STONE ARTIFACTS FROM THE PUNCHAW LAKE SITE (AREA C): A LATE PREHISTORIC OCCUPATION IN CENTRAL BRITISH COLUMBIA

by

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ABSTRACT

This thesis is an analysis of 6971 stone artifacts excavated from one area of the Punchaw Lake Site (FiRs:1) in Central British Columbia.

Following the decision model (Bonnichsen 1974) or artifact life history approach, lithic artifacts are examined in terms of raw material, technology, form, and function, with a separate typology created for each category. Seven raw materials are identified and an attempt is made to trace their sources. On the basis of preliminary replication experiments using basalt, several technological stages are identified. A detailed formal typology is presented for formed tools and some inferences of tool use are based on macromorphology, microscopic analysis, and ethnographic analogy.

Analysis of the site matrix and artifact distributions support the conclusion that the excavated area represents a long series of seasonal occupations. Three C-14 dates and typological comparison with other plateau assemblages place the occupation between 1510 ± 100 B.P. and 240 ± 150 B.P. Strong cultural continuity throughout the occupation is observed.

ACKNOWLEDGEMENTS

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Lastly, I would like to thank my husband, Paul Harder, for draughting many of the maps and illustrations, composing the artifact photographs, and, most of all, providing the constant encouragement I needed to finish this project.

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Part I. The Research Context

This thesis presents the results of an analysis of lithic artifacts excavated from the Punchaw Lake site (FiRs: 1) during the summer of 1974. It has 2 goals: first, to offer a technological and functional , as well as stylistic, interpretation of the stone tools and debitage found at the site, and second, to integrate this new knowledge with previous culture historical reconstructions in the British Columbia Interior Plateau.

The body of the report is divided into 2 sections. Part I provides, in 2 chapters, the background and context of research. Chapter 1 outlines the theoretical orientation of the project, while Chapter 2 describes the geographical area of research - the Nechako Plateau - and outlines the history of human occupation on the plateau.

Chapter 1. Introduction

"Archaeologists must...obtain from artifacts what ethnologists obtain from direct observation of behavior"

(Redman 1973:8)

A. The Goals of Lithic Analysis

Lithic analysis is a means of access to information about the original tool makers. But, like other anthropological techniques, it has inherent limitations. Stone does not readily reflect idiosyncratic styles of individual craftsmen. Because stone working is a subtractive rather than additive industry, lithic remnants recovered from archaeological sites may not adequately represent the full range of activities performed there; and, as members of a population of artifacts in a site, stone tools are also subject to the requirements of adequate sampling strategy and field recovery techniques. Nevertheless, in the central interior stone tools are the most plentiful, and often the only, archaeological resource. Under these circumstances, lithic analysis is one of the main concerns of archaeology.

Sackett (1973: 320) identified 2 approaches to archaeological materials, the functional and the stylistic.

In the functional approach, tools are regarded in terms of "role and meaning in the immediate cultural setting". In this general sense, 'function' includes all aspects of tool manufacture and use at a given time and place. The functional approach may be contrasted with the stylistic approach, where artifacts are viewed as evidence of a genetic framework or cultural tradition.

As Sackett (1973) points out, these 2 kinds of analysis are natural products of 2 different kinds of data. The study of intra-assemblage variability leads naturally to synchronic functional interpretation, whereas inter-assemblage comparisons, especially where long time spans are involved, are conducive to diachronic, historico-genetic interpretation (Sackett 1973). Both functional and stylistic analyses are integral aspects of archaeological reconstruction, but intra-site functional analysis to control for variation within the site logically precedes external stylistic comparisons.

The basic assumption made in functional, or 'behavioral' analysis, is that the behavior of craftsmen and tool users is manifested in the form and distribution of artifacts in a site. On this assumption, Deetz (1968: 41-42) proposed an analogy between artifacts and behavior. He identified 4 levels of correspondence: 1) attributes of artifacts reflect the behavior of individuals; 2) clusters of artifacts reflect the activities of groups of individuals and can be used to identify families, lineages, work groups; 3) the articulation of all artifact patterns within a site reflects the behavior of the community; and 4) the combination of patterns from several sites represents the settlement pattern of the society.

While the tendency to interpret artifact distributions simply in terms of descent and residence variables has been criticized (Johnson 1972: 369), there seems to be a concensus that meaningful patterns may be observed in the distribution of artifacts within sites. This position has been stated concisely by Struever (1971: 11),

> if...prehistoric communities were structured and different activities were performed in various localized precincts within them, then it might be expected that artifacts and features associated with these activities would be correspondingly localized in distribution.

While many archaeologists have advocated the functional approach, Binford has taken the most optimistic stance concerning results:

> The formal structure of artifact assemblages together with the between element contextual relationships should and do present a systematic and understandable picture of the total extinct cultural system (Binford 1962: 219).

This extreme position may be unrealistic, but has encouraged recognition of spatial configurations of artifacts which might correspond to activity patterns of the site occupants. Binford also made the important point that, beyond 'behavioral' reconstruction, the results of functional analysis contribute to the understanding of culture as a system (cf. Binford and Binford 1966; Binford 1973). As Flannery (1968: 6) pointed out in a classic statement,

> ...the process theorist is not ultimately concerned with 'the Indian behind the artifact' but rather with the system behind both the Indian and the artifact.

The subject matter of this thesis is the assemblage of stone artifacts from Area C of the Punchaw Lake site. The analysis incorporates both functional and stylistic variables, dealing first with the role of artifacts in their specific cultural setting and then viewing the site in terms of its culture historical position. The first goal is to identify past intra-site activity patterns, while the second goal is to determine the site's cultural affiliations.

B. The Artifact 'Life History'

Functional and stylistic analyses are based on artifacts as discrete objects possessing certain physical characteristics, or attributes. For the purposes of this study, an artifact is regarded as any object modified by human activity. In his treatise on archaeological systematics, Dunnell (1971: 48-50) emphasized the importance of attribute selection in the formation of classificatory units and defined attributes as the smallest qualitatively distinct units involved in classification.

Difficulties of attribute selection have been recognized by many authors (cf. Brew 1971; Ford 1971; Spaulding 1974: 514; Sackett 1966: 360). Speth (1974: 7) categorically states that "the selection of appropriate attributes for analysis is clearly becoming one of the most fundamental problems faced by the archaeologist".

Deetz' (1971) equation of attributes with levels of behavior has already been mentioned. This correspondence was pursued by White (1967), who could identify individual craftsmen by idiosyncratic variations in the form of stone artifacts.

After reviewing some pitfalls of artifact analysis, such as the danger of confusing cultural and non-cultural variables, ignoring multiple tool functions, and relying upon finished artifacts to the exclusion of tools in different stages of manufacture, Bonnichsen (1974, Chapter 2) proposes studying artifacts by focussing on decisions made by the stoneworker and examining physical attributes that result from these decisions. He calls this approach the "decision model".

The "decision model" is based on 2 assumptions: first, that "the common denominator which underlies the production of all stone tools is the decision making process...", and second, that "an interacting social group of artisans will share in common many of the same tool making decision models as a consequence of participating in the same ongoing cultural experience" (Bonnichsem 1974: 1-3). In other words, people working together in social groups and participating in the same activities will share techniques of making and using stone tools.

Given these assumptions, Bonnichson structures the shared decision making process involved in the manufacture and use of tools into 4 levels:

1. decisions about raw materials
2. decisions about how to induce fracture
3. decisions abut microstructure (constructional units and their sequential ordering)
4. decisions about macrostructure or outline form

These categories represent not only related decisions but also a logical sequence of actions, and in this sense, the decision model framework is very similar to the 'artifact life history' approach advocated by many lithic analysts (cf. Wheat 1976; Hassan 1976; Sheets 1975). For example, in a defense of use-wear studies, Tringham et al outline the debate between 'stylistic' analysts and 'functional' analysts, and offer a simple solution to the dilemma, "a systematic combination of macromorphological and functional attributes" (1974: 173). This solution is justified by invoking the concepts of the artifact life history and the decision sequence:

> At each stage in the history of a stone artifact, from the initial mining and knapping of the stone, to the use and then rejection of the tool, choices were made by the knapper or user. Each set of choices contributed to the overall and ultimate appearance of the stone artifact, but none was made ...in isolation from the other sets (Tringham et al 1974: 173).

Thus 2 categories of attributes previously regarded as conflicting (functional and stylistic) are given equal weight as 2 aspects of the same decision sequence.

The decision model, or artifact life history approach, is also advocated by Muto (1971), who emphasizes the intent of the craftsman. According to Muto (1971), this intent shapes the entire process of artifact production:

> ...the vision of a desired end product persists from the formative stages of manufacture to the final stages....each flake removed in the process is designed intentionally, each mistake corrected ....each blow of the knapper's tool has meaning in a progression toward a purposive, intentional end product (Muto 1971: 110,115).

As pointed out in these quotations, none of the decisions of the tool maker can be considered out of context, since they are all to some extent interactive. Thus, the choice of raw material is in part determined by aesthetic preference, in part by technological considerations, and in part by the intended function of the tool. The entire process of tool manufacture is a complex 'feedback' system, with output represented by lithic artifacts.

The artifact life history approach has been adopted for this project because it encourages an integrated analysis of all cultural aspects of stone tools. Following Bonnichson (1974), with some modification, artifact life history has been divided into 4 sequential stages related to decisions and actions of the stoneworker:

1. decisions about raw materials (Raw Material)
2. decisions about manufacturing technique (Technology)
3. decisions about outline form (Form)
4. decisions about tool use (Function)

Since the artifact 'life' is a continuous process, the division of the sequence into 4 segments is entirely arbitrary. The continuum could as easily be divided into 2 broader segments such as manufacture and use, or split into many more specific categories. The choice of 4 categories is based primarily on the kinds of information available, and ultimately on the literature pertaining to lithic analysis (eg. the search for raw material sources, replicative experiments, stylistic analyses, and use-wear studies).

Artifact life history is reconstructed by separately considering each of the sequential stages. Artifacts may be grouped first by raw material, then regrouped by technological criteria, again by formal criteria, and lastly by functional criteria. Thus, within each stage a different typology may be constructed. As mentioned above, this is not to say that the stages are independent, rather they are interactive: tool function is unquestionably dependent upon tool form, and tool form upon manufacturing technique.

In combination, information about the 4 life history stages provides a thorough description of stone tools at the site, accounting for the functional role of each artifact. 'Stylistic' analysis, or the search for culture-historical affiliations, is accomplished by examining the broader spatial and temporal distribution of attributes from all 'life history' categories. In other words, it is possible that cultural choice of raw material, manufacturing technique, tool form, or tool function could vary independently through time or space.

CHAPTER 2. The Nechako Plateau : Environment and Human Occupation

The Punchaw Lake site (FiRs:1) is situated on the southwest shore of Punchaw Lake, which is located about 30 miles south of the city of Prince George in central British Columbia. The site extends from the lake outlet about 500 meters along the western bank of Tako Creek, which drains the lake southward into the Blackwater River (Fig. 1). This chapter places the site into regional context by considering the environment and prehistory of the Interior Plateau.

A. The Environment

Punchaw Lake is located at the southern extremity of the Nechako Plateau. The Blackwater (or Westroad) River about 20 km from the lake (Plate 1A) marks the arbitrary boundary between the Nechako and Fraser Plateaux (Holland 1964: 68).

The Nechako Plateau is an area of low relief, with an average elevation of 1106 m. The land surface is flat to gently rolling but deeply incised by the Fraser River and its tributaries. Glacial features such as drumlins, eskers, erratics, and meltwater channels are common, and innumerable depressions left by glacial scouring are now lakes and ponds.

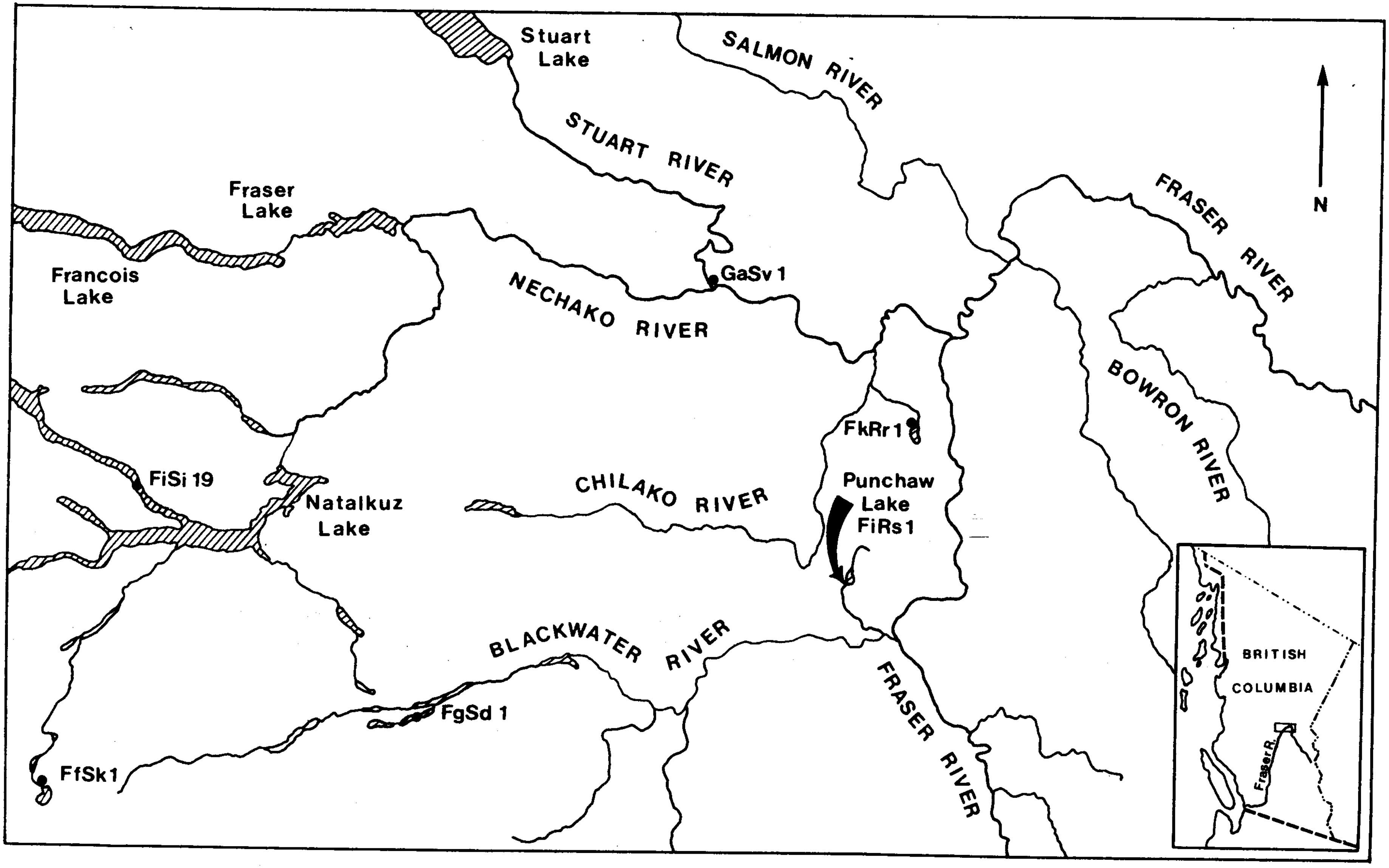


Fig. 1. Archaeological sites on the Nechako Plateau.

On the basis of glacial features, 3 ice advances during the last glacial period have been postulated for the central plateau. During the main advance, known as the Fraser Glaciation, the entire plateau, including the Punchaw Lake area, was covered by an ice sheet which accumulated in the Coast and Cariboo Mountains and flowed as a coalesced mass northeast toward the Parsnip River. Rock debris was transported primarily from the coast mountains and deposited in low lying areas such as the Nechako Plain. This till became the parent material for the Chilako, Barrett and Driftwood soil series, which are widespread on the Plateau (Farstad and Laird 1954:8). A subsequent post-Fraser advance was more limited and did not extend as far as Punchaw Lake (Tipper 1971a: 746).

During de-glaciation, ice blocks inhibited the natural drainage pattern and caused the formation of a large pro-glacial lake in the vicinity of the present city of Prince George. The lake level is estimated to have been less than 2500 feet, which would have placed the Punchaw Lake location above but near the shoreline (Tipper 1971b: 33,48). As Fladmark has pointed out, "from a paleoenvironmental standpoint there seems to be no reason why the Punchaw Lake area could not have been occupied for at least the last 8-9000 years (1974: 20).

The plateau climate today is continental and humid with cold winters (January mean temperature -9 degrees C) and cool short summers (July mean temperature 15 degrees C). Precipitation, 38-51 cm annually, falls mostly as rain during the summer (Canada Land Inventory Map 1970). Although there is no direct evidence for post-glacial climatic changes in this region, pollen samples from the southern interior show an increase in *Artemisia* (sagebrush) during the period 9300-4000 B.P., with a return to more humid conditions around 3000 B.P. (Hansen 1955). Considering its position in an environmental ecotone, climatic shifts may have produced dramatic changes in local vegetation in the vicinity of the Blackwater drainage.

Most sources place the central interior in the Subalpine Forest biotic area, a zone characterized by great variation in average elevation and precipitation (McTaggart Cowan and Guiguet 1965: 19,23; Lyons 1952: 6). However, considering the distributions of plants and animals throughout the province, it may be more appropriate to regard this area as an ecotone between the dry grasslands and parklands of the southern interior and the dense boreal forests of the north. Climatic imperatives restrict many plant and animal species to one or the other of these zones, although there are also many crosscutting species.

The present forest on the plateau consists of a dense cover of lodgepole pine, spruce, Douglas fir, aspen, cottonwood, birch, and alder. Mammal and bird species presently found in the central interior are listed in Tables I and II. Moose are recent immigrants to the central interior, first observed around 1900. Freshwater and anadromous fish suitable for human consumption are outlined in Table III. As shown in the list, more species of salmon ascend the Skeena River than the Fraser, and given the relative distances from the coast, the fish arriving in Carrier territory via the Skeena are healthier and larger, as well as more plentiful, than those in the Fraser.

Table I. Mammals presently found in the Central Interior (McTaggart Cowan and Guiguet 1965; Cahalane 1947).

UNGULATES	
Mule deer	Odocoileus hemionus
Whitetail deer	Odocoileus virginianus
Elk	Cervus canadensis
Woodland caribou	Rangifer tarandus
Moose	Alces alces
Mountain goat	Oreamnos americanus
Mountain sheep	Ovis canadensis
CARNIVORES	
Coyote	Canis latrans
Wolf	Canis lupus
Red fox	Vulpes fulva
Cougar	Felis concolor
Bobcat	Lynx rufus
Lynx	Lynx canadensis
Black bear	Ursus americanus
Grizzly bear	Ursus arctos horribilis
Racoon	Procyon lotor
Marten	Martes americana
Fisher	Martes pennanti
Weasel	Mustela ermina
Mink	Mustela vison
Wolverine	Gulo luscus
River Otter	Lutra canadensis
RODENTS	
Beaver	Castor canadensis
Marmot	Marmota monax
Muskrat	Ondatra zibethica
Porcupine	Erethizon dorsatum
Hare	Lepus americanus

Table II. Birds presently found in the Central Interior (Williams Lake Field Naturalists Club 1976).

COMMON NAME	ORDER	NUMBER OF SPECIES
Loons	Gaviformes	2
Grebes	Podicipediformes	5
Pelicans, Cormorants	Pelcaniformes	2
Herons, Bitterns	Ciconiiformes	2
Swans, Geese, Ducks	Anseriformes	32
Hawks, Ospreys, Falcons	Falconiformes	15
Grouse, Ptarmigan	Galliformes	6
Cranes, Rails	Gruiformes	5
Shorebirds	Charadriiformes	36
Pigeons, Doves	Columbiformes	2
Owls	Strigiformes	11
Goatsuckers	Caprimulgiformes	2
Swifts, Hummingbirds	Apodiformes	4
Kingfishers	Psittaciformes	1
Woodpeckers	Piciformes	8
Songbirds	Passeriformes	113

Table III. Fish presently found in the Central Interior (Carl, Clemens and Lindsay 1959).

FRESHWATER FISH

Sturgeon	*Acipenser transmontanus*
Whitefish	*Prosopium williamsoni*
	Proscpium coulteri
	Coregonus clupeaformis
Lake trout	*Salvelinus namaycush*
Dolly Varden	*Salvelinus malma*
Cutthroat trout	*Salmo clarki*
Rainbow trout	*Salmo gairdneri*
Kokanee	*Oncorhynchus nerka*
Suckers	*Catostomus macrocheilus*
	Catostomus commersoni
	Catostomus catostomus
	Catostomus columbianus
Squawfish	*Ptychocheilus oregonenses*
Chub	*Cyprinidae* sp.

ANADROMOUS FISH

Sockeye salmon	*Oncorhynchus nerka*
Chinook salmon	*Oncorhynchus tshawytscha*
Pink salmon	*Oncorhynchus gorbuscha*
Coho salmon	*Oncorhynchus kisutch*
Steelhead	*Salmo gairdneri*

B. Culture History - Ethnography

At the time of European contact, the Nechako Plateau was occupied by the Athapaskan-speaking Carrier (Fig. 2). Morice, one of the principle ethnographers, differentiated 3 Carrier 'subtribes' within this area on the basis of dialect and location: 1) the Babine inhabited Babine Lake and the Bulkley River, 2) the Upper Carrier occupied the Stuart Lake-Nechako River area, and, 3) the Southern Carrier occupied the Blackwater River drainage (Morice 1906: 4).

Because they shared a broadly similar landscape and resources, and the same technological means of access to those resources, the 3 'sub-tribes' may be regarded as members of a single adaptive or exploitative zone. However, there were differences in social organization, settlement pattern, and material culture between the 3 subtribes.

Carrier subsistence was based on fishing, land-mammal hunting and plant collecting. Freshwater fish could be taken in large numbers from lakes in spring and fall, and by ice fishing during the winter. Runs of anadromous species arrived in Carrier territory in late summer via the Skeena and Fraser Rivers. Fishing technology included harpoons, leisters, hooks, nets, and weirs (Morice 1893: 71-74).

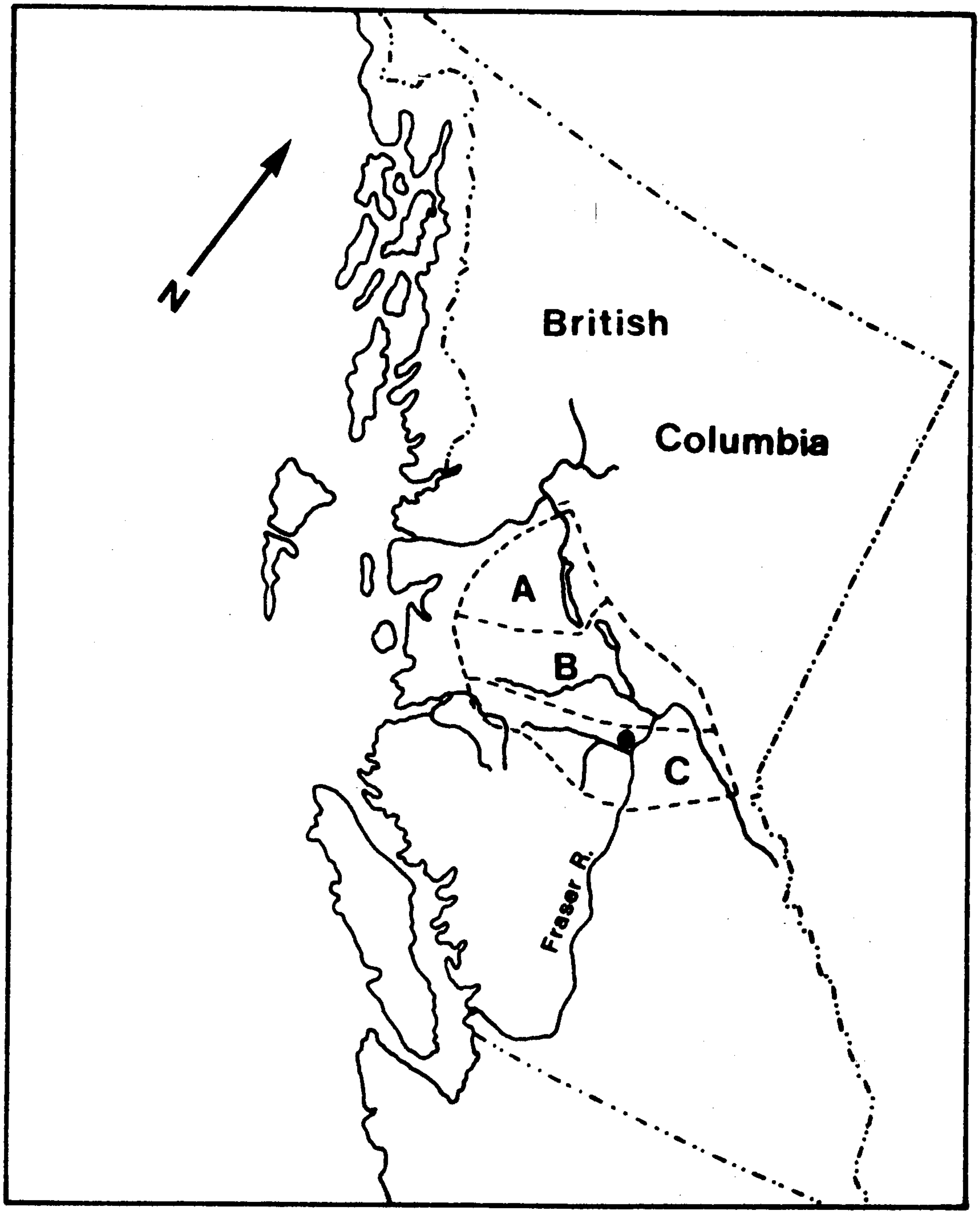


Fig. 2. Ethnographic territory of the Carrier Indians (A.D. 1800 - 1900) : A. Babine, B. Upper Carrier, C. Southern Carrier.

Mammals hunted primarily for meat were moose, caribou, deer, elk, mountain sheep, mountain goat, marmot, groundhog, hare, porcupine, and beaver (Morice 1893). The ungulates were most accessible during the fall mating season and in winter when they gathered in lowlands and valleys, although they could also be hunted during the summer in the highlands. Hunting techniques included snares, traps, pitfalls, and bow and arrow, later replaced by guns. Traplines were maintained through the winter for beaver, muskrat, marten, fisher, otter, wolverine, lynx, fox, wolf, coyote, ermine and mink (Morice 1893).

The hunting of waterfowl - ducks, grebes, geese and swans - is mentioned briefly. There is little information on plant foods, except that berries, the inner bark and sap of certain trees, and some roots were eaten. Fish, moose meat, and soapberries were dried and stored (Morice 1893: 70-100). Fall was the season of greatest abundance, when ungulates were easily hunted and salmon abundant, while spring was the season of greatest paucity, when prey animals were thin and scattered through the hills, and hunting and fishing difficult on the melting snow and ice.

In general, all of the Carrier followed the same pattern of seasonal transhumance. This pattern may be illustrated with selected passages from the ethnographies:

SPRING (April-July):

"Toward the middle of April...they leave their villages to go and pass about two months at the small lakes, from which...they take whitefish, trout, carp, etc, in large numbers. But when these begin to fail, they...subsist on the small fish, which they dried when at the lakes, or on salmon, should they have been so provident as to have kept any until that late season, or they eat herbs, the inner bark or sap of the cypress [?] tree, berries, etc. In this manner the Natives barely subsist, until about the middle of August" (Harmon 1816: 247-248).

SUMMER (August-September):

"Towards the latter end of August they go to the Riverside to take and dry salmon for the ensuing winter" (Harmon 1816: 174).

[On the Babine River in 1904]"...we beheld the immense array of dried salmon. On either side there were no less than 16 houses...filled with salmon from the top down so low that one had to stoop to get into them, and also an immense quantity of racks, filled up outside. If the latter had stood close together they would have covered acres and acres of ground, and though it was impossible to form an estimate, we judged it to be nearly three quarters of a million fish..."(Carrothers 1941: 3).

FALL/WINTER (October-March):

"...they migrated again up the lake and dispersed themselves along the shores and on the several islands, where the women caught whitefish and trout...while the men trapped the various fur-bearing animals" (Morice 1906: 21).

"...it was customary for those Indians to migrate at the approach of every winter, to a place where the firewood was plentiful enough to supply the needs of the different families, and to erect, during the cold season, large huts of slender logs..."(Morice 1906: 10).

Thus settlement pattern was closely tied to the nature of the seasonal resources. During late summer salmon runs many families congregated at traditional fishing stations; in the fall they dispersed along lakeshores, banding together in winter camps at the lakes and dispersing again in the springtime when stored foods were expended.

However, while the Babine clustered into several large winter villages, the Upper Carrier had only 1 winter village of comparable size, and the Southern Carrier were dispersed in many small camps with no large villages (Wilson 1976: 10, based on reports of Harmon 1816, Morice 1906, Mackenzie 1793). This gradient of settlement aggregation correlates with the accessibility of salmon in each of the 3 areas, with the largest and most accessible runs in the Skeena River and the least rewarding runs in the upper Fraser (Wilson 1976: 10-11). In fact, both early and modern observers are unanimous in attributing critical cultural importance to the salmon runs (Jenness 1932: 364; Steward 1960: 737; Sneed 1971: 229).

As Kew (1974: 4) has pointed out with reference to the Southern Carrier, "seasonal movements here never consisted of completely regular sequences in which the same group shifted from place to place in identical pattern year after year". Rather, flexibility was the rule, with the possibility of merging into large groups or dispersing into nuclear families to expoit various resources. According to Kew, "it was this fund of knowledge and the organizational capacity to split into small groups and spread throughout the territory which provided security from unpredictible vagaries of game and fish supply" (Kew 1974).

The largest social unit among most of the relatively dispersed Southern Carrier was the bilateral extended family, although the most important kin group was the nuclear family (Kew 1974:33). The Algatcho, closest to and undoubtedly influenced by coastal people, developed a crest group, while the Babine and Upper Carrier had a formal system of matrilineal clans (Goldman 1953).

There is little information on the material culture of the Carrier. Early explorers mention houses, canoes, and graves, but offer little descriptive detail. Morice describes several structures, but his descriptions are probably based on observation of the Upper Carrier and Babine. He reports 3 types of dwellings used during the summer: 1) a large ceremonial lodge of spruce planks 'owned' by a nobleman, 2) a smaller summer dwelling of logs and poles which probably housed a single family, and, 3) a salmon fishing lodge similar to the summer lodge but with open gables to facilitate fish drying (Morice 1893: 185-189). Winter dwellings are described as multi-family wooden houses with separate storage areas for each family; in addition semi-subterranean 'huts', which Morice believed were copied from the Shuswap, were constructed as winter dwellings by some of the Southern Carrier (Figs. 3 and 4). Other specialized structures were fortified houses, food caches above or below ground, and burial monuments and poles (Morice 1893: 195,199).

Mackenzie provides the only other detailed description of a structure, observed on June 20, 1793 on the Fraser River a few miles above its confluence with the Blackwater (1793: 309). The house was rectangular, 20' by 30', with 5' high walls constructed of spruce logs held by upright poles with gaps between the logs; a ridgepole was supported about 10' above the ground by 2 upright forks and roof poles and bark covering were tied with cedar [?]. One gable end was closed with split boards and 1 end with poles. Near the ceiling were fish drying poles. The house had apparently been constructed for 3 families with 3 doors, 3 evenly spaced fireplaces with beds, and fish storage behind the beds. It also contained a 15' long fish trap.

There is some disagreement about the use of pithouses among the Carrier. Morice claims they were used only among the Southern Carrier, who borrowed the idea from the neighboring Shuswap. Harmon also describes winter dwellings made by

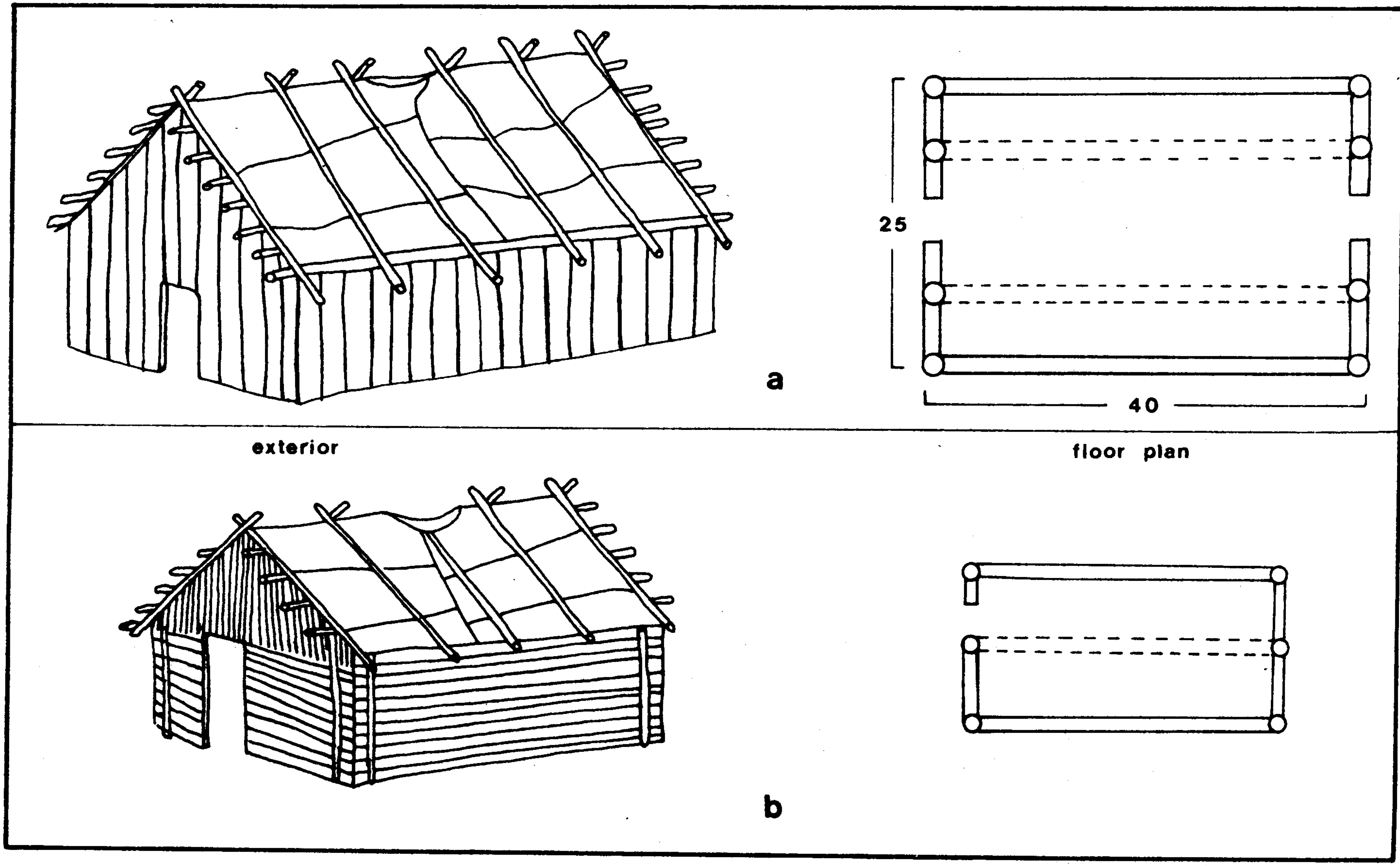


Fig. 3. Carrier summer dwellings (after Morice 1893): a. ceremonial lodge, b. summer house.

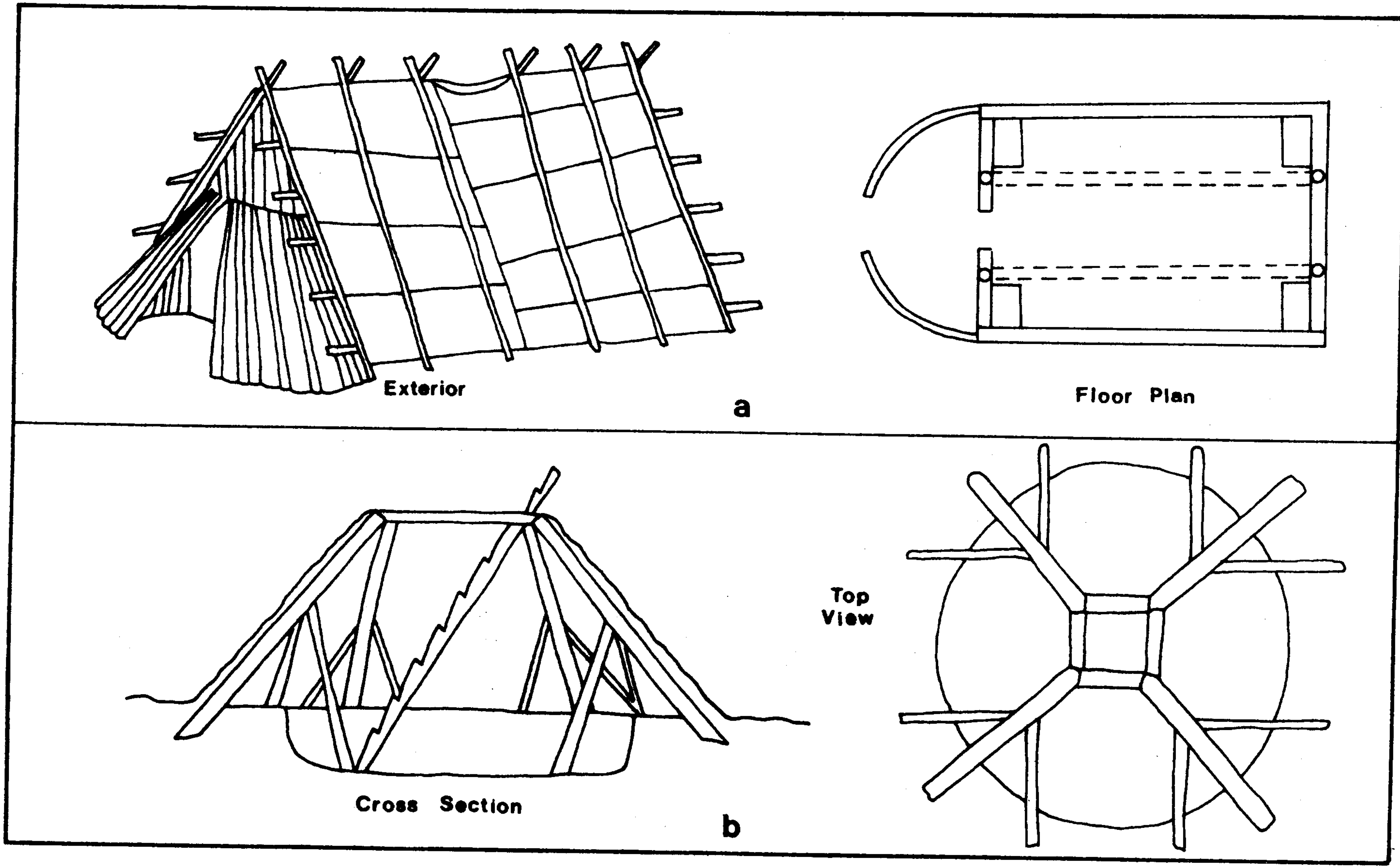


Fig. 4. Carrier winter dwellings (after Morice 1893): a. winter house, b. semi-subterranean 'pit house'.

"many of the Carrier" consisting of a 2' deep pit roofed with poles, covered with hay or bark and dirt (1816: 255). Mackenzie mentions one "subterraneous house" along the Fraser between Alexandria and Quesnel (1793: 318, 331), but also quotes the Carrier's derogatory view of the Shuswap as "a very malignant race who lived in large subterranean recesses" (Morice 1906: 43).

Morice (1893: 35-82) presents an incomplete but valuable discussion of tools in use among the Upper Carrier. The following list has been compiled from his descriptions.

Hunting Tools

- arrowheads of stone, bone, horn, beaver teeth, caribou antler, wood
- triple headed bone points and blunt wooden arrow tips for small game
- bow points; larger and wider than arrow points, attached as bayonets to the end of bows
- spears; larger and narrower than bow points
- dagger; large blade (8-10 inches) with short handle
- war club; resembles nipple-top maul
- beaver harpoons; unilaterally barbed fixed and toggling points of bone or antler

- beaver nets
- snares, traps, and pitfalls

Fishing Tools

- salmon leister; 60 cm head on 15' shaft
- salmon traps and weirs
- nets, leisters, and traps for small fish
- bone fish lures resembling small fish
- fishhooks with barb of loon's wingbone or immature beaver rib mounted on wooden base
- fish gorges
- net sinkers of natural stones

Butchering and Processing Tools

- skinning knives of basalt with rounded cutting edge, 5-7 cm., hafted
- concave fat scrapers of socket end of caribou scapula
- hair scraper of caribou tibia
- awl of caribou or bear fibula
- scraper of serrated bone or horn
- stone hide scrapers of flat pebbles trimmed at one end and hafted, 8 x 13 cm.
- salmon knife of quartzite with serrated edge and backing for thumbrest

Construction Tools

- -adzes ground over part of total surface, owned by wealthy heads of families, often traded
- -wedges of wood, horn [antler?] or stone used with wooden mauls or hammerstones
- -carving knives of beaver incisors sharpened on abrasive stone and hafted

Miscellaneous

- -bark peelers and cambium scrapers of caribou antler
- -spoons of wood or mountain sheep horn
- -robes of beaver, lynx, marmot, and rabbit
- -labrets (only among the Babine)
- -ceremonial whistle of bird bone, 16 cm. long
- -bone drinking tube, ornamented and hung around the neck by sinew, 17-18 cm. long
- -gambling sticks - bone cylinders hollowed to hold small pebbles, 7 cm. long

Trade Goods

- -tobacco and pipes, kettles, axes, knives, guns and ammunition, clothing and blankets

While it is clear that during the 19th century the Blackwater drainage was occupied by the Southern Carrier, there are more specific references that place the Nazkhu'tin band at the mouth of the Blackwater River and in the vicinity of Punchaw Lake.

Mackenzie spent one night at a Carrier camp in this area during his overland trek to the coast, although it is not clear exactly where the camp was located . On July 3, 1793, Mackenzie's party reached the mouth of the Blackwater River, and on the advice of their Indian guide proceeded to the camp of the "Nascud Dene" which was on a small lake nearby. The journey to this lake led them from "the entrance of a small rivulet" where they left their canoe and continued overland along a path beginning with a steep ascent about 1 mile long. After a hike of 6 1/2 hours covering an estimated 12 miles through country "rugged and ridgy and full of wood", they arrived at the camp where Mackenzie observed 3 fires, and the people living poorly at this season. He also mentions seeing several European articles, including a lance from the coast, as well as sea otter furs traded from the coast (Mackenzie 1793: 222-229).

During their travel west the following day, the party passed along 3 small lakes and 3 winter huts, and early the next morning again came in sight of the Blackwater River and a well marked 'road'. According to Morice, Mackenzie's camp of July 3 had been "on a lake called Poencho" (Morice 1906: 48).

Morice recorded a story concerning a feud between the Stuart Lake and Blackwater River Carrier, which he estimates to have taken place around 1780 (1906: 21). According to the story, an influential member of the Nazkhu'tin subtribe died "near the confluence of the Blackwater River with the Fraser, where those aborigines had but recently a village".

In 1974, Fladmark interviewed an elderly member of the Nazko band, who recalled camping on the Punchaw Lake site around 1900 for spring fishing in the creek (Fladmark 1974: 2).

It seems that, at least as early as 1793, the Punchaw Lake vicinity held a well-established sequence of seasonal camps occupied by small groups of Southern Carrier, specifically the Nazkhu'tin band. Ethnographically the site was occupied during springtime, and would also have been a suitable camp for winter lake fishing and trapping.

C. Culture History - Archaeology

Archaeological information from the Nechako Plateau has accumulated rapidly during the past few years, although there is still a lack of data from excavated sites, but interpretive problems plague the analyses. This brief summary will outline the known sites and discuss some trends in interpretation.

The first archaeological research on the Nechako Plateau was undertaken by Borden, who conducted salvage survey and excavations in Tweedsmuir Park and at Chinlac village during the summers of 1950-52. 130 sites were recorded in Tweedsmuir Park, the ethnographic territory of the Cheslatta Carrier (Borden 1952: 34,35). Most of the sites, along lakes and rivers, were hunting, fishing, berry-picking, and cambium gathering locations which Borden interpreted as the remains of late prehistoric Cheslatta camps. In addition, circular housepits, 12-27' in diameter, were found on the shores of several lakes, especially in the eastern part of the park where they usually occured singly or in pairs. Excavation of 1 pit (FiSi:19) on Natalkuz Lake (Fig. 1) revealed 2 components: 1 associated with the house itself, dated 2415 ± 160 B.P., containing crudely flaked rhyolite blades and bifaces and an obsidian microblade core with microblades, and 1 component near the surface consisting of "Carrier" implements (Borden 1952).

Chinlac village (GaSv:1) consisted of 10 rectangular depressions, each about 25' x 40', on a bank of the Stuart River (Borden 1952: 32,33). Excavation of 1 house revealed a structure similar to the summer lodge described by Morice (Fig. 3) with a bed of ash along the floor representing 6 hearths. Of 1500 artifacts, most were chipped stone, with a few bone and antler objects. According to Morice, Chinlac was abandoned in 1745, but on the basis of European trade goods, Borden suggests it was occupied till the end of the 18th century (Borden 1952: 34).

In 1970 Donahue excavated at Ulkatcho Village (FfSk:1), a Carrier settlement on Gatcho Lake (Fig. 1) occupied historically from at least 1793 until 1945 (Donahue 1973: 157). A trash midden, hearths, a flagpole base, pit, and postholes were uncovered, as well as approximately 2300 stone artifacts, a few bone and antler objects, and several hundred fragments of European artifacts (Donahue 1973). Donahue defined a main occupation during the fur trade period, and an earlier prehistoric occupation represented by a microblade core and microblades, a chert biface, a transverse burin, and a projectile point fragment.

Donahue returned to the plateau in 1971 to test the Tezli site (FgSd:1), a cluster of 44 cultural depressions on Kluskus Creek near the outlet of West Kluskus Lake (Fig. 1) (Donahue

1972, 1975). Most of the 12 tested depressions were housepits, each consisting of a bench and floor with a central hearth. One housepit lacked a bench, 1 pit was considered too small to be a house, and 3 raised earthen rings were interpreted as tent rings, apparently without hearths. C-14 dates for house pit occupation range from 3850 ± 140 B.P. to 565 ± 65 B.P., while dates of 335 ± 135 B.P. and 240 ± 155 B.P. indicate a late surface occupation of the depressions. On the basis of continuity in the technology and form of stone tools at Tezli, Donahue proposes an in situ development over almost 4000 years, although continuity after A.D. 1385 is uncertain.

In 1972 Hudson tested a site (FkRr:1) containing 5 circular depressions, each about 6' in diameter, on Nadsilnich Lake (Fig. 1). Excavations in 3 of the pits revealed many fire broken rocks and charcoal, as well as basalt artifacts (Hudson 1972). Hudson interpreted the features as storage and/or cooking pits.

During the summers of 1974-5, four surveys in Carrier territory were organized by the Archaeological Sites Advisory Board of B.C. Three were located on the Skeena drainage, on Babine Lake, the Bulkley River, and Morice Lake, while the fourth survey concentrated on the Blackwater drainage.

In evaluating survey results, it should be kept in mind that site discovery is probably biased in favor of sites containing pits since no log or plank houses, fish drying racks, burial huts, or above ground caches described by ethnographers have survived to the present. Furthermore, there are no tested criteria for determining pit functions, although small pits less than about 3 meters in diameter are commonly identified as cache pits, and larger depressions as house pits.

Mohs recorded a total of 108 sites on the north arms of Babine Lake, including, in his terminology, 9 'isolated finds', 1 burial, 1 signal station, and 97 sites containing pits or depressions. The pit sites consisted of 6 'village' sites, 7 'habitation' sites, and 84 'cache pit' sites (Mohs 1974, 1975). Each village or habitation site consisted of from 3 to 1100 pits of various sizes; the 84 cache pit sites contained an average of 11 pits each, with as many as 98.

Rafferty (1975) reports 22 prehistoric sites on the shores of small lakes and streams at the headwaters of the Bulkley River. Ten of the sites contained only cache pits, with an average of 3 pits per site; 3 sites consisted of single house pits, and 6 sites contained both cache and house-size pits with up to 3 large pits per site. A fish weir, a burial, and a single artifact make up the rest of the sites.

Sites were even more sparse on Morice Lake, where Burley recorded 25 prehistoric sites around the shore (Burley 1975). Twenty-two of these contained only cache pits with about 3-5 pits per site. The remaining 3 sites contained house pits, with a maximum of 3 large pits per site.

In contrast, 149 pit sites were discovered along the shores of rivers and lakes in Southern Carrier territory (Helmer and Wilson 1975). One hundred and nine cache pit sites had an average of 4 pits each, while 12 house pit sites had an average of 2 pits. Twenty-seven sites containing both house and cache pits had up to 14 large pits per site. In addition 136 sites represented by surface artifacts only were recorded.

These survey results are summarized in Tables IV and V. In terms of site size (measured by number of pits per site), Babine Lake ranks first, followed by the Blackwater, then Morice Lake, and finally the Bulkley River. However, in terms of site density (measured by number of sites per linear km of shoreline), the Blackwater area is highest followed by Babine Lake, Morice Lake, and the Bulkley River. These results parallel the ethnographic settlement gradient, with a few very large villages in Babine territory, and many small camps in the territory of the Southern Carrier.

	SURFACE ARTIFACTS ONLY	CACHE PITS ONLY	HOUSE PITS ONLY	CACHE AND HOUSE PITS	OTHER SITES	TOTAL SITES RECORDED

BABINE LAKE	?	sites = 84
		# pits/site = 1 - 98
		X = 11
			?	sites = 13
				# pits/site = 3 - 1100
					sites = 2	sites = 108

BULKLEY RIVER	sites = 1	sites = 10
		# pits/site = 1 - 12
		X = 3
			sites = 2
			# pits/site = 1
				sites = 6
				# pits/site = 3 - 22
				#housepits/site= 3
					sites = 2	sites = 22

MORICE LAKE	sites = 0	sites = 22
		# pits/site = 1 - 18
		X = 3-5
			sites = 2
			# pits/site = 1 - 3
			X = 2
				sites = 1
				# pits/site = 18
				#housepits/site= 2
					sites = 0	sites = 25

BLACKWATER RIVER	sites = 136	sites = 110
		# pits/site = 1 - 26
		X = 4
			sites = 12
			# pits/site = 1 - 4
			X = 2
				sites = 27
				# pits/site = 2 - 48
				#housepits/site= 14
					sites = 0	sites =285

Table IV. Archaeological survey results - site size.

	Total Sites	Approximate Area Surveyed (km)	Average Site Density (sites/km)
Babine Lake	108	160	.68
Bulkley River	22	200	.11
Morice River	25	100	.25
Blackwater River	285	280	1.02

Table V. Archaeological survey results - site density.

During the summer of 1973, Fladmark conducted the Simon Fraser University archaeological field school at the Punchaw Lake site (FiRs:1)(Fig. 1). One of the first field precedures was detailed mapping of all of the cultural features on the site (Fig. 5) including 43 house platforms, 57 storage pits, and part of a native trail (Fladmark 1974: 4). House platforms were defined as flat to slightly dished oblong areas about 8 X 6 m, lacking lips or rims, while circular depressions less than 2 m. wide were considered storage pits (Fladmark 1974). On the basis of their spatial proximity Fladmark recognized 2 major clusters of house platforms, and this division was supported by plots of tree density and age which show 2 areas of maximum arboreal succession (Fladmark 1974: 8,9).

Excavation focused on house platform #1 in Excavation Area 'A', the largest platform at the site, situated in the southern cluster (Fig. 5). In addition, the remainder of a platform disturbed by a bulldozer cut (#2) was salvaged and test pits were placed in house platforms #34, 36, and 43 and in storage pit #50.

House platform #1 contained a central hearth area consisting of fire broken rock, ash, and calcined bone fragments, surrounded by a subrectangular pattern of post holes outlining the periphery of the structure. These features

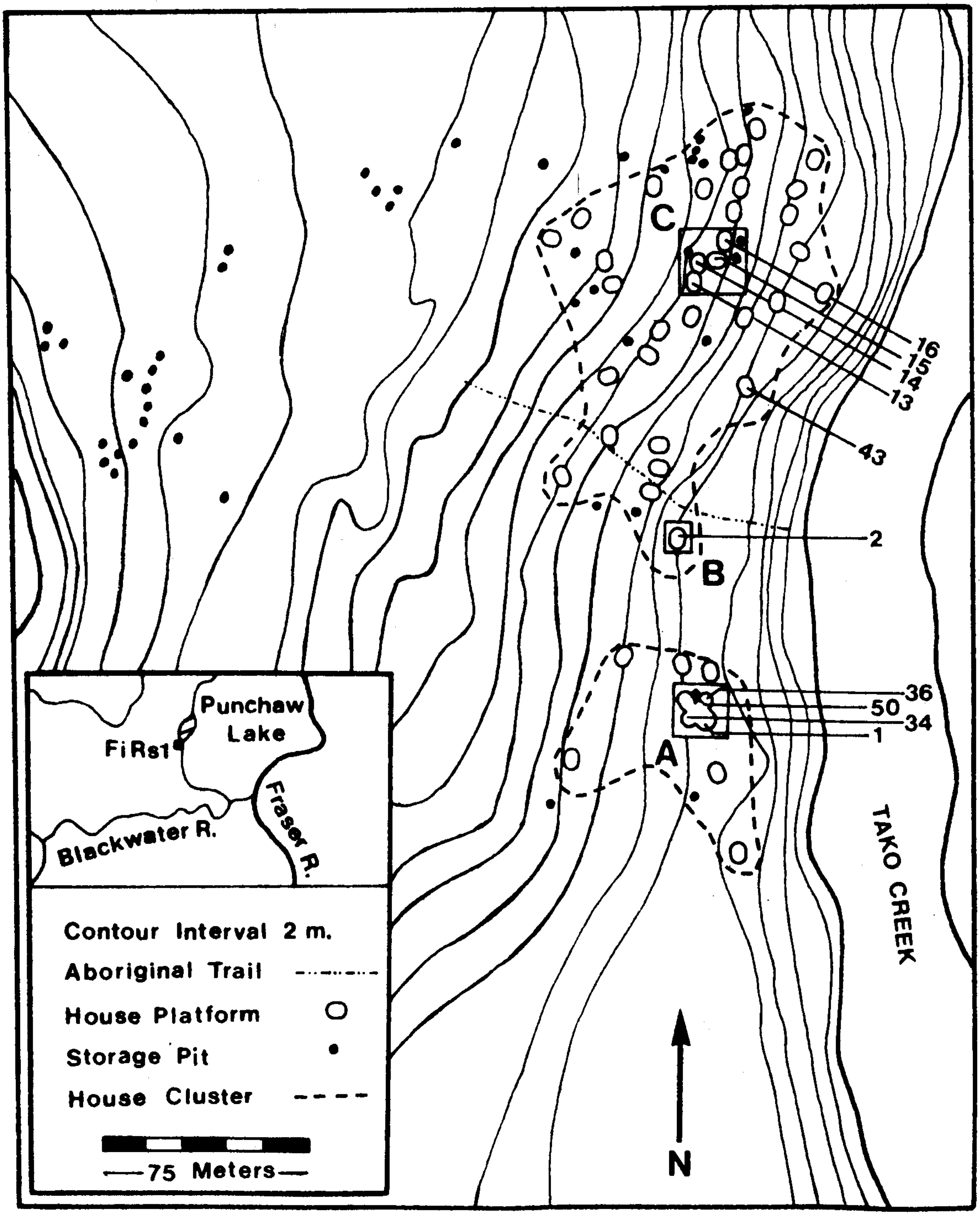


Fig. 5. Surface features of the Punchaw Lake Site (FiRs:1).

indicate successive occupations within the original platform area (Fladmark 1974: 12,13). A burial from beneath the central hearth was C-14 dated to 3980±100 B.P. and fragmentary remains of another individual were located in the lower part of the same hearth. Carbon from the upper zone of the house produced a date of 560±75 B.P., while wood from a storage pit just outside the house was dated 290±70 B.P.

A C-14 date of 250±70 B.P. was received for material just below the surface of platform #2, which also contained a burial, and charcoal from platform #43 dated the occupation floor to 240±70 B.P. (Fladmark 1974: 20). Both platforms #2 and #43 are part of the northern house cluster.

Approximately 6200 recorded artifacts include faunal remains and unmodified lithic debitage as well as 'tools' (Fladmark 1974: 15). Only 3 European artifacts were recovered.

Fig. 6 illustrates relative chronologies for 5 of the sites described above. A possible earlier occupation is indicated by Alberta and Scottsbluff/Eden-like points in surface collections from the Fraser Lake and Stuart Lake areas (Donahue 1975: 49). However, in terms of excavated components, the dates 3850 ± 140 B.P. and 3980 ± 100 B.P. from Tezli and Punchaw Lake reflect the earliest occupancy of the largest habitation sites discovered

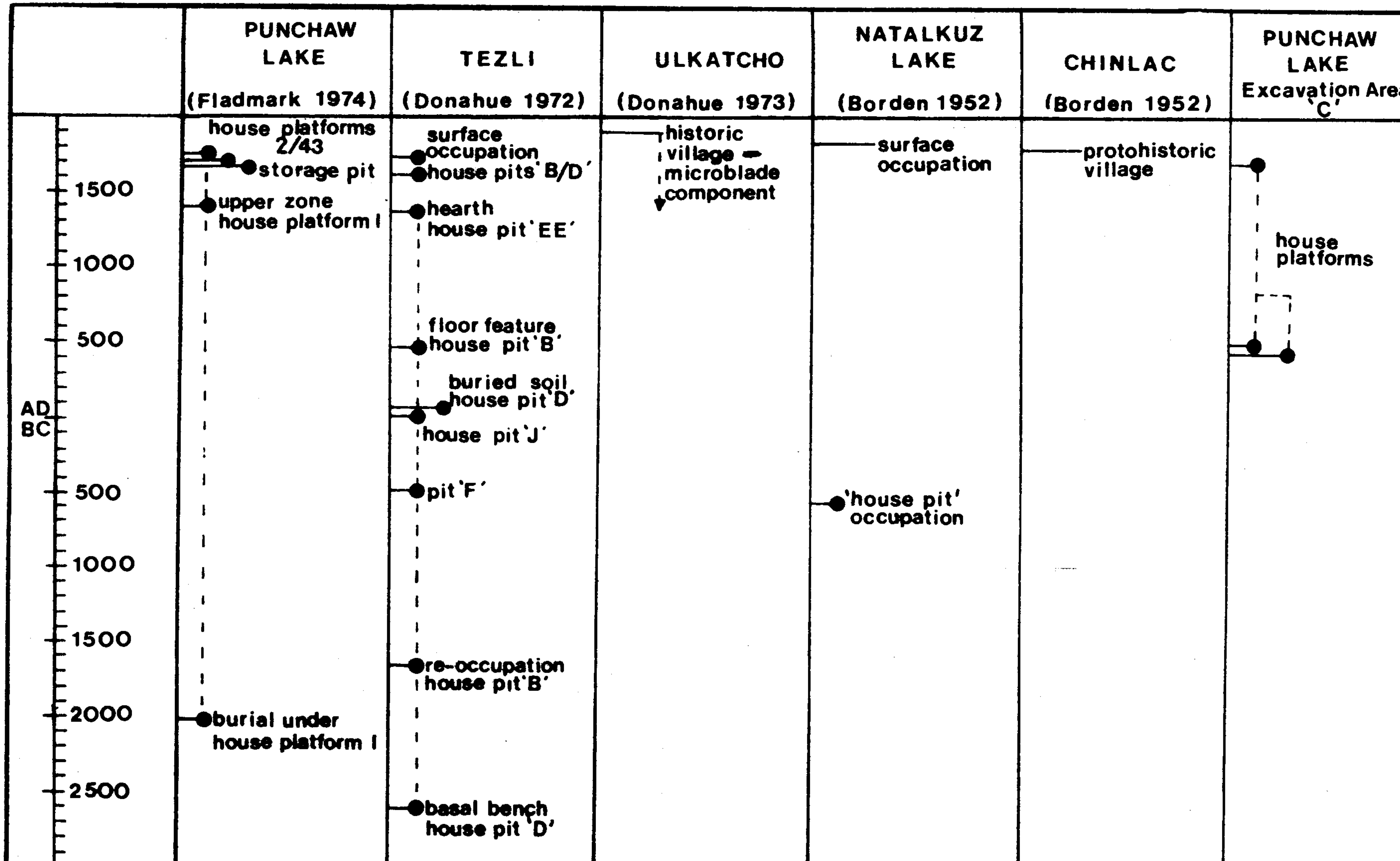


Fig. 6. Comparative site chronologies.

so far in the region. At this early date the Tezli site occupants constructed a pit house while the inhabitants of Punchaw Lake placed a burial beneath the hearth of a surface dwelling. This may only be a functional difference, reflecting use of the sites during different seasons, or may represent differences in cultural tradition.

The Tezli house pits were re-occupied occasionally until about 600 years ago, while the upper zone of the multi-component house platform at Punchaw Lake is about 560 years old. Approximately contemporaneous with these sequences of occupation was the construction of a pit house on Natalkuz Lake at 546 B.C.

C-14 dates on several features at Punchaw Lake suggest a major occupation of the site around A.D. 1700 (Fladmark 1974: 21). Similarly, dated surface occupations indicate activity at the Tezli site around the same time. Considering that ethnographic reports place the Carrier at the Chinlac and Ulkatcho sites and in the vicinity of Punchaw Lake as early as 1793, it is safe to assume continuity between the late prehistoric occupations and the historic period.

Culture historical interpretations in the central interior have been based primarily on 3 archaeological features: 1) house styles, 2) the presence or absence of a microblade industry, and 3) projectile point styles. Borden observed a striking difference between the 546 B.C. 'pit house' component containing microblades and large rhyolite tools at Natalkuz Lake and the subsequent 'Carrier' surface occupation there and at Chinlac, and concluded that the early component was left by a group later displaced by invading Athapaskans (Borden 1952: 39). In fact, in terms of artifacts the Natalkuz Lake house pit is anomalous among all assemblages from the region. Borden later revised his interpretation to suggest that Athapaskans brought microblades to the plateau during the terminal Pleistocene (Borden 1969).

Donahue prefers to emphasize 'cultural stability' at the Tezli site, represented in broad terms by pit house construction and a riverine orientation, although this would not preclude a gradual assimilation of invading Athapaskans (Donahue 1975: 55). He sees strong parallels in projectile point sequences, pithouse dwellings, and subsistence patterns between the central and southern plateaus and the Columbia plateau, while a distinctly different cultural pattern developed in northern British Columbia (Donahue 1975: 53-54).

Helmer proposes exactly the opposite affiliations (1976: 33-34). He believes that the southern interior sequence as defined at Lochnore-Nesikep shows little similarity to the central interior, while there are strong correlations between projectile points from the central interior and sites in northern B.C. and the Yukon (specifically the Callison site and the Taye Lake phase).

Neither house structures nor microblades are very reliable indicators of cultural relationships in this area. In the earliest dated components both house pits and surface dwellings are represented, and both types of structures are reported ethnographically, although there is some debate concerning their significance. Over 63 'housepits' had been recorded in surveys by 1975, representing about 15% of the total number of archaeological sites in the area.

Microblades and cores were found in the early component at Natalkuz Lake, at Tezli, and at Ulkatcho, although Donahue considers them an early manifestation intrusive in the sites. A few microblades, but no cores, were also found at Punchaw Lake, and they have also been reported in late contexts on the nearby Chilcotin Plateau (Wilmeth 1971: 2). While the association of a microlithic industry with late components may be tenuous, the point to be made is that microblades are neither common nor plentiful at any of the sites. Although Donahue (1975: 36) concludes that microblades were not in use after 2400 B.C., his initial hypothesis that microblades played an insignificant role after 2400 B.C. seems more applicable. The excavated sites in the central plateau so far offer no evidence for evaluating theories of the origin or spread of microblade technology. The most profitable direction for culture historical research may be detailed comparison of whole artifact assemblages, including projectile points.

To summarize, the earliest occupations in the central interior may be represented by a few surface collected Plano-like points. Dated prehistoric components span the period 2404 B.C. to A.D. 1710, and at 1 site at least, there is no evidence for abrupt population replacement during this period.

Projectile points, as illustrated in the literature and as described by Donahue (1975: 54) and Helmer (1976: 32) show a general progression from lanceolate, large stemmed, and large unbarbed corner notched shapes, to barbed corner notched and large side notched points, to the very small side notched and small stemmed arrow points of the historic period. Although it is difficult to judge from illustrations, large side notched points may appear at Tezli by 1875 B.P., while small side notched points do not occur until after 1462 B.P.

Cultural continuity, representing Carrier occupation , is inferred from about A.D. 1700 to the historic period, and is represented by components from at least 4 sites.

Part II. The Analysis: Excavation Area 'C' at the Punchaw Lake Site

The second part of this thesis presents the results of 1 season of archaeological field work at the Punchaw Lake site. Chapter 3 contains a description of the archaeological deposit beginning with the soil matrix, and focuses on a summary of the lithic artifacts, including 4 categories of attributes: 1) raw material, 2) technology, 3) form, and 4) function. Chapter 4 considers the nature of the site occupation in terms of site activities and temporal change. Chapter 5 compares this occupation to other sites to place it in regional perspective. Chapter 6 summarizes the project results.

Chapter 3. The Archaeological Deposit

This chapter describes the archaeological deposit. The first part outlines soil stratification, cultural features, and non-lithic artifacts such as faunal remains. The second part describes lithic artifacts recovered from Excavation Area C.

The original purpose of our work at Punchaw Lake was to investigate the larger cluster of house platforms located at the northern end of the site (Fig. 5). We wanted to test whether the 2 main clusters represented some kind of temporal or functional dichotomy in the site occupation, and we felt that only total excavation of several platforms would provide adequate comparative data (Wilson and Helmer 1974: 4). We chose 4 closely associated platforms from the center of the large cluster (originally labelled platforms #13,14,15, and 16) and we designated this section of the site Excavation Area 'C'. This report deals only with materials recovered from this area of the site.

An initial surface contour map of Excavation Area 'C' revealed that there were actually only 2 flat 'benches' of irregular outline following the curve of the hillside (Fig. 7). Subsequent excavation also failed to provide evidence of 4 distinct platforms, and this interpretation

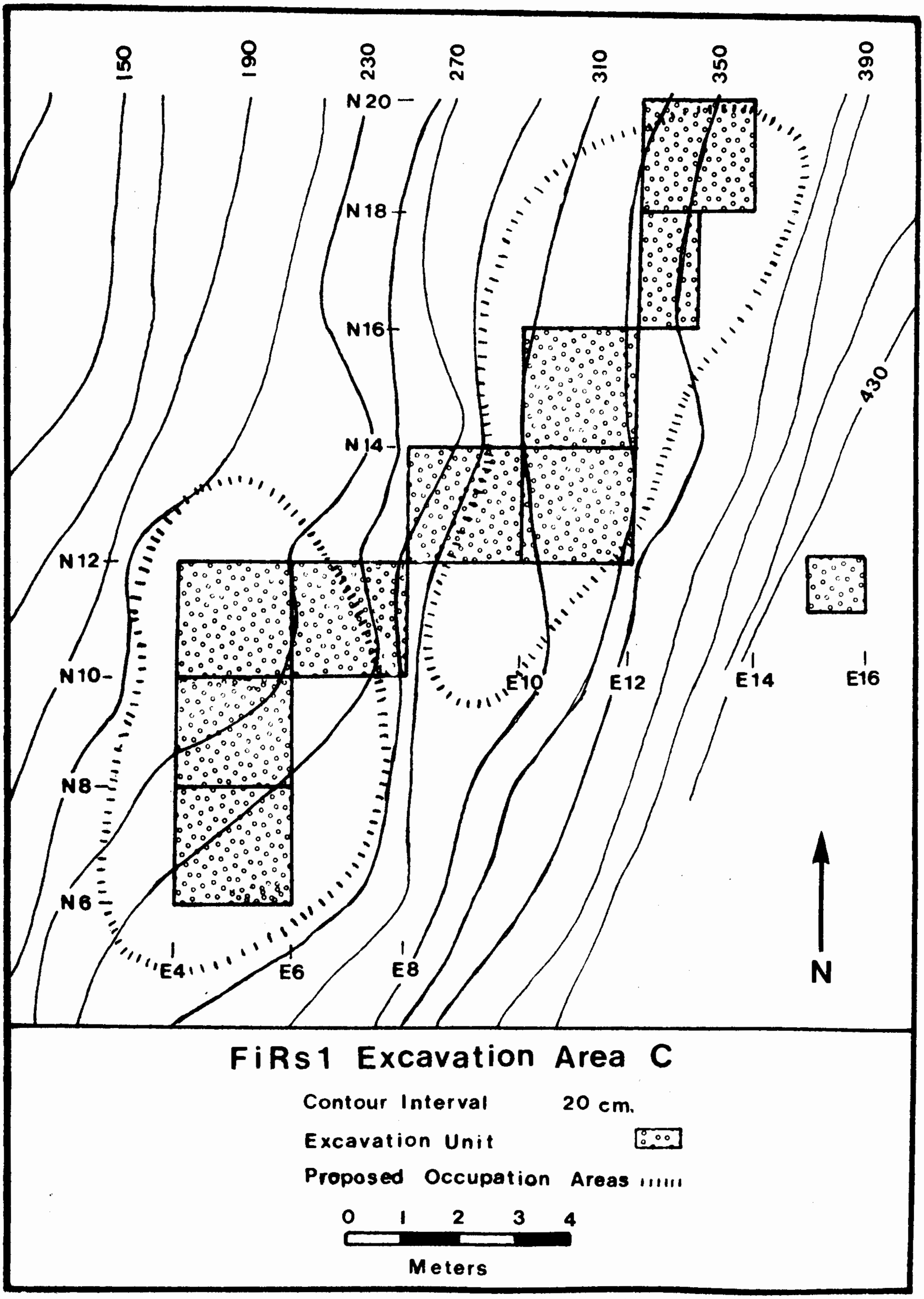


Fig. 7. Excavation Area C - surface features.

was eventually dropped in favor of 2 possible occupation areas, described below.

Two x 2 m excavation units were gridded over Excavation Area 'C' with the intention of completely excavating the platforms (Plate 1B). Unfortunately we were forced to modify this plan, and completed excavation units are shown in Fig. 7. All cultural deposits were excavated by trowel and screened through 1/4" mesh (Plate 2A). All identifiable faunal materials, stone tools and lithic debitage, except unmodified flakes smaller than about 2 cm, were recorded individually on coded forms. Small, unmodified flakes, much of the faunal material, and fire-broken rocks were recorded per 10 cm level of each pit and mapped on level drawings.

A. Matrix

Physical Stratigraphy

Soils in the vicinity of Punchaw Lake are of the Chilako Stony Soil series developed on glacial till under coniferous forest, and exhibit a Grey Wooded profile development. The Grey Wooded group is associated with lakes, streams, muskeg, and heavy forest cover and forms one of the dominant groups of the Interior Plateau (Farsted and Laird 1954: 23,50). The Chilako Stony series profile is characterized by "a light grey A , a hard nuciform structured B, and a grey indurated subsoil" (Farsted and Laird 1954).

The Excavation Area 'C' deposit represents a Chilako series profile modified by human activities on the site. It consists of 3 clearly distinguishable horizons (Fig. 8, Plate 2B). On the surface is a thin layer of humus, 5 cm or less deep, holding a dense mat of plant roots. Under the humus is a dark organic deposit produced by cultural activities. It ranges from dark reddish brown to reddish brown in color (Munsell 2.5YR 2/4 to 2.5YR 4/4). All of the artifacts came from this zone, which varies in thickness from 20-40 cm. The dark 'greasy' cultural matrix has assumed the role of the A horizon, and materials leaching from it have stained the adjacent B horizon, which is compact, blocky, and light colored. The enriched zone is generally yellowish red (Munsell 5YR 4/8), while the light soil is pinkish white (Munsell 5YR 8/2). The strong contrast between the dark cultural matrix and the light culturally sterile sub-soil, which was tested to a depth of 80 cm below surface, provided a clear marker for the vertical limits of excavation.

Test pits in 3 possible house platforms outside Excavation Area 'C' (Fig. 8) exhibit a relatively thin cultural matrix between the surface humus and the culturally sterile gravelly sub-soil. If depth of cultural matrix is an indication of the duration or frequency of human occupation, it would seem that house platforms in Excavation Area 'C' were occupied more often or for a longer period than some adjacent platforms.

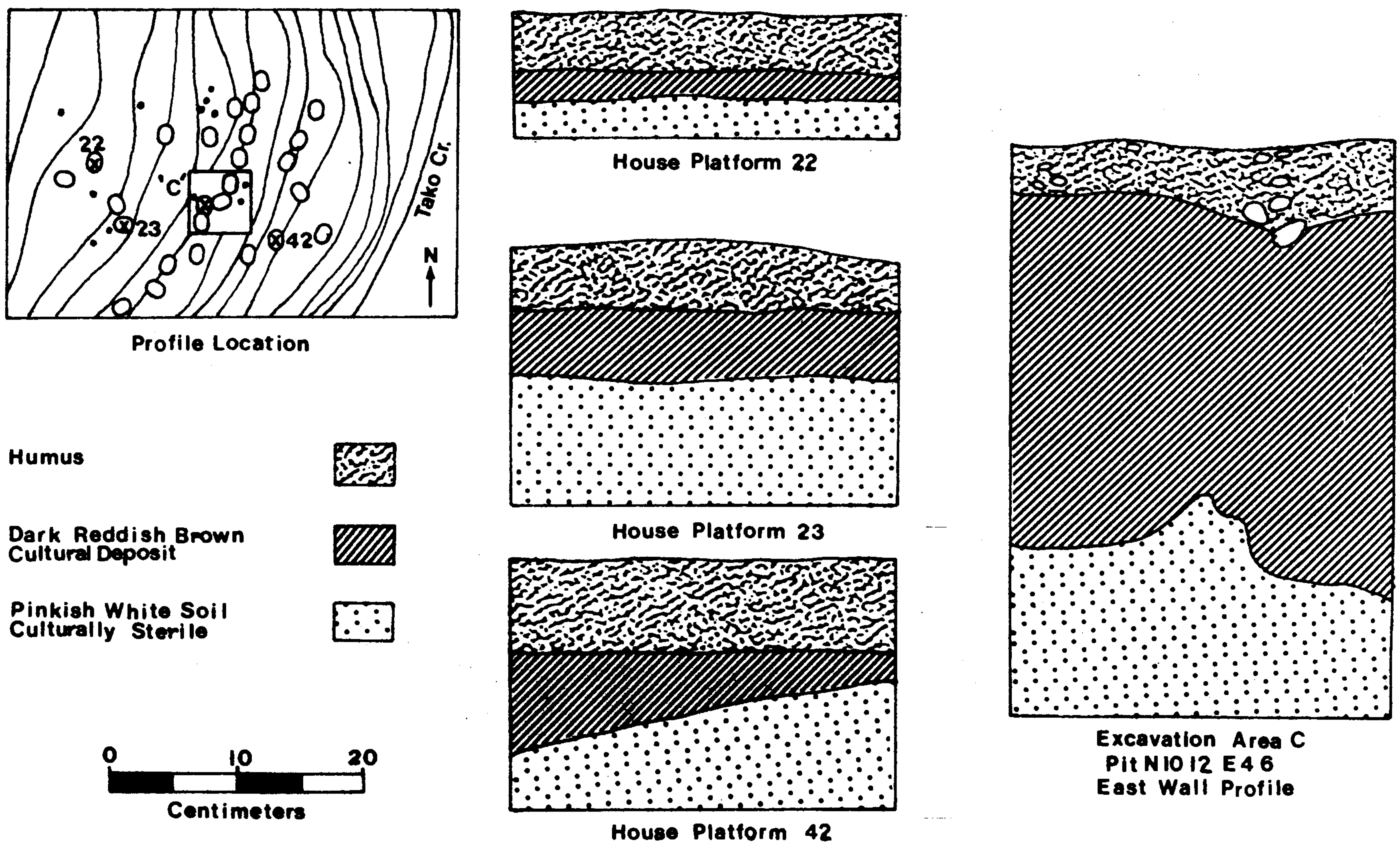


Fig. 8. Comparative profiles.

Cultural Stratigraphy

Cultural deposits in Excavation Area 'C' show no obvious vertical separation into occupation units. However, we can assume that the thick cultural matrix, containing a high density of artifacts, is not the product of a single winter or spring occupation by 1 family. Natural deposition in this environment is slow, and even successive annual occupations would probably not leave distinctly stratified components. Since ethnographic accounts describe Carrier bands, and indeed most groups in the interior, as mobile settlement units, it seems most likely that the Excavation Area 'C' deposits represent discontinuous re-occupation over a period of many years.

There is as much difficulty in localizing occupation areas horizontally as there is in separating them vertically. Stratigraphy does not delineate the boundaries of house platforms, and structural features are conspicuously absent. Only a few postholes were encountered and extensive root disturbance in the top 10-15 cm of the cultural matrix casts doubt on even these identifications. This negative evidence indicates that the structures built in this area did not require deep pits or massive structural elements. Fladmark (1974:13) has suggested that "light self-supporting A-frame structures, bark or skin covered" such as those described ethnographically by Morice (1893), may have been constructed in Excavation Area 'A'. If the absence of structural features in Excavation Area 'C' is not a sampling problem, it would suggest the use of an even less permanent type of structure, such as skin tents or lean-tos.

In the absence of structural features, depth of cultural matrix may indicate areas most frequently chosen for occupation. Although the evidence is not strong, there are at least 2 areas of relatively deep deposit, 1 centering on the southwest half of the excavated area, and 1 in the northeast. This division is supported by the surface contour map, where the 2 elongated 'benches' correspond to proposed occupation areas (Fig. 7). There also appear to be several disruptions in stratigraphic profiles in the suggested boundary area. The nature of the house platform deposit may best be illustrated with profile drawings which crosscut the Excavation Area from north to south and east to west (Figs. 9 and 10).

Cultural Features

Seven cultural features, consisting of various configurations of fire-broken rock, bone, and pits or depressions, were identified in Excavation Area C. After a brief discussion of their constituent elements, each feature will be described individually.

Fig. 9. North - South stratigraphic profile of Excavation Area C.

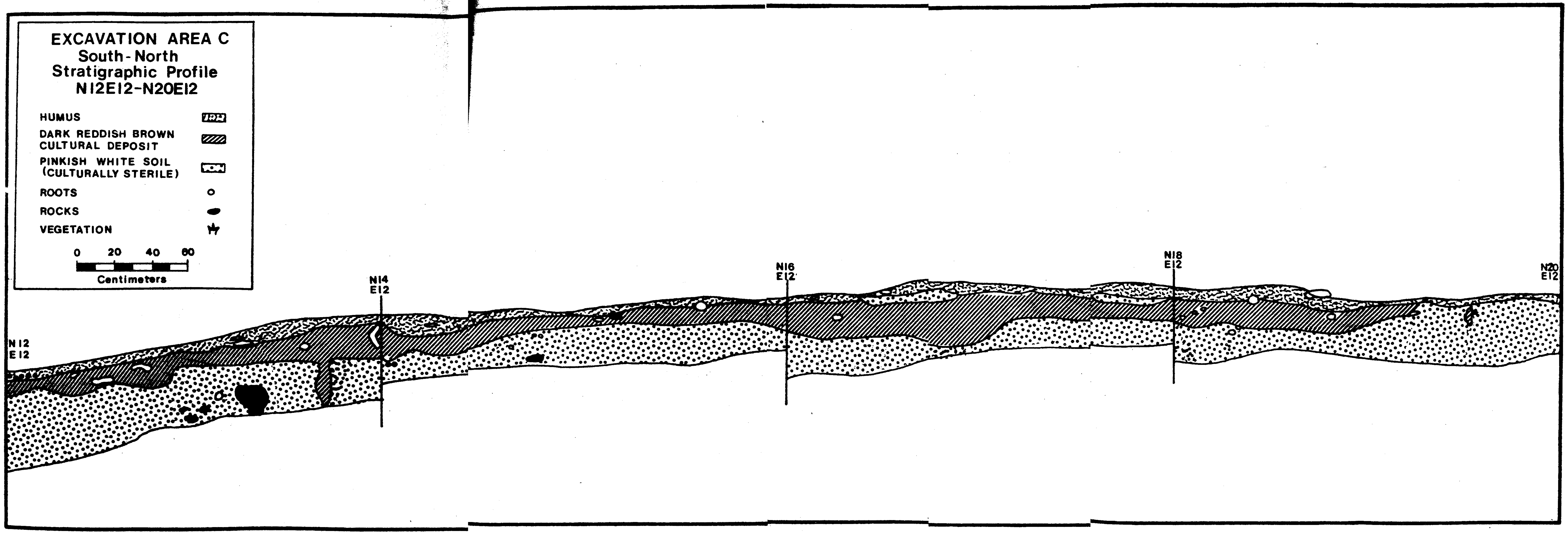

EXCAVATION AREA C
South-North
Stratigraphic Profile
N12E12-N20E12
HUMUS
DARK REDDISH BROWN CULTURAL DEPOSIT
PINKISH WHITE SOIL (CULTURALLY STERILE)
ROOTS
ROCKS
VEGETATION
0 20 40 60
Centimeters
N12 E12
N14 E12
N16 E12
N18 E12
N20 E12

Fig. 10. East - West stratigraphic profile off Excavation Area C.

A considerable amount of fire-broken rock was found in all excavated pits. Density, plotted in 50 x 50 cm horizontal units, ranges from 0 to 44 fragments per unit, with an average of 11. The coarse granitic cobbles are probably from nearby Tako Creek. Many fragments from the site are blackened and show scars of thermal fracture, suggesting they were used directly in fires. It is also possible that some were used as boiling stones, then discarded within the house structures.

There are 4 clusters of fire-broken rock, where density exceeds 19 fragments in each of several adjacent 50 x 50 cm units. Each cluster represents a cultural feature. However, fire-broken rock is not limited to the areas of concentration; fragments are scattered in an apparently random manner through the rest of the excavated area. Considering the overall quantity of fire-broken rock fragments, it seems likely that many fire and food processing areas once existed which later became scattered.

Faunal remains were also recovered from all excavation units. Approximate densities range from 0 to 117 fragments per 50 x 50 cm unit, with an average density of 10. Much of the bone was in small burned fragments, allowing it to be preserved but making identification almost impossible. Table VI presents a preliminary species list compiled by J. Driver. Plots of the horizontal distribution of faunal material indicate 3 areas

Table VI. Preliminary faunal identification (Driver: pers. comm., 1976).

MAMMALS	
Bear	*Ursus* sp
Deer	*Odocoileus* sp
Larger ungulate	Cervidae
Lynx	*Lynx canadensis*
Mink	*Mustela* sp
Wolf	*Canis lupis*
Dog	*Canis familiaris*
Hare	*Lepus americanus*
Muskrat	*Ondata zibithecus*
Beaver	*Castor canadensis*
BIRDS	
Grebe	*Podiceps* sp
Loon	*Gavia* sp
Duck	Anatidae
Grouse	Tetraonidae
Jay	Corvidae
FISH	
Sucker	*Catostomus* sp
Trout	*Salmo* sp
Chub	Cyprinidae
SHELLFISH	
Bivalve (clam or mussel?)	

of concentration, where density exceeds 19 fragments per 50 x 50 cm unit. Each concentration is related to 1 of the cultural features described below.

Feature 1. (Fig. 11)

Type: concentration of fire-broken rock

Location: Horizontal-N 16.00-16.50, E 12.00-13.00
Vertical-10 to 30 cm below surface (d.b.s.)

Description: about 100 fire-broken rock fragments clustered in a 1 x 1 m area. Their compact distribution suggests either a restricted fire area or a structural boundary.

Feature 2. (Fig. 11; Plate 3A)

Type: concentration of fire-broken rock

Location: Horizontal-N 18.00-20.00, E 12.25-14.00
Vertical-surface to 20 cm d.b.s.

Description: this concentration of fire-broken rock may be envisioned as 2 overlapping clusters; these clusters have slightly different distributions when plotted in 10 cm vertical levels. In the upper level (surface to 10 cm d.b.s.) there are approximately 170 rock fragments in the area N 18.00-19.40, E 12.25-14.00 and their configuration suggests a boundary along the northern edge of the cluster. This may

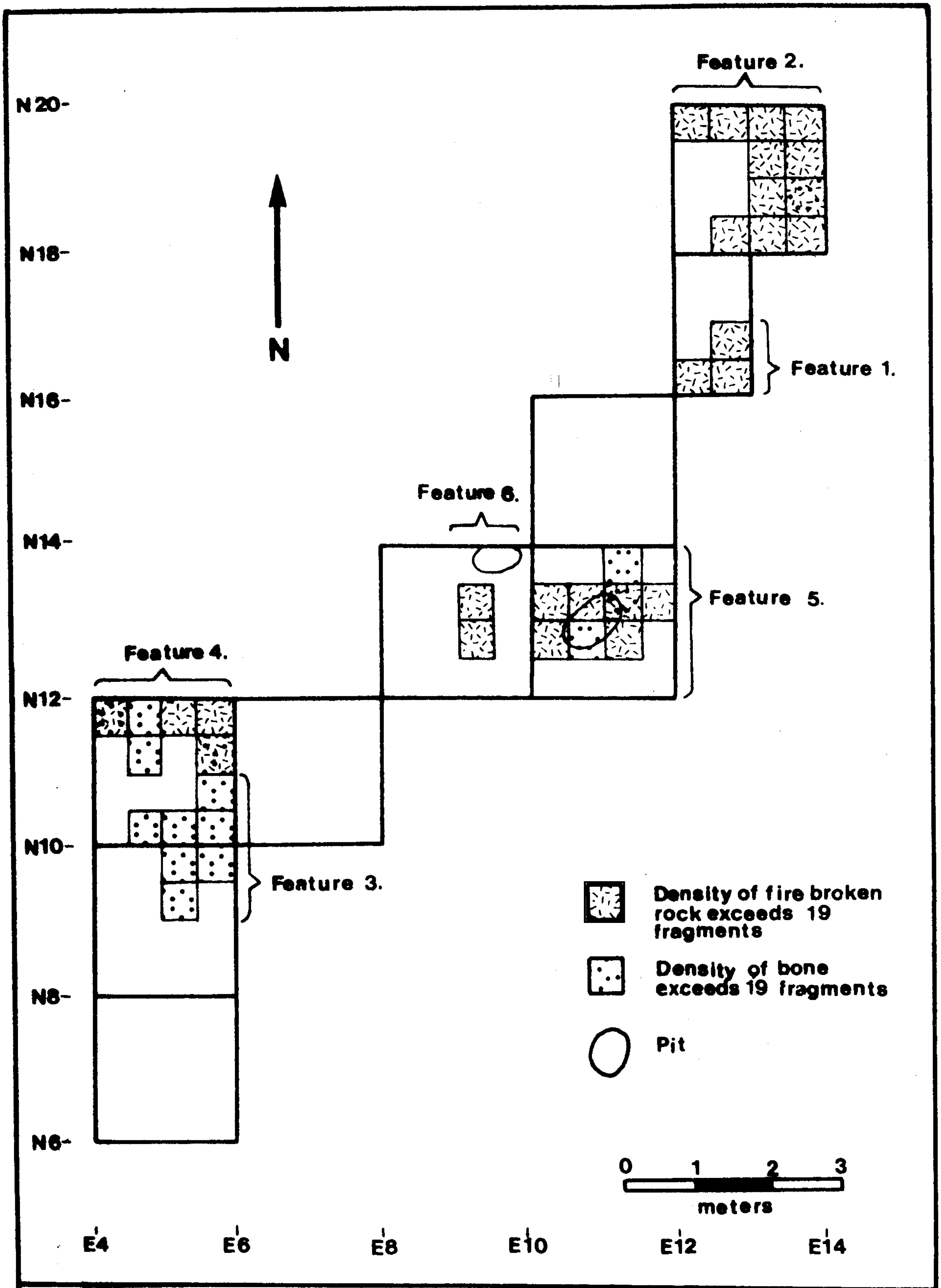


Fig. 11. Location of cultural features.

correspond to a structural feature during a later site occupation. In support of this interpretation, the distribution of faunal material in this pit is also confined to the area south of N 19.25 and corresponds closely to the distribution of fire-broken rock in the upper level. In the lower level (10 to 20 cm d.b.s.) there are about 145 rock fragments clustered within the area N 18.00-20.00, E 12.25-14.00.

Feature 3. (Fig. 11)

Type: concentration of faunal remains

Location: Horizontal-N 9.50-10.50, E 4.25-6.00

Vertical- 10-20 cm d.b.s.

Description: about 150 bone fragments in a cluster not associated with fire-broken rock.

Feature 4. (Fig. 11)

Type: hearth

Location: Horizontal-N 11.50-12.00, E 4.00-6.00

Vertical- surface to 10 cm d.b.s.

Description: the hearth consists of combined concentrations of fire-broken rock and faunal remains in a matrix filled with many small fragments of wood charcoal. About 100 fragments of fire-broken rock cluster compactly along the edge of the excavation unit and extend north into an un-excavated unit. The cluster of about 190 burned bone fragments is more restricted in distribution. The hearth was apparently constructed on a flat ground surface, and is situated within the proposed southern occupation area.

Feature 5. (Fig. 11; Plates 4A and 4B)

Type: hearth

Location: Horizontal-N 12.75-14.00, E 10.00-12.00

Vertical- 10-40 cm d.b.s.

Description: this hearth is the most complex of the cultural features. It consists of overlapping clusters of fire-broken rock and burned bone in and above a circular depression. The pit or depression, which was restricted to the lowest levels of the hearth (20-40 cm d.b.s.), was 80 cm wide and excavated about 20 cm into the floor. The pit contained about 100 large pieces of fire-broken rock mixed with at least 40 bone fragments. Above and slightly to the west of the pit, in the 10-20 cm d.b.s. level, about 170 fire-broken rock fragments and 130 bone fragments were clustered in the area

N 12.50-13.50, E 8.50-10.25. Apparently the earliest use of the hearth was associated with the pit, while later uses were associated with flat ground surfaces.

Feature 6. (Fig. 11; Plate 3B)

Type: pit

Location: Horizontal-N 13.50-14.00, E 9.25-9.80
Vertical- 20-30 cm d.b.s.

Description: A shallow oval depression about 50 cm long and 40 cm wide, but only 10 cm deep. Only a few rock and bone fragments are associated with the pit, and there is no definite evidence of its function.

Feature 7.

Type: possible burial

Location: no specific provenience

Description: fragments of a human mandible, skull, ribs, cervical vertebra, and unidentified limb bones probably represent 1 mature individual (Driver: pers. comm.). The burned and fragmented condition of the bones suggests cremation, however they were not found in a burial context but were scattered and mixed with hearth deposits.

To summarize, the cultural matrix consisted of a dark organic deposit 20-40 cm deep containing large amounts of fire-broken rock and burned bone fragments, as well as lithic artifacts. In the absence of structural features, the ground contours and depth of cultural deposit suggest at least 2 areas of 'habitual' occupation, each associated with a hearth. The high density of artifacts, fire-broken rock, and faunal material, combined with the horizontal shifting and overlap of concentrations, gives the impression of a long series of occupations during which shelters or structures were temporary.

Seven cultural features were identified in the site deposit. These included 2 concentrations of fire-broken rock, 1 concentration of faunal remains, 2 hearths (combined clusters of rock and burned bone fragments), 1 small pit, and a possible cremation.

B. Lithic Artifacts

Approximately 7000 stone artifacts were recovered from Excavation Area 'C'. Their description will be divided into 4 parts, each dealing with a separate category of attributes. The 4 categories, (1) Raw Material, (2)Technology, (3)Form, and (4)Function, relate to sequential decisions made by the tool maker, as outlined in Chapter 1.

It should be noted that a different typology may be constructed using each of the categories of attributes. A raw material typology was created by distinguishing the several kinds of stone recovered from Excavation Area C. A second typology based on technological stages was established by regrouping artifacts according to industry - flaking or grinding. Within each industry, artifacts were subdivided according to their degree of modification. The stone flaking industry at Excavation Area C is graphically summarized in Fig. 12, where arrows represent presumed decisions and actions of the stoneworker.

A third typology, of artifact form, was created for the smaller group of modified formed tools. Since raw material and manufacturing technique limit the finished shape of tools, formed artifacts were divided by industry - flaking or grinding.

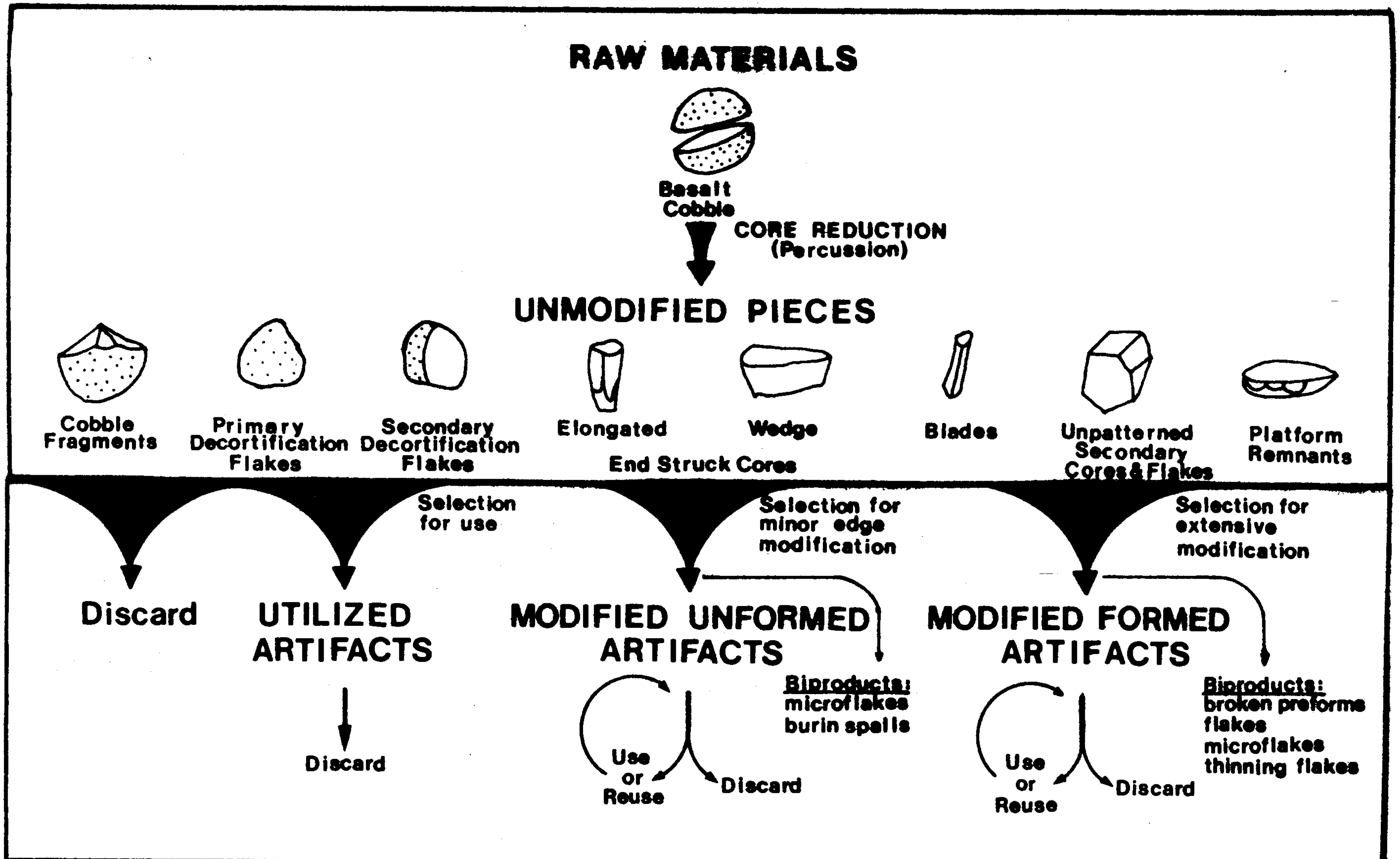


Fig. 12. The Stone Flaking Industry at Excavation Area C.

Flaked stone tools were then subdivided into unifacial and bifacial groups. Using this organization as a basis, the tools were grouped into formal classes using attributes of shape and size. Different stages of manufacture were accomodated for all classes by including separate categories for preforms and broken tool fragments. Finally, a functional typology followed the same outline of formal classes, since it was found that functional attributes are fairly consistent within each formal class.

Raw Material

The first important decision made by the toolmaker was the choice of raw material. This choice was archaeologically examined by identifying raw materials from the site and attempting to trace the source of each type. Eight raw materials are outlined in Table VII. Basalt is by far the predominant raw material, accounting for 91% of the total assemblage; only 6% of the artifacts were chert, 1% obsidian, and remaining types (shale, quartzite, slate and sandstone) altogether make up less than 1% of the assemblage. A few artifacts were unidentifiable because they were burned.

Table VII. Processing of raw materials.

Raw Material	N	Unmodified	Modified Unformed	Modified Formed
Basalt	6374	6059	97	218
Obsidian	77	63	4	10
Chert	440	416	7	17
Shale	17	0	0	17
Quartzite	11	1	0	10
Slate	3	0	0	3
Sandstone	4	0	0	4
Other	45	42	0	3
TOTAL	6971	6581	108	282

A large basalt quarry is located along the Baezaeko River, about 60 km southwest of Punchaw Lake. Basalt cobbles (baseball sized and smaller) are plentiful there, where they have been redeposited by the river, and the quantity of basalt debitage suggests that the locality was used prehistorically as a 'quarry-workshop' (Helmer and Wilson 1975). It is likely that other similar basalt sources exist closer to Punchaw Lake. Chert outcrops can be seen today at the Blackwater River Lower Crossing only 18 km south of Punchaw Lake, although much of the archaeological site there has been obliterated by recent roadwork. Quartzite cobbles are plentiful in river bar deposits along the Blackwater and Fraser Rivers. There are no recorded sources in the region for shale, slate or sandstone.

Although there is no way to determine whether artifacts from the Punchaw Lake site were acquired from these particular quarries, it is possible to reliably link obsidian artifacts with their sources, using X-ray flourescence (Nelson et al 1975). Fifteen obsidian samples from Excavation Area 'C' were compared to samples from known quarries, and attributed to 3 sources, 1 near Anahim Peak and 2 in the Ilgachuz Mountains southwest of Punchaw Lake (Nelson: pers. comm.).

Basalt was clearly the preferred material for tool manufacture at the site. The texture of basalt from the site ranges from very coarse, with many inclusions, to a very fine-grained vitreous material. In general, the quality of basalt selected for use was good, often approaching the smooth 'waxy' consistency of chert. This may be contrasted with an evaluation of Idaho basalt made by a modern stoneworker:

> Basalts are tough and require fast, sharp, very hard blows and, because it is grainy, the worker must make slightly stronger platforms and strike slightly further back from the margin than on the glassier materials...The work is subject to more breakage, and particularly to step fractures... The same remarks apply with even greater truth for pressure flaking with basalt, which is particularly difficult because of the greater amount of force necessary to cause fracture (Bucy 1974: 28).

Another choice facing the stoneworker concerned the use of each type of raw material. Basalt artifacts from Excavation Area 'C' represent the full sequence of tool manufacture, from primary decortication, through core reduction, to formed tools and tool rejuvenation and resharpening. Basalt must have been acquired as cobbles and completely processed at the site.

Although they were used much less frequently, there is some indication that obsidian and some pieces of chert were also fully processed at the site. Table VII outlines the frequency of different processing stages for raw materials. Decortication flakes of both obsidian and chert were recovered, and the proportion of unmodified and modified artifacts of chert is comparable to that of basalt.

However, the proportion of obsidian tools (modified formed) is considerably higher than in basalt. Some of the obsidian tools may have been manufactured off the site or acquired through trade, or perhaps obsidian was utilized more efficiently than basalt. If the latter was true, fewer unmodified fragments (debitage) of obsidian would be expected, and they, as well as obsidian tools, would probably be smaller. Table VIII compares the relative sizes of basalt and obsidian artifacts, indicating that obsidian artifacts are indeed smaller, and the proportion of unmodified fragments, as shown in Table VII, is slightly lower (82% of obsidian artifacts and 95% of basalt artifacts are unmodified). These figures support the conclusion that obsidian was used more efficiently than basalt, perhaps due to its rarity.

In contrast, the use of 2 other raw materials was more limited. Quartzite is found in Excavation Area 'C' only in the form of large cortical spalls and 1 small flake undoubtedly derived from a spall. The lack of manufacturing debris indicates that the spalls were produced away from the site. Considering the size and weight of the required quartzite boulders, it seems likely that the tools were manufactured on the riverbanks where boulders occur naturally.

Table VIII. Relative size of obsidian and basalt artifacts.

UNMODIFIED ARTIFACTS

	Obsidian (N = 63)	Basalt (N = 2323)
Length ($\bar{X}$)	18 mm	22 mm
Width ($\bar{X}$)	15 mm	21 mm
Thickness ($\bar{X}$)	5 mm	5 mm
Weight ($\bar{X}$)	1.9 gr	2.9 gr

FORMED TOOLS (complete)

	Obsidian (N = 2)	Basalt (N = 99)
Length ($\bar{X}$)	44 mm	36 mm
Width ($\bar{X}$)	14 mm	25 mm
Thickness ($\bar{X}$)	4 mm	7 mm
Weight ($\bar{X}$)	2.3 gr	8.1 gr

Similarly, most of the 16 shale flakes found at the site have at least 1 polished surface indicating they are celt fragments. In fact, 6 of the flakes were reassembled into a fragmentary celt after the model of 1 complete specimen from the site. The preponderance of finished tools again suggests that celts were manufactured away from the site, although some resharpening may have taken place there.

Technology

The term technology encompasses all decisions faced by the stoneworker in reducing raw material to a finished form. Information on prehistoric stoneworking techniques comes from 3 sources: 1) ethnographic description, 2) research concerning mechanical principles of stone fracture (Crabtree 1972a,b; Faulkner 1972; Speth 1972; Bonnichson 1974), and 3) the experimental replication of stone tools (Crabtree 1966,1973; Bordes and Crabtree 1969, etc.). However, most current research has focused on flint and obsidian, hence the results may not be directly applicable to a basalt industry. Some problems in defining prehistoric stoneworking techniques will be considered followed by an artifact typology based on technological stages.

Before actually flaking a core, the stoneworker had the option of pre-treating the rock. Ethnographic accounts report that heat treatment of stone prior to tool manufacture was widely practiced in North America (Hester 1972). Experiments in thermal alteration of chert and obsidian indicate that heat treatment improves the workability of silicious stone by removing interstitial water from the crystal structure (Crabtree 1972a: 4; Crabtree and Butler 1964; Purdy 1974: 51). After heat treatment, the rock will fracture more like glass.

Purdy suggests that successfully heat treated chert may be recognized by increased luster of fracture surfaces (in contrast to dull texture of the original surface) accompanied by minor changes in color. However, if the chert is heated or cooled too quickly, surface 'crazing' or explosion may occur (Purdy 1974: 41,44).

The possibility that basalt artifacts were heat treated was tested experimentally. The purpose of the tests was to determine whether heated basalt alters in recognizable and consistent patterns, i.e., whether heated artifacts can be identified. Test conditions and results are outlined in Appendix A. All results indicate that, even when heated to extreme temperatures for extended time periods, or when rapidly heated and cooled, basalt appears unaltered. Surface color and texture remain unchanged, and neither surface 'crazing' nor heat spalls occur. Thus there are no visual criteria useful in recognizing heated basalt artifacts.

The next operation was reduction of the core. Crabtree (1972a: 8-17; 1973) outlines several stoneworking techniques such as anvil, direct percussion, indirect percussion, pressure flaking, etc. However,it is difficult to archaeologically identify various techniques of percussion or pressure, especially when they have been combined to produce a finished tool.

It has been proposed that by examining certain flake characteristics (eg. striking platform size, ventral lip, and compression rings) it is possible to determine whether they were struck with a hard or soft hammer (Crabtree 1972a: 44; Bucy 1974: 3-4). Proposed hard hammer traits are a large striking platform which may be crushed, a pronounced bulb of percussion, strong compression rings, and no lip on the ventral surface, while soft hammer flakes may be identified by a small striking platform that is not crushed, a 'diffuse' bulb of percussion, subdued compression rings, and a ventral lip.

These proposed diagnostic attributes were tested experimentally by comparing a sample of basalt hard hammer flakes to a sample of soft hammer flakes from the same raw material (the results are summarized in Appendix B). It was found that a ventral lip, pronounced compression rings, and 'shearing' of the bulb of percussion occur equally often on hard and soft hammer flakes, while striking platform length and width vary more with the absolute size of the flake than with hammer type. Platform crushing, which occurred on 63% of hard hammer flakes and 43% of soft hammer flakes, is the only variable to show a statistical relationship to hammer type. It should be noted that these tests dealt only with secondary flakes removed from 'blocky' cores. There may be specialized applications, such as biface thinning, for which a soft hammer is more suitable. However, for the purposes of this analysis, it is concluded that soft and hard hammer flakes cannot be easily distinguished.

Similarly, there is confusion concerning the nature of flakes produced by pressure. According to Crabtree (1972a: 14), pressure flaking consists of applying "pressing force", usually with an organic tool, against a prepared or natural platform at the edge of an artifact to detach carefully controlled flakes. Pressure flaking is most commonly used to finish or resharpen edges. Flakes are characteristically small, thin and uniform, with diffuse bulbs of percussion, small platforms, and subdued compression rings (Crabtree 1972a: 16, Bucy 1974: 4). However, 3 of these attributes (diffuse bulb, small platform, and subdued compression rings) are exactly those proposed to distinguish soft hammer from hard hammer flakes. How can the same traits be used to characterize 2 entirely different processes?

As shown above, when flaking raw basalt cores, hammer type may not be easily distinguished by examining resulting flakes. Similar tests were performed to compare samples of pressure and percussion flakes (Appendix C). Results indicate that pressure flakes are indeed small, and slightly more uniform in shape than percussion flakes of equal size. However, compression rings appear equally often on pressure and percussion flakes, and, surprisingly, striking platforms were on the average, longer and wider on pressure than percussion flakes.

There seem to be only 2 tested attributes useful in archaeologically distinguishing pressure and percussion techniques: 1) overall size, and 2) the presence of a sheared or shattered bulb. In our experiments, maximum size for pressure flakes reached only 10 mm long. While Crabtree (1972a: 15) claims that hand-held pressure techniques may produce flakes longer than 2 inches (51 mm), he may have used a different hand position or raw material. Undoubtedly, pressure flakes 50 mm long are exceptionally large. It is tentatively concluded that applying simple hand-held pressure as illustrated in Bordes (1968: 25) to vitreous basalt produces flakes with a maximum length of approximately 10 mm.

Certain technological principles apply to the detachment of all flakes, regardless of the specific technique used. The size and shape of a flake are determined by the morphology of the core face, the force and angle of the detaching blow, and the point of impact on the core (Wilmsen 1968: 985). Thus large and thick flakes are detached using a large striking platform further from the core edge and striking 'into the core', while small thin flakes are produced by using a small striking platform near the core edge and striking 'away from the core'. The success of the latter approach may be improved by micro-flaking or abrading the striking platform which allows the impactor to grip the platform nearer the core edge (Crabtree 1972a: 67,68,84).

Four kinds of striking platform were observed on Excavation Area 'C' artifacts. The platform was either cortical or non-cortical, and both of these were often 'splintered' producing cortical splintered and non-cortical splintered conditions. Splintering refers to the scars of many small step or hinge flakes removed from the platform edge prior to detachment of the large flake (Fig. 13) and may be replicated simply by 'battering' the platform edge with any kind of hammer.

If splintering was an intentional platform preparation, it would probably be found on flakes of a certain shape; in other words, it may have been applied to strengthen the platform in order to produce larger or thinner flakes. This possibility was tested by comparing the dimensions of splintered and non-splintered flakes (Table IX). The nearly identical average dimensions indicate that splintering was probably not an intentional treatment, but simply represents previous unsuccessful attempts to remove flakes.

One possible hammerstone was recovered from Excavation Area 'C'. It is a granite cobble about 8 cm long, 6 cm wide and 2 cm thick, weighing 172 grams. Although apparently unmodified,

Fig. 13. Splintered striking platform.

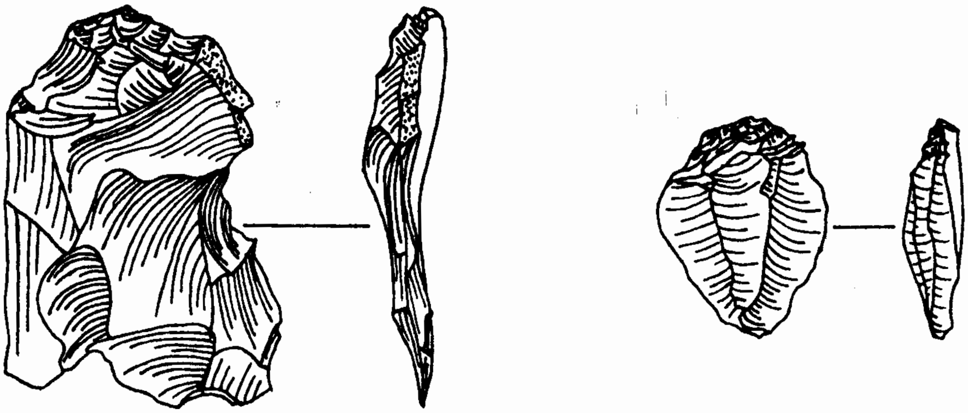


Table IX. Dimensions of splintered and non-splintered flakes.

	Splintered (N = 289)	Non-splintered (N = 1035)
Length ($\bar{X}$)	23 mm	23 mm
Width ($\bar{X}$)	23 mm	22 mm
Thickness ($\bar{X}$)	5 mm	6 mm
Weight ($\bar{X}$)	3.2 gr	3.3 gr

this type of cobble is intrusive in the site and presumably imported for some purpose.

As well as the mechanical process of detaching a flake from a core, technology includes the entire sequence of steps by which raw material is reduced to tool form. Following is an artifact typology based on technological stages:

	N	%
Ground stone	27	.4%
Flaked stone	6944	99.6%
1. Unmodified artifacts	6546	93.9%
split cobble fragments (14)		
decortication flakes (372)		
end-struck cores (129)		
elongated (115)		
wedge-shaped (14)		
unpatterned secondary cores and flakes (6004)		
blades (14)		
platform remnants (13)		
2. Modified unformed artifacts	108	1.5%
3. Modified formed artifacts	251	3.6%
4. Resharpening flakes	35	.5%
biface thinning/resharpening (33)		
uniface resharpening (2)		
5. Reworked tools	4	0%
	6971	

Sheets (1975: 372) defines an industry as "a manufacturing or productive enterprise focusing on a raw material and involving certain common means of processing that material". According to this definition, 2 lithic industries existed at the site: stone grinding and stone flaking. Ground artifacts are modified primarily by heavy grinding and polishing, although they may be given rough form by chipping, while flaked artifacts are modified primarily by percussion, although some have polished surfaces. This division effectively separates raw materials as well, since only certain materials were consistently subjected to grinding and polishing.

GROUND STONE. The ground stone industry represented at Excavation Area 'C' is minimal, consisting of only 27 pieces. Seventeen of these are silty shale, representing 1 complete celt and celt fragments. Each of the shale fragments was roughly shaped by percussion and has at least 1 ground and polished surface. No other artifacts were as extensively ground and polished. One small piece of sandstone was shaped by grinding and polishing, and a small slab of slate was ground to a smooth surface on one face. Several fragments of sandstone representing 1 broken artifact were ground on both faces, but the rough longitudinal striations suggest use-wear rather than manufacturing technique. This piece was probably an abrasive stone. The remaining ground stone artifacts are fragments of slate and a metamorphic rock with polished surfaces.

FLAKED STONE. The majority of artifacts were manufactured by percussion. This industry has been divided into 5 categories based on degree of modification: 1) remnants of core reduction which exhibit no further shaping or edge modification are referred to as unmodified; 2) pieces which show some evidence of edge alteration that is not extensive enough to affect the overall form of the tool are called modified but unformed artifacts; 3) pieces which are flaked extensively to produce a characteristic shape are called modified formed tools; 4) resharpening flakes are derived from formed tools; and 5) a few tools show evidence of having been reworked.

Unmodified Artifacts. N = 6546

Secondarily unmodified artifacts provide the clearest evidence for the processes of core reduction. Unfortunately, it was not possible to re-assemble individual cores since basalt cobbles are very homogeneous and the number of fragments very large. Nevertheless, core fragments give a general indication of the pattern of core reduction.

Fourteen split cobble fragments (Fig. 14, Plate 5A) illustrate the initial stage of manufacture. In this step, the cobble is split or shattered by percussion into large fragments, each with some cortical surface. Raw materials and maximum dimensions of cobble fragments are outlined in Table X.

Fig. 14. Split cobble fragments.

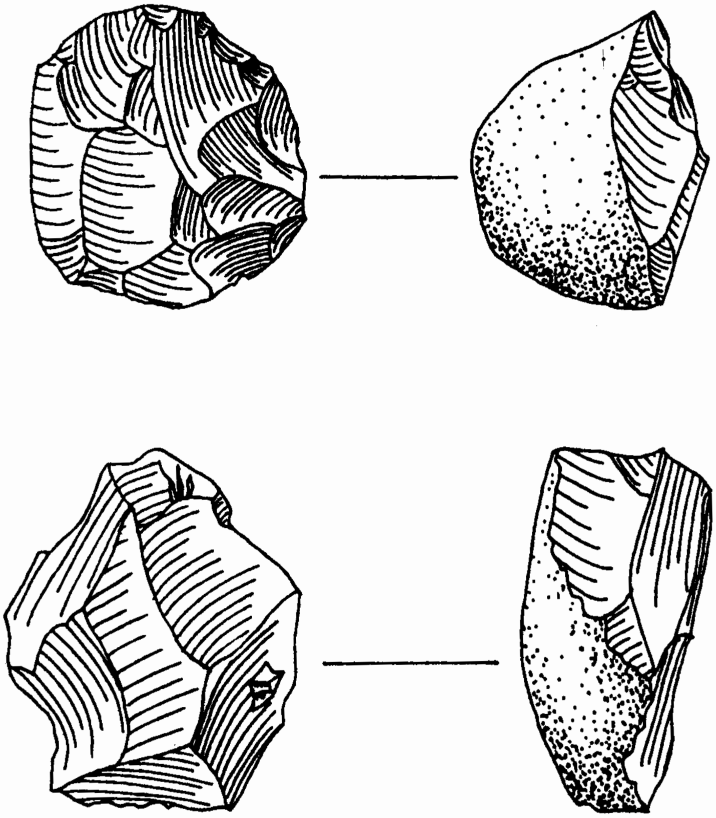


Table X. Dimensions of split cobble fragments.

N	Maximum Dimension X	Range	Raw Materials
14	39 mm	16 - 62 mm	basalt (11) obsidian (2) chert (1)

Further evidence for the initial process of core reduction is offered by decortication flakes (N = 372). Primary decortication flakes are identified by cortex covering most of the dorsal face, while secondary decortication flakes have cortex on only a small area, for example along 1 edge. The relatively large size of decortication flakes (Table XI) is consistent with their removal early in the sequence of core reduction. Frequencies for these artifacts are presented in Table XI. The proportion of decortication flakes to secondary (or non-cortical) flakes and cores is 1 : 15.

End-struck core remnants (N = 129) indicate 1 general pattern of core reduction. Flakes have been struck from 1 or both ends of elongated cores, leaving multiple negative flake scars (Fig. 15; Plate 5B c-f). A special category has also been created for a few shorter cores that taper from a sub-rectangular platform to a wedge shaped base (Fig. 15; Plate 5B a-b). 'Wedge-shaped' cores had flakes removed from both the 'platform' and the 'wedge' ends, making them a variation of end-struck cores. Flake scars on all end-struck cores have a wide range of shapes but are generally small; there is no consistent removal of blades or other specialized flakes. However, most of the remnants recovered from the site are probably exhausted cores, accounting for the small flake scar size. Dimensions and raw materials of end-struck cores are outlined in Table XII.

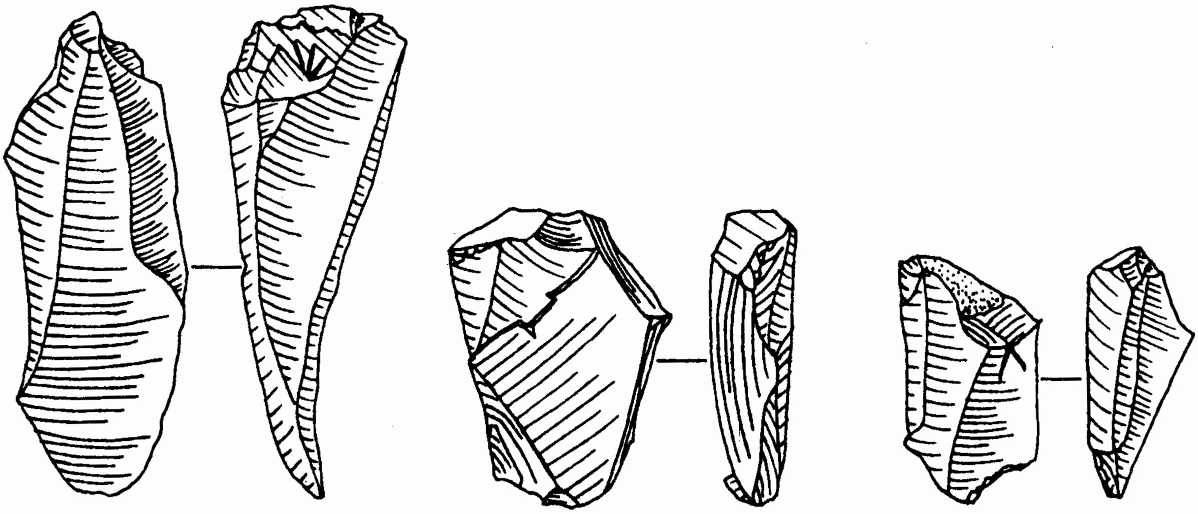
Table XI. Dimensions of decortication flakes (unmodified).

	Primary (N = 105)	Secondary (N = 267)
Length ($\overline{X}$)	29 mm	25 mm
Width ($\overline{X}$)	28 mm	22 mm
Thickness ($\overline{X}$)	8 mm	7 mm
Weight ($\overline{X}$)	9.8 gr	4.3 gr
Raw Material		
Basalt	92	235
Obsidian	4	5
Chert	7	24
Other	2	3

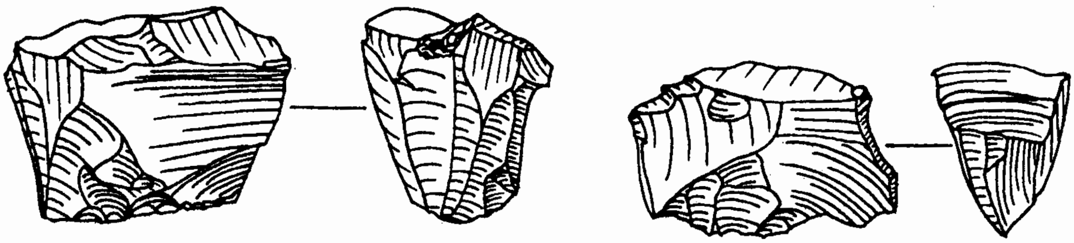
Table XII. Dimensions of end-struck cores.

	Elongated (N = 115)	Wedge (N = 14)
Maximum Dimension		
$\overline{X}$	30 mm	30 mm
Range	11 - 61 mm	23 - 43 mm
Raw Materials		
Basalt	107	13
Obsidian	1	1
Chert	5	0
Other	2	0

Fig. 15. End-struck cores.



elongated



wedge - shaped

The remaining unpatterned cores and fragments are included in a larger undifferentiated category called 'secondary cores and flakes'. The majority of these artifacts are small blocky fragments bearing both negative and positive flake scars so that the taxonomic distinction between flakes and cores did not seem appropriate or useful. All artifacts in this category are secondary products of core reduction, i.e., lacking cortical surface. Raw materials and average dimensions of unpatterned secondary cores and flakes are presented in Table XIII.

Despite the fact that no specialized blade cores were discovered, a few blades and blade-like-flakes have been identified (Fig. 16; Plate 6A d-k), following the definition that blades are flakes at least twice as long as they are wide with even, parallel edges and ridges. The very small sample (N=21), lack of platform grinding or other preparation, and absence of specialized cores suggests that blades may be fortuitous rather than intentional. At any rate, the frequency of blades in Excavation Area C is very low. Of the total 21 blades, 7 show some edge modification that will be described below and 14 are unmodified. Blade dimensions are summarized in Table XIV.

In addition to the secondary products of core reduction already mentioned, 13 platform remnants were observed (Fig.

Table XIII. Dimensions of unpatterned secondary artifacts.

	N	$\bar{X}$	Range	s
Length	2054	21 mm	1 - 97 mm	9
Width	2054	20 mm	3 - 56 mm	8
Thickness	2054	5 mm	1 - 37 mm	4
Weight	2054	2.3 gr	0.1 - 171.9 gr	6

Raw Materials: basalt (1816)
obsidian (28)
chert (180)
other (30)

In addition, 3950 unmodified flakes less than 1 cm in maximum dimension were recorded by level. These consisted of: basalt (3736), chert (190), obsidian (20), and other materials (4).

Fig. 16. Unmodified blades.

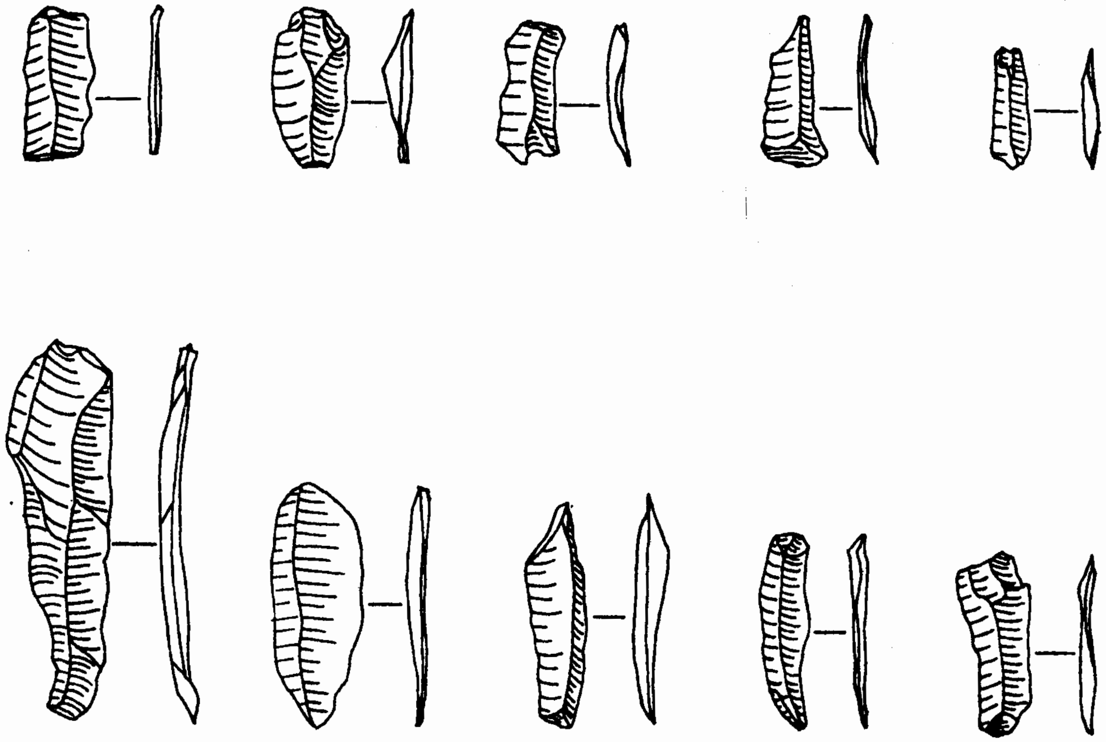


Table XIV. Dimensions of unmodified blades.

	N	X̄	Range	s
Length	12	23 mm	15 - 48 mm	9
Width	12	9 mm	6 - 14 mm	2
Thickness	12	2 mm	1 - 3 mm	1
Weight	12	.4 gr	.1 - 1.6 gr	4

Raw Material: basalt (13), chert (1)

17; Plate 6A a-c). These are flakes removed from a core edge to rejuvenate the striking platform. Each platform remnant carries on its dorsal surface a remnant of the old striking platform edge as shown by multiple negative flake scars. Raw materials and size of platform remnants are outlined in Table XV.

Modified Unformed Artifacts. N = 108

At any point in the progressive reduction of a core, the stoneworker could select a piece for secondary modification. Pieces selected for intentional retouch were larger, on the average, than those left unmodified, as shown in Table XVI which compares average length and weight of unmodified and modified artifacts.

Many unmodified artifacts required minimal secondary alteration to serve as functional tools. As defined above (p. 86), modified unformed tools have some edge modification restricted to a small area of the atifact edge. Resulting tools exhibit limited retouch flaking (flake scars longer than 2 mm) with different modifications sometimes appearing on 2 or 3 different edges of the same tool. However, the limited extent of most edge modification suggests that these tools were expendable, that is, they were more easily replaced than reworked. White (1969: 18-19) has described a similar assemblage, limited to "small, chunky formless tools", from

Fig. 17. Platform remnants.

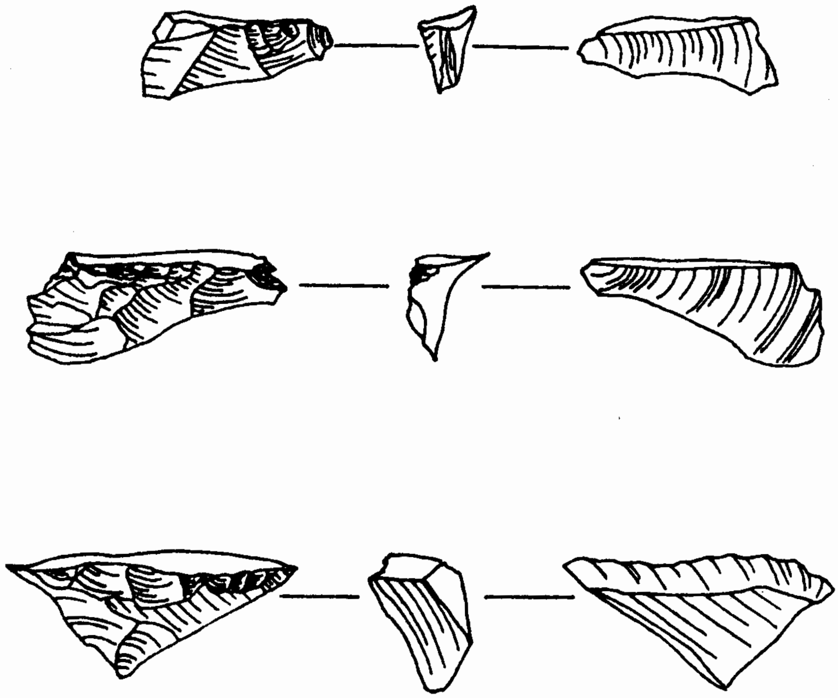


Table XV. Dimensions of platform remnants.

	N	$\overline{X}$	Range	s
Length	13	25 mm	8 - 39 mm	10
Width	13	22 mm	6 - 45 mm	12
Thickness	13	6 mm	3 - 11 mm	2
Weight	13	2.8 gr	.3 - 6.1 gr	2

Raw Material: basalt (11), chert (2)

Table XVI. Artifact size related to modification (basalt only).

ARTIFACT LENGTH

	N	$\bar{X}$	Range	s
Unmodified	2298	21 mm	1 - 86 mm	9
Modified Unformed	97	31 mm	11 - 67 mm	12
Modified Formed	99	36 mm	13 - 145 mm	17

ARTIFACT WEIGHT

	N	$\bar{X}$	Range	s
Unmodified	2298	2.9 gr	.1 - 75.1 gr	5.3
Modified Unformed	97	7.7 gr	.6 - 39.4 gr	7.0
Modified Formed	99	8.0 gr	.3 - 53.1 gr	9.9

Table XVII. Modified unformed artifacts - raw materials and number of modified edges.

		# Modified Edges Per Tool			
	Total # Artifacts	1 edge	2 edge	3 edge	Total # Modified Edges
basalt	97	81	15	1	114
other	11	8	3	0	14
total	108				128

New Guinea, in which "certain features were appropriate to the intended use while the rest of the implement could come in a wide variety of forms".

A total of 108 unformed tools were recorded. For the purposes of analysis, however, each individual modified edge was considered separately; the total number of modified edges is 128. Table XVII outlines raw materials and numbers of modified edges per tool.

Nine different edge shapes were identified on unformed tools. These were: 1) straight, 2) convex, 3) concave, 4) recurved, 5) denticulate, 6) notched, 7) beak, 8) point, and 9) burinated (Fig. 18). The degree of curvature was measured for convex and concave edges by comparing the modified edge to a straight line drawn on a piece of transparent plastic; maximum divergence at right angles to the line was recorded (Fig. 19). Results of this measurement for convex and concave edges are presented in Table XVIII and show that convex edges have a greater curvature than the more homogeneous group of shallow concave edges.

Recurved edges are defined as the combination of concave and convex segments, while denticulates consist of a series of flake scars or small notches producing an irregular, jagged edge. A notched edge has a single flaked notch, while a pointed edge is simply the intersection of 2 modified

Fig. 18. Idealized edge shapes for unformed tools.

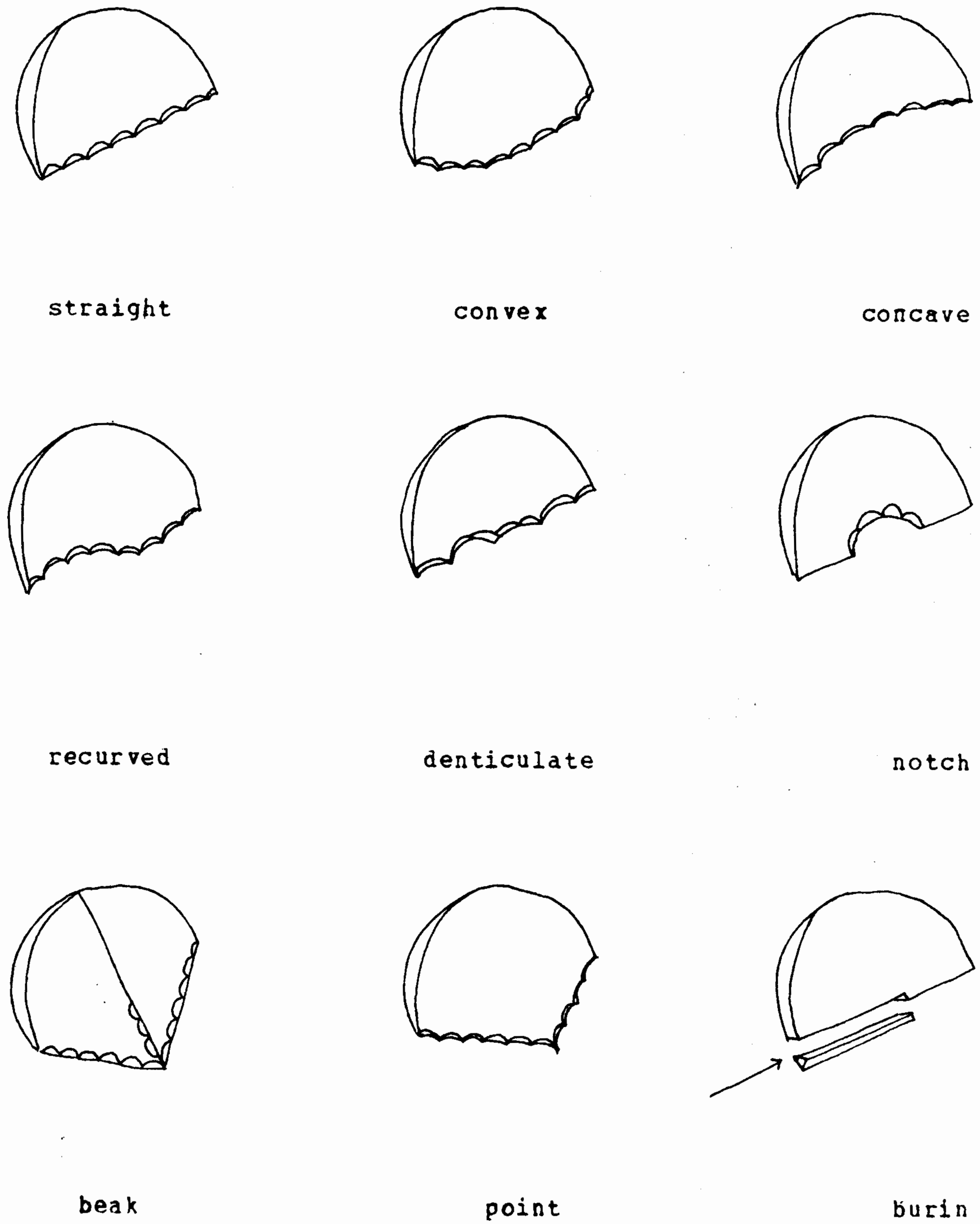


Fig. 19. The measurement of curvature.

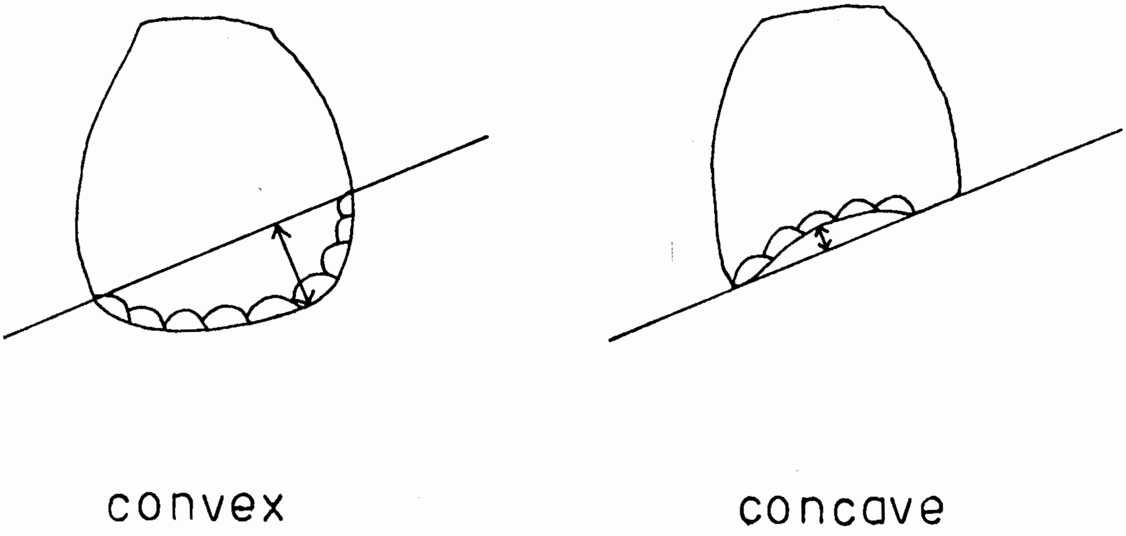


Table XVIII. Curvature of convex and concave edges.

	N	Divergence from straight X	Range	s
convex	48	7 mm	1 - 25 mm	6
concave	11	2 mm	1 - 3 mm	1

edges at an angle less than 180 degrees. Two pointed edges were created by alternate retouch, while 5 have continuous unifacial or bifacial flaking around the point. A burin fracture, caused by a blow parallel to the long axis of the edge, is regarded as a distinct preparation, leaving a functional edge that may or may not be subjected to further shaping. Frequencies for the 9 edge shapes are shown in Table XIX.

Edge modification on unformed tools was accomplished by scalar flaking or step flaking. Scalar flaking refers to a continuous series of simple conchoidal microflakes, while step flaking consists of overlapping microflakes often ending in hinge fracture. Frequencies for edge modification techniques are given in Table XX. Scalar and step flaking occured in almost equal proportions.

The location of retouch was also recorded. Eighty-seven (68%) of the modified edges were unifacial (3 burins are included in this group), 33 (26%) were bifacial, and 8 (6%) were alternately retouched.

Length of modifying flakes, both scalar and step, was measured perpendicular to the tool edge. Since flake scars of varying size are usually found on the same edge, maximum flake scar length was recorded (exceptions

Table XIX. Edge shape frequencies.

Shape	N	%
straight	32	25
convex	48	38
concave	11	9
recurved	11	9
denticulate	11	9
notch	2	2
beak	3	2
point	7	5
burin	3	2

Table XX. Edge modification technique.

Modification	N	%
scalar flaking	65	51
step flaking	63	49

were made where only 1 or 2 extremely large flakes were removed from an edge with otherwise uniform flake scars). Maximum flake length ranged from 3 to 14 mm. On bifacial edges modifying flakes were slightly longer on 1 face, with an average discrepancy between faces of less than 1 mm. On both unifacial and bifacial edges, retouch flakes averaged 5 mm long.

Edge length, or the length of each section of continuous or nearly continuous modification ranged from 5 to 93 mm, with an average length of 29 mm (s = 16). Fig. 20 shows the frequency distribution of edge lengths, illustrating the dominance of short lengths and again emphasizing the minimally modified nature of these tools.

Finally, spine-plane angle was recorded on a polar coordinate grid as demonstrated by Wilmsen (1968: 985). This measurement reflects the strength and thickness of the modified edge (Tringham et al 1974: 179). On unformed tools this angle is not manufactured but consists of the natural flake contour. Spine-plane angles ranged from 10 to 90 degrees, with a mean angle of 38 degrees (s = 22). The distribution of spine-plane angles (Fig. 21) shows a predominance of very narrow angles, from 10 to 20 degrees, and another small peak in the 50 to 60 degree range. Very few tools had angles greater than 60 degrees.

Fig. 20. Length of modified edges on unformed tools.

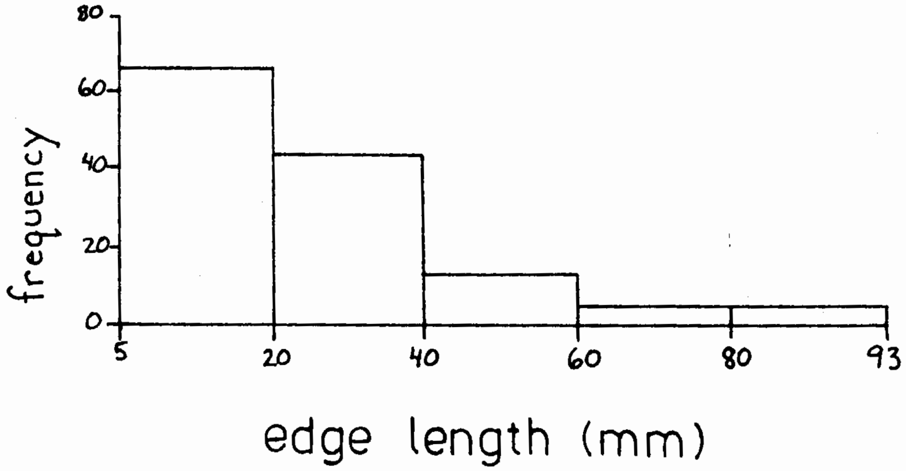
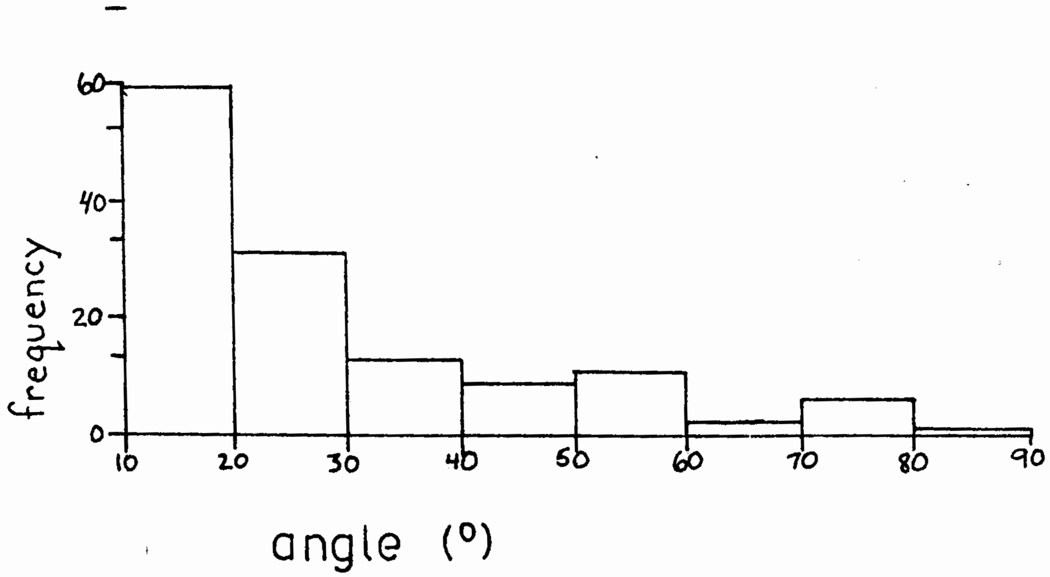


Fig. 21. Spine-plane angle on unformed tools.



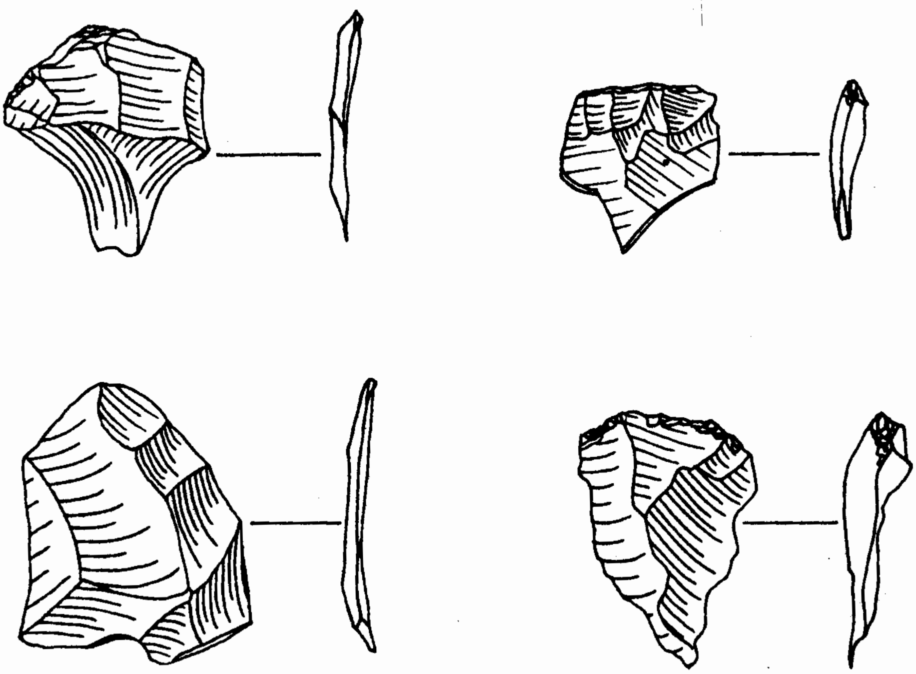
Modified Formed Tools. N = 251

As defined above, modified formed tools are flaked either unifacially or bifacially around the entire edge, giving the tools a characteristic shape. This category includes all traditionally 'diagnostic' tool types such as scrapers and projectile points. As shown in Table XVI, formed tools are considerably larger, on the average, than either unformed tools or unmodified artifacts, although there is considerable size variation within the formed tool category. A detailed classification of formed tools is presented in the following section.

Resharpening Flakes. N = 35

After a period of use, some tools required rejuvenation to sharpen a dulled edge. As suggested by Frison (1968: 49), 2 different kinds of resharpening flakes can be identified: 1) biface thinning/resharpening flakes with a small section of the old bifacial edge remaining on the dorsal face, and 2) uniface resharpening flakes with a remnant of the old working edge and some unifacial retouch on the dorsal surface (Fig. 22). Most of the 33 bifacial flakes may be thinning flakes removed during initial biface manufacture, which are difficult to distinguish from biface re-sharpening flakes. Only 2 uniface resharpening flakes were identified.

Fig. 22. Thinning and resharpening flakes.



biface thinning flakes

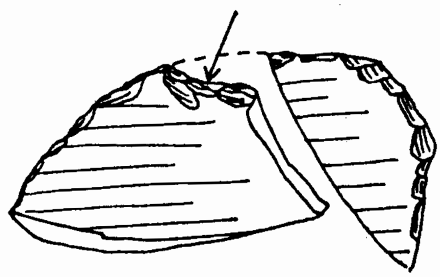
uniface thinning flakes

Reworked Tools. N = 4

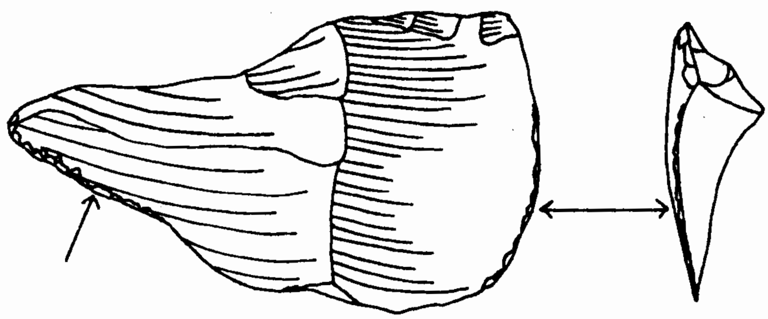
Sometimes formed tools were remodelled after a period of use. In most cases these alterations would go unnoticed, archaeologically, however in a very few cases it is possible to trace the steps that produced multi-purpose tools.

Three basalt artifacts are examples of tools that were originally bifacially flaked, but after breakage were reworked unifacially. This is most clearly illustrated by fragments of a broken biface which was unifacially flaked after breakage (Fig. 23 a). Fig. 23 c illustrates a flake with bifacial retouch around the entire perimeter which was modified by a burin blow - the burin edge was subsequently utilized, producing unifacial modification.

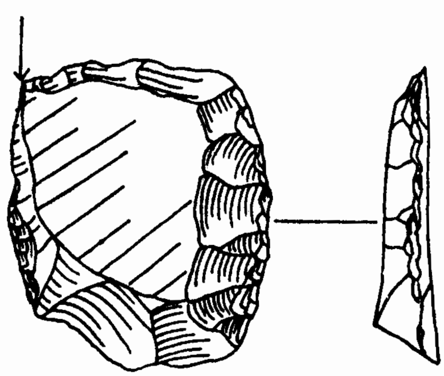
Fig. 23. Reworked or multi-purpose tools.



a. biface fragment unifacially modified after breakage



b. biface fragment unifacially modified after breakage



c. biface fragment modified by burin blow, then utilized

Form

In this analysis, 'form' refers to the overall configuration of an artifact, produced by a combination of manufacturing processes. The overall pattern or form is more than just the sum of its parts. For example, a flake that is bifacially retouched to produce a convex edge assumes a new functional, and perhaps aesthetic, identity as a knife.

In contrast to unformed tools, formed artifacts have a distinct, consistently reproduced shape. Consequently formal artifact types, defined as the consistent association of a set of formal attributes, can be observed in the artifact assemblage.

Twelve formal classes were defined; each category will be described according to the following outline:

Flaked Stone	N	%
Unifacial		
Class 1. Steep edge formed unifaces -----------------	32	12%

Subclass 1-A. Expanding edges - large (8)
Subclass 1-B. Expanding edges - small (19)

Subclass 1-C. Contracting edges (3)
Subclass 1-D. Parallel edges (2)

Class 2. Miscellaneous formed unifaces -------------- 4 1%

Class 3. Formed uniface fragments ------------------ 5 2%

Bifacial

Class 4. Possible bifacial blanks ------------------ 19 7%

Class 5. Bifacial points ---------------------------- 85 31%

Subclass 5-A. Side notched - small (29)
Subclass 5-B. Side notched - large (2)
Subclass 5-C. Corner notched - convex bases (8)
Subclass 5-D. Corner notched - concave bases (2)
Subclass 5-E. Corner notched - basal notch (1)
Subclass 5-F. Notched fragments (11)
Subclass 5-G. Stemmed (4)
Subclass 5-H. Leaf-shaped (3)
Subclass 5-I. Lanceolate (3)
Subclass 5-J. Miscellaneous (3)
Subclass 5-K. Asymmetrical point tips (5)
Subclass 5-L. Symmetrical point tips (14)

Class 6. Convex bifaces ----------------------------- 27 10%

Subclass 6-A. Semicircular (11)
Subclass 6-B. Ovoid/subrectangular (3)
Subclass 6-C. Irregular (4)
Subclass 6-D. Circular (discoid) (9)

Class 7. Miscellaneous bifaces ---------------------- 3 1%

Class 8. Biface fragments --------------------------- 56 20%

Class 9. <u>Pieces esquillees</u> -------------------------- 10 4%

Class 10. Quartzite spall tools -------------------- 10 4%

Ground stone

Class 11. Celts and celt fragments ----------------- 17 6%

Class 12. Miscellaneous ground stone --------------- 10 4%

Class 1. Steep edge formed unifaces (N = 32)

All steep edge formed unifaces have a uniform convex edge created by the removal of retouch flakes at least 5 mm long at an angle of 40-70 degrees to the flake surface. Retouch flakes are 5-16 mm long with an average length of 8 mm (s=5), while mean edge angle is 50 degrees (s=7). The average length of the modified edge is 54 mm. Four of the artifacts were made on primary decortication flakes, 10 retain some trace of cortical surface, and the remaining 18 were made on secondary flakes (1 of these is a thermal spall of chert). In 30 cases, retouch is on the dorsal flake surface, although in 2 cases it is on the ventral surface. Steep retouch is usually placed on the flake edge opposite the bulb of percussion (24); in a few cases it has been placed at the bulbar end (3) or along one side (5).

The general configuration of the steep edge unifaces was evaluated by orienting all retouched or working edges in one plane, regardless of the location of the bulb of percussion. In this position, 4 categories of shape were distinguishable.

Subclass 1-A. Large steep edge unifaces with expanding edges

N = 8

Raw Material: basalt (7), chert (1)

Fig. 24, Plate 6B

Fig. 24. Large steep edge unifaces with expanding edges.

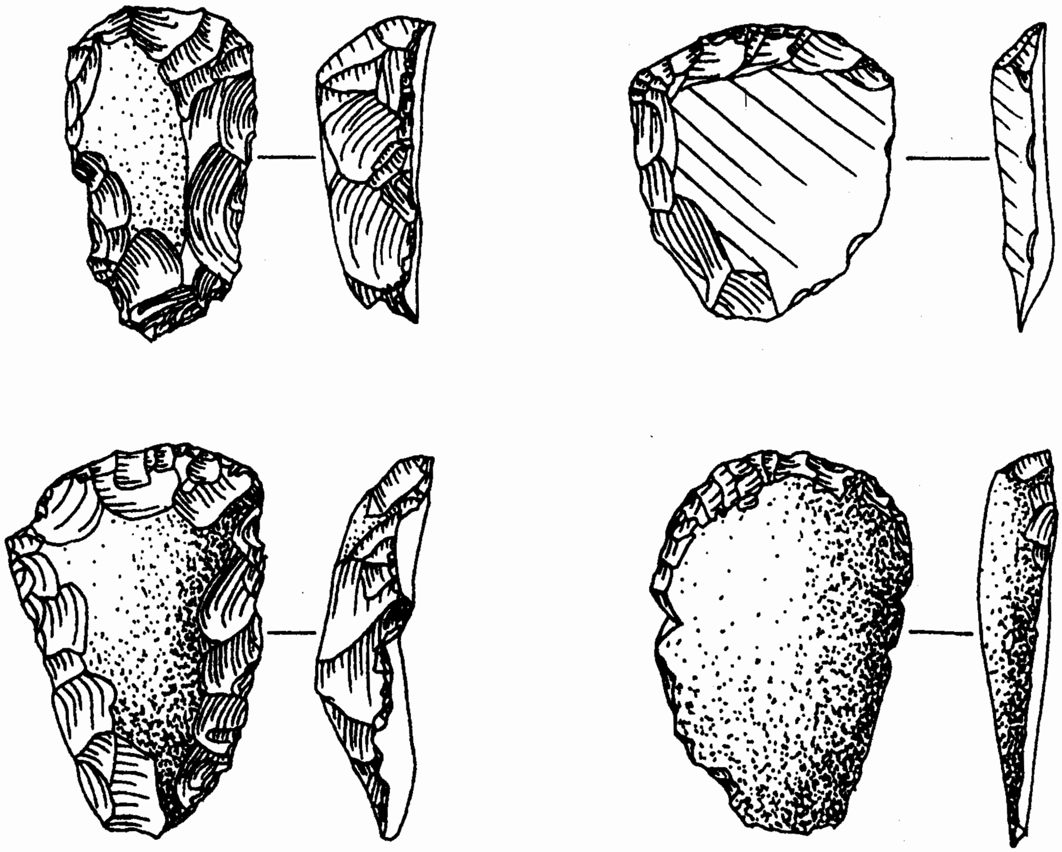


Table XXI. Dimensions of large steep edge unifaces with expanding edges.

	N	$\bar{X}$	Range
Length	8	44 mm	35 - 53 mm
Width	8	32 mm	25 - 37 mm
Thickness	8	10 mm	7 - 13 mm
Weight	8	12.1 gr	4.4 - 19.3 gr
Modified Edge Length	8	67 mm	34 - 143 mm

The majority of steep edge unifaces have expanding edges. That is, the flake is narrowest at the proximal end and expands to its widest point at the distal retouched end, resulting in an overall triangular or tear-drop shape. In most cases (25) the proximal end is truncated to some extent by the presence of a flat striking platform or the removal of a few flakes.

Large expanding edge tools are at least 35 mm long measured between proximal and distal ends. Basic dimensions are given in Table XXI. Their expanding edges have been achieved by using the natural flake contour, or by retouching the flake sides. Steep edge retouch is limited to the margins of 6 large expanding edge tools, but extends over the dorsal surface of 2. In addition to an even convex edge, 1 tool has a prominent beak formed by the intersection of 2 segments of steep retouch.

Subclass 1-B. Small steep edge unifaces with expanding edges

N = 19

Raw Material: basalt (18), chert (1)

Fig. 25, Plate 7 a-h

Small steep edge unifaces have the same expanding shape as the previous category, but are all less than 35 mm long.

Fig. 25. Small steep edge unifaces with expanding edges.

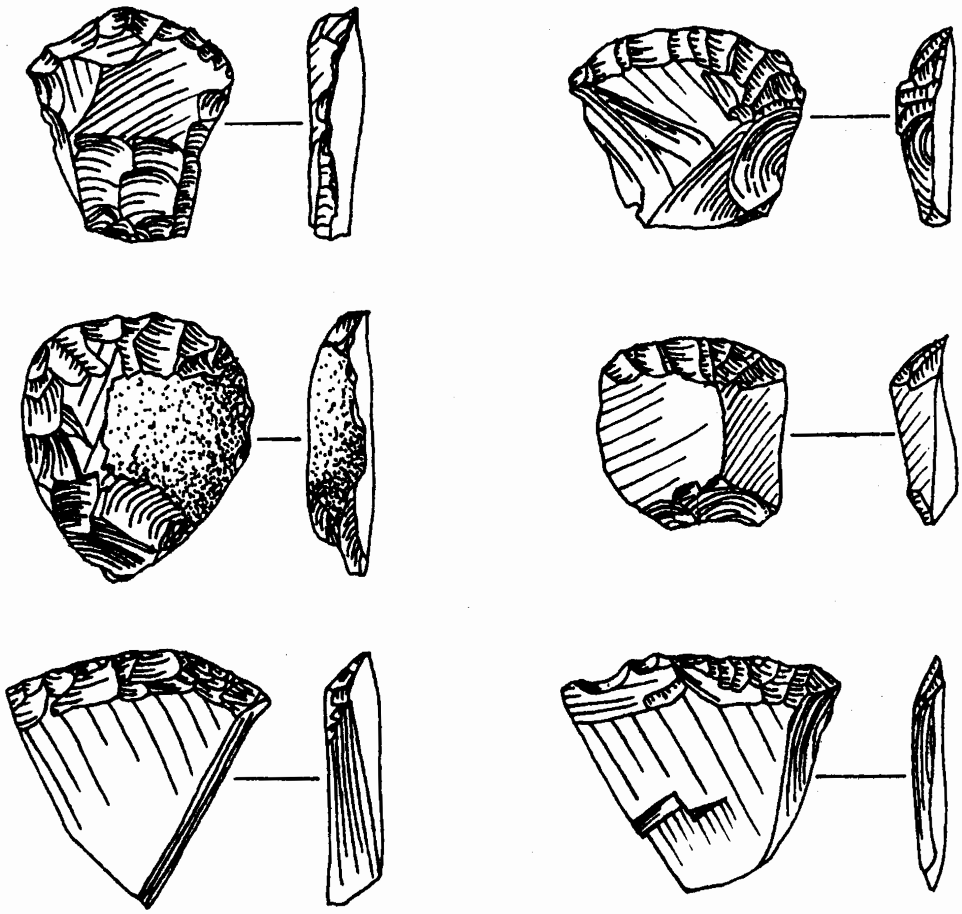


Table XXII. Dimensions of small steep edge unifaces with expanding edges.

	N	$\bar{X}$	Range	s
Length	19	29 mm	22 - 34 mm	4
Width	19	26 mm	19 - 34 mm	6
Thickness	19	8 mm	4 - 10 mm	4
Weight	19	5.2 gr	3.5 - 9.2 gr	2.7
Modified Edge Length	19	38 mm	27 - 79 mm	16

Two small tools have beaks formed by the intersection of steep edges at a 'corner' of the flake.

Expanding side edges on small unifaces follow natural flake contours or were produced by slight edge retouch. However, 7 tools were shaped by snapping off 1 or both side edges of the flake. These basalt tools form a very homogeneous group with flat dorsal surfaces, snapped edges, and retouch limited to the dorsal margin (Fig. 24, Plate 7 e-h).

Subclass 1-C. Steep edge unifaces with contracting edges

N = 3

Raw Material: basalt (3)

Fig. 26, Plate 7 j-k

A few steep edge unifaces have the retouched edge at the narrowest end of the flake. Thus the flake contracts from a wide proximal end to a narrow working end. Side edges have been shaped with small retouch flakes. Due to its placement, the steep retouch is restricted in length, (12-20 mm long). Retouch does not carry beyond flake margins. Basic dimensions are outlined in Table XXIII.

Fig. 26. Steep edge unifaces with contracting edges.

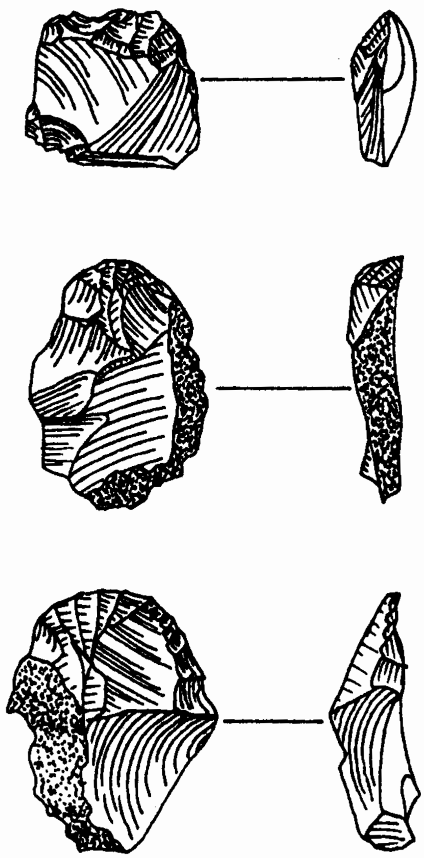


Table XXIII. Dimensions of steep edge unifaces with contracting edges.

	N	$\bar{X}$	Range
Length	3	29 mm	23 - 33 mm
Width	3	26 mm	20 - 32 mm
Thickness	3	6 mm	4 - 8 mm
Weight	3	2.6 gr	1.3 - 5.2 gr
Modified Edge Length	3	54 mm	37 - 82 mm

Subclass 1-D. Steep edge unifaces with parallel edges

N = 2

Raw Material: basalt (2)

Fig. 27, Plate 7 i

Two tools are nearly identical, made on large rectangular flakes with steep marginal retouch placed along 1 long edge. If length is measured from the proximal end to the distal working edge, both tools are exceptionally short and wide. Table XXIV presents exact measurements.

Class 2. Miscellaneous formed unifaces

N = 4

Raw Material: basalt (2) chert (2)

Fig. 28, Plate 7 l-o

The remaining 4 complete formed unifaces are unique shapes resulting from combination of convex and concave edges. All 4 were retouched around the entire perimeter, and 3 were flaked over the dorsal surface as well. Following are brief descriptions of the miscellaneous tools:

-The first artifact was made on a roughly rectangular basalt blade. One short end is formed by the striking platform, while the opposite short end is snapped off. Both long edges

Fig. 27. Steep edge unifaces with parallel edges.

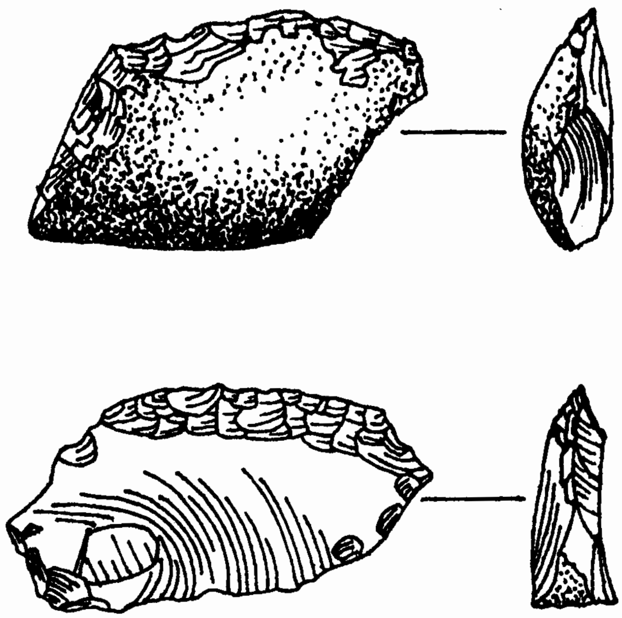


Table XXIV. Dimensions of steep edge unifaces with parallel edges.

	N	$\bar{X}$	Range
Length	2	27 mm	26 - 27 mm
Width	2	50 mm	45 - 54 mm
Thickness	2	11 mm	10 - 11 mm
Weight	2	16.3 gr	14.8 - 18.0 gr
Modified Edge Length	2	47 mm	-------

Fig. 28. Miscellaneous formed unifaces.

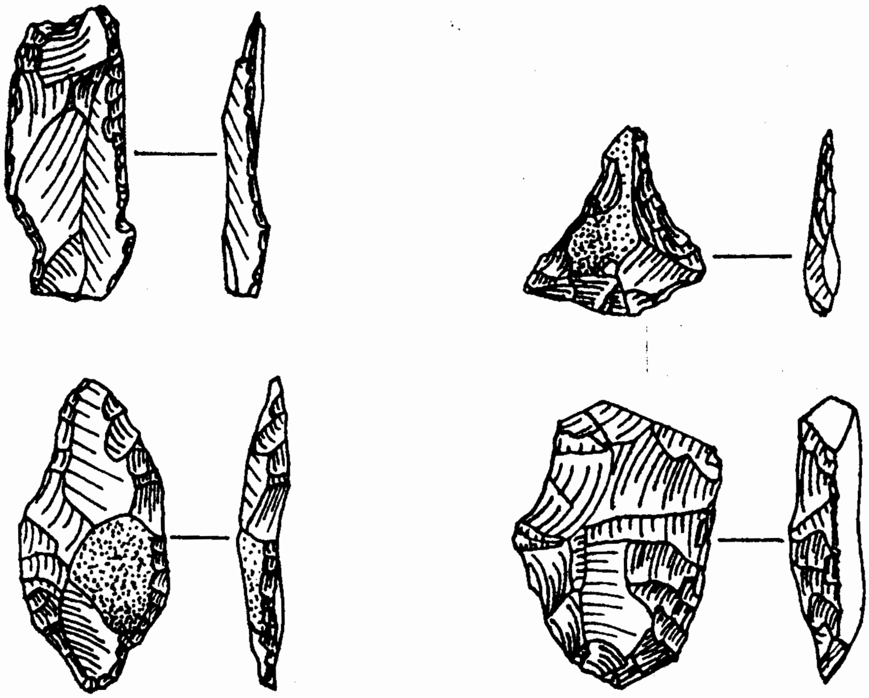
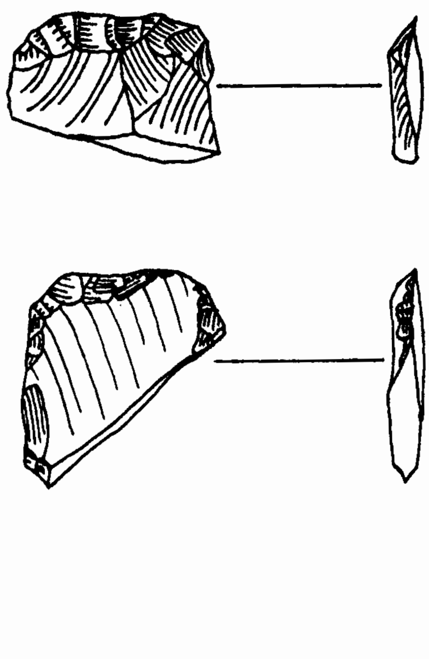


Fig. 29. Formed uniface fragments.



were shaped by small retouch flakes (less than 2 mm long) to produce straight parallel edges that constrict near the snapped end. Length: 38 mm, width: 15 mm, thickness: 4 mm, weight: 2.4 gr.

-The second artifact, also made on a basalt flake, has a triangular shape with the striking platform at the base of the triangle. The sides are both concave and all 3 corners are sharp points. Length: 24 mm, width: 23 mm, thickness: 5 mm, weight: 1.6 gr.

-The third uniface, based on a green chert flake, has an asymmetrical leaf shape formed by 1 convex side and 1 recurved side. One narrow end is blunt, and the opposite end has a small projection that may be a hafting element. Length: 40 mm, width: 19 mm, thickness: 5 mm, weight: 4.0 gr.

-The fourth specimen is made on a thick pink chert flake. One side is straight, while the opposite side has convex and concave segments which meet in a 'beak'. The distal end has been snapped off. Length: 36 mm, width: 26 mm, thickness: 8 mm, weight: 7.2 gr.

Class 3. Formed uniface fragments

N = 5

Raw Material: basalt (5)

Fig. 29

These pieces were too fragmentary to include in any of the formed uniface classes, but retain segments of steep edge retouch. All but 1 were snapped from the margins of larger tools; the exception was removed by percussion perpendicular to the retouched edge. Some indication of size may be given by maximum dimension, which ranges from 19 to 28 mm.

Class 4. Possible bifacial blanks

N = 19

Raw Material: basalt (19)

Fig. 30

The bulk of formed tools were bifacially retouched. As outlined above, they have been divided into 7 formal classes: 1) possible bifacial blanks, 2) bifacial points, 3) convex bifaces, 4) miscellaneous bifaces, 5) biface fragments, 6) _pieces esquillees_, and 7) quartzite spall tools.

Blanks are roughly shaped by the removal of large percussion flakes, and their edges are generally uneven with no evidence of utilization. They are considered to be an unfinished stage in the manufacture of bifacial tools. While they are easy to distinguish from finished bifaces, they may be confused with bifacially flaked core fragments; for this reason they are referred to as possible blanks.

Fig. 30. Bifacial blanks.

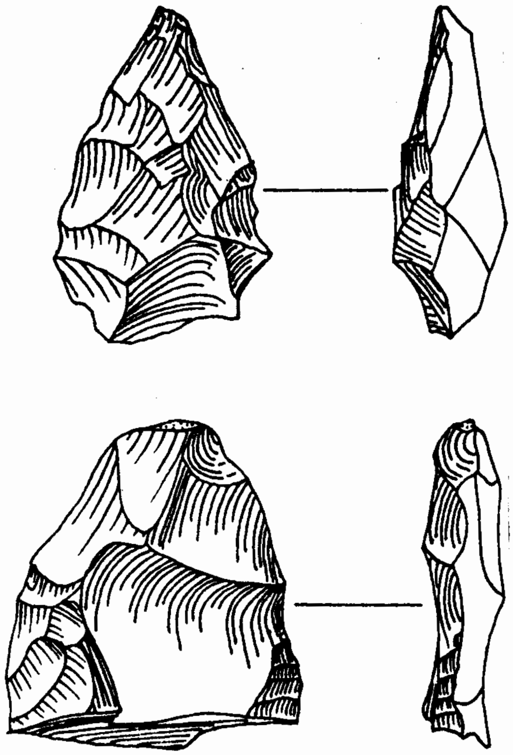


Table XXV. Dimensions of complete bifacial blanks.

	Triangular	Triangular	Ovate
Length	37 mm	42 mm	42 mm
Width	34 mm	28 mm	61 mm
Thickness	9	14	18
Weight	12.0 gr	9.4 gr	39.5 gr

Table XXVI. Dimensions of bifacial blank fragments.

	N	$\bar{X}$	Range	s
Length	16	31 mm	21 - 46 mm	10
Width	16	36 mm	24 - 65 mm	10
Thickness	16	10 mm	7 - 15 mm	2
Weight	16	12.9 gr	4.4 - 39.2 gr	8

Muto (1971: 109-118) identifies various stages in the sequence of tool manufacture. He applies the term 'blank' to an early stage of manufacture in which the stone has been roughly blocked out to approximate tool dimensions. He suggests that the term 'preform' should be applied only when it is possible to recognize the specific intent of the stoneworker, and then only in conjunction with a modifying adjective, eg 'side notched point preform'. None of the atifacts in this category are sufficiently complete to identify with a specific formed tool, hence all are regarded as preliminary blanks.

Only 3 blanks are complete; the rest are fragments of larger artifacts that were presumably broken during manufacture. Of the complete specimens, 2 are triangular and may have been intended for points, while the third is a large oval flake with a convex edge. Fourteen fragments have crudely shaped convex edges and are broken with snap fractures in such a way that it is not possible to predict their intended form. The last fragment is a nearly complete point preform bifacially shaped with large expanding flakes and cortex remaining on 1 face. This blank apparently shattered at the thick base end during manufacture. Dimensions are given separately for whole preforms and fragments in Tables XXV and XXVI.

Class 5. Bifacial Points N = 85

As the name implies, these artifacts have sharp edges and taper to a point at 1 end (Fig. 31). They range in size from a small point 15 mm long to a large pointed biface 145 mm long. Points have been further classified according to size and shape of the hafting element.

The most common hafting treatment, accounting for 62% of the identifiable points, is notching. Single notches were removed from sides or corners. The basic distinction between side and corner notches follows Forbis (1960: 93), "...corner notched points have no basal edge. If there is a determinable basal edge (no matter how much narrower the base may be than the body), the point is side notched ". Strictly speaking, the removal of corner notches produces a 'stem'. However, following conventional usage, points with notches oriented to produce an expanding stem are called 'corner notched', while corner-removed points resulting in parallel-sided or contracting stems are referred to as 'stemmed'. Side notched points are generally small and thin, therefore 2 conspicuously larger side notched points have been placed in a separate category. Due to greater variation in form, corner notched points have been divided into 3 distinct sub-groups.

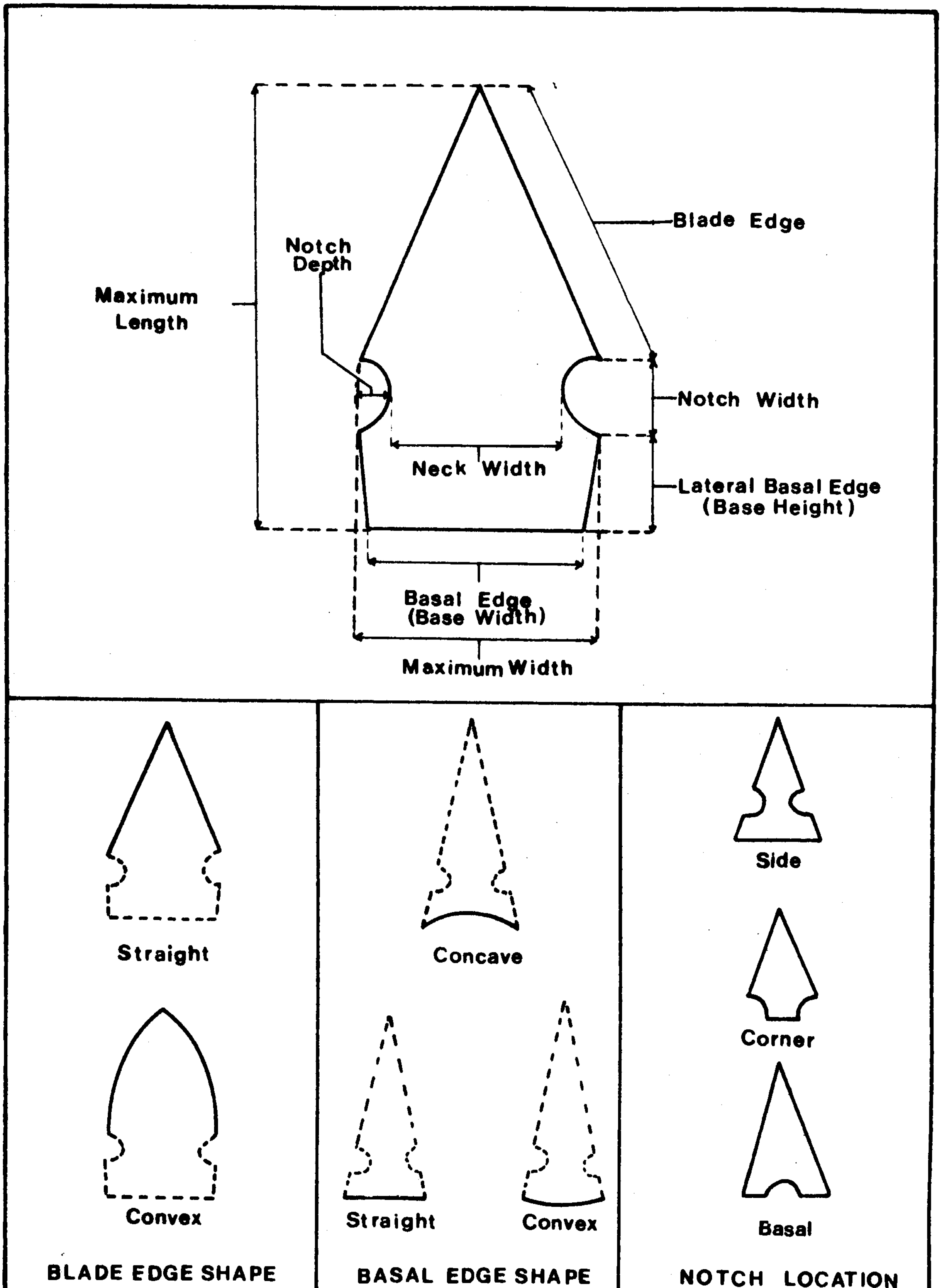


Fig. 31. Point terminology (after Sanger 1971 : 37)

Subclass 5-A. Small side notched points

N = 29

Raw Material: basalt (26), obsidian (3)

Figs. 32-33, Plate 8 a-u

Small side notched points, all less than 35 mm long, were shaped with small irregular expanding retouch flakes in a roughly collateral pattern (cf. Crabtree 1972a: 52). Retouch has been kept to a minimum, and in several cases is restricted to the flake margin.

The mean size of small side notched points is 24 x 12 x 4 mm. In 10 cases the blade is slightly wider than the base, while in 17 cases the base is wider, but the maximum difference is only 3 mm. Height of the basal edge averages 4 mm. Greatest variation occurs in blade length, which ranges from 7-48 mm and produces a similarly wide range in measurements of overall point length and weight. These figures are summarized in Table XXVII. All but 1 of the small points have slightly convex blade edges; the exception has straight edges. On 15 points the basal edge is nearly straight; 11 are slightly convex, and 3 are slightly concave. Lateral edges contract toward the base in 17 cases, suggesting use of an oval preform; the edges expand in 3 cases, suggesting a triangular preform, and the remaining 10 have straight edges. 28 points are bi-convex in both longitudinal and transverse cross-section; the exception is plano-convex.

Fig. 32. Small side notched points.

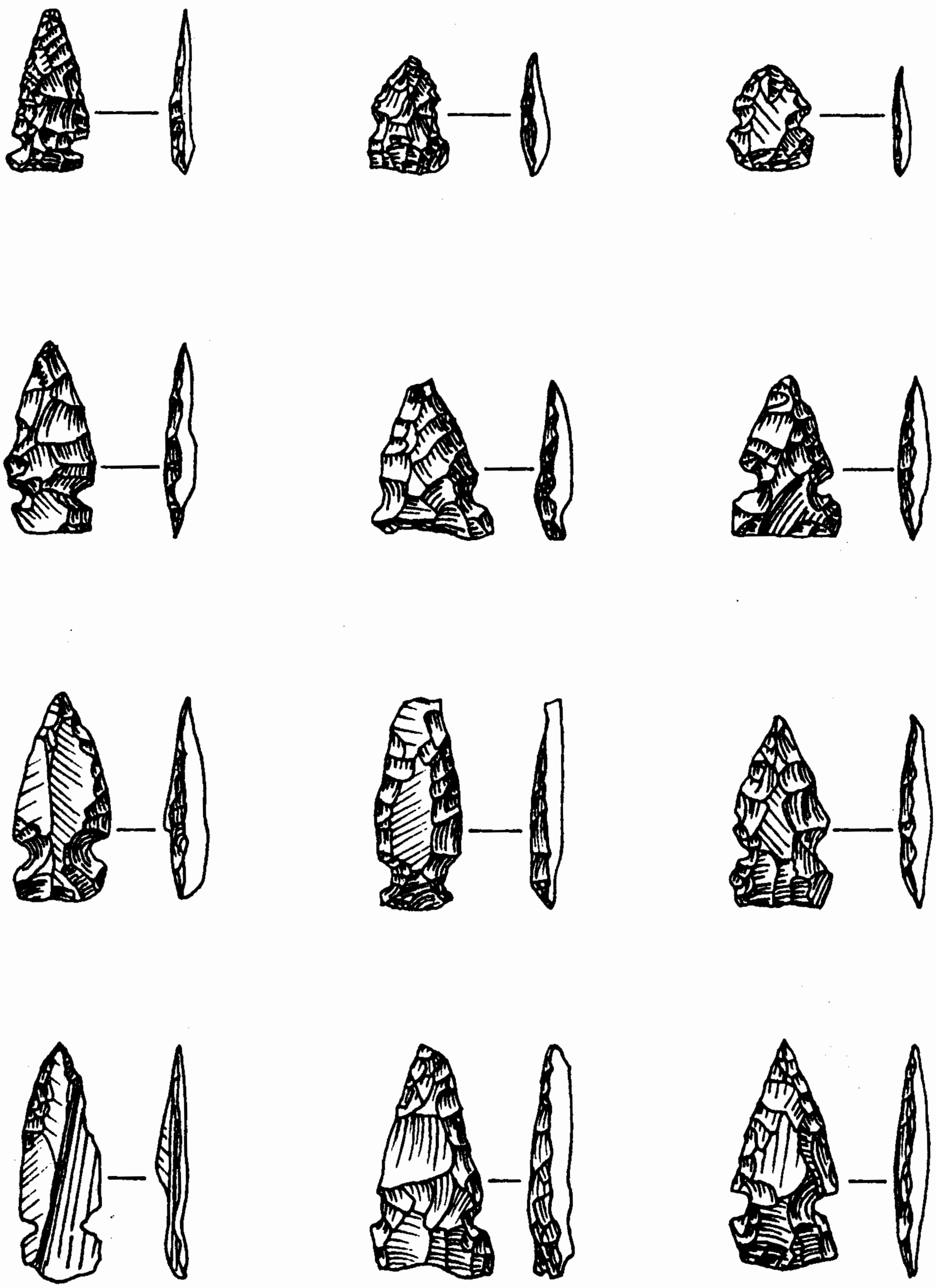


Fig. 33. Small side notched points.

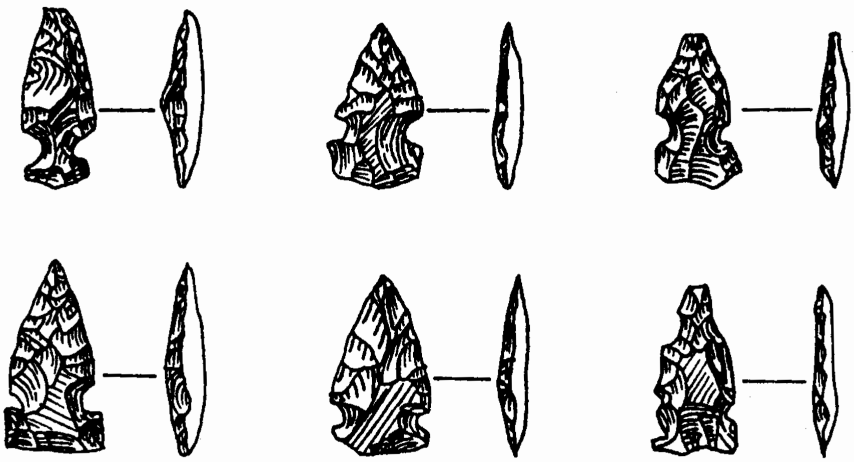
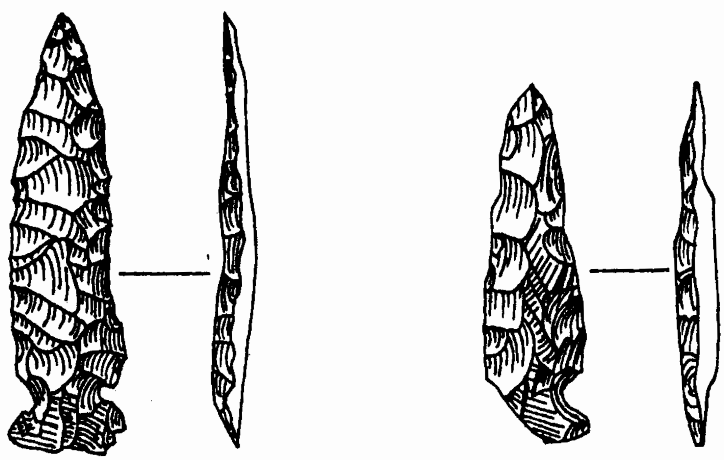


Fig. 34. Large side notched points.



Notches are expanding and rounded, and have been placed at right angles to the edge so that none are barbed. Notch width averages 4 mm, while notch depth averages 2 mm (Table XXVII). There is little variation in the size of notches which are always wider than they are deep. In an analysis of over 1000 Plains side notched points, Forbis (1960: 90) found the relation of height of the basal edge to notch width to be a reliable chronological indicator. This index calculated for Punchaw Lake artifacts reveals that 11 points have notches wider than the base, 3 have notches narrower, and 8 have notches and bases of equal size. The neck width produced by notching averages 11 mm.

Subclass 5-B. Large side notched points

N = 2

Raw Material: basalt (1), obsidian (1)

Fig. 34, Plate 8 v-w

Two especially large side notched points have been isolated from the previous category. The primary criterion for this distinction is blade size, averaging 44 x 15 x 6 mm - well beyond the range of the small side notched points described above. Blade size is also reflected in measurements of overall point length and weight, which average 51 mm and 3.5 gr respectively. Workmanship is also noticeably superior

Table XXVII. Dimensions of small side notched points.

	N	$\bar{X}$	Range	s
Point length	22	24 mm	15 - 33 mm	5
Blade length	21	17 mm	7 - 24 mm	4
Base length	29	4 mm	1 - 6 mm	1
Body width	26	12 mm	9 - 15 mm	2
Base width	27	13 mm	8 - 17 mm	2
Point thickness	22	4 mm	2 - 5 mm	1
Point Weight	22	1.1 gr	.5 - 2.3 gr	.5
Notch Width	29	4 mm	3 - 7 mm	.9
Notch Depth	29	2 mm	1 - 3 mm	.6
Neck Width	29	11 mm	5 - 13 mm	5

Table XXVIII. Dimensions of large side notched points.

	N	$\bar{X}$	Range
Point length	2	51 mm	47 - 55 mm
Blade length	2	44 mm	39 - 48 mm
Base length	2	4 mm	
Body width	2	15 mm	14 - 16 mm
Base width	2	14 mm	
Point thickness	2	6 mm	5 - 6 mm
Point weight	2	3.5 gr	3.1 - 3.8 gr
Notch width	2	6 mm	
Notch depth	2	3 mm	
Neck width	2	9 mm	8 - 9 mm

on the large obsidian point, which has diagonal pressure flaking on both faces.

In all other formal attributes, large points are similar to small side notched points. Blade edges are convex, the basal edge is straight or convex, lateral-basal edges contract toward the base, and both points are bi-convex in cross section. Hafting elements are large but within the variation displayed by small side notched points: bases average 4 mm high and 14 mm wide, while notches average 6 mm wide and 3 mm deep. Neck widths also remain narrow, averaging 9 mm across. These measurements indicate that size and shape of the hafting element remain relatively constant across all side notched points while blade size varies.

Subclass 5-C. Corner notched points with convex bases

N = 8

Raw Material: basalt (8)

Fig. 35, Plate 9 a-h

These points share expanding stems and convex basal and blade edges. In fact, the base of 1 point is so convex it might be called 'button-like'. Basic dimensions are summarized in Table XXIX. By definition, stems formed by corner notches are expanding, but in all cases under consideration, the stem is narrower than the blade.

Fig. 35. Corner notched points with convex bases.

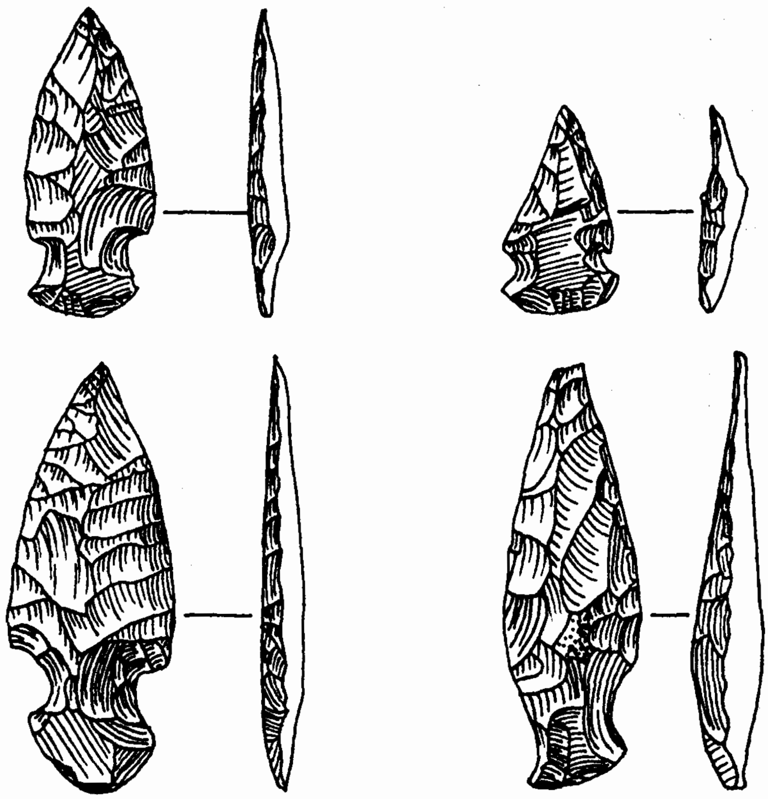


Table XXIX. Dimensions of corner notched points with convex bases.

	N	$\overline{X}$	Range
Point length	8	45 mm	28 - 55 mm
Blade length	8	33 mm	21 - 41 mm
Blade width	8	19 mm	14 - 23 mm
Stem width	8	14 mm	10 - 16 mm
Point thickness	8	7 mm	3 - 8 mm
Point weight	8	5.1 gr	1.3 - 7.9 gr
Neck width	8	11 mm	8 - 12 mm

Minimum neck measurements, taken near the blade, average 11 mm.

Subclass 5-D. Corner notched points with concave bases

N = 2

Raw Material: basalt (1), chert (1)

Fig. 36, Plate 9 j-k

Except for raw material, these 2 points are very similar with broad triangular blades, expanding stems (narrower than the blade), and slightly concave bases.
They overlap the other corner notched points in terms of average length (44 mm) and thickness (7 mm), but are slightly wider at the blade (24 mm) and neck (13 mm) (Table XXX). Both are flaked in a roughly collateral pattern with expanding or parallel flakes.

Subclass 5-E. Corner notched point with basal notch

N = 1

Raw Material: basalt (1)

Fig. 37, Plate 9 i

The single remaining corner notched point is very small, 22 mm long, 15 mm wide, and 3 mm thick, weighing 1.0 gr. The blade edges are convex, and the 8 mm wide expanding stem has a single small basal notch. Neck width is only 7 mm.

Fig. 36. Corner notched points with concave bases.

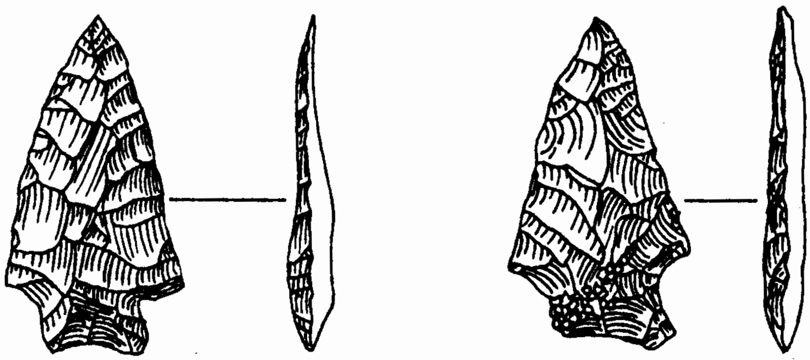


Table XXX. Dimensions of corner notched points with concave bases.

	N	$\overline{X}$	Range
Point length	2	44 mm	
Blade length	2	36 mm	34 - 37 mm
Point width	2	24 mm	
Stem width	2	15 mm	14 - 15 mm
Point thickness	2	7 mm	6 - 7 mm
Point weight	2	5.5 gr	5.1 - 5.9 gr
Neck width	2	13 mm	

Fig. 37. Corner notched point with basal notch.

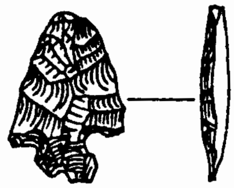
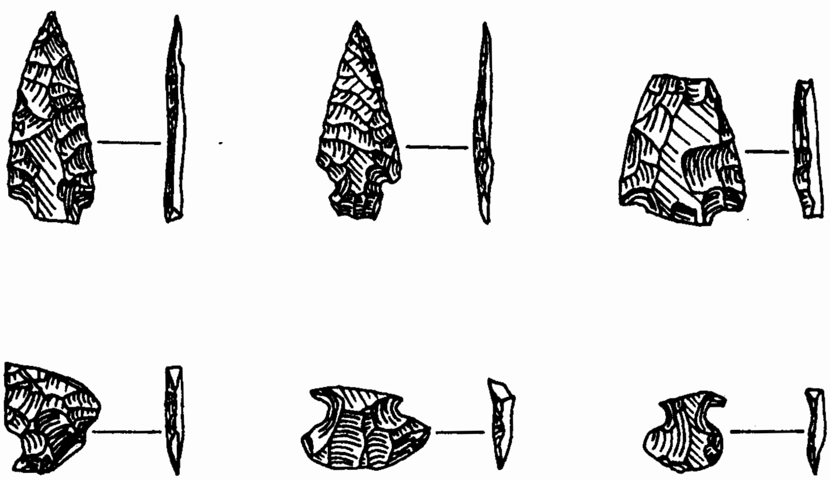


Fig. 38. Notched point fragments.



Subclass 5-F. Notched point fragments

N = 11

Raw Material: basalt (9), obsidian (2)

Fig. 38, Plate 8 x

These point fragments carry some evidence of notching but are too incomplete for specific identification. Seven are blades lacking bases, and 4 are bases broken off at the notch. Noteworthy are 1 small blade (21 x 12 x 3 mm) with uniform diagonal flaking on both faces; and 1 roughly flaked blade with slight 'ears' or barbs at the shoulder. All base framents are convex and lack lateral basal edges.

Subclass 5-G. Stemmed points

N = 4

Raw Material: basalt (3), chert (1)

Fig. 40, Plate 10 i-l

All points in this category have, by definition, stems with parallel or contracting edges and straight bases. Due to vast differences, they will be described individually.

The largest stemmed point, and indeed the largest point in the assemblage, is made of basalt and was recovered from

Fig. 39. Leaf-shaped points.

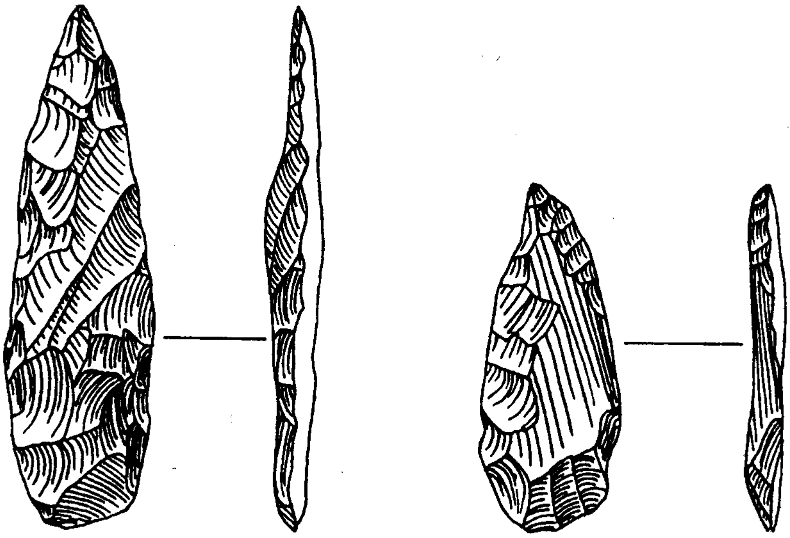
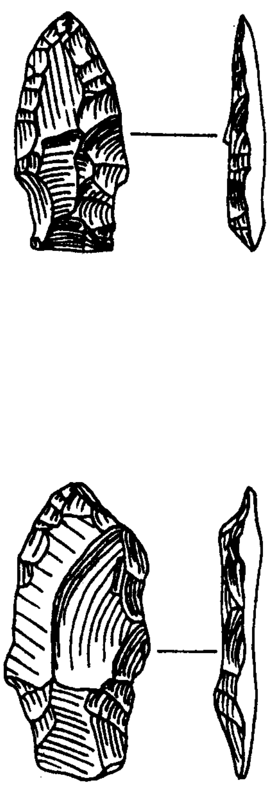
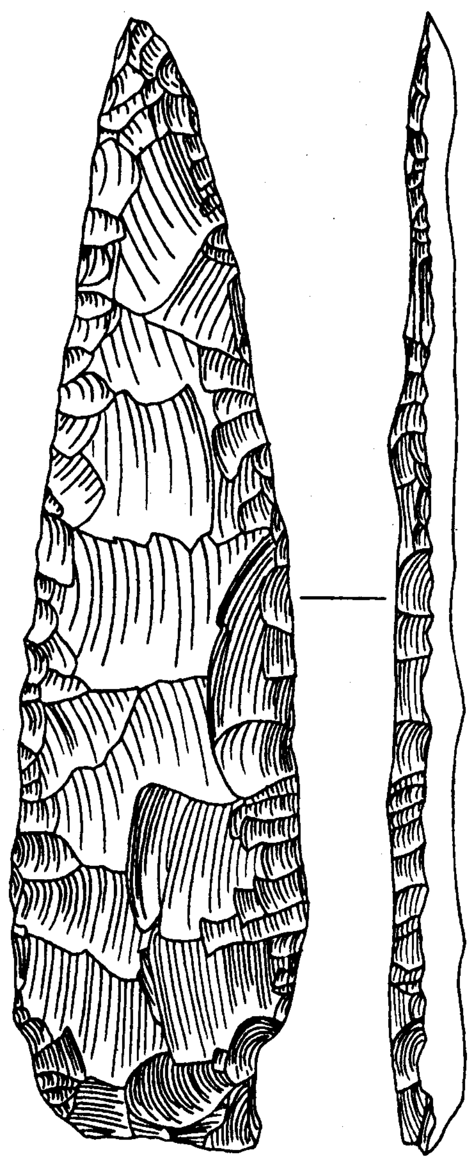


Fig. 40. Stemmed points.





the site in 4 fragments. Reassembled it is 145 x 39 x 3 mm, and weighs 53.2 gr. The leaf shaped blade has been shaped with large irregular expanding flakes. Both lower corners have been removed to form a very short wide stem (15 mm long and 28 mm wide) with parallel sides. Both faces of the point have been thinned to such an extent that the cross section is bi-plano.

A smaller point has been very crudely shaped around the margin to produce a thick parallel-sided blade joined to a wide contracting stem at rounded shoulders. Overall the point is 38 mm long and the stem decreases from 14 mm wide near the blade to 11 mm wide at the base.

Another basalt point fragment was broken off just above the shoulders. The fragment is 26 mm wide at the rounded shoulders, and tapers to a parallel sided stem 10 mm long and 17 mm wide. The base is straight.

The final stemmed point, of chert, is the smallest in this category at 30 mm long, 14 mm wide, and 4 mm thick. The blade has convex edges and rounded shoulders joined to a broad parallel sided stem 9 mm long and 10 mm wide.

Subclass 5-H. Leaf shaped points

N = 3

Raw Material: basalt (3)

Fig. 39, Plate 10 f-h

Leaf shaped points have convex edges and bases with no hafting modification other than basal thinning. Again, the examples are so diverse they will be described independently.

The largest leaf shaped point measures 68 x 19 x 7 mm. It is plano-convex in cross section and shaped with short expanding flakes in a random pattern. The basal edge was slightly squared in the process of thinning.

The second point (45 x 18 x 4 mm) was asymmetrically shaped from coarse basalt. The base is rounded and the cross section is plano-convex.

The last leaf shaped point was formed primarily by alternate retouch on a thin tear-drop shaped flake to create a finished tool 34 x 14 x 4 mm. It is also plano-convex in section.

Subclass 5-I. Lanceolate points

N = 3

Raw Material: basalt (3)

Fig. 41, Plate 10 a-c

Two thick lanceolate points are widest at shoulders located above the center line, with straight basal edges. One, 57 x 26 x 10 mm, has rounded shoulders and tip, while the other, 33 x 17 x 8 mm has sharper angles.

The third lanceolate, a basal fragment with a deeply concave base, is thick, with biconvex cross section, 45 (incomplete) x 20 x 7 mm. This point is unusual in that it has been retouched to remove a heavily patinated surface and sharpen dull edges.

Subclass 5-J. Miscellaneous points

N = 3

Raw Material = basalt (3)

Fig. 42, Plate 10 d-e

Miscellaneous points are triangular, sub-triangular, and oval, with average dimensions of 29 x 21 x 5 mm. Their broad, flat shape, with retouch limited to the margin, and lack of wear (discussed under Function) suggest that these may be unfinished point preforms.

Fig. 41. Lanceolate points.

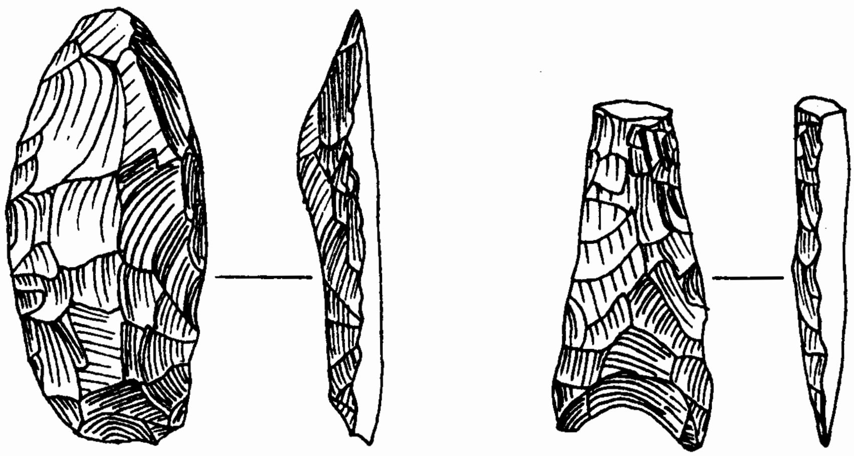
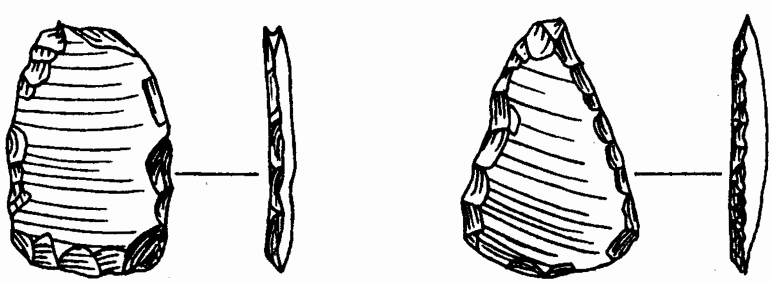


Fig. 42. Miscellaneous points.



Subclass 5-K. Asymmetrical point tips

N = 5

Raw Material: basalt (5)

Fig. 43

Point fragments are tips broken from their bases leaving little indication of complete tool form or hafting treatment. Asymmetrical tips have 1 concave edge and 1 convex edge, meeting in a point that 'curves' to one side. In general, the tips are large and thick, comparable in scale to large bifaces rather than projectile points. However, there are no complete tools from the excavation resembling these fragments. Three are bi-convex and 2 plano-convex in transverse cross section. Measurable dimensions are presented in Table XXXI.

Subclass 5-L. Symmetrical point tips

N = 14

Raw Material: basalt (13), chert (1)

Fig. 44

Symmetrical fragments are tips with convex or straight edges, ranging from a thick rounded point to a thin, sharp, needle-like tip. Several tips are in the size range of side and corner notched points from the site. The fragments were

Fig. 43. Asymmetrical point tips.

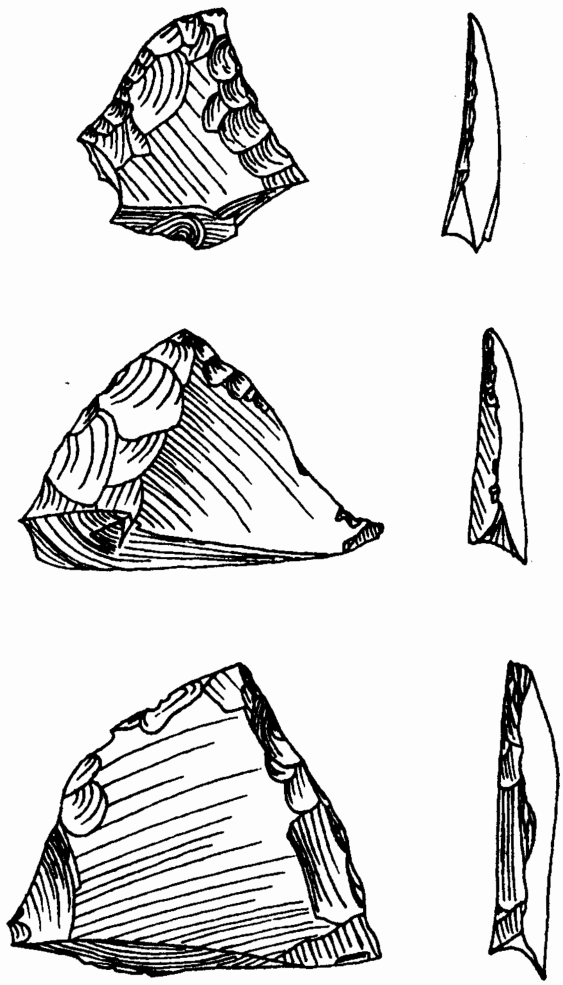


Table XXXI. Dimensions of asymmetrical point tips.

	N	$\overline{X}$	Range
Length	5	34 mm	25 - 45 mm
Width	5	40 mm	21 - 50 mm
Thickness	5	8 mm	6 - 12 mm

Fig. 44. Symmetrical point tips.

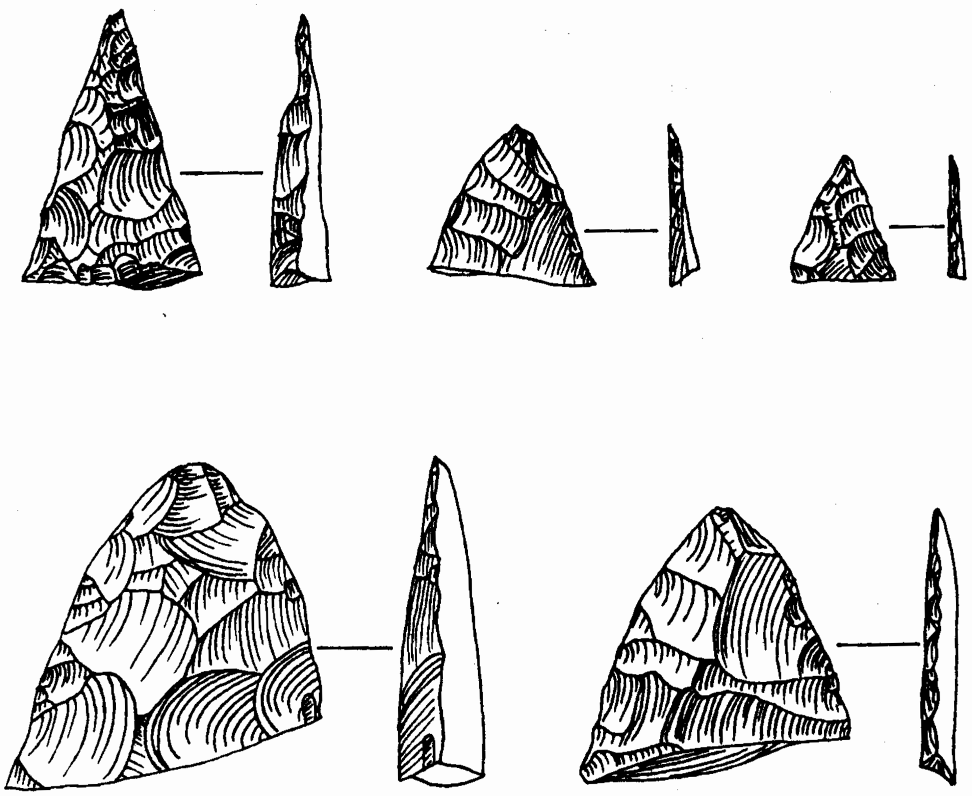


Table XXXII. Dimensions of symmetrical point tips.

	N	$\bar{X}$	Range	s
Length	14	27 mm	11 - 48 mm	11
Width	14	22 mm	10 - 44 mm	10
Thickness	14	6 mm	2 - 12 mm	3

shaped with a combination of broad expanding flakes and long narrow parallel flakes. Four tips are bi-convex in cross section, 4 are plano-convex, 1 is bi-plano, and the rest are too fragmentary to evaluate. Basic dimensions are presented in Table XXXII.

Class 6. Convex Bifaces N = 11

Convex bifaces have 1 broadly convex retouched edge which extends partially around the circumference of the artifact. They have been subdivided into 4 groups.

Subclass 6-A. Semicircular convex bifaces

N = 11

Raw Material: basalt (11)

Fig. 45, Plate 11 c-g

Semicircular bifaces are made on large flakes. Each tool has a thick straight base which was the original striking platform (in 7 cases this base is a wide cortical surface). The tool tapers from its thick base to a thin semicircular or 'fan-shaped' edge.

The extent of retouch on each tool varies. Eight have only marginal retouch, while 3 are more extensively shaped over the dorsal face. One of the latter has been thoroughly polished on

Fig. 45. Semicircular convex bifaces.

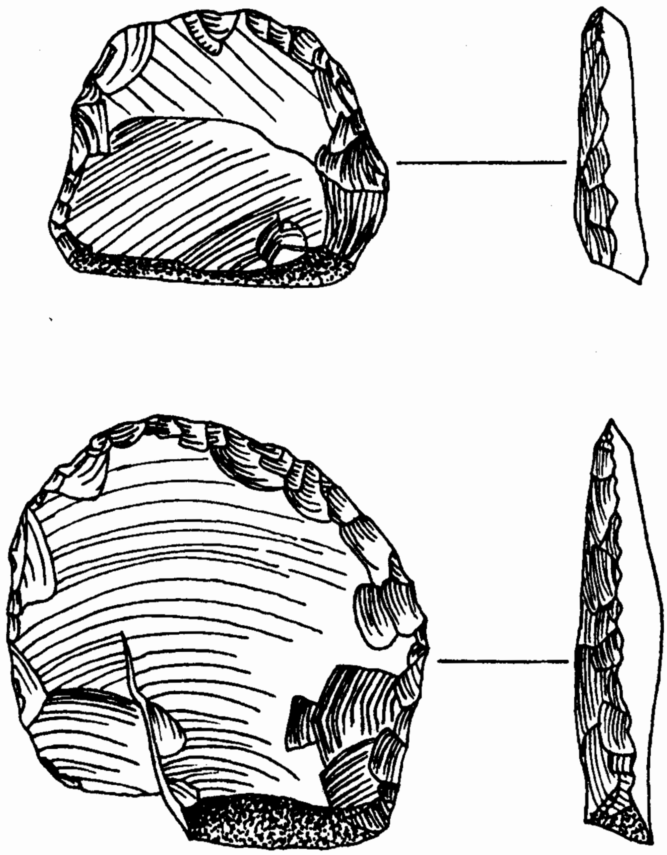


Table XXXIII. Dimensions of semicircular convex bifaces.

	N	$\bar{X}$	Range
Length	8	42 mm	26 - 76 mm
Width	8	53 mm	40 - 75 mm
Thickness	8	9 mm	8 - 11 mm
Weight	8	23.4 gr	9.8 - 52.3 gr

both faces - one of the few basalt artifacts to show intentional polish. Another of the dorsally shaped tools has a section of steep unifacial retouch at 1 end, while the midsection is bifacial. Three bifaces are fragmentary but retain enough of the thick base and convex edge to place them securely in this category. Measurements for 8 complete tools are given in Table XXXIII.

Subclass 6-B. Ovoid and subrectangular convex bifaces

N = 2

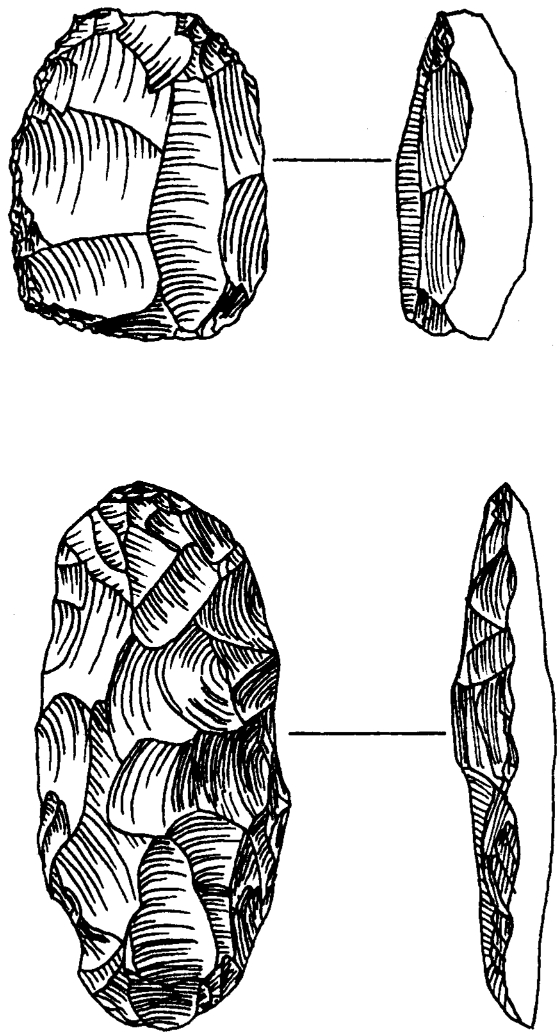
Raw Material: chert (2)

Fig. 46, Plate 11 a-b

A grey-brown chert tool was completely shaped over both faces with large expanding irregular flakes. It has a symmetrical oval shape and is bi-convex in transverse section. An outstanding feature of this tool is its heavy polish, covering the rounded edges as well as both faces (71 x 34 x 13 mm; weight: 37.1 gr).

The other artifact in this category is a thick, subrectangular biface of amber colored chert. One face was flaked in a Levallois pattern, with large flakes converging from opposite edges truncated by removal of a blade along the medial ridge. The other face has an irregular flaking pattern. The tool is bi-convex in cross section. There is no apparent

Fig. 46. Ovoid and subrectangular convex bifaces.



edge retouch, but the entire edge is heavily battered and dulled (41 x 35 x 18 mm; weight: 19.7 gr).

Subclass 6-C. Irregular convex bifaces

N = 4

Raw Material: basalt (4)

Fig. 47

The irregular contours of these bifaces are formed by convex and straight edges meeting at various obtuse angles around the tool perimeter. One was shaped with large percussion flakes around the margin, 2 have small expanding retouch flakes, and the last has sharp edges thinned with small retouch flakes. Dimensions are outlined in Table XXXIV.

Subclass 6-D. Circular bifaces (discoids)

N = 9

Raw Material: basalt (9)

Fig. 48, Plate 12 e-h

The circular bifaces are a homogeneous group of small discoidal tools. They are flaked from the circumference toward the center on both faces, producing a bi-convex cross section. In general the flakes are broad and expanding, with no pressure retouch. One artifact has cortex remaining on 1 face.

Fig. 47. Irregular convex bifaces.

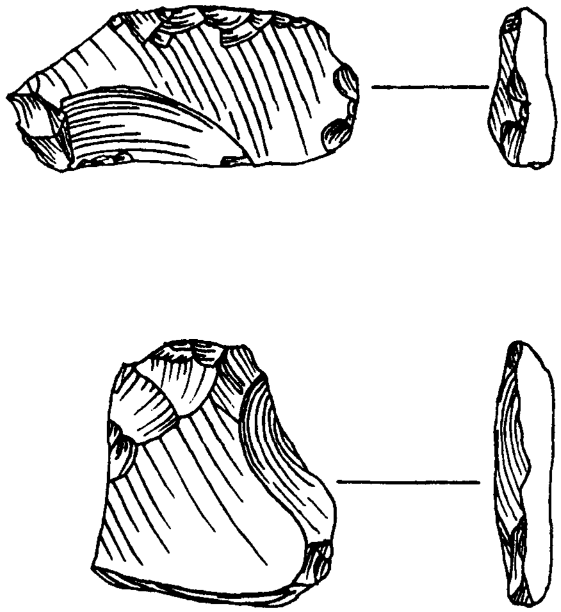


Table XXXIV. Dimensions of irregular convex bifaces.

	N	$\overline{X}$	Range
Length	4	32 mm	25 - 41 mm
Width	4	29 mm	23 - 36 mm
Thickness	4	7 mm	
Weight	4	8.0 gr	4.2 - 12.6 gr

Fig. 48. Circular bifaces (discoids).

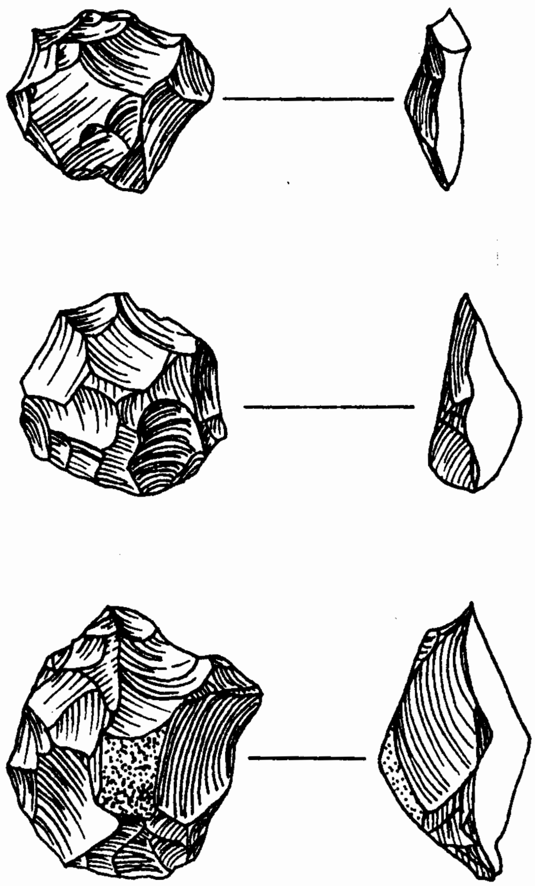


Table XXXV. Dimensions of circular bifaces.

	N	$\bar{X}$	Range
Diameter	7	30 mm	27 - 37 mm
Thickness	7	11 mm	7 - 20 mm
Weight	7	9.1 gr	3.1 - 22.2 gr

Their sharp sinuous edges are made up of adjacent concave and straight segments, created by removal of large flakes. Thus, while the overall artifact shape is circular, the edge itself is rather jagged. Average dimensions are outlined in Table XXXV. Two of the artifacts are fragments of discoids broken with snap fractures.

Class 7. Miscellaneous Bifaces

N = 3

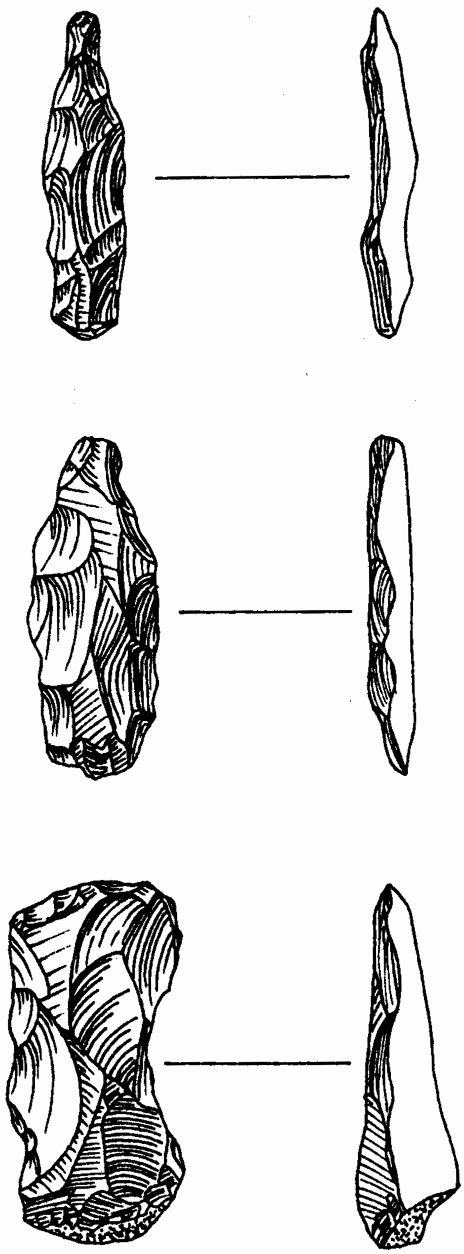
Raw Material: basalt (3)

Fig. 49, Plate 13 a-c

The 3 remaining bifaces are unique. A small basalt artifact approaches the form of a leaf shaped point with symmetrical convex edges, rounded base and bi-convex cross section. However, the thick rounded point is unsuitable for piercing. The tool may be an unfinished point preform, since it also lacks fine edge retouch; it may have been intended as a blunt projectile tip, or the blunt tip may actually be a hafting element.

A small 'cigar shaped' basalt biface is so narrow and thick that its cross section is nearly circular. It has been steeply flaked with small expanding flakes on both faces. One end is blunt and the other tapers to a narrow rounded tip (42 x 10 x 8 mm; weight: 3.7 gr).

Fig. 49. Miscellaneous bifaces.



The last of the complete bifaces is roughly rectangular. It has been crudely shaped with expanding flakes converging from the long edges on both faces, making it bi-convex in transverse section. Its wedge shape tapers from one short thick end bearing remnants of cortical surface to an opposing thin edge (47 x 24 x 15 mm; weight: 4.5 gr).

Class 8. Formed Biface Fragments

N = 56

Raw Material: basalt (50), chert (5), obsidian (1)

Fig. 50, Plate 13d-k

Fragments of formed bifaces, which have no pointed edges, may be divided into 4 groups: 1) rounded end fragments, 2) squared end fragments, 3) midsections, and 4) truncated edges. Each category reflects some aspect of a complete bifacial tool.

End fragments are bases or tips broken from formed bifaces, usually by snap fracture. Noteworthy among 10 rounded or convex end fragments is 1 narrow fragment of chert that resembles a drill bit. It has been carefully flaked along both sides to produce straight parallel edges terminating in a rounded tip (4 mm wide, 2 mm thick). Dimensions of the remaining rounded fragments are summarized in Table XXXVI.

Fig. 50. Formed biface fragments.

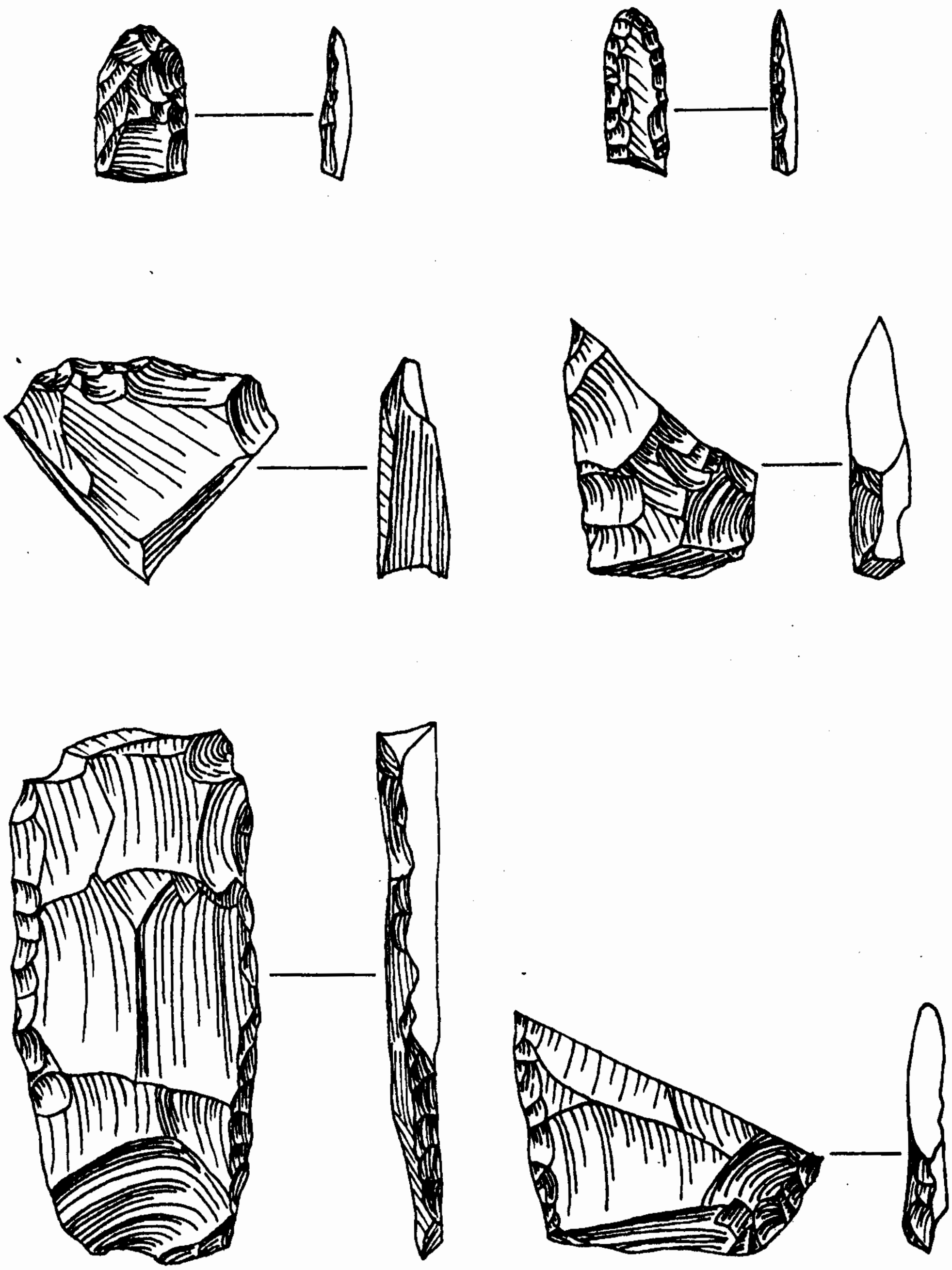


Table XXXVI. Dimensions of rounded end fragments.

	N	$\overline{X}$	Range
Length	9	25 mm	15 - 29 mm
Width	9	23 mm	14 - 30 mm
Thickness	9	8 mm	3 - 11 mm

Table XXXVII. Dimensions of small squared end fragments.

	N	$\overline{X}$	Range
Length	14	17 mm	8 - 24 mm
Width	14	21 mm	15 - 25 mm
Thickness	14	5 mm	3 - 8 mm

Table XXXVIII. Dimensions of large squared end fragments.

	N	$\overline{X}$	Range
Length	2	51 mm	30 - 71 mm
Width	2	39 mm	35 - 43 mm
Thickness	2	7 mm	6 - 8 mm

Table XXXIX. Dimensions of midsection fragments.

	N	$\overline{X}$	Range
Length	10	22 mm	9 - 34 mm
Width	10	21 mm	11 - 30 mm
Thickness	10	6 mm	2 - 11 mm

Table XL. Dimensions of truncated edge fragments.

	N	$\overline{X}$	Range	s
Length	18	29 mm	16 - 49 mm	10
Width	18	29 mm	17 - 61 mm	10
Thickness	18	7 mm	3 - 14 mm	3

Eighteen end fragments are 'squared' with sides joined to base at a sharp angle. Eleven have parallel sides, and 7 expand from the base. While the fragments are, in general, small and thin, with biconvex cross-section, 2 heavily patinated bi-plano specimens are especially large. Their form, though incomplete, is reminiscent of the largest complete bifacial point (see stemmed points). Dimensions of large and small fragments are given separately in Tables XXXVII and XXXVIII.

Midsections are fragments truncated at both ends, usually by snap fracture. Four are small and thin, with parallel retouched edges. Six larger midsections have expanding retouched edges (Table XXXIX).

Eighteen 'truncated edges' are similar to midsections in that they are broken at both ends, usually by snap fracture. However, unlike midsections, they retain only 1 bifacially retouched edge. Snapped edges converge in a thick 'point' opposite the bifacial edge, producing a wedge shaped cross section (Table XL).

Class 9. Pieces Esquillees

N = 10

Raw Material: basalt (9), obsidian (10)

Fig. 51, Plate 12 a-d

Pieces esquillees are generally small and rectangular with paired opposite edges crushed and flaked, reflecting modification by bipolar percussion (MacDonald 1968: 85). Most pieces esquillees from Excavation Area C have only 1 pair of extensively battered edges, although 1 specimen has 2 pairs of flaked edges. Basic dimensions are presented in Table XLI. Length, measured as the maximum distance between bipolar edges, is shorter than width in 6 cases. The 3 smallest pieces esquillees appear to be fragments, terminating at both sides in snap fractures or burin-like scars.

Class 10. Quartzite Spall Tools

N = 10

Raw Material: quartzite (10)

Fig. 52, Plate 14

Fig. 51. Pieces esquillees.

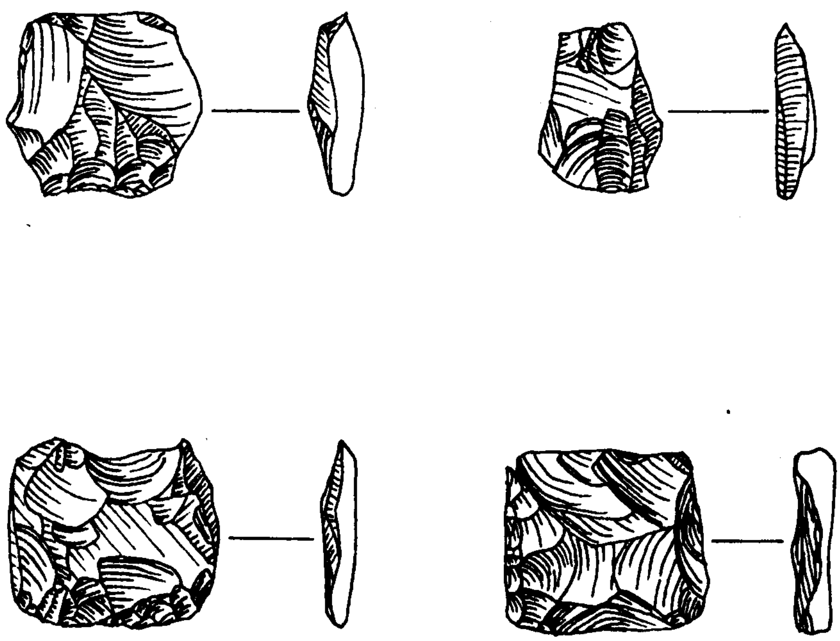


Table XLI. Dimensions of pieces esquillees.

	N	$\bar{X}$	Range	s
Length	10	22 mm	18 - 29 mm	4
Width	10	25 mm	16 - 34 mm	7
Thickness	10	6 mm	4 - 8 mm	1
Weight	10	3.4 gr	1.2 - 6.1 gr	1.7

Fig. 52. Quartzite spall tools.

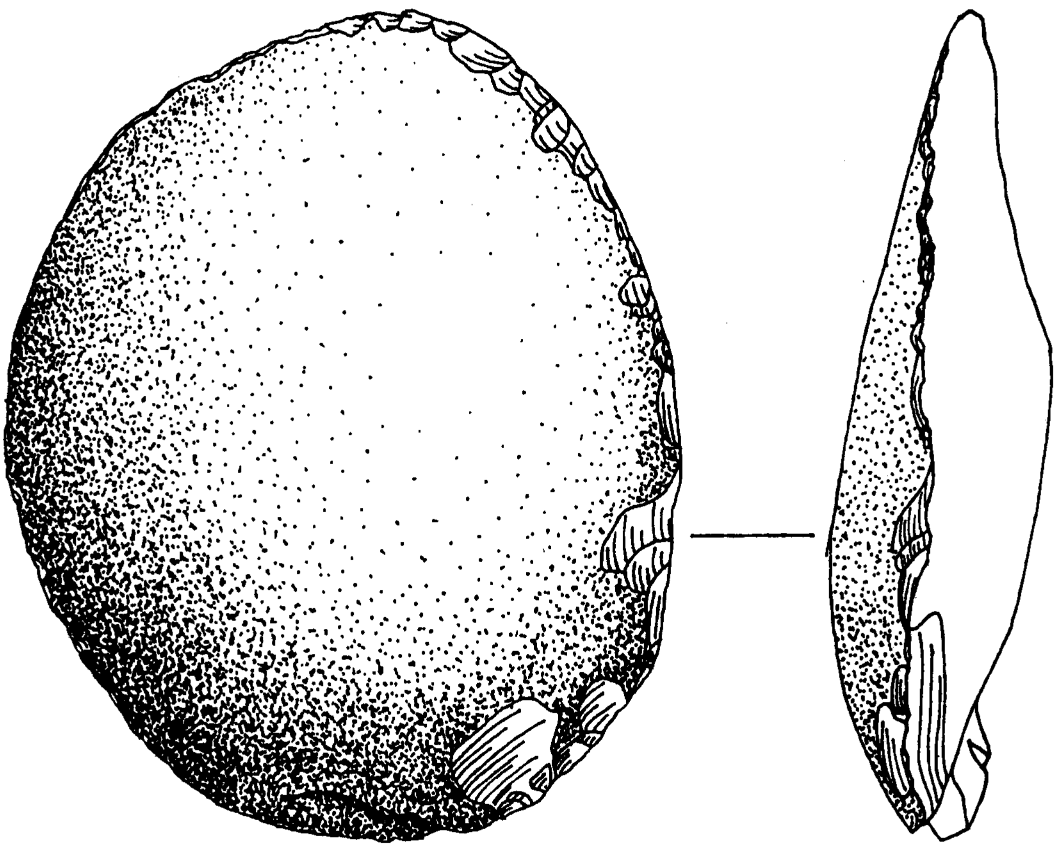


Table XLII. Dimensions of quartzite spall tools.

	N	$\overline{X}$	Range
Length	7	101 mm	84 - 113 mm
Width	7	74 mm	66 - 88 mm
Thickness	7	16 mm	12 - 22 mm
Weight	7	143 gr	79 - 245 gr

Quartzite spall tools are made on large round to oval shaped primary decortication flakes from quartzite boulders. Seven are complete, while 3 are fragments. Nine tools show continuous 'nibbling', or small irregular flakes within 5 mm of the edge, although in a few places flakes up to 20 mm long were removed. This evidence comes mainly from the smooth cortical surface since flake scars are obscured by the coarse grain of the ventral surface. Regardless of the extent of flaking, the edge contour of all tools remains very smooth and even. All tools show some edge dulling or rounding, with a few visible striations running perpendicular to the edge, and some areas of edge gloss or polish. Dimensions of complete quartzite spalls are given in Table XLII.

Ground Stone

Class 11. Celts and Celt Fragments

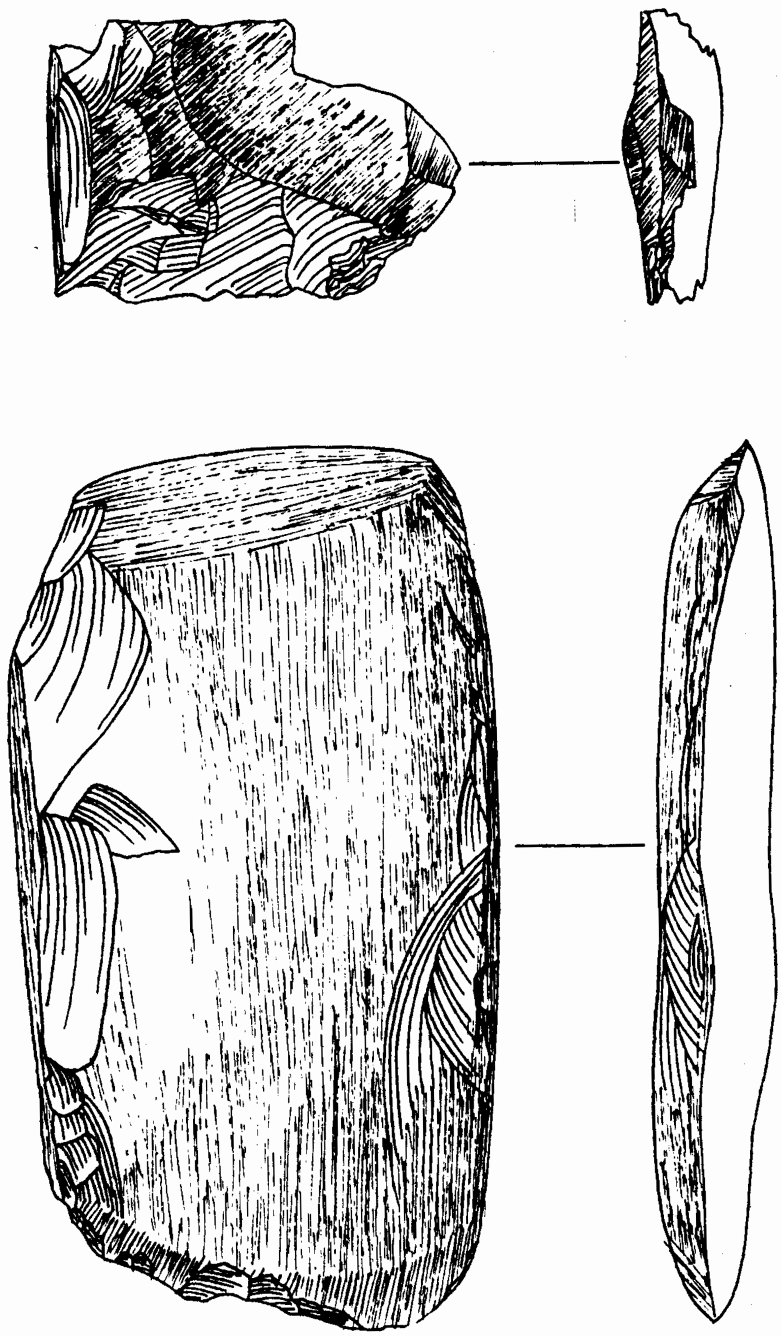
N = 17

Raw Material: silty shale (17)

Fig. 53, Plate 15B

Celts and celt fragments are defined primarily on the basis of a single complete specimen from Excavation Area 'C'. Six fragments were reassembled to form 1 incomplete tool and it is assumed that the remaining 10 flakes, which show grinding and polishing, are also celt fragments.

Fig. 53. Celts and celt fragments.



The only complete tool is subrectangular in outline, 115 x 62 x 14 mm. One end was double bevelled to an angle of about 65 degrees by grinding. This working edge is slightly convex in plan view and has fine striations less than 3 mm long running perpendicular to the edge on both faces. The long side edges of the tool have been roughly thinned by flaking, then ground and polished. One face has been more extensively ground than the other, which still retains rough flake scars. The end opposite the working edge was split by a blow to the edge, leaving a large flake scar.

Class 12. Miscellaneous Ground Stone

N = 5

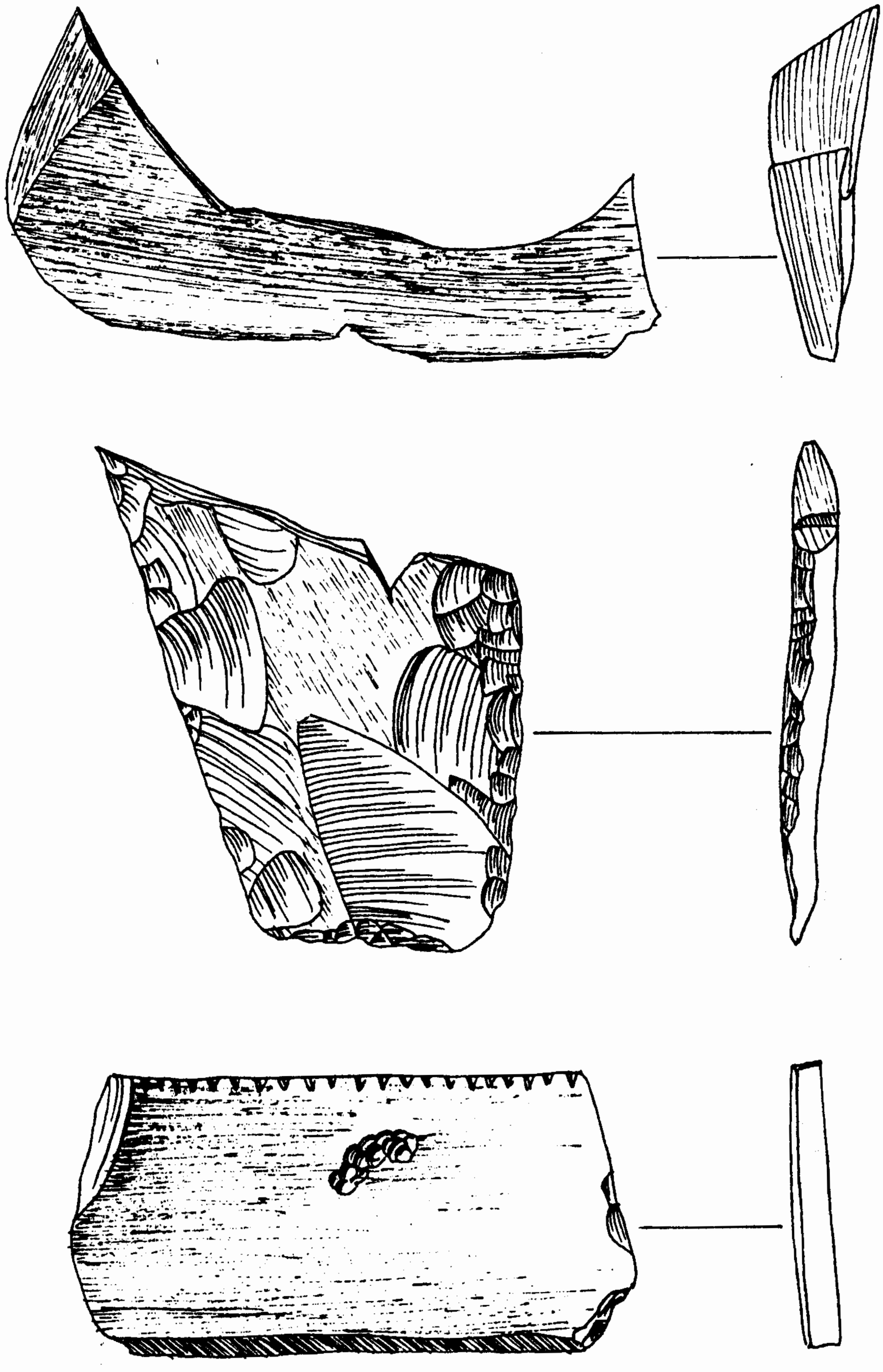
Raw Material: slate (3), sandstone (4), other (3)

Fig. 54, Plate 12 i-k

The miscellaneous pieces of ground stone are so dissimilar that they will be described individually.

1. A rectangular slab of slate (84 x 41 x 6 mm) has straight parallel sides terminating in irregular fractures at both ends. One face, completely ground to a smooth surface, is covered with long striations running longitudinally and diagonally, and there is also a small

Fig. 54. Miscellaneous ground stone.



area of pecking near the center. Twenty-one small notches are evenly spaced along 1 long edge.

2. A thin sheet of slate has irregular jagged edges with some evidence of edge rounding on a few straight segments (64 x 57 x 6 mm; weight: 30.5 gr).

3. A piece of sandstone worn to a thin crescent by abrasion on both faces was recovered from the site in 3 fragments. The crescent is thickest at both ends, and carries a longitudinal trough marked with striations on each face.

4. Another flake of sandstone has been removed from the edge of a ground and polished tool of unknown form (25 x 48 x 5 mm).

5. Lastly, 3 fragments of a metamorphic material were reassembled to form the basal end of a large flat biface. It was roughly shaped with large expanding flakes across both faces, producing a bi-plano cross section. Flakes up to 8 mm long were removed from the edges, leaving them straight and sharp. The basal edge is straight and the sides expand from the base to the broken edge. Higher ridges and flat surfaces on both faces were thoroughly ground and polished. The reassembled fragment is 76 (incomplete) x 55 x 8 mm.

Function

The final stage in the 'life' of an artifact, assuming it was not discarded during manufacture, was its use as a tool. This section will discuss some evidence of tool use at Punchaw Lake. Interpretations are based on macro-morphological traits with reference to ethnographic analogy. In addition, some inferences are supported by microscopic examination, but this is not intended as an exhaustive use-wear analysis which, with an assemblage this size, would be a thesis project in itself. Functional categories will follow the outline of technological stages presented above.

Unmodified Artifacts (N = 6546)

Despite the fact that unmodified artifacts show no evidence of secondary edge modification, they may have been used as tools. However, before unmodified edges could be examined for traces of wear, it was necessary to make a distinction between edge modifications resulting from tool use and those resulting from intentional retouch, and to explore the kinds of use wear that might be encountered.

As was the case with technological experimentation, the literature on use-wear analysis is limited to materials other than basalt. In the absence of appropriate studies, it was necessary to replicate various kinds of flake utilization on basalt. While the primary goal of these tests was to determine whether utilized edges can be distinguished from unmodified edges and/or purposely retouched edges, the results also provide preliminary guidelines for the recognition of some kinds of use-wear. Techniques of replication and resulting edges are described in Appendix D.

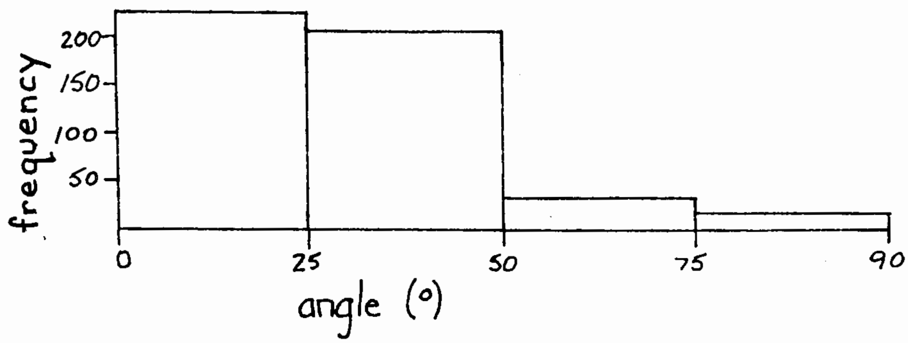
On the basis of the replication experiments, it was concluded that not all wear traces are visible at low magnifications. Edges used to cut raw meat showed no evidence of utilization at 14X. However, use on all harder materials left visible microflaking and/or edge snapping. Edges used on medium to hard materials may be distinguished from unmodified and accidentally modified edges by the presence of continuous or nearly continuous series of microflakes on 1 or both faces. Utilized edges may be distinguished from intentionally retouched edges by the limited length of microflakes, which are generally less than 2 mm long, and rarely up to 4 mm long. Specific descriptions and comparisons of utilized edges are offered in Appendix D.

Initially, all 2596 unmodified artifacts with specific provenience in Excavation Area 'C' were examined macroscopically for signs of use-wear and/or edge modification. During this examination, 370 artifacts were found to bear edge alterations within the definition of use wear, that is, continuous series of microflakes up to 2 mm in length. The lower limit of microflake length clearly visible in this cursory examination and without magnification was found to be about 1 mm. Since some artifacts had more than 1 utilized edge (Table XLIII), each edge was treated as an analytical unit. The total number of utilized edges was 485.

The same attributes recorded for unformed tools (see Technology) were measured on unmodified but utilized artifacts. The shape of the utilized edge was found to be either straight, convex, concave, recurved, denticulate, beaked, pointed, or snapped, with 78% of the tools falling in the first 3 categories. Edge shape frequencies are shown in Table XLIV.

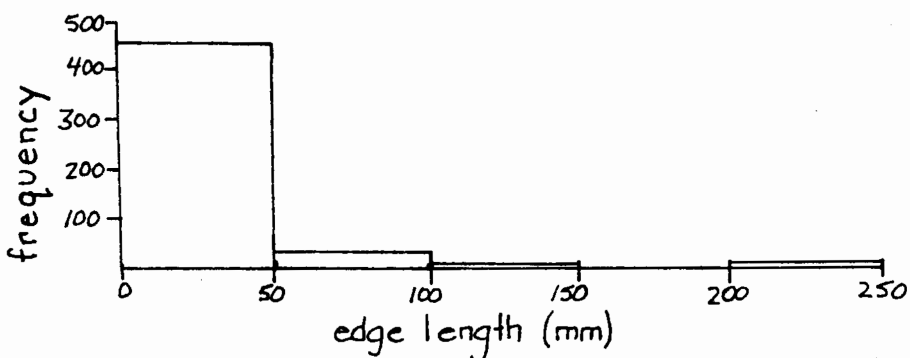
Edge modifications were grouped into 5 categories: scalar flaking, scalar flaking with edge rounding, step flaking, step flaking with edge rounding, and edge rounding, following definitions given above (p. 100). Eighty-seven percent of the tools manifested simple scalar flaking (Table XLV). In the replicative experiments described in Appendix D, only use on the hardest material, antler, produced step flaking, and edge rounding did not occur in any case.

Fig. 55. The spine-plane angle of utilized unmodified artifacts.



N = 481 $\overline{X}$ = 30 degrees Range = 5-90 degrees s = 18

Fig. 56. The length of utilized edges on unmodified artifacts.



N = 485 $\overline{X}$ = 24 mm Range = 4 - 240 mm s = 20

Table XLIII. Utilized artifacts: raw materials and number of modified edges.

	Total # Artifacts	# Modified Edges Per Tool			Total # Edges
		1 edges	2 edges	3 edges	
Basalt	342	242	91	9	451
Other	28	22	6	0	34
Total	370				485

Table XLIV. The shape of utilized edges on unmodified artifacts.

Shape	N	%
straight	170	35
convex	133	28
concave	71	15
recurved	35	7
denticulate	10	2
beak	6	1
point	47	10
snap	11	2

Table XLV. Edge alteration of utilized unmodified artifacts.

Alteration	N	%
scalar flaking	419	87
scalar flaking with edge rounding	14	3
step flaking	41	9
step flaking with edge rounding	1	0
edge rounding	8	2

Table XLVI. Location of use-wear on unmodified artifacts.

	N	%
Unifacial	385	80
Bifacial	34	7
Alternate	64	13

Tringham *et al* (1974: 188-189) report that when flint edges are utilized, the first microflakes to be detached leave scalar scars, regardless of the subject material. Further use on hard materials (bone and antler) quickly results in hinge fracture and step flaking, while even prolonged use on soft materials (skin and flesh) produces only scalar microflakes. Similarly, Keller (1966: 508) reports that using unmodified obsidian flakes for paring, sawing, or scraping soft wood and scraping flesh from cowhide produces only microflakes and edge dulling even after extensive use, whereas paring or shaving hard wood produces step flaking and denticulate edges.

On the basis of these observations, it is concluded that the 87% of utilized edges with scalar microflaking must have been used extremely briefly or exclusively on soft to medium hard materials while the 9% of edges with step flaking must have been used on hard materials such as antler. There is no clear association between type of flaking and edge angle categories. No conclusions can be drawn concerning the cause of edge rounding or dulling on basalt except to suggest that it may be produced by friction against a pliable substance. In this regard, it is interesting to note that while scalar and step flaking were associated with every edge shape, edge rounding was found independently only on straight and convex shapes which are probably more suitable for scraping soft materials such as skin or hide.

Eighty percent of utilized artifacts were found to have only unifacial alteration; this total may be increased to 93% by including alternate use-wear in the unifacial category (Table XLV). Only 34 artifacts, or 7%, had bifacial use-wear. Unifacial wear was created experimentally by paring and scraping actions, while bifacial wear was created by paring and sawing. (This is in contradiction to Keller's (1966: 50) observation that paring and sawing soft wood produce mainly unifacial microflakes.) A large proportion of edges with alternate wear are points, indicating a possible function as perforators used in a twisting motion.

Unmodified edges selected for use had spine-plane angles between 5 and 90 degrees, with a mean angle of 30 degrees (Fig. 55). The great majority of narrow angles suggests that strength was not sought after in unmodified tools. In his study of Paleo-Indian artifacts, Wilmsen (1968: 986) found 3 peaks in the frequency curve of spine-plane angles: 26-35 degrees, 46-55 degrees, and 66-75 degrees. He equates these peaks with different functional capacities, with narrow angles suitable for cutting meat and skins, medium angles suitable for a variety of tasks including skinning, scraping, shredding, and heavy cutting, and wide angles suitable for woodworking and heavy fiber shredding. The utilized artifacts from Excavation

Area 'C' show 1 major peak (10-20 degrees) in a range even more narrow than Wilmsen'S proposed "meat and skin cutting" range. There is also a slight 'bulge' in the middle range (50-60 degrees) and a third small peak at the wide end of the scale (70-80 degrees). It might also be noted that none of the obtuse angles (90-130 degrees) reported by Crabtree (1973b: 46) as functional edges were discovered in our sample.

Lastly, the length of utilized edges ranged from 4-240 mm with a mean length of 24 mm (Fig. 56). In fact, 94% of utilized edges were less than 50 mm long, with only 1% longer than 100 mm.

To summarize, 370 unmodified artifacts exhibit traces of use-wear extending 1-2 mm from the tool edge. The utilized edges are primarily straight, convex and concave, although recurved, denticulate, beaked, pointed, and snapped forms are also recognized. Most edges have simple scalar microflaking suggesting use on soft to medium hard materials, although a few step flaked edges also suggest use on hard materials. Most utilized edges are unifacial, although a few are bifacial or alternate. A specialized function, as perforators, may be hypothesized for 22 tools with alternate wear on points. Spine-plane angles on utilized tools are primarily narrow, indicating that strength was not a criterion for selection. Utilized edges are generally short with an average length of 24 mm.

Considering that the lower limit of clearly observable use-wear in this examination was about 1 mm, the possibility arose that some wear traces had been overlooked. This possibility was explored by re-examining a sample of 100 randomly chosen unmodified artifacts that previously had shown no wear. Edges were scanned from both faces using a binocular microscope at low magnification (14X).

Of 100 artifacts, 54 showed no edge alteration. Another 21 have discontinuous flaking and/or snapped edges which in themselves do not constitute good evidence for use. This brings the total regarded as non-utilized to 75. Twenty-five artifacts, or 25% of the sample, exhibit continuous flaking or edge rounding constituting use-wear. In all cases, the use-wear extends less than 1 mm from the edge and could not be readily identified without magnification.

Microflaking, consisting of simple scalar flaking, occurs on 23 of the 25 utilized flakes. In 20 cases, microflakes are unifacial, and in 3 cases bifacial. Two of the unifacial edges are also rounded, as is 1 of the bifacial edges. Edge rounding occurs independently only twice, where it is combined with arris rounding on 1 tool.

The absence of crushing combined with the short length of microflakes suggests that these artifacts were used on soft to medium hard materials. Unifacial microflakes less than 1 mm long were replicated experimentally by paring frozen meat and bone and scraping wood and bone, while bifacial microflakes less than 1 mm long were replicated by paring wood and sawing wood, frozen meat, and bone. Edge rounding on some edges suggests use on more pliable surfaces.

The total number of unmodified artifacts used in this study is 2596. Of this total, 370 artifacts, or 14%, show use-wear that extends 1-2 mm from the edge and is visible without magnification. In a sample of 100 artifacts drawn from the remaining 2226, 25% have use-wear that extends less than 1 mm from the edge and is only clearly visible under magnification. If this percentage is applied to the total collection, the number with use-wear extending less than 1 mm from the edge may be estimated to be about 557 tools [± 195 tools (95%)]. Combining these 2 categories, a total of 39% of artifacts exhibit some form of use-wear visible at 14X.

In addition to the bulk of unmodified artifacts, 21 unmodified blades were also examined under low magnification (14X) for signs of use. 11 blades or blade fragments show no edge alteration. One blade-like-flake, rounded over the dorsal surface but lacking edge wear, may have been removed from a utilized tool. The remaining 9 blades and blade fragments show evidence of use in the form of continuous series of microflakes sometimes combined with edge rounding.

More specifically, 1 complete blade has continuous scalar flaking up to 1 mm long on the ventral surface of 1 edge. Two fragments also have unifacial use-wear in the form of flakes removed from 1 or both long edges; of these, 1 is also heavily rounded over both dorsal and ventral surfaces. Five blade fragments have alternate retouch, that is, flaking along 1 long edge dorsally, and the opposite edge ventrally. Flake scars range from .2 to 2.0 mm long, and on 2 tools the opposing utilized edges are both concave in outline. None of these tools are rounded. The last blade has cortex providing 'backing' along 1 long edge; the opposing edge has bifacial microflakes up to 1 mm long and the entire tool is heavily rounded on all surfaces and edges.

The predominance of simple unifacial scalar microflaking, combined with the absence of rounding on the utilized edge, suggests that 8 blades were used in a transverse action on medium hard materials. Similar uniform and steep flake scars are most closely approximated by scraping bone or wood in replication experiments. The single heavily rounded and bifacially flaked edge may have been used to 'saw' or cut a pliable substance.

Modified Unformed Artifacts (N = 108)

By definition, modified unformed artifacts have retouch flakes longer than 2 mm (in fact, retouch flakes average 5 mm long). Edge attributes, described in detail above (see Technology), indicate that unformed tools generally have short areas of retouch on predominantly straight or convex edges with narrow (10-20 degrees) or middle (50-60 degrees) spine-plane angles. Flaking is either scalar or stepped, but is more often unifacial than bifacial or alternate.

Edge shapes on modified tools are compatible with a wide range of uses. Most edge shapes are also associated with a variety of spine-plane angles, from very acute to nearly obtuse, although the denticulate and the recurved shape are found exclusively on spine-plane angles less than 60 degrees. Some edge shapes (concave, denticulate, point, and beak) have primarily unifacial edge modification, but more common shapes (straight, convex, recurved, and notch) show both unifacial and bifacial modification.

Scalar and step flaking are found in equal proportions on most edge shapes, except that the notch and beak are exclusively step flaked. Scalar flaking, reflecting use on soft to medium hard materials only (if the tools were used at all), is more common on narrow spine-plane angles, while step flaking is distributed more evenly on all angles. In other words, wider spine-plane angles are step flaked more often. However, on intentionally modified tools step flaking may result from use-wear overlapping the retouched edge rather than use on hard materials. Edge rounding, presumably the result of use on pliable materials, occurs rarely on unformed tools (N = 5), and is found only on convex, recurved and pointed edges with spine-plane angle less than 50 degrees.

In some respects, minimally retouched tools are similar to unmodified but utilized tools, being predominantly unifacial, with short lengths of retouch and narrow spine-plane angles. Both utilized and minimally retouched tools also show a small peak in the middle range of spine-plane angles, although retouched tools lack a third wide angle peak. Apparently the few very wide angles selected for use did not require edge modification. On the other hand, step flaking is much more common on retouched tools (49%) than on utilized tools (9%), either as a result of manufacturing technique or through use on harder subject materials.

Modified Formed Artifacts (N = 278)

Modified formed artifacts will be considered by formal classes with categories for preforms and broken fragments eliminated.

Class 1. Steep edge formed unifaces (N = 32)

Due to their evenly convex, unifacially retouched edge, these tools resemble ethnographically recorded skin scrapers. Subclass 1-A, 'large steep edge unifaces with expanding edges', in particular compares favorably in size and edge angle with 2 collections of Eskimo socketed skin scrapers, as shown in Table XLVII (Nissen and Dittemore 1974:88; Wilmsen 1968:157). This is, of course, intended to represent a functional analogy, not a genetic relationship. Although their overall configuration is comparable, 'small steep edge unifaces with expanding edges' (Subclass 1-B) and 'steep edge unifaces with contracting edges' (Subclass 1-C) have smaller average dimensions and narrower average edge angle.

It has been suggested that skin scrapers can be used either hafted or unhafted, by either pushing the tool away from the operator or drawing the tool towards the operator with each technique leaving distinctive wear patterns (Nissen and Dittemore 1974: 68). To locate wear on Excavation Area 'C' unifaces, the artifacts were examined under low maginification (14X).

As a group, the Excavation Area 'C' unifaces are heavily worn, with flaking and/or rounding on almost every surface and edge. Because wear patterns are similar in all

	N	Tool Width	Tool Thickness	Edge Angle $\bar{X}$	Edge Angle Range
Lowie Museum Eskimo scrapers	9	38 mm	8 mm	58°	49 - 69°
U.S. National Museum Eskimo scrapers	19			59°	
Punchaw Lake Area 'C' Subclass 1-A	8	32 mm	10 mm	60°	40 - 70°
Punchaw Lake Area 'C' Subclass 1-B	19	26 mm	8 mm	50°	40 - 70°
Punchaw Lake Area 'C' Subclass 1-C	3	26 mm	6 mm	50°	40 - 70°
Punchaw Lake Area 'C' Subclass 1-D	2	50 mm	11 mm	40°	

Table XLVII. Comparative scraper dimensions.

subclasses, they will be described together. Of 32 unifaces under consideration, 21 show extensive rounding of arrises and protrusions over both dorsal and ventral faces; 4 tools exhibit similar rounding of the dorsal surface only, and 1 tool of the ventral surface. The steeply retouched edge is step flaked in 30 cases; 26 of these are subsequently rounded over the flake scars, while 1 chert tool shows polish across only 1 corner of the retouched edge. Five unifaces have a few discontinuous, shallow flakes removed from the ventral, or underside of the retouched edge. Rounding extends 1-3 mm from the working edge onto the ventral surface on 29 tools, while on 19 of these edge rounding continues around the entire perimeter of the tool. It is also noted that of 7 unifaces with snapped edges (see Form), 6 show subsequent dulling and rounding of 1 or both snapped edges, suggesting that they may have been broken intentionally.

Nissen and Dittemore (1974: 68-71) report that Eskimo scrapers, used in a 'pushing' fashion, sustain edge dulling and polish only near the bit on the ventral surface. They also refer to Semenov's conclusion that tools used in a 'pulling' fashion have no evidence of wear at all on the ventral surface. If these observations are correct, then the 91% of Excavation Area 'C' unifaces which are rounded onto the ventral surface must have been used by 'pushing'. Rounding on the proximal end, and to some extent on the dorsal and ventral surfaces, which occurs on 80% of the tools, probably results from friction against the hand or haft.

Class 2. Miscellaneous Formed Unifaces (N = 4)

The roughly rectangular basalt blade and the asymmetrical chert leaf shape are both heavily rounded over both faces and around the entire edge. There is no wear differential to indicate manner of holding or hafting, but the heavily rounded edge suggests friction against a pliable material.

The third miscellaneous uniface, a basalt 'triangle', is most heavily step flaked in the concave segments between vertices or points. The points themselves show some step flaking and slight rounding. While a transverse action is suggested by the extensive unifacial wear, it is difficult to envisage the irregular edge of this tool used against soft skin or hides. This conclusion is also supported by the absence of edge rounding on concave segments.

Lastly, most wear on the pink chert uniface fragment is concentrated near the 'beak' at the intersection of convex and concave segments. While the entire dorsal edge is step flaked, a few ventral flakes and edge polish are restricted to the beak underside.

Class 5. Bifacial Points (N = 55 complete)

In his 1893 monograph on the Carrier, Morice mentions that stone points served as arrowheads, spears, daggers, and bayonets (or bow points). He describes the bayonet as larger and wider than the arrow point, the spearhead as larger but with a narrower base than the bayonet, and the stone dagger as a long blade (8 - 10 inches) with a short handle (Morice 1893: 60-63).

Symmetrical contour, sharp edges, and points make the archaeological specimens suitable for piercing and/or cutting actions. Notches and stems also indicate that most points were hafted. However, before placing the tools into a functional category, 47 points were examined under low magnification. It was found that edges and surfaces commonly exhibit rounding or smoothing that is not clearly visible without magnification.

Many of the bifacial points show rounding on some part of the hafting element which was either done intentionally to facilitate hafting, or perhaps by friction against the haft during use. On 24 complete small (Subclass 5-A) and large (Subclass 5-B) side notched points, the sides of the base are usually rounded (N = 21), while the basal edge is sometimes rounded (N = 7) but more often unmodified after thinning.

The surfaces of the base are also occasionally rounded on arrises and protrusions (N = 10). The notches themselves were never smoothed, but steeply flaked on 1 or both faces. Blade faces and edges also show wear near the notch that was probably related to hafting. Twelve side notched points show surface rounding concentrated in the area just above and between the notches, as well as blade edge rounding extending 2-10 mm from the notch.

'Hafting wear' on corner notched points is not as extensive. Of 11 complete corner notched points, only 3 'corner notched with convex bases' (Subclass 5-C) show rounding of both the basal edge and basal surfaces. Three other points have similar light rounding of only the basal edge. Blade edge rounding possibly related to hafting is more common: 7 corner notched points have rounding extending 2-10 mm along the blade edge from the notch.

While 2 of 3 stemmed points (Subclass 5-H) are extensively worn over all surfaces and edges, there is no clear differential in stem wear to demonstrate hafting. Similarly, all 3 leaf shaped points (Subclass 5-I) are rounded over the entire edge with heaviest wear in the form of rounding at the pointed tip. Three of 6 miscellaneous points (Subclass 5-J) uncharacteristically lack any wear at all, supporting the hypothesis that they are unfinished preforms. The pentagonal point has no apparent basal wear, but the remaining tools, both lanceolate, are heavily worn. One of these, with a convex base, is step flaked and heavily rounded around the base and along blade edges up to the shoulders. The other, with a steeply flaked concave base, is also heavily rounded, perhaps intentionally ground, around the projecting basal 'ears'.

Wear on blade faces and edges is more likely to have resulted from contact with the subject material. On 8 side notched points the blade is surface rounded over arrises and the blade edge is slightly dulled all the way from notch to tip. Blade edges only are rounded on 6 tools. On 2 obsidian points this wear takes the form of crushing and microflaking of arrises and edges, and on 1 obsidian tool there are a few striations visible running parallel to the blade edge near the edge. While this evidence is hardly conclusive, it may reflect longitudinal tool movement in a cutting or sawing action.

A comparable proportion of corner notched points show blade wear. One large convex based point has rounded arrises over both surfaces and the entire edge is also rounded. Five small points with convex bases are rounded only on dorsal and ventral surfaces and 1 of these is smoothed over the point tip as well.

As mentioned above, 2 stemmed points are rounded over surface arrises and the entire edge. The third shows no wear at all, perhaps because it is made of chert. Three leaf shaped points are also extensively rounded, with heaviest wear at the point tip. One lanceolate point has rounded blade edges all the way to the tip, the convex based lanceolate is heavily step flaked to the blunt tip but shows only slight rounding, and the concave based lanceolate is dulled on protrusions along the blade edge and worn smooth over the broken edges of the tip.

None of the bifacial points exhibits the burin-like scars at the tip or the longitudinal striations proposed as evidence of impact damage (Wylie 1975: 8), although the actual point tip has been broken by transverse snap fracture on 6 side notched and 3 corner notched points.

To summarize the results of point examination, most points show basal wear probably related to hafting. Many points also show blade wear presumably resulting from use, however the use-wear, consisting of edge and arris dulling and rounding, is not the kind expected from impact damage. In other words, wear on 28 of 47 points (60%) suggests use involving friction against the worked material producing edge dulling without fracture. In fact, there is more direct support for the use of these points as knives than as projectiles.

Sanger (1970: 107) has suggested that neck width may reflect projectile function, with wide necks suitable for heavy spear shafts and narrow necks more appropriate for light arrow shafts. His projectile point sequence shows a gradual decrease in neck width through time, from an average 17 mm to 7 mm. Excavation Area'C' notched points are within the narrow end of this scale with average neck widths for subclasses ranging from 9-13 mm. However, in view of their apparent use in capacities other than projectiles, there is no reason to assume that they were hafted to arrow shafts at all. Stem width on 4 stemmed points ranges from 10-28 mm, clearly too wide for arrow shafts.

Class 6. Convex Bifaces (N = 27 complete)

Convex bifaces, as a group, have heavily battered and dulled edges combined with arris rounding over the faces. Apparently these tools saw long periods of rigorous use. They too were examined under low magnification (14X).

In strictly formal terms, the 'semicircular bifaces' (Subclass 6-A) have a particular orientation, with the thick base at 1 end and the thin fan-like edge at the other. In all but 1 case, both tool faces are rounded. This rounding is usually intensive, and if it is not the result of intentional polish, it must represent extensive use. Edges are extremely rounded and in places battered, leaving heavily step flaked segments cn 10 tools. In contrast to the bifacial points, striations are clearly visible on several edges, even without magnification. On 3 different tools these scratches are perpendicular or oblique to the edge, while on another tool they are parallel to the edge. Contrary to expectations, rounding continued around the tool base in 9 cases, and on 2 was noticeably heavier than rounding on the tool edge. While this basal wear may result from hafting, it seems more probable that the thick base was also a functional edge.

The chert ovoid (Subclass 6-B) is heavily step flaked and rounded over the edge and polished to a gloss on both faces. The subrectangular chert biface is crushed and battered around the perimeter but exhibits no polish.

Irregular (Subclass 6-C) and circular (6-D) convex bifaces have no particular orientation. All 4 irregular bifaces are rounded over both faces and have rounded or dulled edges with intervals of step flaking. Of 6 circular bifaces or discoids, 5 are at least slightly rounded on both faces (the sixth is heavily patinated). Four show some step flaking and rounding on the edges, but 2 have no visible edge wear.

Class 7. Miscellaneous Bifaces (N = 3)

The miscellaneous bifaces appear to be as miscellaneous in terms of function as in form. The leaf shaped biface is rounded over both faces and the edge has intervals of step flaking and rounding; the constriction at 1 end is even more heavily rounded, whether from use or hafting. The cigar shaped basalt tool is also steeply step flaked around the edge and subsequently rounded over all faces and edges. Finally, the wedge shaped biface is rounded on both faces but shows only step flaking on both the thick blunt end and the thin blade end.

Class 9. Pieces Esquillees (N = 6)

It has been hypothesized that pieces esquillees were used as wedges in the manufacture of bone and antler tools (MacDonald 1968: 88-90). In support of this view, only 1 of 6 tools examined shows slight rounding on arrises of both faces. This same tool, as well as 1 other, also exhibits slight edge dulling of the unmodified edge rather than the flaked and crushed 'bipolar' edge. Bipolar edge battering thus remains the predominant damage on these flakes, and is consistent with use as wedges.

Class 10. Cortical Spall Tools (N = 10)

Cortical spall tools similar to those from Excavation Area 'C' occur commonly in archaeological sites in the Northwest, as well as other parts of North America. They were collected ethnographically from the Shoshone and Ute, where they functioned as women's knives for butchering and skin dressing (Eyman 1968: 9-12). According to Morlan (1973: 251), both boulder spalls and the closely related "tci-de-tho" from the Yukon served as hide scrapers and "their scraping and planing function can still be observed in Old Crow...". Morice illustrates a "stone scraper" made from half of a pebble, that was used by the Carrier in tanning hides, and resembles a cortical spall tool. He also records that the scrapers were hafted temporarily for use (1893: 49-51).

Turning to the archaeological analysis of cortical spalls, Coulsen observed 5 classes of edge wear on a large sample of spall tools from Fraser River sites, and concluded that they may have been used to deflesh or dehair hides, or in some stage of fish preparation (1971: 22). On the basis of tool morphology, Ham proposes 2 functions for another sample of cortical spalls from the same region: tools with edge polish were used in dressing hides, while heavier spalls with chipped edges were used as choppers (1975: 164). Multiple functions have also been hypothesized for spall tools from 3 sites in the Fraser Valley. Both Hansen (1970: 192-198) and Von Krogh (1976: pers. comm.) have identified retouch flaking, edge battering, polishing, and notching on spalls from this area. Hansen suggests that notches served as spokeshaves, abraded V-shaped edges as stone cutting saws, and battered and blunted edges as pounding tools in activities such as bark shredding (Hansen 1970: 198).

The Punchaw Lake Area 'C' sample of spalls lacks notched or V-shaped edges which were probably associated with specialized activities such as nephrite carving in the Fraser Valley. All of the spalls and fragments have dulled edges, in places heavily rounded with striations perpendicular to the edge. Battered and flaked edges possibly resulting from pounding actions are found in conjunction with rounded edges on 3 tools, but the remainder lack heavily chipped edges altogether. It is concluded that the Excavation Area 'C' spalls were primarily intended for uses involving friction, such as hide processing, but were also occasionally used as pounding or chopping tools.

Class 11. Celts (N = 1 complete)

The single complete chipped and ground shale celt displays no grooves or notches to indicate hafting method. It has only 1 working end with a slight double bevel producing an edge angle of from 60 to 70 degrees. The bit, as well as most of the tool surface, is polished to a smooth gloss and striations can be clearly seen without magnification. Long striations parallel the working edge, and are crosscut by short (less than 3 mm long) striations perpendicular to the edge. It is not known whether these result from manufacture or use. The tool could theoretically have been hafted as an axe or adze, or may even have served as a large chisel, wedge, or hand-held chopping tool (Sonnenfeld 1962: 56).

Morice refers to tools ground over their surface as axes or adzes interchangeably (1893: 44-46). With reference to "finer axes" he states that "among the Carrier such instruments were possessed by the notables and a few wealthy heads of families only", and also asserts that "their best axes were bartered from the Sekani and sea-coast Indians (1893: 46-47).

Class 12. Miscellaneous Ground Stone

As mentioned in the tool description, extensive abrasion and longitudinal striations on the sandstone fragment suggest that it may be a grinding stone. In the absence of ethnographic parallels it is not possible to infer functions for any other ground stone artifacts.

Chapter 4. The Occupation of Area C

A. Vertical Patterning

As pointed out earlier, cultural deposits in Excavation Area C show no obvious vertical separation into occupation units or 'living floors'. Due to slow natural deposition, the cultural matrix is a very concentrated deposit with a high density of artifacts.

Three charcoal samples from Excavation Area C were submitted for C-14 dating. A combined sample of wood charcoal fragments from Level 3 of pit 16-18 North, 12-13 East at the north end of the Excavation Area produced a date of 1510 ± 100 B.P.: A.D. 440 (Gak-6230). A second wood charcoal sample from the bottom of Cultural Feature 6 (shallow depression) in pit 12-14 North, 8-10 East, corresponds closely to the first date at 1470 ± 100 B.P.: A.D. 480 (Gak-6231). The third charcoal sample, taken from near the surface of Cultural Feature 4 (hearth) in pit 10-12 North, 4-6 East, was dated 240 ± 150 B.P.: A.D. 1710 (Gak-6232). The older dates from the lowest levels, and the younger date from near the surface are assumed to bracket the period of occupation, indicating a 1200 year span.

Given a 1200 year period of occupation, whether continuous or discontinuous, the possibility arose that stone artifacts might show some vertical patterning reflecting attribute change through time. In the absence of stratigraphic boundaries, this possibility was tested by separating the deposit into vertical levels and comparing the levels in terms of artifact content.

The first step in testing for vertical patterning was choosing the optimal depth for each analytical level. One consideration in this decision was the amount of post-depositional disturbance. Extensive root and rodent activity was observed throughout the cultural matrix, and particularly in the top 20 cm. An attempt was made to evaluate the significance of this displacement by plotting the locations of broken artifact fragments. The assumption was made that broken fragments were originally discarded in approximately the same location.

A total of 17 broken artifacts, represented by 44 fragments, was plotted 3-dimensionally on site maps. In terms of measurements below ground surface, in 11 cases fragments of the same artifact were found within 10 vertical cm of each other, but in the remaining 6 cases, parts were separated by up to 20 vertical cm. In terms of horizontal location, the distance between fragments of the same artifact ranged from 10 to 730 cm, averaging 150 cm. In a cultural deposit only 30-40 cm deep this presents serious problems for recognition of discrete occupations. Due to the probability of post-depositional disturbance, combined with the clumsiness of calculating exact sub-surface provenience from depth below datum measurements, it was felt that arbitrary 10 cm below surface levels would be the most appropriate units for comparison.

Attributes representing all stages of the artifact life history (Raw Material, Technology, Form, Function) were selected and evaluated per 10 cm level of each excavation unit. The computer performed frequency counts and simple descriptive statistics. Tested attributes are listed in Table XLVIII, and excavation units are illustrated in Fig 57. Comparisons were made individually between vertical levels of each excavation unit and, where samples were large enough, the chi-square test of independence was used to evaluate the relationship between attribute and level. Attributes with small sample sizes (less than about 30), labelled 'small sample' on Table XLVIII, were plotted on site maps and visually evaluated.

Table XLVIII. Attributes tested for vertical patterning.

Raw Material
- frequency of each raw material
- frequency of obsidian from each source

Technology
- frequency of decortication flakes
- frequency of end-struck cores
- frequency of unpatterned secondary cores and flakes
- frequency of blades (small sample)
- frequency of platform remnants (small sample)
- frequency of modified unformed tools
- frequency of modified formed tools

Form
- frequency of steep edge formed unifaces (small sample)
- frequency of miscellaneous formed unifaces (small sample)
- frequency of side notched points (small sample)
- frequency of corner notched points (small sample)
- frequency of stemmed points (small sample)
- frequency of leaf shaped points (small sample)
- frequency of semicircular convex bifaces (small sample)
- frequency of ovoid/subrectangular bifaces (small sample)
- frequency of circular bifaces (small sample)
- frequency of pieces esquillees (small sample)
- frequency of spall tools (small sample)
- frequency of celts and celt fragments (small sample)
- frequency of miscellaneous ground stone (small sample)

Function
- frequency of utilized unmodified tools with scalar microflaking, step flaking, and rounded edges
- frequency of utilized unmodified tools with spine-plane angle 10-30 degrees, 50-60 degrees, and 70-80 degrees
- frequency of modified unformed tools with scalar microflaking, step flaking, and rounded edges

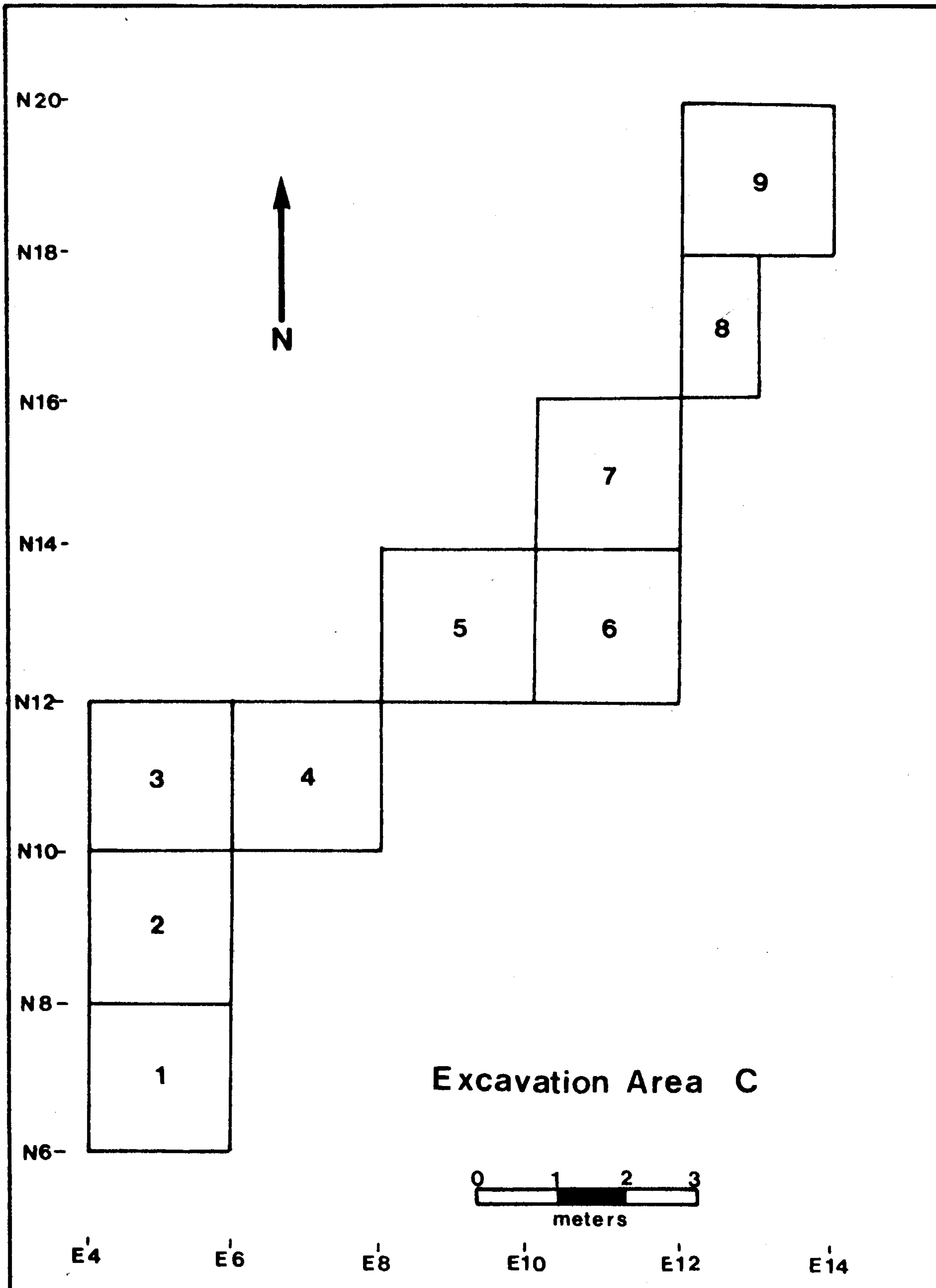


Fig. 57. Excavation units used in tests for vertical patterning.

While a few attributes show a statistical relationship to vertical level, the results are inconsistent and difficult to interpret. Three attributes (raw material frequency, frequency of cortical flakes, and frequency of modified unformed artifacts) show significant relationships to level, but this is limited to 3 excavation units and does not follow the same pattern in all 3 units. For example, raw material frequencies are significantly related to level in excavation units 5,6 and 9, in the north half of Excavation Area C. However, high chi-square values were produced by a high frequency of chert in the upper levels of Unit 9, but the lower levels of units 5 and 6 (Fig. 58). The anomalous frequency of chert in Unit 9 may be explained by the presence of a very specific 'activity area' at the northern extremity of the excavation area, where grey-brown chert was flaked. This area will be described below. In Units 5 and 6, on the other hand, high chert frequencies (causing high chi-square values) are produced by several kinds of chert.

The frequencies of decortication flakes and modified unformed tools show significant relationships to level in excavation units 5,6 and 5,9 respectively. However, in both cases very small samples (expected frequencies less than 3) cast doubt on the reliability of the results.

Fig. 58. The relationship of raw material to vertical level: chi-square test format and results.

Excavation unit 5

Level	Raw Material: Basalt	Obsidian	Chert	Other
1	270 (261)	5 (4)	6 (15)	2 (3)
2	374 (375)	4 (5)	22 (22)	7 (4)
3	167 (119)	3 (3)	19 (10)	0 (2)
4	10 (10)	0 (0)	1 (1)	0 (0)

Chi-square value : 38.47

Excavation unit 6

Level	Raw Material: Basalt	Obsidian	Chert	Other
1	229 (217)	2 (1)	10 (25)	4 (3)
2	331 (315)	2 (1)	20 (36)	3 (4)
3	534 (538)	2 (1)	65 (61)	6 (6)
4	207 (231)	0 (1)	52 (26)	2 (3)

Chi-square value : 48.81

Excavation unit 9

Level	Raw Material: Basalt	Obsidian	Chert	Other
1	350 (299)	7 (5)	57 (59)	5 (3)
2	184 (236)	2 (4)	102 (46)	1 (3)
3	24 (23)	1 (0)	3 (5)	0 (0)
4	1 (1)	0 (0)	0 (0)	0 (0)

Chi-square value : 92.03

Similarly, only a few attributes with sample sizes too small for statistical analysis are clearly restricted in vertical distribution. Miscellaneous ground stone, platform remnants, biface midsection fragments, and discoid bifaces are found primarily or exclusively in the top 20 cm of the deposit, while stemmed points, ovoid and subrectangular bifaces, symmetrical point tip fragments, and pieces esquillees are found primarily or exclusively in the lower levels (10 cm below surface and lower).

While these observations suggest some possible changes through time, lack of consistency and small sample sizes prevent the separation of distinct vertical components. This is not to say that consistent changes could not have occurred over a period of 1200 years. Rather, the compact nature of the archaeological deposit, produced by short seasonal occupations in shifting horizontal locations, combined with post-depositional mixing, makes it impossible to isolate vertical units by presently available methods.

B. Horizontal Patterning

Two very specific activity areas relating to the manufacture of stone tools were identified. The first, consisting of a concentration of about 75 basalt flakes and microflakes, was found in an area about 40 x 40 cm wide and less than 5 cm deep. This pile of lithic debitage (Plate 15A), clearly derives from the reduction of a single core, and probably represents a short flaking session by an individual knapper.

The second activity area consists of 108 pieces of grey-brown opaque chert concentrated in the most northerly excavation unit (Fig. 59). All unmodified pieces of this material (N=99) are restricted to the north half of Area C. These unmodified pieces include 6 blocky core fragments, 91 miscellaneous flakes, and 2 platform remnants. In addition there are 3 possible biface thinning flakes. Nine modified pieces, including 8 unifacially retouched flakes and 1 bifacial point, show a broader spatial distribution, with 3 tools in the southern half of Area C (Fig. 59). The very limited distribution of this homogeneous material suggests that at least 1, but possibly several chert cores were reduced in a 'workshop' about 1 m square. Modified tools were probably later moved to other parts of the site.

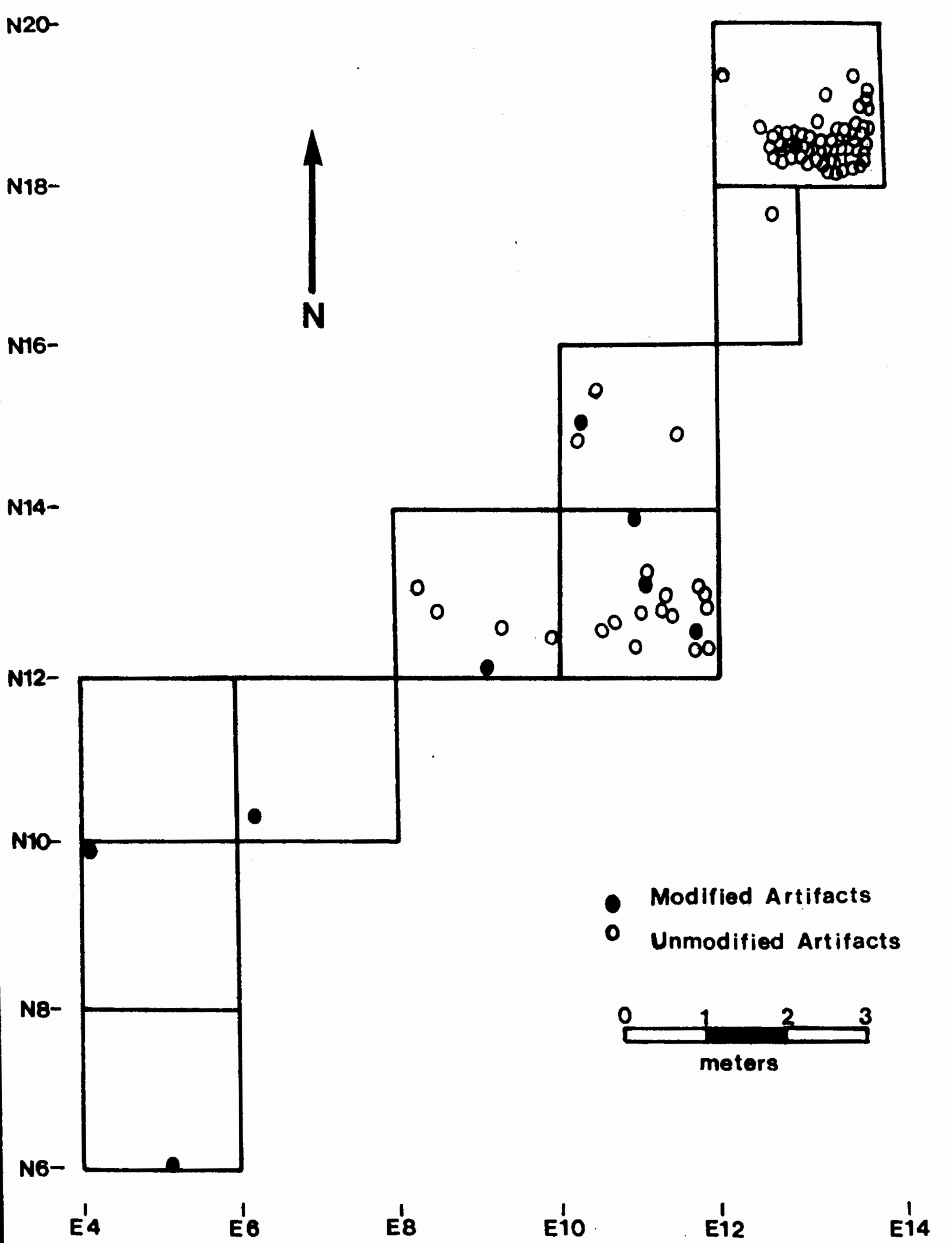


Fig. 59. The distribution of grey-brown opaque chert in Excavation Area C.

In Chapter 3, it was suggested that, rather than representing 4 separate 'house platforms', the ground surface contours and depth of cultural deposit in Excavation Area C indicate only 2 areas of habitual occupation, each associated with a hearth. This possibility was explored by dividing the site into proposed occupation areas and comparing their artifact content.

The attributes used previously in the test for vertical patterning (Table XLVIII) again provided the basis for comparison. Initially, Excavation Area C was divided into 4 horizontal sections, each corresponding to a 'house platform' as originally mapped during the 1973 field season (Fig. 60). Attribute counts were tabulated per 'house platform' and the chi-square goodness of fit statistic calculated for each attribute, with expected frequencies based on the proportions of total artifacts within each 'platform'. Fig. 61 illustrates the format used for these chi-square tests, while Table XLIX lists 11 attributes which produced significant values of chi-square at the .05 significance level.

The results of this survey indicate differential horizontal distribution of certain artifacts, but they do not specify the areas in which frequencies depart from expected values. This problem was pursued by re-evaluating the 11 attributes, comparing frequencies first between the 2 large

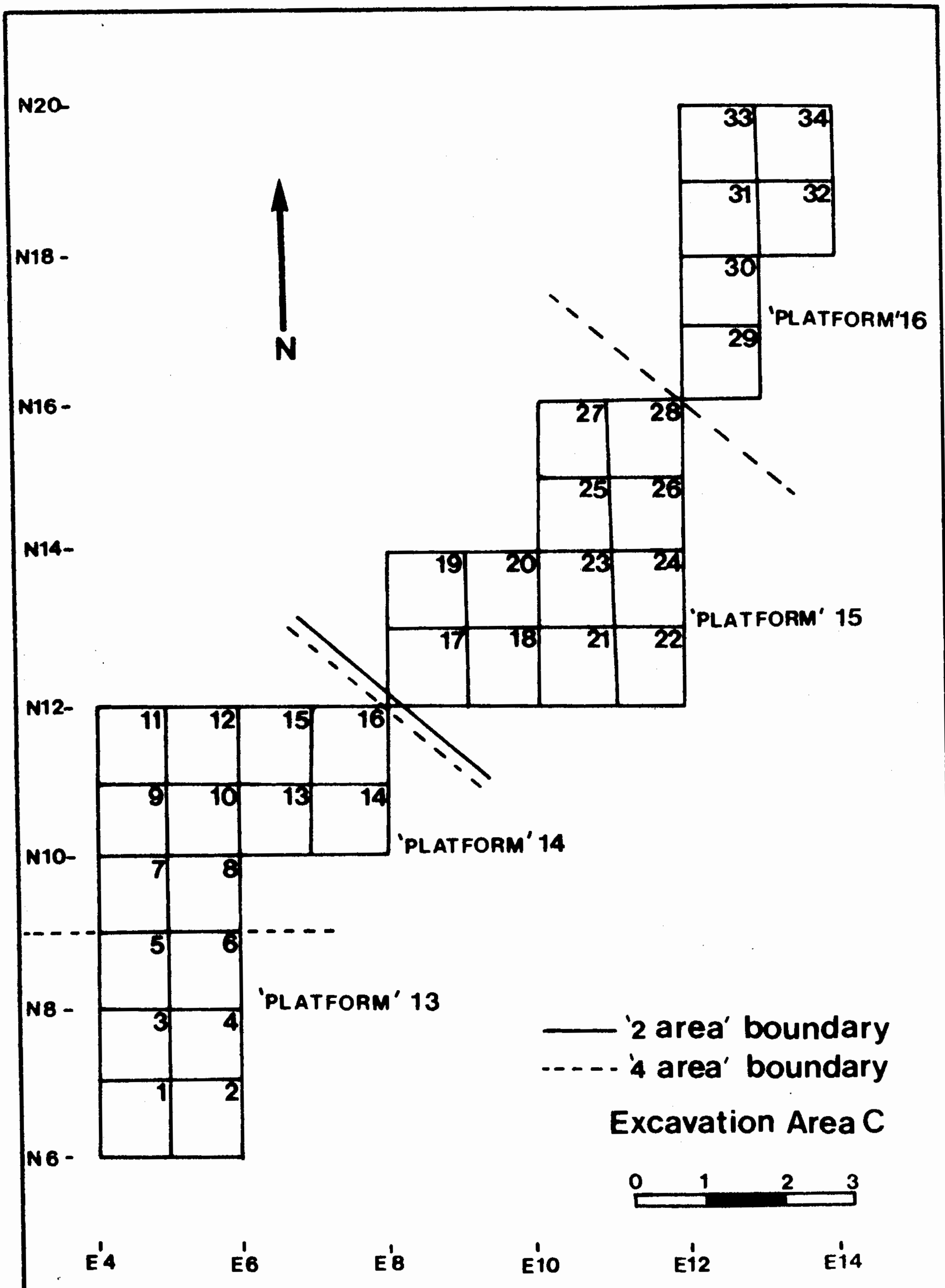


Fig. 60. Excavation units used in tests for horizontal patterning.

Fig. 61. Format for chi-square tests comparing attribute frequencies within house platforms.

Platform	Biface fragments Observed	Biface fragments Expected
13	9	8.29
14	22	13.36
15	16	25.24
16	8	8.11

df = 3 $X^2 = 9.03$

Table XLIX. Attributes showing significant association with house platform.

Attribute	X^2 value
side notched points	13.00
celts and celt fragments	16.89
biface fragments	9.03
point tip fragments	9.09
basalt	17.25
obsidian	37.98
chert	271.59
modified formed tools	18.15
decortication flakes	13.15
end struck cores	12.67
unpatterned secondary artifacts	9.16

occupation areas, then between house platforms within each occupation area (Fig. 60). This comparison in effect tests the '2 area' hypothesis against the '4 area' hypothesis. Results are summarized in Table L, where significant values of chi-square are listed. All chi square tests had df=1 thus the required value for significance at the .05 level was 3.84.

In support of the '2 area' hypothesis, 5 attributes (side notched points, celts, biface fragments, obsidian, and modified formed artifacts) show significant differences in frequency between the 2 proposed occupation areas, but no significant differences within each sub-area. In all 5 cases, the attribute in question occurs more frequently than expected in the southern half of the excavation area.

However, in contradiction to the '2 area' hypothesis, the remaining 6 attributes do show significant differences between individual 'house platforms'. More specifically, basalt, chert, and point tip fragments show significant differences in frequency between the northern platforms, 15 and 16, while end struck cores, decortication flakes, and unpatterned secondary artifacts show significant differences between the southern platforms, 13 and 14.

Table L. Results of the chi-square test on attribute frequencies within 2 and 4 horizontal areas.

	Significant X^2 values		
Attribute	Between 13/14-15/16	Between 13/14	Between 15/16
side notched points	12.98	----	----
celts/fragments	15.52	----	----
biface fragments	6.61	----	----
obsidian	37.24	----	----
modified formed	17.92	----	----
basalt	10.03	----	6.87
chert	157.07	----	63.72
point tip fragments	----	----	6.29
end struck cores	----	7.60	----
decortication	----	12.24	----
unpatterned secondary	----	8.70	----

There are several possible explanations for these results. First, there may indeed be 4 distinct occupation areas, which were occupied at different times. In this case, we would expect 'time sensitive' attributes to distinguish them. But this is not the case. As shown in Table L, attributes which distinguish platforms 13 and 14 are entirely different from those that distinguish 15 and 16. Furthermore, half of these attributes (end-struck cores, decortication flakes, and unpatterned secondary artifacts) are the debris of core reduction with little potential as chronological indicators.

A second possible explanation is that some of the variation in attribute frequencies is produced by horizontal 'activity areas', or areas in which specific tasks were performed. For example, it seems likely that the high frequencies of end struck cores, decortication flakes and unpatterned secondary artifacts in 'house platform' 13 actually represent a workshop in which cores were reduced. Unfortunately, it is difficult to classify individual attributes as 'functional' or 'temporal'. We are left with the probability that at least some of the observed variation is a product of spatial segregation of activities. At the same time, the wide variety of attributes distinguishing the large occupation areas also supports the existence of temporal units.

In an attempt to clarify this situation, horizontal units were subjected to multidimensional scaling. Scaling is

> ...the problem of representing n objects geometrically by n points, so that the interpoint distances correspond in some sense to experimental dissimilarities between objects (Kruskal 1964: 1).

In this case, the objects were 34 1 X 1 m horizontal excavation units (Fig. 60), and their relationships were based on raw attribute frequencies within each unit, as recorded for previous tests. It was hoped that a geometric representation of these relationships would help to interpret horizontal artifact patterns.

A data matrix, consisting of 27 attributes recorded for 34 horizontal units, was processed using a series of NT-SYS programs (Rohlf, Kishpaugh, and Kirk 1964). A similarity (or dissimilarity) matrix was produced using the "distance coefficient" or "average taxonomic distance" between variables. The similarity matrix was then subjected to multidimensional scaling beginning with a random configuration of points and ending when least stress was reached. Scaling was done initially in 2,3,4, and 5 dimensions, and since stress values for all dimensions indicated 'excellent fit' to the data, 2 dimensions were selected as optimal on the basis of interpretability (Kruskal 1964: 3,16). Fig. 62 shows the 34 horizontal units plotted on dimensions 1 and 2.

To explore the meaning of the 2 dimensions, the order of units in each dimension was compared to the order of units on each of the 27 attributes and Spearman's rank order correlation coefficient was calculated for each pair. The results show that both dimensions are highly correlated with total number of artifacts (correlation, dimension 1: .9891, dimension 2: .8666), secondary unpatterned artifacts (.9906, .9063), basalt artifacts (.8000, .7448), chert artifacts (.5917, .4763), decortication flakes (.4890, .7100), modified unformed tools (.3889, .6337), other raw material (.5613, .3913), pieces esquillees (.4103, .5498), and blades (.3501, .3718).

Since the first 6 attributes listed also have large sample sizes, it would appear that both dimensions are strong reflections of overall artifact frequency. In addition, dimension 1 shows a weaker correlation with corner notched points (.2264) and a negative correlation with side notched points (-.2484), while dimension 2 shows a correlation with point tip fragments (.4667) and a negative correlation with stemmed points (-.2435). Considering the map of scaled

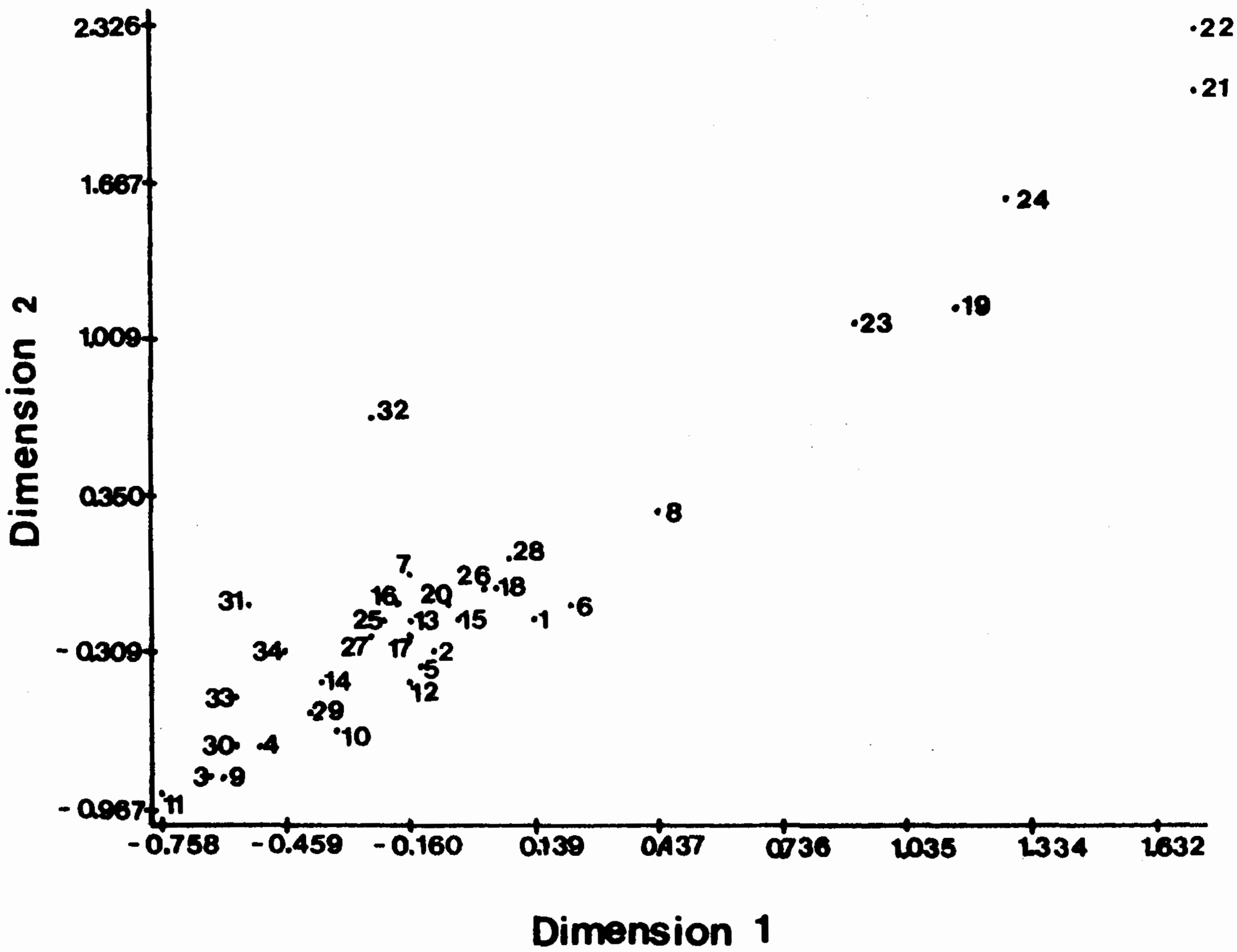


Fig. 62. Multidimensional scaling of horizontal units in 2 dimensions.

units (Fig. 62), it would seem that a few horizontal units have very high artifact frequencies and are also distinguished by high frequencies of blades, pieces esquillees, corner notched points, and point tip fragments, and very low frequencies of side notched and stemmed points. Fig. 63 illustrates the horizontal units loading highest on both dimensions.

While these results do not correspond exactly to the results of chi-square tests described above, they do suggest an interpretation that accounts for most of the observed variation. Rather than dividing the excavated area into northern and southern horizontal areas, it should perhaps be divided into a 'core' area with very distinctive characteristics, and the remaining area on both sides of the 'core'. Combining information from all tests, the 'core', corresponding roughly to platform 15 as shown in Fig. 63, is characterized by high overall artifact frequencies, high proportions of various kinds of chert, point tip fragments, corner notched points, pieces esquillees, and blades, and low frequencies of side notched and stemmed points.

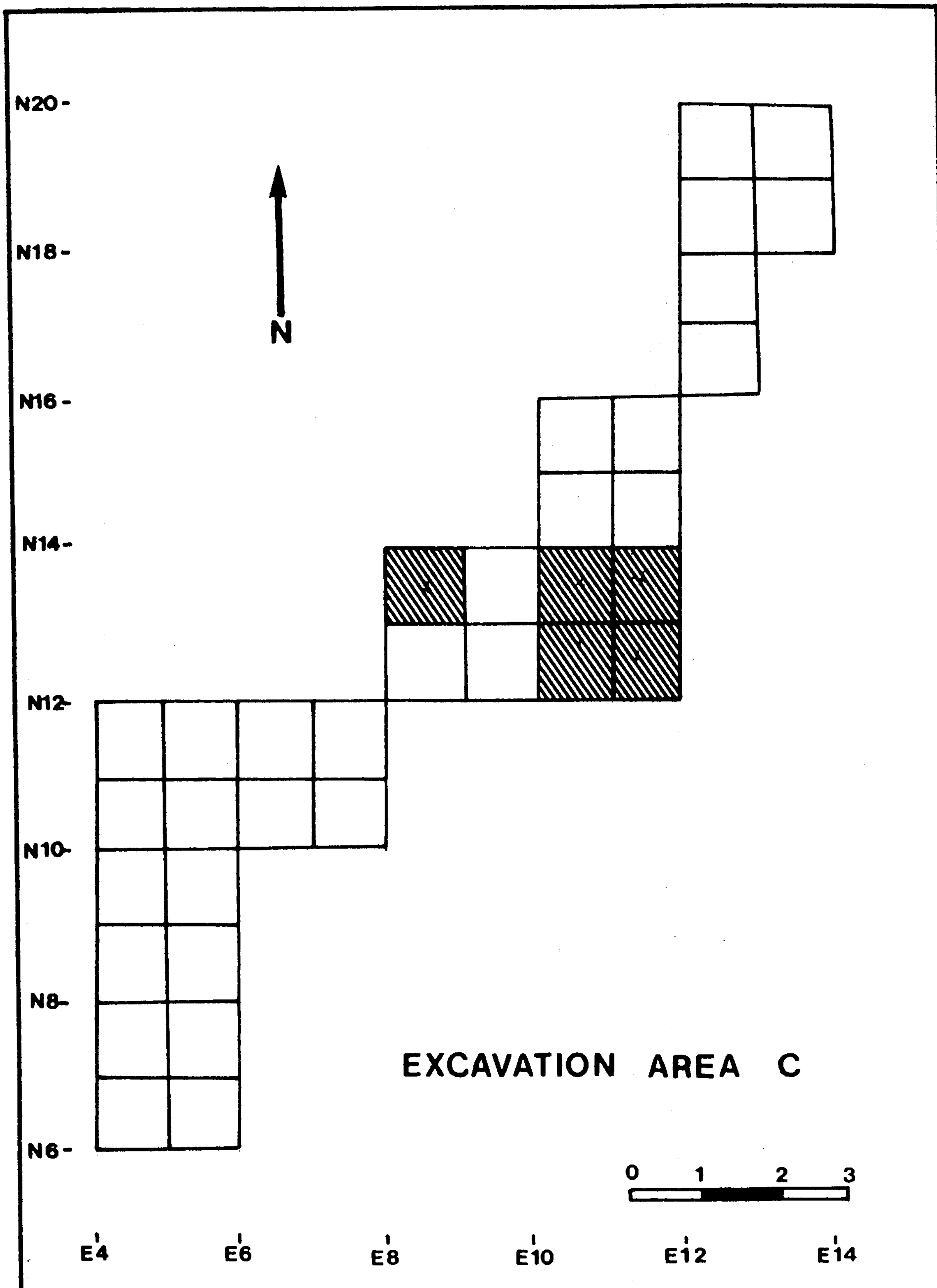


Fig. 63. Horizontal units loading highest on dimensions 1 and 2.

With this model in mind, the trends observed in vertical patterning may be re-considered. Through tests of vertical artifact distribution it was found that chert artifacts occur more often than expected in the lower levels of units 5 and 6 (in the 'core' area). Within the site as a whole, ground stone, platform remnants, biface fragments, and discoid bifaces are found in the upper levels, while point tip fragments and _pieces esquillees_ are limited mainly to the lower levels. These facts suggest that temporal (vertical) change may indeed be represented, but only in the 'core' area. In other words, the lower levels of the 'core' may represent an earlier occupation overlain across the entire excavation area by later deposits. It might also be noted that the unique hearth pit (Cultural Feature 5) is also located in the lowest levels of unit 6.

The existence of a 'core' area is the strongest indication of the data, but weaker trends probably have meaning in terms of horizontal activity areas. High chert frequencies in the northern excavation units result from the use of grey-brown chert exclusively, as described above. The southern half of Area C still contains higher proportions of celt fragments, biface fragments, obsidian artifacts, and modified formed tools.

In the face of so much emphasis on variation within the site, it should be pointed out that, even where patterning exists, the variations are quantitative, not qualitative, and merely indicate possible trends over a 1200 year period. Overall, there is strong continuity in all aspects of lithic technology.

Chapter 5. External Comparisons

The purpose of this chapter is to place the Punchaw Lake Area C assemblage into regional perspective by comparing it with other archaeological sites and collections. These comparisons confirm the late prehistoric culture-historical position of the Excavation Area C assemblage and indicate affinities with other Interior Plateau sites, especially those on the Nechako Plateau. Site by site comparisons will be dealt with individually, beginning with nearby locations, first to the north, then to the south of Punchaw Lake.

Physically closest to Area C is the remainder of the Punchaw Lake site itself, with excavation concentrated in house platforms in areas A and B. As outlined in Chapter 2, Fladmark describes this part of the site as multi-component, with occupations spanning the period 2000 B.C. to A.D. 1700. However, in the absence of specific component definitions, the 6200 artifacts from Areas A and B will be treated as a single group.

The range of raw materials recovered from Areas A and B is nearly identical to that of Area C (Fladmark 1974: 15). In terms of technology, it may be broadly stated that artifacts from Areas A/B were manufactured by flaking with the exception of a few ground adze fragments, slate fragments, abrasive stones, and a single piece of carved argillite.

Detailed comparisons of artifact form may be made in 2 categories: points and cortical spall tools. Points from Areas A/B exhibit a predictably wider range of shapes, but there are strong similarities in some categories. For example, side notched points are very similar with close average dimensions, notch size, and neck width. Both groups have convex or straight blade and basal edges with very small proportions of concave edges.

Further parallels exist between corner notched but unbarbed points. Eight of 20 points in this category from Areas A/B have flaring or expanding stems and convex bases, resembling the corner notched points with convex bases common in Area C. However, the corner notched points from Areas A/B are consistently larger by 4-5 mm in every dimension. At least 1 corner notched point bearing a single basal notch was also noted in the Area A/B assemblage.

Leaf shaped and pentagonal points from Areas A/B are all considerably larger than those from Area C. The remaining Area A/B points (large notched with prominent barbs, and fishtailed) find no parallels in the Excavation Area C artifacts.

Considering cortical spall tools, 13 artifacts from Area A fall within the definition used in this report. They are almost identical in raw material, manufacture, and wear, to the spall tools from Area C, except that a few are larger. As in most artifact categories, there is also more variation in the Area A spalls.

To summarize artifact comparisons within the Punchaw Lake site, Area C tools are generally smaller and show less variation in form than tools from other excavated parts of the site. Strongest similarities in the point group exist between side notched points, while there are also some correlations in the corner notched category. Cortical spall tools are nearly identical but slightly larger in Area A.

Given that Area C represents a late prehistoric occupation beginning about A.D. 450, the smaller size of side notched, corner notched, and leaf shaped points and spall tools from this part of the site suggests an overall diminution in tool size through time. While functional variation must be taken into consideration, the wider range of point and spall forms also supports the longer period of occupation in Areas A/B. Based on this interpretation, it may also be hypothesized that point forms found exclusively in Areas A/B (large notched with barbs, and fishtailed) were made before A.D. 440.

North of Punchaw Lake, the nearest excavated site is the circular depression on Natalkuz Lake. Here an undated surface component overlay a second component dated 546 B.C. (Borden 1952:36; Donahue 1975). The few artifacts from the pit itself are predominantly of rhyolite, with a few tools of obsidian, basalt, and siltstone. In contrast, artifacts from near the surface are mainly basalt and obsidian. Illustrated points from the pit deposit include 1 corner notched, 1 lanceolate, and 2 large leaf shaped points, none of which resemble Punchaw Lake Area C artifacts. The remaining tools are large blades and bifaces and an obsidian microcore with microblades. The Natalkuz Lake pit assemblage is unlike any other collection from the Plateau, especially in the almost exclusive use of rhyolite. The upper component, which has not been described or illustrated, is reported to be dramatically different from the lower component, and similar to the assemblage from Chinlac.

The Chinlac site consists of 10 rectangular houses overlooking the Stuart River (Borden 1952: 32). More than 1500 artifacts, primarily chipped basalt, obsidian, quartz, and an igneous rock, were excavated from the floor of 1 house. In the ground stone category, only a few adze blades and abrasive stones are reported. Although frequencies are not given, scrapers, points, drills, bifaces, and utilized flakes were also found. These tools are described as small or even diminutive.

Small side notched points from Chinlac are very similar to those from Area C, with the exception of a slightly narrower average neck width. In contrast, small stemmed points with parallel or contracting stems are completely absent from Excavation Area C. Since the main occupation of Chinlac was protohistoric, it seems most likely that small contracting stem points represent a very late trend in tool manufacture probably appearing in the Nechako Plateau after A.D. 1700.

Further north, suitable sites for comparison are rare, the nearest appropriate collection being in the southwest Yukon where a series of small buried sites originally investigated by MacNeish (1964) have most recently been studied by Workman (1974).

The Yukon sites are small and contain relatively few artifacts, but resemble Area C at Punchaw Lake in their concentrations of calcined bone, fire-cracked rock, and amorphous hearths, combined with the absence of structural features. Workman (1974: 132) attributes the lack of structural evidence to the use of temporary brush shelters and skin tents such as those described ethnographically.

Artifacts have been grouped into 4 phases, the late prehistoric Aishihik Phase (A.D. 400-1800) corresponding to the Area C occupation at Punchaw Lake (Workman 1974: 562). This phase is characterized by the absence of trade goods and the presence of native copper, abraded cobbles, and contracting stem Kavik points - none of which are found at Punchaw Lake. Small side notched points, grooved adzes, tabular schist, and certain slate pieces are also characteristic of the late period in the Yukon. Some slate artifacts, with thick, flat and sometimes 'nicked' edges are possible 'relatives' of the single slate tablet with notched edge found in Area C. However, other than at the broadest level (the presence of a few side notched points, end scrapers of about the same size, the presence of cortical spalls and absence of microblades) no similarities are apparent between central British Columbia and the southwest Yukon at this time. This is not to say that relationships may not have existed earlier (cf. Helmer 1976: 33,34), but during the late prehistoric period, aside from functional similarities related to the transient nature of the occupations, there appears to have been little sharing of lithic technology. As Workman (1974: 727) points out, at this time the southwest Yukon shows closest affinities with the North Pacific Coast.

Shifting attention to the south of Punchaw Lake, the nearest comparable archaeological site is the multi-component Tezli site, situated southwest along the Blackwater drainage. As outlined in Chapter 2, Donahue reports pit house occupations there spanning the period 2400 B.C. to A.D. 1368, with later surface occupations around A.D. 1615 and A.D. 1710. On the basis of published photographs, drawings, and descriptions, artifacts from Tezli have been compared to those from Area C, with emphasis on points and steep edge unifaces.

Of all raw materials, basalt was most common at Tezli, comprising 93% of the artifacts (Donahue 1975: 28). Quartzite spall tools, a small percentage of obsidian artifacts, and a few chert tools are also mentioned. Basalt was acquired from the immediate riverbank, and obsidian from the Rainbow Mountains or Dean River Gravels. Although they are in the same vicinity, it is not clear whether these are exactly the same sources exploited by residents of Punchaw Lake.

Illustrated artifacts from Tezli are broken down into 4 age brackets: 2400-1656 B.C., A.D. 20-A.D. 75, A.D. 488, and A.D. 1368. Considering points first, corner notched points are generally short with expanding stems, straight basal edges, and convex blades. However, as a group they are noticably larger than Area C corner notched points, represented by an average neck width of 17 mm at Tezli. Most leaf shaped points, which occur infrequently in all periods, are also larger than Area C artifacts. Only 2 of 4 illustrated stemmed points resemble small stemmed points from Area C. Individual side notched points appear in illustrations of the last 3 time periods. The earlier fragments are large, with average blade width of 23 mm and neck width of 14 mm. On the other hand, the single very small side notched point shown from the latest period falls within the Area C range. In addition to these various parallels, there are several forms (contracting stem, lanceolate, barbed corner notched, and large triangular which may be point preforms) that occur at Tezli but are not found at Area C.

Unifaces from Tezli are illustrated for only 3 periods. Since it is not possible to reliably measure retouch length from photographs, only artifacts that appear to be within the steep edge uniface definition used here were included. At the earliest period, and again at A.D. 488, all but 1 uniface are large with expanding edges. Average dimensions for 16 large unifaces are 45 mm x 33 mm. However, by the latest period, A.D. 1368, only 2 large unifaces occur, while 4 smaller unifaces (27 mm x 24 mm) are shown. In comparison, the majority of steep edge unifaces from Area C are small.

The most striking disparity between these 2 sites, aside from the basic contrast between pit house structures and 'house platforms', is the apparent low frequency of small side notched points at Tezli, and their predominance at Excavation Area C. As was the case in the older parts of the Punchaw Lake site, points from Tezli are also generally larger and exhibit a wider range of shapes. Points found at Tezli that do not occur at Area C, and are presumably older, include barbed corner notched, lanceolate, and triangular forms. Unifaces as a class are more homogeneous, but also show a diminution of size through time, as suggested for other artifact classes at Punchaw Lake.

Excavation at the Ulkatcho site, an abandoned Carrier village further west on Gatcho Lake, revealed a proto-historic occupation and a possible earlier microblade component (Donahue 1975: 26). Stone artifacts are predominantly obsidian from sources in the Rainbow Mountains or Dean River gravels. Basalt and chert/chalcedony are also mentioned.

Table LI compares the relative frequency of technological stages at Ulkatcho and Area C (the list includes only information available for both sites). As the table indicates, percentages of unmodified artifacts are nearly the same, while modified unformed artifacts are slightly more common and modified formed tools slightly less common at Ulkatcho. At both sites, modified unformed tools commonly have 1 or 2

Table LI. A comparison of artifacts from Ulkatcho and Punchaw Lake Area C.

	Ulkatcho N	Ulkatcho %	Area C N	Area C %
Unmodified	2118	92%	6546	94%
decortication	148	7%	372	5%
Modified Unformed	139	6%	108	2%
1 edge modified	105	79%	89	82%
2 edges modified	28	21%	18	17%
3 edges modified	0	0	1	1%
unifacial	102	92%	95	74%
bifacial	10	8%	33	26%
straight	46	41%	32	25%
convex	36	32%	48	38%
concave	25	22%	11	9%
notch	6	5%	2	2%
Modified Formed	48	2%	251	4%
unifaces	17	39%	41	15%
bifacial points	25	52%	85	31%
convex bifaces	5	10%	27	10%

modified edges that are usually unifacially modified. The Punchaw Lake tools in this category have a higher frequency of bifacial and convex edges, while Ulkatcho tools have more straight edges. Unifaces and bifacial points form a larger proportion of formed tools at Ulkatcho, which apparently lacks several tool types found at Punchaw Lake, specifically pieces esquillees, cortical spalls, and ground stone. Stone tools may have been replaced to some extent at Ulkatcho by historic artifacts of metal and glass.

Points collected at Ulkatcho are strongly reminiscent of those from Chinlac, being either small side notched or stemmed. Illustrated side notched points are similar to those from Punchaw Area C but share a slightly narrower average neck width (8 mm) with Chinlac points. Small contracting stem points are within the size range found at Chinlac, but completely absent from Area C. This lends support to the hypothesis that small stemmed points are very late, since ethnographic reports and the presence of historic artifacts place the main Ulkatcho occupation firmly in the protohistoric/historic period.

All of the sites mentioned so far, except those in the Yukon, have been located in ethnographic Carrier territory on the Nechako Plateau. Further south, several sites have been excavated in the vicinity of Anahim Lake, in the ethnographic territory of the Chilcotin.

Wilmeth (1969, 1971a,b, 1975) has reported work at the Potlatch Site (FcSi 201) on Anahim Lake, and Goose Point (FcSi 200) and Daniktco (FdSi 3) on the Dean River. Excavation at the Potlatch Site focused on Potlatch House (A.D. 1820), a large rectangular structure, Bes Yaz House (A.D. 250), Tlo'kut House (A.D. 75, A.D. 1640), and Tshandu House (A.D. 1830), all circular depressions with associated trash mounds (Donahue 1975: 44-46). Shallow cultural deposits in some parts of the site contained microblades as well as historic artifacts, which Wilmeth attributes to mixing of at least 2 distinct components. Points from Potlatch Site, which are not illustrated, are said to include 2 lanceolates, small stemmed, contracting stem, triangular, corner notched, and a large side notched point.

Excavation at Goose Point concentrated on Bes Tco House (an oval depression), the area around the house, and Suzchet House, another shallow depression C-14 dated at A.D. 1240. Points from Bes Tco House and vicinity were a contracting stem and a corner notched point.

At Daniktco, a single large circular depression, dated A.D. 699 and A.D. 703, and an associated roasting pit dated A.D. 733, were excavated. Microblades were again found associated with stemmed points and other artifacts.

In the absence of artifact measurements or illustrations, it is difficult to make specific comparisons between these sites and Punchaw Lake. However, the bulk of evidence points to basic dissimilarities. Circular pit house structures, some with bench, central hearth, and interior support posts, as well as the large rectangular wood structure called Potlatch House do not resemble any structures at Punchaw Lake. While a few microblades are present at Excavation Area C, they do not constitute as large a proportion as in some of the Anahim Lake assemblages. While small stemmed and side notched points in Anahim area sites probably represent late prehistoric activity, the presence of 4 small side notched points is hardly convincing evidence of affinities between Punchaw and Anahim Lakes.

In the same vicinity, Mitchell (1970) investigated a site at Natsadalia Crossing (FdSi 2) near the outlet of Anahim Lake, as well as 2 sites farther south - Poplar Grove (FaRx 1) on the Chilanko River, and Horn Lake Southwest (EkSi 1). Artifacts from Natsadalia Crossing were primarily obsidian (80%) with some basalt (19%), porphyry, and other cryptocrytallines. Basalt (97%) predominated at Poplar Grove, followed by obsidian (2%), cryptocrystalline, andesite, porphyry, and gneiss. At both sites unifacially and bifacially retouched flakes were the most common artifacts, but there were no resemblances between the few formed tools and those from Punchaw Area C.

At Horn Lake Southwest, 2 small depressions and a buried hearth, as well as 135 stone artifacts, were recorded. Stone tools were made of basalt (54%), obsidian (41%), rhyolite, and cryptocrystalline. Points and microblades were also recovered. While this assemblage bears little resemblance to Excavation Area C, it might be noted that the combination of small circular depressions, leaf shaped points, obsidian microblades, and rhyolite tools recalls the features of the Natalkuz Lake pit site.

The long archaeological sequence reported by Sanger (1970) for the well known Lochnore-Nesikep Locality is based on excavation of several burial and housepit sites along the Fraser River between Lytton and Lillooet. Artifacts, carbon dated between 6650 B.P. and 310 B.P. (Sanger 1970: 103), have been grouped into 4 periods: Early 5000-3000 B.C., Lower Middle 3000-1500 B.C., Upper Middle 1500-1 B.C., and Late A.D. 1-1850.

There are many parallels between this sequence and the general trends of Punchaw Lake lithic artifacts. However, as Sanger (1970: 122) points out, basic changes in point form are common to a large area encompassing the Plateau and Plains: an early abundance of leaf shaped points followed by variations of large corner notched points, and lastly an increasing frequency of side notched points, accompanied by overall diminution in size. However, on closer inspection, there are substantial differences between point classes here and at Punchaw Lake. One obvious difference is the high frequency of concave bases (48%) on Lochnore-Nesikep points in general, which occur rarely (3%) at Area C. A few corner notched points with expanding stems and convex bases are illustrated in Sanger's report, but they are shorter, wider, and thinner, with neck width 3 mm wider than the same class at Area C. Of Sanger's 3 side notched point categories, 2 consist of large points; the remaining small side notched points are about the same size as Area C specimens but notches are narrower by 2 mm, and necks only half as wide (average 6 mm), while the height of the basal edge is noticeably greater (average 9 mm). Furthermore small side notched point bases are typically concave or straight and blades serrated or multiply notched at Lochnore-Nesikep.

Several artifact groups categorized by Sanger as bifaces would have been classed as points in this report. However, the elliptical, triangular, pentagonal, and leaf shaped pointed bifaces are all uncommon at Punchaw Lake. Similarly, the variety of formed unifaces defined at Lochnore Nesikep is much broader than the homogeneous group of small formed unifaces from Area C, which fall midway in size between Sanger's thick and thin convex unifaces (Groups 1,2,4).

Finally, several artifact types attributed to the earlier periods at Lochnore-Nesikep are predictably rare or absent at Punchaw Lake: microblades and microcores, hafted scrapers, and cobble choppers. In addition, several ground stone artifacts said to characterize the Late Period seem limited to the southern Interior (steatite carving, hand mauls, saws, and ground slate).

Sanger proposed that the last 7000 years of prehistory at Lochnore-Nesikep be viewed as a cultural continuum called the Nesikep Tradition, leading up to historic Shuswap occupation of the area. THe Nesikep Tradition has been further substantiated and elaborated by Stryd (1971) and Wilson (197) based on pit house excavations in the vicinity of Lillooet and Kamloops respectively.

On the basis of 81,228 artifacts recovered from 6 pit house sites, Stryd clarified the microlithic (5000-800 B.C.) and non-microlithic (800 B.C.-A.D. 1858) stages of the Nesikep Tradition. During the later Nesikep period in the Lillooet area, basalt was the most common raw material, followed by chert/chalcedony, steatite, nephrite, slate, and obsidian. Most stone tools were chipped (98%) while the remainder were ground or pecked. Eighty-seven percent of artifacts were unmodified chipping debris, while unformed tools, such as utilized and retouched flakes, predominated among modified artifacts. Points, which include unnotched, stemmed, and notched arrow and atlatl points, had mainly convex or straight blade edges and expanding stems; 40% of bases were concave, 30% straight, and 30% convex; basal lateral grinding was rare and serrated blades absent.

Side notched arrow points correspond to small side notched points from Area C, except that the Lillooet specimens are slightly smaller in all dimensions, with neck width averaging only 8 mm. Corner notched arrow points from Lillooet are also smaller than any corner notched category at Area C, while all notched atlatl points are considerably larger. For example, the largest neck width encountered on Punchaw notched points was 13 mm, while Lillooet atlatl point neck widths average 15-16 mm.

These discrepancies may be a product of Stryd's division of all points into small arrow and large atlatl groups.

In another paper, Stryd (1973:15-29) has characterized the later Nesikep Tradition as a riverine/fishing adaptation following an annual subsistence cycle based on salmon. During this period, reliable access to salmon runs allowed the storing of food surpluses and the development of large winter pit house villages; this semi-sedentary pattern perhaps providing more leisure time for artistic pursuits. Thus by the late prehistoric Kamloops phase, characteristic stone artifacts (in addition to side notched points) were steatite pipes and carvings, zoomorphic hand mauls, beads and pendants, and spindle whorls. Whether it is explained by the lack of sufficient food surpluses, the non-sedentary settlement pattern, or the absence of burial sites containing ceremonial goods, the inhabitants of Punchaw Lake apparently produced no stone carvings or 'art work'.

SUMMARY

In terms of raw material use, there are few clear spatial or temporal patterns in the central interior. At most late prehistoric sites, as at Punchaw Lake, basalt is most common, although obsidian is also prevalent, especially closer to source areas.

Artifact technology is also broadly similar throughout the Plateau, with small proportions of ground and/or pecked tools in otherwise chipped assemblages. Basalt and obsidian are almost universally obtained in the form of small water rolled cobbles and initially reduced by splitting and percussion flaking. Microlithic technology, as a significant element in the lithic repertoire, is universally absent by A.D. 1 from the southwest Yukon to the Southern Interior of British Columbia. A few sites at the western edge of the Plateau in the vicinity of Anahim Lake may represent the persistence of microlithic technology on a small scale, if the presence of microblades in late components is not a result of mixing.

In terms of overall artifact form, the Punchaw Area C assemblage is similar to other sites on the Interior Plateau: artifacts are small and well made of cryptocrystalline materials, and both tools and lithic debitage are plentiful. This is in contrast to the southwest Yukon where relatively scarce artifacts are more crudely made, using a larger proportion of granular materials. Of course, artifact form depends strongly on the availability of raw materials.

Again, in terms of specific formed tool categories, Punchaw Lake shows strong affinities with other sites on the Interior Plateau. Small side notched points are characteristic of the late prehistoric period from the Yukon through B.C. and onto the Plains. Thus, while the presence of these tools is an excellent chronological marker, it is a poor indicator of cultural or 'ethnic' affiliations. On a more specific level, Area C small notched points are most similar in size and shape to points from other parts of the Punchaw Lake site. They are also close in average dimensions (albeit with slightly wider neck widths) to small side notched points from Ulkatcho and Chinlac on the Nechako Plateau. The same artifacts from the Lillooet area are smaller, and like those from Lochnore-Nesikep, have a much higher incidence of concave bases, as well as taller bases. The association of small side and corner notched points is typical of sites that slightly pre-date or parallel Area C, rather than those which post-date A.D. 1700, when small tapering stem points become common.

Cortical spall tools, usually of quartzite, are found at all time periods from the Yukon to southern B.C., with especially high frequencies near raw material sources such as the Fraser River. For this reason they are not good cultural indicators, although their average size may have chronological significance.

In contrast to artifact content, which in general points to affiliations with nearby Plateau sites, comparisons of site structure reveal similarities to far northern sites, where transient camps left little for the archaeological record. Thus, amorphous living floors with concentrations of fire broken rock and calcined bone fragments are typical of both Punchaw Area C and the southwest Yukon. However, these analogies indicate functional, and not necessarily genetic, relationships.

Large pit house villages, common on the southern Plateau, suggest a different overall settlement strategy. In this respect, it should be noted that while house pits or circular depressions are not uncommon on the Nechako Plateau, the pits themselves are small and rarely occur in large clusters. Large pit house sites such as Tezli are extremely uncommon.

In conclusion, most artifact traits that have patterned distributions appear to define chronological rather than cultural units. Thus, there is no clear line dividing 'Shuswap' from 'Chilcotin' from 'Carrier' assemblages. However, in general terms, Punchaw Area C artifacts show greater similarity to nearby assemblages and those on the southern Plateau than to those in the far north. Similarities in site structure to northern regions are probably functional and do not represent contact or 'diffusion' between the Yukon and the central Interior of British Columbia.

Chapter 6. Conclusions

The cultural deposit in Excavation Area C contained a high density of lithic artifacts, fire broken rock, and broken and burned bone, associated in some places with pits or depressions. High artifact density, combined with shifting and overlapping concentrations, suggests discontinuous re-occupation of the site over a long period. The absence of structural features indicates the use of temporary structures such as skin tents or brush lean-tos. Based on ethnographic accounts, supported by the archaeological presence of grebe, loon, and duck bones, at least some of these occupations took place during the spring or summer, although the location would have been suitable for winter camps as well.

A total of 6971 stone artifacts recovered from 9 2x2 m excavation units have been analysed using the 'decision model' or artifact life history approach. This approach provides a framework for integrating information on all aspects of stone artifacts and relating this information to decisions and actions of the stoneworker. In terms of this project, the artifact life history was broken down into 4 sequential stages: 1) raw material, 2) technology, 3) form, and 4) function.

A raw material typology was created by identifying 8 different raw materials, tracing possible sources, and examining the use of each material at Excavation Area C. It was found that basalt, by far the predominant raw material, and chert, both locally acquired, as well as obsidian from Anahim Peak and the Ilgachuz Mountains, were completely processed at the site, from raw cobble to finished tool. On the other hand, quartzite, available in nearby riverbeds, and shale, slate, and sandstone, for which local sources are not presently known, were all processed away from the site.

Information on techniques of manufacturing basalt tools is virtually non-existent. Therefore, prior to analysing the basalt industry at Excavation Area C, it was necessary to undertake replication experiments. Through experimentation, it was found that:

1. heated basalt cannot be visually distinguished from unheated basalt.

2. hard and soft hammer percussion techniques cannot be easily distinguished by examining single attributes of basalt flakes as proposed in the literature.

3. basalt percussion flakes may only be easily distinguished from pressure flakes by their larger size.

4. unmodified basalt flakes exhibit only discontinuous microflaking and/or edge snapping, even when subjected to considerable physical abuse.

5. unmodified basalt flakes used to cut soft material, such as raw meat, do no exhibit any wear traces visible at 14X magnification.

6. unmodified basalt flakes used to pare, scrape, or saw medium to hard materials such as wood, bone, antler, or frozen meat, exhibit continuous series of microflakes usually less than 2 mm and rarely up to 4 mm long. These microflakes are all visible at 14X magnification.

7. although absolute criteria were not established for identifying causes of edge wear, the wear resulting from different actions on various medium to hard materials was conspicuously different.

8. retouch flakes on basalt edges intentionally modified by percussion or pressure are generally longer than 2 mm and occur in continuous series of uniform size.

On the basis of these results, unmodified, utilized, and retouched artifacts were identified.

The results of replication experiments are regarded as preliminary, and are intended to provide reliable guidelines for recognizing various technological stages in the manufacture and use of basalt tools. Tests of several commonly accepted indicators of manufacturing process (eg heat treatment, hammer type) produced negative results. However, the experimental use of basalt flakes in various tasks produced distinctive, clearly visible, wear traces, and it is felt that further exploration of tool function would be very productive. Of course, the results of these tests are applicable to many (indeed, most) sites in interior B.C., where basalt is the predominant raw material.

The majority of stone artifacts (94%) recovered from Area C are by-products of core reduction and lack further modification. A small proportion of total artifacts (2%) are modified but unformed. A detailed typology of tool form was constructed for the remaining group of 'modified formed' tools, which altogether make up only 4% of the total collection. In general, formed tools were manufactured by flaking, although a few were ground and/or polished. Tools are small and well made with irregular flaking patterns. The majority of formed tools are bifacial, with 70% consisting of bifacial blanks, points, convex bifaces, and bifacial fragments. Altogether 12 formal classes were defined on the basis of outline shape and size.

Microscopic examination of all artifacts revealed that many bear wear traces visible at low magnification. For example, it was found that 39% of unmodified artifacts exhibit microflaking and/or edge rounding representing utilization visible at 14X. However, limited wear on modified unformed, as well as unmodified, artifacts emphasizes the 'minimal' and expendable nature of these tools. On the other hand, formed tools were found to be extensively worn.

For the most part, wear patterns were consistent within formal classes, thus all steep edge unifaces were heavily dulled with extensive polish on all edges and faces, while pieces esquillees showed little alteration other than bipolar battering. In most cases, wear traces support common functional attributions. For example, steep edge unifaces were probably used as 'scrapers'. However, wear on many points suggests they were used in tasks involving friction, such as cutting, while there is no direct evidence of their use as projectile points. The power of interpretations based on wear traces could certainly be increased by detailed replication experiments using basalt.

Judging from 3 C-14 dates based on charcoal samples from the upper and lower levels of the deposit, Excavation Area C was probably intermittently occupied over a period of about 1200 years, from A.D. 440 to A.D. 1710. However, due to the condensed nature of the archaeological deposit, combined with post-depositional mixing, artifact patterns within the site were difficult to interpret. The best interpretation seems to be that a 'core' area represents an earlier occupation of the site, overlain by later deposits which encompass the entire excavation area. In addition, several horizontal 'activity areas' represent areas in which specific tasks were performed.

Despite hypothesized changes in artifact content through time, the late prehistoric period as a whole was one of strong continuity. During the entire occupation, the use of raw materials, techniques of reducing cores and manufacturing tools, and tool functions as represented by wear patterns remained constant. Changes were merely quantitative trends rather than qualitative or abrupt changes. Considering the transient nature of the camps made by prehistoric site occupants, their adaptation, represented by persistent re-use of the same site in the same way over a very long period, was successful and, indeed, permanent.

The question of cultural affinities, especially related to Athapaskan origins, is one of long standing in plateau archaeology. Borden (1952) originally hypothesized the late arrival of the Carrier in the central Plateau on the basis of differences between components in the Natalkuz Lake pit site. He later suggested that Athapaskans brought microlithic technology to interior British Columbia at a very early date (Borden 1969). Wilmeth (1975: 10-16) has listed several traits common to protohistoric Athapaskan sites in the interior, including small contracting and parallel stemmed points, 'eared' scrapers, cut and rolled birch bark, and bone beamers. On the basis of lack of continuity (based on lack of sites) with prehistoric components, he concludes that:

> ...there is no reason to believe that Athapaskan speaking groups have occupied the central interior of British Columbia for any great length of time (Wilmeth 1975: 16).

He does, however, present an alternative - if the gap between A.D. 1240/A.D. 1368 and the protohistoric period were filled, the Athapaskan presence could be extended back in time. Donahue (1975: 55) has emphasized continuity over almost 5000 years at the Tezli site, and concludes that no abrupt population replacement took place. But, according to Donahue, this does not necessarily preclude a gradual assimilation of migrants from the north.

The Punchaw Area C occupation spans approximately the 'gap' between late prehistoric and protohistoric periods described by Wilmeth. Due to the absence of historic trade goods, the later stages of the occupation cannot be absolutely linked to the protohistoric period. However, continuous use of the Punchaw Lake site over a period of 1200 years implies that if a late Athapaskan 'invasion' took place, it must have been very late, after about A.D. 1700 in the vicinity of Punchaw Lake. Furthermore, this 'invasion' could not have accomplished much more than the spread of small stemmed points, since all other aspects of lithic technology remain constant. Major changes in settlement pattern in the protohistoric/ historic period can as easily be linked with European, as Athapaskan contact. Much more likely than a very late and very abrupt Athapaskan entrance is a continuous Athapaskan occupation of the central interior from a much earlier date (at least as early as A.D. 400/500 on the basis of Area C at Punchaw Lake).

Culture historical reconstructions are complicated by the paucity of excavated sites in the central and northern interior of British Columbia and the lack of detailed descriptions of existing sites and artifacts. Hopefully, problems of cultural continuity, 'ethnic' boundaries, and Athapaskan affiliations will be solved as spatial and temporal gaps are filled in the archaeological record.

Appendix A. The Heat Treatment of Basalt

The hypothesis that heated basalt may be visually identified was tested experimentally.

All basalt used in the following tests was collected in the form of water rolled cobbles from a small stream bed a few miles north of the town of Cache Creek, British Columbia. Small pieces of vitreous basalt, less than 2 cm in at least 1 dimension, were heated under various conditions in a tube oven. After heating, test specimens were compared to unheated samples from the same basalt core. Examination was both macroscopic and microscopic, using a binocular microscope at magnifications up to 100X. In all cases the heated specimens resembled the unheated control exactly in color and texture. There was no evidence of surface 'crazing' or heat spalls. Test conditions using the tube oven were:

1. Specimen placed directly into preheated oven at 350-400 degrees C, left at temperature for 1 hour, then cooled slowly (over 3 hours) in the oven.

2. Specimen placed directly into preheated oven at 550-650

degrees C, left at temperature for 1 hour, then cooled slowly (over 3 hours) in the oven.

3. Specimen heated rapidly (within 1 hour) to 400-450 degrees C, left at temperature for 8 hours, then cooled slowly (over 3 hours) in the oven.

4. Specimen heated rapidly (within 1 hour) to 900 degrees C, then cooled slowly in oven.

5. Specimen heated rapidly (within 1 hour) to 500 degrees C, left at temperature for 4 hours, then dropped directly from the hot oven into a beaker of cold tap water.

As shown above, the basalt pieces were tested under conditions of rapid heating, rapid cooling, heating over an extended time period, and heating to high temperature. To eliminate the possibility that the oven was not correctly simulating conditions of an open campfire, 2 basalt fragments were thrown directly into the flames of a wood burning fire and left for several hours, during which the basalt became red-hot. Even under these extreme conditions, the basalt appeared unaltered when compared to a control core.

It was concluded that heated basalt may not be visually identified or distinguished from unheated material.

Appendix B. Hard Hammer Vs. Soft Hammer Flakes

The hypothesis that hard hammer flakes can be distinguished from soft hammer flakes was tested experimentally.

Flakes were detached from 2 large cores of vitreous basalt using a granite cobble (296 gr) as a hard hammer and an antler billet (214 gr) as a soft hammer. Flakes were collected as they were manufactured if they fit pre-determined size categories. A total of 136 flakes, half hard hammer and half soft hammer, were examined:

	N	
Size Category	Hard Hammer	Soft Hammer
length and width 1 - 5 mm	10	10
length and width 6 - 10 mm	10	10
length and width 11 - 15 mm	10	10
length and width 16 - 20 mm	10	10
length and width 21 - 30 mm	10	10
length or width 31 - 40 mm	10	10
length or width 41 - 50 mm	4	4
length or width >50 mm	4	4

The following attributes were recorded for each flake:

<u>length</u> (mm): maximum distance from striking platform to opposite edge

<u>width</u> (mm): maximum distance perpendicular to length

<u>thickness</u> (mm): maximum thickness

<u>weight</u> (gr)

<u>platform length</u> (mm): maximum length of striking platform along flake edge

<u>platform width</u> (mm): maximum distance across platform from flake face to face

<u>ventral lip</u>: presence or absence

<u>platform crushing</u>: presence or absence of small flakes and crushing on dorsal face at edge of striking platform, presumably caused by hammer impact

<u>bulb shearing</u>: presence or absence of a shattered or collapsed bulb of percussion

<u>compression rings</u>: presence or absence of concentric ripples emanating from the bulb of percussion

The last 6 attributes were evaluated for distribution and frequency, and subsequently tested statistically for a significant difference between hard hammer and soft hammer techniques. The results, which indicate that hammer type cannot be distinguished using these attributes, are outlined below.

Platform length ranged from 1 - 37 mm, with a mean length of 9 mm. The null hypothesis, that there is no difference in striking platform length between hard and soft hammer flakes, was evaluated with the Kolmogorov-Smirnov test, which compares 2 samples on an ordinal scale (Blalock 1960: 262-265). The .05 significance level was adopted for all tests. Computations are shown in Table LII. In order to reject the null hypothesis at the .05 level, D must be at least .23. Since the computed D is only -.09, it must be concluded that there is no statistical difference in platform length between hard and soft hammer flakes.

Platform width ranged from 1 - 14 mm, with a mean width of 2 mm. The Kolmogorov-Smirnov test was again used to evaluate the difference between samples. Computations are shown in Table LIII. In this case, D must be at least .24 to reject the null hypothesis. Since D is only -.17, it is concluded again that there is no statistical difference in platform width between hard and soft hammer flakes.

Table LII. Computation of the Kolmogorov-Smirnov test: platform length x hammer type.

Platform Length	Hammer Type Hard		Soft		Difference
0 - 5 mm	26	.38	32	.47	-.09
6 - 10 mm	45	.65	50	.74	-.09
11 - 15 mm	60	.87	57	.84	.03
16 - 20 mm	65	.94	63	.93	.01
21 - 25 mm	67	.97	66	.97	.00
26 - 30 mm	67	.97	66	.97	.00
31 - 35 mm	67	.97	66	.97	.00
36 - 40 mm	69	1.00	68	1.00	.00

D = -.09

Table LIII. Computation of the Kolmogorov-Smirnov test: platform width x hammer type.

Platform Length	Hammer Type Hard		Soft		Difference
1 - 2 mm	40	.58	51	.75	-.17
3 - 4 mm	64	.93	60	.88	.05
5 - 6 mm	65	.94	65	.96	-.02
7 - 8 mm	66	.96	68	1.00	-.04
9 - 10 mm	67	.97	68	1.00	-.03
11 - 12 mm	68	.99	68	1.00	-.01
13 - 14 mm	69	1.00	68	1.00	.00

D = -.17

If striking platform size is not clearly related to hammer type, it may simply be a function of overall flake size. To explore this possibility, the correlation between flake weight and each of the platform dimensions was calculated using the correlation coefficient (Ferguson 1959: 10). Calculations of the correlation between platform length and flake weight are shown in Table LIV. The result, r = .67, shows a positive correlation between the variables, while r x 100 (in this case 45) indicates that 45% of the variance of platform length may be predicted from the variance of flake weight (ibid: 116). Similarly, calculation of the correlation between flake weight and platform width (Table LV) shows a weaker positive relationship - r=.42. In this case r x 100 = 18, indicating that only 18% of the variance in platform width is predictable from the variance of flake weight. Apparently, striking platform length is more directly related to flake size than is platform width.

Returning to proposed diagnostic attributes, 23% of the total 136 flakes were found to have a ventral lip; 54% have crushed striking platforms; 39% exhibit compression rings; and only 9% have sheared or fragmented bulbs of percussion. The relationship between hard and soft hammer techniques was tested for each attribute using the chi square test of independence for nominal variables (Ferguson 1959: 182-191). Calculations are shown in Table LVI.

Table LIV. Calculation of the correlation coefficient: platform length x flake weight.

X = Flake Weight

Y = Platform Length

ΣX	ΣY	ΣX^2	ΣY^2	ΣXY	N
4241	1204	796824	17980	84192	136

$$r = \frac{136(84192) - 4241(1204)}{\sqrt{[136(796824) - 4241^2][136(17980) - 1204^2]}}$$

$r = .67$

$r^2 \times 100 = 45$

Table LV. Calculation of the correlation coefficient: platform width x flake weight.

X = Flake Weight

Y = Platform Width

ΣX	ΣY	ΣX^2	ΣY^2	ΣXY	N
4238	389	803446	2107	23069	136

$$r = \frac{136(23069) - 4238(389)}{\sqrt{[136(803446) - 4238^2][136(2107) - 389^2]}}$$

$r = .42$

$r^2 \times 100 = 18$

Table LVI. Calculation of chi-square for hammer type.

$$\chi^2 = \frac{N\ (AD - BC)^2}{(A+B)\ (C+D)\ (A+C)\ (B+D)}$$

Ventral lip (pres/abs) X Hammer type (soft/hard)

$$\chi^2 = \frac{137\ [\,15(51) - 17(54)\,]^2}{(15+17)\ (54+51)\ (15+54)\ (17+51)} = .20$$

Platform crushing (pres/abs) X Hammer type (soft/hard)

$$\chi^2 = \frac{136\ [\,45(38) - 29(24)\,]^2}{(45+29)\ (24+38)\ (45+24)\ (29+38)} = 6.59$$

Compression rings (pres/abs) X Hammer type (soft/hard)

$$\chi^2 = \frac{137\ [\,32(46) - 22(37)\,]^2}{(32+22)\ (37+46)\ (32+37)\ (22+46)} = 2.82$$

Sheared bulb (pres/abs) X Hammer type (soft/hard)

$$\chi^2 = \frac{136\ [\,4(59) - 9(65)\,]^2}{(4+9)\ (65+59)\ (4+65)\ (9+59)} = 2.21$$

Referring to the table of chi square values at 1 df and the .05 level of significance, chi square must be at least 3.84 in order to reject the null hypothesis. Only 1 value, representing platform crushing and hammer type, exceeds this level. In other words, there is a statistically significant relationship between platform crushing and hammer type. The direction of this relationship may be illustrated with percentages: while 63% of hard hammer flakes have crushed platforms, only 43% of soft hammer flakes are crushed. Unfortunately, while the relationship between variables is statistically significant, it would be difficult to operationalize as a test of hammer type because the raw percentages are close.

To summarize, 6 proposed diagnostic attributes (platform length and width, ventral lip, platform crushing, compression rings, and sheared bulb) were recorded for experimentally manufactured hard and soft hammer flakes. It was found that all 6 attributes occur on both hard and soft hammer flakes. In 5 cases, the relationship between the proposed diagnostic attribute and hammer type was statistically insignificant. Only the relationship between platform crushing and hammer type was statistically significant, but even this indicator would be difficult to operationalize in evaluating archaeological specimens. It is concluded that hammer type may not be clearly distinguished using any of the above attributes.

Appendix C. Pressure Vs. Percussion Flakes

The hypothesis that pressure flakes can be distinguished from percussion flakes was tested experimentally.

Flakes were detached from a single core of vitreous basalt using percussion (granite hammerstone and antler billet) and pressure (hafted copper rod) techniques. In order to control for the effects of flake size, the 35 largest pressure flakes were selected and a sample of 40 percussion flakes with maximum dimension less than 10 mm was drawn for comparison.

Attributes recorded were generally the same as those in Appendix B, with the exception of weight, which was in all cases negligible, and platform crushing, eliminated because pressure flaking requires preliminary abrading of the platform. Again, the attributes were evaluated for distribution and frequency, then tested statistically for significant differences between the 2 samples.

With reference to overall size, the maximum upper size limit clearly distinguished pressure from percussion flakes. Maximum dimensions achieved by pressure were: length - 10 mm, width - 9 mm, and thickness - 2 mm.

A rough evaluation of shape uniformity was attempted by using the length/width ratio. The mean ratio for pressure flakes was .96, indicating that flakes are slightly wider than they are long (range: .71 - 1.50). In comparison, percussion flakes averaged a ratio of 1.03, indicating flakes slightly longer than wide (range: .60 - 1.67). These ranges demonstrate that pressure flakes show slightly less variation in form than percussion flakes, although their fields are overlapping.

Platform length averaged 4 mm for pressure flakes (range: 2-8, s=1) and 3 mm for percussion (range: 1-9, s=2). Again, the range and standard deviation measurements demonstrate slightly less variation among pressure flakes. The 2 samples were compared with the Difference of Means test (Blalock 1960: 226-227), challenging the null hypothesis that there is no difference in platform length between pressure and percussion flakes. Computations are shown in Table LVII. The resulting value of t (2.53) exceeds the value required at df=73 and the .05 significance level (1.996), therefore the null hypothesis is rejected and it is concluded that there is a significant difference in platform length between the 2 samples.

Due to its very narrow range (1-2 mm), platform width was treated as a nominal variable for statistical purposes,

Table LVII. Computation of Difference of Means test for platform length on pressure and percussion flakes.

$$s = \frac{1}{N}\sqrt{N(\Sigma X^2) - (\Sigma X)^2}$$

$$\hat{\sigma}_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{N_1 - 1} + \frac{s_2^2}{N_2 - 1}}$$

$$t = \bar{X}_1 - \bar{X}_2 / \hat{\sigma}_{\bar{X}_1 - \bar{X}_2}$$

$$df = N_1 + N_2 - 2$$

	N	$\bar{X}$	ΣX	ΣX^2
Platform Length (Pressure Flakes)	35	4.26	149	697
Platform Length (Percussion Flakes)	40	3.35	134	572

$s_1 = 1.34$

$s_2 = 1.75$

$$\hat{\sigma}_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{1.34^2}{35 - 1} + \frac{1.75^2}{40 - 1}} = .36$$

$$t = \frac{4.26 - 3.35}{.36} = 2.53$$

$df = 73$

significance at .05 = 1.996

and recorded in a 2 x 2 contingency table. Sixty percent of pressure flakes had platforms only 1 mm wide, while 92% of percussion flakes were that narrow. The chi square test of significance was applied (Table LVIII), producing a value of 11.25 which exceeds by far the required value of 3.84 at df=1 and the .05 significance level. Again it is concluded that there is a significant difference between samples.

The final 3 nominal variables were also evaluated with the chi square test. Calculations are shown in Table LVIII. Two of these variables showed no significant difference between samples: approximately 2% of all flakes have a ventral lip, and 33% show compression rings, regardless of whether they were manufactured by pressure or percussion. On the other hand, there is a statistically significant difference in the occurrence of bulb 'shearing' or shattering on pressure and percussion flakes, with 17% of percussion bulbs sheared, but no pressure bulbs sheared.

In summary 7 variables were measured on 2 samples of flakes produced by pressure and percussion (overall size, shape uniformity, platform length and width, ventral lip, compression rings, and bulb shearing). It was found that there is a consistent maximum size limit of about 10 mm for pressure flakes. Pressure flakes are slightly more uniform in shape, although the range of length/width ratios overlaps

Table LVIII. Computations of chi-square for pressure and percussion flakes.

$$\chi^2 = \frac{N\ (ad - bc)^2}{(a+b)\ (c+d)\ (a+c)\ (b+d)}$$

Platform width (1 mm/ 2 mm) X Technique (percussion/pressure)

$$\chi^2 = \frac{75\ [21(3) - 37(14)]^2}{(21+37)\ (14+3)\ (21+14)\ (37+3)} = 11.25$$

Ventral lip (pres/absent) X Technique (percussion/pressure)

$$\chi^2 = \frac{75\ [4(32) - 31(8)]^2}{(4+8)\ (31+32)\ (4+31)\ (8+32)} = 1.02$$

Compression rings (pres/absent) X Technique (perc./pressure)

$$\chi^2 = \frac{75\ [6(21) - 19(29)]^2}{(6+19)\ (29+21)\ (6+29)\ (19+21)} = 3.19$$

Sheared bulb (pres/absent) X Technique (percussion/pressure)

$$\chi^2 = \frac{75\ [0(34) - 6(35)]^2}{(0+6)\ (35+34)\ (0+35)\ (6+34)} = 5.71$$

entirely that of percussion flakes. Pressure flakes have, on the average, significantly longer and wider striking platforms, although again the range of possible values overlaps percussion flakes. There is apparently no statistical difference in the occurrence of a ventral lip or compression rings, while bulb shearing occurs exclusively on percussion flakes, albeit rarely.

Only 2 variables may prove useful in the identification of archaeological specimens. Flakes larger than about 10 mm and those smaller than 10 mm exhibiting sheared bulbs, may be tentatively identified as percussion flakes. It should be emphasized that it dces not logically follow that flakes smaller than 10 mm were made by pressure, since small flakes can also be easily manufactured by percussion.

Appendix D. The Replication of Utilized Edges

Utilization was replicated experimentally by using unmodified flakes to perform 3 actions on 5 different subject materials. Resulting edges were examined and illustrated under low magnification (14X).

The actions performed were:

1. paring - a transverse movement drawing the flake towards the operator with the working edge forward at an angle of about 30 degrees to the worked material. A single motion towards the operator was regarded as 1 stroke. Acute spine-plane angles only were suitable for this action.

2. scraping - a transverse movement, drawing the flake towards the operator while trailing the working edge at an angle of about 70 - 80 degrees to the worked material. A single motion towards the operator was regarded as 1 stroke. Both narrow and wide spine-plane angles were suitable.

3. sawing - a longitudinal motion, running the flake edge back and forth across the worked material at an angle of about 90 degrees. A bi-directional movement away from

and then towards the operator was regarded as 1 stroke. Narrow spine-plane angles only were suitable.

The subject materials were:

1. dry deer antler
2. fresh bone (cow)
3. a freshly cut branch of Douglas fir about 2 " in diameter.
4. frozen meat (cow)
5. fresh uncooked meat (cow)

Two initial tests were performed on the hardest material, antler, to determine the number of strokes required to produce maximum flake scar length. Both paring and sawing actions were used and edge wear recorded after 0, 10, 50, 100, and 300/400 strokes. Results, shown in Figs. 64 and 65, indicate that most of the edge was modified after only 10 strokes, but maximum flake scar length was attained between 50 and 150 strokes. After 150 strokes, the length of use flakes actually diminished through gradual edge attrition. All subsequent tests, except cutting raw meat, were limited to 50 strokes.

Replicated edges are illustrated in Figs. 66 through 70, where a 1 cm long segment of the edge is viewed from dorsal and ventral faces before and after modification.

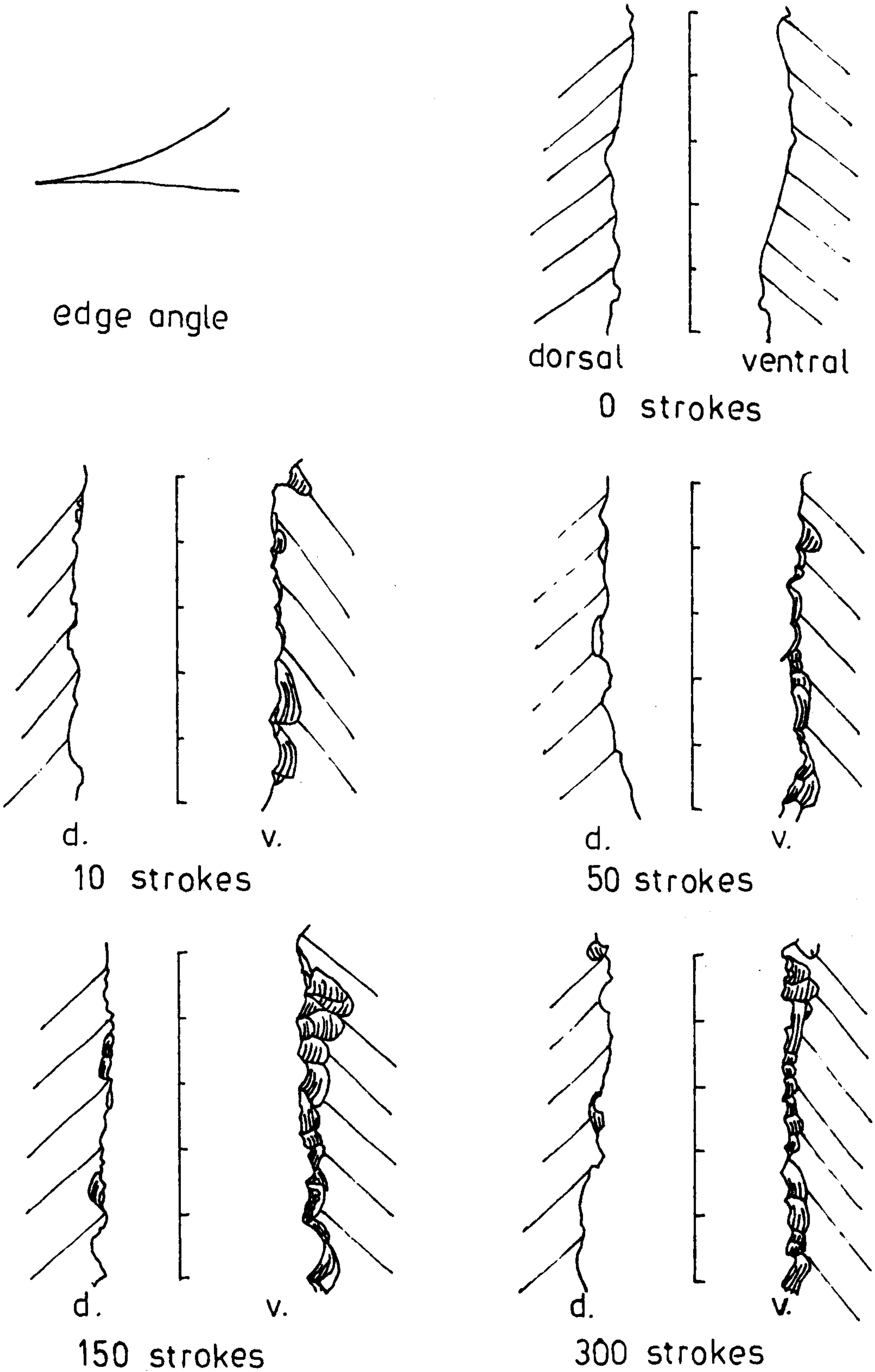


Fig. 64. Basalt edge used to pare antler (0 - 300 strokes).

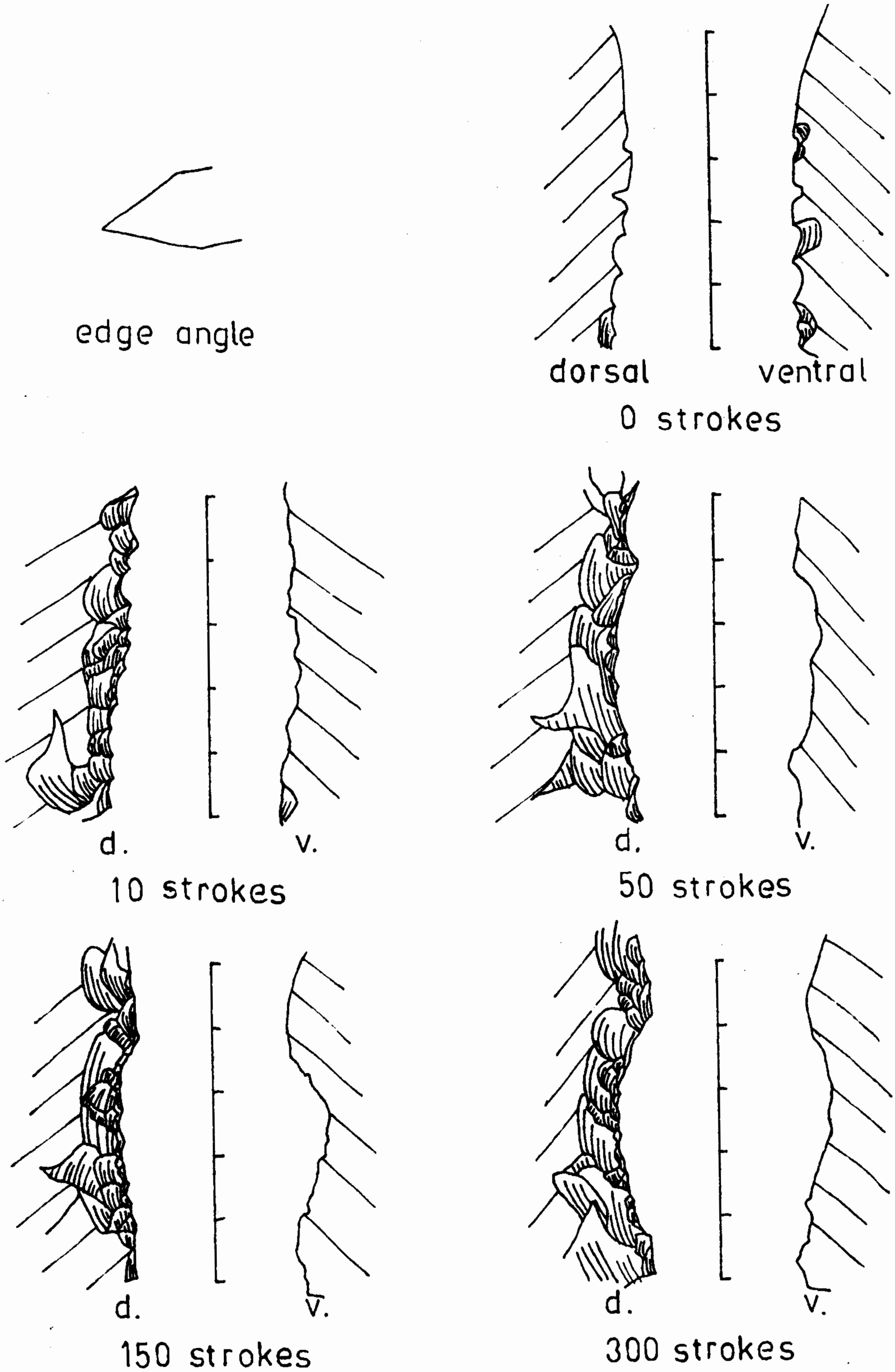


Fig. 65. Basalt edge used to scrape antler (0 – 300 strokes)

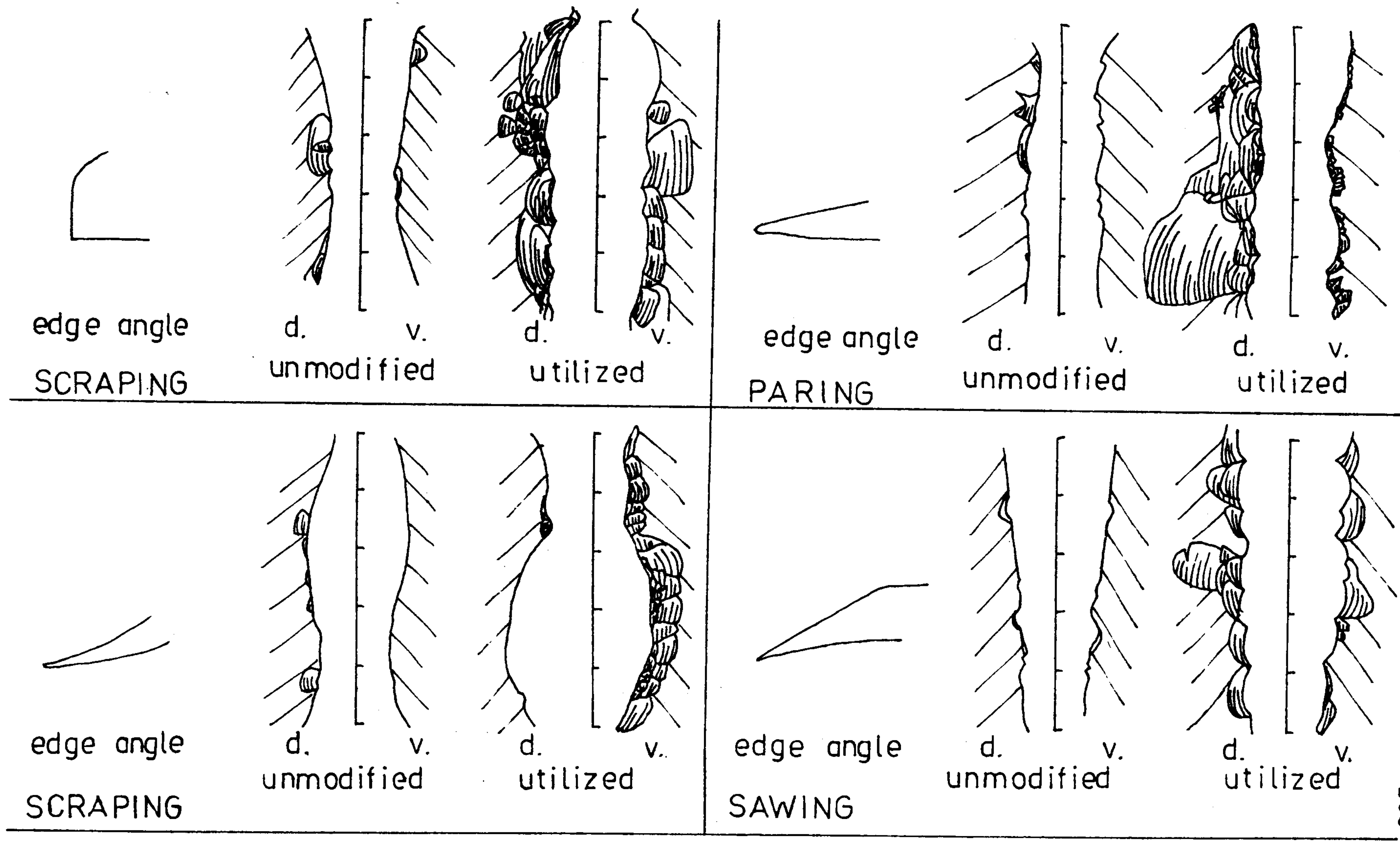


Fig. 66. Basalt edges used to scrape, pare, and saw antler.

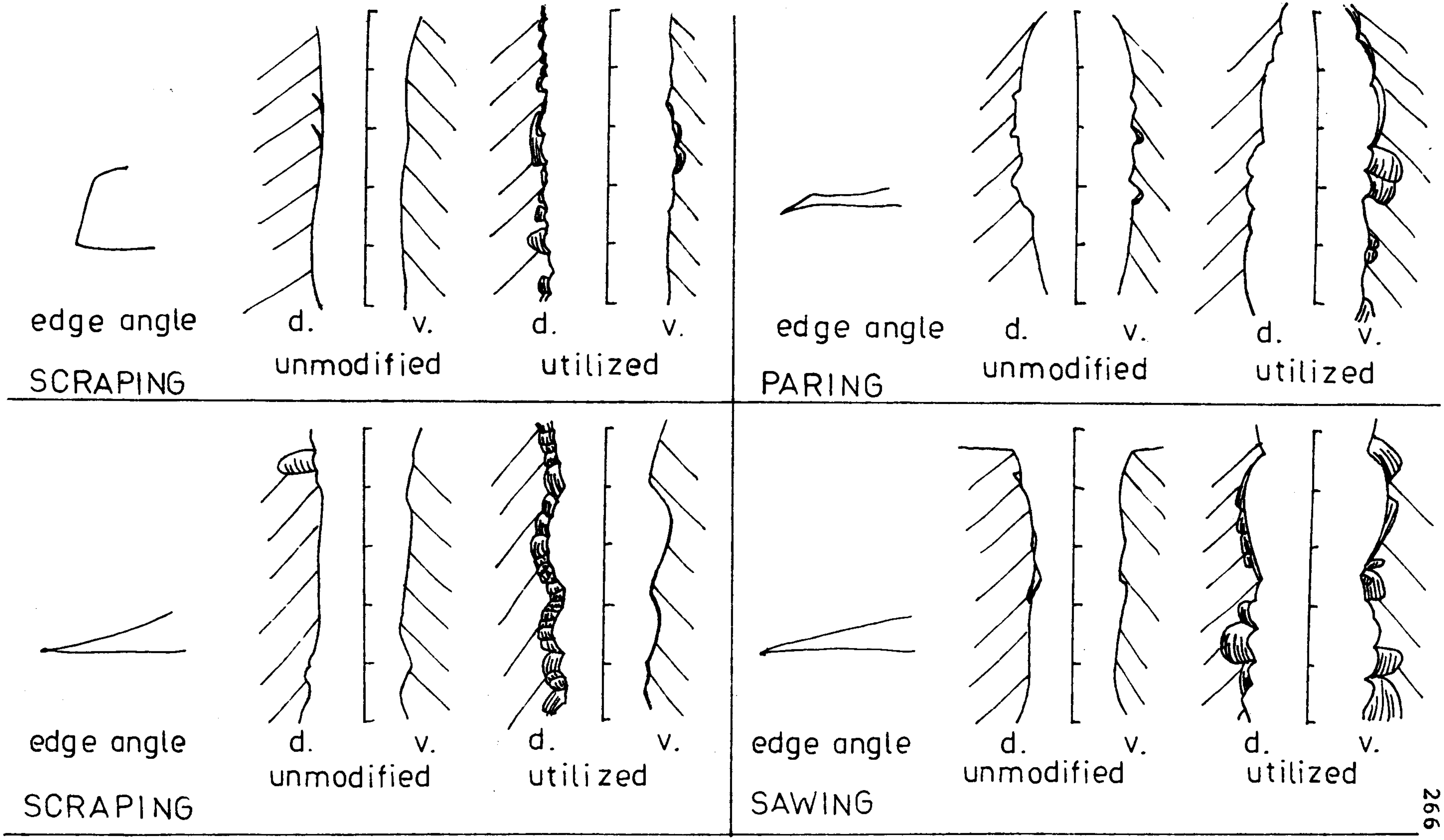


Fig. 67. Basalt edges used to scrape, pare, and saw bone.

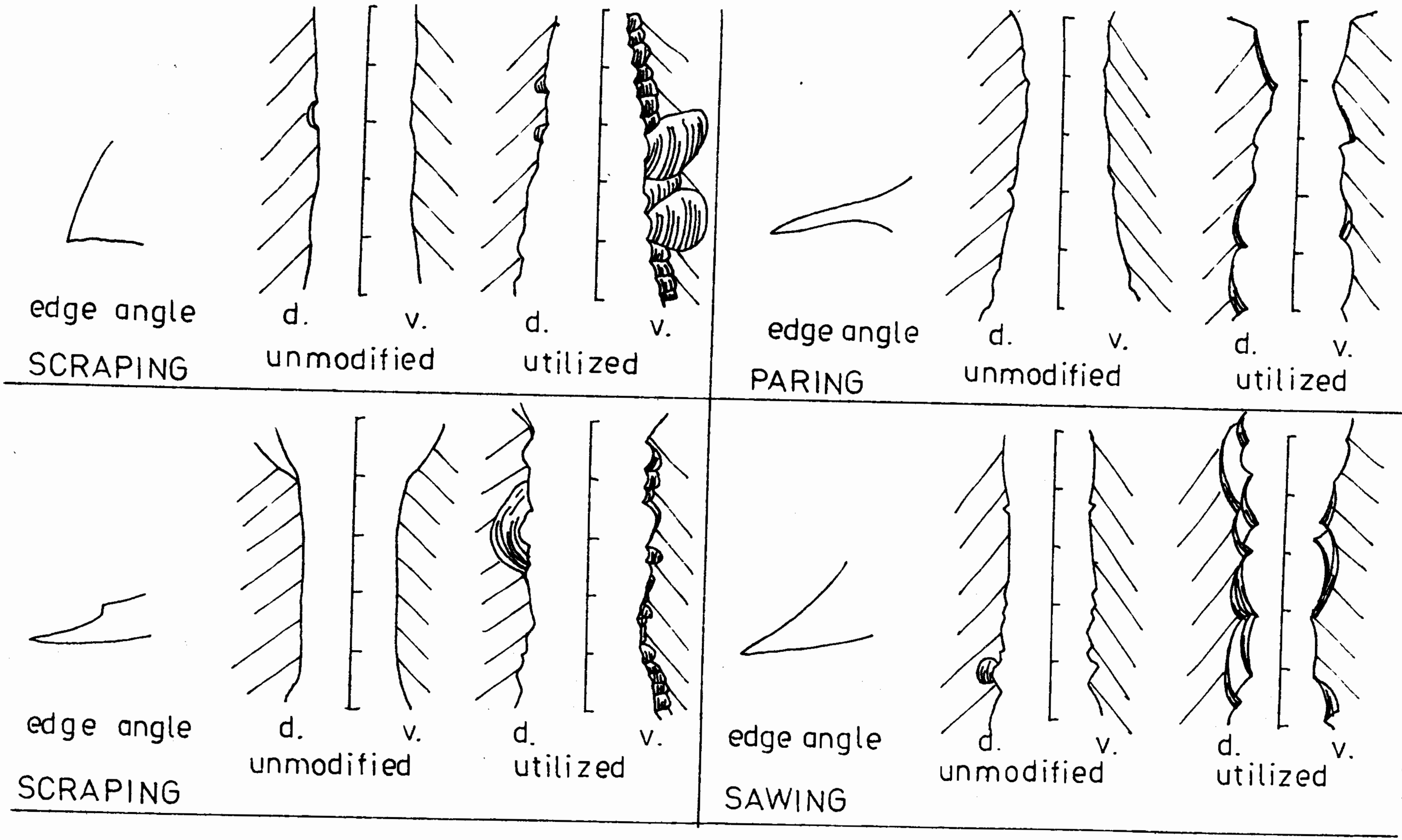


Fig. 68. Basalt edges used to scrape, pare, and saw wood (Douglas fir).

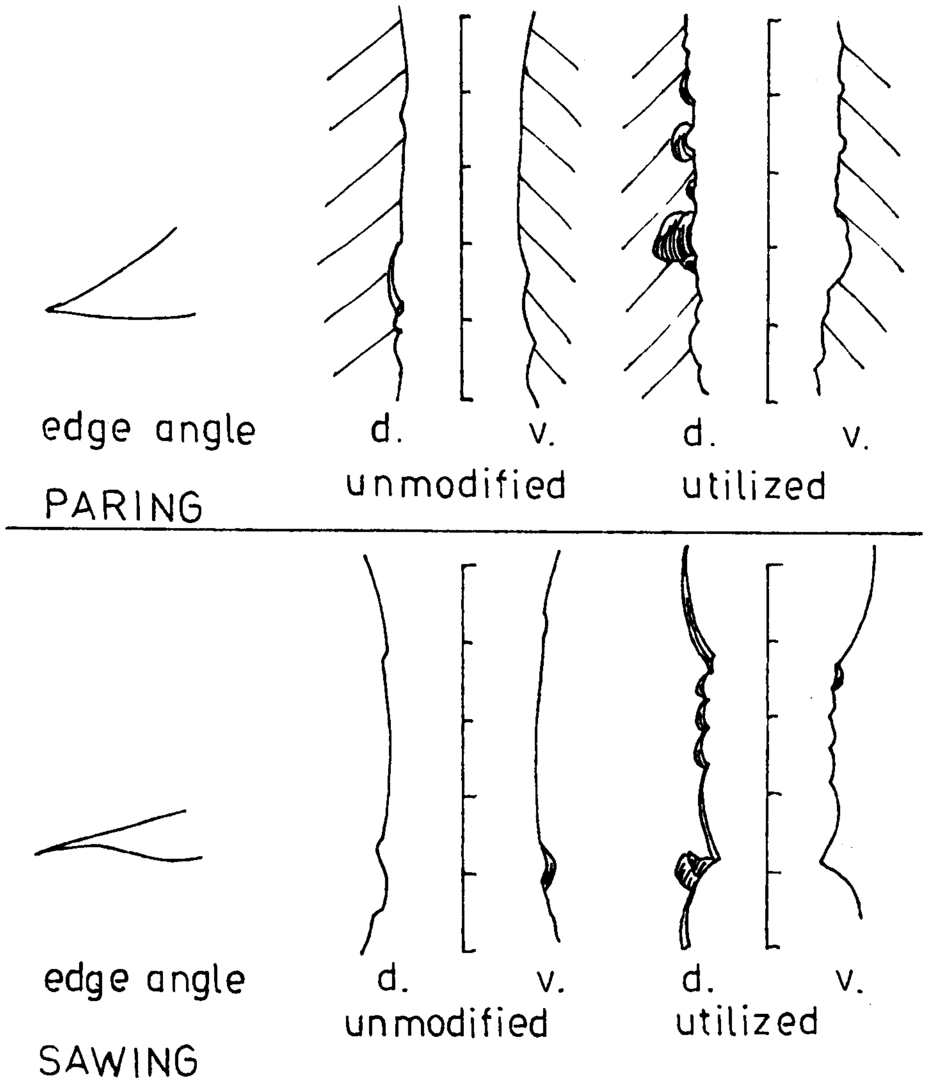


Fig. 69. Basalt edges used to pare and saw frozen meat.

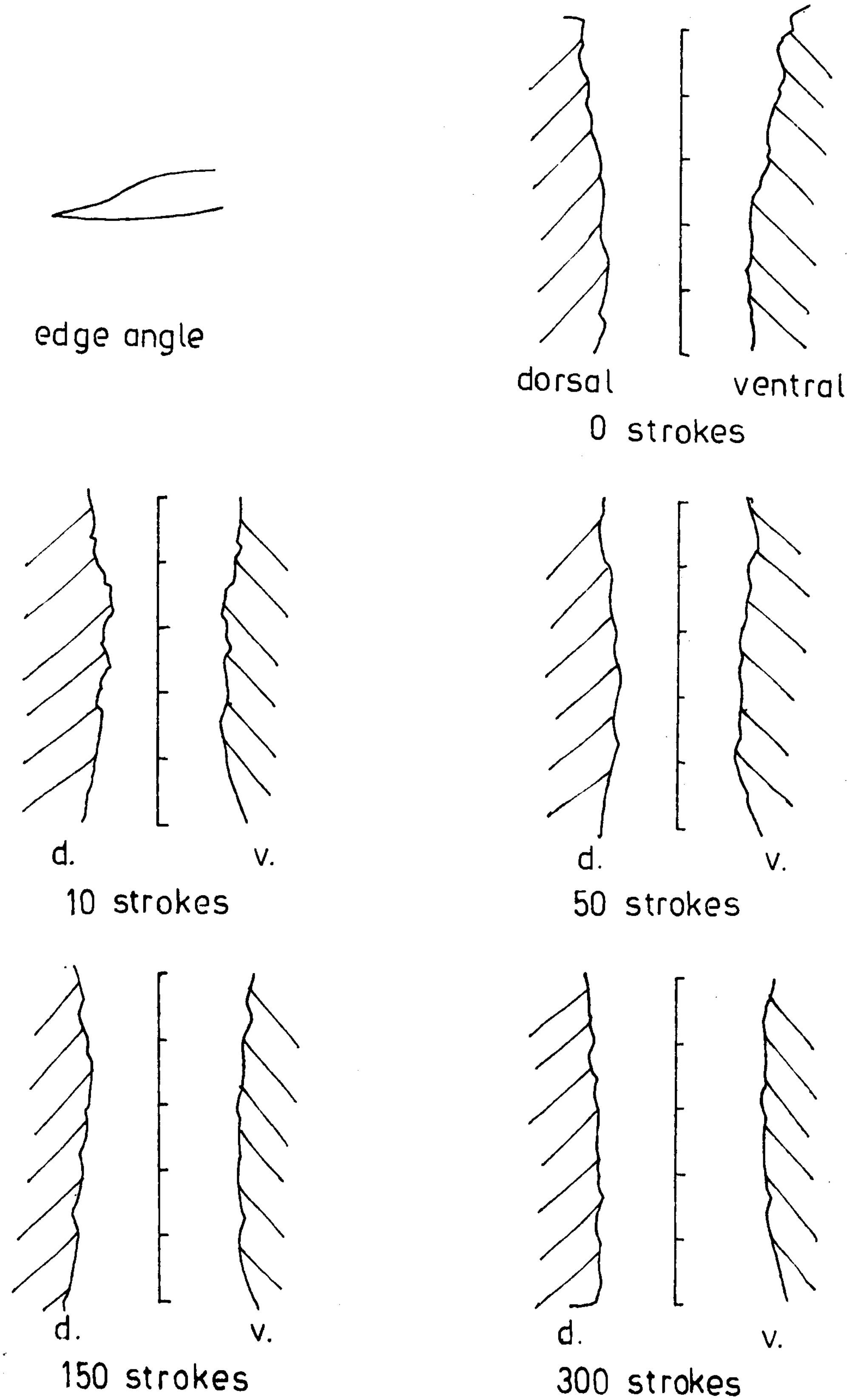


Fig. 70. Basalt edge used to saw raw meat (0 - 300 strokes).

Considering first the problem of distinguishing unmodified edges from utilized edges, it may be observed than on unmodified edges major irregularities in contour are related to natural flake morphology, ie protrusions appear where concentric ripples meet the flake edge, or around inclusions in the basalt. Unmodified edges are also characterized by isolated flakes, sometimes reaching 1 mm in length. Flakes may also occur in discontinuous series, but are generally irregular in size and shape.

Turning to utilized edges, it must be admitted that some kinds of use do not leave traces visible at low magnification. A soft material such as raw meat does not offer enough resistance to fracture the edge. However, every other tested material caused edge damage visible at 14X. Use on soft wood, bone, frozen meat, and antler caused edge snapping and micro-flaking, with flakes removed in continuous or nearly continuous series. Maximum flake scar length on all utilized tools combined averaged 1.5 mm, with a maximum length of 4.1 mm. However, only 4 edges exhibited flake scars longer than 2 mm and in 2 of these cases the long flakes were isolated features on an edge with otherwise smaller, more uniform micro-flaking.

Length of modifying flakes was also chosen as the best criterion for distinguishing utilized edges from intentionally retouched edges. Two mm was adopted as the upper limit of use-resulting flakes (with the understanding that exceptional flakes may reach 4 mm long).

As Keeley (1974: 327) has pointed out, a major problem in the analysis of use-wear is distinguishing use-wear from the accidental effects of weathering and other post-depositional "indignities". To control for 2 possible accidental effects, basalt flakes were examined after having been stepped on and after agitation in a box filled with basalt debitage. An unmodified flake was placed on a dirt surface and stepped on 10 times, with observations recorded after 0, 1, 3, and 10 steps. Results, illustrated in Fig. 71, reveal little edge modification - a few small and isolated crescent shaped snaps around the perimeter. Another unmodified flake was placed in a large cardboard box with about 5 pounds of basalt debitage including many large cobbles. The contents of the box were agitated by rolling the debitage from 1 end of the box to the other, while the experimental flake was removed and examined after 0, 5, and 50 'rolls'. Again, the results indicate little damage - a few irregular, isolated flakes removed from both faces.

Returning to the replicated use wear patterns, differences between edges used on different subject materials were considerable. The same action, paring, produced a different alteration when used on each material. Paring wood left a jagged

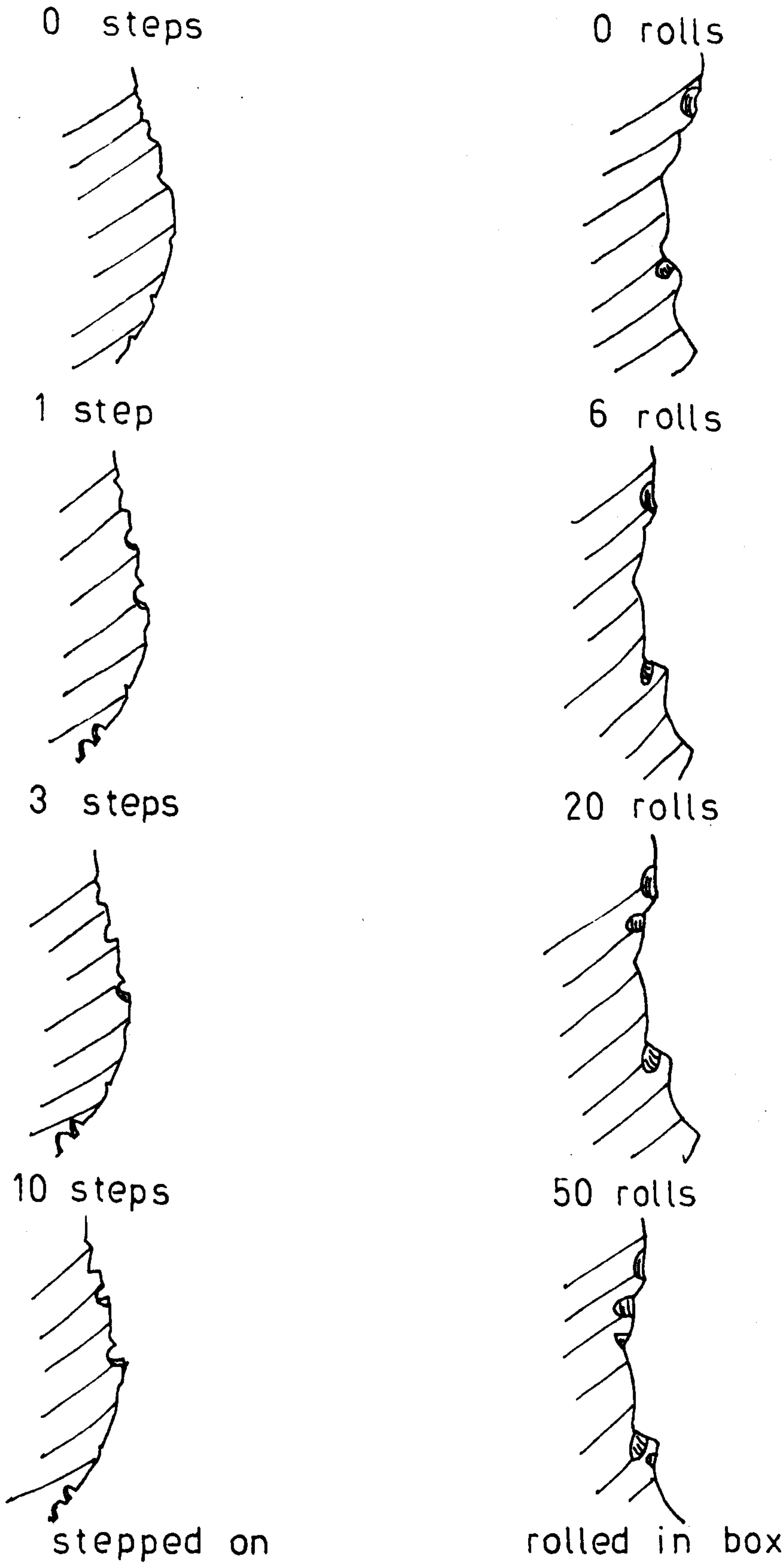


Fig. 71. Wear on 'accidentally' crushed basalt flakes.

edge formed by a continuous series of steep crescent shaped scars resembling snap fractures (.5 mm long and 1.5 - 2.0 mm wide). Paring frozen meat left a series of shallow conchoidal scars .2 - 1.00 mm long and about .5 - 1.5 mm wide. Paring fresh bone produced a nearly continuous series of flakes, with some expanding scars reaching 1 mm long, and some short crescent shaped flakes reaching 2 mm wide. Paring antler produced the most extensive wear, consisting of overlapping expanding and crescent shaped flakes reaching 4.1 mm from the tool edge, as well as continuous edge rounding and crushing.

Scraping wood or bone with a narrow spine-plane angle left a series of uniform, expanding and crescent shaped flake scars up to .6 mm long and about .5 mm wide, whereas scraping antler produced extensive wear including overlapping flakes, mostly expanding, up to 2.5 mm long and 3.0 mm wide, and continuous heavy rounding and crushing.

Scraping wood and bone with a wide spine-plane angle again produced similar wear, leaving small, regular, expanding scars about .5 mm long and equally as wide. The edge used on wood also sustained 2 larger flakes (2 mm long and 2 mm wide). Again, scraping antler produced wide (up to 2.5 mm) but shallow overlapping flakes and crushing.

The final action, sawing, left a jagged edge made up of wide (up to 2.5 mm) shallow (.8 mm deep) flake scars when applied to wood. Sawing frozen meat left a very similar edge with slightly more shallow flake scars (.5 mm deep), whereas the edge used to saw bone was similar but with conchoidal flakes up to 1.2 mm long. Sawing antler produced overlapping broad, crescent shaped scars about 1.5 mm long, and a single larger expanding flake 2.4 mm long.

In terms of comparisons between actions, paring removed flakes from only 1 tool face (the face held away from the subject material), except on wood. The flakes were also non-uniform in terms of both size and shape. Scraping with a narrow edge also remcved flakes from only the face held away from the material. In contrast, a few isolated flakes were removed from the 'contact' surface as well as the 'back' when scraping with a wide angle. Sawing produced the most easily recognized wear on all edges - a jagged or 'scalloped' edge consisting of wide shallow scars on both faces. These especially wide flakes may be caused by bi-directional movement against the subject material.

In summary, edges utilized against medium to hard materials may be distinguished from unmodified edges by the presence of continuous or nearly continuous series of micro-flakes or edge snapping, with flake scars usually less than 2 mm long but reaching 4 mm long in rare cases. This upper limit of flake length also distinguishes utilized edges from intentionally modified edges with continuous series of retouch flakes longer than 2 mm. Accidental effects, such as crushing or agitation, produce an edge similar to the unmodified edges, with small isolated snap fractures or irregular micro-flakes.

In general, on harder material the same action removed larger flakes, but flakes of the same general type. The hardest material, antler, also consistently caused overlapping flakes as well as edge crushing and rounding. Paring and scraping with a narrow spine-plane angle removed micro-flakes from only 1 tool face, whereas scraping with a wide angle flake also removed a few small flakes from the 'contact' surface. Sawing left bifacial evidence in the form of wide, shallow scars.

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Plate 1A. The Blackwater River.

Plate 1B. The Punchaw Lake Site (FiRs 1)- Excavation Area C.

Plate 2A. Excavation technique.

Plate 2B. Stratigraphic profile (south wall)-
Excavation Area C.

Plate 3A. Cultural Feature 2: concentration of fire broken rock.

Plate 3B. Cultural Feature 6: oval depression.

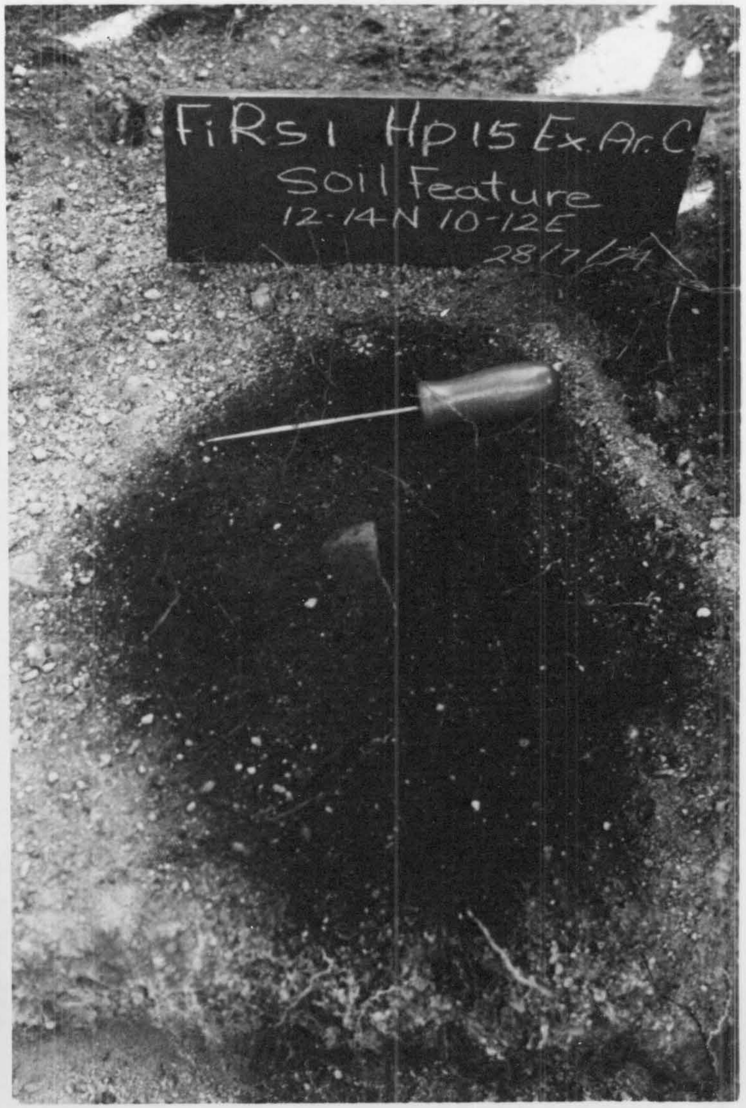

Plate 4A. Cultural Feature 5: hearth pit before excavation.

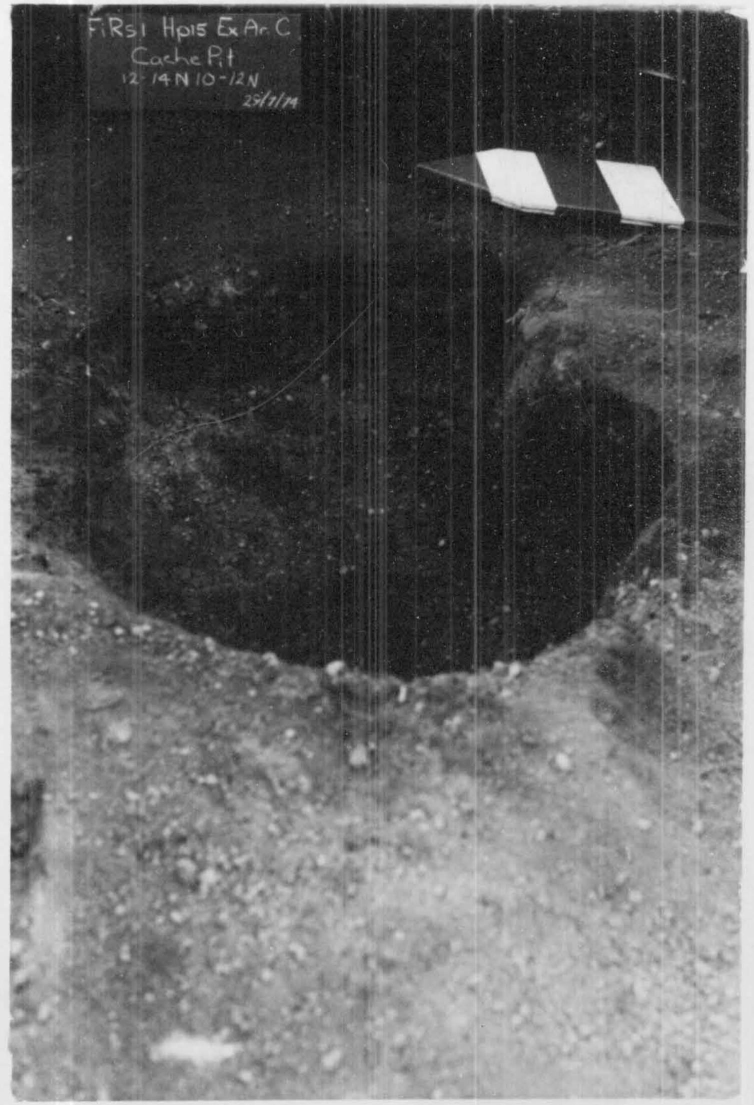

Plate 4B. Cultural Feature 5: hearth pit after excavation.

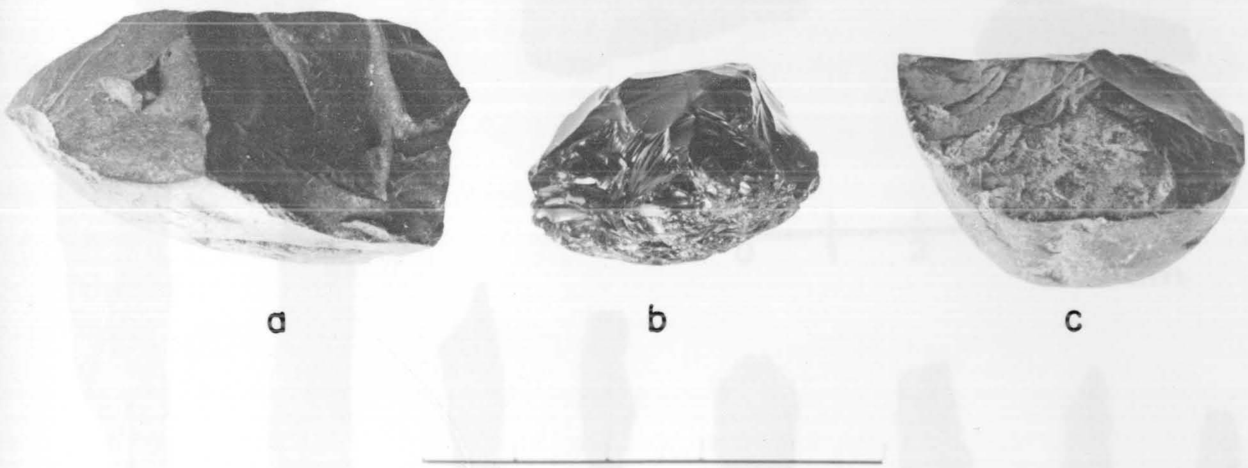

Plate 5A. Split cobble fragments.

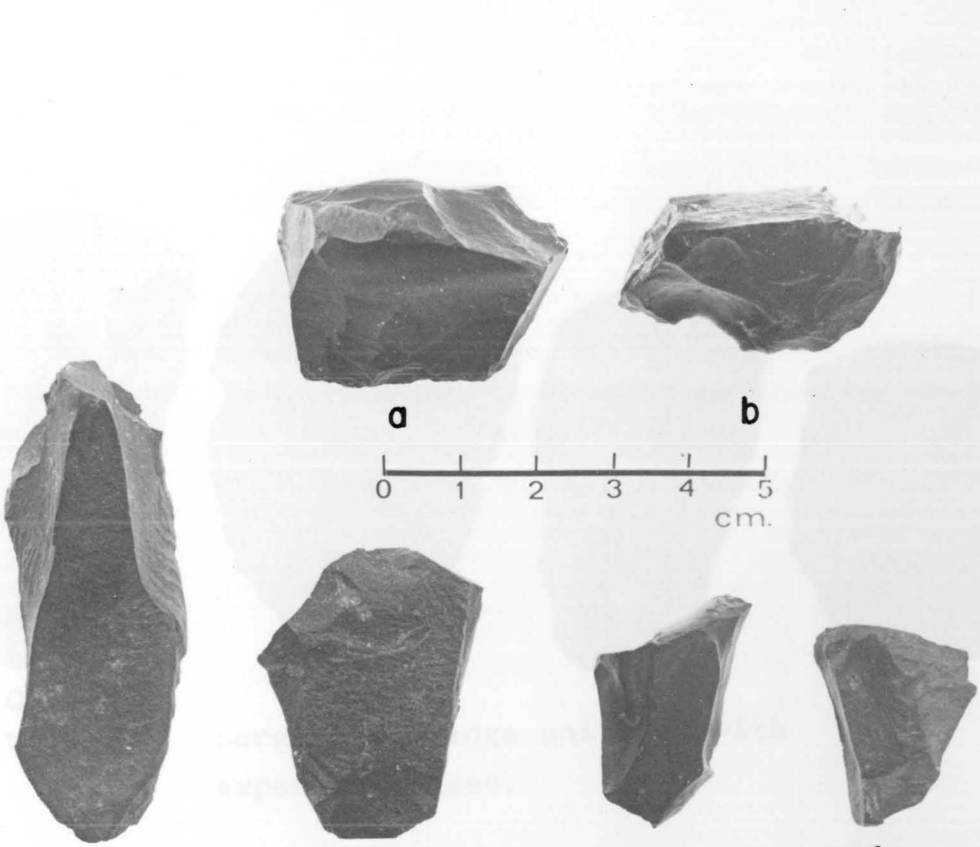

Plate 5B. End struck core remnants: a-b wedge cores, c-f elongated cores.

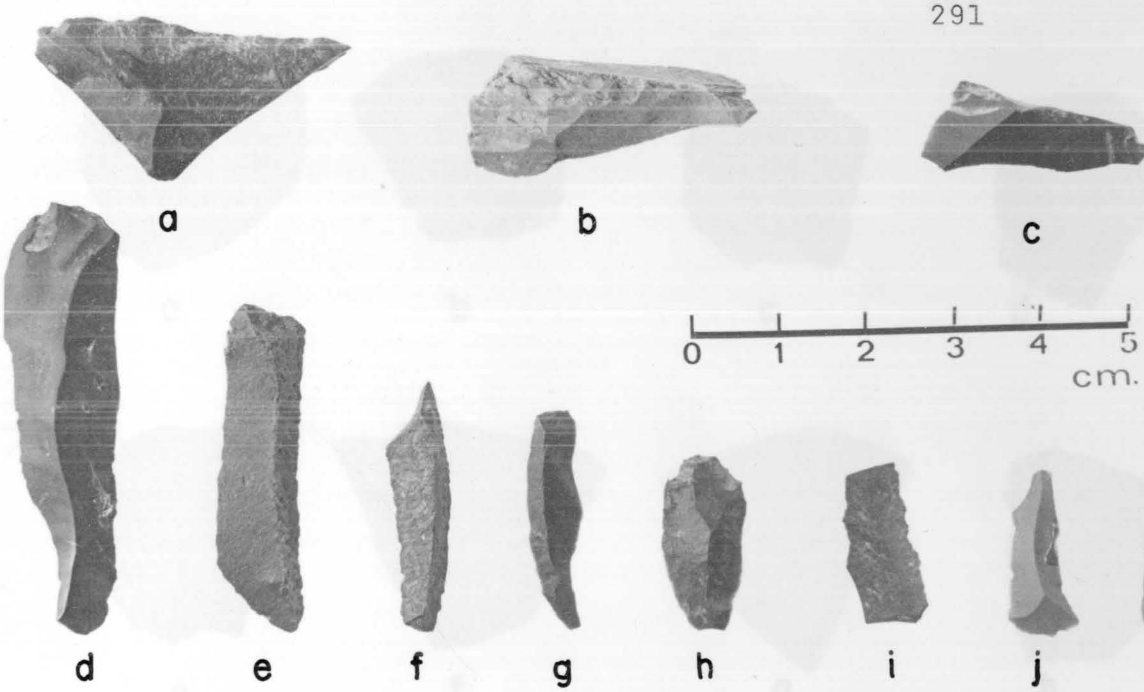

Plate 6A. a-c platform remnants, d-k blades and blade-like-flakes.

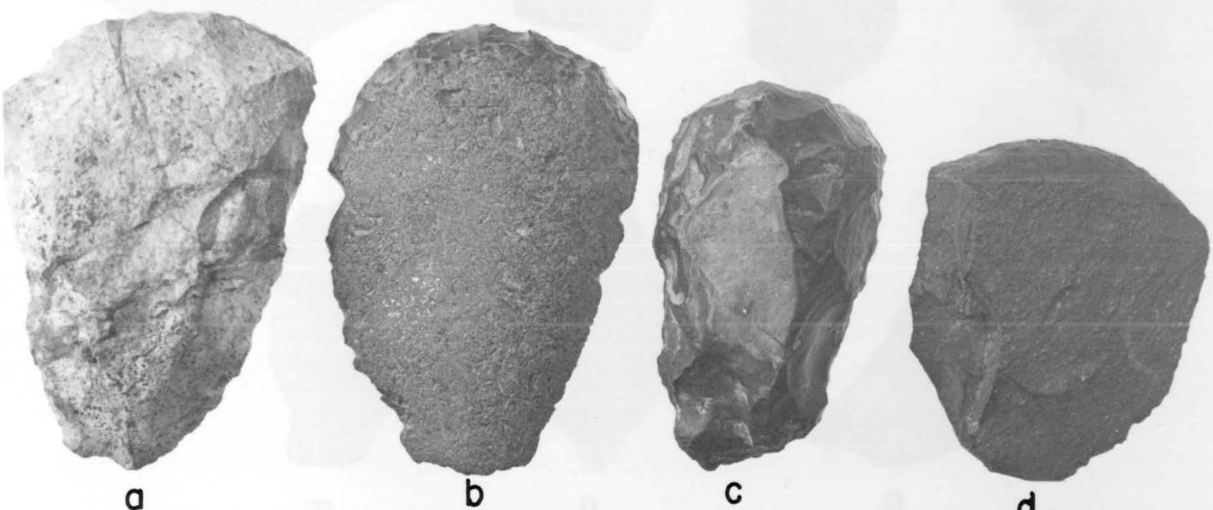

Plate 6B. Large steep edge unifaces with expanding edges.

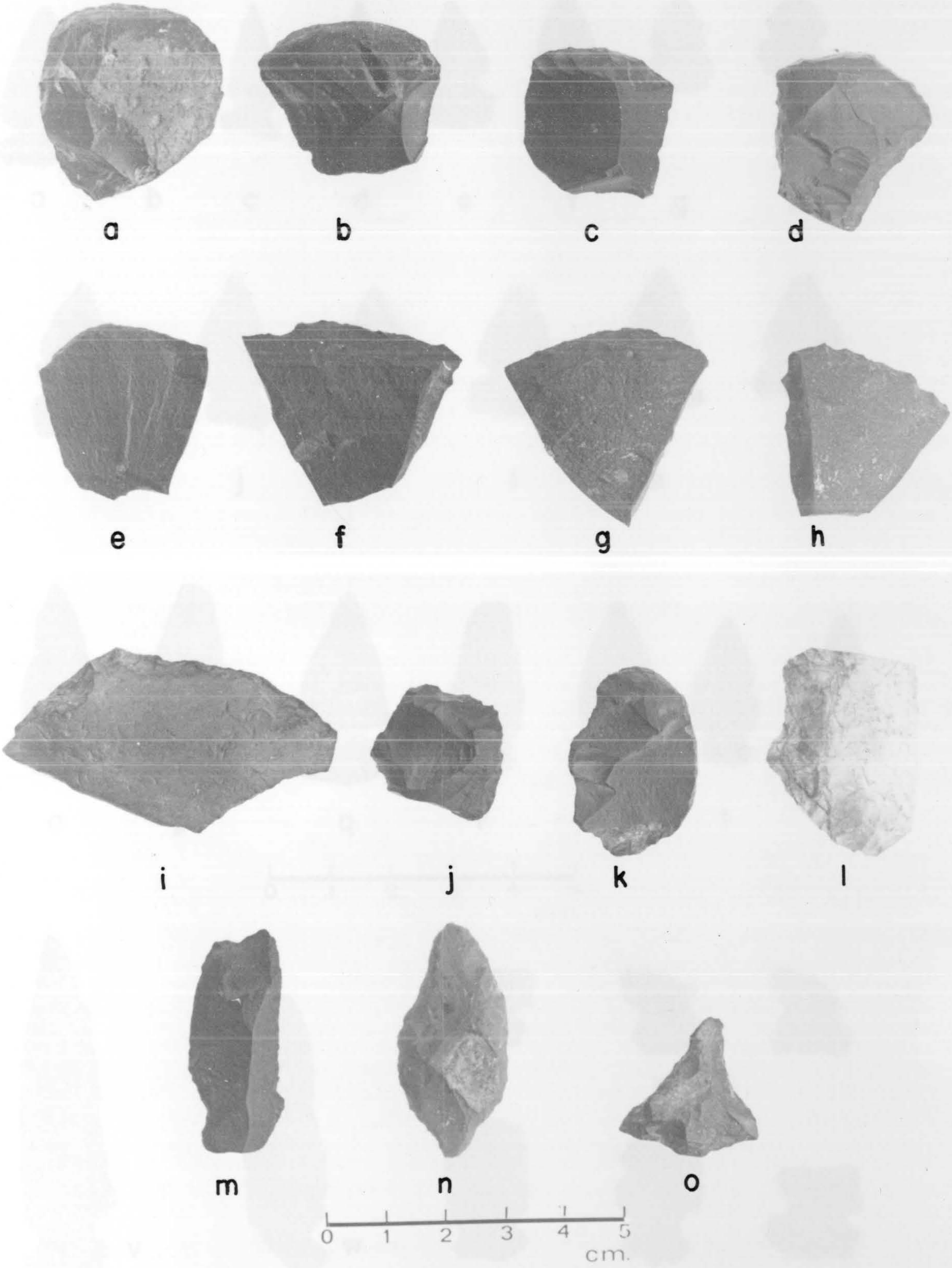

Plate 7. a-k steep edge unifaces, l-o miscellaneous formed unifaces.

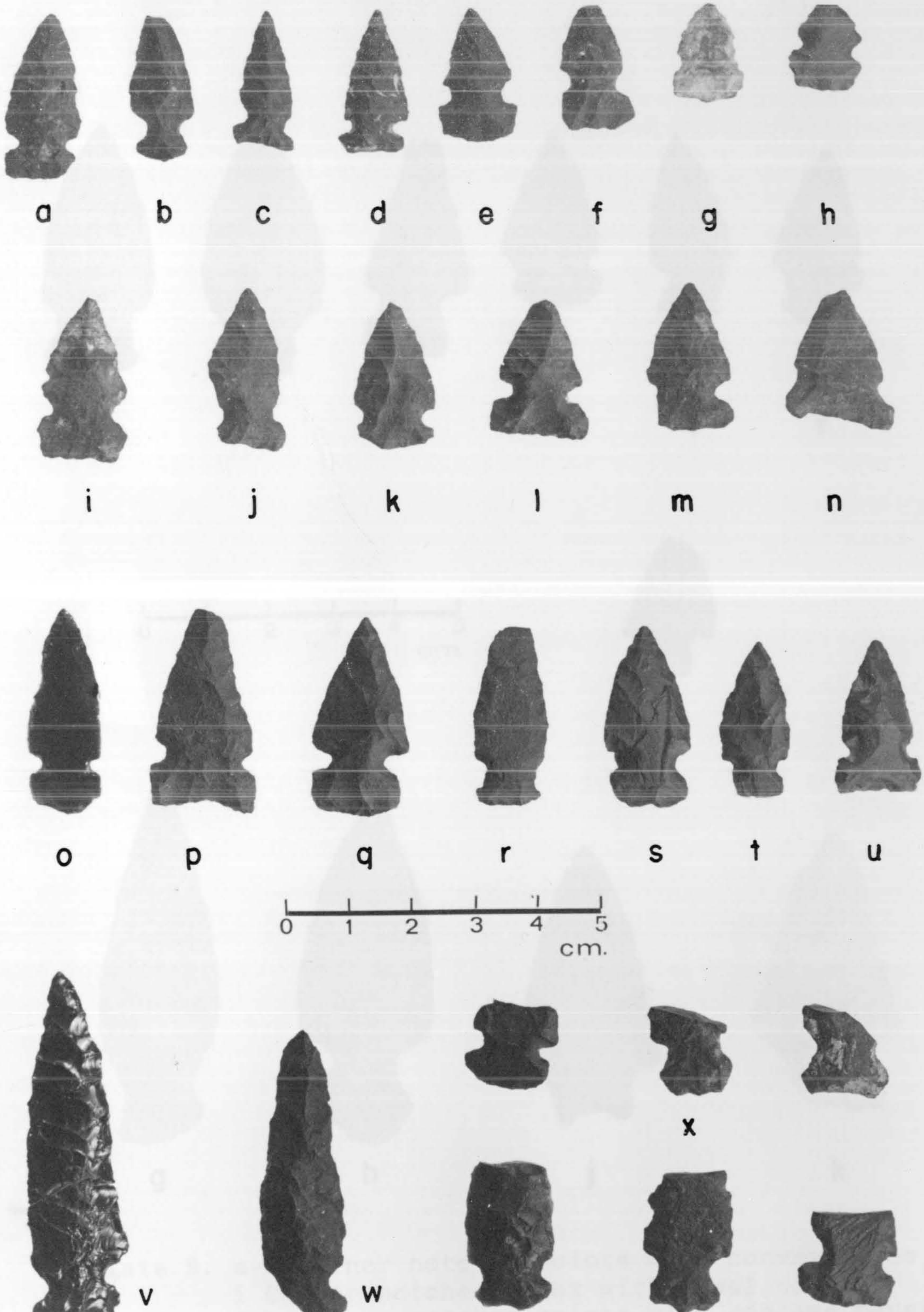

Plate 8. a-u small side notched points, v-w large side notched points, x notched point fragments.

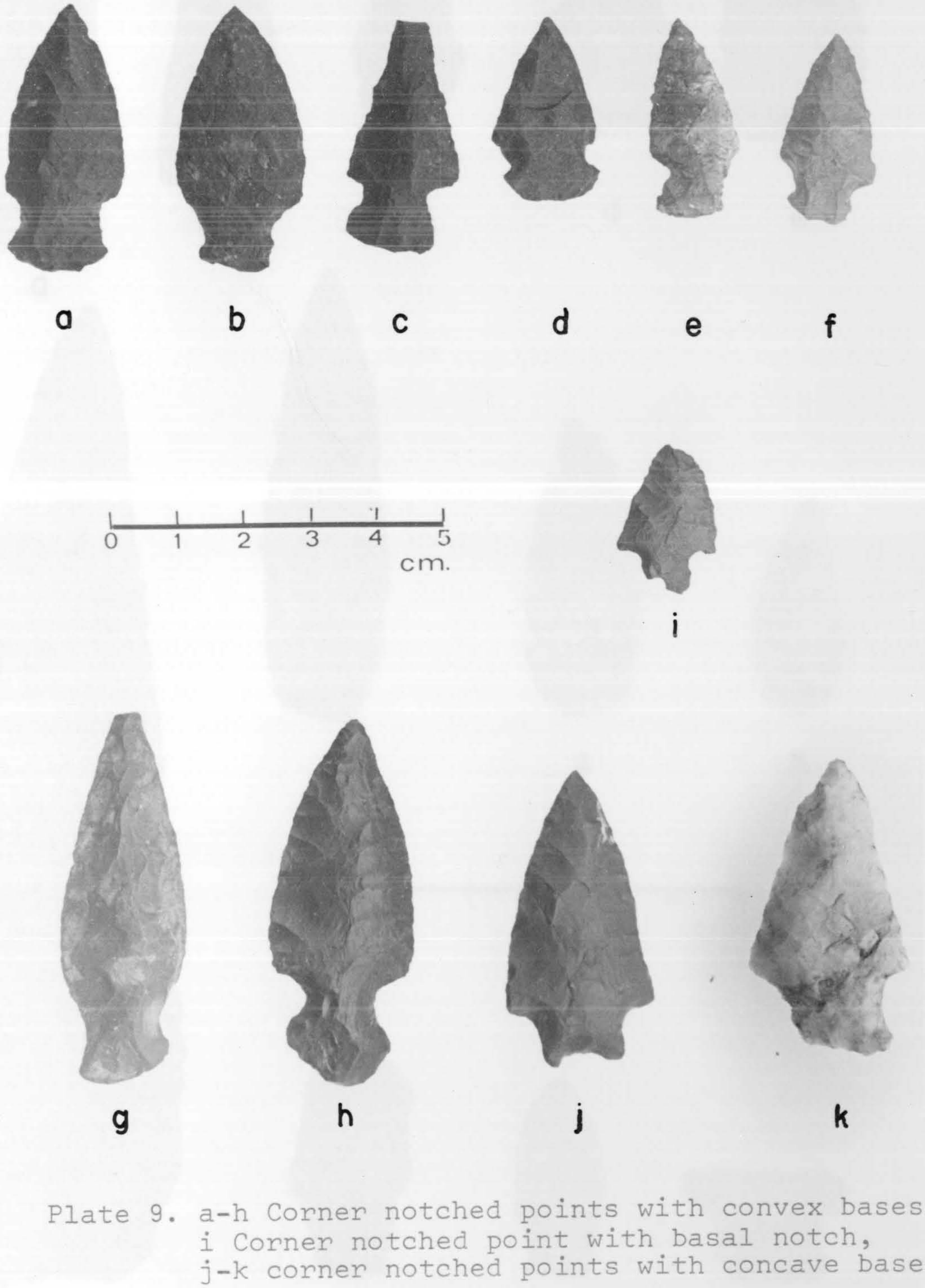

Plate 9. a-h Corner notched points with convex bases,
i Corner notched point with basal notch,
j-k corner notched points with concave bases.

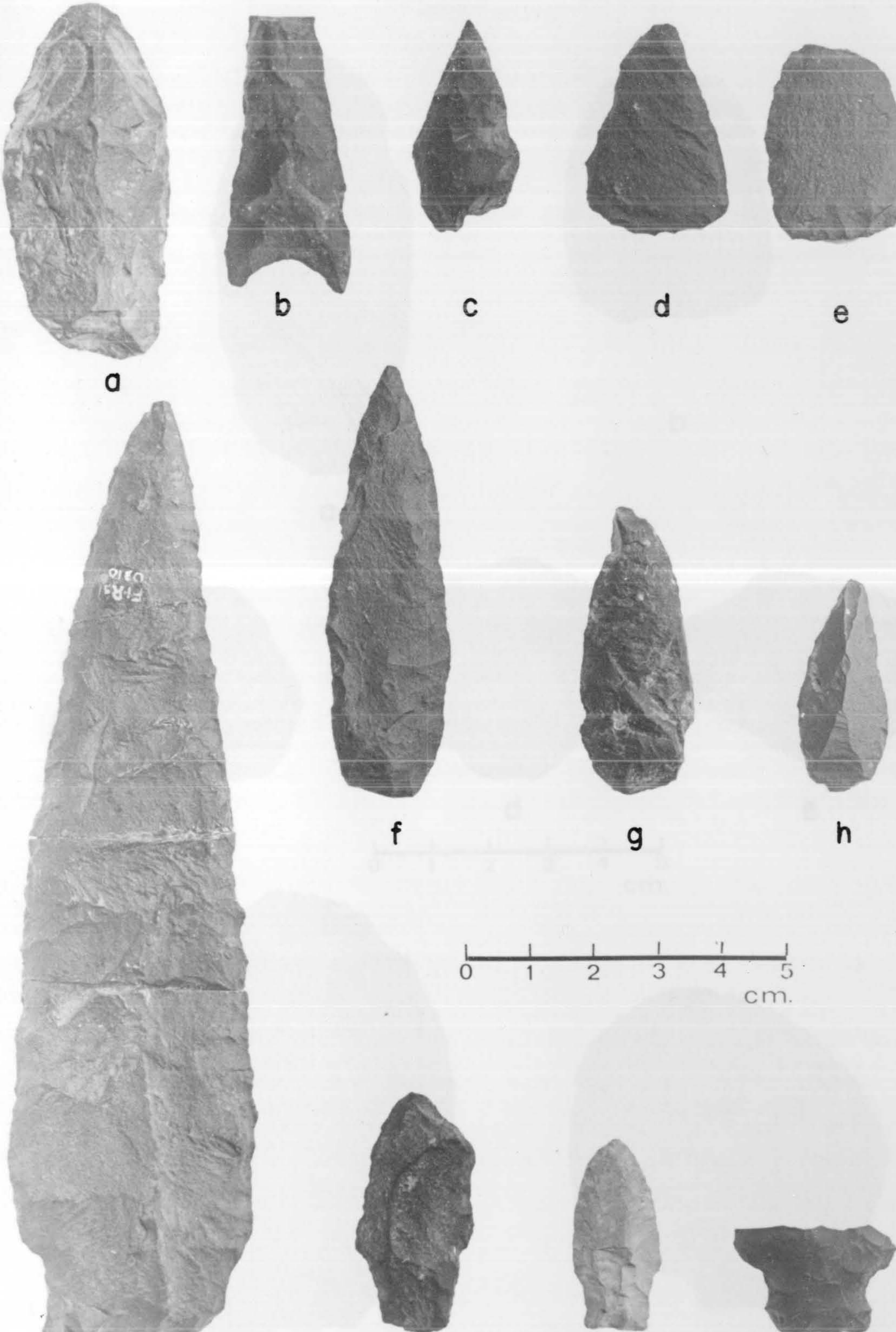

Plate 10. a-c lanceolate points, d-e miscellaneous points, f-h leaf shaped points, i-l stemmed points.

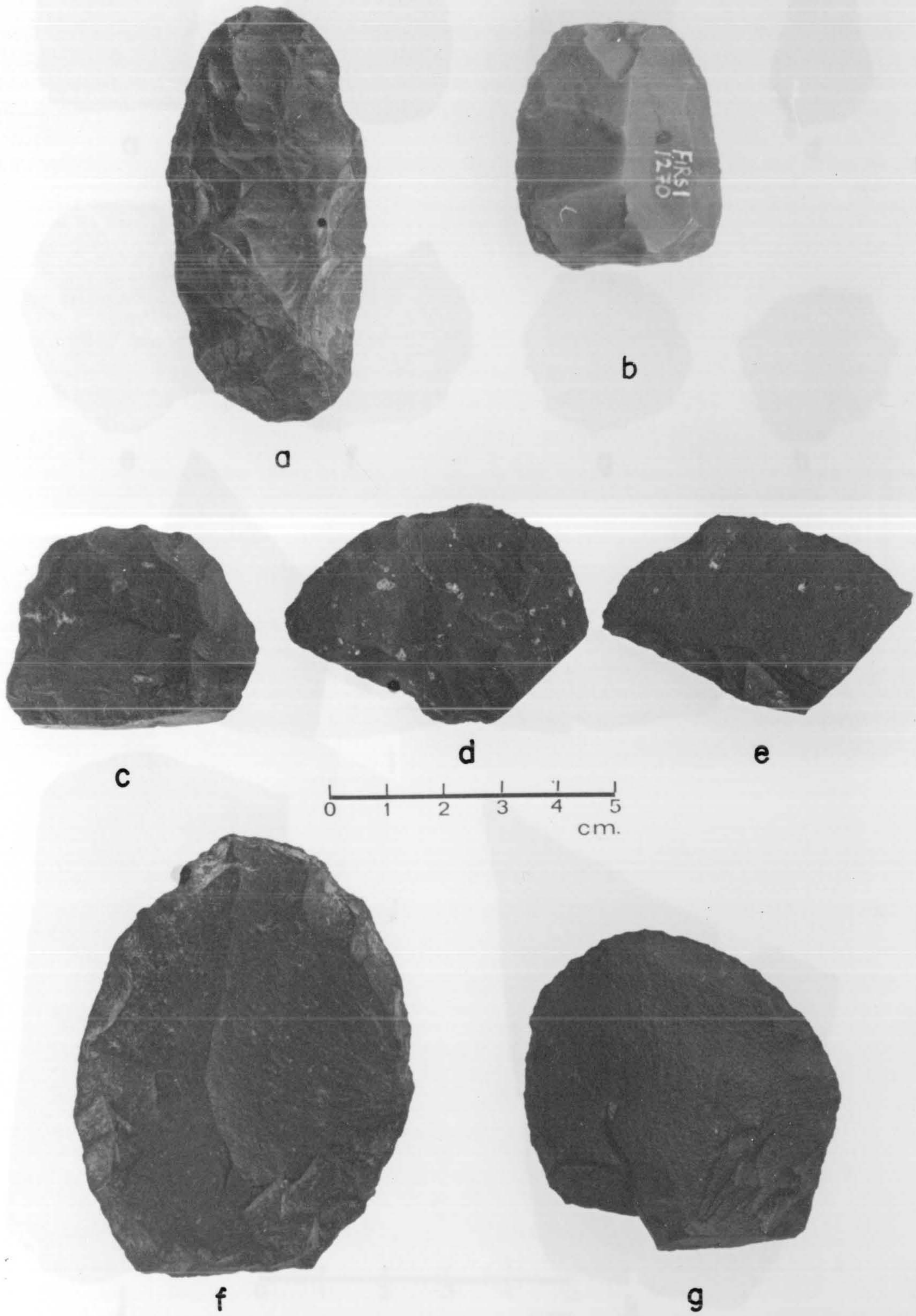

Plate 11. a-b Ovoid and subrectangular convex bifaces,
c-g semicircular convex bifaces.

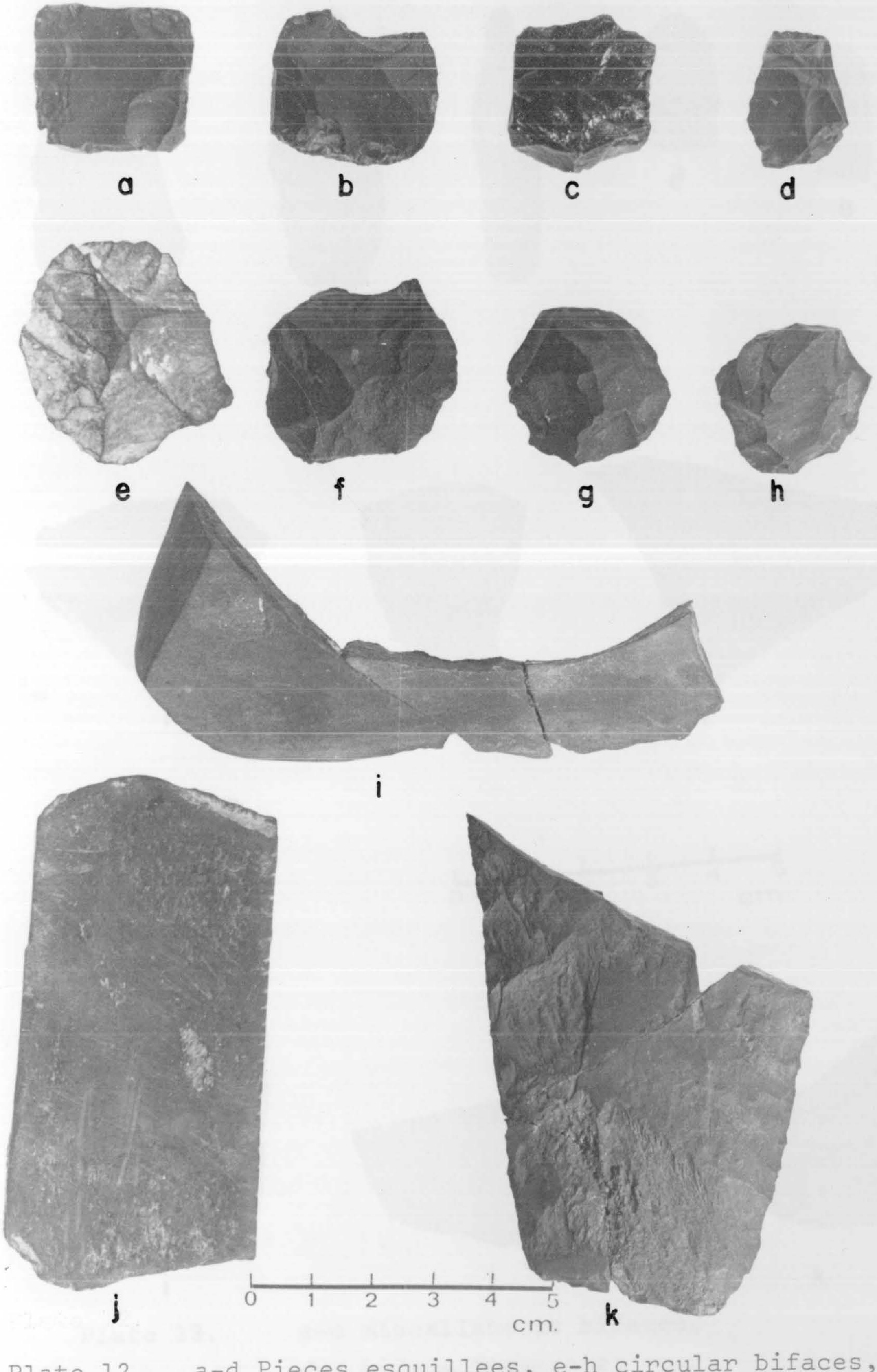

Plate 12. a-d Pieces esquillees, e-h circular bifaces, i-k miscellaneous ground stone.

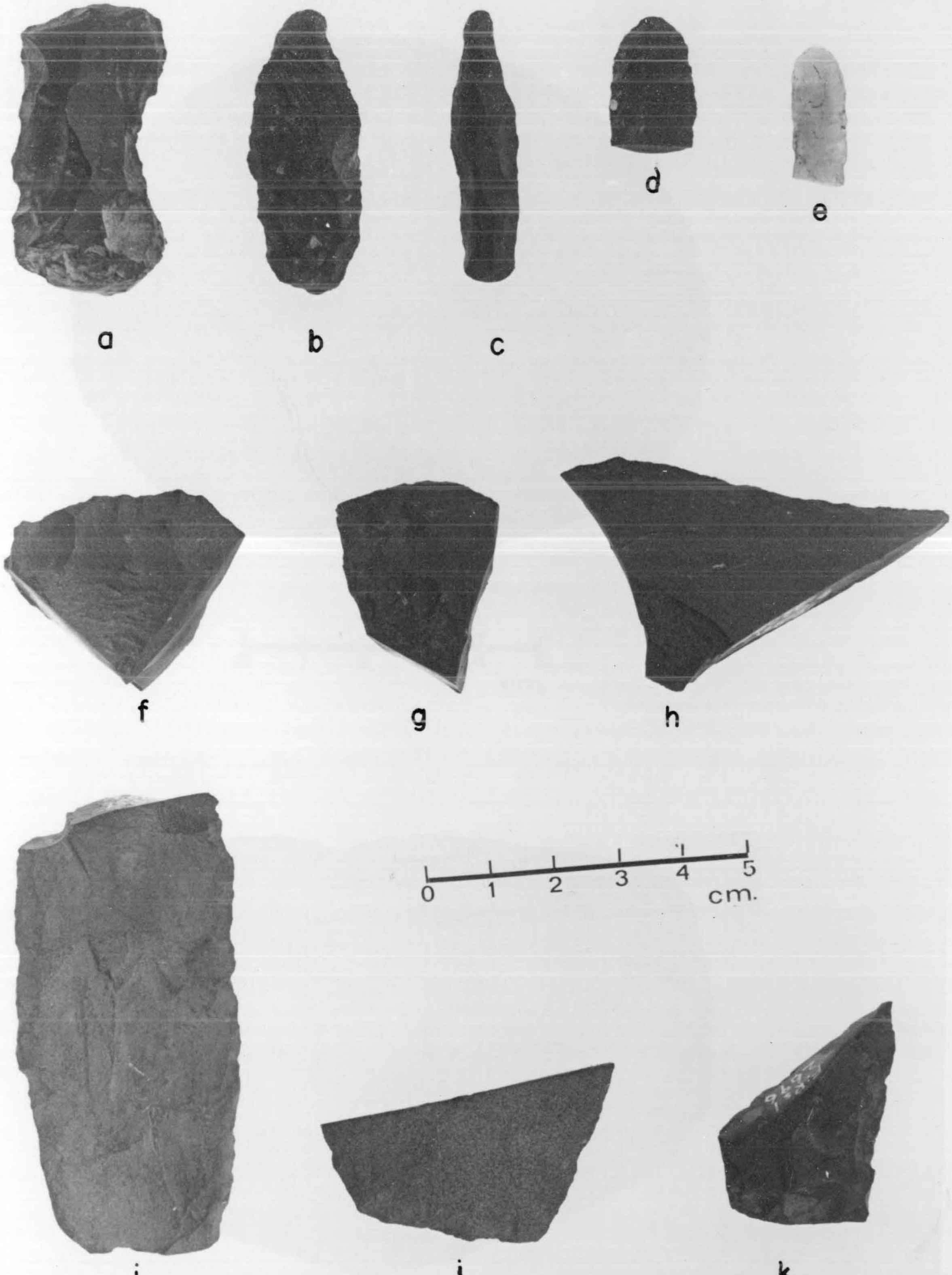

Plate 13. a-c miscellaneous bifaces,
d-k biface fragments.

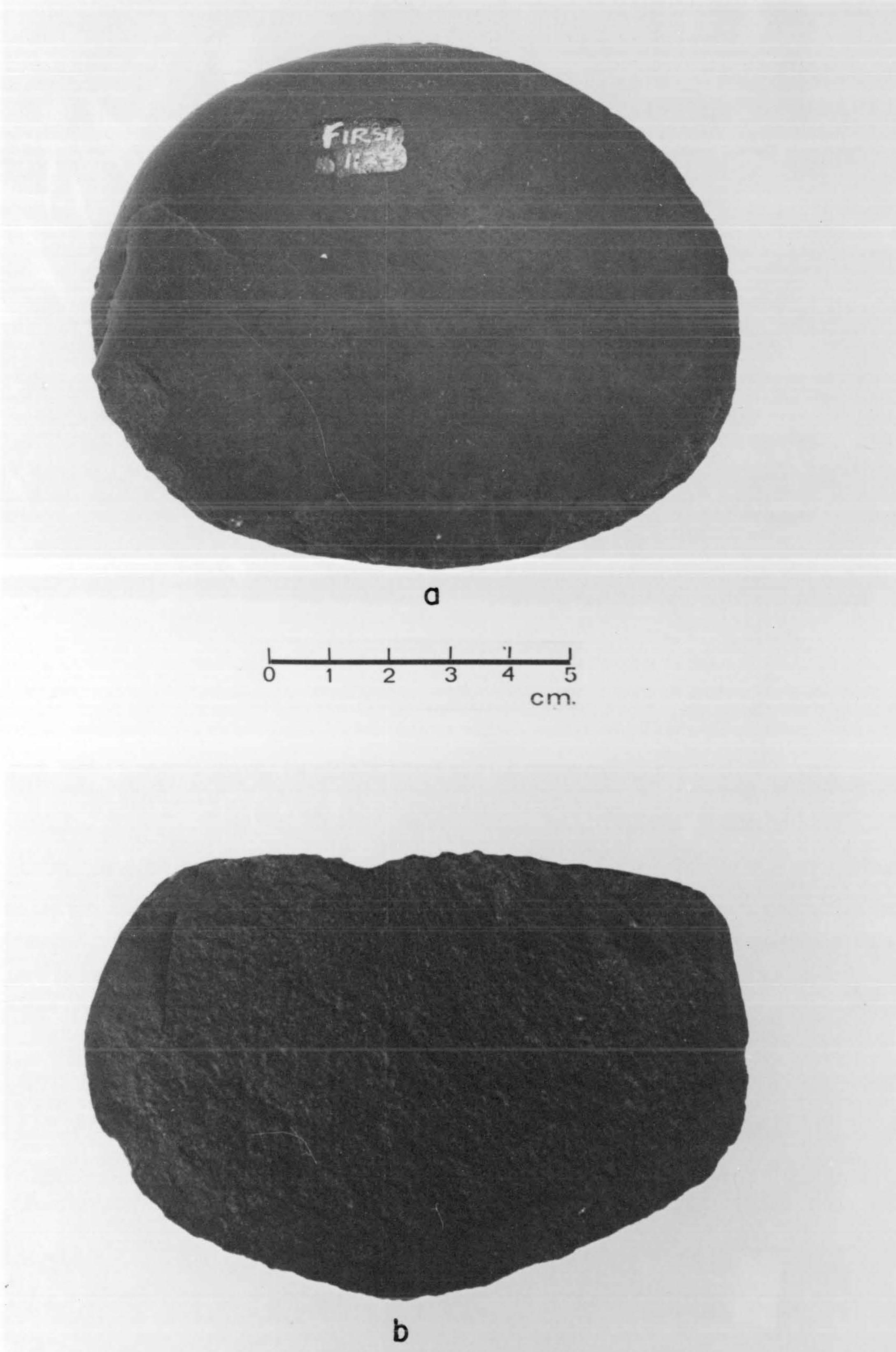

Plate 14. Quartzite spall tools.

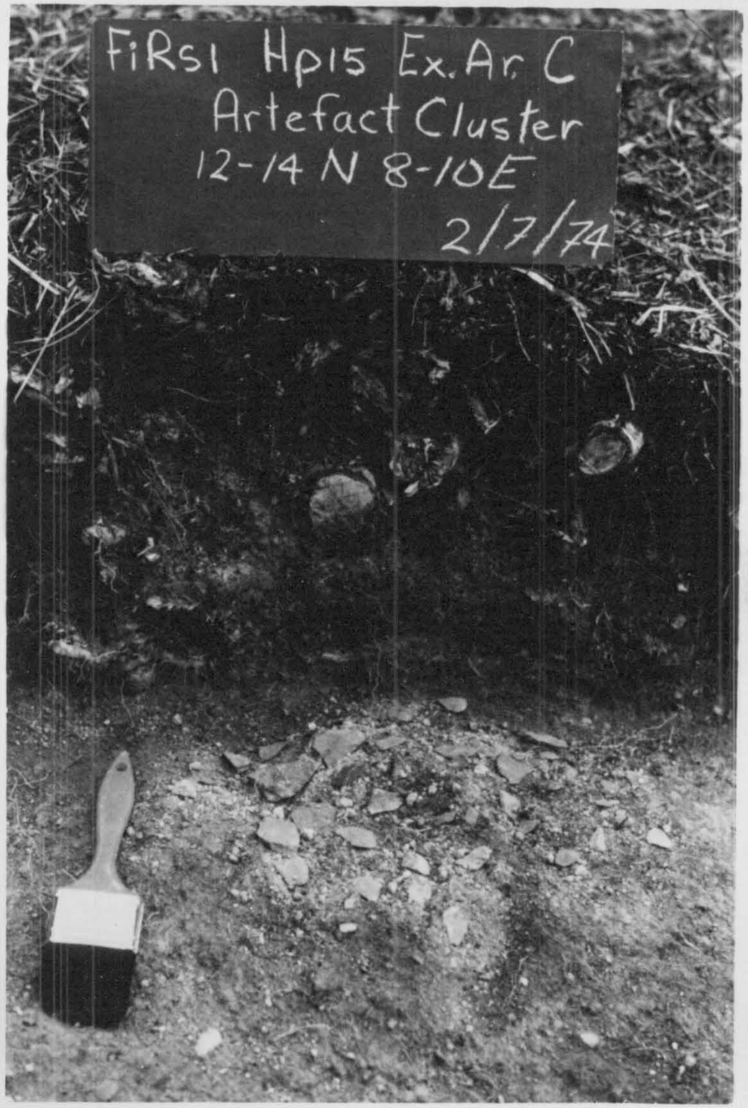

Plate 15A. Activity area - basalt debitage.

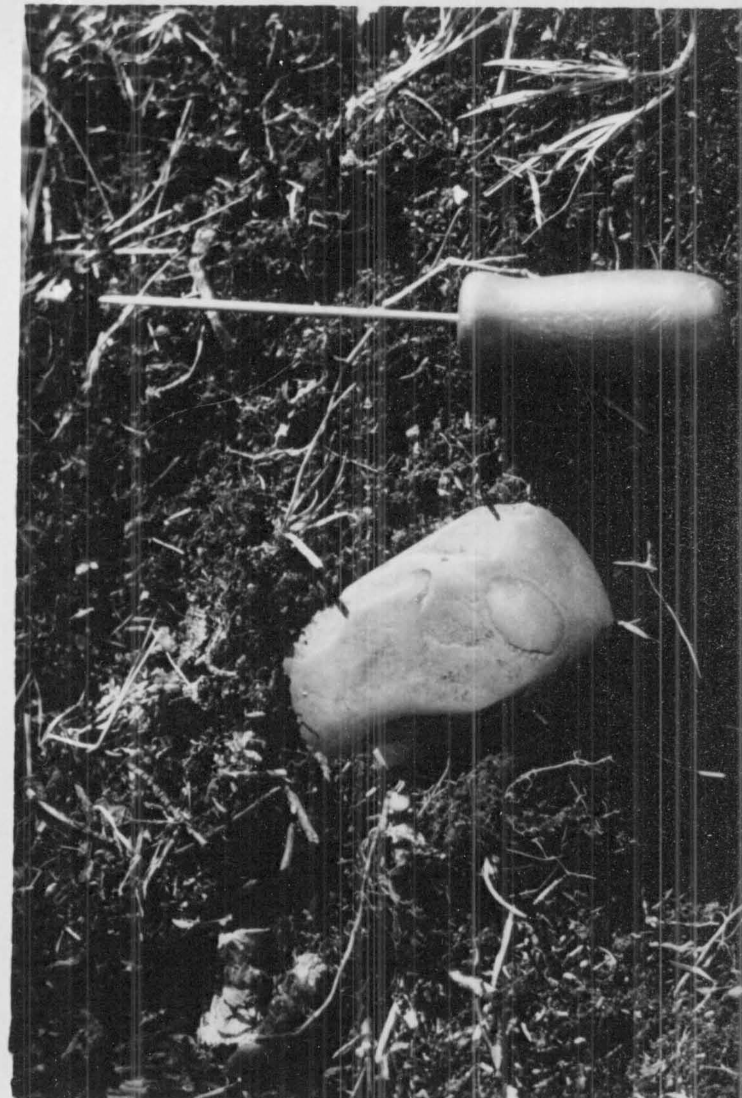

Plate 15B. Shale celt _in situ_.