

Anangula: An 8,500 B.P. coastal occupation in the Aleutian Islands

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with Pl. III-IV

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Part 1

Introduction

A. Geological Background (Black 1974, 1975, 1976)

Anangula (Ananiuliak Island on the U.S. Coast and Geodetic Survey charts) is a small island 7.1 km north-northwest of Nikolski Village on Umnak Island in the eastern Aleutians (Figs. 1 and 2). The island, which is composed of andesitic (keratophyre) flows of Tertiary age, lies at latitude 53° north and longitude 168°54' west in the Bering Sea. It trends northeasterly on the north side of Nikolski Bay and fronts to the southwest on water 70 m deep. Anangula is separated from Umnak Island on the southeast by a pass about 1.6 km wide and up to 11 m but mostly less than 5 m deep.

Anangula Island is 2.5 km long and generally 180 to 640 m wide. The coastline is steep, irregular and

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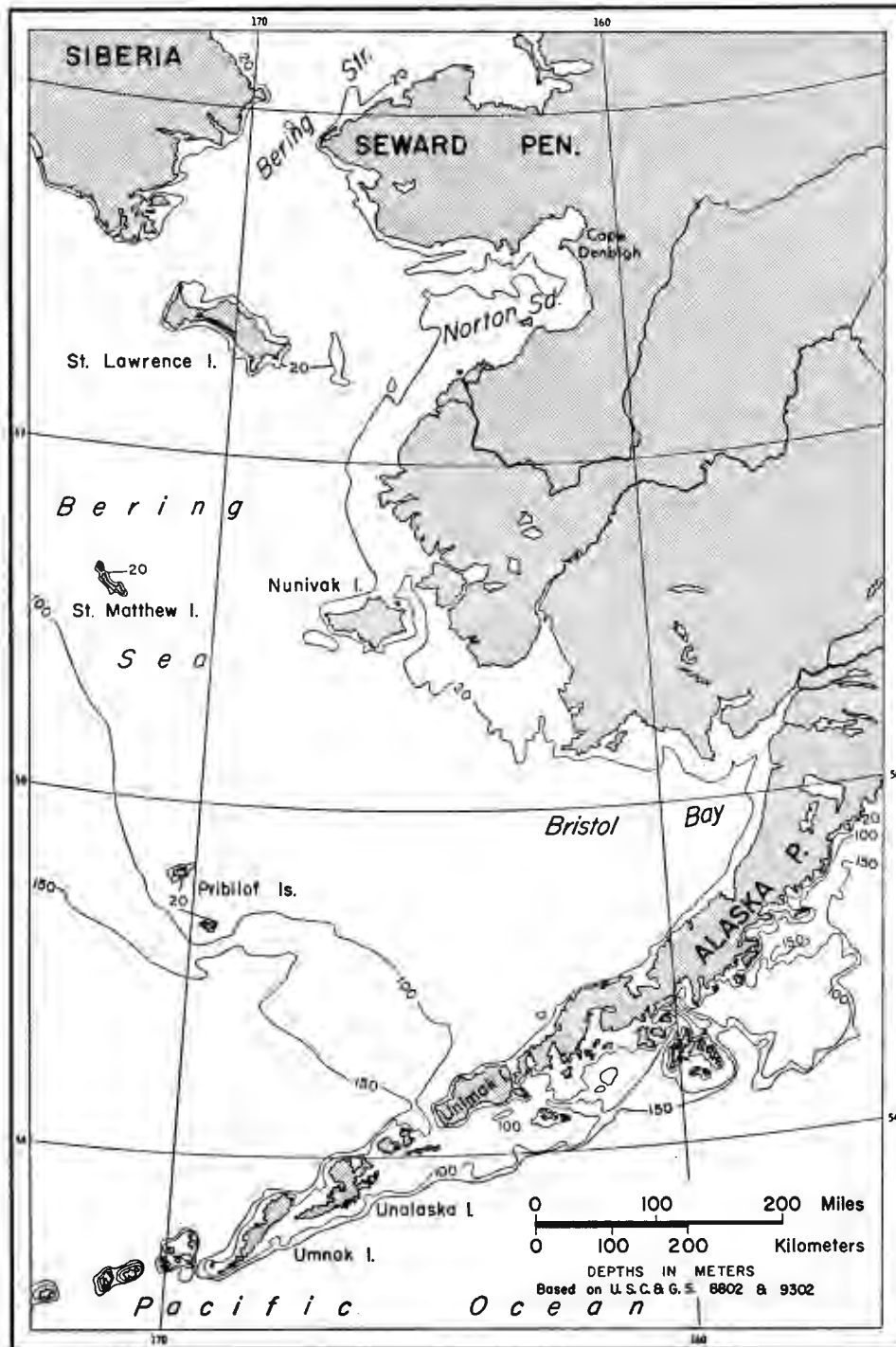


Fig. 1. Map of the eastern Aleutian Islands in relation to the Alaska mainland and northeastern Siberia. The 100 m contour indicates the former extent of Beringia.

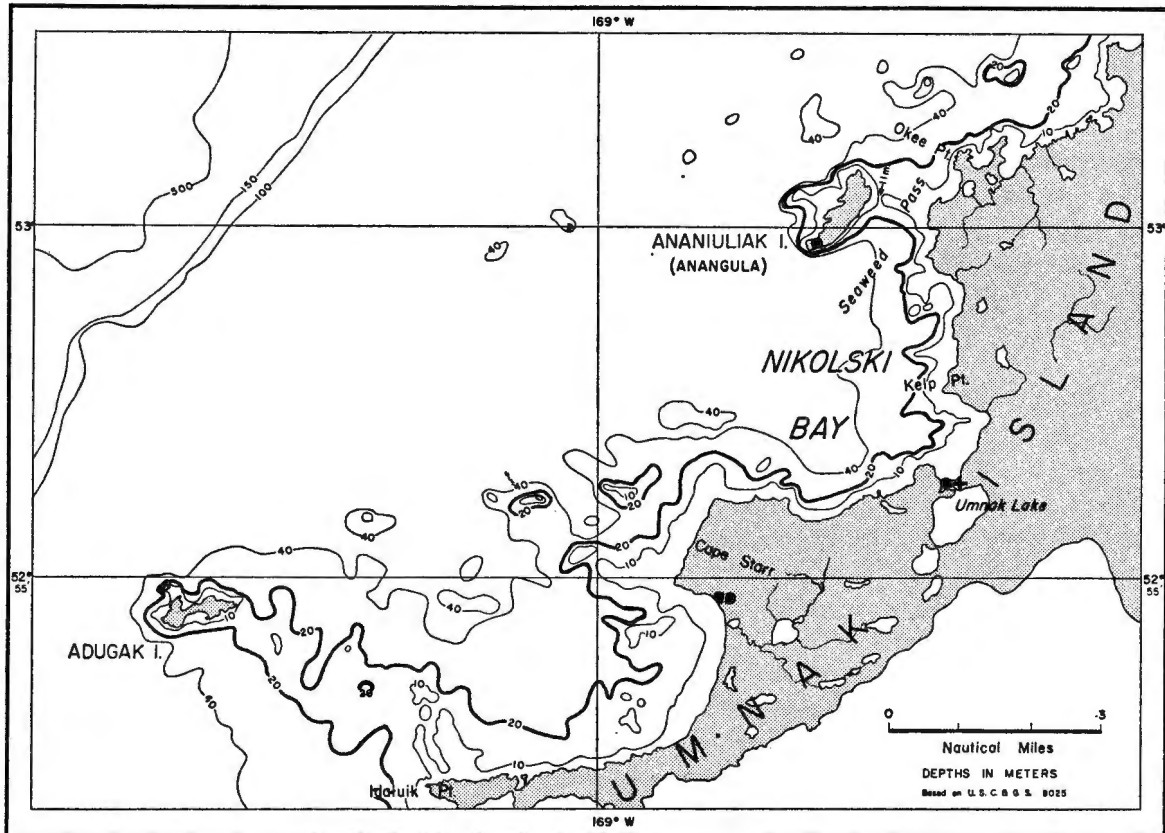


Fig. 2. Map of the Nikolski Bay area indicating Nikolski Village (+), Chaluka and Anangula sites (●), Sandy Beach Bay (●●).

jagged; deep notches are common. Rocky cliffs rise abruptly from deep water on the southwest end, from local strandflats 10 to 50 m across, and from rocky shoals. The beaches are very steep and contain no sand – only very coarse gravel, cobbles or boulders. The intricately gullied and blocky cliffs often slope 50 to 70 degrees and rise to elevations of 50 to 70 m, abruptly terminating the smoothly undulating tundra surface of the island.

The southwest end of the island with the old archaeological site is low and relatively flat, rising only about 17 to 20 m above sea level, and fronting on water 70 m deep (Fig. 3). No perennial streams or lakes are present on the island today although fresh water trickles down the axes of most swales and can be obtained easily by excavating small pits. Two small lakes or ponds formerly existed near the north and south ends of the island.

The southwestern end of Umnak and Anangula were glaciated prior to 20,000 years ago and deglaciation is believed to have begun by 20,000 years ago, earlier for example than Cook Inlet. The length of time the area was under ice cannot be ascertained directly at this time. Deglaciation seems to have been more closely controlled by sea level changes on Umnak Island than by climatic changes. A rapid rise of sea level beginning about 20,000 years ago would have destroyed quickly the bulk of ice on the now submerged Aleutian Platform in the vicinity of Umnak Island. This would lead to the early destruction of the rest of the low level ice on the southwestern part of Umnak Island because its small volume would have been unstable.

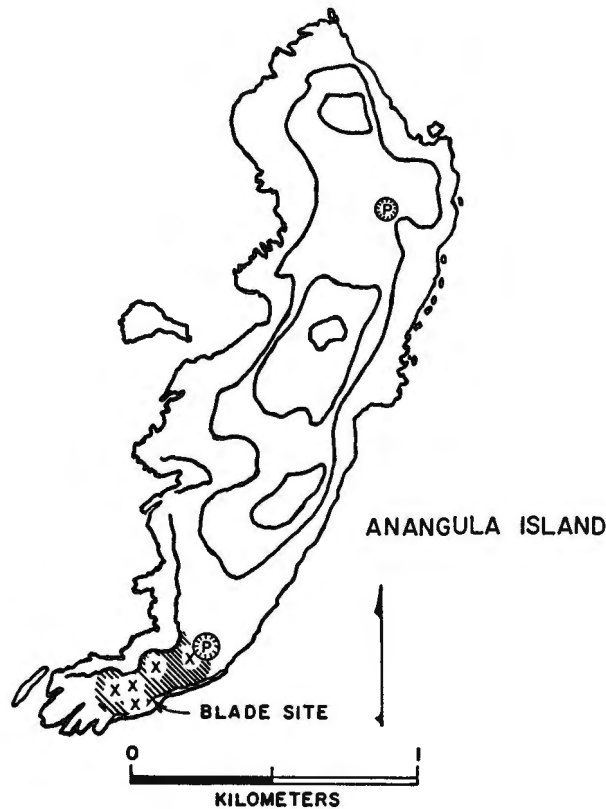


Fig. 3. Map of Anangula Island showing ancient ponds (P), the Anangula site (hatched), and approximate location of excavated areas reported here (X, not to scale). Contours are at 100 foot intervals (30.5 m); highest point on the island is 301 feet (91.8 m).

A thin, patchy veneer of till from an ice cap formerly centered on Umnak Island to the south of Anangula rarely exceeds 1 m in thickness. The northward flow of ice from the area of Umnak Lake and further south indicates its independence of the high mountains of Vsevidof and Recheshnoi to the northeast. Ash deposits generally less than 2 m thick overlie till on the flatter portions of Anangula while hill slopes steeper than a few degrees have retained little till or ash because of mass movements and slope wash. Multiple soil horizons in the ash sequence are characteristic.

Anangula Island at times of lower sea level has been connected to Umnak Island which, in turn, was the westernmost extension of the Alaskan mainland. It was not part of Umnak Island at the time of the occupation described here (Black 1976). At times, it was the terminus of the Bering land bridge's southwestern peninsula. Passes between the Aleutian Islands west of Umnak are too deep to have been exposed at times of lowered sea level during the late Pleistocene.

Sea level about 10,000 years ago was on the order of -55 m and about 12,000 years ago at -90 m, dropping to -130 m at 15,000 years ago (Milliman and Emery 1968). Using more conservative estimates (Black 1974, 1975, 1976) does not greatly alter the Aleutian situation in this regard. The problem of finding coastal sites older than Anangula is quite apparent. To be preserved, those sites must today be more than 10 m above present sea level. This means habitation at 10,000 years ago was at least 65 m above sea level, at 12,000 years ago 100 m above sea level, and so on. Probably such high elevations would

not have been chosen if alternate lower sites existed – if present habitations are any guide. Furthermore, sites could not have survived on the edges of the coastal bluffs because the rate of coastal erosion is too great.

At the time the Anangula site was first occupied, at least 8,500 radiocarbon years ago, sea level was approximately the same as that of today (Figs. 1 and 2). The ancient Aleuts were evidently isolated in an unusually rich habitat but severed from the land bridge by rising waters and cut off from the rest of Alaska by the southern ice mass. The rise of sea level subsequently, at least 3 m above the present level, had a devastating effect in coastal erosion and in destruction of sites closer to sea level along that platform.

B. Relation of Anangula Island to the Bering Land Bridge

Anangula Island has not been placed in proper perspective by most authors with respect to the Bering land bridge. First, prior to about 9,500 years ago Anangula was the westernmost extension of mainland Alaska (i. e., the reduced land bridge) but by 8,000–9,000 years ago was no longer part of Umnak Island. Second, for some thousands of years preceding the Anangula occupation, the Alaska Peninsula was largely under extensive ice sheets that probably cut off any flow of land-based organisms between the Aleutians and the mainland. It also may have effectively isolated the early Aleuts from other peoples. Third, it has been shown that the Aleuts are sufficiently different from the Indians and from the Eskimos to have required considerable time to evolve. The separation from Indians is of course considerably longer than from Eskimos, but an effective separation from the latter for perhaps 5,000 years or more after the initial occupation of the Aleutian area is suggested (Aigner 1970; Laughlin 1967).

Fourth, the richness and variety of sessile and free-swimming marine life is as great in the Aleutians as anywhere in the world and it is available on a year-around basis. All things considered, the Aleutians contain the most favorable environment for survival and development of humans in Beringia. Because of upwelling and mixing, the Aleutian Island waters are among the richest producers in the world; and during the glacial stages there is evidence that there was in this area no major reduction in the biomass, and there may in fact have been an increase (Black 1974, 1975, 1976).

Finally, total changes in habitat and environment of the Aleutians during the late Pleistocene were probably least of any part of Beringia. No major changes in the general circulation pattern over the Aleutians seem to have occurred during the glacial periods since even when Beringia was enlarged the Aleutians would have remained on the outer fringe in a zone of increased circulation. Still, winter ice may have formed locally during glacial periods and winter pack ice may have reached many of the islands (Black 1974, 1975, 1976).

The ice which covered the Alaska Peninsula area and the easternmost Aleutians may have existed as recently as 10,000 years ago. Present evidence indicates there was an intermittently ice-free corridor along the northern coast which permitted movement of early Aleuts into the area (primarily by boat since maritime adaptation is at least this ancient). Deglaciation took place from west to east, evidently permitting Aleut expansion by boat east into hitherto unoccupied zones at the same time Eskimo groups may have been moving south across the peninsula to the Kodiak area and westward. Isolation from the mainland would account in part for the Aleut physical, cultural and linguistic divergence from Eskimos of the mainland.

The geological evidence is clear in indicating a coastal/marine adaptation for the earliest inhabitants in the Aleutian area (Black 1974). There was simply no choice because ice sheets to the east eliminated most if not all migrations of grazing animals into the Aleutian zone. So while a land-based food economy would not have been possible in the eastern Aleutians or western Alaska Peninsula during the late

glaciation there, marine life should have changed very little. Hence the earliest migrants must already have had an economy based on sea resources.

This, as well as the ethnographic, physical and linguistic evidence, leads to the hypothesis that the ancestral Aleuts (and also ancestral Eskimos) followed the south shore coast, not the interior, of Beringia into the New World. I am suggesting that the beginning of the Eskimo-Aleut cultural and economic adaptation with the basic ancestral population system(s) already developed, took place prior to 10,000 years ago, and perhaps more than 14,000 years ago, either on the coasts of Beringia or the Old World. Physical, genetic, linguistic and cultural considerations make it impossible for us to accept the hypothesis that Eskimos and presumably Aleuts derive from some proto-Indian/Eskimo-Aleut group in interior Beringia or Alaska which became secondarily coastally adapted. Some, at least, of these coastally adapted peoples would be led southward quickly to the more equable climate and richer year-around habitat of southern Beringia. At no time was migration restricted by the cold since the Aleutian area specifically offers the antithesis of the limiting Arctic factors of large seasonal oscillation, low production of nutrients, and youthfulness in the ecosystem (Aigner 1970; Laughlin 1967).

Of all of Beringia, the Aleutians changed least in climate and food resources during the late Pleistocene and would have provided the most stable and richest resource base for those equipped to exploit it. That this exploitative ability was already developed early is attested to by the very presence of Anangula at least 8,500 years ago, which we must assume represents occupation several thousand years after initial entry into the Aleutian land bridge area and even longer since a pattern of coastal and marine exploitation was adopted.

Archaeological Investigation of the Anangula Unifacial, Core and Blade Site

A. Introduction

The unifacial, core and blade site on Anangula was first identified by Laughlin and May, who were part of Hrdlička's Smithsonian Field Expedition to the Aleutian and Commander Islands in 1938. Materials were collected off the surface. In 1952 Laughlin attempted to recover materials *in situ* but was not successful. In 1962 Laughlin's Aleut Konyag Prehistory Project did locate *in situ* remains and Black was able to make a stratigraphic study of the locality (see Aigner 1974).

The 1963 work which is described here was still only preliminary work in the sense of its particular problem orientation. The main goals were to define the extent of the site, prove contemporaneity or not of the *in situ* and surficial blowout remains, collect a large *in situ* sample, and attempt to locate remains intermediate in age between Anangula and the 4,000-year-old Aleut site at Chaluka on the same bay. In all but the last effort the work was successful². I have concentrated in later work (1970) on defining tool complexes and activity areas within the site, mapping the settlement pattern, attempting to find temporal variation within the site and locating intermediate sites on the same bay.

The 1963 work consisted of several 2 × 2 m test pits and a 4 × 12 m trench dug partly into the 1962 pit in the area of the exposed blowout as well as in unexposed zones adjacent (Figs. 3, 4). The site was found to extend across the entire southern end of Anangula, 75 to 110 m, with an unknown amount eroded both north and south, and for 300 m west to east, from exposed bedrock to the freshwater lake in the east. The heaviest concentration of tools was found nearest the Nikolski Bay side of the site, not overlooking the Bering Sea (i. e., the blowout side of the site).

² Two sites discovered in subsequent seasons of work in the Nikolski Bay area which are intermediate in age are Sandy Beach Bay, a base village circa 5,600–4,800 radiocarbon years B.P., and Idaliuk Bay, a fishing camp circa 4,200 B.P. (see Aigner 1974).

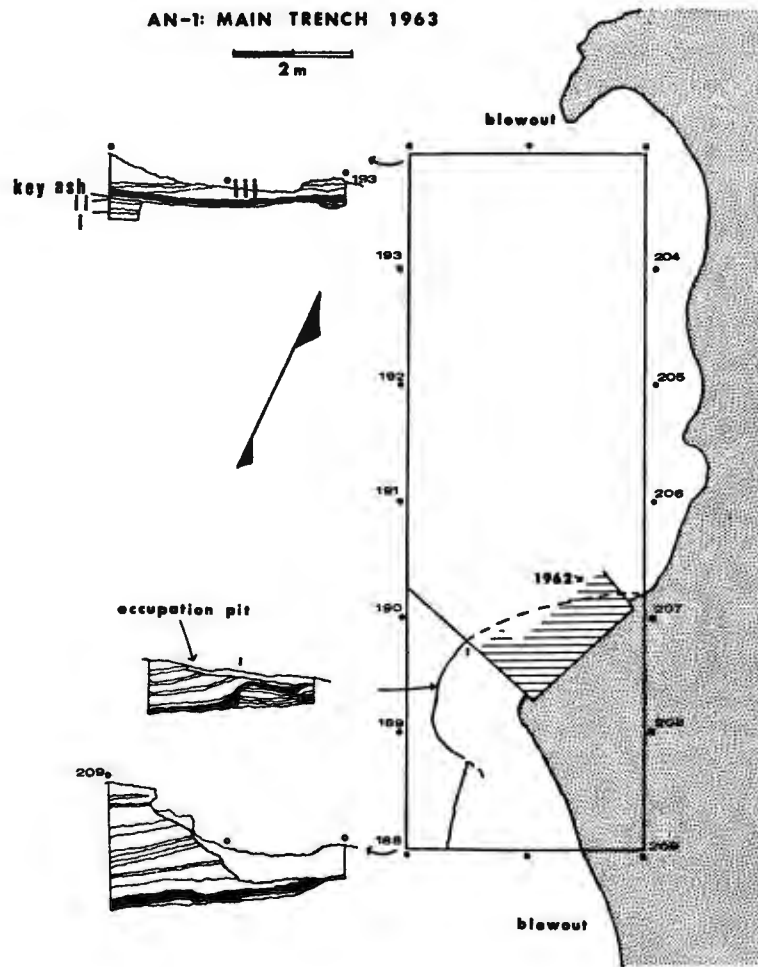


Fig. 4. Main 1963 trench showing the stratigraphy at three sections.

The cultural level everywhere identified was compacted, 20 to 30 cm thick, except in one house depression where thickness was up to 50 cm and three superimposed hearths were identified. An artificial depression dug 35 to 75 cm below the cultural zone, with three different hearths (at different levels within the 50 cm thick deposit) and one possible post hole were located. The entire feature was not exposed. Outside the blowout area, the cultural zone lay beneath between 1 to more than 2 m of overburden, entirely and only between Black's key ashes III and IV, which are volcanic in origin (Black and Laughlin 1964).

The general profile for the site shows deposition of glacial till on andesitic bedrock, overlain by many laminations of volcanic ash (Fig. 4 and Pl. III; 1). Black (1974, 1975, 1976) has identified four major ash falls for stratigraphic descriptions. On the basis of ash accumulation and soil formation, Black estimates that the cultural level represents less than 500 years of occupation, albeit of an intensive and extensive nature.

A number of carbon dates are available for the site from the cultural zone. The initial sample (W-1180) gave an age of $7,660 \pm 300$ on a charcoal sample which was smaller than normal. Subsequently dates of $8,425 \pm 275$ (I-715) and $7,990 \pm 230$ (I-1046) were obtained on charcoal samples of larger size from the

same area. The three dates were still considered too young by a factor of 10 to 20 per cent because of contamination by younger humic acids and living rootlets. That conclusion has been partly confirmed by Black's geological studies and my stratigraphic studies. Two samples from the same horizon were given an NaOH pretreatment and yielded dates of $8,173 \pm 87$ (P-1103) and $8,129 \pm 96$ (P-1104) – using a half-life of 5,568. Four other samples without pretreatment were $7,701 \pm 93$ (P-1102), $7,932 \pm 497$ (P-1105), $7,657 \pm 95$ (P-1107) and $7,287 \pm 86$ (P-1108) B.P. These various dates indicate that the cultural layer is 8,000-plus radiocarbon years old (Table 1). The use of $8,500 \pm 250$ B.P. as the age of Anangula in various papers is based on use of the Pennsylvania half-life, confidence in the pretreated samples P-1103 and P-1104, and recent contamination by humic acids (Black and Laughlin 1964).

Table 1
Carbon-14 determinations from charcoal remains in the Anangula Cultural Zone prior to 1970.
* Pretreated

| | Libby half-life of 5,568 | Pennsylvania half-life of 5,730 |
|--------|--------------------------|---------------------------------|
| W-1180 | $7,660 \pm 300$ | $7,890 \pm 309$ |
| I-715 | $8,425 \pm 275$ | $8,678 \pm 283$ |
| I-1046 | $7,990 \pm 230$ | $8,030 \pm 237$ |
| P-1103 | $8,173 \pm 87^*$ | $8,418 \pm 90$ |
| P-1104 | $8,129 \pm 96^*$ | $8,365 \pm 99$ |
| P-1102 | $7,701 \pm 93$ | $7,932 \pm 96$ |
| P-1105 | $7,932 \pm 497$ | $8,170 \pm 512$ |
| P-1107 | $7,657 \pm 95$ | $7,887 \pm 98$ |
| P-1108 | $7,287 \pm 86$ | $7,506 \pm 89$ |

B. Character of the Occupation and Size of the Settlement

Inferences about the size of the settlement and nature of the occupation draw heavily on geomorphological and geological reconstruction of the area and, to some extent, on our knowledge of the character of later settlements in the same area. Stone tools in themselves, except for some of the heavy and obvious equipment (ochre pallets and grinders, etc.) do not provide information on the nature of economic exploitation, only on part of the technology associated.

According to Black's interpretation of the ash sequence and my assessment of the cultural zone, the occupation of the site was less than 500 years long. The extent of the midden and presence of one and perhaps two house depressions in the very small area initially excavated, as well as the diverse lithic assemblage with its non-procurement oriented component, all suggest occupation by a number of individuals of the appropriate age and sex composition attendant to a base village. There is geological evidence that sea mammal hunting was important although no direct archaeological evidence (i. e., mammal bone)³. Clearly fishing was also important. Although bone fishing equipment is lacking we do possess possible line weights. That sewing, spearing and harpooning were going on is inferred from the shaft sizes smoothed (as measured from the grooved smoothing stones). In addition there are many stone tools which most likely indicate bone and woodworking (gravers, scrapers and abraders), and skin working (scrapers and impressions of awls on abraders). Pallets and ochre are present as is a fragment of a carved stone bowl – both diagnostic of the Chaluka Aleut lithic complex on the same bay.

³ Burned mammal bone was found in 1970; charred bird bone and six more houses were also excavated.

Environmental reconstruction, site size and tool composition indicate the orientation was to the sea with a year-around supply of plentiful fish (deep sea halibut and cod as well as fish of shallower waters, bays and shoals), some invertebrates, and a good supply of sea mammals (stranded whales, resident hair seal, sea lion, sea otter, and migratory whales and fur seal; walrus may also have been available). The site is most likely a base village and is surely not a butchering site nor a transient camping area. The resource base of the area was rich and the village may have housed 75 to 150 individuals as a conservative estimate.

Raw materials for stone tools were locally available – basalt in the Nikolski Bay area and altered andesitic and dioritic fragments for pounding tools, weights and other coarse objects on Anangula. The source for the various grades of chert (i. e., “felsites, calcareous chert, chert,” etc.) was argillites and tuffs that crop out on the strandflats in Nikolski and Driftwood Bays. The obsidian source was Okmok Caldera on the northern end of Umnak (see Black 1974, 1975, 1976).

Fresh water was available immediately adjacent to the site in a small lake or pond and a second lake was found on the north end of Anangula. Sheep Creek on Nikolski Bay had already been formed and possibly even then served as a camping area for salmon fishing. This hypothesis will be tested in future work there.

Study of the Lithic Remains from the Anangula Locality

A. Background to the Study

In a preliminary examination of the Anangula stone materials, I attempted to recover the steps in stone tool manufacture and determine core “phase histories” through a study of the cores and the associated blades, flakes, rejuvenation tablets, etc. (Laughlin and Aigner 1966a, 1966b; Aigner 1968, 1970). The Anangula remains lent easily to such studies which in turn suggested the use of a weighted hierarchy to describe tool production. It seemed obvious that a descriptive system which retained and emphasized the relationships observed between cores, and flakes and blades, would provide more information about the total technological system than would a standard typological analysis isolating tools from this context.

In my concern with developing a series of weighted criteria to group specimens into categories (such as blades and flakes), an initial requirement was the establishment of unambiguous definitional and descriptive terms. Hence, I developed sorting criteria to distinguish blades and flakes consistently and with a minimum of between-observer error.

Next I attempted to develop a weighted hierarchy which described first the constant and distinguishing features of Anangula technology – unifaciality and marginality of retouch. There is not a single bifacially worked implement – not a “chopper” or “pebble tool” with either alternate flaking or even rough flaking on both faces; no tool has been flaked entirely facially, either. Since retouch rarely alters the original blank form, the blank type (blade or various form of flake) is also an important identifiable feature. Groupings of tools are based essentially on a combination of shape and use features. Again shape is largely determined beforehand by preshaping on the core (for whole blade tools) and use is distinctive. Other tools are made on deliberately broken flakes and blades and several subgroupings may be distinguished on the basis of use.

Minor variations in blank shape, including size and thickness, were permissible within the Anangula technological system since no attempt was made to “correct” these features. Hence, I consider such differences of secondary importance in descriptions – they contribute to the total variation within major tool categories but do not reflect conscious subdivision on the part of the manufacturers in my opinion, since variation derives through basic blank production and is not corrected by shaping retouch.

A basic assumption throughout this study is that blades were preferred blanks for most tools a Anangula and blade-like flakes were often treated similarly. Ancillary is the assumption that irregular flakes were

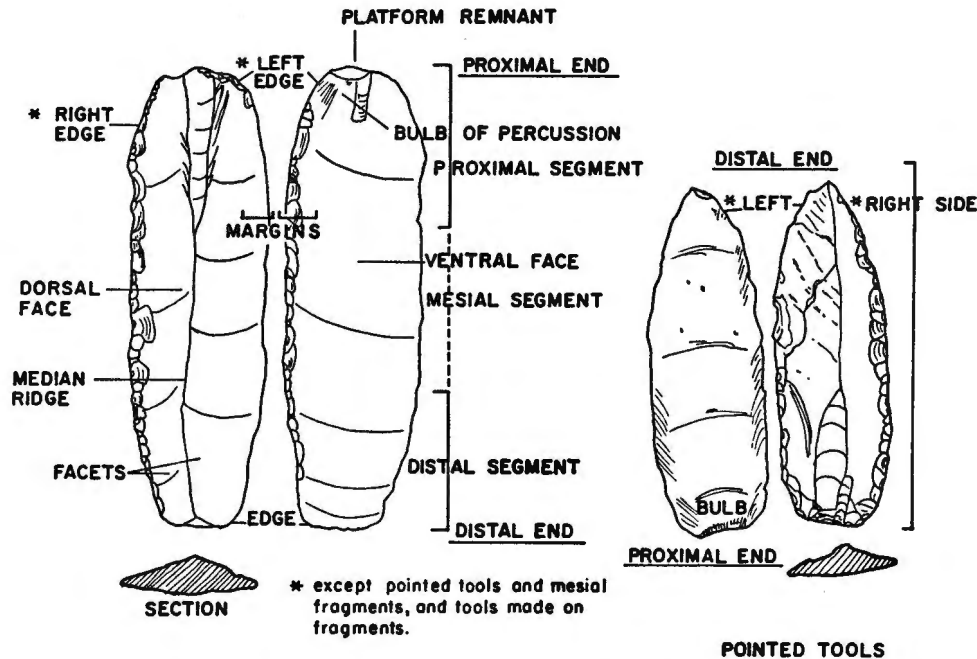


Fig. 5. Terminology and orientations for blades and for pointed tools.

less important as blanks and/or slated from the beginning for different tools. Blade and flake tools are described in parallel fashion to provide data to test these interpretations of the Anangula tool manufacturing system and cultural preferences within it.

I have found advantages in the present hierarchy with its weighted characteristics and parallel descriptions. First, the criteria permit the regular distinction between true blades, blade-like flakes, platform flakes and other irregular flakes – distinctions I believe also held for the people at Anangula. Second, parallel descriptions and weighted features permit recognition and assessment of convergence in tools made on different blanks and the range of variation permissible in tool form. Third, the system of description has proved flexible in providing a framework for my changing interpretation of the materials. It permits the addition of new categories, recognition of unique features, and re-evaluation and re-weighting of criteria as study deems necessary. Fourth, the inherent flexibility should accommodate new features of the assemblage as they come to light in the continuing analysis of materials from Anangula. Finally, the hierarchy continues to provide a description of the entire assemblage, including data on techniques of manufacture, patterns of retouch, features of shape and use, and the like. I believe the descriptions can be most effectively utilized in comparisons with other total technological systems and their assemblages since (hopefully) basic features such as unifaciality and marginality of retouch, lack of any bifacial element and tool shaping characteristics will be foremost in the comparison. Furthermore, other (negative) features will be built into the comparisons – this is not a microblade tradition nor does the assemblage contain either a definable and separate microlithic component nor typical Upper Palaeolithic or Denbigh, etc., burins, all of which have been ascribed to it by various scholars.

Definitions

Blades (Fig. 5) are punched from cores with suitable prepared platform after removal of all or part of the cortex. Successive circuits or courses of blades have little or no cortex on their dorsal face; instead

they possess two or more parallel (to each other and to the direction of the detaching blow) and concave scars on the dorsal face. Blades are identified by a single ventral surface, convex in cross section, bearing a bulb of percussion and platform remnant at the proximal end (when present), and two or more parallel facets, concave in cross section, on the dorsal surface parallel to the direction of the detaching blow. Blade length is dependent on the height of the core and breadth, curvature and thickness on placement of the detaching blow in relation to core height and shape. The definition of blades as stated here does not depend on subsidiary characteristics of length and breadth, but, rather, on the recognition of criteria essential to the manufacturing process.

Ridged or blade-like flakes are sometimes confused with blades (see Fig. 13d). Ridged flakes are identified by the non-parallel or non-concave nature of one or more dorsal facets. Otherwise, in possession of a median ridge and two or more dorsal facets, and in their length and breadth characteristics, they may be quite similar to blades. At Anangula some ridged flakes have been struck off the "corner" of a core where one or two cleavage planes or flat cortical surfaces form the median ridge. The result is a flake with a cross section showing one ventral, convex surface, and two flat dorsal surfaces. Some are produced by detaching flakes from the core platform edge with the edge serving as the dorsal ridge and the platform surface and fluted core side as the facets. In some cases there is no platform remnant at the bulbar end. The number of ridged flakes which can be consecutively removed from a core or from unprepared raw material is necessarily limited.

In addition, a number of other kinds of flakes are distinguished – irregular cortex flakes, platform rejuvenation flakes, large irregular flakes struck from cores, tiny chips and flakes resulting from retouch, and transverse spalls derived from using the burin technique. Cortex flakes have more than 50% of their dorsal surface as cortex and include symmetrical ridged and irregular cortex flakes. Tablet flakes are struck from the core platforms for rejuvenation purposes with blows parallel to the platform surface. The bulb of percussion is large and the platform edge a diagnostic feature; there is no remnant of a prepared platform at the bulbar end, although there may be flake scars where the tablet is thick.

Weighted hierarchy

The hierarchy which is not detailed here includes features of manufacture, initial blank shape, retouch and use to describe the Anangula materials. Individual tools were keyed out using this hierarchy, and metrical, kind of material and other information collected. The actual descriptive section of this paper is greatly abstracted and summarized from these earlier studies. The hierarchy is also set up to accommodate features of the Anangula tools and estimate the variation within each major grouping.

First, a basic distinction is made among nuclei and core-derived materials (as flakes and blades) and these materials are separated from the secondarily derived flakes and chips (non-blanks) and from the tools not made on cores or core-derived blanks (i. e., tools such as ochre pounders, carved bowls, etc.). At the second level, the cores, flakes and blades are distinguished, with several flake types being recognized and grouped separately.

Third, I recognize that retouch on blanks at Anangula is exclusively unifacial and almost unvaryingly marginal. There are no bifacial tools and no tools have the entire face flaked. These are constants in the technology and heavily weighted. Fourth, major blank shapes and major features of their retouch and use-alteration are recognized and distinguished. I make five major categorizations here: pointed tools on whole blades (and flakes); unpointed tools with marginal retouch and/or use; tools made on transverse segments, or "fragments," of the last grouping and with their distinctive use patterns (described below); "fragments" which have not been further altered (i. e., potential blanks for the above or simply discards); and tools made on irregular flakes which are described as essentially unique specimens.

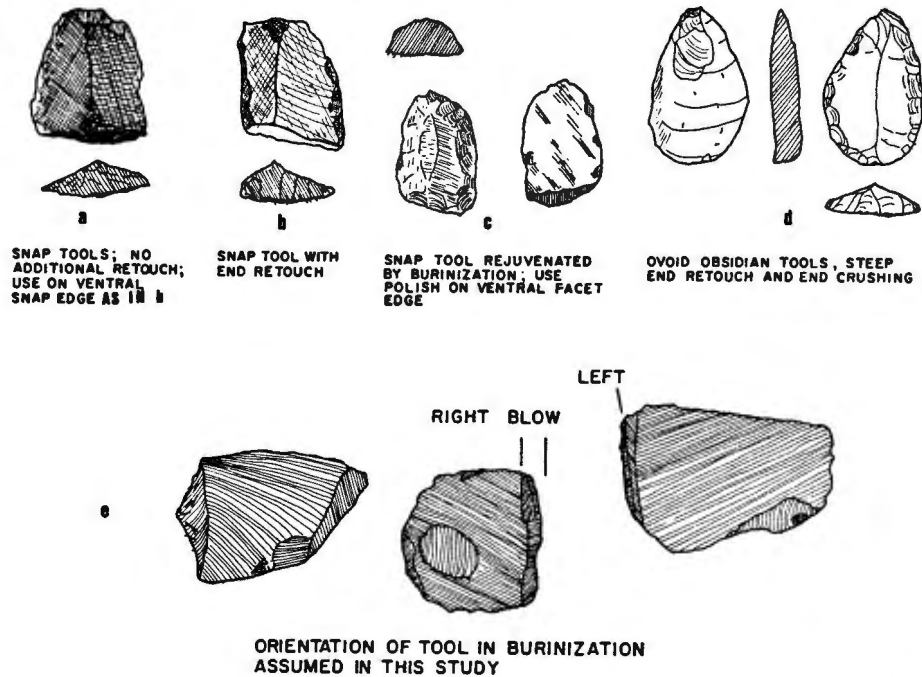


Fig. 7. Drawings of tools made on transverse segments or fragments of blades and flakes. Four categories are defined. Also shown is the orientation assumed in the description of burinized segment tools.

level distinguishes on the basis of the extent of retouch and use. Use takes the form of tiny chips mainly on the dorsal face, removed at angles between 60° and 80° and individually visible (rather than obliterated by shearing off in use).

Tools made on transverse segments or "fragments" of the above are among the most interesting and variable, due partly to their secondary manufacture (Fig. 7). Four subgroupings are formally recognized. First, there are those examples where the fragment has been utilized on the ventral "snap-edge" without further alteration, and second, those where the "snap-face" has been straightened by rough and steep chipping (Fig. 7 a, b). The angle of the snap-edge which is utilized in the former is 90° and in the latter near 75° . The third form evidently derives from the first two and includes all those examples which have had the snap (or snap and chipped) face rejuvenated by using the burin technique (Fig. 7 c, e). A long spall is driven off across the snap-face, removing it and the battered working edge in one blow. Because it is removed at an angle (in virtually all cases at Anangula), the angle of the rejuvenated snap-edge is consistently in excess of 100° . However, the working edge is better in the sense that it is free of the irregularities so often present on the snap-edge which is not altered. Use takes the form of polish.

The fourth type of snap tool stands somewhat apart from the first three, which are "genetically" related. The last shows some alteration of the blank shape by retouching the ends until rounded slightly to meet the lateral edges (Fig. 7 d). Retouch is generally steep and therefore long and deep at the ends; the angle of the working edge is between 60° and 85° and use takes the form of very heavy unidirectional crushing. Other features common to each subgrouping are described below in the summary of tools.

Retouched and utilized blade tools which have been broken but not subsequently utilized are grouped on the basis of original marginal retouch and use characteristics. These fragments represent potential blanks for the fragment tools described above or rejects.

Irregular tools, unless pointed or typical fragment tools, are described separately at the fifth level.

Two forms are actually recurrent and distinguished; a third subgrouping describes unique examples with significant use or retouch while the bulk of the retouched and/or utilized irregular flakes and broken flakes are subsumed in the two groupings. Recurrent forms include large triangular flakes with marginal retouch along the two thin, non-bulbar sides and use chips along the retouched edge which are visible individually (i. e., not in the form of crushing). A second category consists of medium and large-sized semi-lunar flakes with the long cutting edge opposite a thick bulbar side. Use is unifacial, consisting of linear crushing and use different from the above.

In addition to the tool descriptions, platform flakes and cores are described in some detail as are the spalls derived using the burin technique and non-core derived tools such as pallets and net sinkers.

The full hierarchy and definitions associated with the blade and flake tools, as well as with the cores, spalls and heavy cobble tools will not be described here since a monograph dealing with the details of the Anangula remains will cover this data. It is hoped that the above notes and the tool summaries given below provide necessary background for an understanding of the kind of study which I have attempted for Anangula and which is summarized in Part 2 of this paper.

Limitations on Intersite Comparisons

Comparisons with other Alaskan and Siberian sites outside the Aleut area are not presented in detail here because, for the most part, they are invalid or vitiated by gross differences. These differences pertain to the important contextual features of geographic position, environment, animal resource base, distance from other sites, time, position with reference to the domain of a population system, settlement pattern and lithic assemblage or technological system. The same contextual factors favor comparison and detection of meaningful continuities with the succeeding Chaluka site facing the other side of the same bay (Aigner 1970, 1974).

Anangula differs from all other sites in its unique position which relates it directly to the Bering land bridge. Since Anangula is located near a major water exchange between the Pacific Ocean and Bering Sea, and near the former ice sheet overlying the greater part of the land to the east, a marine adaptation is automatically defined. The adaptation is defined by geological facts, not by the lithic assemblage which accompanies it. All contemporaneous and near-contemporaneous sites in Alaska and Asia are located inland from the coast of the land bridge and therefore, at the very least, reflect different economic adaptations. It is suggested that the differences are on the order of population systems as well; that is, the coast was occupied by the (then undifferentiated?) ancestral Aleut/Eskimo population system and the interior by part of the more migratory and heterogeneous "Indian" populations (Aigner 1970, 1974; Laughlin 1967).

At the same time, geographic distance separating Anangula from other sites of potential interest is measured in many hundreds or thousands of miles and accompanied by many diffusion barriers, both geographic and cultural, including economic, linguistic, etc., which no doubt obtained in land bridge times as well as in the last 10,000 years. Anangula is actually closer to Siberia, following the southern coast of the land bridge (which I believe its progenitors did) than it is to the Onion Portage, Healy Lake or Campus sites in Alaska.

Also to be considered is the fact that temporal control at most sites for which comparisons have been made by others is poor. In general, compared sites are later in time, undated by radiocarbon analysis, or lack established relationships to sea level, ash falls, or other major geophysical events.

Of considerable importance for theoretical reasons, Anangula is situated within the geographic domain of one single population system, that of the Aleuts, who possess a distinctive race, language and culture. There is no evidence in the Aleutians of any other people having entered the area. Accumulating

evidence indicates the early arrival of ancestral Aleuts from the land bridge and their subsequent expansion from Umnak-Anangula (the terminus of the land bridge) both east and west in the chain.

Although economically the Aleutians were rich, they were no crossroads, and Anangula was never on the periphery of a population distribution (as has been hypothesized for Onion Portage). There is no hint that Indians came to the coast of the land bridge and it seems likely that they in fact migrated through the Beringian interior, most of which, incidentally, is now under water. The Aleutian area, then, has always been occupied by a single Mongoloid population which entered early, prospered in the abundance of food and fabricational resources, and expanded to occupy the entire available coastal area. The people were limited in the far west by the distance from Attu to the Commander Islands, and in the east by the similarly late Konyag Eskimo expansion along the coasts of the Alaska Peninsula, and earlier by the ice sheets.

Settlement pattern in the oldest Alaskan and north Asian sites differs from Anangula. Campus, Healy Lake, Onion Portage and others probably represent seasonal hunting stations and camps visited by only a segment (able-bodied males?) of the larger population. For that reason, the range of activities represented in those sites is limited. For the most part skin working and manufacturing, fabrication and decoration, and activities undertaken by the old and very young are not represented. At the same time, occupation was of short duration and not extensive; the low frequency of artifactual remains and relative typological homogeneity are related to that fact. Compare this situation to Anangula with its thousands of artifacts of considerable variety, from tools believed related to hunting and fishing, to those for bone and wood working, paint grinding and so on.

The remains from Anangula are interpreted to represent a population of ancestral Aleuts which made its base village on the island, built houses, and included the necessary age and sex components to account for manufacture and use of carved stone bowls, fishing line weights, pallets and grinding stones, red ochre, shaft smoothers for awls, spear, harpoon and larger shafts, and blade and flake tools in large numbers.

A feature of the settlement for Anangula, which covered a considerable area and included a number of people performing many activities, is the recovery of thousands of artifacts from less than 5 per cent of the site⁴. Sample sizes of less than 100 tools in total samples of less than several hundred in other Alaskan sites render even comparisons of the lithic techniques of limited value. At the same time, the latter sites represent only an inadequate sample of activities and a poor sample of the range of variation present. Statistical treatment is obviated.

In terms of its lithic technology which in most respects is altogether silent about the economic adaptation of the site, Anangula is characterized by the following features. Typologically it is exclusively unifacial. All other sites in western Alaska and eastern Siberia to which Anangula has been compared contain a significant bifacial element. The presence in these sites of bifacial implements suggests a gross difference between them and Anangula, and indicates the absence of exchange. There is technological diversity among the Siberian sites with Mal'ta most striking in lacking bifacial flake and blade tools. There has never been demonstrated nor should there be expected a replication of Siberian assemblages in Alaska.

I believe the best model, based on the present geological, archaeological and biological evidence, to explain the lack of exchange hypothesizes (1) different initial land bridge adaptations by ancestral Eskimo/Aleuts and by ancestral "Indians" (not some progenitor of all, but possibly several different non Eskimo-Aleut groups), and (2) contact and exchange patterns at least as sporadic and tenuous as in modern times, perhaps more so given the larger interior area in land bridge times. The ancestors of the Aleuts who are represented at Anangula had no tradition of bifacial flaking and, prior to entering the area, must have

⁴ The area excavated in 1970 was five times as large.

been effectively isolated from peoples with it (i. e., coast vs. interior); this does not necessarily mean that the Anangula technological system is typical of all ancestral coastal Eskimo-Aleuts but it may represent one of several lithic technologies carried by different groups of this then -intact, larger population system. That the Aleut (and Eskimo) ancestors were a distinctive, non-"Indian" population is demanded on genetic grounds.

I have examined the British Columbian, Alaskan, Siberian and Japanese collections of D. Anderson, K. Borden, J. Campbell, N. Dikov, D. Dumond, J. L. Giddings, W. Irving, R. McKennan and J. Cook, R. Solecki, I. Skarland, F. Hadleigh West, and with the guidance of M. Yoshizaki, various Japanese collections. H. Müller-Beck has had access to Anangula and to Siberian remains. In every case there are no obvious similarities of entire assemblages although, as one would expect, meaningful general similarities are present in a minority of the elements.

Summary

To recapitulate briefly, the information about Anangula concerns both the lithic industry as such, the intra-site events, and the accompanying contextual features which indicate the nature of the adaptation. There is nothing in the nature of the cores and blades which indicates what animals they were used on. The uses of the tools must be inferred from faunal remains or from a geographic position which permits no economic ambiguity. It should be reiterated that the only possible economic adaptation for the Anangula people was littoral and marine. There is every indication that these resources were approximately the same then as now.

The information is drawn from four sources and these constitute the basis of my interpretation: first, the position of the site with Black's full examination of the geophysical events, the nature of the shoreline, intertidal zone, reef system, water depth, currents and the proximity of such features as the ice sheet; second, the kinds and numbers of artifacts. This includes the categories of tools - line weights, paint grinders and pallets, dishes and abraders, as well as as the cores and blades. It also includes the analysis of unfinished tools, the reassembly of tablets and blades with their cores or, in short, the full sequence of steps in the manufacturing process. Thousands of artifacts, rather than hundreds, provide information on variation that cannot be secured with small numbers.

Third, the succeeding Chaluka occupation provides specific continuities in tablets, unifacial tools, line weights, abraders, paint grinders, stone dishes, etc., and critically, shows a trend to a decline over 4,000 years in the frequency of unifacial tools. Since the Chaluka inhabitants exploited the same bay, the large series of faunal remains fills out the picture of marine adaptation.

Fourth, the living Aleuts are an interesting source of information owing to the fact that they constitute a single population system with a distinctive race, language and culture. The position of Anangula well within the geographic domain of this population, rather than on the periphery which might have been occupied by contiguous peoples, or in a place subject to migration of different peoples, augments the indications of stability, continuity, and internal development.

The focus has been on the examination of events at and around Anangula. Until other sites are found that are demonstrably relevant to the coast of the Bering land bridge or with more pronounced similarities to the Anangula adaptation and assemblage, it is misleading to speculate on connections in even a general technological sense, let alone in terms of actual genetic connections, with other sites than Sandy Beach Bay and Chaluka (Aigner 1974). The geophysical and ecological context of Anangula is clearly more important for these comparative studies than the stone tools found within the site.

Part 2

Introduction

In Part 1 of this paper I summarized the geological information collected during the 1962 and 1963 and subsequent seasons which bears directly upon the early human occupation of Anangula Island. At the same time, I provided background information on the history of the archaeological work on Anangula Island through 1963 and detailed the preliminary interpretations on the character of the occupation and size of the Anangula settlement. A tentative reconstruction of Aleut origins and affinities was presented, based upon not only the geological data, but also upon other lines of evidence, including archaeology, physical anthropology and linguistics. Part 2 of this paper presents in more detail a description and definition of the impressive lithic tool collection from the Anangula site. My rationale and problem orientation have already been presented in Part 1. A brief discussion of continuities within the Aleut area, specifically around Nikolski Bay, and of new data from my 1970 work at Anangula and Chaluka follows the descriptive section of this paper. More details are available in Aigner 1974.

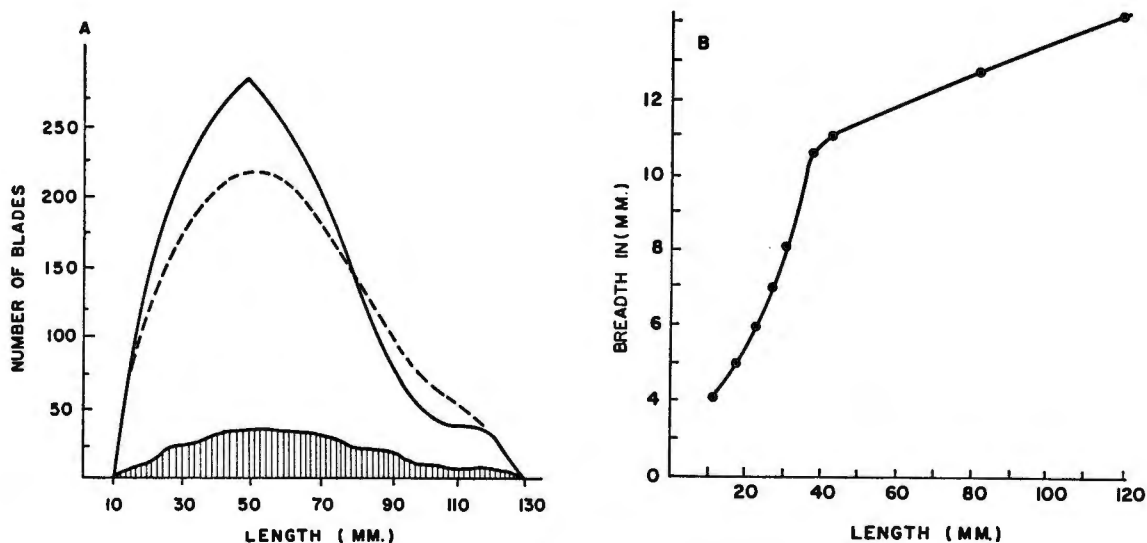


Fig. 8a, b. Lengths of blades at Anangula (a) and nature of breadth increase in Anangula blades (plotted against length increase) (b).

A. Unretouched and Non-utilized Blades and Flakes

There are 770 whole and broken blades which are unretouched and show no traces of use. Lengths for the blades were measured directly on unbroken specimens and estimated for broken specimens. The accompanying figure gives these for the 1336 blades in the collection (Fig. 8a). Whole blades are represented by the darker portions, and reconstructed length for broken blades in white. Mean length for the continuous distribution of blades is 56 mm. This is an underestimate since I assumed each fragment was $1/2$ the total length; I know that in fact each was probably $1/4$ or $1/3$ total length. Correcting for counting segments from the same blade twice or more, and for underestimating their length, the still conservative estimate for length distribution of the blade population is shown below the dotted line. The mean approaches 65 mm although the distribution of lengths between 13 mm and 125 mm is continuous and approaches normality.

For selected length classes, including only whole blades, length and breadth ratios were plotted

(Fig. 8b). Breadth does not increase proportionately with length. There is greater breadth increase in short blades at Anangula so that for blade length between 11 mm and 45 mm, there is an increase in breadth of 0.5 mm for every 1 mm increase in length. In longer blades the rate decrease abruptly – for every 1 mm of length increase, breadth increases at a rate of less than 0.01 mm.

Flakes distinguished by the presence on the dorsal face of at least 50 % cortex are defined as cortex flakes. These normally represent the first materials removed from nodules or areas secondarily prepared for flake and blade removal. The pattern at Anangula was to remove overlapping long flakes in such a way that longitudinal ridges formed on the core exterior (potentially the blade median ridge and dorsal facets).

Flakes tend to be longer than broad and 50 % to 65 % cortex. Some show a platform remnant while others, evidently removed prior to platform preparation, do not. Forty-four of the 163 flakes are regular enough to be considered ridged cortex flakes; twenty of these are retouched and another three utilized (compared to only eight of the other cortex flakes).

Tablet or platform flakes are not always easily distinguished from irregular flakes struck off a prepared platform. The estimate of 454 tablet flakes considers only the indubitable specimens (Pl. IV; 1) and therefore is conservative. There are a number of features observed on known flakes of reconstructed platform-tablets and applied to the flake population at large (dorsal face characteristics, lack of platform remnant, size and shape, size of bulb, platform edge remnant, etc.) which aid in identification.

I identified a minimum of 85 platform tablets from different cores from the flakes. Thirty-one are probably composed of no more than two or three large flakes; another forty-two consist of numerous small flakes (Pl. IV; 1b). The large number of flakes remaining is conservatively estimated to represent twelve additional tablets on the basis of material alone.

The observations which follow are based on forty to forty-two tablets complete enough to permit the measurements outlined in the hierarchy (not reproduced here). The number of facets visible on the tablet sides ranges up to 8 and the maximum number of flakes for a tablet which I have succeeded in reconstructing is 14. The amount of the platform which was actually used for blade and flake removal in no example exceeds 80 % of the perimeter. Roughly half show removal around more than 50 %. The maximum platform dimension for the Anangula tablets is uniformly greater than that on intact cores, as one would expect. Only one platform tablet is less than 30 mm across (maximum) and only two greater than 91 mm. Many (17) were between 61 and 75 mm across with somewhat less (8) between 76 and 90 mm. Seven were between 31 and 45 mm and eight between 46 and 60 mm.

Thirty-four of the forty-two observed specimens were from cores with round or oval platforms (as opposed to wedge-shaped or some other form). From one core I have reconstructed two tablets (Pl. IV; 1a). Significantly, only 39 flakes show utilization and 24 some retouch (Pl. IV; 1c).

Ridged flakes (in addition to those in the cortex flake category) of three sorts are recognized in this study. Those removed from the edge of a platform are most irregular since they are highly curved. The 20 examples identified from this source range in length from 27 to 71 mm. Two show some signs of utilization. Ridged flakes struck off the sides of cores which had been rotated have an old platform edge as the median ridge (Fig. 13d). Since the flake is removed from the prepared platform down the core as for a blade, shape characteristics are more regular. Forty-six flakes from this source are identified and 19 have been retouched or utilized. Length ranges from 16 to 72 mm and breadth and thickness from 5 to 35 mm and 3 to 15 mm respectively. Blade-like flakes which lack specific criteria for assigning origin as in the above cases undoubtedly vary in derivation. They are usually struck from the platform and differ from blades in lacking the essential sorting criteria (parallel, concave scars). There are 105 of these flakes. Of the ridged varieties these most closely fit the range of variation for blade characteristics and not surprisingly more than 50 % are utilized or retouched.

There are 1,298 irregular flakes (excluding irregular cortex and platform-tablet varieties discussed above) which lack traces of retouch and use. They vary greatly in size but the majority (more than 95 %) were struck from cores (rather than from slabs or collected). The maximum dimension is defined as in excess of 10 mm.

B. Cores

My interest in a phase analysis approach to parts of this study in order to understand the etiology of various tools first suggested the usefulness of a weighted hierarchy for descriptive purposes. I invested in a similar approach in this analysis and classification of cores. There are several kinds of cores and associated products. In some cases core tablets, blades and flakes could be reassembled with the core from which they had been struck. By noting retention of cortex, core rotations, flake and blade scars, and associated rejuvenation flakes (tablet flakes or platform tablets), flakes and blades, I could often reconstruct several steps in its previous history. Therefore I chose to describe each core at the particular phase in its "life" which I observed, including the previous steps in its history.

However one cannot place each core in a type category on the assumption that the end product observed is the end product of the manufacturing process. Equally unacceptable is the corollary assumption that the Anangula cores can be arranged in a "true" sequence which represents steps in a single, linear manufacturing process. My reconstructed phase sequences for a number of cores make it clear that not only does the form of the Anangula core change with each blade and flake removed, but, more important, there commonly occur changes in the same core in one course of removal (as from nearly exclusive blade removal to flake removal). Therefore, not only is one unable to objectively generalize a single core life history, one cannot even make a simple dichotomy into blade and flake cores. What has happened in the history of a core can be seen in several steps; what would happen to it next cannot be foreseen (Pl. IV; 2).

To summarize briefly the forty cores recovered *in situ* from Anangula: three have blade scars around more than 80 % of the exterior (i. e., last course of removal only) (Pl. IV; 2b); six have blade scars around 60 % to 80 % (Pl. IV; 2h); another six cores show 40 % to 60 % removal (Pl. IV; 2f); six 20 % to 40 % (Pl. IV; 2a, c); and nineteen less than 20 % of the total core exterior removed as blades in the last course (Pl. IV; 2d, e, g). Core shape is partly related to amount of blade removal so only 30 % of the cores with little or no blade removal are regular (conical or cylindrical). The rest are blocky or amorphous. These same cores tend to be out of the coarser grained felsites and basalts as well. Fine grained chert is the most common core material (14 examples compared to 9 felsite, 7 basalt, 5 obsidian and five others).

To some extent material affects blade production (i. e., there is a cultural preference with a technological basis). Most of the basalt and felsite cores show little or no blade removal in the last course while most obsidian and chert cores have extensive removal (75 % in both instances). Cores with more than 60 % of the exterior removed as blades are mainly chert and obsidian. Coarse grained materials were used for blade production most commonly when initially prepared and therefore large.

The amount of core height reduction resulting from platform rejuvenation by tablet removal (as opposed to rotation which is nearly ubiquitous) varies to some extent with core size – thicker tablets are associated with larger cores. My sample of 67 tablets (which probably gives a measure of maximum if not average thickness) ranges from 4 mm to 20 mm; but the dimensions are not evenly distributed and most are 10 mm thick, give or take a few millimeters. Hence, height reduction on the order of 10 mm with each rejuvenation is the pattern.

The maximum core platform dimension is smaller than for tablet-platform maximums – as expected. A comparison of core blade scar lengths with blade length is instructive in reiterating the fact that cores were used, rejuvenated, reused, again rejuvenated and so on. The core scar lengths are generally less than

40 mm long, while most blades are far in excess of 40 mm in length. The data show no clear relationship between actual core size and the core (maximum) height: breadth ratio.

Significantly, more than 75 % of the blades removed from cores were struck off of flat platforms (parallel to the core base) which were prepared by flaking. Blade scars and the platform form angles between 92° and 82° . On most regularly shaped cores, the angles on a single core are within 5° of each other.

On the cores the greatest number of blade scars associated with the last course of removal is 14; the mean for the forty cores is 4. These figures can be juggled to show that if one eliminates the nineteen which in the last course served almost exclusively for flake removal the average rises to 7, and so on.

Short cores are not diagnostic of the assemblage and the commonly referred to, illustrated, and described examples in no way typify the Anangula collection. There are several very attractive, short, conical cores with blade scars around the entire perimeter (Pl. IV; 2b), but there are many more large, amorphous examples which lack blade scars entirely. There is no single Anangula type core nor are there only two kinds of cores. The examples are distinguished by their variation in size and shape while retaining in common characteristics of platform angle, rejuvenation by rotation, rejuvenation by platform-tablet removal, platform preparation by flaking, and use as producers of blade as well as flake blanks.

C. Non-Core Debris

Non-core debris includes all pieces of broken flakes and flakes not slated as blanks, core preparatory or core shaping flakes, and whole chips less than 10 mm long (maximum dimension) of which there are 2,773, and the spalls (which may be longer than 10 mm) derived secondarily off of blade and flake blanks using the burin technique.

There are 73 spalls in the 1963 Anangula collection and several are clearly from the same tool blank. Not one shows utilization after removal. Using my orientation (Figs. 7 and 9) for the tool from which the spall was removed, $\frac{2}{3}$ were struck with blows delivered by the right hand [and not the left hand, as

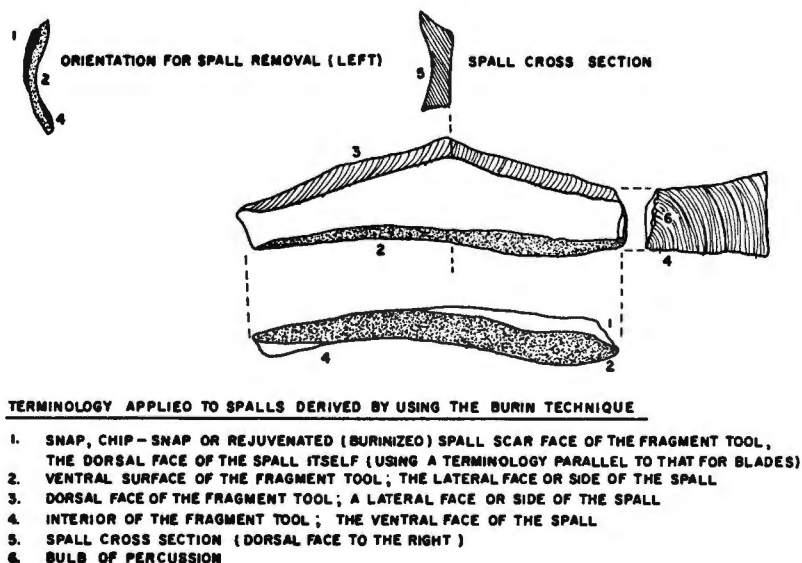


Fig. 9. Diagram showing the terminology used to describe spalls, including in relation to the segment tools from which they have been struck.

in the orientation used by Giddings (1964) and Cook (1965, 1968)]. Double ended specimens (burinized at both ends) show the tool was rotated a full 180° for removal of the second spall (i. e., there was a preferred orientation which was related to the handedness of the manufacturer).

Interestingly, only 4 % of the spalls were struck off of unaltered snapped fragments (i. e., see description of fragment tools above and below); 16 % were struck from snapped tools with end chipping (thus understandably uncommon); the remaining 80 % of the spalls are at least the second removed from their particular tool (Fig. 17e). All but perhaps one show clear traces of use prior to removal and specifically on the ventral snap or burinized-snap margin (i. e., the edge utilized in the fragment tools as defined). The rest show polish or crushing on the ventral edge. Crushing across or near the dorsal edge of the face is present in only 32 % of the examples.

Breakdown by material is interesting, showing most spalls of felsite (50 %) and fewer of chert (33 %), in reversed frequencies to fragment tools of those same materials. Apparently the coarser grained tools more frequently needed rejuvenation of the working edge – this was the purpose of the spall removal – than did the chert examples. Spalls range in length from 15 to 33 mm with 22 mm the average. Breadth averages about 6 mm (4–9 mm) and thickness 2.5 mm (range 1–4 mm).

Spalls representing the first rejuvenation (of the raw snapped edge or the chipped end) are triangular, thicker on the face corresponding to the fragment tool ventral surface (this accounts for the angle of the burinized examples). Second and third spalls are more often rectangular in cross section.

D. Blade and Flake Tools

There are 16 symmetrical, tapering, pointed tools. The points form from the intersection of two margins at an angle greater than 25°. In all, the points are dorso-ventrally thinned; use traces are present at the margins near the point tip. Eight of the tools are retouched but only one (Fig. 10h) is thinned by secondary chipping; the rest retain the original blank shape (which is thinned either by conscious shaping on the core or fortuitously, probably the former). Dorsal marginal retouch and/or use is present along both margins of 15 examples; only one deviates with a short span of ventral use chipping along one margin. Use along margins is in the form of small (less than 1 mm) individually distinct chips driven off nearly perpendicular to the edges (angles greater than 60°).

Length characteristics provide one means for internal subdivision. Four of the pointed tools are short, ranging from 29 to 48 mm with breadth 13 to 20 mm (Fig. 10b, g). Two of the tools are medium in length, 60 to 64 mm by 31 mm (Fig. 10c, h). Most of the tools are long, from 77 to 99 mm, and relatively narrow (from 16 to 29 mm) (Fig. 10d–f, i).

Twelve of the tools are made on blade blanks, all with basal thinning (again probably from shaping the blank on the core, not from secondary shaping). Of the three ridged flake pointed tools, two are on thinned blanks but one does not appreciably thin at the base (Fig. 10h). One basally thinned specimen was made on an irregular flake (Fig. 10g).

The tools may also be subgrouped on the basis of their perimeter form. Using this criterion, there are five medium to large, fairly broad, leaf shaped tools which, additionally, taper slightly at the base (Fig. 10a, c, h, i). Four specimens are nearly parallel sided to the straight base: these include one short and three long specimens (Fig. 11b, d, f). The remaining three small and two large unbroken tools (Fig. 10e, g) have irregular bases – one margin flares slightly near the base. Since perimeter form of the blanks is not altered, the shape groups are to some extent fortuitous, although of course some control over shape was possible by shaping the blank on the core.

With regard to the function or uses of these tools, it is suggested that the larger, symmetrical examples served as thrusting or dispatch points and were hafted onto shafts (Müller-Beck, oral communication

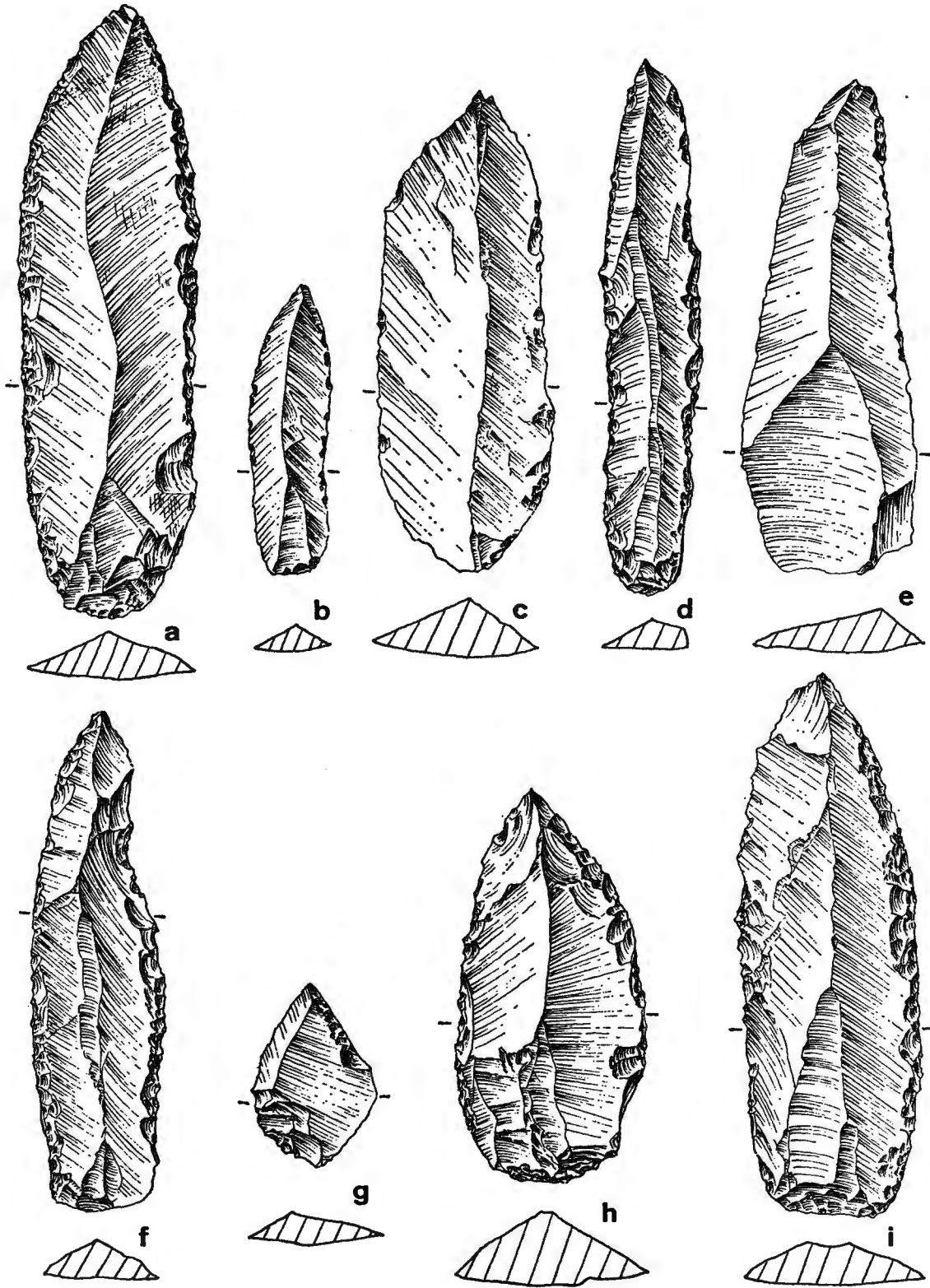


Fig. 10. Symmetrical pointed tools. 1:1.

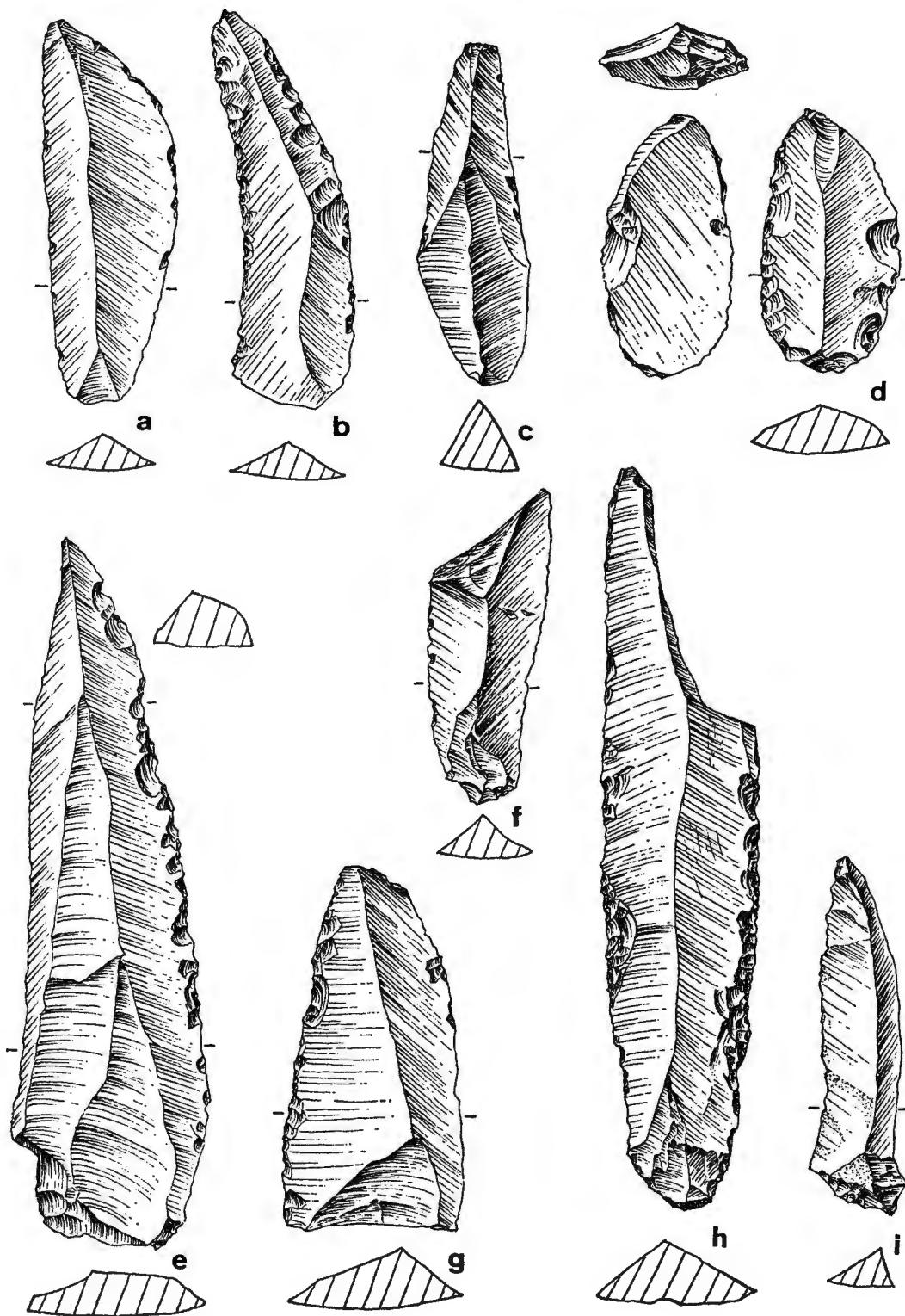


Fig. 11. Various categories of pointed tools. 1:1.

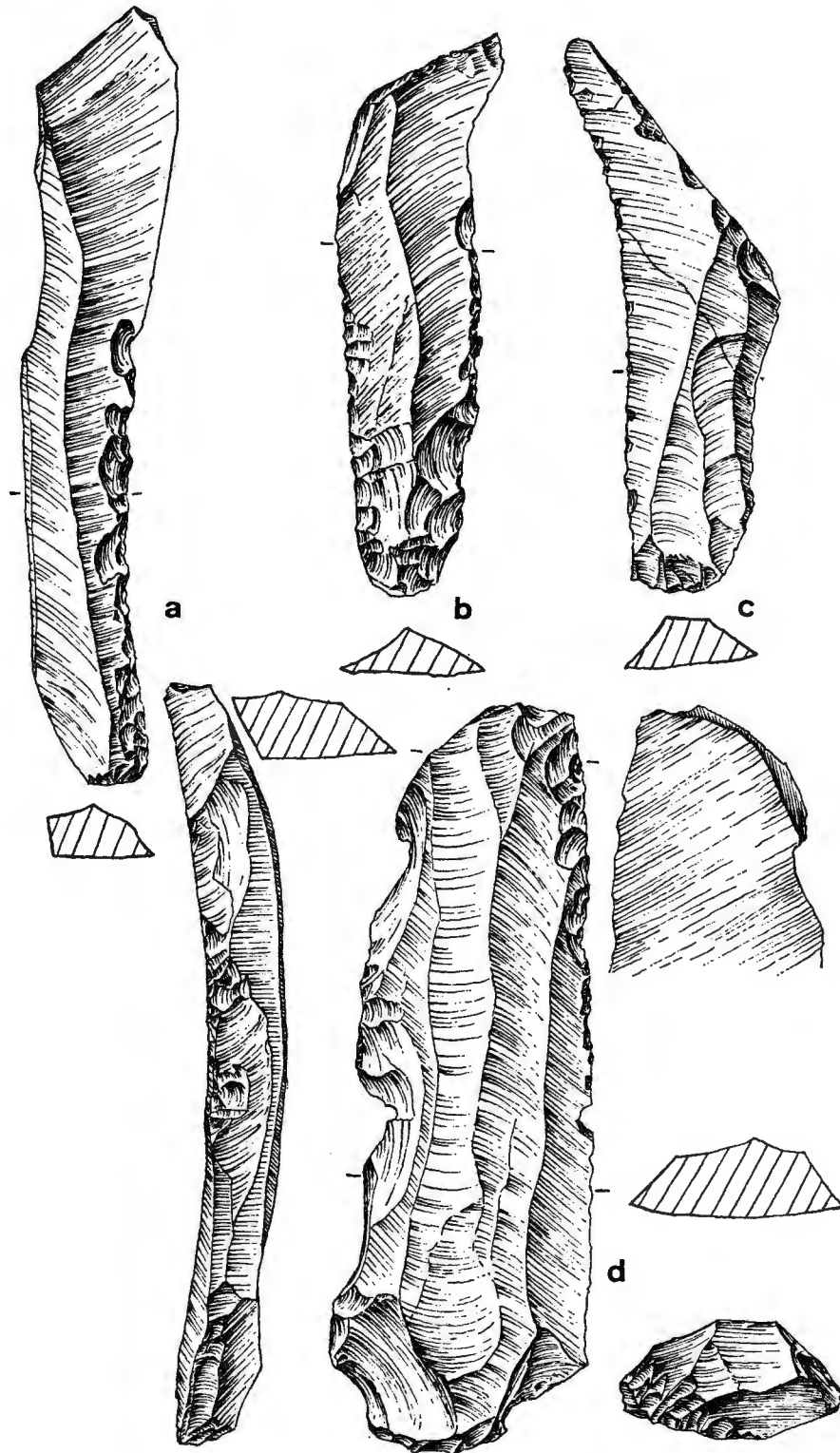


Fig. 12. Blunt ended pointed tools. 1:1.

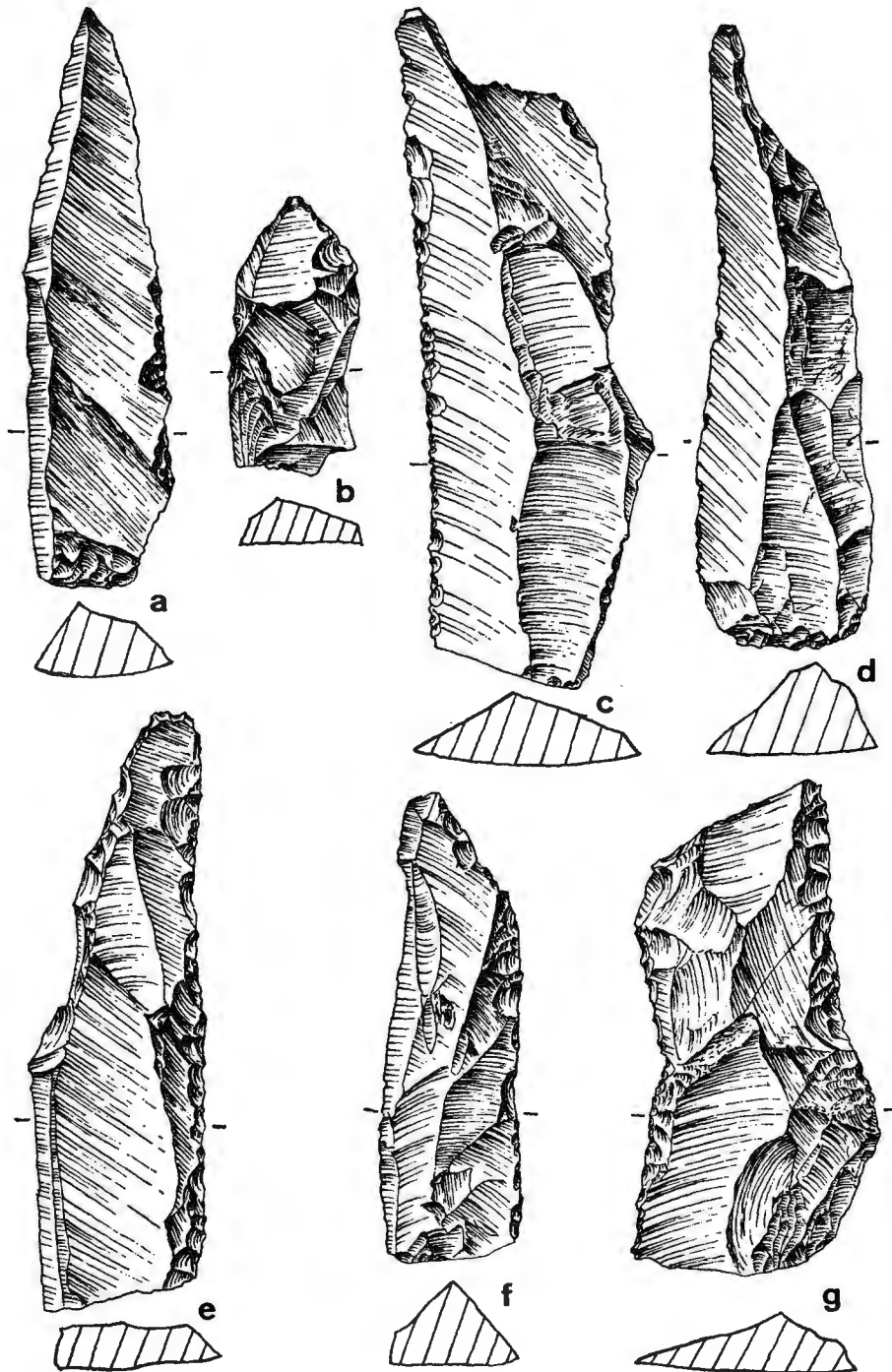


Fig. 13. Several categories of pointed tools. 1:1.

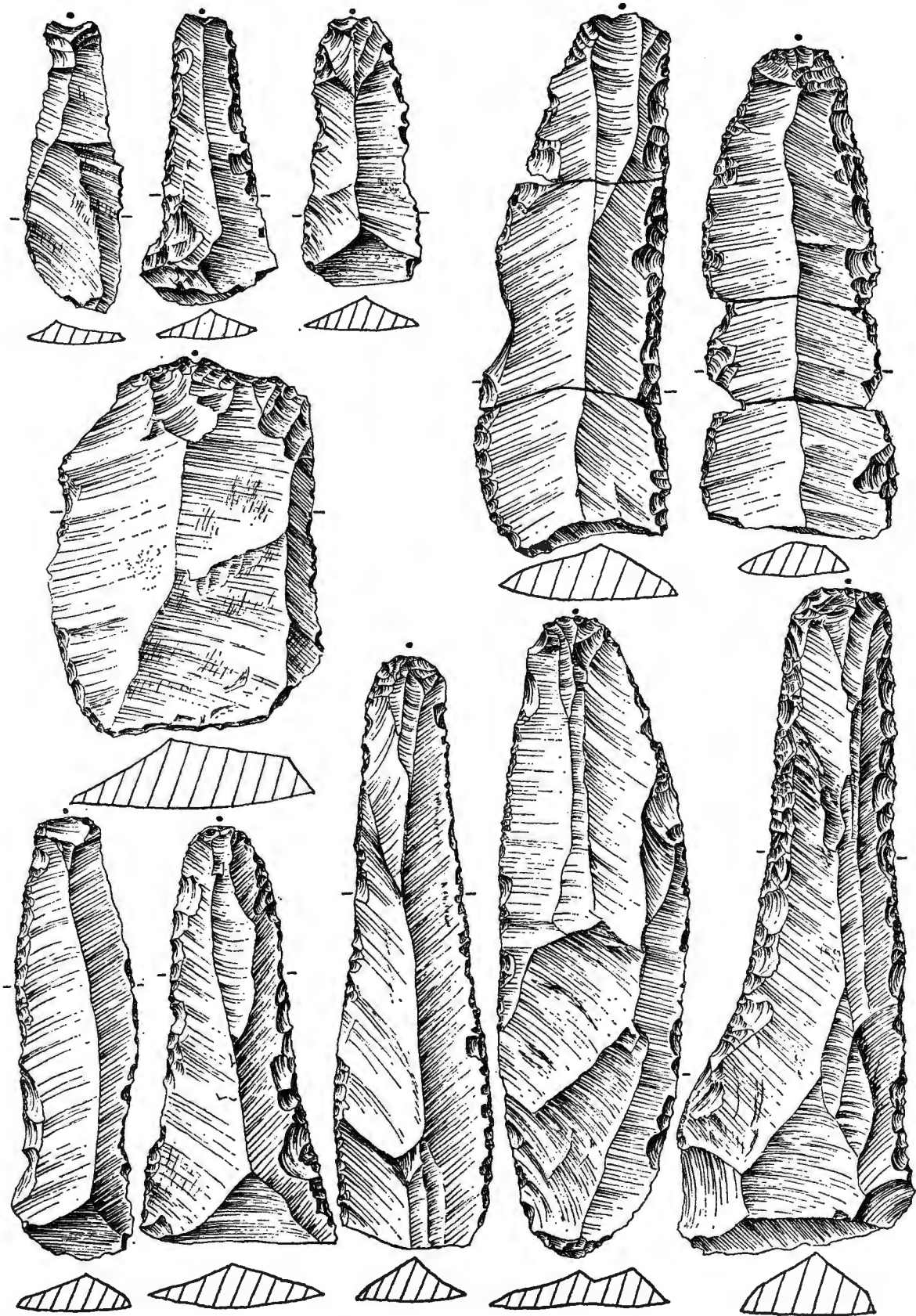


Fig. 14. Marginally retouched and/or utilized blades and ridged flakes. 1:1.

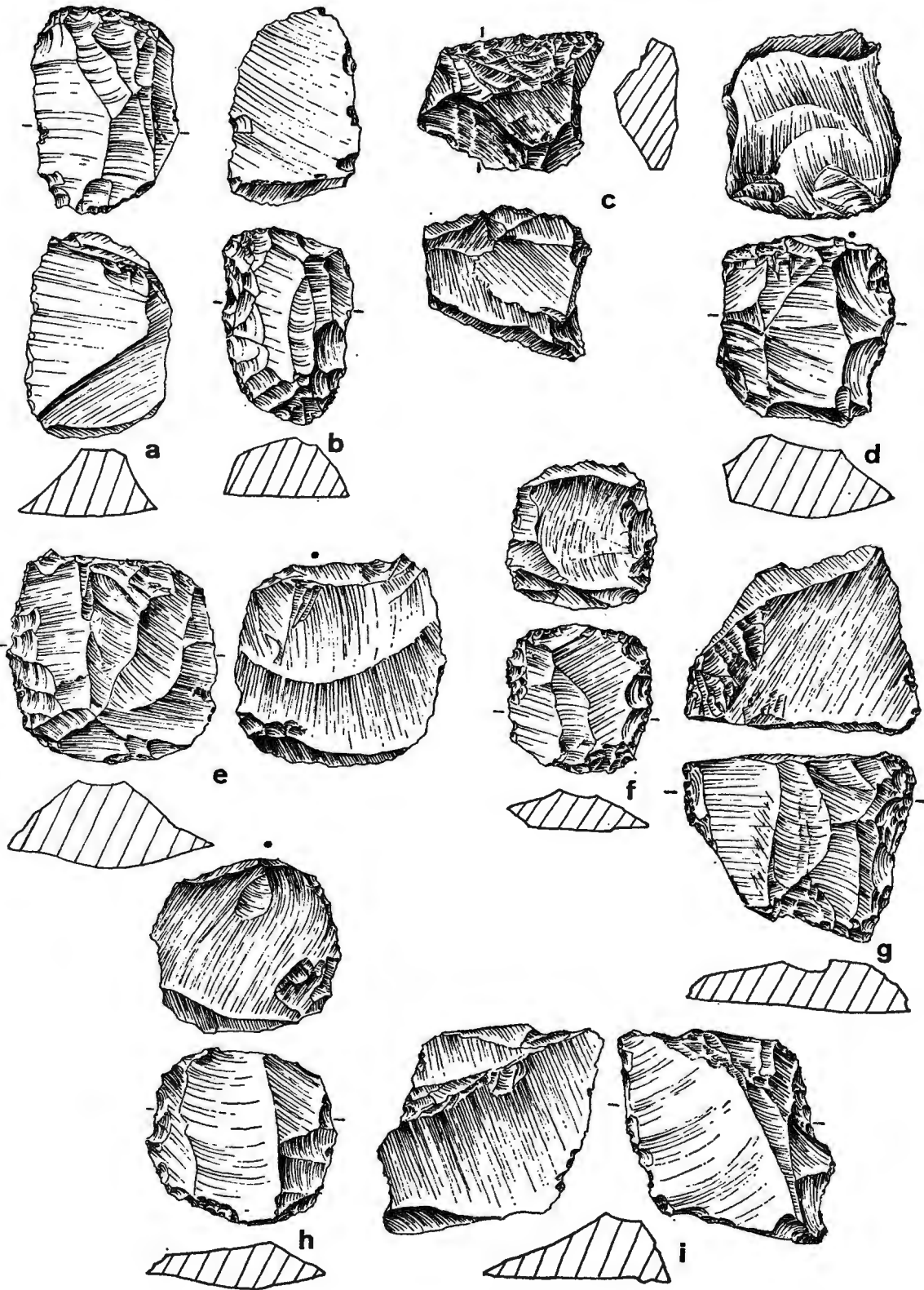


Fig. 15. Segment tools rejuvenated by spall removal (burinization). 1:1.

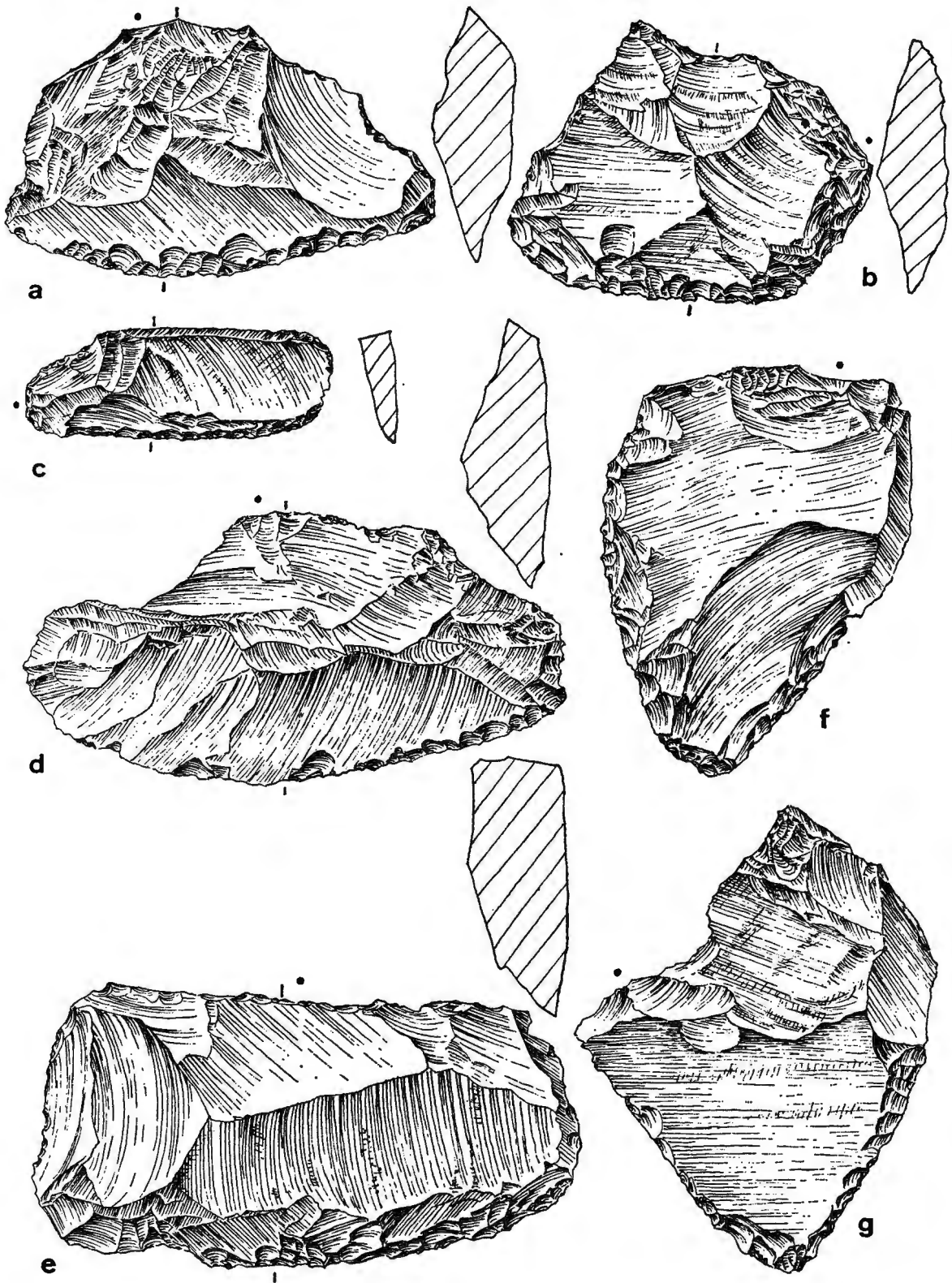


Fig. 16. Several categories of tools made on irregular flakes. 1:1.

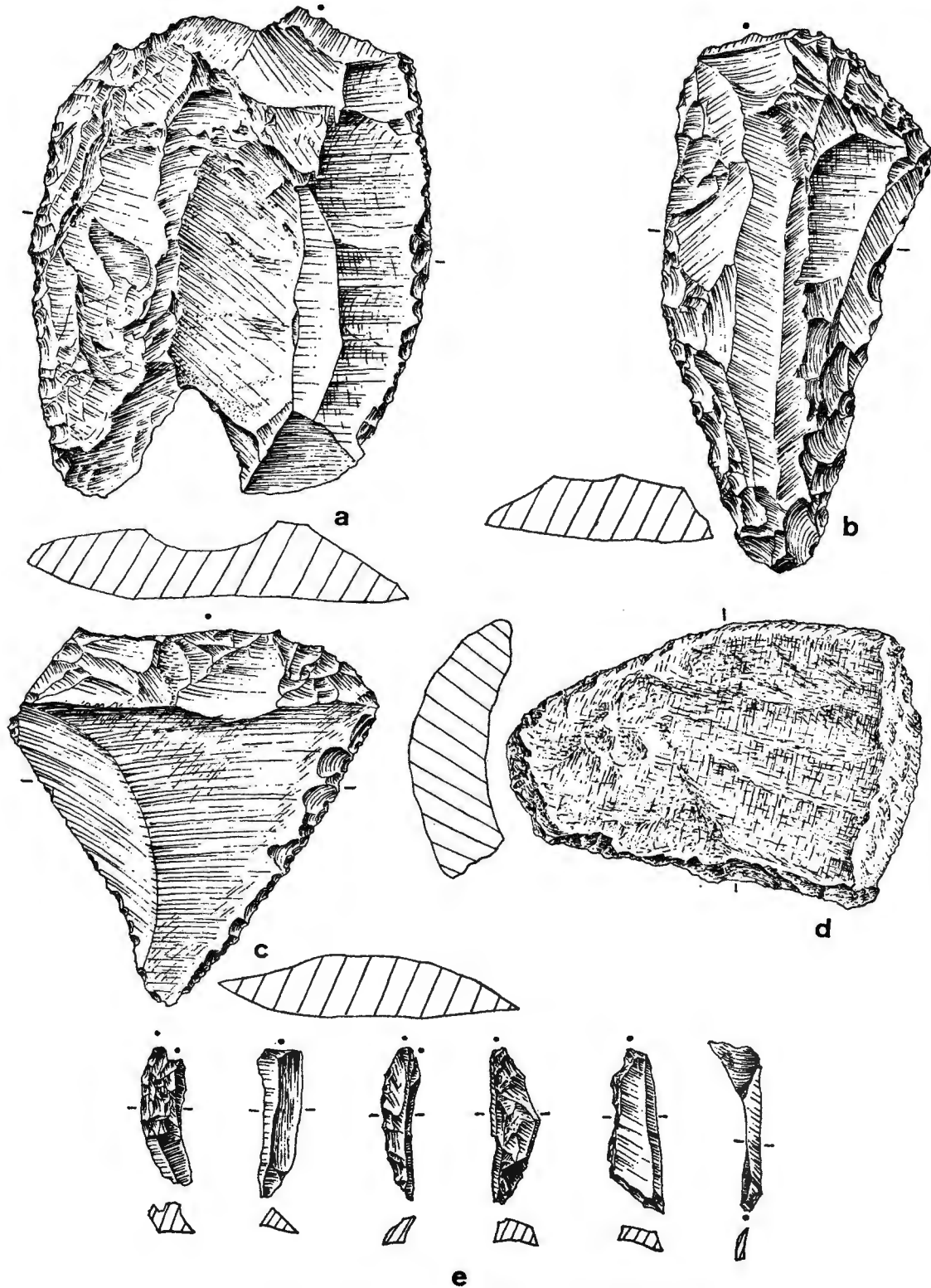


Fig. 17. Several irregular flake tools, a bowl fragment and spalls. 1:1.

1968). Perhaps some of the small pointed examples were inserted on spear or harpoon heads, despite the common irregularity of thickness of such pointed tools. Most of the larger points with extensive marginal retouch and/or use probably functioned as cutting implements or knives.

There are 21 asymmetrical tapering, pointed tools. The pointed ends are formed by the merging of the margins at an angle in excess of 25° . All the examples are thinned dorso-ventrally at the point (none secondarily) and show retouch and/or use near the point tip. Ten of the tapering points are asymmetrical to the right (the point is oriented away from the observer, dorsal face up, in this case) and 11 to the left. Thirteen of the tools show retouch but only seven have any near the point; the rest show use. For the 18 whole specimens, thinning at the base is present in only 9 (not secondary retouching). Compare this with the symmetrical tools above.

Use and retouch patterns are somewhat different than in the symmetrical examples. Both margins show use or retouch on only 15; five have use along one margin only (three along the margin of asymmetry). One specimen has use apparent only near the pointed end.

Subdivisions on the basis of lateral edge use and blank size are made here. Even for the blade blank examples, shape is less regular overall than in the symmetrically pointed tools. The pointed tool with use only near the point is short (43 mm) and lacks a long, straight margin. Five tools which have retouch and/or use along only one margin include two short flake tools, 31 and 37 mm in length. The two medium length flake tools (one of which is snapped distally) measure near 70 mm (one length is reconstructed) (Fig. 11 g). There is only one long, narrow flake which is regular in its thickness characteristics as well as in its perimeter form (Fig. 13 a); length is 79 mm.

The 15 tools with two utilized lateral edges include 12 examples made on blade blanks. Five short tools range from 32–47 mm and tend to be broad as well; the length to breadth ratio is less than 2 to 1 in four cases. Medium length tools number 7, including two distally snapped examples of 51 and 57 mm. The whole examples range from 55 to 74 mm; these are more narrow than in the shorter specimens (Fig. 11 a, b). The long asymmetrically pointed tools with two major cutting edges include three examples ranging from 78–90 mm in length.

With regard to function and use, the asymmetry and use patterns suggest cutting was their primary function (they are knives). It is possible that the short pointed blades were hafted as projectiles, but as suggested above, irregularity of thickness and base form, particularly in utilized examples, may have precluded such use. The three short ridged flake examples have narrow points but lack traces of use which might indicate they served as perforators. For this reason and because there is typical edge use, they are grouped with the cutting tools.

The 32 examples of blunt, pointed blade and flake tools have heavy use at the point marginally or ventrally. Only 10 specimens have, in addition, extensive marginal retouch (Figs. 11 d; 12 b; 13 e, g) although another 8 do have some retouch, especially near the point tip (Figs. 11 c, f; 12 a, c, d; 13 f, g).

In 19 cases the tools are made on blade blanks; they are either highly curved and twisted blades, or very thick ones. Perimeter form is unaltered in most cases for these tools. However, three have retouched nub points and three are pointed by burinization (spall removal) (Figs. 11 d; 12 d). Size and perimeter form of these tools vary considerably, as one might expect, since it is the point tip itself which is the important feature of the tool as defined. Blanks include, in addition to the blades (13 of which are retouched), 1 platform flake, 6 ridged flakes (3 retouched), and 6 irregular flakes (2 retouched).

These pointed tools have heavy buttressed points. Use patterns, laboratory experiments, and analogy with known prehistoric and contact Aleut tools, indicate as most likely a use in incising and grooving bone and wood. It is unlikely that symmetry or lack of it was important. The lack of marginal retouch and utilization as well as general irregularity of form (i. e., curvature, thickness) support this hypothesis.

Among those with marginal retouch are the three retouched nub points. They may also have functioned

in cutting flesh, although features of the angle of use chips (smaller angle than for cutting tools described above) differ from most knives. Two examples which may also have been used for cutting are on highly curved blades (Fig. 12b, c). The only good possibility of a tool which could be either a graver or a knife (primary function) is Fig. 13g, made on an irregular flake.

Tools with long narrow points and which show use along both margins and on the dorsal ridge at the point tip number 13. These include one double ended example. There are narrow tapering points (Fig. 11e) with point angles less than 25° , and constricted narrow points (Figs. 11h; 13c, d). The former grouping includes three long and five very short examples; the short tools show little or no retouch. The five constricted points include 4 long and one short specimen. Again, it is the long pointed tools which show retouch.

These tools are interpreted, on the basis of the point configuration and use pattern at the point tip, as perforators (or drills or awls). Symmetry and asymmetry of the tool is probably of little significance to function and use. While the point shape is highly suggestive of perforating functions, the dorsal use at the point, in addition to marginal use, fairly well clinches the interpretation. Some with marked dorsal and marginal crushing might well have been used for drilling into materials more resilient than skin.

Large examples (as in Fig. 11e, h) made on blades and with marginal retouch may have served additionally as cutting tools. The ridged flake example, Fig. 13d, may also have been used for cutting, but marginal retouch is limited.

Sixteen pointed tools which cannot be grouped into any of the above categories because they lack diagnostic utilization patterns consist primarily (10) of unretouched tiny or highly curved blades; there are one tablet flake, one ridged flake, and two irregular flake examples. The three retouched tools include two on blades and one on an irregular flake. On shape alone, one might be considered an asymmetric, tapering, pointed tool (and so might Fig. 11i save for the peculiarly perpendicular use chips off one lateral edge). Another is thick or blunt pointed but lacks the diagnostic use pattern of those tools. Seven are narrow pointed or have constricted points, although most are thin and fragile; they all lack the diagnostic use characteristics of the grouping. The remaining six lack even diagnostic shapes. They simply show some use of the point (although three show some marginal use also).

The 185 whole blades and ridged flakes with marginal retouch and/or use show use in the form of nearly perpendicular chips (individually visible) driven off the dorsal face (Fig. 14). Blade blanks are most numerous (148); slightly more than half of all the examples are retouched (105).

Ninety-eight of the tools have retouch and/or utilization of both margins (31 use only). Twenty-one have one margin retouched but both utilized, and 87 have only one retouched and/or utilized (49 utilized). Utilized examples tend to be shorter than retouched ones. Breakdown by material shows 43 basalt (23%), 29 chert (16%), 38 calcareous chert (21%), 60 felsite (32%), 14 obsidian (8%), and 1 siliceous shale (<1%). Several of the specimens have one ventrally retouched or utilized margin and a few show end use in addition to marginal utilization.

Experimentation and expert opinion (Müller-Beck, oral communication, 1968) are in accord in considering these as cutting tools; i. e., knives. The tools could have been used with or without handles. Some of the pointed tools with similar use patterns are likely functionally identical.

Fragment tools are manufactured on segments of whole unpointed marginally retouched and utilized blades and ridged flakes. A total of 217 such tools made on segments which evidence prior marginal use of the preceding grouping have been identified (153 with marginal retouch). Common in the assemblage are those which utilize a snapped segment of marginally retouched and utilized blades and ridged flakes (Fig. 7a). The edge which is used after the longer tool has been segmented (by design with a controlled break) is the ventral edge of the snap which forms a 90° angle with the ventral face of the blank. Use takes the form of crushing and chipping on the face of the snap (90° angle with faces) from

the ventral edge of the snap. Of the 102 in the collection, some 90 are simple; that is, lack any use in addition to that on the snap edge; 12 show utilization of a corner point formed by the snap and one margin. Thirty-three of the simple and 5 of the complex (point use) blanks show marginal retouch; the remainder were utilized. Breakdown by material indicates 21 basalt (21%), 19 chert (19%), 27 calcareous chert (26%), 32 felsite (31%), and 3 obsidian (3%) examples.

These tools functioned as scrapers; in use they must have been held at a steep angle and moved in one direction – pulled toward the user (hence the removal of use chips only from the ventral edge onto the snap face and not onto the ventral face) (Pl. IV; 1a).

Perhaps a variant of the above, 14 specimens show rough chipping along the snap face (Fig. 7b), perhaps to rejuvenate the working edge or prepare the end for use or for spall removal. Use is present along the ventral edge of the chip face and chips are driven off onto the snap face as in the above subgrouping. Included with the 10 simple are 4 complex (i. e., with a utilized corner point) examples. The angle of the chipped face and ventral face of the blank is steep, 65° and greater. Breakdown by material shows 3 basalt (21%), 5 chert (36%), 2 calcareous chert (14%), and 4 felsite (29%) tools. This does not differ considerably from the breakdown by material for snap tools (Pl. IV; 1b).

These tools, as the above, served as scraping implements. They may have been held at an angle slightly less steep than in the above but use was generally similar: the tool was pulled toward the user.

Tools on which the working edge is formed by removal of a transverse spall (i. e., burinization) form the second largest subgrouping (Figs. 7c, e; 15). Spalls are removed slightly ventrally, rather than perpendicular to the faces, and the resulting angle of the working end is obtuse. The effective working edge is the ventral spall scar edge; use takes the form of polish on the edge (across or central rather than toward either end). On some examples, slight crushing on the edge (but not characteristically onto the scar face) is also present. Only 8 of the 62 total have, in addition to the working edge, a utilized corner point (formed by a margin and the rejuvenated end) (Fig. 15i).

Features associated with this tool are, most prominently, dorsal chip scars (on 41%) (Fig. 15f); these may be remnants of chipped snap ends. Dorsal crushing confined near the proximal end of the spall scar is not uncommon (on 27%) (Fig. 15d). Nearly 20% of the examples show no crushing or dorsal scars (Fig. 15g); the remainder are too complex in their histories to be so simply categorized.

Spalls were removed from the right in nearly 2/3 of the cases, from the left in the remainder. Double ended examples on blade blanks and most on ridged flakes show removal from the same direction for both ends (Fig. 15e). Several of the specimens on irregular flakes, however, show one end with a right, and the other with a left removal (Fig. 15a). Breakdown by material is particularly interesting for the high percentage of chert tools. This likely reflects a material preference on the part of the people. That this material less frequently required rejuvenation is reflected in the relatively low percentage of chert spalls in the collection (and the high frequency of felsite spalls). Five tools are of basalt (8%), 32 of chert (52%), 7 of calcareous chert (11%), and 18 of felsite (29%).

The working angle for these, judging by the pattern of use, was low; in order to account for polish on the facet edge I hypothesize movement was both toward and away from the user. I suggest that these were finishing scrapers since polish use, rather than chip use, is characteristic. Conceivably, bone, wood and skin could have been worked. That these were commonly rejuvenated is attested to by the number of second and third spalls of the same tool and the small number of first spalls.

Obsidian fragments with extensive, steep end retouch which alters the rectangular or square form of the segment-blank are fairly numerous (39) (Fig. 7d). Nineteen of these have retouch around nearly the entire perimeter of the tool. The remainder have one extensively retouched end in addition to the marginal retouch of the blank and secondary additions to it. Most also have a utilized snapped end opposite. Use on the convex or rounded, retouched end(s) takes the form of a narrow band of

nearly perpendicular crushing on the dorsal retouch scars. All 39 are on obsidian blanks, mainly blades and irregular flakes.

Use again was for scraping as opposed to cutting, perforating, engraving or sawing. In order for the steep band of use to develop, the tools must have been held at nearly a 90° angle in use and drawn toward the user. The convex shape of the working edge may suggest that scraping of relatively soft pliables was the common use (Fig. 7d).

As in the other scraper subcategories, several examples additionally show use at a corner or nub point. Based on the blunt point area and use crushing at the tip (either marginally or ventrally), the inferred use is engraving.

Transverse segments (fragments) of marginally retouched and utilized blades and ridged flakes are common in the site. Of the 228 segments, 207 are blades. Retouched examples include 37 with both margins retouched and utilized, 36 with one margin retouched and both utilized, and 68 with only one margin retouched and utilized. Eighty-seven of the fragments show no retouch but have been utilized on both (28) or only one (59) lateral edge. There is no evidence for use of these segments after they were removed from the parent tool.

The segments are mainly mesial (101, 44%) with 70 proximal (31%) and 57 distal (25%). Breakdown by material, compared to material of fragment tools, is given below:

Table 2

| | Fragments | Fragment tools (the number is roughly the same) |
|------------------|-----------|---|
| Basalt | 56 (25%) | 14% (roughly 1 of 3 segments was used) |
| Chert | 33 (14%) | 28% (2 of 3 segments used) |
| Calcareous chert | 29 (13%) | 18% (1 of 2 segments used) |
| Felsite | 62 (27%) | 27% (1 of 2 segments used) |
| Obsidian | 47 (20%) | 12% (1 of 3 segments used) |
| Siliceous shale | 2 (1%) | 0 |

Fragment tools ("scrapers") of chert are most common, relative to the number of chert segments available as blanks, suggesting a material advantage and preference for this material. At the same time, only 1 of every 3 basalt segments was reused, and roughly 1 of every 2 calcareous chert and felsite segments. Obsidian, like basalt, was not heavily utilized.

It is of interest that the fragment tools were often systematically manufactured by snapping existing whole unpointed cutting tools at predetermined points (notched or nicked) and selecting suitably shaped blanks to serve as scraping implements. This information indicates that raw counts of whole and fragmented tools are misleading unless one considers the latter as (in most cases) potential blanks or rejected blanks (rather than merely as broken implements).

Knowing that a third or perhaps more of the snapped segments became fragment tools, there is a means of assessing the many remaining segments (much in the same way as for segments of blades in estimating length). Segments not made into tools secondarily may also be viewed as (formerly tools which subsequently served as) cores and then blanks for several varieties of scraping implements.

There are four large, roughly triangular basalt flakes with marginal retouch along both non-bulbar sides. The four have working edges from 40 to 60 mm long and thickness is greatest at the bulbar side or end, thinning toward the other sides. The retouch and chipping suggest that cutting, rather than scraping, was the primary function. Use chips along the retouched edges are visible individually as in the cutting tools described made on blade and ridged flake blanks; it does not take the form of crushing present in the scraping tools (fragment tools) (Fig. 16b, g).

Large and medium sized semilunar (and not so regular) flakes with one long retouched or utilized margin include 10 examples, seven of which are retouched. Side margins are not utilized or retouched; the utilized margin is raggedly chipped, the chips off the dorsal face are not distinct but appear to be sheared off. Blanks include only various irregular flakes – “cortex,” “platform” and “irregular.”

Possibly the tool was held or hafted and used at nearly a 90° angle and drawn through material as in sawing (i. e., on lateral edge rather than the face) or over the material as in working skins. Use may have been in one direction only or, as in sawing, back and forth. Shape is reminiscent of the common Eskimo “woman’s knife” or ulu (Fig. 16a–e).

Included also are a number of other retouched and utilized irregular flakes which are whole or fragments. Most of these are so crude or minimally utilized as to preclude further description. Included are 165 whole and broken flakes, 92 of which are utilized only. Blanks are mainly irregular flakes (111) and platform flakes (48) with a few irregular cortex flakes.

Still, there are 17 irregular flake tools which have retouch and use warranting further description. The most common form has a thick, utilized corner point (which may have served in engraving and grooving). Other examples are shown (Fig. 17a–c).

E. Pebble and Boulder Tools

In the Anangula collection there are 52 tools which are not cores and not made on materials derived from cores. Most of these have archaeological and ethnographic parallels in the central and eastern Aleutian Islands, including from both the Aleut midden, Chaluka, and the modern Aleut village of Nikolski. The two are located on the same bay as Anangula. Because of the likelihood that similarity of form and function will hold—there is no evidence that the lifeway or basic material culture of the Aleuts has changed appreciably over time – many of the tools are assigned to functional rather than purely descriptive categories.

There are 23 grooved and plain pumice and scoria smoothing and sharpening stones. These are identical to stones used throughout the Aleutian occupation for the last 4,000 years for shaping spear and harpoon shafts, and for smoothing and sharpening awls and needles (Pl. III; 2d).

The 20 grooved pieces accommodated tools with shaft diameters between 2 mm and 30 mm. Of the 62 separate grooves which were measurable, 40 are less than 4 mm across, the size range for bird bone awls and needles so common in Aleut collections. Twelve of the grooves accommodated shaft diameters 4 mm to 8 mm, the size range of some awls and small shaft diameters of Aleut bone spears and harpoons. Three grooves have diameters between 8 mm and 12 mm, common dimensions for spear and harpoon shafts in Aleut collections. Müller-Beck (oral communication 1968) indicates that this is the common diameter of small throwing spears.

Seven grooves (on two stones) measure 20 mm to 30 mm in diameter. Such large diameters suggest that large throwing spears and thrusting lances were likely smoothed. Müller-Beck suggested 20–25 mm as the range for large throwing spears and 30–35 mm as the range for pushing lances. He also noted that the range present at Anangula, including the absence of grooves between 12 and 20 mm, parallels the condition of European Pleistocene sites. The maximum number of grooves on any single tool, and many of these are small fragments, is 9 (all less than 4 mm in diameter). Generally only one size class is represented on any single tool. The average number of measurable grooves is three. The deep, broad well-worn grooves which took the large shafts occur on hard scoria. The rest are mainly pumice and two are a softer material. Also in the collection are three ungrooved, artificially smoothed pieces of irregular shape.

Three ochre grinder/pounders are identified in the collection shipped back from the field (Pl. III; 2a, c). Lengths are 74 mm, 92 mm and 94 mm; the shape is ellipsoidal. One is single faceted with ochre embedded over the entire face and traces at one abraded end. The other two were well washed in the laboratory and retain only a few, if any, traces of ochre.

In Aleut collections, as from Sandy Beach Bay and Chaluka, ochre pounders and grinders are not uncommon. They may be single or multifaceted. One of the Anangula specimens has two flattened and smoothed faces. Of interest in regard to ochre grinding and pounding is the pallet described below.

Four split pebbles from Anangula, with maximum dimensions 75–99 mm, have crushing at one broken edge. Use may have consisted of hacking. On the four the disposition of the crushed edge suggests the tool was held and used with a motion slightly toward the user. Only one broken, jagged edge shows use in the form of large chips crushed off the edge on both the split face and the exterior face (but not uniformly on either). At Chaluka similar tools were found mainly in urchin levels (Denniston 1966). The same is true on Amchitka (Richard Sense, oral communication 1968).

The three large globular pebbles with end crushing are battered on the ends. By analogy with Aleut material from the area they could have served as hammer stones or large net sinkers, or both. The three are roughly ovoid (110–121 mm \times 66–78 mm) and round in section through the short axis.

From Anangula there are 15 regular, smallish (maximum dimension less than 100 mm) pebble line weights⁵ with end crushing and occasionally notching. These are indistinguishable from stones used today at Nikolski to weight lines and nets and identical to weights common in Aleutian sites. These were also identified by an Aleut informant, Sergie Sovoroff, who saw similar examples on Anangula in 1968.

Subdivision of these by size has one alone at 93 \times 87 \times 30 mm. There are both pecking and crushing at the ends. Four are 60–70 mm by 21–60 mm; seven pebbles are 41–60 mm long by 21–60 mm across. Two are less than 41 mm long and one is broken. Six of the pebbles have end pecking and 3 are notched. Four evidence no end alteration and two are too weathered to assess on this trait.

One broken pallet of several found *in situ* was returned from the island. The original perimeter form of the broken specimen was round or more likely oval. Original size is reconstructed at 300 mm \times 250 mm \times 60 mm. The surface was smoothed, most likely through grinding with a stone (see above, ochre grinders and pounders). There is no trough worn. Similar examples of pallets with traces of ochre, and with and without basins or shallow depressed areas smoothed in, are well known from Chaluka.

One small scooped-out pebble, 50 mm long, was found. It is regular and smooth in the interior with thinning rather uniform at the rim. Small artificially and naturally basined pebbles are also present at Chaluka. Whether they actually functioned as receptacles or served as children's items is unclear.

The second example in this grouping is unequivocally a fragment of a carved bowl or dish (Aleut lamps, as distinguished from bowls and dishes, are very thick based and low sided). It is a rim and body fragment. Body thickness is 12 mm near the base, thinning to less than 4 mm at the rim. The maximum dimension of the fragment is 60 mm (which measures the rim-curve). Striations from carving implements are clearly visible, especially on the interior. Both the shape, method of manufacture and material are duplicated on single items in the Chaluka collection (Fig. 17d; Pl. III; 2b).

Finally, there is a single piece of a split soft stone, 40 \times 25 \times 13 mm, with faint incising of a feather-like pattern. Incised stones are present at Chaluka and other Aleut sites where similar poorly executed "grafitti" are found on beach cobbles (Aigner 1966, 1972).

⁵ The context and associations of similar tools excavated in 1970 indicate that some are retouchers. The notched examples may be line weights.

F. Summary

Of considerable interest are the proportions of tools made on regular blanks (blades and ridged flakes) and those made on the irregular flake blanks. There are 1,336 blades, of which 566 are tools (42.4%). Some 334 (25%) are retouched and another 232 utilized. Compare this to the various categories of irregular flakes: of the 119 irregular cortex flakes, only 8 are tools (and only 3 are retouched); only 63 of the 454 platform flakes are tools (only 24 retouched); 1,488 irregular flakes (exclusive of the above) include only 190 tools (again less than 15%) of which slightly more than half have retouch. Of the total of 2,021 irregular flakes, only 261 (12.9%) show retouch or utilization.

Blade-like or ridged flakes are somewhat subjectively identified and it is not surprising that they commonly serve as tool blanks. However, the flakes struck from the edge of the platform and which are highly irregular in section and curvature rarely served as blanks (2 of 20). Of the 151 more regular ridged flakes, 72 are tools (48%); however, slightly more ridged flakes than blades show retouch (34% compared to 25%). This reflects the natural superiority of blades as blanks, with their straight margins and thin, sharp edges.

Regular blanks (blades and ridged flakes) number 1,551 and 663 or 42% were retouched and/or utilized. Nearly 27% are retouched compared to 6.4% of the irregular flakes. There can be little doubt and even less surprise that blades were the preferred blanks at Anangula.

The paucity of certain kinds of tools (such as symmetrical pointed tools) argues strongly for extensive use of bone (barbed spears, etc.). It is also assumed that most of the small fragment (scraping) tools were hafted into bone and wood and not hand held. The smoothing stones suggest the use of bone and wooden shafts and spears and also awls and needles (awls or perforators are also uncommon in stone). The situation is analogous to that at Chaluka, where hunting equipment and manufacturing tools are very much under represented in stone but comprise the bulk of the bone tools (Aigner 1966; Denniston 1966). At the same time stone cutting tools and their fragments are extremely common as are scraping implements both at Anangula and at Chaluka.

Continuity within the Aleut Area

Continuity between Anangula and the Chaluka Aleut village site on the same bay is evidenced in five specific tools, in a declining continuation of unifacial tools in the latter, in the use of red ochre, and in the retention in Chaluka of certain aspects of the true core and blade technology. All this is in addition to geologically and archaeologically demonstrable similarities in resource base and other factors.

With regard to specific shared patterns there are the presence of faceted pounder/grinding stones with red ochre embedded, pallets for grinding ochre, pumice and scoria shaft and awl smoothers with similar distribution of shaft diameters, line weights used in fishing and carved stone vessels. In addition, the base of Chaluka, some 4,000 years younger than Anangula, still retains a high proportion of unifacial tools; the bifacial element increases through time. Sandy Beach Bay presents a similar picture and is slightly older than Chaluka (Aigner 1974).

The cores from Chaluka are irregular and generally lack platform preparation. However, several of them show some platform preparation despite the fact that true blades were not habitually punched from them. The proportion of directed or ridged flakes is, however, higher early in the Chaluka sequence than it is late. There are several indisputable tablet flakes from early Chaluka and evidence of core rejuvenation by rotation. These infrequent examples are of special interest because they represent an important retention of production techniques in the lithic technology. The old pattern of core platform rejuvenation persisted beyond the preparation and use of cores for routine blade removal.

New Information from the 1970 Fieldwork

With a grant from the National Science Foundation, I returned to the Aleutians in 1970. From excavations at Anangula which covered an area roughly 5 m by 20 m, no less than six house structures were excavated. I also reopened and completely excavated one of the 4,000 year-old houses at Chaluka (Denniston 1966). Similarities in size and deposition were striking. Evidently a small interior hearth area was present in houses from both periods and located next to a wall. There was little accumulation of floor debris in any of the houses; the bulk of the fill consisted of roof fall. Stone working activities took place outside of houses in both instances. To date my best guess is that entry was from a roof hole and ladder at Anangula and possibly also at the Chaluka house.

Anangula artifacts with clear counterparts throughout the Chaluka sequence include large carved stone bowls, lamps, carved stone faces and/or full figures associated with houses (the "Image of the Deity" in Chaluka houses from 4,000 B.P. into contact times). In addition fragments of burned bone recovered from Anangula are tentatively identified as including sea mammal (whale) and bird.

The 1970 work has provided data which bolster the likelihood of direct physical and cultural development between Anangula and Chaluka on the same bay. At the same time the early Aleut coastal origin and adaptation suggested above is strongly supported by all the new information: many houses at Anangula dating within relatively narrow limits; sea mammal remains identified in direct association with the houses and with the debris and activity areas between houses and on roofs; and patently Aleut traits such as large carved bowls, oil lamps, ochre grinders and pallets, etc.

Acknowledgements

I wish to acknowledge the support provided by the National Science Foundation (Grant GS 1756, University of Wisconsin; Grant GS 2823, University of Connecticut) for preparation of this paper and the detailed monograph on Anangula to be published in the near future. Geological details are summarized from data supplied in discussion and from papers by R. F. Black. Invaluable support and discussion were provided by W. S. Laughlin throughout this study. I take full responsibility for the views presented here. Artifact drawings are by Jerry Erdman and Mrs. M. Kemper, Erlangen.

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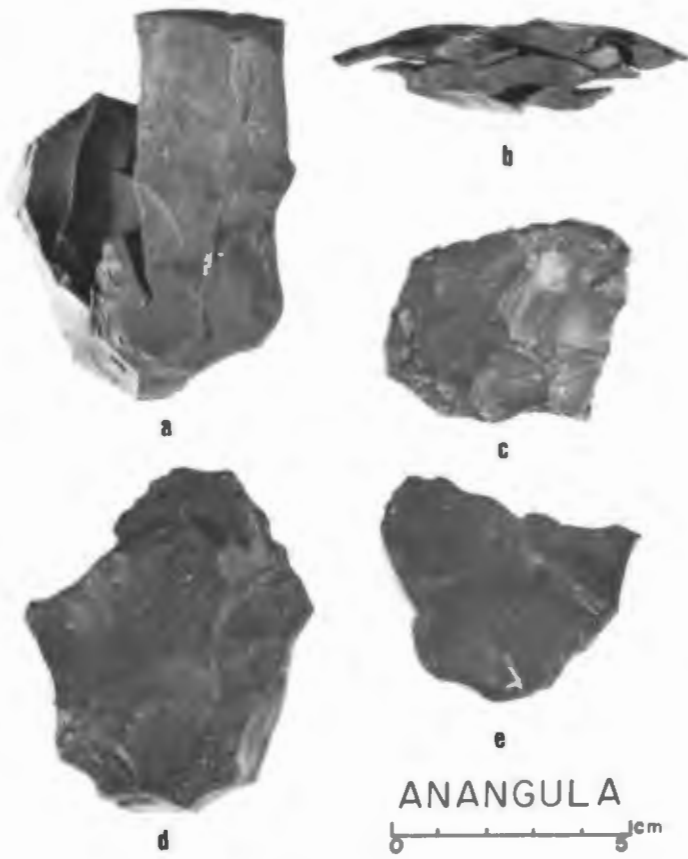
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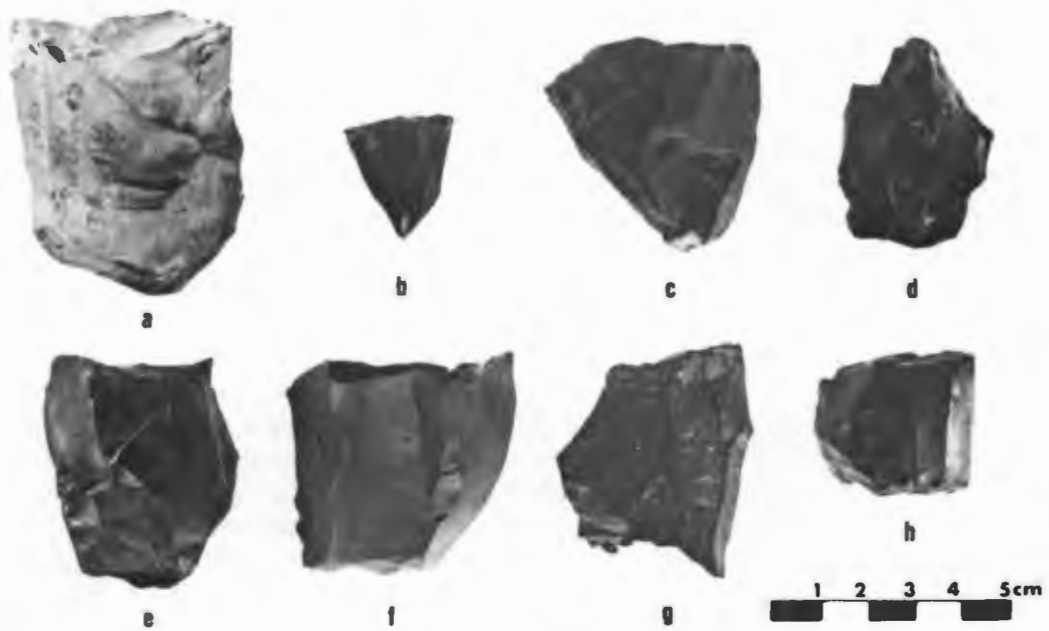
1. Stratigraphic section showing the relationship of the cultural layer to major ash falls.



2. Ochre pounders, bowl fragment and pumice smoother.



1. Platform tablets.



2. Cores.