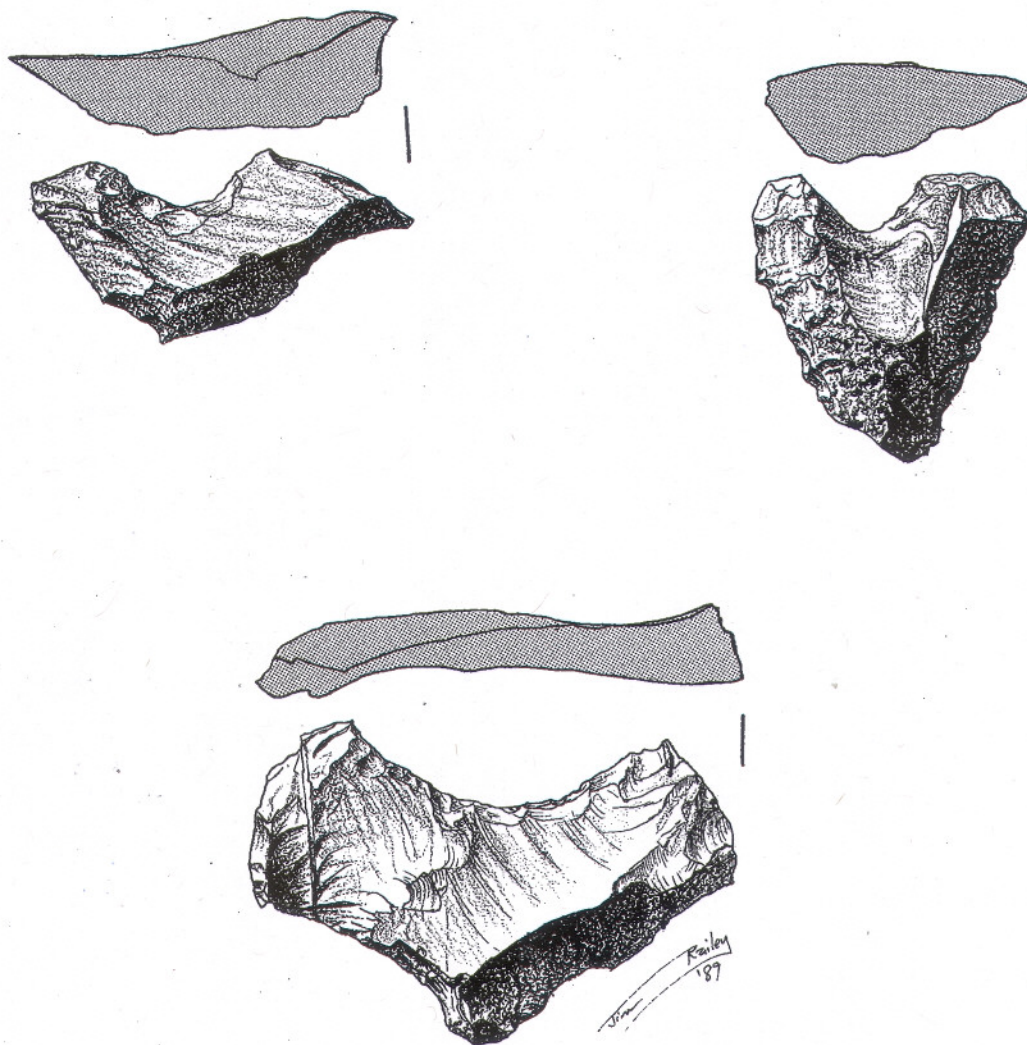


Figure 15. Type 13: incurved or notched secondary flake tools (n=86)

- ▶ appear in several forms, usually irregular and amorphous.
- ▶ have distinctive convex, incurved use-edge or often, multiple use-edges.
- ▶ steep edge and tool angles.

Metrics:

<i>Dimensions in millimeters</i>	<i>Mean</i>	<i>Mode</i>	<i>Standard deviation</i>
Length	41.6	38	10.1
Width	30.2	23, 31	9.7
Thickness	12.6	8	4.7

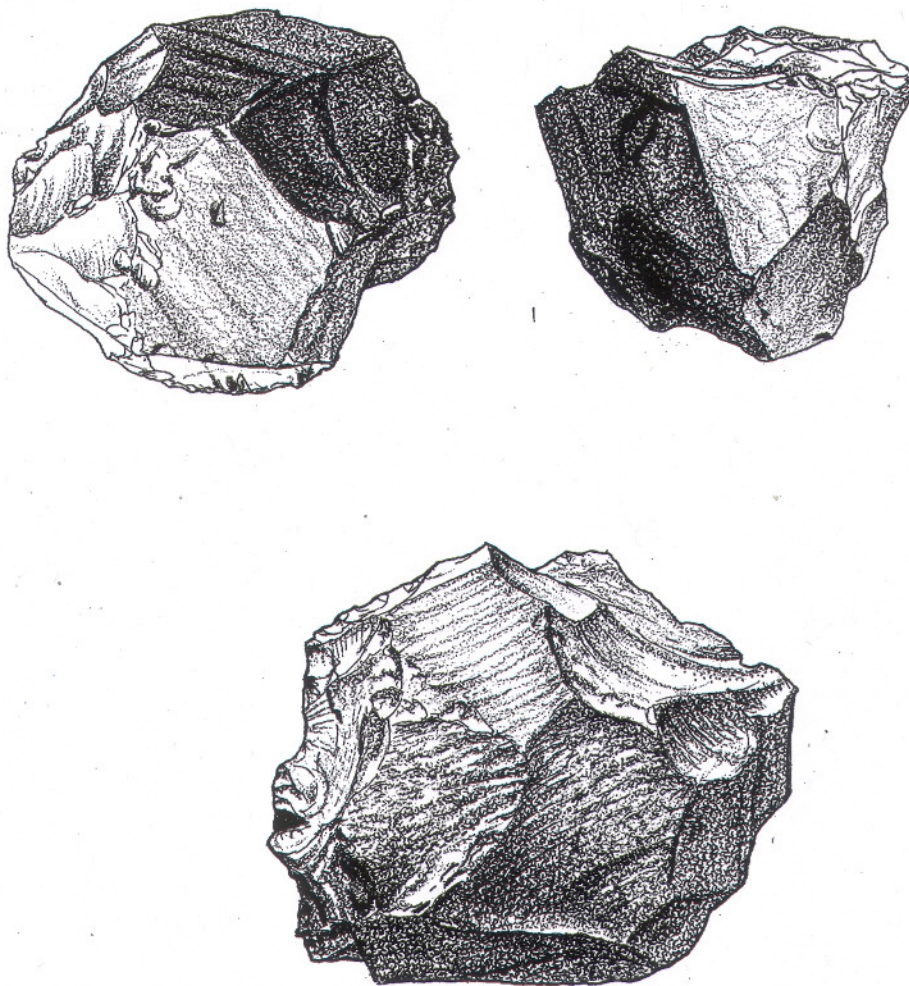


Figure 16. Cores of the NLT, including two exhausted specimens (top) and one non-exhausted specimen (bottom).

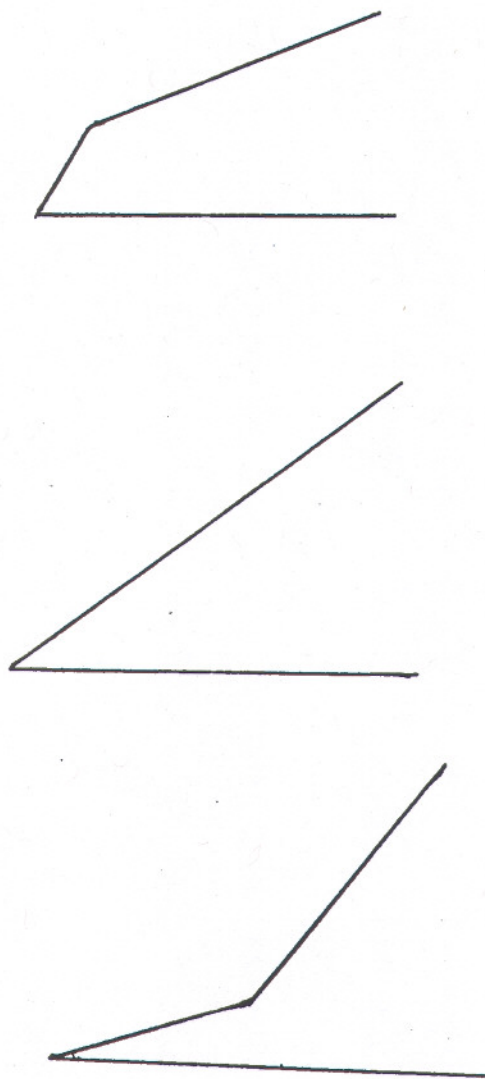


Figure 17. Idealized schematic cross-sections of tool edge types: edge angle greater than tool angle forms a heavy edge (top); equal edge and tool angles form a medium edge (middle); edge angle less than tool angle forms a fine edge (bottom).

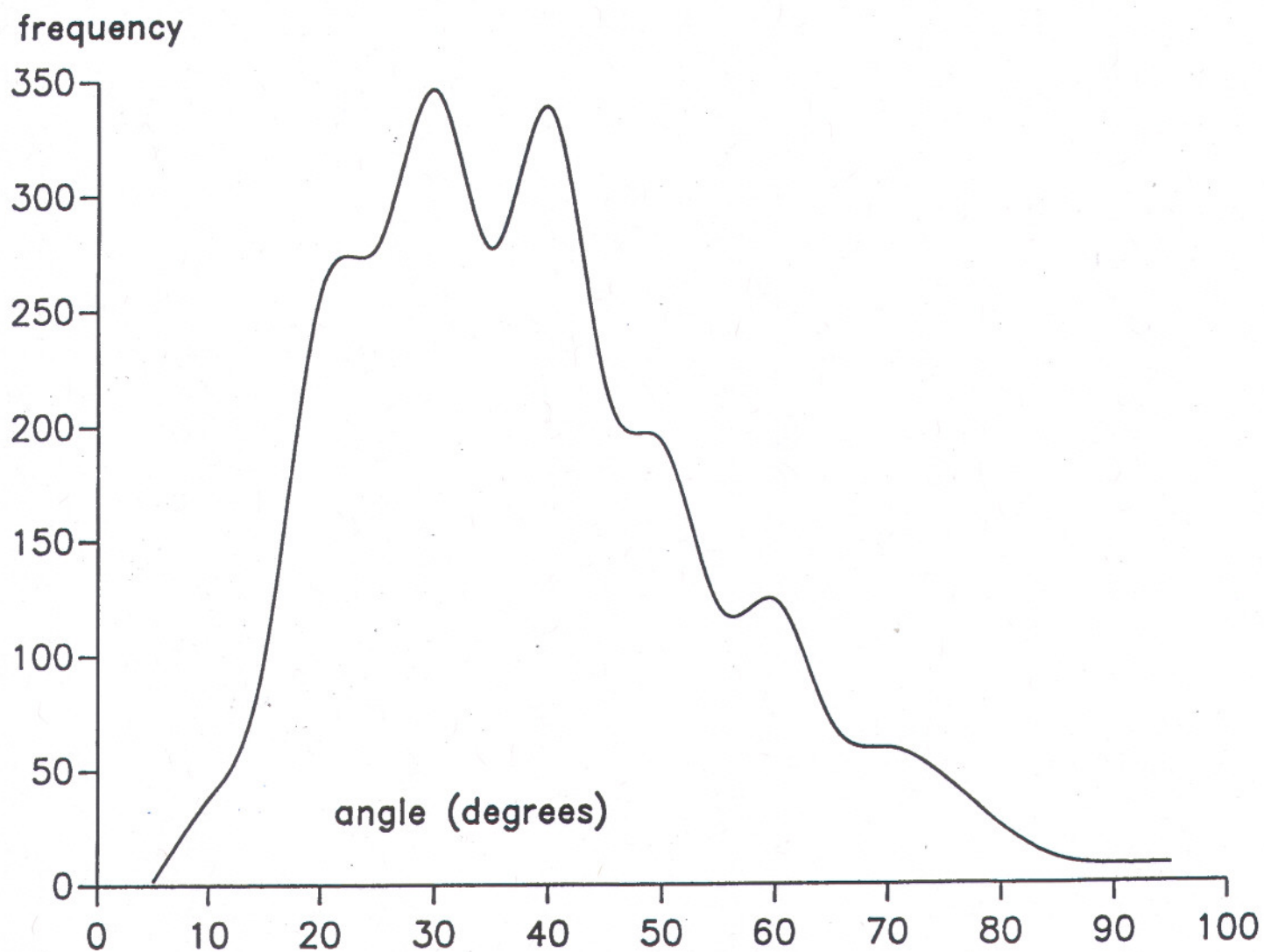
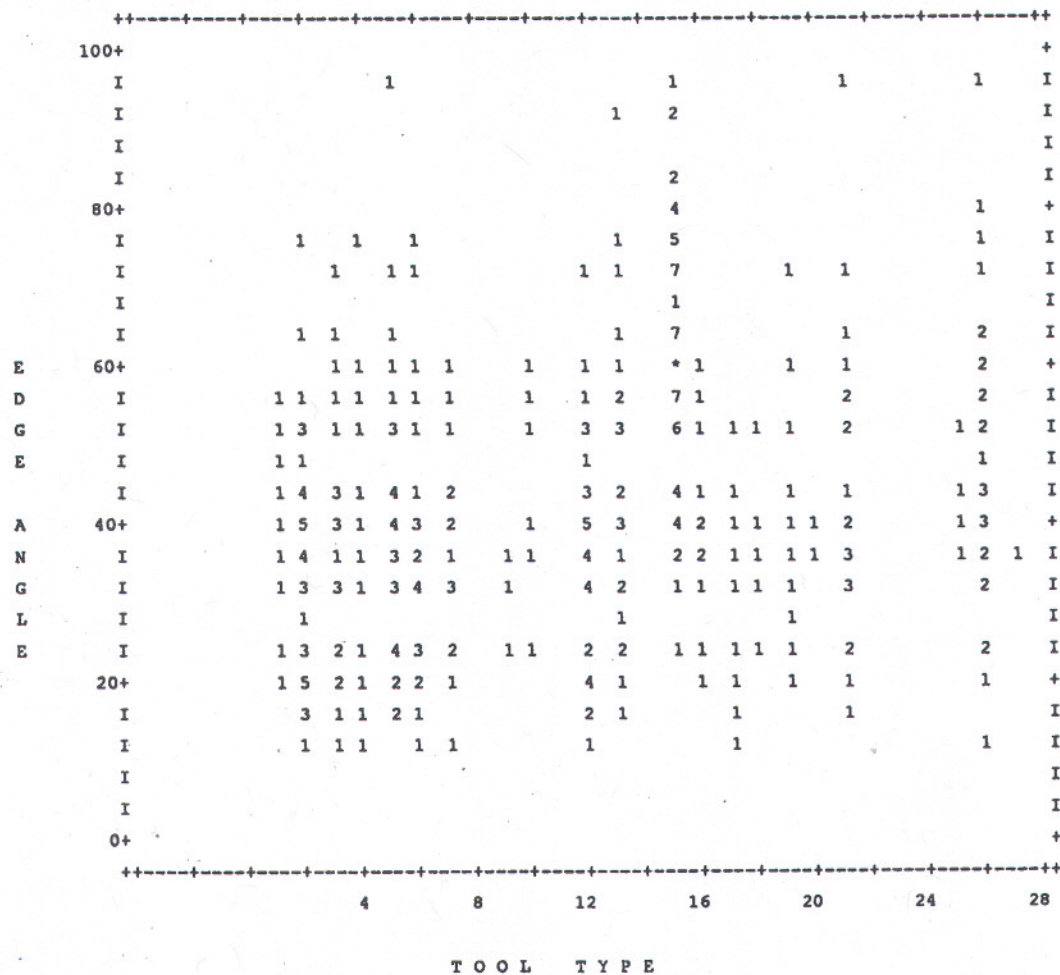


Figure 18. Line graph of edge angle frequencies in the NLT.



I		I
I	2515 cases plotted	I
I		I
I	Cutpoint=5	I
I		I
I	1- 5 = 1 26-30 = 6	I
I	6-10 = 2 31-35 = 7	I
I	11-15 = 3 36-40 = 8	I
I	16-20 = 4 41-45 = 9	I
I	21-25 = 5 >45 = *	I
I		I

Figure 19. Edge angles plotted against formal tool types, with a cutpoint of 5. Unmodified utilized flakes (Type 14) have been omitted due to their high frequencies. Clinal versus multiple-peak angle distributions are one method of discerning single from multiple function tools. Type 8 are multi-faceted pointed tools (burins) without true use edges, while Types 11, 22, 23, and 24 are unassigned numbers.

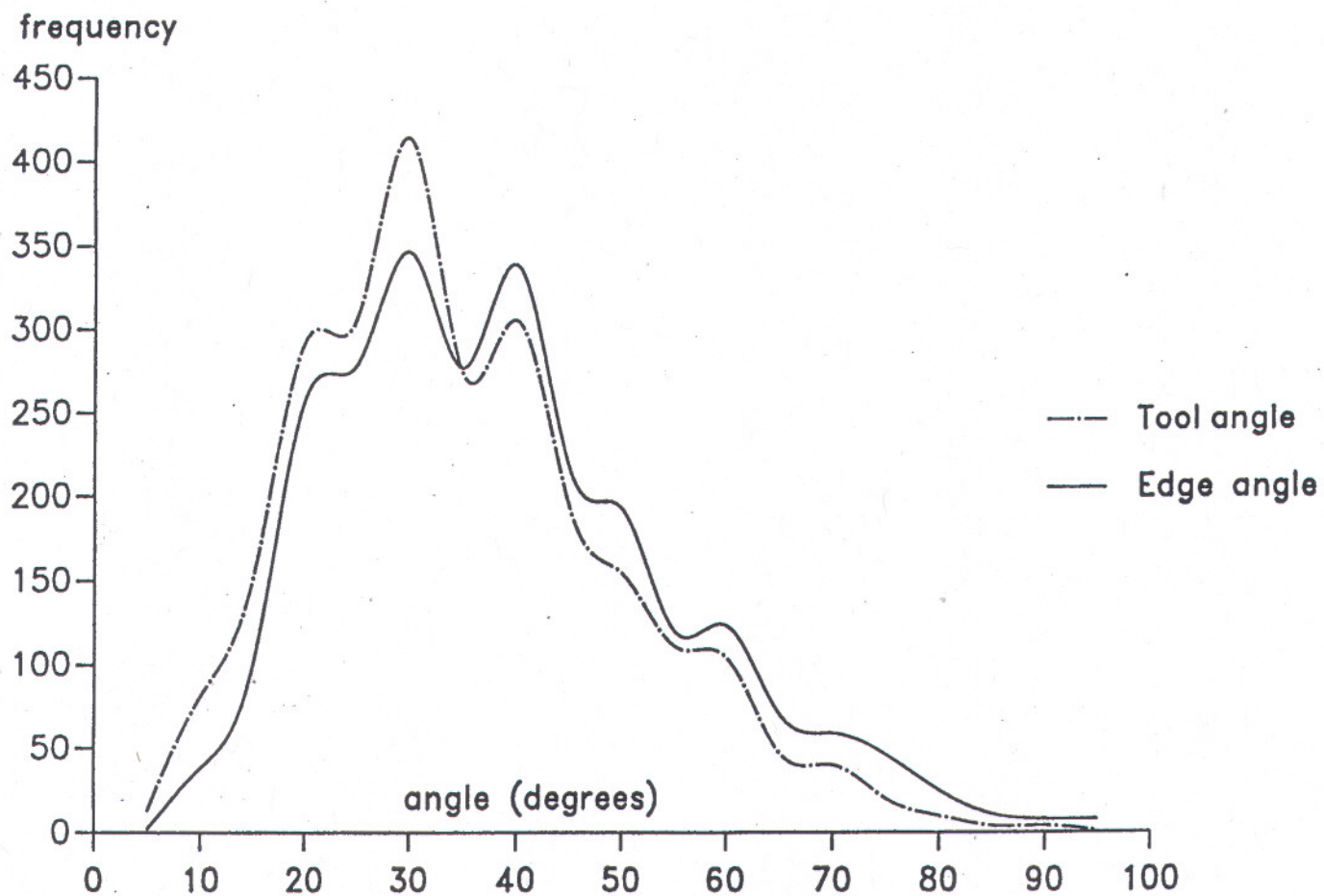


Figure 20. Edge and tool angle frequencies of the NLT.

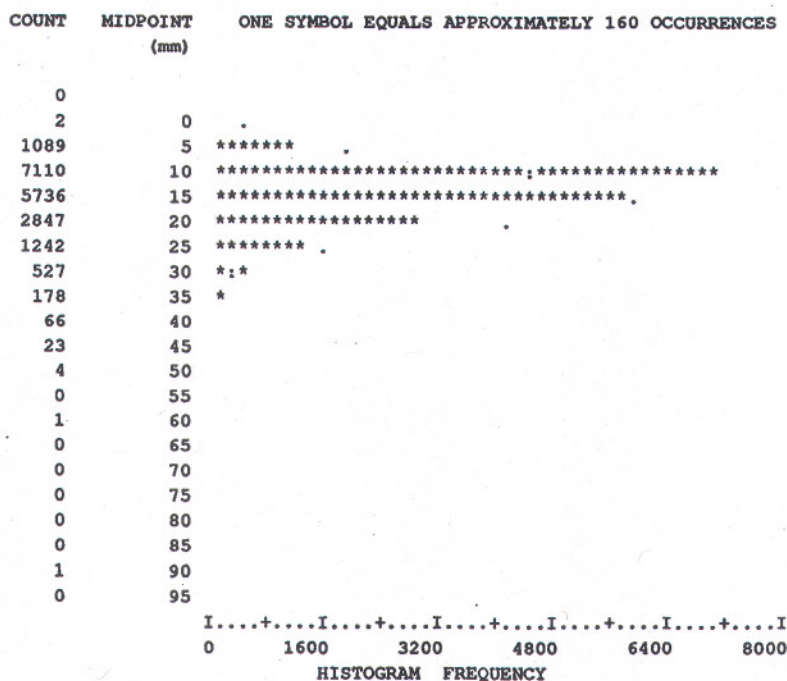


Figure 21. Computer-scaled histograms of flake length and width.

Table 1. Radiocarbon dates from the Quebrada de Las Pircas.

Site	Provenience	Depth	Uncorrected date (Before Present)	Lab #
CA09-27	1985 test unit N 1 W 75, level 3	28 cm	7950 +/-180	Beta12385
CA09-27	N 1 W 62, level 3 dwelling floor	25 cm	7630 +/-80	Beta30778
CA09-27	N 2 W 63, level 4 beneath floor	32 cm	7690 +/-70	Beta30779
CA09-28	S 3 W 5, burial 1 pit bottom	36 cm	8210 +/-180*	Beta33523
CA09-28	S 1 E 1, level 4	39 cm	8260 +/-130	Beta33524
CA09-52	N 10 W 4, level 2	17 cm	8080 +/-70	Beta30781
CA09-52	N 10 W 6, level 4	33 cm	7850 +/-140*	Beta33525
CA09-52	1985 test unit N 22 W 10, level 3	27 cm	7920 +/-120	Beta12384
CA09-52	S 13 W 7, level 4	38 cm	2270 +/-70	Beta30780
CA09-85	Test unit 1, south 1/2, level 4	36 cm	8410 +/-140*	Beta33526
* denotes extended count date (small samples)				

Table 2. List of formal tool types of NLT.

- 1 large quadrilateral
- 2 medium quadrilateral
- 3 small quadrilateral
- 4 large semilunar
- 5 medium semilunar
- 6 small semilunar
- 7 thick semilunar
- 8 multi-faceted pointed
- 9 simple pointed
- 10 large core
- 12 pentagonal
- 13 incurved use edge
- 14 unmodified (untrimmed) utilized
- 15 blocky
- 16 thick rectangular
- 17 thick pentagonal
- 18 small triangular
- 19 medium triangular
- 20 large triangular
- 21 amorphous 1
- 25 amorphous 2
- 26 long-handled, short use edge

Table 3. Frequencies and percentages of chipped lithic raw material types (all lithics, all sites).

Material	Color	Mat Code	Frequency	Percent
basalt	black	1	16520	46.5
quartzite	violet	2	353	1.0
andesite	gray	3	2658	7.5
*silex	banded	4	41	.1
*silex	cream	5	25	.1
*silex	coffee	6	13	.0
*silex	dark green	7	70	.2
limestone	off-white	8	2788	7.8
*silex	general	9	3	.0
rhyolite	banded	10	2298	6.5
quartz	milky	11	88	.2
*quartz	crystalline	12	50	.1
*quartz	crystal	13	2	.0
*quartz	var. colored	14	48	.1
*chalcedony	white	15	24	.1
*silex	black	16	67	.2
*silex	black w coffee	17	1	.0
granite	gray	18	104	.3
mylonite	gray, veined	19	4572	12.9
*jasper	black w red	20	33	.1
*silex	gray	21	35	.1
diorite	cream, off-white	22	5576	15.7
granite	green	23	1	.0
basalt	black, white flecks	24	7	.0
*quartz	amber	25	3	.0
*silex	gray, red streaks	26	11	.0
copper ore	dark green	28	126	.4
*jasper	cream, black & red	29	16	.0
*silex	dark pink, violet	30	1	.0
*mica	silver	31	1	.0
*silex	maroon	32	3	.0
*silex	black & yellow	33	1	.0
Total			35537	100.0

* denotes material type considered exotic.