TECHNOLOGICAL DEVELOPMENT AND CULTURE CHANGE ON ST. LAWRENCE ISLAND: A FUNCTIONAL TYPOLOGY OF TOGGLE HARPOON HEADS

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TECHNOLOGICAL DEVELOPMENT AND CULTURE CHANGE

ON ST. LAWRENCE ISLAND:

A FUNCTIONAL TYPOLOGY OF TOGGLE HARPOON HEADS

By

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Abstract

Our understanding of the culture history of the Bering Strait region is based on the chronology of St. Lawrence Island toggle harpoon heads proposed by Henry Collins in 1937. Subsequent attempts to develop harpoon head typologies from other parts of the Bering Strait are built on Collins' stylistic classification, which does not account for the full range of variation in St. Lawrence Island harpoon heads. The resulting confusion of harpoon head categories has clouded the interpretation of patterns in the material remains and has perpetuated a unilineal theory of culture change in Bering Strait Eskimo groups.

This dissertation critically examines previous investigations and interpretations of archeological sites on St. Lawrence Island and Punuk Island. A contextual analysis of radiocarbon dates from these sites serves to evaluate the currently accepted chronology of occupation.

The typology of St. Lawrence Island toggle harpoon heads proposed is based on a structural analysis of the raw materials and a functional analysis of the components of the harpoon head. The concept of functional strategies explains variation in harpoon head styles and gives meaning to the statistical analysis of attribute associations. A series of dendrochronological dates from the Kukulik site is compared with radiocarbon dates from other sites and

combined with the harpoon head typology to develop a chronology of St. Lawrence Island occupations.

The harpoon head typology reveals the presence of two distinct culture groups co-resident on St. Lawrence Island and the Bering Strait region from approximately 1600 to 1000 cal C-14 B.P. The Old Bering Sea/Birnirk group, associated with a generalized Eskimo subsistence adaptation, was present from 1600 to 1300 cal C-14 B.P. The Okvik/Ipiutak group, focused on sea mammal and whale hunting, is undated on St. Lawrence Island. Based on comparison with date ranges in other Bering Strait sites, the Okvik/Ipiutak group is assumed to be roughly contemporaneous with the Old Bering Sea/Birnirk group. The interaction of these two groups on St. Lawrence Island, interpreted by Collins as the Punuk culture, was present from 1300 to 1000 cal C-14 B.P.

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Acknowledgements

This dissertation had its genesis as a class project for Problems in Arctic Archeology, in the Anthropology Department of the University of Alaska Fairbanks, taught by Dr. S. Craig Gerlach. I am indebted to Dr. Gerlach for his guidance and encouragement and for the lesson of his critical approach to the interpretation of received archeological knowledge. I have also benefitted greatly from the enouragement and expertise of Dr. Linda Ellanna, Dr. Roger Powers, Dr. Peter Schweitzer and Dr. Richard Scott, all of the University of Alaska Fairbanks Anthropology Department.

Dr. Aldona Jonaitis, Director of the University of Alaska Museum, greatly facilitated access to the collections of the University Museum that are instrumental in this study. The cooperative staff and oustanding facilities of the Archeology Department made this study possible.

I would like to take this opportunity to formally thank my wife, L.J. Evans, whose support and encouragement during four years of duolocal residency has made it possible for me to not only complete this project but to thrive in the process.

Chapter 1 - INTRODUCTION

Background

North American archaeologists searching for the origins of the modern Eskimo have long been intrigued by the culture history of the Natives of St. Lawrence Island (Murdock 1892; Nelson 1899; Collins 1929, 1937; Spencer 1959). The presence of large midden deposits at several locations on the coastline of the island held the promise of extensive collections of the material remains of prehistoric occupations (Geist and Rainey 1936; Collins 1937).

Henry B. Collins, assistant curator of the United States National Museum, and Otto Geist, with the Alaska Agricultural College and School of Mines in Fairbanks, conducted the first systematic archaeological investigations on St. Lawrence and nearby Punuk Island between 1928 and 1939. The publication of *Archaeology of St. Lawrence Island* (Collins 1937) and *Archaeological Excavations at Kukulik* (Geist and Rainey 1936) provided the first detailed descriptions of material remains that Collins interpreted as predating modern Eskimos.

Collins' interpreted the material remains excavated at five sites on the gravel plain at Gambell (Sivuoqoq) and on the slope of Sivuoqoq Mountain as evidence of a thousand years of technological change. Collins assumed a temporal relationship among the five Gambell sites on the basis of their relative positions on the gravel beach ridges (Collins 1937; Giddings 1986; Mason and Ludwig 1990). Excavations at the Hillside site revealed ivory objects decorated in a simple style that Collins interpreted as older and antecedent to the elaborately decorated Old Bering Sea materials found in the mounds on the plain below. Collins produced a relative chronology of the occupation of St. Lawrence Island on the basis of a classification of toggle harpoon heads, emphasizing decorative styles and morphological characteristics. He combined data from vertical distribution, decorative styles and physical variables of the harpoon heads to produce a relative temporal sequence of technological variation, which he interpreted as evidence of culture change. Since radiocarbon dating had not been developed, Collins' seriation of St. Lawrence Island harpoon heads styles provided the first temporal sequence for the occupation of the island (Collins 1937).

In 1929, Collins described the earliest materials as the most elaborately decorated, leading him to conclude that later cultures represented a degenerated form of an earlier complex culture with origins on the southern coast of what was then the Soviet Far East (Collins 1929:34-40). Collins equated technological change with culture change and defined the Old Bering Sea and Punuk decorative styles as cultural phases of the prehistoric Eskimo occupation of the island (Collins 1929:1-3). Although Collins' analysis was groundbreaking for his time and provided the first chronology for Bering Strait cultures, subsequent researchers have failed to evaluate Collins arguments and have not re-examined his conclusions in light of current theory and methodology (Geist and Rainey 1936; Rainey 1941; Larsen and Rainey 1948; Collins 1954; Ford 1959; Ackerman 1961, 1962; Bandi 1969; Stanford 1973; Bradley 1974; Crowell 1984; Staley 1994).

Otto Geist discovered the Okvik Site on Punuk Island in 1934 and interpreted the Okvik material as older than the Old Bering Sea material from St. Lawrence Island. He based this inference on comparison of the Okvik decorative style with that of harpoon heads described by Collins as older than Old Bering Sea, found in the Hillside site near Gambell (Rainey 1941:466). J. Louis Giddings, working for Geist on the St. Lawrence Island excavations, found what he thought were Okvik harpoon heads at the Hillside site in 1939 (Rainey 1941; Giddings 1973). Collins interpreted the stylistic similarities between the materials from the Okvik and Hillside sites as evidence of a culture predating the earliest Old Bering Sea material (Giddings 1973:172). Giddings' date of 2258 ±230 (C-505) C-14 B.P. (Arnold and Libby 1951) from a housepost from the Hillside site further convinced Collins that the Hillside material represented an earlier and simpler form of the Old Bering Sea culture (Collins 1937:40-56; Giddings 1973:172).

In 1929 Geist began excavations at Kukulik, where he worked for the next six years. Geist documented the presence of artifacts in the Kukulik mound decorated in Old Bering Sea and Punuk styles, as well as harpoon heads that stylistically resembled those identified as Birnirk, Ipiutak and Thule. Ivar Skarland and Louis Giddings continued excavating at Kukulik in 1937 and 1939.

Since 1937, researchers investigating archaeological sites on St. Lawrence Island and the Bering Strait coast used Collins' chronology as the basis for interpretation of artifact variability and/or chronology (Geist and Rainey 1936; Rainey 1941; Larsen and Rainey 1948; Collins 1954; Ford 1959; Ackerman 1961, 1962; Bandi 1969; Stanford 1973; Bradley 1974; Crowell 1984; Staley 1994). Any interpretation that includes a classification of harpoon heads as part of the analysis (Geist and Rainey 1936; Rainey 1941; Larsen and Rainey 1948; Ford 1959) refers to Collins' seriated stylistic classification as if it reveas a chronological sequence of cultures. Larsen and Rainey (1948) and Ford (1959) correlate cultures through trait list comparisons, and interpret harpoon heads as temporal indicators of a lineal cultural sequence from Okvik through Old Bering Sea, Punuk, Birnirk and Thule.

Gerlach and Mason (1992:65-66) question such a lineal interpretation of the temporal sequences based on calibration of radiocarbon dates from St. Lawrence Island and other sites around the Bering Strait. Calibration of the radiometric record demonstrates a much greater overlap in dates from Old Bering Sea, Punuk and Birnirk sites than was apparent from the uncalibrated assays, suggesting a greater degree of contemporaneity among these occupations than was earlier appreciated. Gerlach and Mason (1992) also raise questions concerning the archaeological context of radiocarbon dates that have implications for the interpretation of the archaeological record.

Problem Statement

There are four problems central to the interpretation of the culture history of the occupations of St. Lawrence Island.

Problem 1: Collins' classification of St. Lawrence Island toggle harpoon heads does not account for Old Bering Sea, Punuk and undecorated closed socket forms. Collins grouped all harpoon heads into two major categories of open and closed socket, however, his chronology of harpoon head development only includes open socket forms. Collins' closed socket Types IV and V are found in all excavation units at all levels of the Mayughaaq mound archaeological site. Since they do not follow the patterns of distribution of the open socket form, Collins eliminated them from the chronology.

Problem 2: Collins' interpretation of a lineal relationship between Old Bering Sea and Punuk decorated artifacts is called to question by recalibration of radiocarbon dates suggesting some degree of contemporaneity among dates associated with the two decoration styles (Gerlach and Mason 1992).

Collins' has never dated or described the Punuk "type" site on which he based his identification of Punuk culture. His proposed relationship between Old Bering Sea and Punuk culture is based on shared stylistic elements among decorated objects and a comparison of overall trait lists. Collins interpretation of the stratigraphic relationship between Old Bering Sea and Punuk decorated materials in the Mayughaaq mound suggests a linear relationship, but the mixed stratigraphy of the site makes such interpretation equivocal.

Problem 3: The relationship between Birnirk harpoon heads and Old Bering Sea and Punuk harpoon heads on St. Lawrence Island has never been adequately explained.

All archaeologists working with materials from St. Lawrence Island note the presence of harpoon heads stylistically identified with those from the Birnirk site at Point Barrow on the Alaska mainland (Collins 1937, 1954; Geist and Rainey 1936; Larsen and Rainey 1948; Ford 1959; Ackerman 1961, 1962; Bandi 1964; Bradley 1974; Crowell 1984; Staley 1994). Collins suggested that the Birnirk points represented an intrusive presence in the St. Lawrence Island sites, though he considered Birnirk culture to have risen from an Old Bering Sea base (Collins 1937:379). Ackerman, in his 1958 excavation at S'keliyuk on St. Lawrence Island, found Birnirk harpoon heads, although fewer in number, associated with Punuk decorated artifacts throughout the site (Ackerman 1961:58-67). For Ackerman, Birnirk points represent a "trait element diffusion" with Punuk acting as the recipient culture (Ackerman 1962).

Birnirk has always been assumed to represent a distinct cultural occupation of the Point Barrow area, despite continual association in style, raw material and form with Old Bering Sea and Punuk decorated artifacts. (Collins 1937; Geist and Rainey 1936; Larsen and Rainey 1948; Ford 1959; Ackerman 1961). The apparent contemporaneity of Old Bering Sea and Punuk suggested by calibrated radiocarbon dates (Gerlach and Mason 1992) also suggests a much closer relationship between Birnirk and the other St. Lawrence Island "cultures."

Problem 4: The relationship among the Okvik material from Punuk Island, the Old Bering Sea decorated material from St. Lawrence Island and the Hillside material from the Hillside site near Gambell has never been established stratigraphically or temporally.

The problems associated with interpretation of the culture history of the Bering Strait are addressed through an understanding of temporal and geographic relationships among archaeologhical sites revealing evidence interpreted as Okvik, Old Bering Sea, Birnirk, Punuk, Ipiutak and Thule cultures.

In this paper I critically analyze Collins' stratigraphic analysis and stylistic classification of artifacts from the Gambell archaeological sites. I reconstruct the stratigraphy of the Mayughaaq mound from Collins' original data and compare Collins' interpretation of the site with my reconstruction. Using exisitng collections from the University of Alaska Museum, I derive a typology of harpoon heads from the Kukulik and Okvik sites on St.

Lawrence Island and Punuk Island, based on functional elements of the artifact.

From my typology, I propose the presence of two culture groups, the Old Bering Sea/Birnirk group and the Okvik/Ipiutak group, that occupied St. Lawrence Island from approximately cal A.D. 300 to the 1878-79 epidemic that decimated the island's population. I demonstrate influences from both groups in the functional elements of the harpoon heads Collins described as characteristic of the Punuk culture. From this evidence I propose that Punuk is not a separate culture unit but is instead a continuation and amalgamation of the two occupations of St. Lawrence Island.

Methods

Ideally, I would approach the three problems proposed above with a systematic, problem-oriented excavation and interpretation of remaining midden sites on St. Lawrence Island, using current methods of stratigraphic control and material analysis. However, this possibility is precluded by the historical Native practice of ivory digging in the mounds on St. Lawrence Island, which has largely compromised the stratigraphic integrity of the remaining archaeological sites. Issues of land ownership and access now complicate further excavation (Crowell 1984; Staley 1994).

Fortunately, large collections of material remains from earlier excavations on St. Lawrence Island and Punuk Island have been maintained in museums, including the University of Alaska Museum in Fairbanks. Study of these existing collections, and their accompanying documentation, helps to clarify the relationships among the occupations of St. Lawrence and Punuk Islands.

The material excavated by Collins on Punuk Island and St. Lawrence Island is at the Smithsonian Institution in Washington, D.C. While the artifacts and documentation from Collins' excavations are available for research, the logistics and expense of such an undertaking is beyond my capability for this study. However, Collins' excavations at the Gambell sites, particularly at the Mayughaaq mound, are documented in *Archaeology of St. Lawrence Island* (Collins 1937).

In this study, I use Collins' published documentation to reconstruct the stratigraphy of the Mayughaaq mound and to determine the spatial relationship among Collins' categories of Old Bering Sea and Punuk decorated harpoon heads. I investigate whether or not Collins' harpoon head categories correlate with patterns of vertical and horizontal occurrence of his harpoon head types in the Mayughaaq mound.

Geist's excavations at the Okvik site on Punuk Island and Giddings' excavations at the Hillside site are undocumented. Much of the Kukulik site documentation was destroyed in a fire in Geist's house in 1965 and is not included in documentation of the collections in the University of Alaska Museum. In the absence of detailed documentation for these sites, I concentrate on a statistical analysis of harpoon heads to formulate a typology based on structural and functional characteristics of the artifacts, with the purpose of exploring evidence for influences among the occupations of the islands.

In the course of this research, I observed and recorded data for 1525 harpoon heads from the Kukulik excavation, 83 harpoon heads from the Okvik site on Punuk Island and six harpoon heads from the Hillside site. I use Spaulding's Chi-Square technique to determine statistically significant occurrences of attribute combinations among the harpoon heads from the three sites. I then organize the resulting groups to form a typology of harpoon heads based on categories of variables with attribute combinations that are meaningful in terms of the structure of the raw materials and the functional elements of harpoon heads. From the typology of harpoon heads I trace the influence of the various occupations of St. Lawrence Island and their relationship to other occupations on the shores of the Bering Sea.

Observation of the collections from the Okvik site on Punuk Island suggests that the material other than harpoon heads bears a strong resemblance to Near Ipiutak material excavated by Larsen and Rainey at Point Hope (Larsen and Rainey 1948; Collins 1973:xxv). In order to date a sample from the Okvik site with as strong an association with Okvik material as possible, I selected a sample of ivory from the site with clear Okvik decoration.

The Hillside material presents a similar dating challenge. Existing dates are compromised by lack of context, complicated by an inability to accurately place dates from driftwood in a cultural context (Giddings 1952; Ackerman 1962; (Gerlach and Mason 1992). To this end, I selected samples of carved ivory from the site for radiocarbon dating, which, although undecorated, at least have a cultural association.

I use the combination of harpoon head typology and C-14 dates to infer cultural and temporal relationships among the occupations of St. Lawrence Island and the Punuk Islands represented by Hillside, Old Bering Sea, Punuk and Birnirk harpoon head styles.

Organization

Chapter 2 presents a background of archeological investigation of sites on St. Lawrence and Punuk Islands. I present descriptions of the sites of Mayughaaq, Hillside, Kukulik, S'keliyuk and the two Punuk Island sites. I critically evaluate Collins' classification of St. Lawrence Island toggle harpoon heads, since this is central to all subsequent attempts to develop a culture history for the region. In Chapter 3, I reconstruct the stratigraphy of the Mayughaaq site from Collins' data and compare my reconstruction with Collins' interpretation of the temporal relationship between harpoon head categories.

Chapter 4 presents the historical development of classification theory to its most recent expression. Chapter 5 presents a structural analysis of ivory, bone and antler, the raw materials of harpoon heads. I emphasize similarities and differences in the characteristics of the materials and the part the structural characteristics of the raw material plays in the design and function of the artifact. I propose that the attributes of socket design and blade orientation are a function of raw material structure, rather than stylistic variation. Based on this understanding of the structure and function of toggle harpoon heads, I identify the functional elements of harpoon heads to be used in the typology derived in Chapter 6.

In Chapter 6, I apply current classification theory to the derivation of a typology of toggle harpoon heads from St. Lawrence Island and the Punuk Islands based on the functional elements identified in Chapter 5. I introduce the concept of functional strategies as an approach to the interpretation of the typology to explain relationships among culture units on St. Lawrence Island and Punuk Island during the past 1500 years.

In Chapter 7, I discuss the history of radiocarbon dating of materials from St. Lawrence Island and other Alaskan sites. I identify problems of context, precision and accuracy that have clouded understanding of temporal relationships among these sites and our interpretation of the culture history of the Bering Strait. I present a summary of date ranges obtained from sites in the Bering Strait region and propose a chronology of occupation of the region.

Chapter 8 presents the implications of my functional typology of harpoon heads in terms of Collins' 1937 classification and his proposition of cultural continuity between Old Bering Sea and Punuk cultures.

Chapter 9 summarizes key points leading to the conclusions that address the four problems identified above. I present a culture history of St. Lawrence Island that reinterprets the lineal relationships among Okvik, Old Bering Sea, Punuk and the materials from the Hillside Site near Gambell. I propose an occupation of St. Lawrence Island by two culture groups, identified by Collins as Old Bering Sea/Birnirk and by Collins, Geist and Giddings as Okvik/Ipiutak. I reinterpret Collins' Punuk culture as a combination of influences from the two culture groups demonstrated by combinations of functional strategies in my harpoon head typology.

Chapter 2 - ST. LAWRENCE ISLAND ARCHAEOLOGY

The Setting

St. Lawrence Island is a Beringian remnant located in the Bering Sea approximately 200 kilometers southwest of Nome, Alaska, and 64 kilometers southeast of the Chukotsk Peninsula of eastern Siberia (Figure 1). The island is approximately 160 kilometers long and from 32 to 64 kilometers wide. Volcanic in origin, the island is composed of rugged mountains, with marshy streams and small lakes and bogs dominating the eastern coasts, and basalt cliffs lining the western shore. Several large harbors are protected by gravel spits, creating bodies of water of low salinity, and in the case of Gambell, resulting in a landlocked freshwater lake.

The weather on St. Lawrence Island is generally windy and cold. The island is surrounded by sea ice throughout the winter, though variable open leads and polynyas, ice free areas produced by persistent winds and upwelling ocean currents, cause this to be a particularly advantageous location for sea mammal hunting (Gerlach and Mason In Press).

The Siberian Yupik inhabitants of St. Lawrence Island live year-round in two main villages (Figure 1): Gambell (Sivuoqoq), on Northwest Cape, and Savoonga, about midway along the northern coast of the island. The island residents were once scattered in numerous villages along the coast, but the survivors of the 1878-79

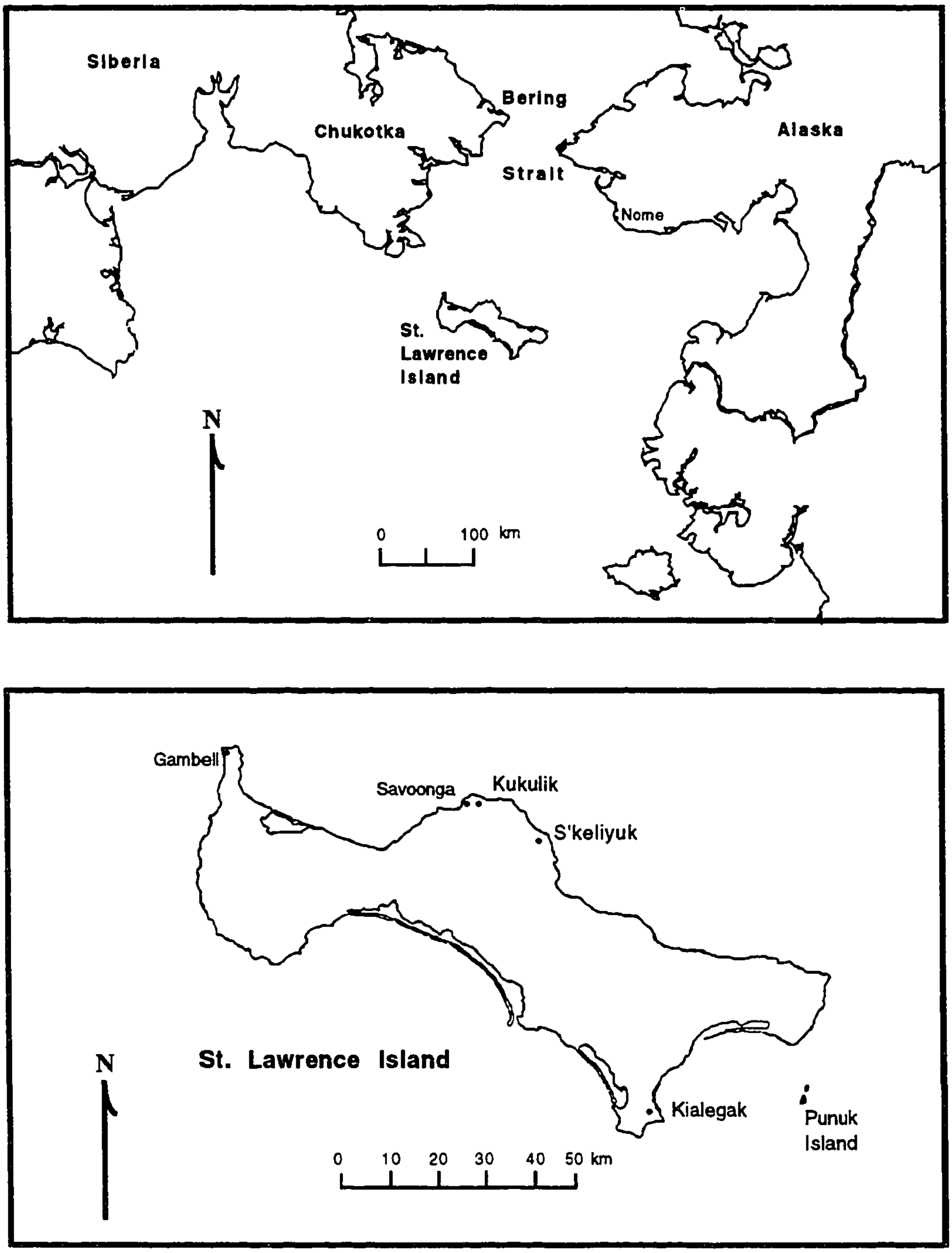

Figure 1 - St. Lawrence Island

famine/epidemic moved to Gambell (Sivuoqoq) (Hooper 1881). In 1915, Savoonga was established as a reindeer station in an attempt to provide an alternative economy for families heavily impacted by the sudden population reduction (Hughes 1960). Modern subsistence activities include hunting for whales, seals and walrus. Although residents of the island have depended for many years on sale of ivory dug from the mounds along the coasts (Staley 1994), this practice is now strongly discouraged by elders in Gambell and Savoonga (Ellanna personal communication, April 1995).

History of Anthropological Investigation

St. Lawrence Island was sighted and named in 1728 by Vitus Bering during his first expedition from 1725 to 1730 . Although a landing party did visit the island, crewmen did not contact the inhabitants (Collins 1937:16). Otto von Kotzebue visited the western shore of St. Lawrence Island in July of 1816 and explored the eastern shore in July of 1817.

There is no further account of visitations to the island until the trip of the US. Revenue Steamer *Corwin* in 1880. Commander C.L. Hooper observed and described the effects of the 1878-1879 famine that killed up to two-thirds of the island's inhabitants (Burgess 1974; Ellanna 1983). Hooper (1881) attributed the cause of the disaster to the debilitating effects of alcohol, which prevented the hunters from walrus hunting at a critical point in time. Subsequent ethnohistorical research casts doubt on the total truth of this claim, though it cannot be denied that alcohol acquired from whaling ships may have been a contributing factor in one or more villages (Muir 1917; Moore 1923; Giddings 1973; Burgess 1974; Ellanna 1983; Geist n.d.). The *Corwin* returned in 1881, bringing E.W. Nelson and John Muir, who recorded their observations of the effects of the famine and collected numerous ethnological and natural history specimens (Nelson 1899; Muir 1917).

Dr. Riley Moore, working for Ales Hrdlicka of the United States National Museum, conducted the first anthropological observations at Gambell in 1912. Moore recorded anthropometric data of the living residents of the village and collected and measured 180 crania from graves in the Northwest Cape area (Moore 1923).

Ales Hrdlicka visited Savoonga in 1926, where he purchased decorated ivory artifacts from residents who had dug them from the mound at Kukulik 3 miles to the east (Hrdlicka 1943). Hrdlicka noted the similarity of the decorative style of these artifacts to materials he had purchased on Little Diomede Island (Hrdlicka 1930).

Otto Geist purchased ethnological and archaeological specimens from Savoonga residents in 1926, as part of an Alaska College and School of Mines collecting expedition throughout western Alaska (Keim 1969). On the basis of a deeply patinated, Punuk decorated harpoon head (UA Museum Accession # 0282), Geist convinced Charles Bunnell, President of the Alaska College and School of Mines, to fund the Bunnell-Geist Bering Sea Expedition to

St. Lawrence Island for the years 1927 through 1929 (Keim 1969:107).

During the years 1927 through 1939, Geist and Froelich Rainey purchased considerable amounts of archeological and ethnological material from the residents of Savoonga and Gambell for the Alaska College and School of Mines, encouraging a market for carved ivory that continues to this day (Staley 1994).

Archaeological Sites on Punuk and St. Lawrence Islands

Punuk Islands

Punuk Site

Collins conducted his first excavation in the St. Lawrence Island area on Punuk Island in 1928 (Collins 1937:29-30). In a two month project, he excavated an occupation site at the western end of the largest of the Punuk Islands (Figure 2), recovering an extensive collection of artifacts decorated in what he named the Punuk style, as well as a few Old Bering Sea decorated artifacts and numerous recent materials.

This site, which was to become the “type site” for the Punuk style, has never been fully reported, restricted only to brief descriptions in Collins’ publications (Collins 1929:14-18; 1937:27-31; 1954:73-75). Other than general observations of the site in

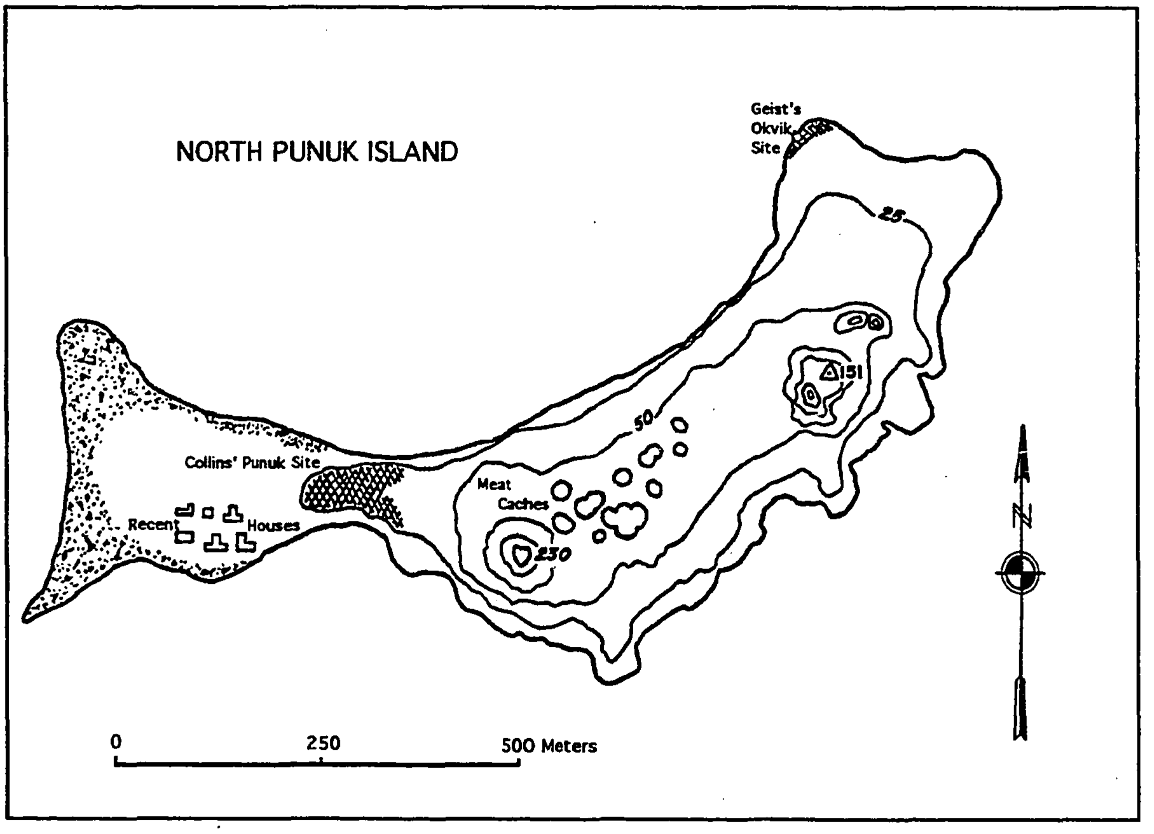

Figure 2 - Archaeological sites on Punuk Island

these references, there exists no description of the site stratigraphy or of the provenience of the artifacts recovered. There are no published illustrations of the harpoon heads found nor of the decorative style Collins originally identified as Punuk.

Okvik Site

In 1934, Otto Geist and Froelich Rainey (1941) excavated a site on the same Punuk Island, which they initially called the Old Punuk site. The site consisted of an occupation mound that was being eroded by the sea on one face. During a single season of poorly controlled excavation, Geist recovered approximately 1400 artifacts, many of which were carved in an elaborate decorative style unlike any encountered previously on St. Lawrence Island. Among these were 82 harpoon heads, all but one of which are carved of ivory (Figure 3).

Rainey (1941:467) refers to the site and the artifact style as Okvik for the first time, from the Siberian Yupik word for "many walrus hauled up on land," to avoid confusion with Collins' Punuk site excavated in 1928. Rainey described the harpoon heads and other artifacts from the site and presented a simple descriptive classification of the artifacts modeled after Collins' 1937 stylistic classification.[1]

Figure 4 is a plan view of the site from Geist's notes showing its location on the eroding beach face. Figures 5 and 6 are three vertical cross sections of the mound from Geist's notes. Note that Geist did not excavate into frozen soils at the base of the mound and therefore did not penetrate into lower levels of the site, if any existed. No provenience data from this excavation have survived. The

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[1] Although the Okvik site was never fully described, Geist's original field notes are maintained in the University of Alaska Fairbanks Archives.

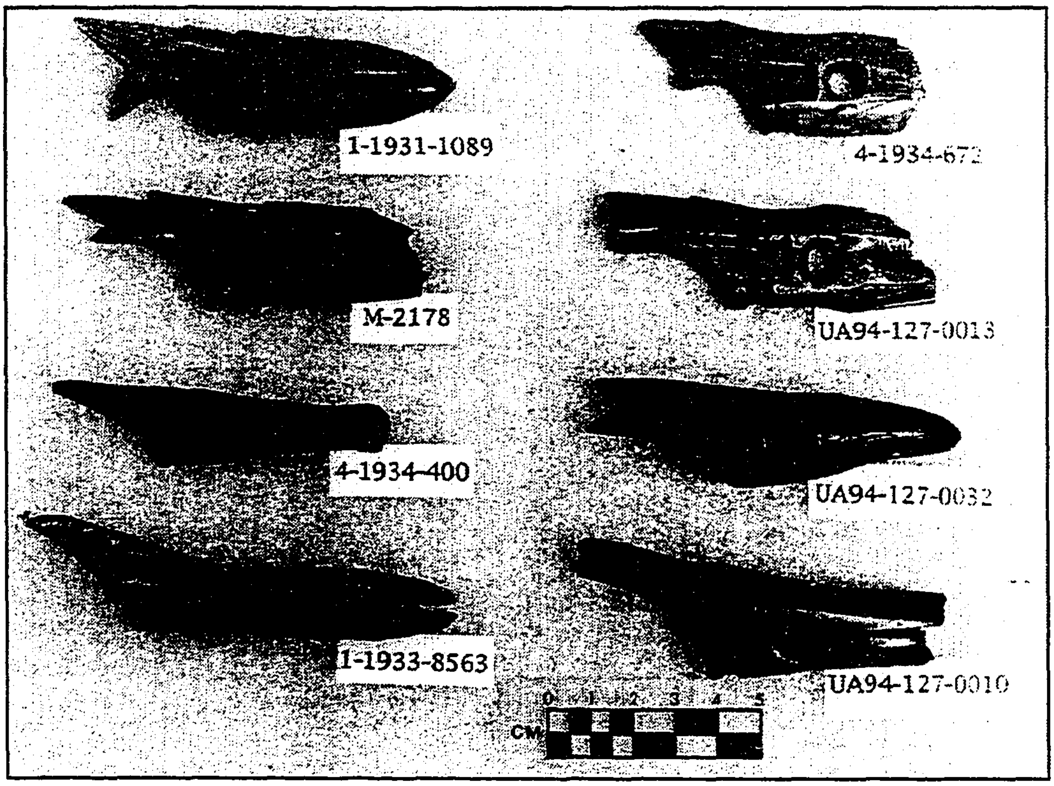

Figure 3 - Harpoon Heads from the Okvik Site

collections from the excavation have never been analyzed and the artifacts were not fully accessioned into the University of Alaska Museum collections until discovered in 1994 as part of this research.

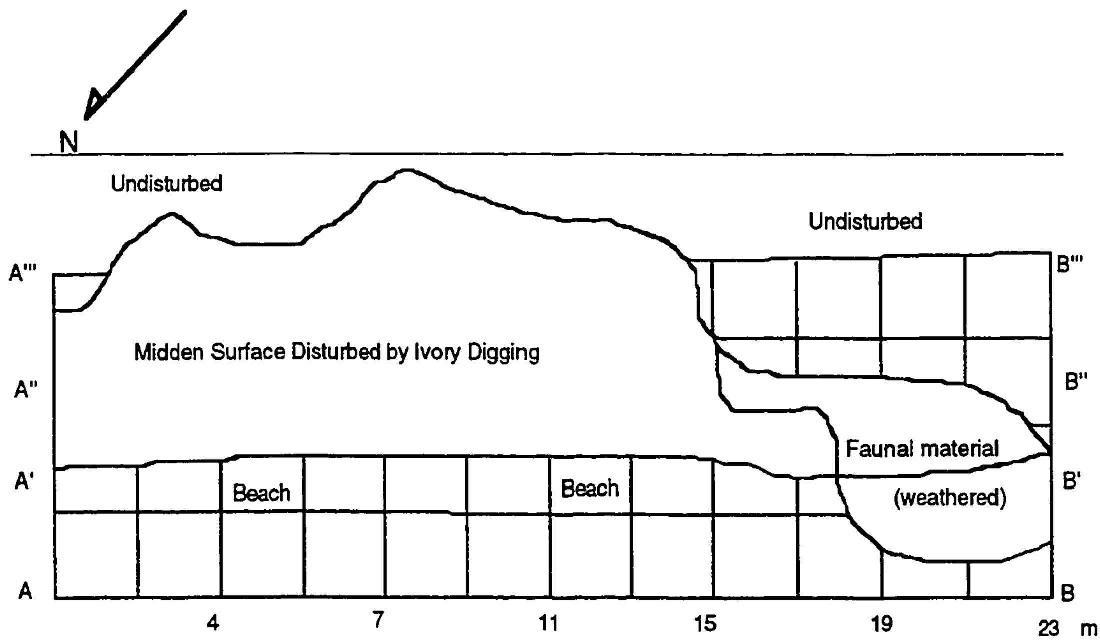

Figure 4 - Plan View of Okvik Site

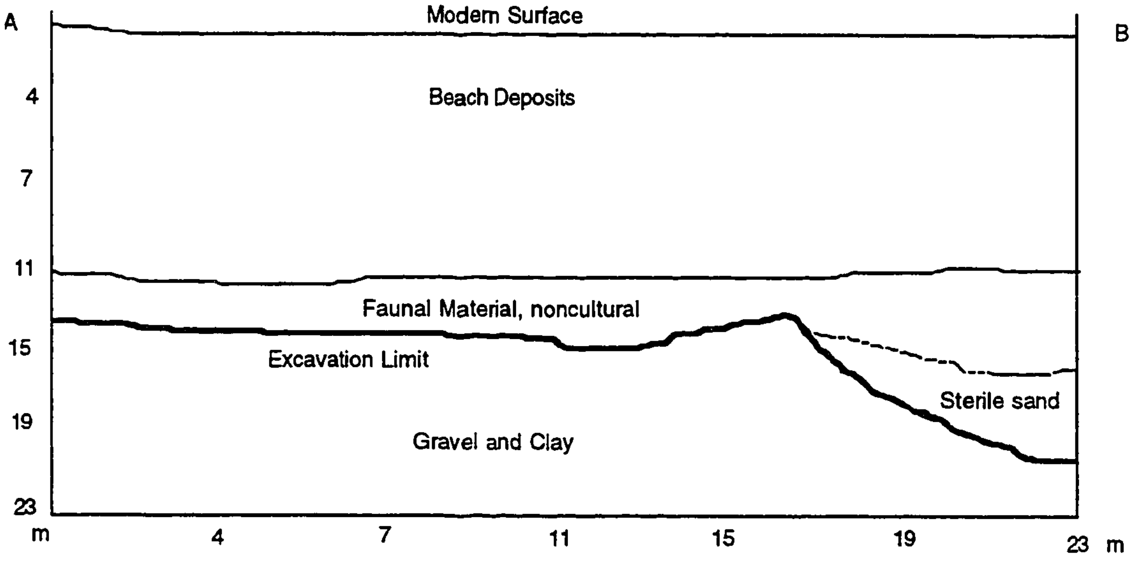

Figure 5a - Okvik Site Cross-Section, A - B

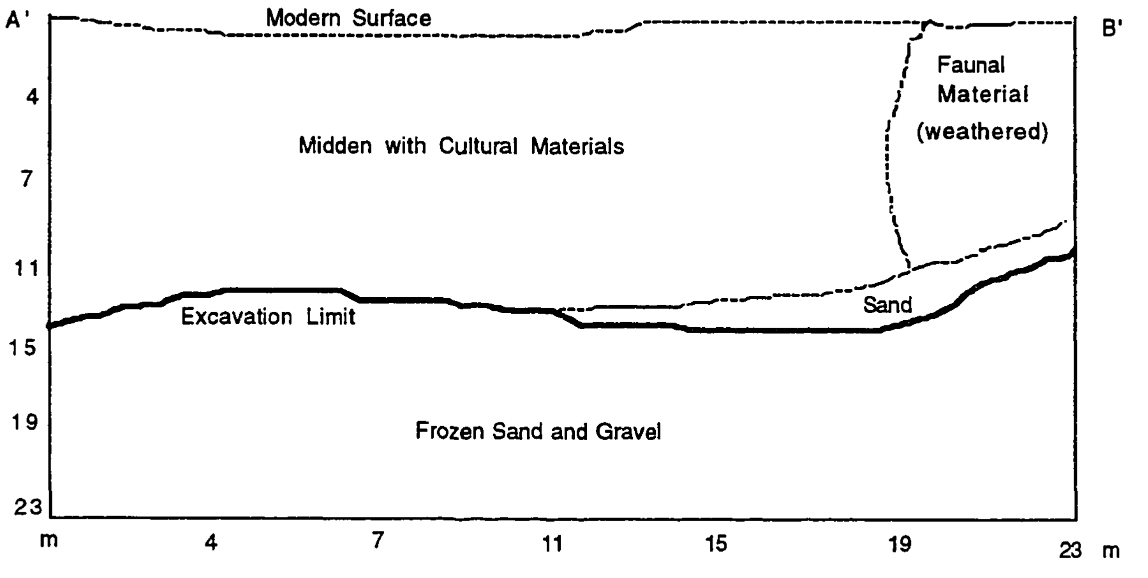

Figure 5b - Okvik Site Cross-Section, A' - B'

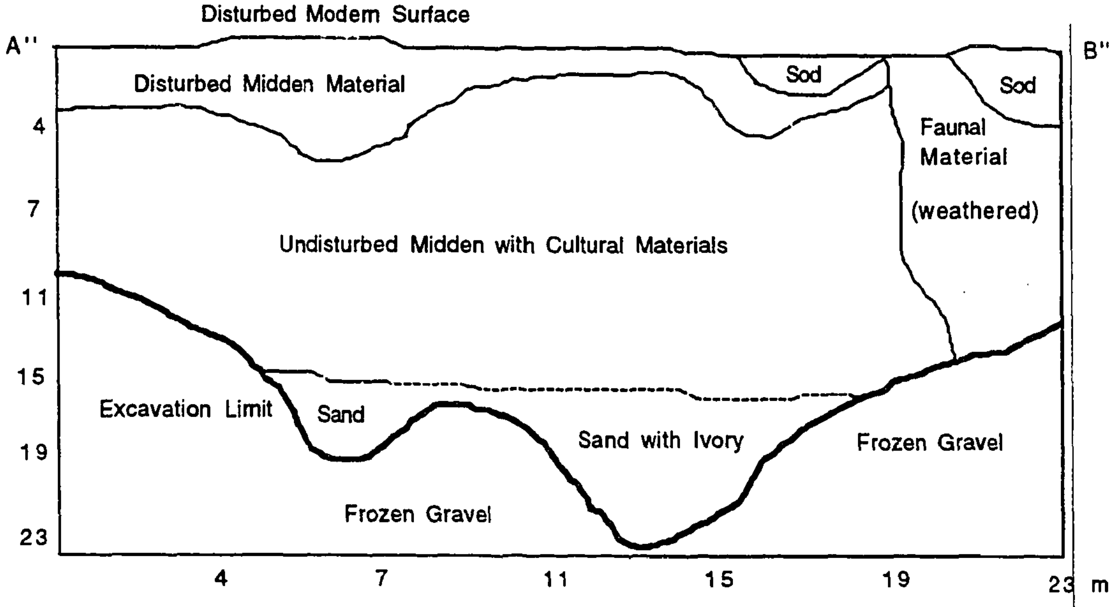

Figure 6a - Okvik Site Cross-Section, A'' - B''

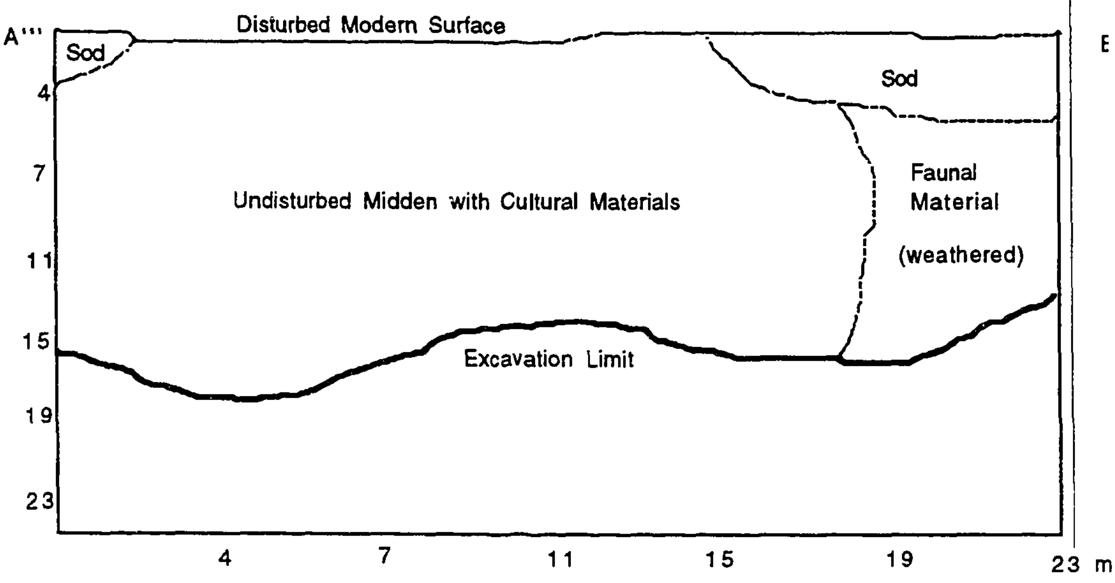

Figure 6b - Okvik Site Cross-Section, A''' - B'''

Archaeological Sites In the Gambell Area

Archaeologists working on St. Lawrence Island favored several sites in the vicinity of the modern village of Gambell for two primary reason: (1) the abundance of cultural materials in these easily accessible midden sites; and (2) their location in a gravel beach ridge formation suggestive of a relative temporal sequence (Collins 1937:33-35; Giddings 1973:16-17; Mason and Ludwig 1990).

Collins worked in five locations in the Gambell area (Figure 7): (1) the old section of Gambell village; (2) Siqlugaghyaget[2] (Seklowaghyaget), adjacent to Old Gambell; (3) Mayughaaq (Miyowagh), a mound located at the base of Sivuoqoq Mountain on the beach ridge farthest but one from the modern shoreline; (4) Ayveghyaget (Ievoghiyoq), a mound with house pits located on an erosional discontinuity 200 m north of the Mayughaaq mound; and (5) the Hillside Site, located on the rocky slope of Sivuoqoq Mountain overlooking the beach ridge plain.

Old Gambell

Collins excavated two house structures at Old Gambell, an extension of the present village of Gambeil that intersects with the Siqlugaghyaget mound at the north end of Troutman Lake (Figure 2, page 31). Artifacts recovered include numerous metal objects as well as harpoon heads of the same style as those used by modern

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[2] All site name spellings are from Crowell 1984 and verified by the University of Alaska Fairbanks Alaska Native Language Center. Names in parentheses are from Collins (1937).

inhabitants of St. Lawrence Island. Collins concludes that the houses at Old Gambell were occupied at the time of the 1878 famine (Collins 1937:189-192).

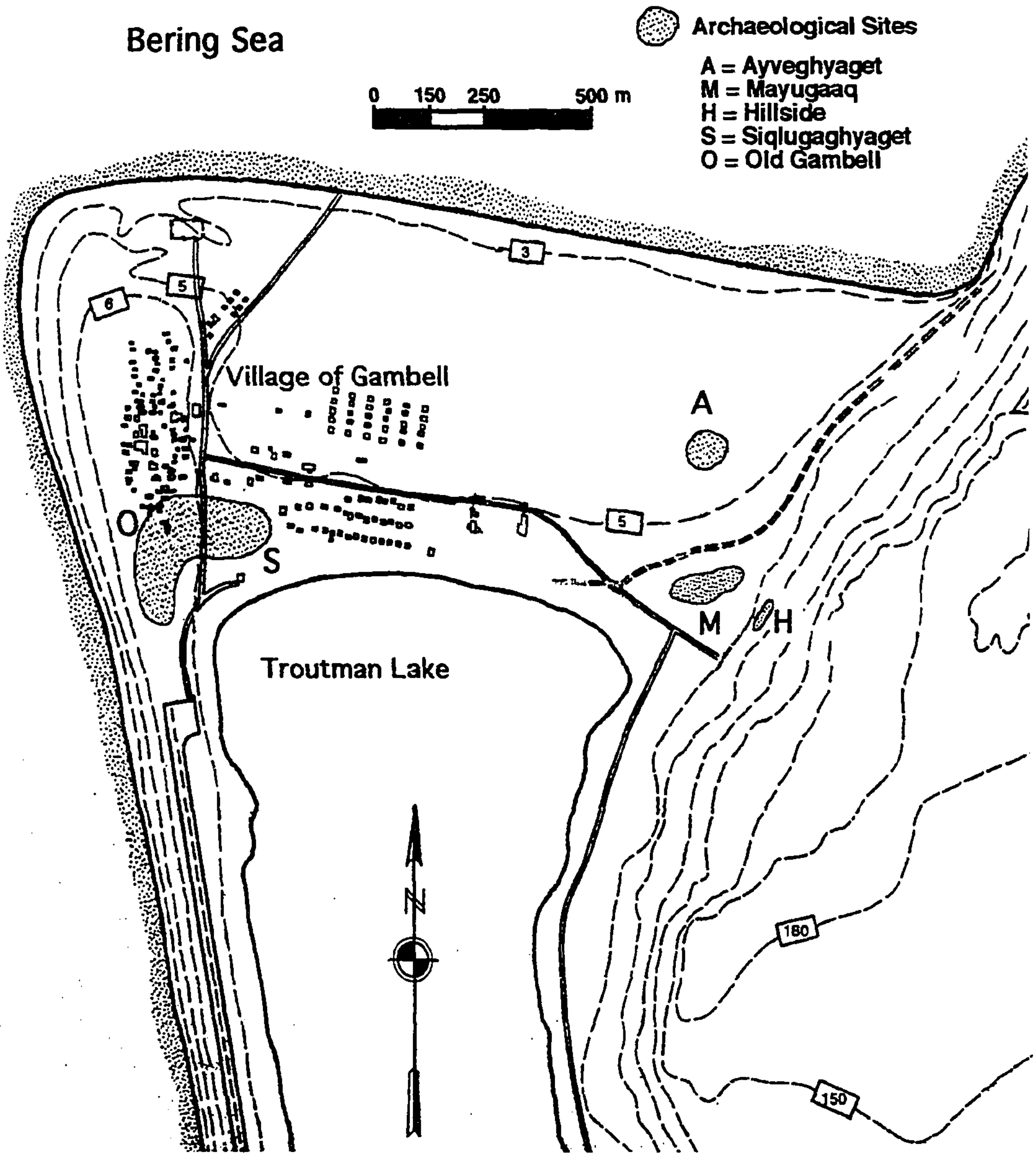


Figure 7 - Archaeological Sites in the Gambell Area

Siqlugaghyaget

Siqlugaghyaget is a crescent-shaped mound approximately 40 m wide by 200 m long that intersects with the Old Gambell site at the south end of the present village of Gambell (Figure 7). Collins dug four 3.7 m square excavation units in 1930 and Chambers dug three units in 1931, ranging in depth from 1.3 to 1.7 m below the surface. Collins reports one house structure in these excavations that contained six human burials.

Collins interpreted the contents of the house and of the mound in general as that of an eighteenth century occupation (Collins 1937:186-189).

Ayveghyaget

The Ayveghyaget mound is located 200 m north of the Mayughaaq mound on the gravel plain east of the present village of Gambell (Figure 7). In 1930 the mound was approximately 46 m in diameter, and less than 2 m in depth.

Collins excavated seven 3.7 m square units at Ayveghyaget in 1930, and Chambers completed two excavation units in 1931. Collins also excavated House 6 at the north end of the mound and Ford excavated House 7 at the south end.

Collins concluded that all of the material from the Ayveghyaget site is Punuk of a slightly different style than that found in the Mayughaaq mound. He interpreted the different decorative style and the placement of the mound closer to the modern shoreline than the Mayughaaq mound as evidence that the Ayveghyaget site is younger than the Mayughaaq site (Collins 1937:42).

Although Collins included data from the Ayveghyaget mound in his analysis of harpoon heads and decorative styles, he did not include a detailed description of the excavations, as he did for the Mayughaaq mound.

Hillside Site

In 1931 Collins excavated at the Hillside site, located on the slope of Sivuoqoq Mountain overlooking the gravel plain at Gambell (Collins 1937:36-56). He describes two house pits in very shallow soil, both disturbed by probable rockfall from the upper slope. Collins found eight artifacts under the floor stones of these houses, decorated in a style he considers simpler and more generalized than the Old Bering Sea style he found on Punuk Island. Collins calls this decorative style "Old Bering Sea I" to distinguish it from the two other styles of Old Bering Sea decoration referred to as Old Bering Sea II and Old Bering Sea III (Collins 1937:40). Figure 8 illustrates five of the six harp[oon heads excavated by Giddings at the Hillside site.

In 1939 J. Louis Giddings excavated a third house floor at the Hillside site. This excavation has never been reported in the literature, apart from a brief description by Rainey (1941) in his

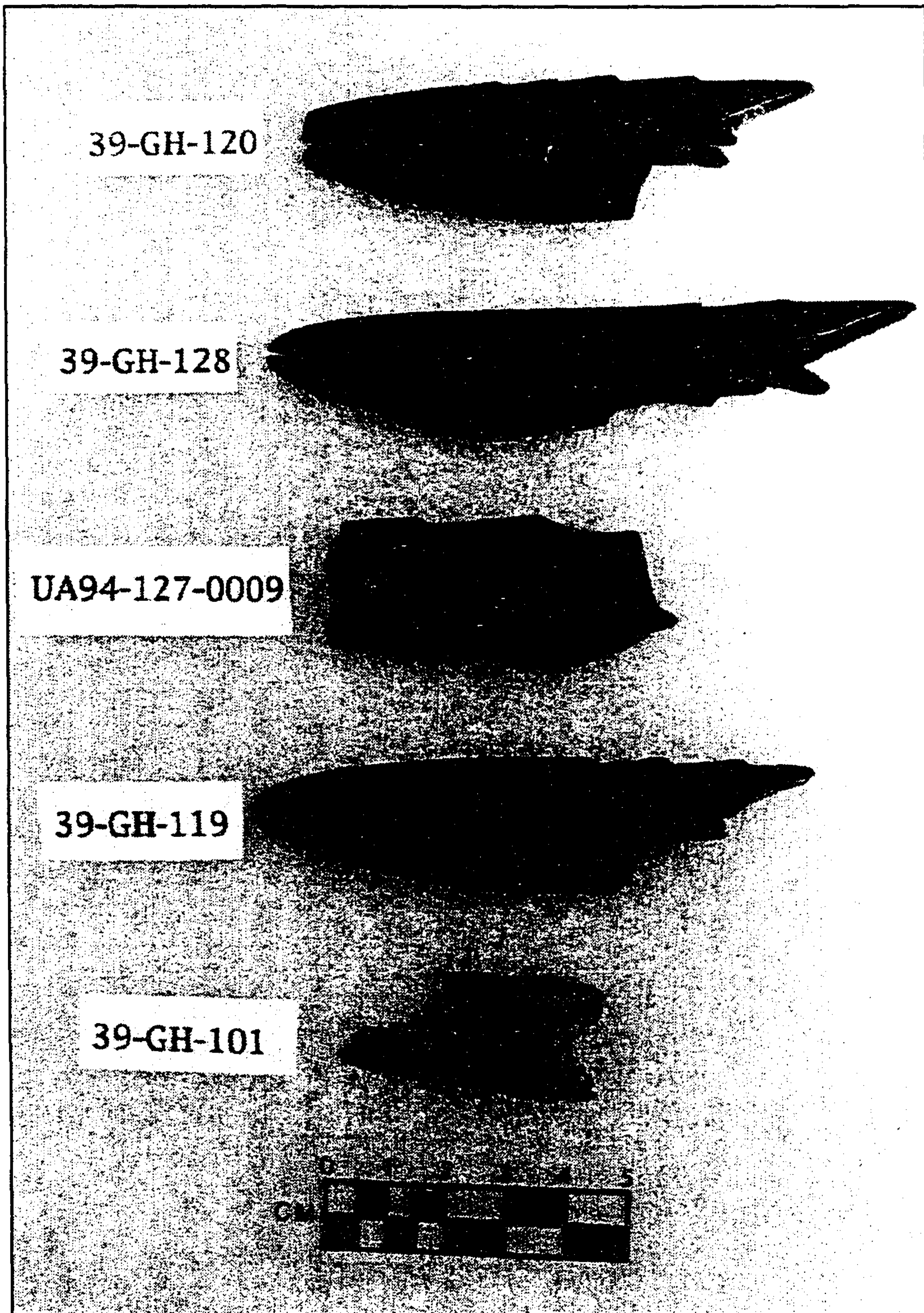


Figure 8 - Harpoon Heads from the Hillside Site

report on the Okvik site on Punuk Island, where he described the excavation and the artifacts recovered. Rainey described ten artifacts with engraved designs, comparing them to his harpoon head types A and B from the Okvik site, illustrated in his Figures 5 and 6 (Rainey 1941:478-481). However, the Hillside artifacts are not pictured in these illustrations and are not illustrated in Rainey's publication.

Rainey and Collins both refer to Giddings' excavation as the Okvik House and identify the materials as Okvik (Collins 1954; Rainey 1941). However, Giddings himself denied the connection between Okvik on Punuk Island and the Hillside house he excavated in 1939.

> "It is clear that the individual, engraved pieces from my Hillside house and from the Punuk Island site would never be mistaken for one another" (Giddings n.d.)

Mayughaaq

Since the Mayughaaq mound (Figure 3) contains cultural materials decorated in both Old Bering Sea and Punuk styles and is reported in detail in *Archaeology of St. Lawrence Island*, I will describe and analyze this site in detail. I will later use these data in a reconstruction of the stratigraphy of the site and a critical analysis of Collins' harpoon head classification and chronology.

Mayughaaq translates as “the climbing up place” in Siberian Yupik, the language of the current residents of St. Lawrence Island (de Reuse 1994), referring to its proximity to Sivuoqoq Mountain overlooking the gravel plain. Mayughaaq consists of a roughly oval mound of midden material, approximately 160 m long by 60 m wide, at an elevation of 5 to 6 m above mean sea level and rising less than 1.5 m above the gravel plain (Crowell 1984). At the time of Collins' excavations, beach gravel covered up to 1 m of the lower limits of the mound (Collins 1937). Extensive depressions on the surface of the mound indicate locations of modern ivory digging and a few recent house pits (Crowell 1984:43-45).

Figure 9 is a plan view of the Mayughaaq Mound as excavated by Collins and his assistants, James A. Ford and Moreau B. Chambers. Collins located his excavation units in areas of the mound with pits or surface debris that indicated the presence of prehistoric house pit locations, with no attempt at systematic sampling. Excavation was slow and laborious because of the permanently frozen midden material. In addition to identifiable artifacts, Collins encountered large quantities of faunal material mixed with pottery sherds, stones and other debris. Collins noted occasional shell lenses but did not note their provenience in his publication.

Collins' excavation units consisted of 3.65 m by 3.65 m squares and were numbered in order of their excavation. Each cut was excavated in 5 to 15 cm levels, the thickness of the level determined by the nature of the midden material and the time

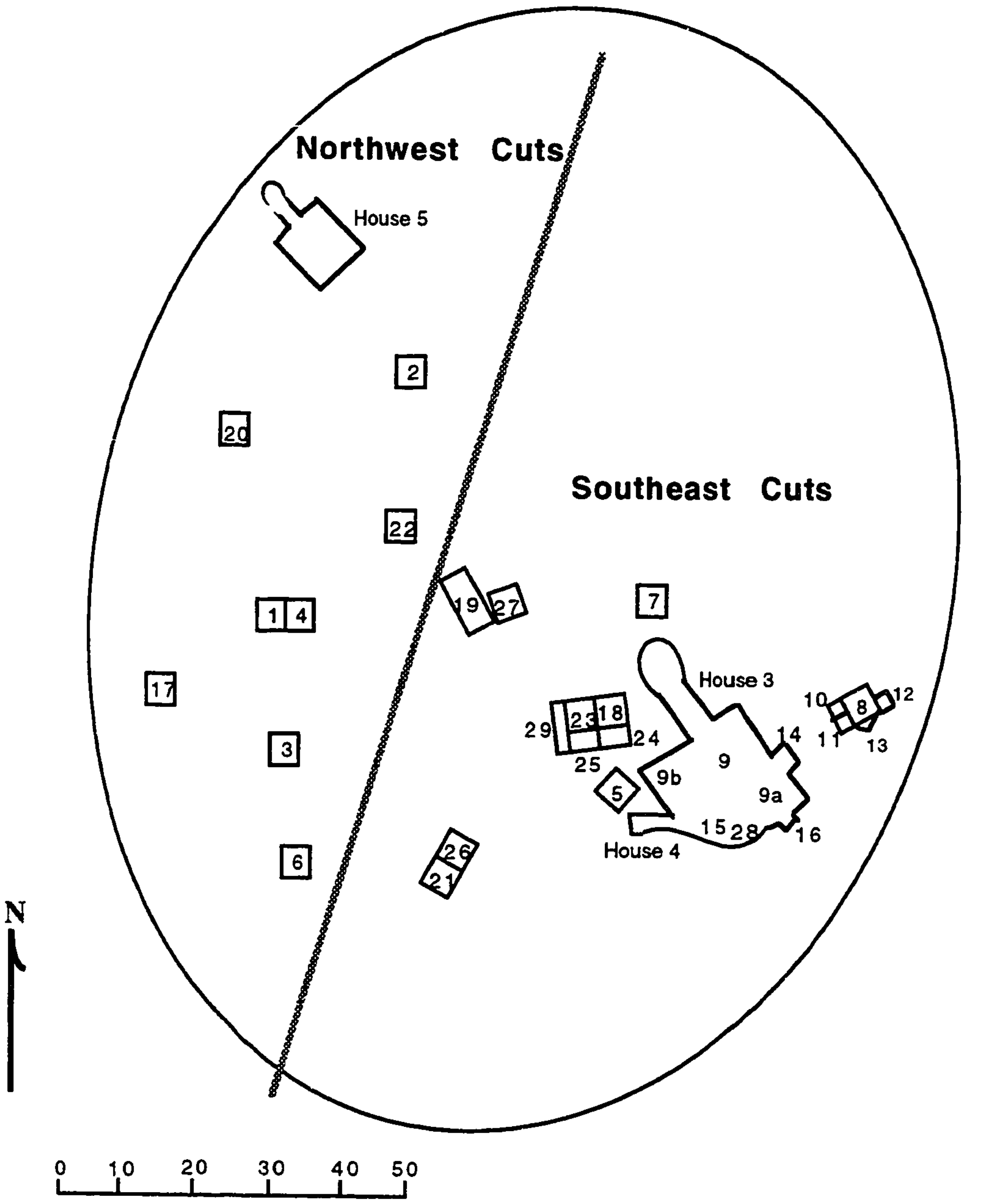


Figure 9 - Plan View of Mayughaaq Mound

necessary for it to thaw. If excavation units revealed house structures, Collins enlarged the excavation to expose the house limits rather than follow arbitrarily measured excavation units. This practice resulted in overlapping excavation boundaries and confusion in provenience data. In four units with no discernible house structures, excavations were continued to sterile gravel at the base of the mound.

Collins recorded three houses in the Mayughaaq mound, numbered House 3, 4 and 5. Although Collins numbered all the houses in the Gambell mounds consecutively in order of their discovery, he does not describe Houses 1 and 2. Collins designates excavation units 1, 2, 3, 4, 6, 17, 20, 22, and House 5 as the northwest cuts and units 5, 7, 8, 9, 9a, 9b, 10, 10a, 11, 12, 13, 14, 15, 16, 18, 19, 21, 22, 23, 24, 25, 26, 28, and 29 the southeast cuts (Collins 1937:58) (See also Table 1).

Collins measured all provenience data from the surface of the mound at the point of each test cut, but he made no reference to an external datum. Consequently, total depth of each unit varies as a function of the varying thickness of the mound. Depth to features within the units varies as a function of the surface topography.

Table 1 presents data from each of the 29 excavation units in the Mayughaaq mound described in *Archaeology of St. Lawrence Island* (Collins 1937:58-69) and shown in Figure 9. Dimensions of each unit are presented as length, width and depth in meters below the surface. The number of artifacts includes only whole artifacts and diagnostic fragments described by Collins. The description includes cultural and stratigraphic features and the general decorative style of harpoon heads and other artifacts. The number of levels for each unit is noted, but thickness of each level is not reported by Collins.

Cut No.	Dimensions L X W X D (m)	Number of Artifacts	Description
1	3.6 X 3.6 X 1.6	198	10 levels. 0.5 m gravel layer at top, cultural material at 0.8 m, Punuk decoration
2	3.6 X 3.6 X 1.3	85	10 levels. 0.5 m gravel layer at top, cultural material at 0.9 m; 4 Punuk, 1 OBS decorated harpoon heads
3	3.6 X 3.6 X 1.5	238	11 levels. 0.4 m gravel at top, 2 Punuk, 2 OBS harpoon heads
4	3.6 X 3.6 X 1.7	195	11 levels. 0.5 m gravel layer at top, all Punuk
5	3.6 X 3.6 X 1.2	68	6 levels, bottom not reached. Cultural material at 0.7 m
6	3.6 X 3.6 X 1.4	98	8 levels. Cache with organic material from 0.7 to 1.3 m, 1 OBS and 1 Birnirk artifact
7	3.6 X 3.6 X 2.5	235	14 levels. House structure 1.8 to 2.2m, 5 OBS, 2 Punuk artifacts
8	3.6 X 3.6 X 1.8	68	7 levels. Meat cache and wall of whale bones, 3 OBS decorated objects
9	8.0 X 9.2 X 1.2	294	3 levels. House 3, 0.6 m gravel layer at top, stone floor at 1.2 m. Punuk objects on and above the floor, OBS objects outside the log walls

Table 1 - Mayughaaq Mound Excavation Units

Cut No.	Dimensions L X W X D (m)	Number of Artifacts	Description
9a	3.0 X 3.6 X 1.5	69	Extension of Cut 9. House structure with floor stones at 1.5 m, all objects with OBS decoration. Human burial at 1.2 m depth at back of House, covered with skin parkas. Objects found nearby but not directly associated with skeleton.
9b	1.8 X 1.2 X 0.8	103	Adjoining Cut 9. Cache with whale skull walls, 1 OBS decorated harpoon head
10 11 12 13	1.8 X 1.2 X 1.4 1.8 X 1.2 X 1.5 1.8 X 1.8 X 0.7 3.6 X 3.1 X 1.8 triangular X 1.5	162	Cut 10 - 7 levels, Cut 11 - 6 levels. Cut 12 - 1 level. Cut 13 - 5 levels. Four units described together. Stone house floors at 1.4 m and 1.5 m with associated posts and debris. 3 OBS decorated artifacts.
14	1.8 X 1.2 X 1.1	7	6 levels Specimens not described.
15	unknown X 1.5	86	Irregular excavation to uncover entrance to House 4. 4 OBS decorated artifacts.
16	1.8 X 0.6 X 1.3	55	8 levels to sterile gravel. 2 OBS decorated objects
17	3.6 X 3.6 X 0.9	153	3 levels in 1930; 3 levels in 1931; bottom not reached. Undecorated artifacts

Table 1 - Mayughaaq Mound Excavation Units

Cut No.	Dimensions L X W X D (m)	Number of Artifacts	Description
18	3.6 X 3.6 X 2.1	363	Cuts 18, 23, 24 , 25, 19 connected. 22 levels, OBS and Punuk artifacts. House structures "near the bottom."
19	5.5 X 3.6 X 2.2	514	22 Levels. House timbers at base. OBS and Punuk artifacts
20	3.6 X 3.6 X 1.0	115	5 levels, bottom not reached. 1 OBS harpoon, 15 Punuk objects
21	3.6 X 3.6 X 1.7	123	Connected with Cut 16. 13 levels. Cache and house structure at bottom. 4 OBS harpoon heads
22	3.6 X 3.6 X 1.2	91	6 levels. Artifacts not described.
23	1.8 X 3.6 X 2.1	285	17 levels. OBS and Punuk artifacts
24	1.8 X 3.6 X 2.1	187	12 levels. OBS and Punuk artifacts
25	1.8 X 1.8 X 2.5	179	13 levels. OBS (7) Punuk (2)
26	3.6 X 3.6 X 1.4	38	7 levels. Described with Cut 21
27	3.6 X 3.6 X 1.3	270	11 levels. Overlaps corner of Cut 19. Corner of structure at bottom. OBS and Punuk artifacts
28	No data	No data	No data
29	0.8 X 5.5 X 0.9	50	4 levels. Birnirk harpoon head

Table 1 - Mayughaaq Mound Excavation Units

Collins' Chronology for St. Lawrence Island

Collins produced a relative chronology of the occupation of St. Lawrence Island on the basis of a classification of toggle harpoon heads, emphasizing decorative styles and morphological characteristics. He combined data from vertical distribution, decorative styles and physical variables of the harpoon heads to produce a relative temporal sequence of technological variation, which he interpreted as evidence of culture change.

Harpoon Head Classification

Collins (1937:98) classified harpoon heads from St. Lawrence Island based on the morphology of six features (Figure 10): (1) the foreshaft socket; (2) lashing slot(s) or notch; (3) spur; (4) line hole; (5) presence or absence of lateral barbs or inset stone blades; (6) the anterior end, which may or may not have an end blade slot.

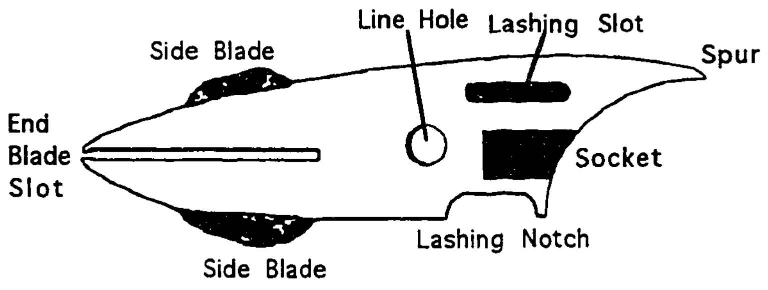


Figure 10 - Features of the Toggle Harpoon Head

Foreshaft Socket

Collins divided all harpoon heads into two categories of open and closed sockets. Open sockets are carved so that one side of the socket is open and the foreshaft is held in place with baleen lashing (Figure 11). Closed sockets are drilled into the solid ivory at the spur end of the harpoon head and do not require lashing to hold the foreshaft in place (Figure 12).

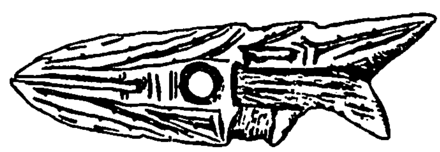


Figure 11 - Open Socket Harpoon Head

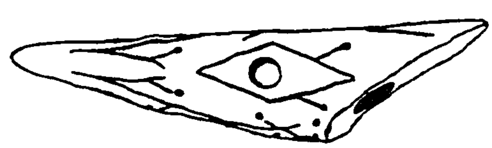


Figure 12 - Closed Socket Harpoon Head

Blade Orientation

Collins distinguished two additional categories of harpoon heads independent of socket design, based on the orientation of the side blade, barb or end blade to the line hole. Harpoon heads with the blades set parallel to the axis of the line hole are designated x, e.g. Type IIx (Figure 13), while harpoon heads with the blades set at right angles to the axis of the line hole are designated y e.g. Type IIy (Figure 14).

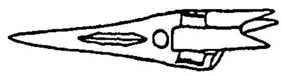


Figure 13 - Type IIx

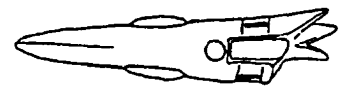


Figure 14 - Type IIy

Within the four broad categories defined by foreshaft socket design and blade orientation, Collins defined 34 categories of harpoon heads, based on differences in the attributes of the six previously defined variables. Table 2 lists characteristics of harpoon heads of the attribute Open Socket; Table 3 lists the characteristics of harpoon heads of the attribute closed socket. Attributes of blade orientation are indicated in the category designation as x or y. The frequency number indicates the total number of harpoon heads in each category reported by Collins from all five of the Gambell sites (Collins 1937:100-124; 203-215).

Type	Spur	Lashing	Line Hole	Side Blades	End Blade	n=
Ix	trifurcated spur	2 slots	drilled, double	two, parallel	None	4
Iy	trifurcated spur	2 slots	drilled, double	two, right angle	None	4
I(a)y	trifurcated spur	2 slots	drilled, double	two, right angle, two barbs	None	1
I(b)y	unknown	2 slots	drilled, double	two small barbs, right angle	None	1
IIx	trifurcated spur, asymmetrical	2 slots	drilled, single	two side blades, parallel	None	6
IIy	trifurcated spur, asymmetrical	2 slots	drilled, single	two side blades, right angle	None	4
II(a)x	bifurcated, asymmetrical	2 slots; slot & groove	drilled, single	two side blades, parallel	None	2
II(a)y	bifurcated, asymmetrical	2 slots; slot & groove	drilled, single	two side blades, right angle	None	3
II(b)x	bifurcated, symmetrical	2 slots;	drilled, single	two side blades, parallel	None	1
II(b)y	bifurcated, symmetrical	2 slots;	drilled, single	two side blades, parallel	None	1
II(c)x	bifurcated, symmetrical	2 slots;	triangle	two side blades, parallel	None	1
II(c)y	bifurcated, symmetrical	2 slots;	drilled, single	two side blades, right angle	None	2
II(d)	bifurcated, asymmetrical	2 slots;	drilled, single	None	None	1
II(e)	bifurcated, asymmetrical	slot & groove	triangle	None	None	1
II(f)x	bifurcated, symmetrical	2 slots;	triangle	None	Parallel	1
II(g)x	bifurcated, asymmetrical	2 slots; slot & groove	drilled, single	None	Parallel	2

Table 2 - Open Socket Harpoon Head Definitions

Type	Spur	Lashing	Line Hole	Side Blades	End Blade	n=
IIIx	Irregular	2 slots	drilled, single	None	Parallel	25
IIIy	Irregular	2 slots	drilled, single	None	right angle	25
III(a)x	Single	2 slots	drilled, single	None	Parallel	40
III(a)y	Single	2 slots	drilled, single	None	Right angle	14
III(b)x	Single, asymmetrical	2 slots; slot & notch; none	drilled, single; triangle	None	Parallel	21
III(b)y	Single, asymmetrical	2 slots; slot & notch; none	drilled, single; triangle	None	Parallel	1
III(c)x	Single, asymmetrical	2 slots; slot & notch; none	drilled, single; triangle	Two barbs, parallel	Parallel	1
IV	Single	2 slots	drilled, single; triangle	Two barbs, right angle	None	9
IV(a)	Single	Slot & notch	Triangle	Two pairs of barbs, right angle	None	1
IV(a)x	Single	2 slots	drilled, single; triangle	Two pairs of barbs, parallel	Parallel	1
V	Single, asymmetrical	2 slots; slot & notch; groove	Triangle	None	None	3

Table 3 - Closed Socket Harpoon Head Definitions

Type	Spur	Lashing	Line Hole	Side Blades	End Blade	n=
Ix	Single, symmetrical	None	Drilled, double	None	Parallel	1
IIx	Trifurcated	None	Single, drilled	None	Parallel	1
IVy	Single, symmetrical	None	Single, drilled	None	Right Angle	2
Vx	Single, symmetrical	None	Single, drilled	None	Parallel	24
Vy	Single, symmetrical	None	Single, drilled	None	Right angle	21
V(a)x	Single, symmetrical	None	Single, drilled	None	Parallel	2
V(a)y	Single, symmetrical	None	Single, drilled	None	Right angle	5
V(b)x	Single, symmetrical	None	Single, drilled	None	Parallel	5
VI	Single, symmetrical	None	Triangle	Two barbs, right angle	None	1

Total n=252

Table 3 - Closed Socket Harpoon Head Definitions

Decoration Styles

Collins determined categories of decoration styles of St. Lawrence Island artifacts while working on the Punuk Island and Kialegak sites in 1928 (Collins 1929). Table 4 contains a brief description of each style and phase defined by Collins, referenced to Figures 15 through 23 as examples of each category. Collins cautions that the numerical designations of the styles and phases do not necessarily imply a chronological relationship (Collins 1937:46).

Old Bering Sea 1	Simple, lightly incised line and circle designs, converging lines (Figure 15)
Old Bering Sea 2	Deeply incised designs; curvilinear, zoomorphic shapes with "eyes" (Figure 16)
Old Bering Sea 3	Similar to style 2 but with concentric circles carved on raised bosses (Figure 17)
Punuk Style 1 Phase 1	Simple line decoration (Figure 18)
Punuk Style 1 Phase 2	Single line and dots at ends of lines (Figure 19)
Punuk Style 2 Phase 1	Single lines with long spurs; harpoon heads only (Figure 20)
Punuk Style 2 Phase 2	Lines, spurs, dots and nucleated circles (Figure 21)
Punuk Style 2 Phase 3	Lines, nucleated circles, short, deeply incised spurs (Figure 22)
Punuk Style 2 Phase 4	Short vertical lines attached to pairs of horizontal lines (Figure 23)

Table 4 - Harpoon Head Decoration Styles

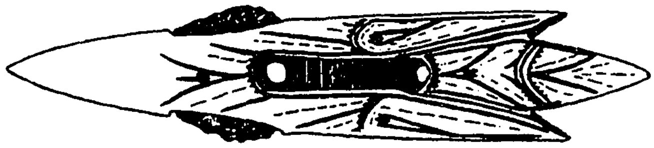


Figure 15 - Old Bering Sea Style 1 Decoration

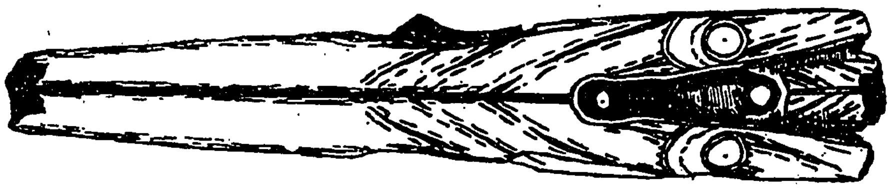


Figure 16 - Old Bering Sea Style 2 Decoration

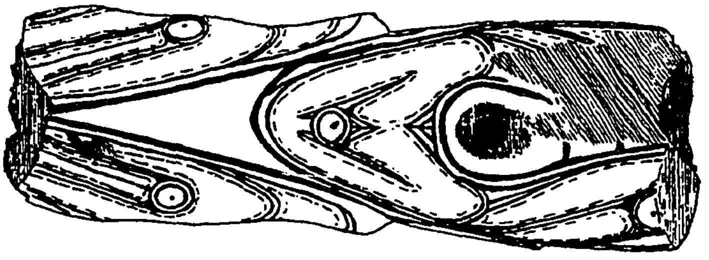


Figure 17 - Old Bering Sea Style 3 Decoration

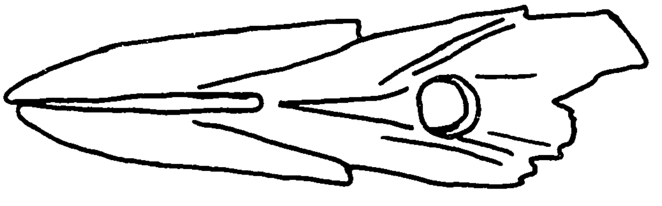


Figure 18 - Punuk Style 1 Phase 1

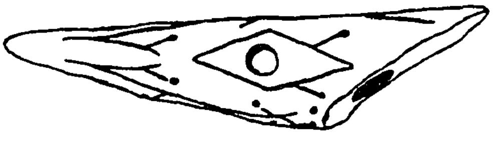


Figure 19 - Punuk Style 1 Phase 2

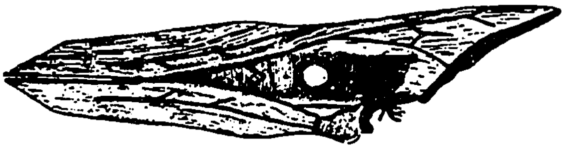


Figure 20 - Punuk Style 2 Phase 1

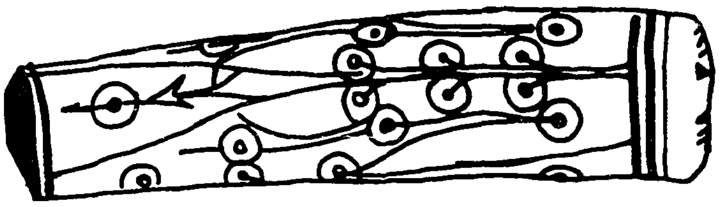


Figure 21 - Punuk Style 2 Phase 2

Figure 22 - Punuk Style 2 Phase 3

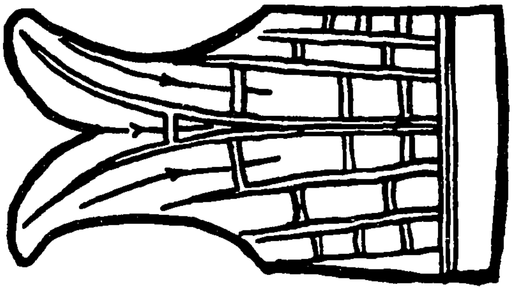


Figure 23 - Punuk Style 2 Phase 4

Vertical Distribution of Harpoon Head Categories and Decoration Styles

Collins reported vertical artifact distribution by site and by arbitrary 60 cm levels within each site (Table 5). In Table 5, the five Gambell sites are arranged from left to right in what Collins considered the temporal relationship suggested by the beach ridge sequence on the Gambell plain, with Old Gambell the youngest and Hillside the oldest. Each site is divided into 60 cm arbitrary levels, measured from the surface and converted to metric in Table 5 from Collins' English measurements. Numbers in parentheses indicate the frequency of occurrence of the category within each level, ordered by relative frequency. Totals indicate the number of harpoon heads in each of the four levels, and in each of the five sites (Collins 1937:216-217).

Table 6a reproduces Collins' Table 1 and shows vertical distribution of decorative styles in the five Gambell sites. Depth data is expressed in cm below surface, converted from Collins' English measurements. Frequency numbers refer to occurrence of decoration styles on all categories of artifacts. Under Old Bering Sea and Punuk styles, "Ind." means indeterminable, referring to those objects for which Collins did not determine a decorative style associated with a particular style or phase within that category.

In Table 6b, I rearrange the data from Table 6a into the same format as that of Table 5 to facilitate the following comparisons. Numbers in parentheses indicate the frequency of occurrence of the category within each level, ordered by relative frequency. OBS refers to Old Bering Sea styles, Px/x refers to Punuk styles and phases, Ind. refers to indeterminable Old Bering Sea or Punuk styles, and Mod. refers to Modern styles.

	Old Gambell	Siqlugaghyaget	Ayveghyaget	Mayughaaq NW	Mayughaaq SE	Hillside	n=
Open Socket							
0-60	III(b)x (38) V (7) III(a)x (2) III(b)y (2)	III(b)x (15) III(a)x (11) V (3) III(b)y (1) III(c)x (1) IV(a) (1)	III(a)x (49) IV (2) II(b)x (1) II(b)y (1) II(c)x (1)	III(a)x(18) II(a)y (3) II(a)x (2) II(d) (1) II(f)x (1) II(g)x (1) IIIy (1) III(a)y (1)	IIIx (8) III(a)x (3) IIx (2) IIIy (2) III(a)y (1)	Ix (3) IIIx (3) IIIy (2) Iy (2) III(a)x (1) III(a)y	191
60-120		III(a)x (7) III(b)x (6)	III(a)x (47) IV (7) II(c)y (2) III(b)x (1) IV(a)x (1)	III(a)x(15) III(a)y(4) IIIx (2) IIIy (2) IIx (1) II(e) (1) II(g)x (1)	IIIx (6) III(a)y (4) IIx (2) IIy (2) Ix (1) IIIy (1) III(a)x (1)		114
120 180		III(a)x (2)	III(a)x (2)	III(a)x (2) III(a)y (2) IIIx (2) IIIy (1) IIx (1) IIy (1)	IIIx (5) IIIy (4) Iy (2) Ix (1) IIy (1) III(a)x (1) III(a)y (1)		28
180 240					IIIx (2) IIIy (1) Iy (1) I(a)y (1) I(b) (1)		6
Closed Socket							
0-60	Vy (1)	V(a)y (1) V(b)x (1)	V(a)y (5) Vx (4) V(b)x (2)	Vx (6) Vy (3) V(a)x (2)	Vx (2) Vy (1)	Vx (2) IIx (1) IVy (1)	32
60-120		Vy (1) V(a)y (1) V(b)x (1)	Vy (2) V(b)x (2) Vx (1) VI (1)	Vx (7) Vy (4)	Vx (5) Vy (5) IVy (1)		31
120 180		Vy (1) V(a)y (1)	Vx (1) V(b)x (1)	Vy (2) Vx (1)	Vy (5) Ix (1) Vx (1)		14
180 240					Vy (1)		1
n=	50	54	133	88	76	16	417

Table 5 - Vertical distribution of harpoon head categories from Gambell sites (after Table 2, Collins 1937:216-217)

Style	Old Bering Sea				Punuk							Modern	Total
	1	2	3	Ind.	1		2				Ind.		
Phase					1	2	1	2	3	4			
Old Gambell								1			1	1	3
Siqlugaghyaget													
0- 60								2	6				8
60-120							3	1		1	1		6
120-180							1						1
Ayveghyaget													
0- 60								2	10		3		15
60-120							6	12	6	1	4	2	31
120-180							2	2					4
Mayughaaq NW													
0- 60		1	1	3	1	22	10	10			2	1	51
60-120		4	1	2	4	24	4				1		40
120-180		4		2	5	6							17
180-240				2									2
Mayughaaq SE													
0- 60		4	4	6	3	8					1		26
60-120		6	11	7	2								26
120-180		11	6	3	3								23
180-240		4	1	2	1								8
Hillside	8	13	1	4									26
Total	8	47	25	31	19	60	26	30	22	2	13	4	287

Table 6a - Vertical distribution of decoration styles from Gambell sites (after Table 1, Collins 1937:202)

	Old Gambell	Siqlugaghyaget	Ayveghyaget	Mayughaaq NW	Mayughaaq SE	Hillside	n=
0-60	P2/2(1) Ind. P(1) Mod. (1)	P2/3 (6) P2/2 (2)	P2/3 (10) Ind. P (3) P2/2 (2)	P1/2 (22) P2/1 (10) P2/2 (10) Ind. OBS (3) Ind. P (2) OBS2 (1) OBS3 (1) P1/1 (1) Mod. (1)	P1/2 (8) Ind. OBS. (6) OBS2 (4) OBS3 (4) P1/1 (3) Ind. P (1)	OBS2 (13) OBS1 (8) Ind.OBS(4) OBS3 (1)	129
60-120		P2/1 (3) P2/2 (1) P2/4 (1) Ind. (1)	P2/2 (12) P2/1 (6) P2/3 (6) Ind. (4) Mod. (2) P2/4 (1)	P1/2 (24) P2/1 (4) OBS2 (4) P1/1 (4) Ind. OBS (2) OBS3 (1) Ind. P (1)	OBS3 (11) Ind. OBS (7) OBS2 (6) P1/1 (2)		103
120 180		P2/1 (1)	P2/1 (2) P2/2 (2)	P1/2 (6) P1/1 (5) OBS2 (4) Ind. OBS (2)	OBS2 (11) OBS3 (6) Ind. OBS (3) P1/1 (3)		45
180 240				Ind. OBS (2)	OBS2 (4) Ind. OBS (2) OBS3 (1) P1/1 (1)		10
n=	3	15	50	110	83	26	287

Table 6b - Vertical Distribution of Decoration Styles from Gambell Sites (after Table 1, Collins 1937:202)

Collins' Analysis

Collins combined the data from harpoon head categories and decoration styles, as presented in Tables 5 and 6b. He presents these data as Figure 24 in *Archaeology of St. Lawrence Island*, as a chronology of open socket harpoon head development (Collins 1937:216-217), reproduced here as Figure 24.

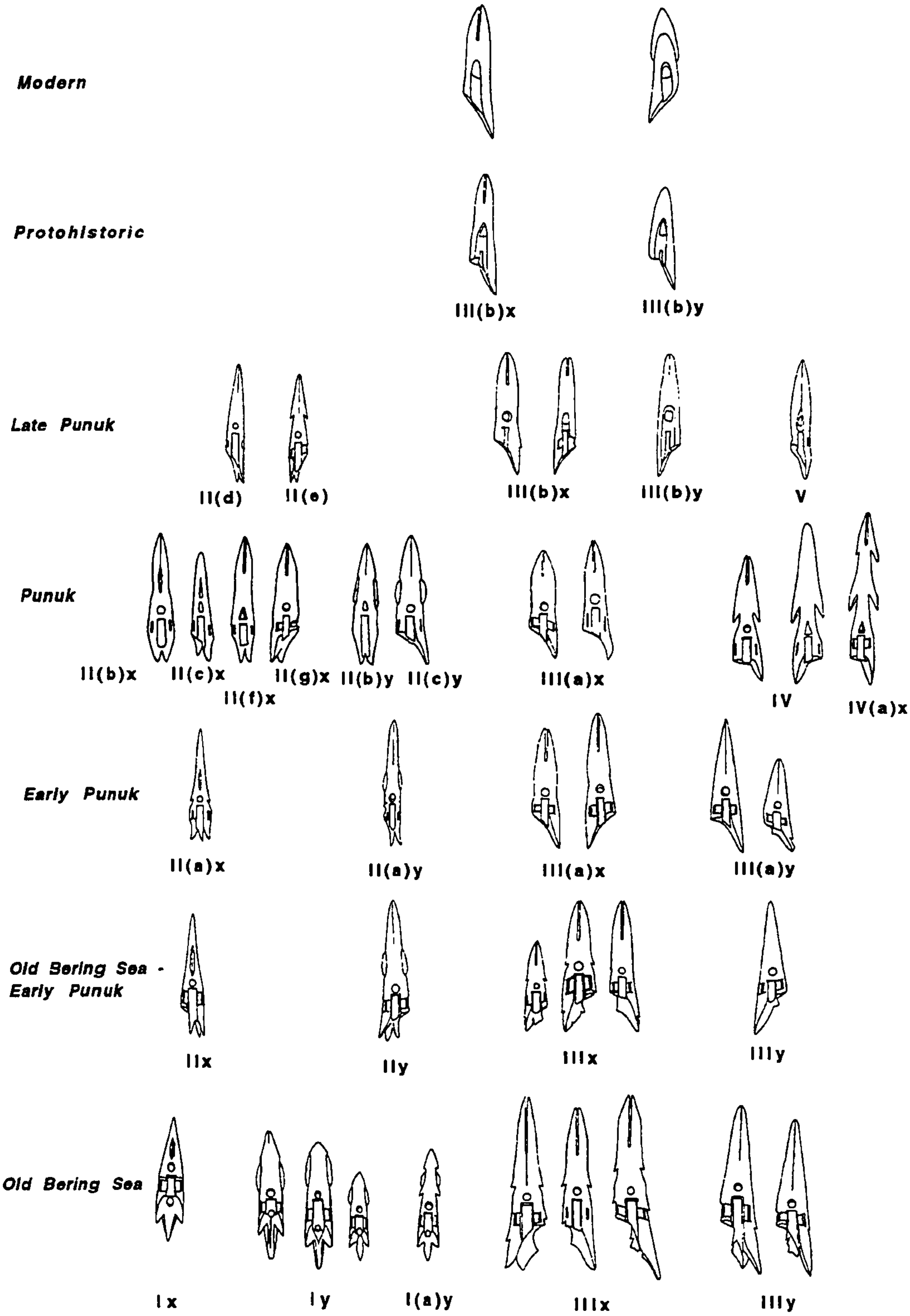


Figure 24 - Collins' Chronology of Harpoon Head Development

Collins used only open socket harpoon heads to formulate his chronology. Table 5 (see page 60) shows that the closed socket harpoon head distribution exhibits no patterning that can be correlated with the distribution of open socket harpoon heads. Collins' closed socket types Vx and Vy are found in all levels of all sites. The Type V harpoon head that appears in Collins' Figure 24 is an open socket form that was found only in Old Gambell and the upper level of Siqlugaghyaget.

Collins interpreted the relative vertical distribution of harpoon head categories and decoration styles as a refinement of the temporal sequence suggested by the relative occurrence of the five Gambell sites on the beach ridges of the Gambell plain. He assumed that the Hillside site, on the slope overlooking the plain, was the oldest site, occupied before the gravel plain was formed. He interpreted the presence of Old Bering Sea Styles 1, 2 and 3 in the house pits excavated in the Hillside site as confirmation of the antiquity of the site. He also interpreted the presence of Old Bering Sea Style 1 artifacts exclusively at the Hillside Site as evidence of their greater antiquity relative to Old Bering Sea Styles 2 and 3.

The Mayughaaq mound contains both Old Bering Sea and Punuk decorated artifacts, as is shown in Tables 6a and 6b. Collins concluded that the Mayughaaq mound consists of two levels. The upper level (surface to approximately 150 cm below surface), contains both Old Bering Sea and Punuk materials; the lower level (50 cm to approximately 225 cm below surface), contains mainly Old

Bering Sea materials mixed with occasional artifacts with Punuk decorations. Collins interpreted the area immediately above and below the contact between the two levels as a transitional Old Bering Sea/Punuk period (Collins 1937:34-35). Collins interpreted the site as consisting of two components, one a primarily Old Bering Sea occupation in the southeast area of the mound mixed with scattered intrusive Punuk material and another, a primarily Punuk occupation in the northwest area of the mound, with a few Old Bering Sea materials at the bottom.

Collins interpreted the distribution of harpoon head categories and decoration styles in the five Gambell sites as evidence of cultural development of Old Bering Sea to Modern peoples on St. Lawrence Island and Punuk Island, and, by inference, on the shores of the Bering Sea where archaeologists have found additional evidence of these cultures.

Kukulik

In 1930, the Kukulik site consisted of a series of occupation mounds on the northern shore of St. Lawrence Island about 3.5 miles (5.8 km) east of the modern village of Savoonga (Geist and Rainey 1936). The mound complex consisted of an L-shaped mound approximately 650 feet (200 m) long, designated the Main Midden, with a smaller mound to the west, the West Mound (Figure 25). The Main Midden was being heavily eroded by wave action at high tide on the seaward side of the mound.

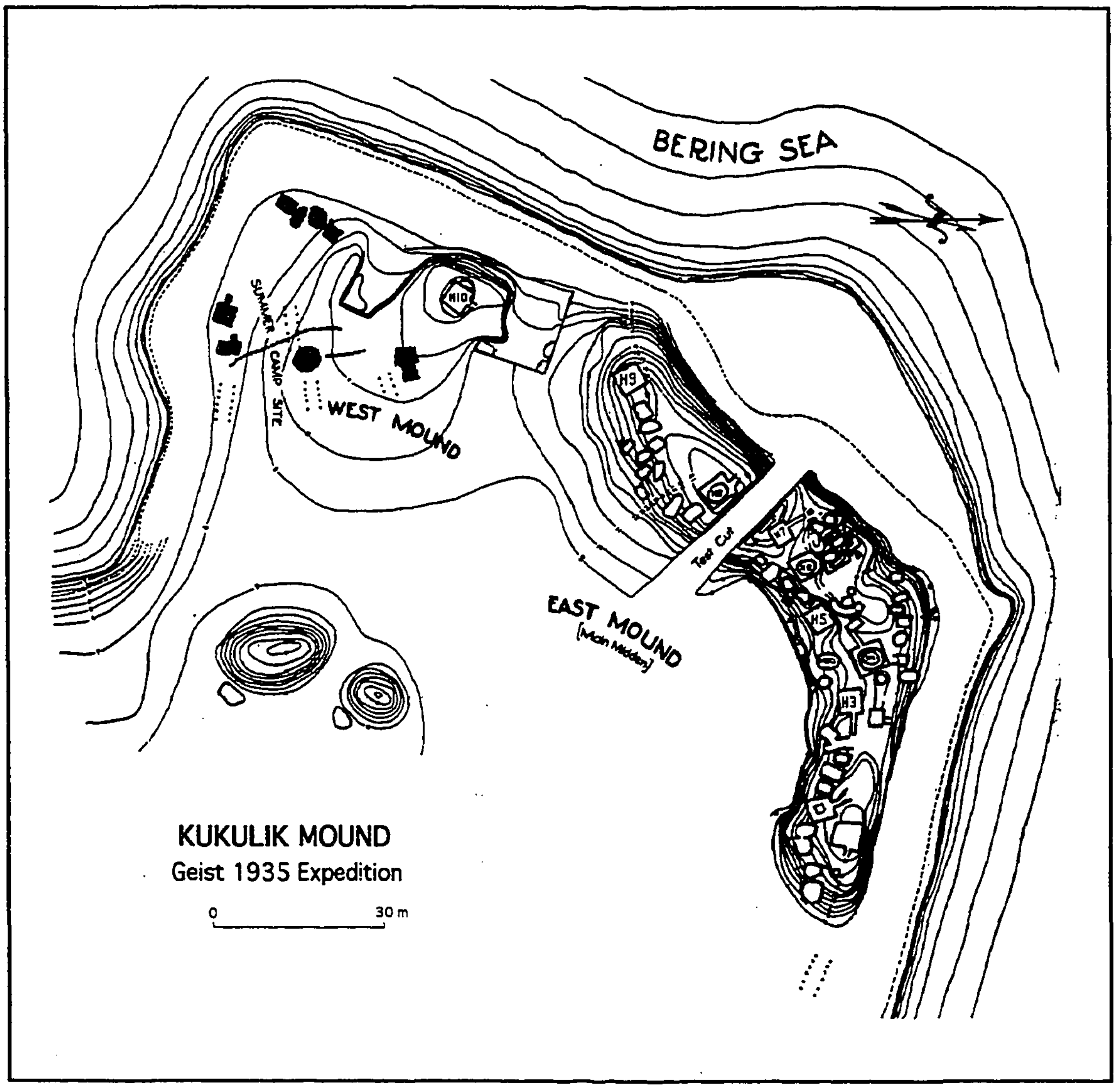


Figure 25 - Kukulik Mound, showing the test trench and surface features explored by Geist from 1931-1935.

When Geist began his excavations of the Kukulik mound, the surface was covered with the remains of houses that were last occupied during the 1878-1879 famine. From ethnohistorical accounts, it appears that no one at this location survived the famine and the houses remained unoccupied until Geist's investigations

(Collins 1937, Burgess 1974; Ellanna 1983; Geist n.d.). Consequently Geist found the contents of the houses relatively complete and undisturbed. He subsequently collected and shipped back human skeltons and associated archaeological materials to the University of Alaska, where they make up the bulk of the collections from St. Lawrence Island. Most of the skeletons from these houses were given to Ales Hrdlicka in 1936 and are now housed at the Smithsonian Institution (Geist n.d.).

The mound was excavated in three stages (Geist and Rainey 1936:38-58). During three field seasons from 1931-1933, Geist excavated the Test Trench (Figure 26), an 11 m by 60 m cross-section cut transversely through the mound, from the modern surface down to the sterile clay layer at the bottom of the mound (Figure 26). In 1934 and 1935, Geist and a much larger crew excavated the top 60 to 90 cm of an extensive section of the mound on either side of the test pit. He also excavated sections in the eroding face to seaward and an excavation on the West Mound from the surface to sterile greavel at the base of the mound. In 1937 and 1939, Geist conducted additional excavations on the surface layers of the mound and on the sides of the 1931 Test Trench (Geist n.d.).

The Test Trench

Geist excavated the Test Trench (Figure 26) to explore the remains of a modern house structure on the surface of the mound and the approximately 6 m of midden material excavated beneath it

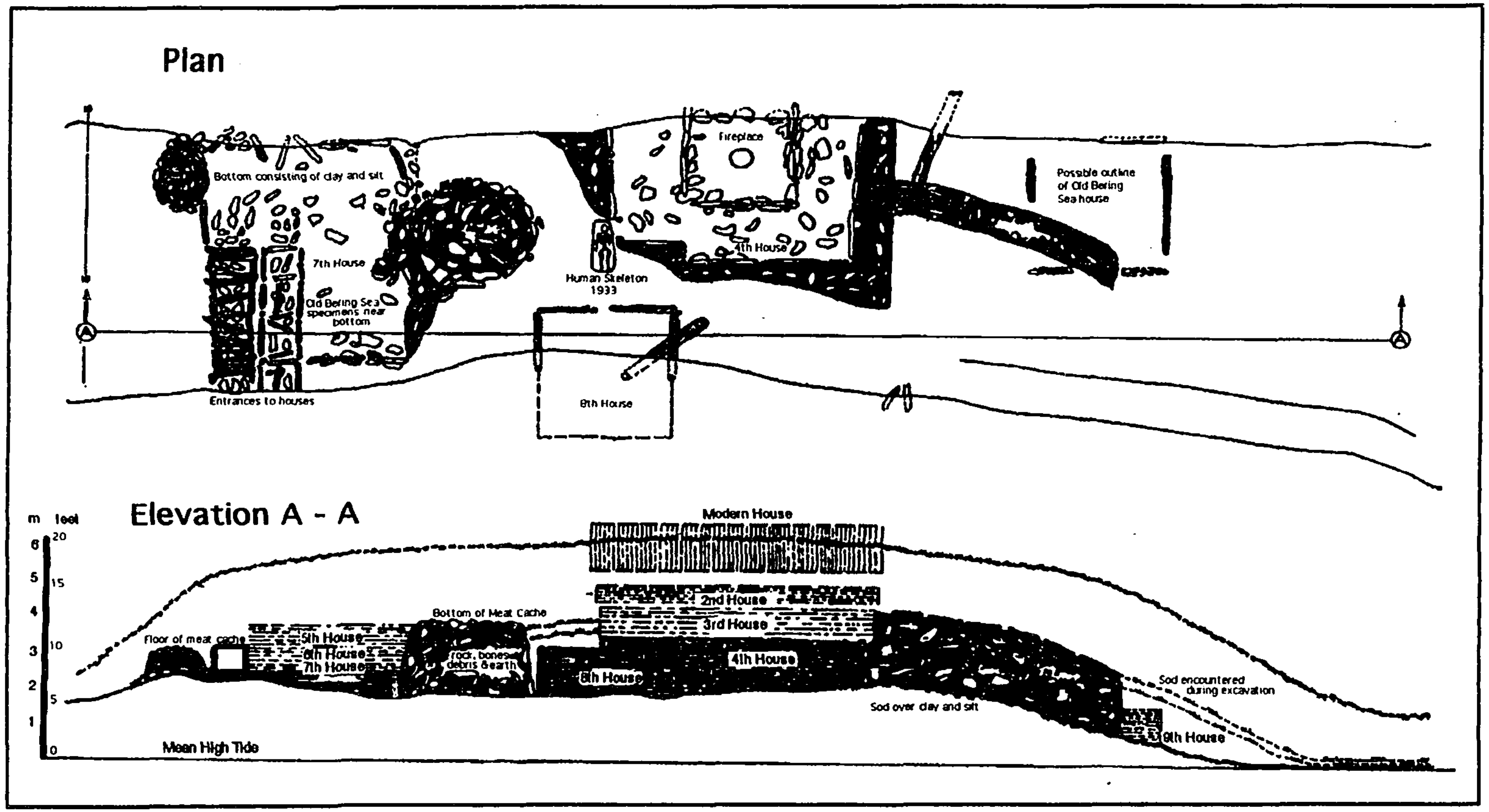


Figure 26 - Kukulik Test Cut- 1931

(Geist and Rainey 1936:38-49). Geist discovered that the modern house was built on the remains of an earlier house, labeled 2nd House, which in turn was built on the remains of a 3rd House, which was built on a 4th house. Geist discovered the remains of seven houses within the Test Trench, with two houses built on the sterile clay at the lowest level of the mound.

Although there are many references and photographs describing surveying activities and a complex system of wires over the Test Trench in the 1931-1933 excavations to facilitate provenience measurements, these data, if any, have not survived. The University of Alaska Museum possesses charts and maps of the excavations compiled by Geist, but I have not located preliminary notes and records of initial data recording.

The accession catalogs compiled by Geist during this period do not contain provenience information other than general references to house associations. Artifacts are recorded as from Modern House, 2nd House, 3rd House, etc. In some cases provenience is recorded as, for example, "between 3rd House and 4th House." The compressed condition of the house remains below the 3rd House were such that Geist recorded provenience as "below 3rd House" and made no attempt to record exact provenience or general artifact association (Geist and Rainey 1936:47). In some cases. Geist recorded provenience in relation to house features or meat cache structures.

The 1934-35 Excavations

Based on results of the earlier excavations, Geist conceived of the next expedition as a larger, more complex effort, designed to locate evidence that would allow him to distinguish among the various types of harpoon heads found in the upper, more recent deposits in the Kukulik mound. Geist intended to take down a large expanse of the mound surface, recovering as much material as possible (Geist and Rainey 1936:55).

In 1934 and 1935 Geist surveyed the area east of the test cut in eleven sections which were further subdivided into subsections that were excavated in rotation as the sun and open air thawed the frozen substrate. The top 38 to 92 cm of the midden deposits were removed during the 1934 and 1935 field seasons. Provenience information was recorded by section with no detailed location for individual artifacts recorded (Geist and Rainey 1936:55-58). No site maps for these years were published in *Archaeological Excavations at Kukulik*, and none of the original drawings have survived to the present. Though section numbers are recorded for the artifacts in the University Museum accession catalogs, the locations of each section in the excavation is unknown, other than east of the test cut.

The artifacts from the 1934 and 1935 excavations are predominantly of recent and late prehistoric origin. Some earlier material was excavated from the West Mound and from the shoreline of the Main Midden during these years.

Later Excavations

The Kukulik site was excavated in 1937 and 1939. University Museum catalog records record extensive collections for this period, provenienced as Sections N through Z. No records exist from either of these field seasons. Investigation of Geist's unpublished manuscripts and diaries in the University of Alaska Archives revealed a small quantities of pages from a 1937 field book that were burned on the edges, suggesting that most or all of Geist's papers from the 1937 and 1939 field seasons were in Geist's house when it burned in 1965 and are now lost.

One hundred and twenty-four harpoon heads from the 1937 excavation have paper tags attached with detailed provenience information with initials indicating that Ivar Skarland was employed in this season's work. According to Giddings' account of these years, Froelich Rainey led the excavations at Kukulik in 1937 (Giddings 1973:164).

The 1939 artifact field numbers are in the numbering style of J. Louis Giddings, who was working for Geist at Kukulik in 1939, according to Rainey's description of the Hillside site and Giddings' own account (Rainey 1941:468; Giddings 1973).

In 1948, Wendell Oswalt excavated three test cuts in the Kukulik Mound . Cut A was a 3 by 25 m trench excavated approximately 9 m west of the 1931 Test Trench. Cuts B and C were 3 by 9 m trenches excavated at the east end of the main mound (Figure 25). The surface of these areas was excavated by Geist in

1934 and 1935, who removed approximately 1 m of soil and cultural material. Oswalt measured provenience for these excavations from the disturbed surface of the at the top of the test cuts (Oswalt 1953).

Artifacts recovered from the 1948 excavation are among the collections at the University of Alaska Museum. However, the collection is unaccessioned and uncataloged and the Museum does not possess documentation for these excavations.

Since 1950, ivory digging by Savoonga residents has virtually destroyed the Kukulik site, though the two mounds southeast of the Main Midden were undisturbed at last report (Crowell 1984).

S'keliyuk Site

In the summer of 1958 Robert Ackerman circumnavigated St. Lawrence Island to locate additional unexplored sites with Old Bering Sea and Punuk decorated materials (Ackerman 1961). He investigated 29 sites along the shore of the island, and conducted test excavations at many of them.

The site that is most interesting for the purpose of this analysis was found east of Savoonga, in a valley identified by St. Lawrence Island informants as S'keliyuk. The site consisted of two mounds with surface indications of recent to late prehistoric occupations (Figure 27).

Ackerman excavated a test trench in one mound, uncovering the remains of house and/or meat cache structures. A number of

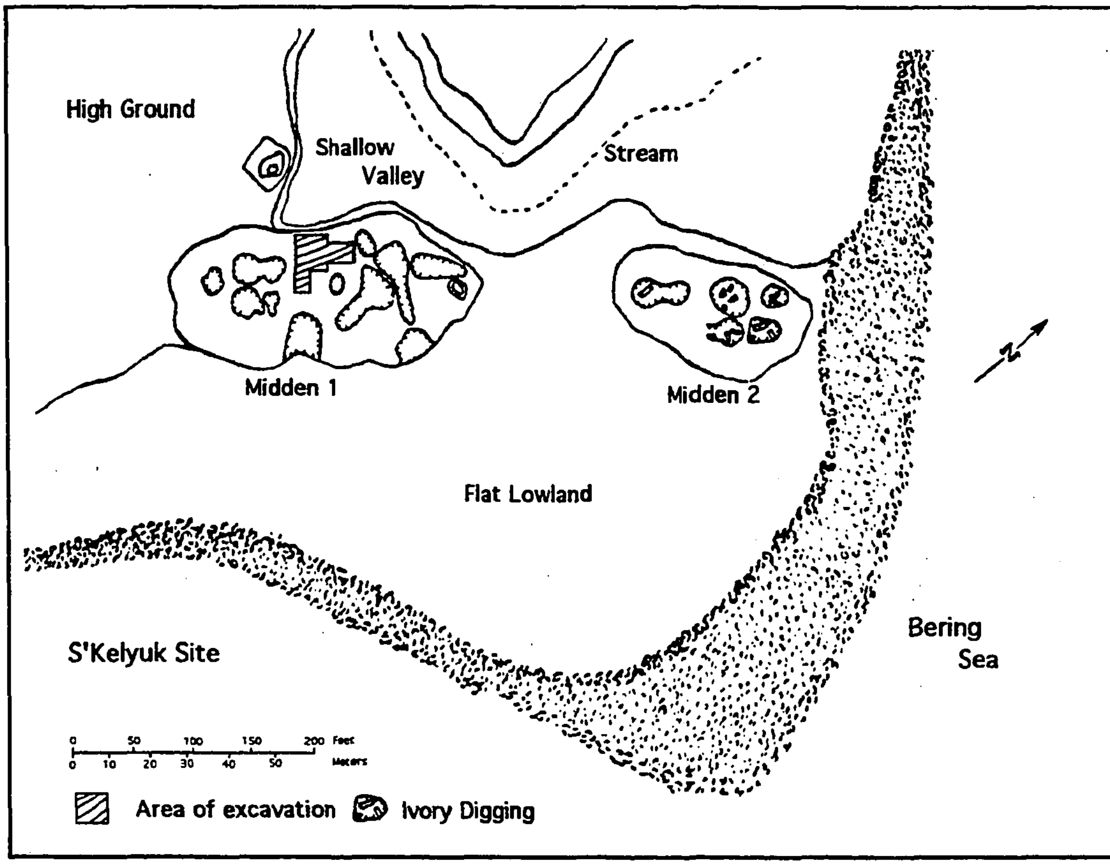


Figure 27 - S'keliyuk Site with two mounds and Ackerman's excavation unit

artifacts were recovered, including harpoon heads with Punuk decoration styles and others resembling Birnirk harpoon head shapes and construction.

Ackerman's description of the artifacts from the 1958 excavations are separated by "Eskimo cultural activities" (Ackerman 1961:43). Ackerman chose not to classify harpoon heads from the sites by any previously defined classification system or nomenclature, but instead described them individually by site. "Rather than add more names to the list or try to modify a symbol system, the harpoon heads described below will be grouped by site and numerically by type within a given site, i.e. S'keliyuk Type 1 (Ackerman 1961:43)."

Ackerman compared the harpoon heads from each site with Collins' and Ford's type designations, but did not coordinate type designations from site to site. He followed Rainey's lead in designating those harpoon heads with greatest numerical frequency as the most important, designating the less numerous types as "rare type" (Ackerman 1961:52). In all, Ackerman described seventeen types of harpoon heads at the S'keliyuk site.

Ackerman attempts no quantitative analysis of the data, apart from a simple comparison of percentage occurrence of sealing vs. whaling harpoon heads and a general listing of pottery sherd types. However, he describes harpoon heads types and reports raw frequency numbers for each site.

Ackerman records the presence of harpoon heads at the S'keliyuk site that resembled some of the styles Ford (1959) described from the Birnirk sites at Barrow (Figure 28), further noting the generally mixed nature of their occurrence among the plain and Punuk decorated harpoon heads and other artifacts in the mound. He concluded, in concurrence with Collins' earlier discussions, that Birnirk represented a trait element intrusion, rather than a St. Lawrence Island site intrusion (Ackerman 1961:185). Ackerman compared the material with that of the

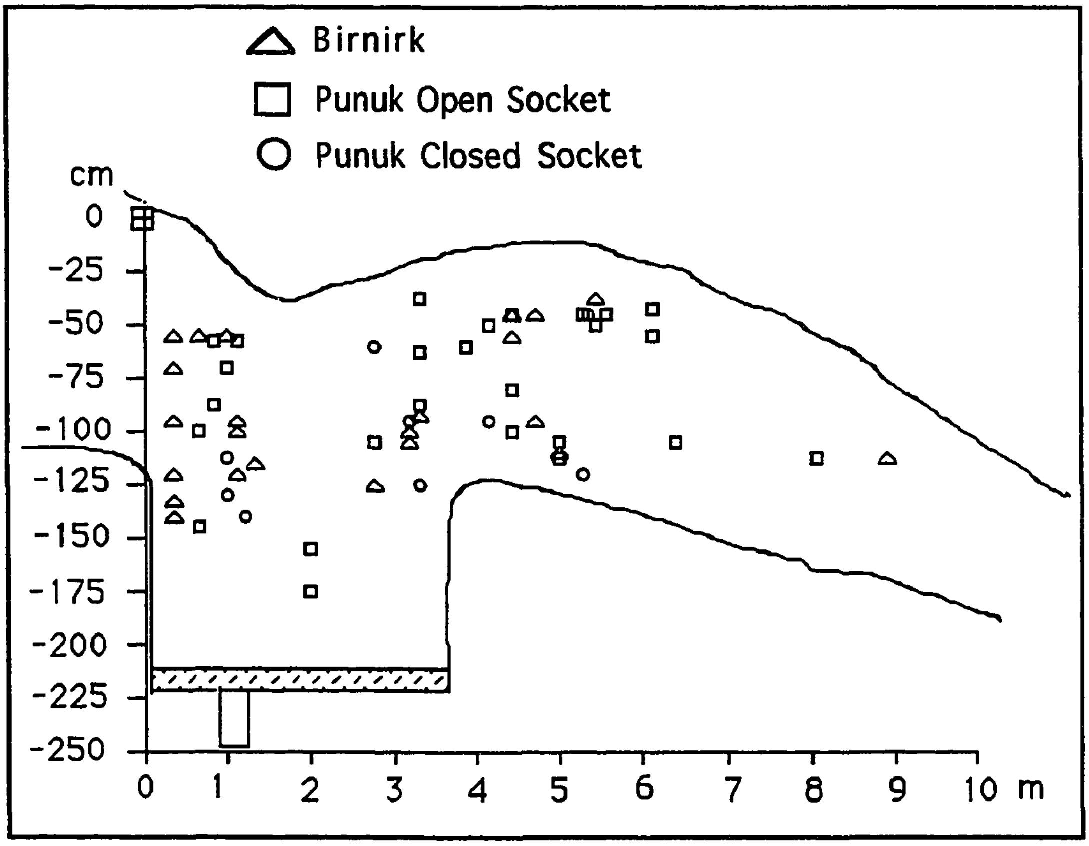


Figure 28 - S'keliyuk Site Harpoon Head Occurrence

Birnirk sites on the basis of shared elements and trait lists, the method Ford (1959) used earlier in his description of the Birnirk materials. On this basis, Ackerman concluded that the Birnirk material was introduced from the Birnirk culture, with Punuk as the recipient culture, receiving the objects through trade or other unspecified mechanism (Ackerman 1961:185).

Chapter 3 - Stratigraphic Reconstruction of the Mayughaaq Mound

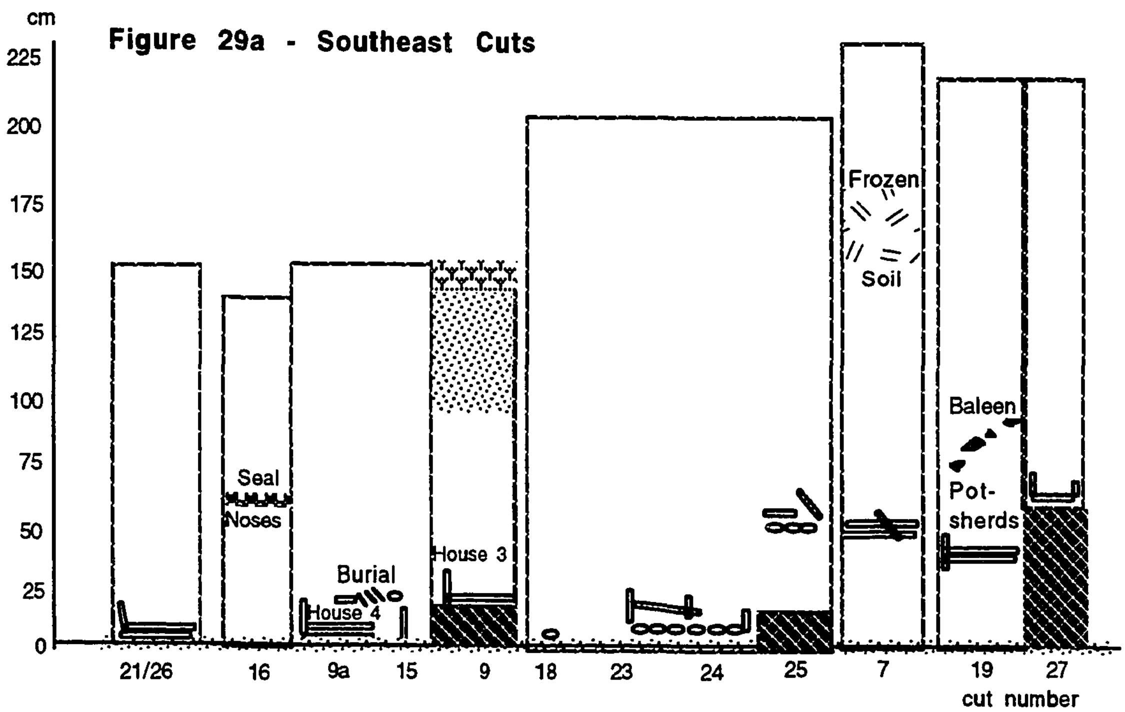
Collins' based his seriation chronology of harpoon head development (Collins 1937:216-217) on a combination of data, including the vertical distribution of decoration styles and harpoon head types from the Mayughaaq, Siqlugaghyaget and Ayveghyaget sites near Gambell. Data from the Old Gambell and Hillside sites are included in this data set without provenience, since Collins interpreted both excavations as single component house structures (Collins 1937:186-192). Data are organized into arbitrary 60 cm levels, as measured from the surface of the mound at the top of the excavation unit. Collins did not analyze the data from these sites for horizontal distribution of the decoration styles and harpoon head types.

Presentation of artifact data from the Gambell sites in large arbitrary levels obscures the finer-grained relationships among the artifacts that are necessary for understanding patterns of artifact variability. Although the sites are mixed due to aboriginal house construction and modern ivory digging, there still remains considerable stratigraphic data that is useful for understanding the complexity of the site. For example, patterns in the horizontal distribution of artifact types are suggestive of patterns of site occupation and potentially may reveal temporal relationships among periods of occupation.

In order to relate patterns of horizontal and vertical artifact distribution and relationships to the stratigraphy of the site, I reconstruct the stratigraphy and spatial artifact distribution of the Mayughaaq Mound below. I choose to focus on this site because the data are recorded in detail in *Archaeology of St. Lawrence Island* (Collins 1937), and because the site contains both Old Bering Sea and Punuk decorated artifacts. Although not all of Collins' harpoon head types are represented in the Mayughaaq mound, the collection from this site is representative of the sites on the Gambell plain. Collins viewed this site as critical to the understanding of the Old Bering Sea to Punuk transition.

Detailed descriptive and provenience data for artifact distribution and stratigraphy of the excavation units in the Mayughaaq mound were gleaned from *Archaeology of St. Lawrence Island* (Collins 1937:56-181, 395-424). These data were entered into a computer data base and then sorted by cut number, depth, and Collins' harpoon head categories. The resulting data were graphed by individual cut according to depth.

Collins measured all provenience data from the surface of the mound at the top of each individual excavation unit. Spatial relationships among the twenty-nine cuts are reported relative to other excavations on the site and not to an external datum. All excavations were taken down to undisturbed gravel at the base of the mound, with the exception of Cuts 5, 12, 15, 17, 20, 22, and 27 (Collins 1937:58-69).



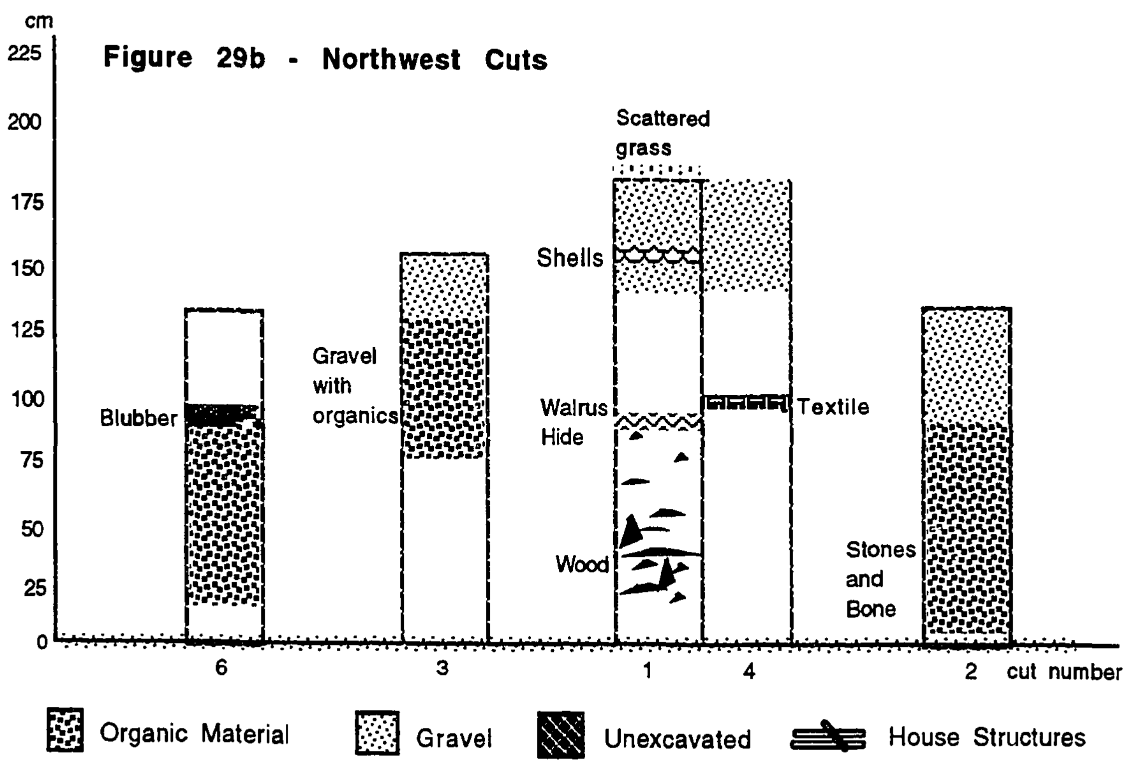


Figure 29 - Mayughaaq Mound Stratigraphy

Since Collins measured stratigraphic and artifact provenience from the variable upper surface of the mound, it is impossible to compare these data among the excavation units in the Mayughaaq mound. In order to rectify this problem, I consider undisturbed gravel at the base of the mound as an external datum and thus convert Collins' English measurements of depth below surface to height above sterile gravel in centimeters, with the exception of Cuts 5, 12, 17, 20 and 22. Data from Cuts 15 and 27 are correlated with adjoining cuts 9 and 19, respectively, by using Collins' descriptions and through comparison with site photographs (Collins 1937:Plates 6-10).

Figure 29 presents a stratigraphic profile of the Mayughaaq mound based on Collins' description of each excavation unit (Collins 1937:56-69). Figure 29a represents a south to north transect through Collins' Southeast Cuts; Figure 29b represents a corresponding transect though Collins Northwest Cuts (Figure 9).

The northwest area of the mound is shallower than the southeast area, resulting in shallower excavations. Cuts 9, 3, 1, 4 and 2 are capped by a dense gravel layer 80 to 140 cm above sterile gravel, with discontinuous gravel continuing in Cut 3 to 75 cm.

The earliest cultural activity is represented by House 4 in cuts 9a and 15, house beams in cuts 21 and 26, and the house floor in cuts 23 and 24. These house floors were constructed on sterile gravel with no midden material underlying them. House 3 in cut 9, the largest and most well preserved house structure, overlies the House

4 floor, inferring a more recent temporal relationship. The human remains in cut 9a are at the same level as House 3 floor, suggesting an association with this later occupation. A similar situation exists in cuts 24 and 25, where an extensive house structure overlies the lower house floor and house beams. The upper house floor is roughly at the same stratigraphic level as those in cuts 7, 19 and 27, all of which are higher than the House 3 and 4 floors.

In the Southeast Cuts, cultural materials appear at 75 cm above sterile gravel. In the Northwest Cuts, cultural materials appear at 100 cm above sterile gravel. The only house structure in the Northwest section of the mound is House 5, interpreted by Collins as a recent house containing no cultural materials. Collins found little cultural materials in the gravel layers in the upper levels of the cuts.

The gravel layer in the upper levels of Cuts 9, 3, 1, 4 and 2 are particularly interesting. As shown in the plan view of the mound (Figure 30) these cuts are located in the area 120 to 170 cm above sterile gravel, surrounding the higher, central area. The pattern of gravel occurrence suggest that the gravel was deposited after the central area of the mound accumulated greater than 170 cm above sterile gravel.

Mason and Ludwig (1990:361) interpret Collins' observations to mean that OBS and Punuk layers are separated by gravel. Although a gravel layer is indicated in these cuts, it is above the cultural material and there is no indication in Collins' text that it separates Old Bering Sea from Punuk occurrences in the mound.

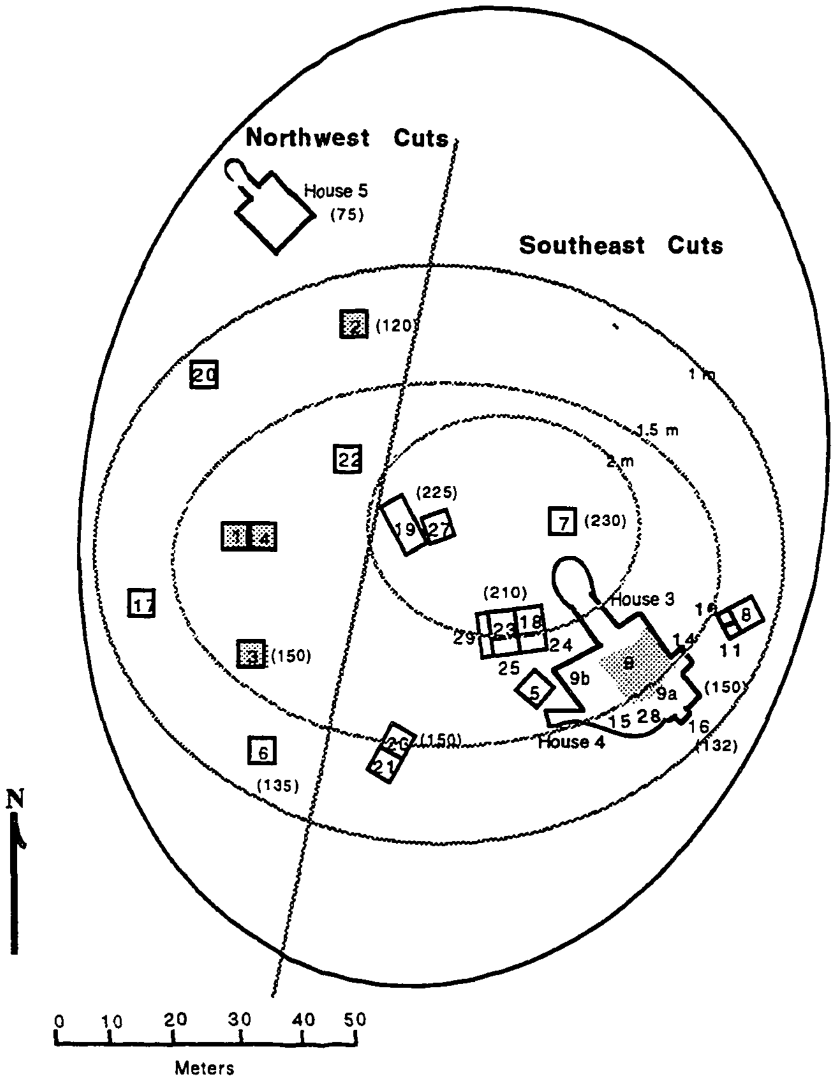


Figure 30 - Plan View of Mayugaaq Mound
(after Collins 1937:56)
(Surface elevation (cm) in parentheses)

Distribution of Harpoon Head Types and Decoration Styles

Table 5 in Chapter 2 presents data from Collins' descriptions of harpoon head types and their provenience in all of the Gambell sites, by 60 cm levels below the surface of the mound. In order to compare the vertical distribution of harpoon head types among the various cuts, I converted the provenience data to height above sterile gravel in centimeters and plotted the resulting data by cut.

Figure 31 presents the vertical distribution of Collins' harpoon head types by cut, arranged in the same manner as the stratigraphic data in Figure 29. Figure 31 shows a detailed picture of the vertical distribution of the harpoon head types as well as patterns of lateral distribution among the cuts. Figure 32 presents the same data in plan view, including those cuts not included in Figure 31 that were not excavated to sterile gravel.

Figures 31 and 32 demonstrate that Collins' Type Vx and Vy closed socket harpoon heads are found throughout the site at all levels. In addition, it is apparent that Type III harpoon heads, and variants, are also found in every cut except 8, 10, 11, 12 and 13, east of House 3. Type II harpoon heads, which Collins' associated with the Birnirk style from Point Hope, are found primarily in the Northwest cuts, especially cuts 1, 2, 3, 4, 19, and 20 (Collins 1937:117-118).

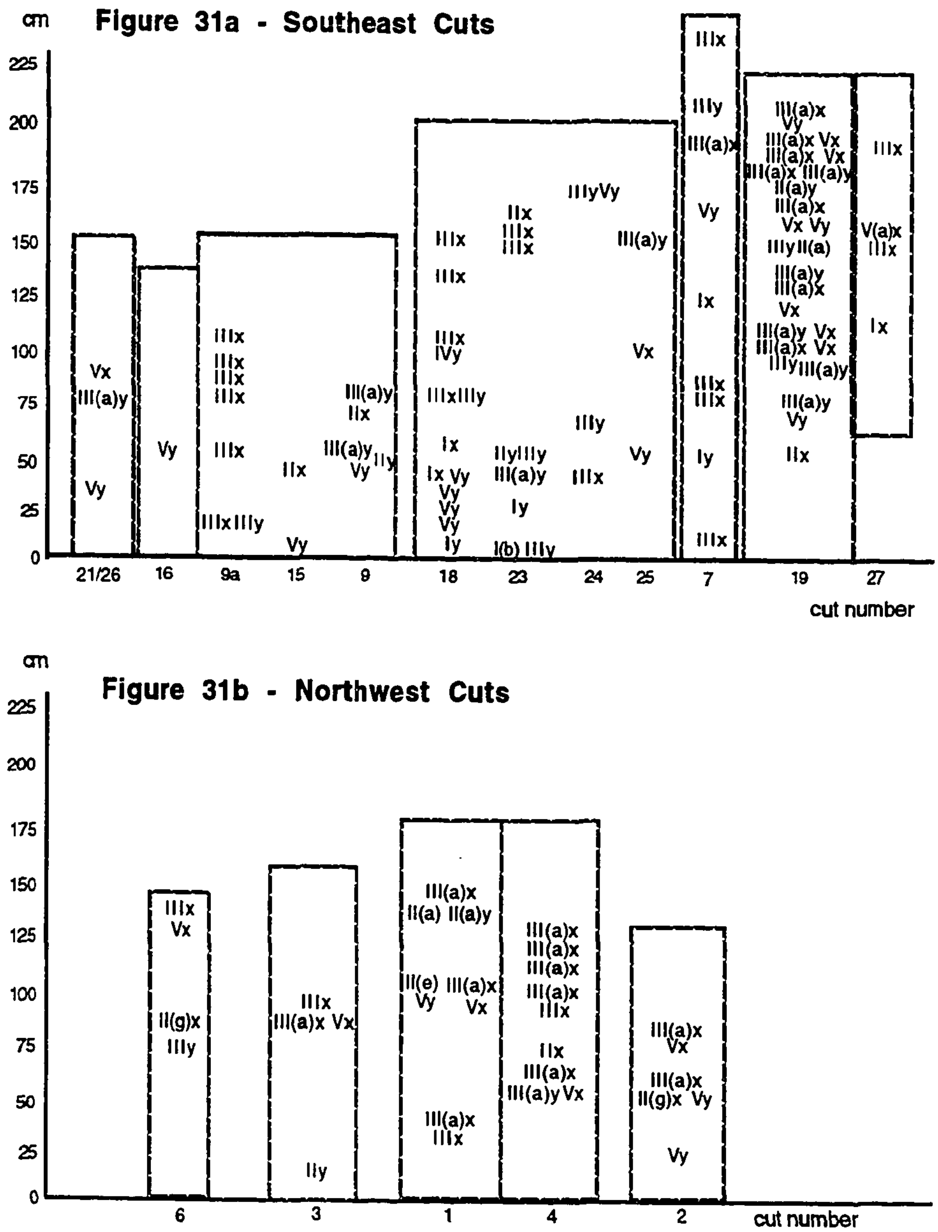


Figure 31 - Harpoon Head Type Vertical Distribution

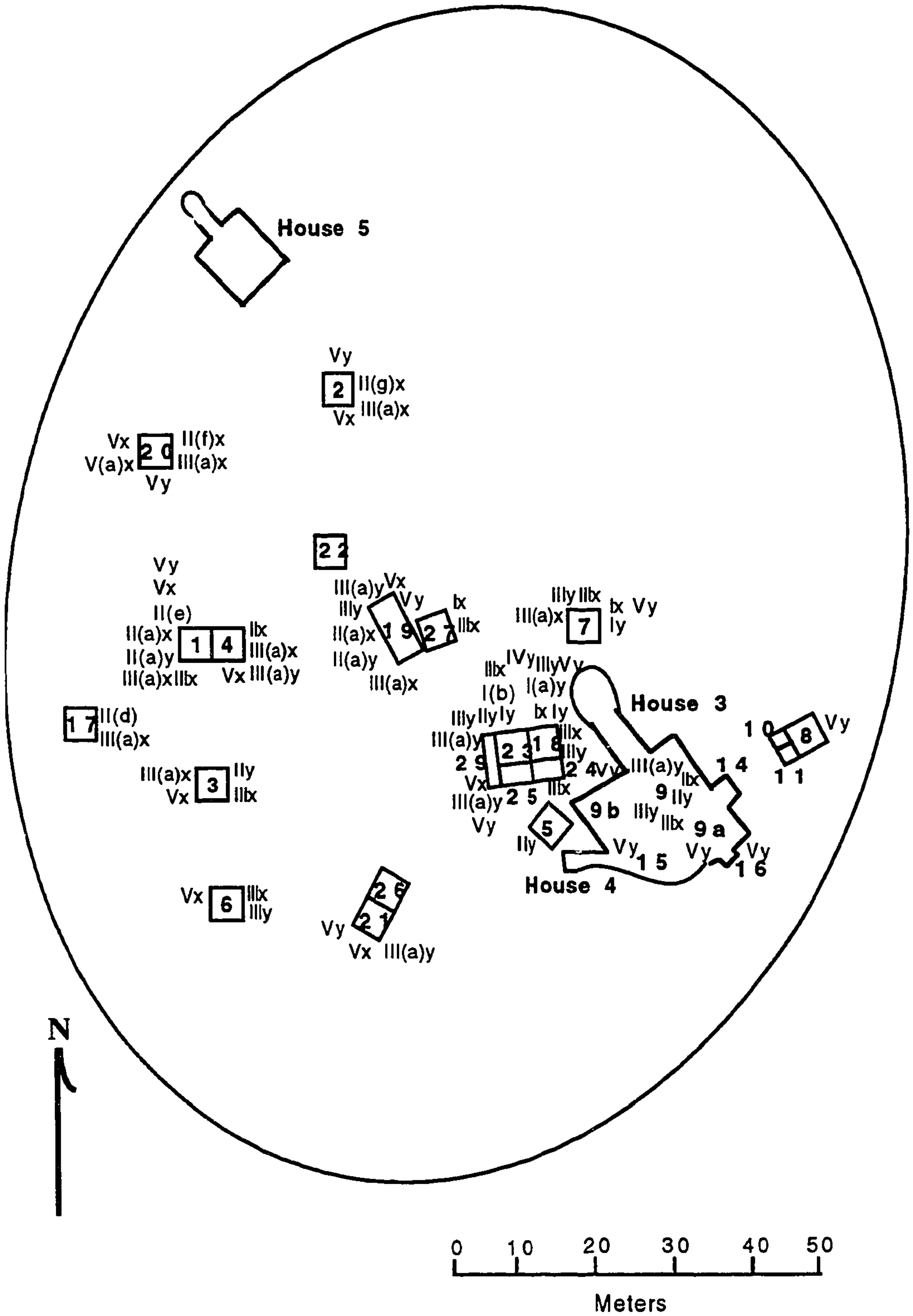


Figure 32 - Harpoon Head Lateral Distribution, Plan View

Figure 33 compares the mean height above sterile gravel for Collins' harpoon head categories from the Mayughaaq mound. Although there is a general progression in height from types I(b), I(a)y and Iy at the base of the mound to the II(a)x and II(a)y types in the upper level of the mound, comparison of overlap among the 95% confidence intervals suggests no significant difference in vertical distribution among harpoon head categories with frequencies greater than one.

As shown in Figure 33, Types III, IV and V have extremely broad vertical distribution and considerable overlap with the distribution of other harpoon head types. Although the broad pattern of distribution of harpoon heads is consistent with Collins' analysis, a finer-grained analysis does not support his conclusions.

Figures 34 and 35 present data for vertical and lateral distribution of decoration styles in the Mayughaaq mound in the same format as for harpoon head categories.

Figure 34 shows vertical distribution organized by cut in the southeast and northwest sections of the mound. Decoration styles are indicated by Collins' categories of Old Bering Sea 2 and 3 (OBS2, OBS3), and Punuk Styles 1 and 2 (P1, P2). Old Bering Sea 1 and Punuk Styles 3 and 4 were not found in the Mayughaaq mound. Figure 35 shows lateral distribution of decoration styles in the plan view of the Mayughaaq mound, using the same style designations, with the addition of Birnirk style harpoon heads (B).

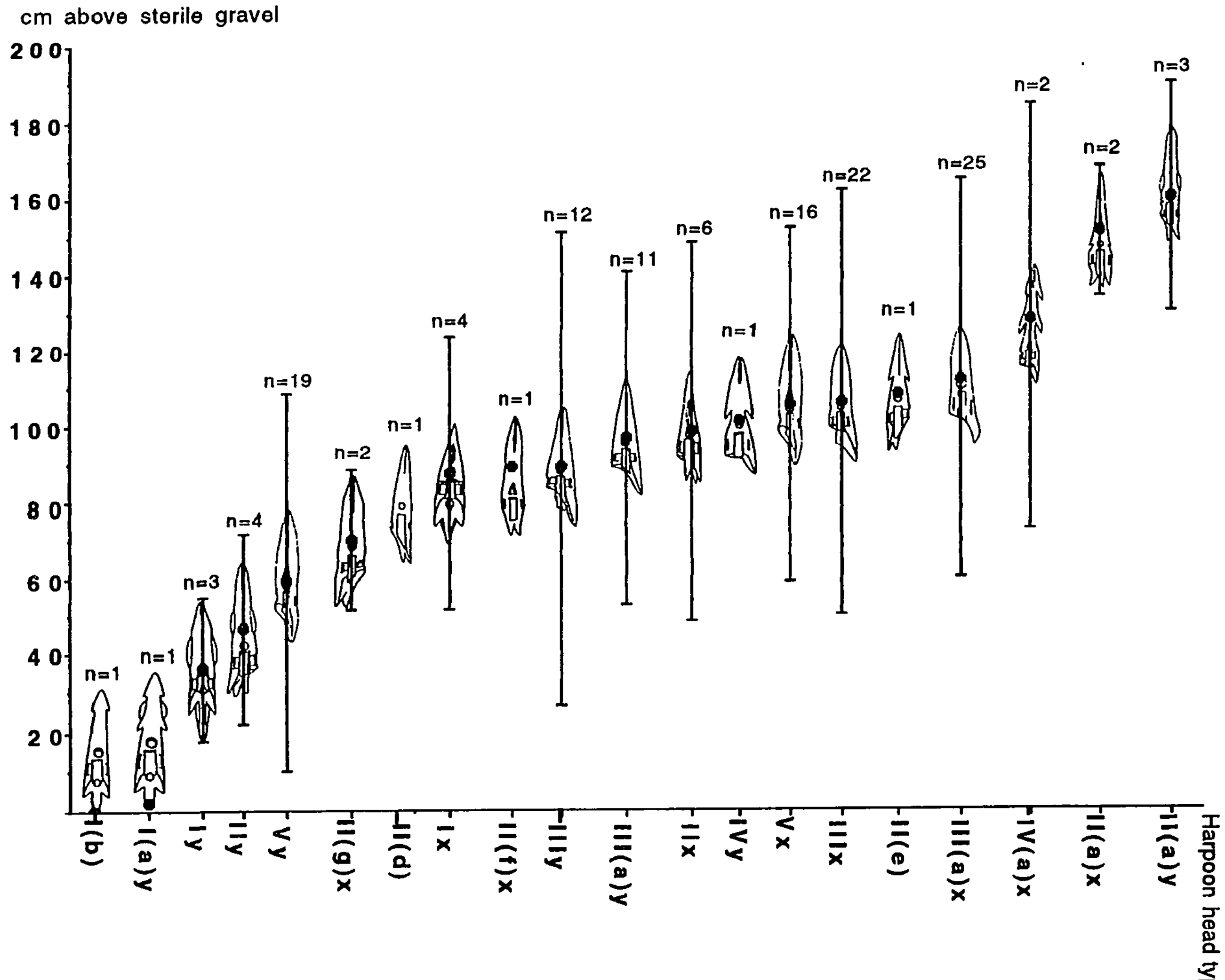


Figure 34 - Comparison of means of harpoon head vertical distribution with 95% confidence intervals of means

Comparison of Figures 29, 31 and 34, and 32 and 35 suggests the following patterns of harpoon head and decoration style distribution.

Old Bering Sea decorated objects are concentrated in the southeast section, in the central, deepest part of the mound. House structures in cuts 23 and 24 contain Old Bering Sea decorated artifacts and Type I, Type III and Type V harpoon heads. Houses 3 and 4 contain Punuk decorated objects and Types II, III and V harpoon heads, but the substrate surrounding the house pits contains Old Bering Sea decorated artifacts and Types III and V harpoon heads. House structures in Cuts 7 and 19 are associated with Punuk decorated artifacts and Types III and V harpoon heads. There are no decorated objects or harpoon heads in the gravel layers at the top of Cuts 1, 2, 3, 4, and 9, except for a Birnirk harpoon head in the shell layer in the gravel of Cut 1.

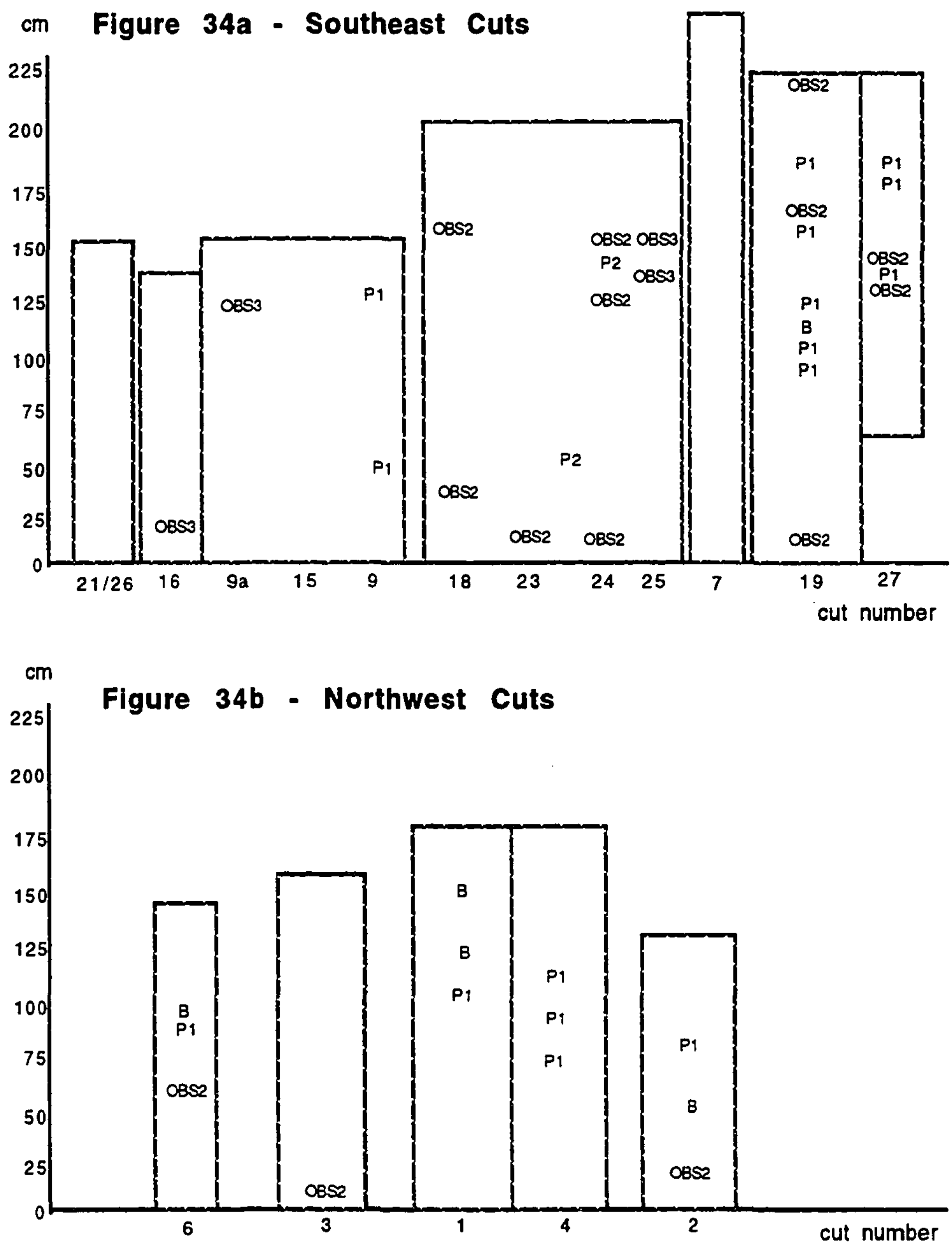


Figure 34 - Vertical distribution of decoration styles in excavation units taken to sterile gravel

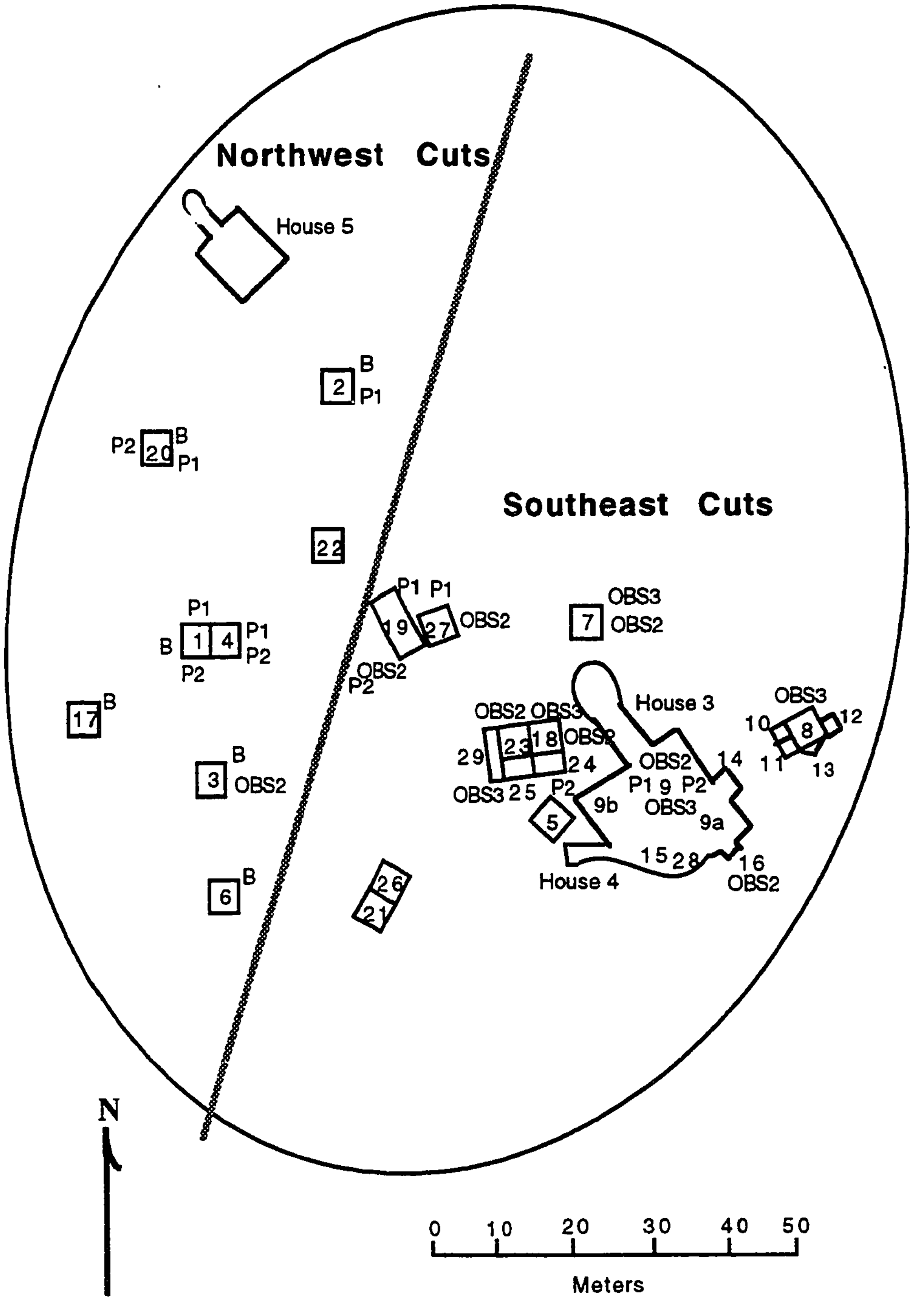


Figure 35 - Plan view of the lateral distribution of decoration styles in the Mayughaaq mound

Collins' Stratigraphic Interpretation

My reconstruction of the stratigraphy of the Mayughaaq mound demonstrates that Collins' simplified stratigraphic analysis and presentation creates patterns of correlation among harpoon head types and decoration styles that mask the complexity of the site. Collins recognized that the site was mixed , yet he attempted to impose order on the data by creating large arbitrary levels of analysis. Though the conclusions of his analysis are generally in accord with my stratigraphic reconstruction, the finer-grained variability evident in the reconstruction are obscured in Collins' broader analysis.

Most importantly, Collins' harpoon head classification fails to account for the random distribution of closed socket harpoon head Types IV and V throughout the site. The lack of patterning in the distribution of a defined artifact category suggests the possibility that the typological distinction may not be reflected in the archaeological distribution of the artifacts.

The problems with the stratigraphic and typological analysis of the Mayughaaq site and artifacts presented in *Archaeology of St. Lawrence Island* are a result of the preliminary nature of Collins' work and the state of archaeology in the 1930s. Collins himself refined his conclusions in later years (Collins 1953; 1973) and other researchers have since added data pertinent to the study of culture change in the Bering Straits.

The greatest problems with the culture history of St. Lawrence Island and with the typology of toggle harpoon heads result from the uncritical acceptance and application by others of Collins' pioneering work, and a general failure to apply basic concepts of taphonomy and contextual analysis to new investigations. All analyses of harpoon head collections on both shores of the Bering Sea have referred to the touchstone of Collins' 1937 interpretation of harpoon head development, resulting in an inadequate assessment of spatial and temporal variability across a vast range of geography and time (Geist and Rainey 1936; Rainey 1941; Larsen and Rainey 1948; Collins 1954; Ford 1959; Ackerman 1961, 1962; Bandi 1969; Arutyunov and Sergeev 1969, 1975; Stanford 1973; Bradley 1974; Crowell 1984; Staley 1994).

Chapter 4 - Classification Theory

Definition of Key Terms

Numerous articles and books have been written on the theory of classification, notably Rouse (1960, 1967), Spaulding (1953, 1954), Ford (1954), Clarke (1968), Dunnell (1971) and Whallon and Brown, eds. (1982). Most recently, Adams and Adams (1991) summarized the theoretical debate in classification theory since the late 1800s, defined critical terms, and laid out procedures for the development of classification, typology and taxonomic schemes with the aim of maximizing the understanding and interpretation of data in a problem oriented framework. In an attempt to encourage standardization of the terms used in classification, I use the following definitions proposed by Adams and Adams (1991).

Attribute - A particular characteristic or feature which is found in many entities, and which helps to define them as constituting a class or type - Adams and Adams 1991:331

Attribute Cluster - A combination of attributes which regularly occur together in particular entities - Adams and Adams 1991:331

Class - One of the categories in a classification - Adams and Adams 1991:333

Classification - a matched set of contrasting categories which, collectively, include all the entities or phenomena within a particular field of study, or set of boundaries - Adams and Adams 1991:333

Entity - whatever is classified and/or sorted in a typology - Adams and Adams 1991:334

Occupation - a spatial cluster of discrete objects which can reasonably be assumed to be the product of a single group of people at that particular locality deposited over a period of continuous residence comparable to other such units - Dunnell 1971:151

Sorting - A comprehensive series of type attributions, in which all of the entities in a particular collection are assigned to one type category or another - Adams and Adams 1991:363

Taxonomy - a particular kind of classification having a specifically hierarchic feature; that is, a classification in which smaller and more specific classes...are grouped into larger and more general ones - Adams and Adams 1991:365

Type - a particular kind of class which is a member of a typology. Types differ from classes more generally in that they must always be mutually exclusive, because they are used as sorting categoriesAdams and Adams 1991:366 - Adams and Adams 1991:367

Typology - a particular kind of classification, one made specifically for the sorting of entities into mutually exclusive categories which we call typesAdams and Adams 1991:370 - Adams and Adams 1991:368

Variable - A feature or characteristic, such as color, which varies from one entity to another, and which is taken into account in the definition and/or description of types. Particular manifestations, or variations, of a variable are referred to as attributes - Adams and Adams 1991:370-71

Several previous attempts to develop a culture history in the Bering Strait region have used harpoon heads as "index fossils" to identify the geographical occurrence and chronological sequence of Eskimo "cultures" (Collins 1937, Geist and Rainey 1936, Rainey 1941, Larsen and Rainey 1948, Ford 1959, Ackerman 1961, Stanford 1973). These efforts have been confusing at best, largely due to a bewildering proliferation of harpoon head "type" designations (cf Ackerman 1961:42-43) and a general lack of consistency in the use of terms such as "classification," "typology," "type" and "taxonomy."

Chapter 5 examines past efforts at harpoon head classification, defines relevant terms as they are used here, and relates their use to the history of archeological investigation in sites in the Bering Strait region.

Previous Approaches to Bering Strait Harpoon Head Classification

Previous analyses of materials excavated from St. Lawrence Island sites have relied on loosely defined classification as the basis for conclusions drawn about the chronology of human occupation of the Bering Straits region. Although differing somewhat in the details of their conclusions, all of these studies are ultimately based on the classification and seriation originally developed by Henry Collins (Geist and Rainey 1936; Collins 1937; Rainey 1941; Giddings 1960, 1964; Ford 1959; Ackerman 1961; Stanford 1976; Bandi 1967, 1969; Crowell 1984; and Staley 1994).

As shown in Chapters 2 and 3, Collins' seriation of St. Lawrence Island harpoon heads does not adequately account for the range of variation in morphology and decorative styles, and does not correlate with my reconstruction of the stratigraphy of the Miyowagh mound. When examined critically, Collins' classification does little to support the proposition of continuity in cultural development between Old Bering Sea and Punuk occupations on St. Lawrence Island.

Collins developed his ideas on Bering Strait cultural development some eight years before his field work, published in 1929 in a small volume for the Smithsonian Institution (Collins 1929). In this work, Collins used descriptions of artistic elements of Old Bering Sea, Punuk and modern decorative styles to propose a continuous sequence of technological development from the older curvilinear style, through the more stylized line patterns of Punuk to the minimally decorated modern styles (Collins 1929:34-40). Collins, and later researchers, equated this technological change with culture change and correlated named archaeological units with culture units.

Collins' (1929:40) initial analysis used presence or absence of twenty-four elements of St. Lawrence Island decorative styles, based on non-quantitative observation of occurrence of the elements Collins concluded:

> "...the Punuk phase of the Old Bering Sea culture, while still characterized by the ancient types of implements and weapons, shows in its decorative art a closer relationship to the modern Eskimo than to the preceding curvilinear stage of the Old Bering Sea culture. On St. Lawrence Island, at least, it represents a transitional stage between the richer curvilinear art and the modern art of the western Eskimo."

Collins' archeological excavations on St. Lawrence and Punuk Islands were conducted in support of his previously developed ideas that Punuk culture, and thence, modern Eskimo, represented a degenerated form of a much richer Old Bering Sea culture that preceded and gave rise to it (Collins 1929:13-14; 1937:377-383). His basic assumption in attempting to systematize the huge variety of materials from the St. Lawrence Island mounds was that these materials were produced by a single initial occupation of the Bering Strait region at some indefinite period in the past which, over time, evolved as a unit into what we now recognize as modern Eskimos (Collins 1954:47). Harpoon heads, being the most numerous, consistently decorated objects, were chosen as the representative bearers of the evidence of culture change, equating technological change with change in culture units. Collins' names for typological categories of artifacts from St. Lawrence Island have become synonymous with the cultures assumed to be responsible for their production and use (Collins 1937:97). To date, there has been little deviation from the Collins outline, and virtually no critical evaluation of the typology and "cultural chronology developed from it.

Collins' brief discussion of typology (Collins 1937:97-99) reveals that, when faced with the complexity of variation in morphology and decorative style, he chose to describe his material in terms of his own perceptions of relevant "types" and to name them, rather than to use objective statistical methods of type formulation (Collins 1937:99). While Collins asserts that he fully tested both approaches, the method and results of these tests are not discusses nor are the criteria for the choice of method that he eventually employed (Collins 1937:99). Therefore, it is impossible to evaluate his classification using objective or quantitaive criteria.

Dunnell (1971:140) describes this approach to classification exemplified by Collins' and Geist's typology of St. Lawrence Island harpoon heads.

> "The 'type descriptions' are in reality unstructured description of groups of artifacts which have already been identified with classes in a classification which has not been presented. Much of the non-replicability associated with the use of classification in prehistory stems directly from this problem — no classification has been presented even though one has obviously been employed."

Adams and Adams (1991) describe American archeology in the time period between the 1920s and the 1950s as the Classificatory Phase, during which researchers were attempting to discover and describe material objects to provide evidence for the systematic classifiaction of prehistoric cultures throughout the world. This is precisely what Collins, Geist and Rainey were doing in their early explorations of St. Lawrence Island, and they did indeed accomplish much to discover the characteristics of the material remains of early occupiers of the region.

At this point, it is important to distinguish between classification and typology (Adams and Adams 1991). Collins' approach produces a stylistic classification, in which objects are grouped in terms of descriptive attributes, and in which all attributes are considered to be elements of style subject to cultural preferences. The purpose of the Collins' classification is to establish index artifacts, indicating the presence of the defined culture, and through an analysis of stylistic changes, determine their temporal relationships. Collins' classification was not used to sort the harpoon heads from the various sites, nor were the classes mutually exclusive. Therefore, although Collins identified his categories as "types," it is more accurate to describe them as classes. This distinction becomes critical in considering the work of later researchers, who used Collins' classification as a typology. Collins' descriptions of harpoon head classes leading to his seriation are included within the 156 pages of detailed descriptions of artifacts excavated from the five major sites on the Gambell plain.

Collins' seriation closed the loop in a tautological classification scheme. The original categories were based on loosely defined similarities in surface decoration, general harpoon head morphology and vertical distribution in the sites. Category names and sequence numbers (e.g. Punuk Style 1, Phase 1) were assigned after the classification was completed. Therefore, the conclusions presented in Collins' Figure 24, illustrating chronological development of open socket harpoon heads are inherent in the definition of harpoon head categories.

Despite the technical limitations of this classifications, Collins provided the only temporal sequence for Bering Strait archaeological sites at the time of its publication. The problems we experience now in applying Collins' work to current interpretation of the archaeological record stem from later researchers who accepted and incorporated Collins' work without critical analysis.

In addition, Collins made significant observations that could have led to very different conclusions had they been given the weight of evidence accorded to perceived similarities in decorative styles. Collins noted that most Birnirk style harpoon heads were made of bone (antler), as opposed to the prevalence of ivory as the raw material for Punuk harpoon heads. He even noted the occurrence of several bone (antler) harpoon heads of Old Bering Sea design and decorative style. He also noted but failed to appreciate the significance of the difference in morphology and structural origin between closed socket and open socket harpoon heads, and between end blade slots parallel and at right angles to the line hole.

Collins thoroughly described the range of variation in St. Lawrence Island harpoon heads and established rough stratigraphic relationships between classes of artifacts. Unfortunately, the most lasting contribution from this work is the assumption of unilineal cultural development in the Bering Straits, a perception that has persisted until today and is only gradually being eroded by the pressure of contradictory evidence (Mason and Ludwig 1990; Gerlach and Mason 1992, Mills 1994).

Rainey (Geist and Rainey 1936, Rainey 1941) followed Collins' lead in classifying harpoon heads by describing and naming them. He assigned letters to classes he considered to be important, while he assigned numbers to those types he considered to be of less importance or rare (Rainey 1941:473). However, Rainey went a step further and attempted to treat Collins' classes, and subsequently his own classes, as if they were types. He used Collins' classification as a typology and attempted to sort the harpoon heads from Kukulik into these loosely defined categories. This resulted in considerable overlap and a number of entities that did not fit existing classes and that required the invention of new, equally loosely defined categories, the so-called "rare types."

Rainey's perception of importance or rarity was based on raw numbers of harpoon heads in the Kukulik mound, through visual comparison with plates published by Collins of harpoon heads from the Gambell mounds. His criteria for grouping was minimally explained, sometimes lumping together extremely diverse forms based on their superficial resemblance to Collins categories. In several cases, classes were defined by the presence of a single harpoon head fragment. Rainey followed Collins' lead in designating his categories of harpoon heads as "types."

Rainey's classes of Okvik harpoon heads are even less discriminatory, lumping many harpoon heads with dissimilar characteristics into poorly defined groups (Rainey 1941).

Ford (1959:238) presented a graphic approach to compare harpoon heads at the Birnirk sites with those from other sites in the Bering Sea area, compiling raw percentage occurrence numbers from the various site reports, and equating high percentage of a particular category with "popularity" of that particular category within the culture that it represented. In all cases, categories were defined by the principal investigator of each site, with little attempt to correlate morphological similarities and differences among sites.

Ford divided harpoon heads into five classes, based on Collins' major groupings of the variables of end and side blade orientation and socket design. He then compared percentage occurrence of the various harpoon head classes, which he called types, between sites, attempting to produce the familiar battleship diagrams he had previously used to classify American Southeest pottery styles (Ford 1952).

Ford's classification scheme is inadequate for this task for several reasons. Comparisons of artifact categories based on raw percentage occurrence fails to take into consideration such factors as differing taphonomic conditions among sites resulting in preferential preservation, relative periods of occupation, and relative numbers of occupants between sites. In the lower levels of St. Lawrence Island mounds, the numbers of surviving artifacts with perceivable features is quite small, often in single digits. In these cases, raw percentage composition does little to measure the significance of the number of a particular category found in the site, compared to the total population in the comparison.

In addition, Ford repeated Collins' view of variation in blade orientation and socket design as stylistic indicators of culture change. As has been demonstrated, these features are structural rather than cultural and are therefore inappropriate in a stylistic classification scheme designed to reveal patterns of technological development.

Furthermore, Ford continued Rainey's (Geist and Rainey 1936; Rainey 1941; Larsen and Rainey 1948) practice of treating Collins' and Mathiassen's classifications as if they were typologies. In considering these general classes as mutually exclusive types, Ford was unable to distinguish those attributes truly held in common within his categories and therefore had no valid basis for comparison of categories between sites.

Ackerman (1961: 43).rejected the previous classification schemes of Collins, Rainey and Ford , preferring instead to produce a site-by-site description of harpoon heads discovered in the 1958 survey. He identified loosely defined categories, and gave them sequential type numbers, which were not coordinated site-to-site. He then compared harpoon heads among sites by various perceived combinations of attributes judged to be similar.

Stanford (1976) used exisiting classification schemes for harpoon heads in his study of the Walakpa site. He based his comparison on earlier classifications by Collins (1937) and Mathiassen (1927), indiscriminately using combinations of their type designations and descriptions. He did not define his criteria for identifying harpoon heads found at Walakpa with Collins' or Mathiassen's type categories.

This review of previous classification schemes for Bering Strait harpoon heads is not presented to prove that these attempts were wrong. They are offered here as examples of the confusion that has occurred in the development of Bering Strait cultural chronologies due to misunderstanding of relevant terms and concepts in the formation of classification schemes.

The following section presents the theoretical basis for the development of the classification scheme used in this study.

History of Classification Theory

A growing dissatisfaction with a loose concept of typology and even looser definition of type was brought to focus by articles, comments and replies between Albert Spaulding and James A. Ford in the 1950s (Spaulding 1953; Ford 1954). Spaulding argued that these informal classifications were inadequate to the task of eliciting patterns of data from the artifacts relevant to patterned human behavior in the past. The informal groupings of artifacts were obviously based on modern perceptions of function and meaning which may or may not have any relevance to the perceptions and behavior of their prehistoric makers. Spaulding insisted that a more objective approach was necessary to discover patterns in the data that would automatically reflect patterned human behavior in the past.

Spaulding (1953) laid out a procedure for statistically determining significant clusters of attributes as a basis for the *discovery* of types. The emphasis on discovery is significant, since Spaulding felt that the process of statistical analysis would reveal clusters of attributes that were favored by the original makers of the artifacts, resulting in types that represented patterned human behavior in the past, rather than the classificatory needs of the modern archeologist. Most of this rather short articles details and justifies the statistical procedure for χ^2 analysis of attribute co-occurrence.

In an unfocused comment on Spaulding's article, Ford (1954) objected to the procedure on the grounds that statistical analysis of an assemblage produces types that are only useful for inter-assemblage comparisons. Ford held that the classification of an assemblage is particularistic to the site; types derived through statistical analysis of assemblages from different sites have no basis for comparison. In this specific objection, Ford was correct, and his objections to "automatic," algorithm-based type selection still holds true today.

Spaulding's (1954) reply to Ford's comment expands on the portion of the article that unfortunately glossed over the most important part of the process of type "discovery." The title of the article mistakenly implies that the statistical technique is the sole basis for type discovery, which is what probably set Ford off in the first place. However, Spaulding explains in detail in his reply that the statistical analysis is merely the first step in the process. Once significant attribute clusters have been determined, they must be examined in the light of the context of the site from which they were derived. Interpretation of statistical clustering is dependent on the meaning of the clusters within the taphonomic and ethnological context of the site. This observation propels Spaulding's technique into the midst of the typological debate some twenty years later (Adams and Adams 1991).

The typological debate of the 1970s was waged over the waters prepared by Spaulding and Ford. David Clarke (1968) steered the flagship of archaeological systematics during this period, applying a systems approach to the entire scale of archaeological endeavor from attribute to culture complex. Clarke agreed with Spaulding that types derived by objective statistical means would automatically possess functional meaning, that empirical analysis designed in the present would detect patterns of human behavior applied to artifacts in the past.

Clarke (1968) also recognized that the bumpy, wiggly world inhabited by real human beings was not as simplistic as theoretical debate made it seem. In his attempt to use the intricacies of systems theory to model complex patterned human behavior, he outlined the concept of polythetic classes as a model to cross the boundary between patterned human behavior in the past and human classification behavior in the present.

Previous attempts to nail down the concept of type tended to view the type as a physical object, an example of the mean, or at least a list of physical attributes that described a physical object.

Clarke (1968:209-217), however, saw the type concept as a dynamic collection of variables having a central core of shared attributes surrounded by a halo of attributes not necessarily shared by all members of the group, the polythetic type. In true systems fashion, Clarke extended this two-dimensional model into multi-dimensional time and space, seeing the attributes of the variables as a constantly shifting cloud that changed through time in patterns that reflected social and cultural processes (Clarke 1968:217-237).

Clarke's most useful contribution to archaeological systematics is this placement of the type concept into the context of the attribute-to-culture complex continuum of social and cultural processes. Even though the semantics of systems theory at times becomes almost hopelessly obtuse, the concept of the type as a dynamic, changing system of attributes is extremely helpful in transforming the earlier static type concept into a practical measure of culture change.

Clarke became a proponent of computer-based numerical taxonomy as a quantitative approach to systematics. However, as Dunnell (1971) and later, Adams and Adams (1991) pointed out, purely quantitative methods produce groupings devoid of meaning and have not proven useful in developing applicable types.

Robert Dunnell's *Systematics in Prehistory* (1971) both clarifies the parameters of systematic classification and further muddies the waters of understanding with unnecessary semantic complication. Dunnell divides the process of organization of an assemblage of objects, which he terms arrangement, into three separate procedures of grouping, classification, and identification, referring to the segregation of physical objects, the creation of units of meaning and the assignment of meaning to physical objects. Although this concept may be useful in a theoretical sense, it adds little to the evolving principals of the type concept. The use of information systems theory and terminology places Dunnell's conceptualization of type formation further out of the mainstream of the debate.

Dunnell offers five simple parameters for the pursuit of classification schemes (Dunnell 1971:46-59):

1) "Classification is arbitrary" - Dunnell differed from his predecessors in recognizing that any classification is a product of contemporary thought, and that no one classification has any more relevancy than any other in the absence of an expressed purpose for the classification

2) "Classification is a matter of qualification" - even in a strictly quantitative approach, classes to be considered must be qualitatively defined if they are to have any meaning in the classification, and must be qualitatively interpreted to give meaning to the phenomenon being classified

3) "Classification states only relationships within and between units in the same system" - classification is meaningful only when the scale is specified

4) "Classificatory units have primacy over labels applied to such units" - labels are arbitrary and must not be used to define the contents of a class

5) "Classifications, classification and classificatory units have primacy over structures, structuring, models, and model-building" - classes must be defined before interpretation can take place

These five parameters explicitly address the problems presented by Collins' stylistic classification of St. Lawrence Island harpoon heads and lay out the path that must be followed in order to re-assess and re-interpret this important data set.

Dunnell (1971:171-176) dismissed Spaulding's attempt to discover natural types through statistical attribute clustering, pointing out that statistical techniques only produce groups, but in no way attach meaning to the groups. This, of course, is what Spaulding himself pointed out in his reply to Ford's comments. Dunnell, however, saw the meaning in classification as coming from the explicitly stated purpose of the process. If the classification and grouping addressed the purpose of the arrangement of the data, the meaning of the classification was self-evident. Without a stated problem, any classification is merely descriptive.

Adams and Adams, two brothers, one a philosopher and the other an archeologist, organized the history of the development of theories of classification and systematics in archeology. Pulling forward the theoretical debate from the past, they assemble a concise history as well as a practical guide to the application of classification theory to problems of archeological typology and interpretation.

Archeological typology and practical reality, a dialectical approach to artifact classification and sorting accomplishes just what the title proposes (Adams and Adams 1991). The authors coherently formulate the history of the theoretical debate within the historical context of scientific thought and endeavor. They clearly define relevant terms, concepts and procedures, presenting the tools of classification and their applications to specific situations.

This work is particularly useful in that it takes the practice of classification out of the airy realm of theory and make it an integral part of the scientific process. The authors recognize at the outset the intuitive nature of most classificatory efforts, and incorporate that reality into the process of classification, recognizing that type concepts arise from a process of ideation and feedback. However, they do stress the necessity of rigorous empirical procedure to validate and confirm intuitive expectations.

Adams and Adams stress that any classification must be informed by a specified purpose, even if that purpose is description and exploration of the limits of a data set. The purpose of the classification gives meaning to the types derived. Types must also be readily identifiable so as to enable sorting of the objects, or of the data derived from the objects, into meaningful categories.

The authors set aside the sixty year-old debate over natural versus artificial types by recognizing that most types are a combination of both perspectives. Researchers realize the necessity for a formal typology through a process of intuitive recognition of perceivable regularities in the attributes of the entities in collections. Empirical processes allow us to explore these regularities and present opportunities for the discovery of additional patterns not immediately perceivable. These patterns may indeed not have been a part of the awareness of the makers of the artifacts we study, but this does not reduce the utility of a classification that can be interpreted to represent social or cultural processes imperceptible to an actor immersed in the context of society.

This practical approach to the theory and practice of classification and typology has contributed to the development of a new classification of St. Lawrence Island harpoon heads, informed by the purpose of a search for threads of meaning in the variation among functionally identified variables common to all forms of harpoon heads. Patterned variation in these functional elements are interpreted as functional strategies specific to the culture groups responsible for their manufacture and use. The functional strategies are then traced through time and space to infer patterns of cultural influence across the Bering Strait over the 2000 years before European contact.

Adams and Adams (1991:208) confirm my contention that stylistic classification and seriation is based on the "assumption of linear, one-directional cultural development, which is not always the way in which cultures actually evolve." Such an assumption clouds our understanding of Bering Strait cultural interaction since Collins' 1937 publication and is laid to rest with a classification derived from functionally identified attribute variation.

Theory of Type Formulation

The typological debate in archeological theory continued unabated from the late 1800s to the present day (Adams and Adams 1991:265-277). One of the central dialectics of this debate involves the perception of typology as representative of either emic or etic perspectives. The question is phrased, "Does the typology developed by the contemporary researcher represent patterns of behavior central to the culture under study, or does the typology represent order imposed on the data by the researcher?" The answer to this "or" question is, "Yes." The typology can be used to demonstrate patterned variability in artifact attributes that are indicative of human behavior patterns, or the typology may be used to impose order on the data for other research purposes.

The question that must be asked in the formation of any classification scheme is, "What is the purpose of this classification?" If the purpose is explicitly understood and stated by the researcher, the answer to the above "or" question is self-evident. A researcher may devise a classification scheme that is explicitly intended to reveal patterns of human behavior that result in patterns of variability observed in the objects under study. On the other hand, the researcher may wish to order the data derived from a collection of material objects with the intent of discovering patterns that may not be evident in the behaviorally produced attributes of the entities in the collection.

Whether or not any classification of a collection of material objects can in actuality reflect the behavior of a prehistoric people can never be known. Such an approach can be used, however, to test the explanation of the observed physical pattern as a function of a postulated human behavior in the past.

Explication of the research purpose leads to the choice of classification scheme necessary to produce the desired result. Classification can be used to describe the collection in general and/or to discover the limits of variation within a collection. Typology can be used to discover relationships among categories within a collection, or even as a practical device for organization and sorting. Taxonomy serves to reveal genetic relationships between identified categories within the collection.

Regardless of the method used to classify a collection, it is important to realize that there is no one form of classification that is applicable to all collections or all problems. Any classification scheme msut be designed to serve a specific research problem; therefore, there may be as many "correct" classification schemes as there are research problems. The only relevant question to be asked is, Does the classification chosen adequately address the purpose of the research.

Another source of much confusion is the choice of attributes, or the choice of variables that serve as the basis for category definition and comparison between categories.

Recently, during the period characterized by Adams and Adams as "the electronic paradigm" (Adams and Adams 1991:274), there has been a tendency to depend on complex computer algorithms and statistical computer programs to determine artifact types through a process of attribute clustering and/or numerical taxonomy. The assumption driving this movement, other than the aura of "scientific respectability" afforded by the use of computers, is that by allegedly removing observer bias, an objective statistical program will automatically produce categories within the classification that more closely reflect patterns produced by aboriginal human behavior. This viewpoint was promoted by Spaulding (1953) and is now part of the received wisdom.

However, an examination of the process of variable selection demonstrates that, as handy as computers are for manipulating large data sets and complex mathematical formulae, the results obtained depend ultimately on the choices made by human researchers regarding the data to be entered. In computer parlance, garbage in equals garbage out.

Any entity within a collection of artifacts to be classified has a virtually unlimited number of attributes by which it can be described. In order to deal with the potentially bewildering array of data obtained, some means of organization must be imposed on the data before it can be classified.

Clarke (1971:70-73) divided these characteristics of entities into three categories: (1) inessential attributes (variables, parameters, etc.); (2) essential attributes (variables, parameters, etc.); (3) key attributes (variables, parameters, etc.).

Inessential attributes are those that do not vary within the study population, or, for other reasons are not pertinent to the purpose of the classification. Essential attributes are those that vary within the study population and pertain directly to the classification purpose. Key attributes are those that exhibit significant correlation, or clustering, after analysis, suggesting a patterned variation within the study population.

The researcher must decide which of the many attributes of the objects under study offer the greatest potential to produce data meaningful to the purpose of the classification. Once the selection of attributes is completed and data gathered, the choice of research tool is less important. An abacus can do the job of arithmetic computation as well as a computer, though in some cases more slowly.

In conjunction with the preference for computer-based analysis, current trends in classification favor complex multivariate analysis over simpler statistical correlation or attribute clustering in type formulation. This partly stems from Ford's (1954) and Clarke's (1971) early criticism of Spaulding's (1953) chi-square technique for attribute clustering, and partly is an attempt to further escape problems of subjectivity in variable and attribute selection, which, as suggested above, is a red herring.

In fact, Adams and Adams (1991) have demonstrated that multivariate analysis produces categories within a classification that have no meaning relative to the classification purpose. Multivariate analysis invariably produces meaningless categories that must be eliminated by subjective researchers (Adams and Adams 1991:292).

Rather than using complex computer algorithms because they are available and produce impressive arrays of data tables, it is far better to carefully determine the purpose of the classification scheme and develop the simplest possible approach to meet those ends, although multivariate techniques do have a plce in class and type formulation.

The Process of Type Formulation

Adams and Adams (1991) thoroughly explore the concept of typology and the requirements for the formulation of types. Their analysis need not be repeated here, but the application of their explanation of type formulation is important to the understanding of the limitations of previous attempts to classify toggle harpoon heads and the basis for the classification scheme here proposed.

The most important of Adams and Adams' conclusions relative to type formulation is their insistence that valid types must have identity and meaning (Adams and Adams 1991:183). Identity is fairly easy, since it is a simple matter to identify a collection of attributes that define a category of objects such that members of the group can be placed in no other identified group. The most extreme example of such a type would be the case in which each individual object defines it own type.

It is important at the outset to select attributes for data gathering that adequately represent the complexity of the objects and offer the greatest potential to address the purpose of the classification. Nothing can be more frustrating to discover, well into data recording, an attribute crucial to the analysis that has not been recorded. If there is any question of the utility of an attribute to the analysis, it should be recorded. An excess of data is far easier to handle than a lack of data.

Once data recording is completed, it is necessary to determine which combinations of the attributes form significant patterns of co-occurrence relevant to the purpose of the classification. Early classification attempts relied on intuitive approaches to class formation, which were relatively easy for the primary researcher to employ and describe, but which were difficult for subsequent researchers to reproduce and verify. Such is the case with Collins' classification of St. Lawrence Island harpoon heads.

Statistical methods of attribute and object clustering are employed to systematize the process of classification and remove the onus of subjectivity. However, statistics are often used to validate conclusions arrived at by the researcher through intuitive perceptions, taking on the nature of post hoc justifications disguised as objective hypothetico-deductive methods. It might be better to admit that subjective perceptions are an important part of the scientific process and formally acknowledge their role in the process of classification.

By the time the researcher has completed the data gathering process, patterns of attribute occurrence will have become apparent. These preliminary patterns can serve as a guide for later data analysis, and in the process of verification or refutation, additional patterns may become apparent. There is, of course, always the possibility that patterns of attribute association not immediately perceivable can be discovered through more formal analysis.

Spaulding's χ^2 method of attribute clustering is a powerful statistical tool for the assessment of attribute association. Although Spaulding originally intended the method to result in discrete types that reflect patterned human activity, Ford's (1948), Clarke's (1971) and Adams and Adams' (1991) criticisms of the technique clearly specify the limitations with respect to type formulation. Nevertheless, the technique is useful to develop a list of significant attribute associations that can be assessed by the researcher as to their applicability to the purpose for classification.

The initial assessment of attribute association will aid the researcher in the choice of attributes and variables to be used in the final classification. From this point, a classification may proceed in several directions, depending on the goal. Statistically determined attribute clusters may be used to describe entity classes, can be further analyzed statistically to develop specific type categories, or may be combined with other data sets to infer functional or behavioral interpretations of the objects.

Chapter 5 - Structure and Function of Toggle Harpoon Heads

Collins' (1937) classification of toggle harpoon heads assumes that all variables are stylistic and therefore culturally determined. In this normative interpretation, the maker of the harpoon head chose to form the features of the object in response to a culturally determined "template" that changed over time in response to various unspecified environmental and/or cultural mechanisms.

> "The toggle harpoon head is the most dependable criterion of cultural change at our disposal, and as such it is destined to bear the main weight of the chronology that must be established if we are to have a clear understanding of the stages of development of Eskimo culture. As a 'time indicator' the harpoon head occupies a position in Eskimo culture analagous to that of pottery in the Southwest (Collins 1937:97)."

While it is no doubt true that some attributes of toggle harpoon heads did respond to changes in the maker's perception of the culturally determined shape of the artifact, it is also equally true that there are structural properties inherent in the raw material of the object that are critical to the ultimate shape and function of the piece. Cultural expectations and response to environmental fluctuation may well play an important role in an artifact's changing morphology over time, but structural characteristics of the raw material provide limiting factors that predetermine certain aspects of construction and form that affect the artifact's ability to perform as desired.

In this chapter, characteristics of the formation and structure of ivory, antler and bone will be compared and contrasted. This understanding of the characteristics of the raw materials will help inform the following discussion of the functional elements of the Bering Strait toggle harpoon head, and to distinguish those artifact variables that are structurally limited from those that respond primarily to cultural factors.

Ivory Structure and Dynamics

MacGregor (1985) provides an excellent summary of the formation, structure and mechanical properties of skeletal materials, including bone, antler and teeth.

The inhabitants of St. Lawrence Island carved ivory artifacts from the tusks of Pacific walrus, *Odobenus divergens,* a species in which both males and females use enlarged upper canines to dig mollusks from the ocean bottom. Ethnographic and historical accounts indicate that ivory carvers prefer juvenile or female tusks for carving because of their smaller size and ease of carving. Male walrus tusks were traditionally used mainly for root mattocks or

Figure 36 - Walrus tusk cross section, showing crystalline inner dentine, outer dentine, and compact, polished surface layer.

picks, which required less surface modification and greater weight and rigidity (Collins 1937:113-114; Geist n.d.).

Walrus tusks are formed primarily of dentine, with a small cap of enamel at the tip. Dentine is composed of parallel microscopic tubules that run longitudinally through the tusk, enhancing its rigidity and resistance to compression. The dentine is formed in two layers (Figures 36), an outer, homogeneous layer with occasional globular inclusions of secondary dentine, and an inner, crystalline layer that forms in the former pulp cavity (MacGregor 1985:18).

Although the outer layer of the tusk is basically homogeneous, it consists of a series of nested cones formed by the annual incremental addition of new layers of dentine, increasing the size of the tusk laterally as well as longitudinally. In cross section, distinctive layers of outer dentine surround the irregular structure of the inner dentine. A thin outer layer of compacted, polished dentine, results from impact and wear throughout the life of the walrus.

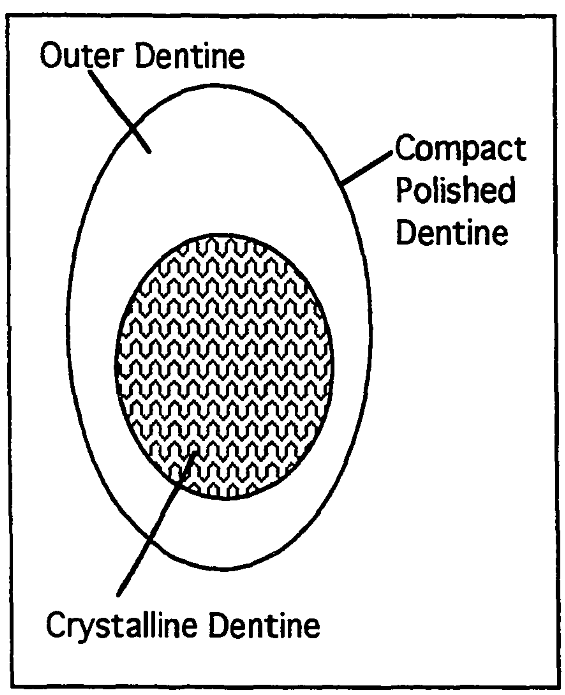


Figure 37 - Ivory Structure

The overall morphology of the outer dentine layers, while basically symmetrical, nevertheless exhibits local variation, being thinner in same areas of the cross section than others (Figure 37). The lateral shape of the cross section is usually more oval than round, varying in regularity throughout the length of the tusk. At the tip of the tusk, the inner crystalline dentine tapers to a narrow point within the remaining outer layer, and is usually located off center from the midline of the tusk.

The layered structure of the outer dentine is important in determining the mechanical properties of ivory as a raw material. MacGregor demonstrates that the layered structure of the outer dentine acts in much the same way as laminated plywood, adding rigidity and resistance to tensile stresses. This structure also introduces anisotropic (directionally oriented) properties into the material that are important in the design and function of harpoon heads and other artifacts (MacGregor 1985).

Layering also adds another property to ivory that determines the way ivory artifacts are carved and decorated. The laminar structure produces what MacGregor refers to as the "Cook-Gordon crack stopper" effect. When a crack is initiated in the surface of the dentine, either through artificial scoring or through natural surface irregularities, stress within the longitudinal structure of the material is concentrated at the point of the crack. In a completely homogeneous material, the crack would quickly run through the material to the other side, causing complete structural failure. In a laminar material, the interface between layers diverts the stresses in the crack and dissipates them laterally. The material retains most of its structural integrity and failure is avoided (MacGregor 1985:23-24).

Antler and Bone Structure and Dynamics

The archeological collections at the University of Alaska Museum contain numerous harpoon heads initially identified by Geist and other early researchers as bone, but which, on closer examination, prove to be antler. Geist may not have distinguished between bone and antler in his own research, but the difference is critical to the understanding of the various sources and cultural correlations of harpoon heads in the Bring Strait region.

Criteria established by Dale, et al (n.d.), distinguish between macroscopic characteristics of artifacts manufactured from caribou, *Rangifer tarandus*, antler and those carved from other forms of terrestrial mammal or sea mammal bone. Antler and bone consist of strands of organic collagen in a matrix of inorganic apatite crystals. These components constitute two basic bone types (See also MacGregor 1985:2-5):

1) Woven bone, in which randomly oriented collagen strands or apatite crystals generally contain a higher ratio of mineral to organic components.

2) Lamellar bone contains layers composed of strands of collagen surrounded by plates of apatite crystals that follow the

orientation of the organic fibrils. The fibrils of individual layers may be oriented in alternating directions.

Both woven and lamellar bone are interpenetrated with cavities or lacunae that are organized around the circulatory system. Osteocytes within the lacunae preferentially resorb or produce bone material, producing a system of channels within the bone called the Haversian system.

The distinction between compact and cancellous bone characterizes skeletal bone. Compact bone has few, if any, lacunae; blood vessels occupy the only breaks in the structure. Cancellous bone has an open structure produced by numerous lacunae of the Haversian system and has as much or more open spaces than actual bone material.

Due to its generation during a period of extremely rapid growth, antler consists of coarse woven bone in which the central cancellous tissue orients longitudinally in long unbroken tubes. After the antler has achieved full growth, the Haversian system is at least partially replaced with compact bone, until all growth stops at maturity.

Compact lamellar bone is mechanically superior to woven bone, approaching the structural strength and strain resistance of ivory. However, even though woven bone is the primary constituent of antler, its growth characteristics produce a material with a greater bending strength than lamellar bone. This factor may be more important in the construction of artifacts subject to extreme lateral stress (MacGregor 1985:27-29).

The structure of the raw materials used to manufacture harpoon heads imposes limitations on the carving of the artifact based on culturally determined needs and expectations and predetermines the dynamics of the response of the artifact to the stresses of use. An understanding of ivory, antler and bone structure informs the following discussion of harpoon head function.

Functional Elements of Toggle Harpoon Heads

The following description of the morphology and function of toggle harpoon heads is based on Murdock (1892), Geist (n.d.) and my observations of 1614 toggle harpoon heads from the collections at the University of Alaska Museum.

There are four functional elements active in a toggle harpoon head (Figure 4): (1) Point; (2) Line hole; (3) Socket; (4) Spur.

Harpoon Head Points

The harpoon head point serves three functions. The sharpened end of the point cuts the surface of the tough hide of the prey, allowing the harpoon head and line to fully penetrate below the inner surface of the hide (Figure 38). The lateral cutting surfaces of the point, whether formed by a wide end blade or by one or two side blades, produces a slit in the hide wide enough to allow the entire harpoon head and accompanying line to penetrate the hide. Finally, after penetration, the point serves as one end of the toggle that secures the harpoon head underneath the hide and allows the hunter to retrieve the prey animal (Murdock 1892:218).

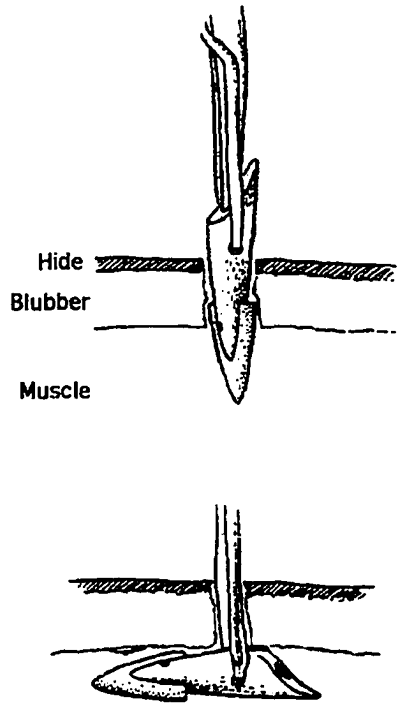


Figure 38 - Toggle harpoon head action (After Spencer 1985)

There are three approaches to the production of a point at the anterior end of a toggle harpoon head: (1) Self end-blade; (2) Side Blades or side blade and barb; (3) End blade.

The self end blade (Figure 39 A) is carved entirely from the raw material, forming the point and cutting edges with no additional composite blades. Self end blades usually have a medial ridge running from the line hole to near the point of the blade and

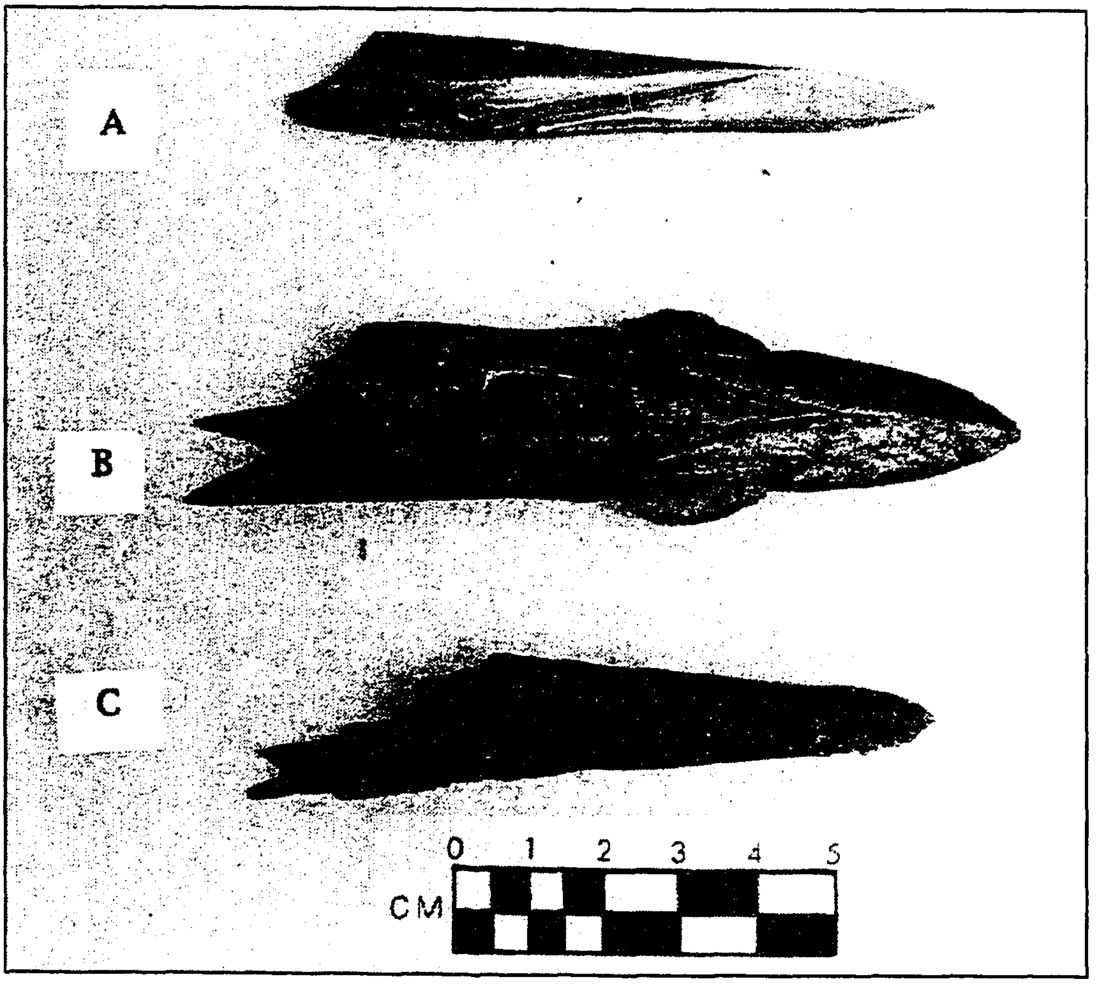


Figure 39 - Harpoon Head End Blades

sometimes form barbs at the lateral cutting edges. Self end blades are oriented either parallel to or at right angles to the line hole.

To carve a composite end blade (Figure 39 C), the maker cuts a slit in the point of the blade and inserts a chipped stone, ground slate or metal end blade. The composite blade is wider on its lateral cutting edges than the harpoon head itself. Some ground slate and all metal blades were held in place by an ivory or metal rivet driven into a hole drilled through the jaws of the end blade slot and the enclosed end blade. The composite end blade is oriented either parallel to or at right angles to the line hole.

The carver assembles a side blade (Figure 39 B) by cutting a groove or grooves on the lateral margins of the harpoon head point and inserting a chipped stone, polished slate or, in some cases, a shell blade. The point may have two side blades, one side blade alone, or a combination of one side blade and one barb. In many harpoon heads with two side blades, the side blade groove penetrates completely through the ivory, creating a continuous slot through the point. The length and shape of the point between the side blades vary considerably, in some cases functioning as a self end blade. Side blades may be oriented either parallel to or at right angles to the line hole.

Line Holes

The line hole serves as an anchor point for the line attached to a float bladder or board that slows the animal and marks its position. To ensure its complete attachment, the line attachment fully penetrates the structure of the harpoon head, either as a drilled hole or as a triangular or D-shaped carved hole.

The line hole is almost exclusively centered in the harpoon head longitudinally and laterally and penetrates the narrowest part of the harpoon head blank. Circular line holes are drilled in the round with sharp or beveled edges, in some cases as two line holes connected by a shallow groove. Triangular line holes are carved, with the pointed end of the triangle toward the point of the harpoon head. D-shaped, sculpted line holes may initially be drilled, but are subsequently carved into their finished shape. (Figure 40)

Foreshaft Socket

The foreshaft socket is the point of attachment between the harpoon head and the foreshaft, usually by way of a detachable foreshaft secured to the main harpoon shaft with a line. The socket functions to securely hold the harpoon head to the foreshaft during the strike, and just as importantly, to release the harpoon head from the foreshaft after the strike (Murdock 1892:219).

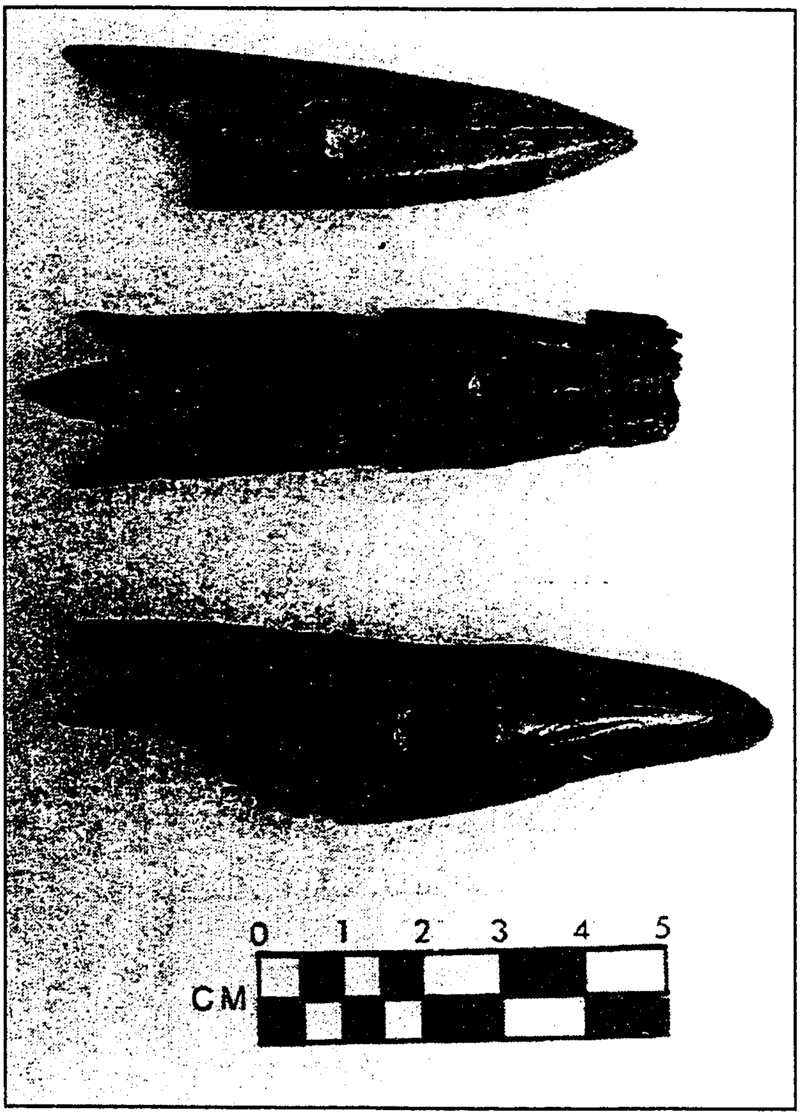


Figure 40 - Harpoon Head Line Holes

The foreshaft socket is at the base of the harpoon head, in the curve from the body of the head to the spur. There are three forms of foreshaft socket (Figure 41): (1) Open Socket; (2) Closed Socket; (3) Triangular Socket.

The open socket is carved on one face of the harpoon head in a C-shaped or square cross section. Since one side is open, lashings made of baleen strips hold the foreshaft into the socket tightly enough for use but with enough freedom to release the foreshaft after the strike. The open socket is flanked by one or two carved lash slots, drilled holes or carved groove, or a combination of these features. The roughened inner surface of the open socket serves to secure the foreshaft.

A longitudinal round hole forms the closed socket, drilled from the base of the harpoon head toward the point. Closed sockets initially require no lashing, however, if the walls of the socket have cracked or broken from the stresses of use, lashing holes, slots or grooves modify the harpoon head to function as an open socket design.

The triangular socket is formed in a manner similar to the open socket, but with a triangular cross section and a relatively narrow opening at the outer surface of the harpoon head. Triangular sockets function initially as closed sockets and often were repaired after breakage with the addition of drilled or carved line holes and/or a carved lashing groove. Collins included triangular sockets in his open socket category.

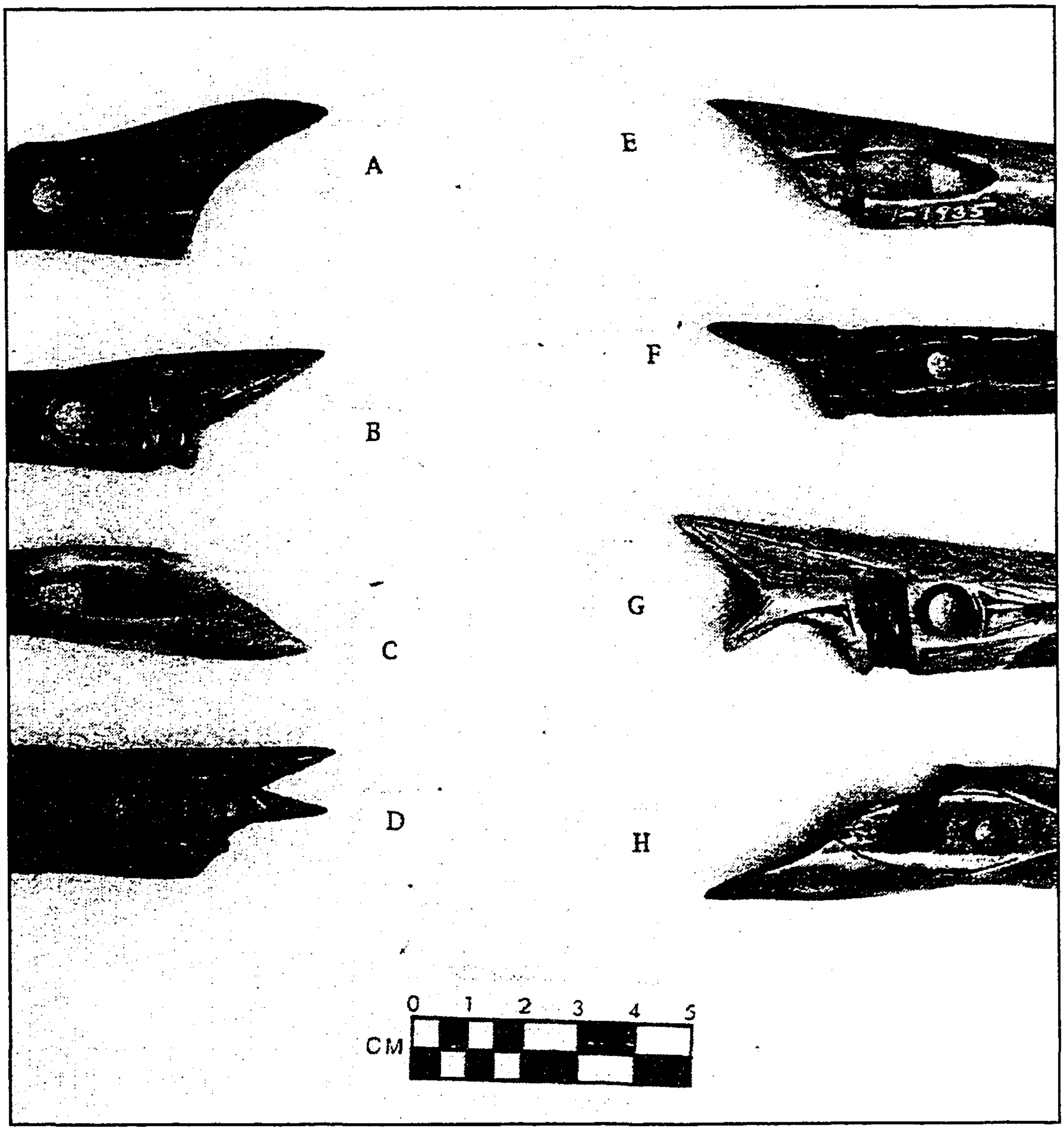


Figure 41 - Foreshaft Sockets

Spur

The spur functions to force the harpoon head to turn sideways in the wound when tension is brought on the attachment line. When the harpoon head is parallel to the hide, the spur acts as the other arm of the toggle, opposite the point, and prevents the harpoon head from being pulled back through the wound (Murdock 1892:219).

Harpoon head spurs exhibit the most variability of any functional feature of the harpoon head (Figure 42). Spurs may be symmetric or asymmetric, single, bifurcated or trifurcated or contain one, two or multiple barbs, or any combination of the above characteristics.

Dynamics of Harpoon Head Use

I derived the following description of forces acting on a toggle harpoon head at the moment of impact from Murdock's description of harpoons in use (Murdock 1892:218-219), and from my own observations of breakage patterns of 1614 harpoon heads from the University of Alaska Museum collections.

At the moment of impact (Figure 43), the harpoon head receives compression forces both from the point toward the socket and from the socket toward the point. These forces transfer laterally at the base of the socket nearest the line hole, and, if an end blade is present, the forces are diverted laterally at the base of the end blade slot nearest the line hole. The end blade itself tends to wedge open the end blade slot, bringing lateral forces to bear

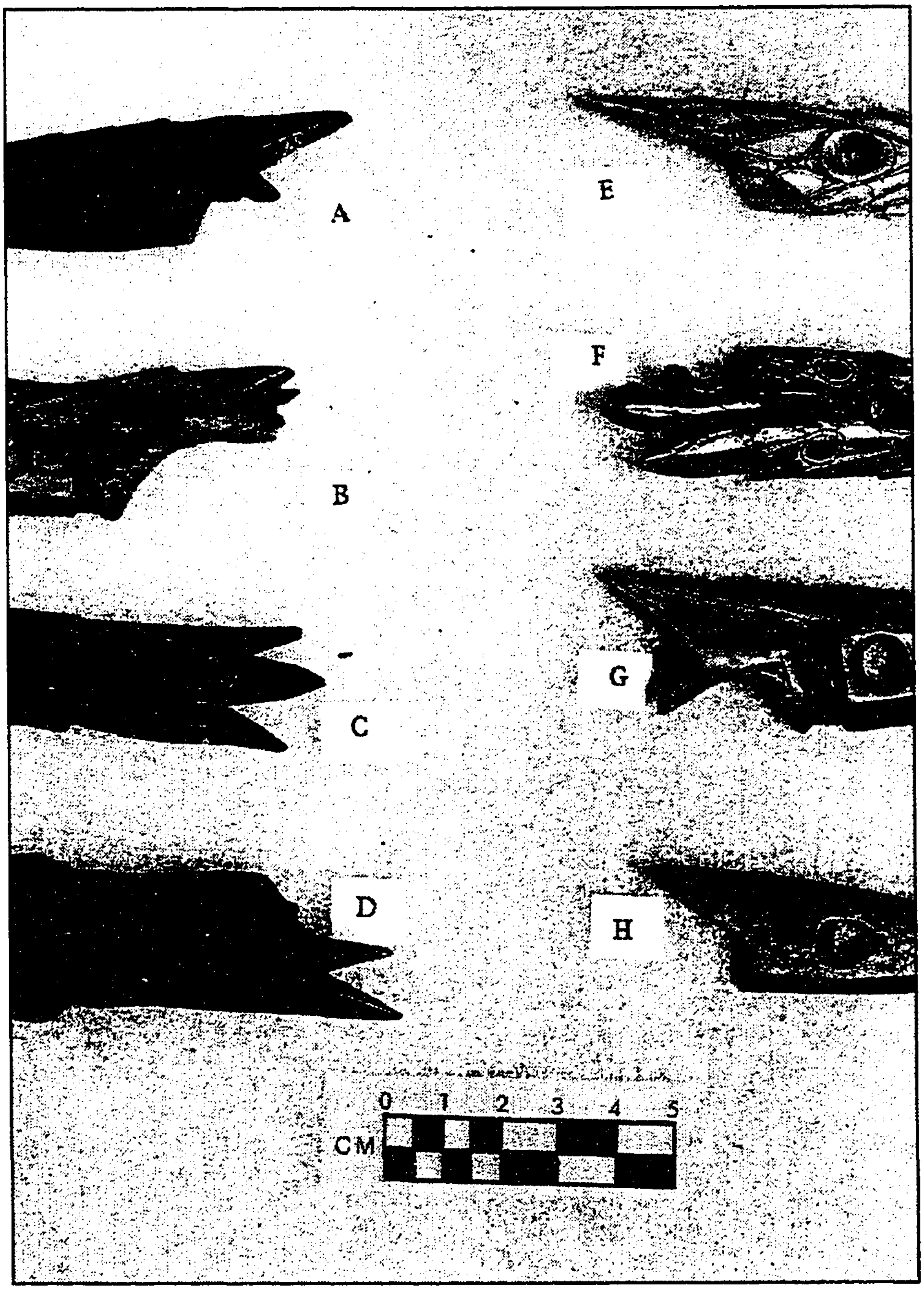


Figure 42 - Harpoon Head Spur Designs

against the two jaws of the end blade slot. The line hole disrupts the lines of force traveling longitudinally through the harpoon head and diverts them laterally (Figure 43).

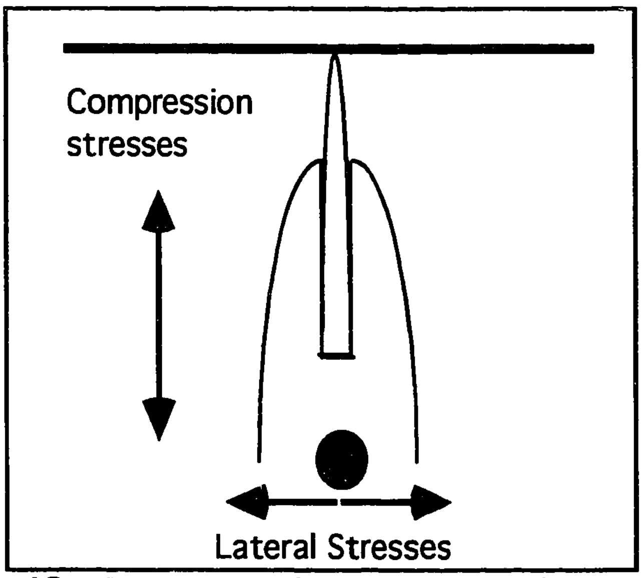


Figure 43 - Stresses on the Harpoon Head at Impact

After the strike, the attachment line tightens, pulling the harpoon head back toward the entry wound. The spur engages the hide at the margin of the wound and causes the harpoon head to twist sideways, parallel to the hide (Figure 38).

This action disengages the harpoon head from the foreshaft, or breaks the foreshaft at the lip of the socket, bringing lateral forces to bear on the edges of the socket, against the spur and point as the harpoon head twists sideways and pulls up against the inner surface of the hide. As the attachment line pulls on the line hole, compression and tension forces move through the harpoon head material adjacent to the line hole. These forces increase and decrease irregularly as the animal struggles and finally dies.

This dynamic picture of the toggle harpoon head in action underlines the interaction between the design of the harpoon head and the physical characteristics of the raw material.

Harpoon Head Construction Sequence

Preparation of raw material

I derived the following description of harpoon head construction from observation of 1614 harpoon heads in the study collection, and observation of numerous walrus tusks used as raw material sources.

Ivory carvers create harpoon heads from the outer homogeneous dentine layer of the walrus tusk (Figure 44). The carver removes ivory by scoring a series of deep parallel longitudinal grooves in the surface of the tusk through to the underlying crystalline dentine. A wedge is employed to break these long narrow ivory slabs from the tusk, which are cut to appropriate lengths for harpoon heads or other artifacts. The remaining conical ivory piece at the point of the tusk is the raw material for the construction of closed socket harpoon heads.

In cross section, the ivory slabs are roughly rectangular and slightly curved (Figure 44), the curvature and thickness varying depending on the shape of the tusk at the point of removal. Since the tusk is roughly oval in cross section, some pieces of ivory are quite flat and slightly curved, while others are thicker with a more steeply curved upper surface. The laminar structure of the ivory follows the curve of the cross section, creating an ivory blank made up of a series of curved plates, tightly bonded together. The outer, convex surface of the slab consists of a compacted and polished layer, while the inner, concave surface contains fresh ivory from within the tusk.

The remaining conical piece from the point of the tusk is roughly symmetrical laterally, with a cone-shaped form of primary dentine surrounding the central crystalline core. The core rarely forms in the exact center of the tusk, but more usually forms toward the edge of the primary dentine. The entire outer surface of the cone consists of a thin compacted, polished layer.

The total number of harpoon head blanks produced from a single tusk varies, depending on the size of the tusk and the quality of the ivory. In general, one tusk yields numerous flat ivory slabs but only one conical, symmetrical point.

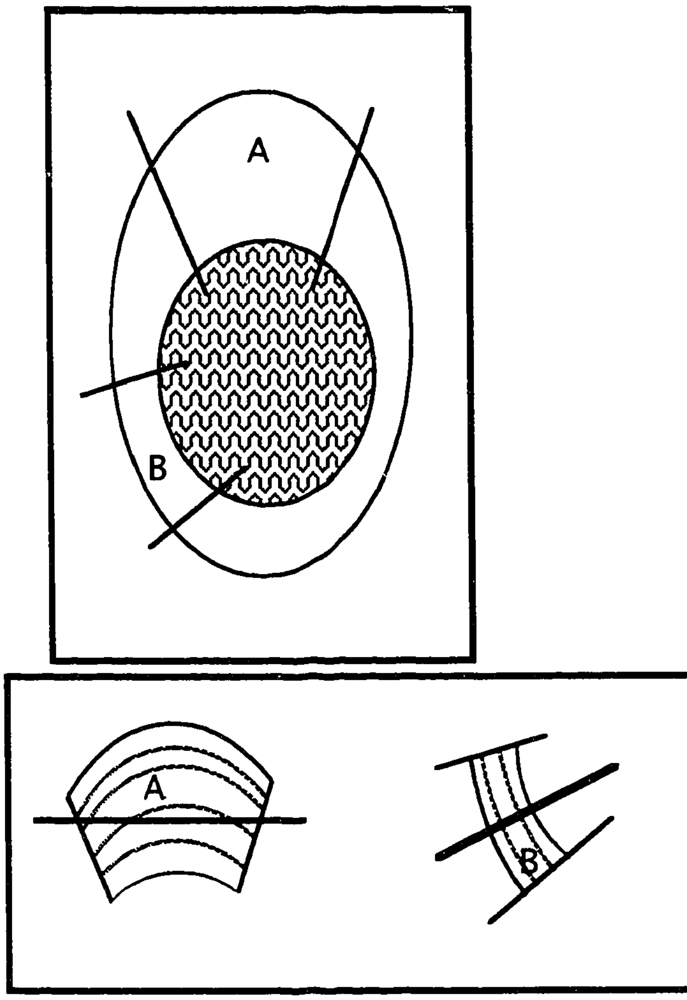


Figure 44 - Comparison of the difference in ivory structure between A) relatively thick ivory removed from a sharply curved surface of the tusk; B) relatively thin ivory removed from a less curved surface of the tusk.

Harpoon Head Construction Sequence

The archeology collections of the University of Alaska Museum contain numerous examples of unfinished harpoon heads (Figure 45), from which I reconstruct the complete construction sequence.

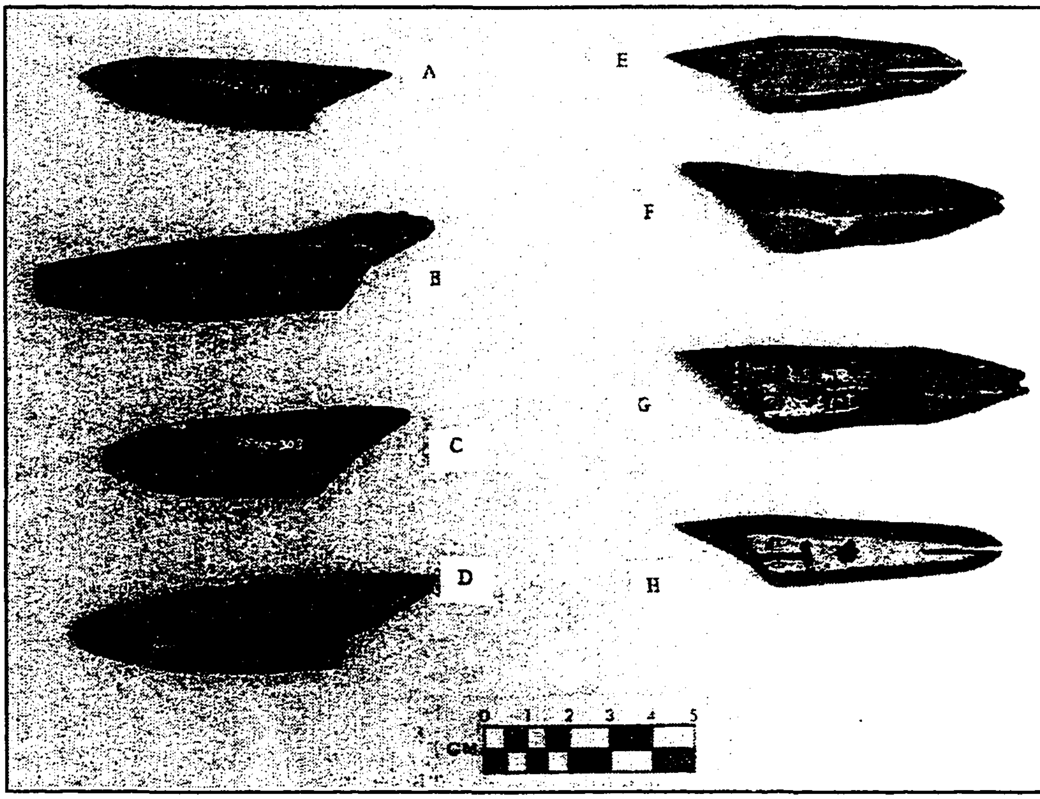


Figure 45 - Unfinished Harpoon Heads

The carver cuts rough ivory slabs from the tusks to a length appropriate for the width of the slab and the intended end product, then roughly shapes the blank to the outlines of the spur and body of the piece.

The socket is the first functional feature of the harpoon head formed. Harpoon heads carved from blanks cut from the sides of the tusk are invariably carved with open or triangular sockets, with the socket placed on the concave curve of the blank. This is the side originally oriented to the interior of the tusk.

Open sockets are formed with four initial cuts, three parallel cuts oriented longitudinally to the finished piece and one cut at right angles to the midline of the piece connecting the parallel cuts at the ends closest to the center (Figure 46). The cross cut serves as an end stop when the ivory remaining between the parallel cuts is gouged out to form the socket (Collins 1937:114).

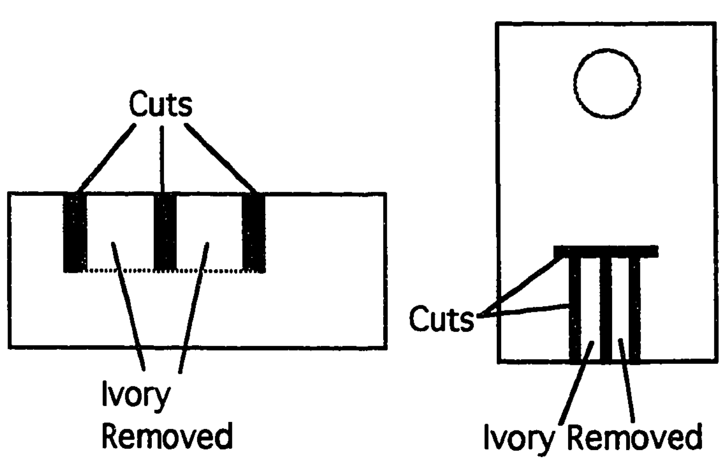


Figure 46 - Open Socket Construction

The triangular socket is carved with three cuts, one of which is at right angles to the midline of the piece, forming the stop cut (Figure 47). The remaining two cuts shape a forty-five degree angle to the vertical midline of the piece, forming an upside-down V, with the apex at the surface of the piece. The remaining triangular shaped piece of ivory is gouged from the piece to the stop cut. In some rare cases, a triangular socket began as a drilled hole close to the edge of the piece, thinning the surface until it intersects the margin of the drill hole.

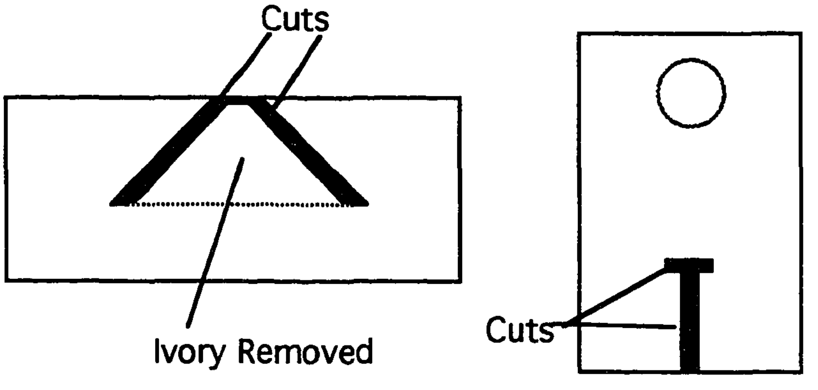


Figure 47 - Triangular Socket Construction

The closed socket is drilled longitudinally into the blank, at the point where the inner, crystalline dentine is closest to the outer edge of the blank. Closed sockets are used almost exclusively in harpoon heads formed from the end point of the tusk (Collins 1937:114).

The end blade slot, if present, is the next feature of the harpoon head formed. A longitudinal slot carved in the point from the midpoint of the piece, not quite intersecting the tip of the point forms the receiving slot for the end blade. The end blade slot in many cases remains unfinished until the line hole is drilled or carved. The end blade slot is finished by continuing the slot to the tip of the point, but narrower than the main part of the end blade slot. This produces an end blade slot narrower at the point than at the midpoint of the piece. With the end blade inserted into the slot, the jaws of the end blade slot create pressure on the blade that helps hold it into position. This apparently does not work as well with a metal end blade, since, on recent harpoon heads, an ivory or metal rivet affixes the blade in the end blade slot (Collins 1937:115).

Lash slots are carved after the end blade slot is initially formed. The end blade slot is finished to the edge of the point and, finally, surface decoration is applied.

Structural considerations in carving the harpoon head

Socket Design

Examination of the 1614 harpoon heads in this study indicates that the closed socket design correlates almost exclusively with ivory cut from the tip of the walrus tusk. The cross section of the tusk illustrated in Figure 37 demonstrates the relationship between the ivory structure and the form of this type of harpoon head.

The primary dentine at the tip of the tusk is essentially symmetrical, although the central crystalline dentine is usually off-center. Drilling the socket into the softer central dentine core places the carved body and spur of the harpoon head in the more resistant outer dentine (Collins 1937:113-114).

Since the layers of dentine at the tip of the tusk are circular and unbroken by socket or lash slot, this design is structurally more resistant to breakage than the open socket designs carved from ivory slabs from the sides of the tusk (Figure 48). In addition, the closed socket design does not require lashing to the foreshaft, making it a much more efficient design in use.

Foreshaft lashing

There are five approaches to lashing the open socket toggle harpoon head to the foreshaft: (1) Two lash slots carved perpendicular to the plane of the blank (Figure 48 A); (2) Two lash slots carved parallel to the laminar structure of the ivory, meeting in a shallow groove on the opposite side as the open socket (Figure 48 D); (3) One lash slot and one notch (Figure 48 G); (4) One groove around the socket (Figure 48 F); (5) Drilled lash holes (Figure 48 E).

Other than the closed socket, two lash slots provide the most secure method for attaching an open socket harpoon head to the foreshaft. There are two approaches to this design. The most common approach is to carve the lash slots at an angle to the plane of the ivory blank such that the ends meet on the opposite side to the socket in a shallow notch. In this design, the lash slots roughly parallel the layers of the ivory blank and distribute the forces

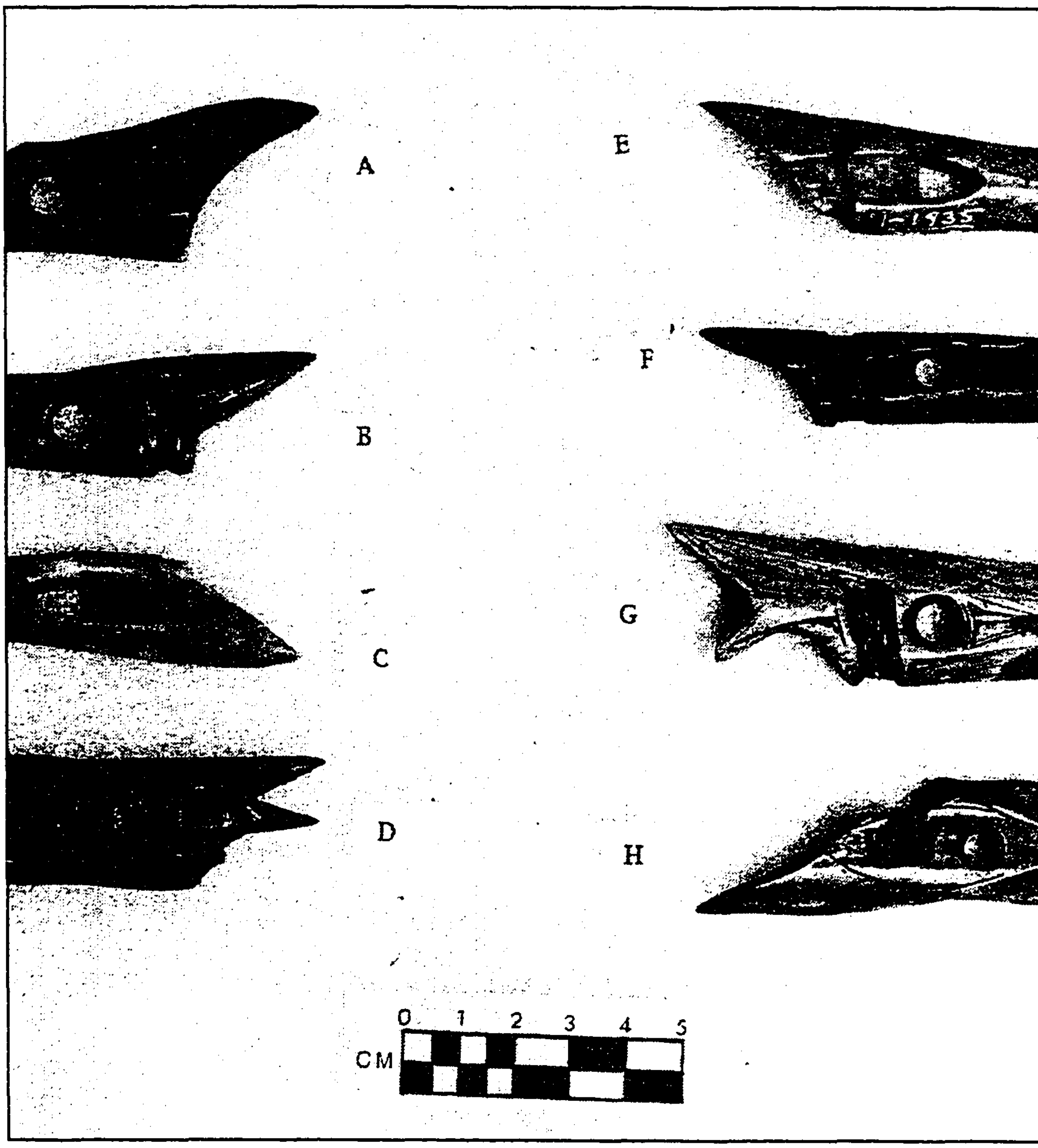


Figure 48 - Harpoon Head Lashing

transferred from the foreshaft to the harpoon head across the planes of the ivory layers (Figure 49).

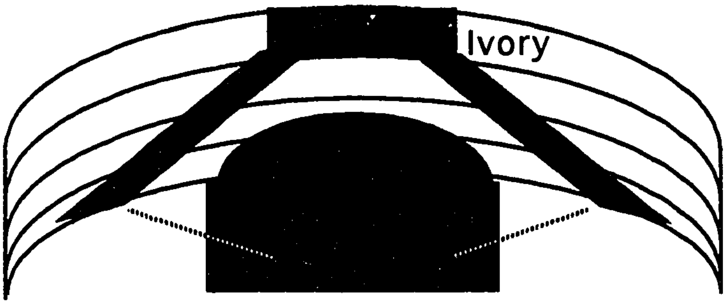


Figure 49 - Angled Lash Slots (Cross-section)

A less common approach is to carve the lash slots perpendicular to the plane of the ivory blank straight through to the opposite side. This produces two parallel breaks in the layers of the ivory and reduces their structural integrity (Figure 50). Harpoon heads with this type of lash slot often break at the outer margin of the lash slot and the edge of the socket.

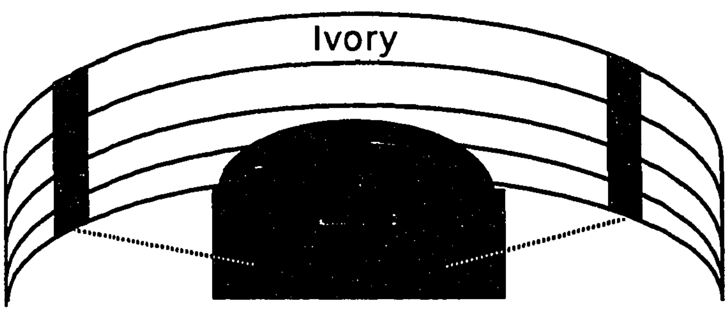


Figure 50 - Parallel Lash Slots (Cross-section)

Use of one lash slot and one notch lashing produces a harpoon head that is faster and easier to haft on the foreshaft than the two lash slot design, due to the presence of only one lash slot to thread the lashing through when attaching the harpoon head to the foreshaft. The lack of perforation on one side also produces a stronger lateral structure resulting in decreased chance of breakage on this side of the harpoon head (Figure 48 G).

The single groove carved entirely around the socket correlates exclusively with harpoon heads with triangular sockets (Figure 48 F). The addition of lashings may strengthen the sides of the socket to withstand lateral stresses in use, as there is no discernible additional difference between harpoon heads with triangular sockets with or without the single groove.

Drilled lash holes are common on harpoon heads from the recent houses at Kukulik (Figure 48 E). They are associated with closed socket or triangular socket design. Unlike those harpoon heads illustrated by Mathiassen (1927) and Ford (1959), the drilled lash holes seem to associate with cracked or broken socket edges on closed or triangular socket harpoon heads (Ford 1959:168). It appears that the drilled lash hole in the Kukulik harpoon heads is a repair feature rather than part of the original design of the harpoon head.

End Blade orientation

Collins and subsequent researchers used orientation of the end blade relative to the axis of the line hole as an attribute for classification. In a stylistic classification, this approach assumes that orientation of the line hole was culturally determined. However, based on observation of the structure of harpoon heads from Kukulik, I suggest that orientation of the end blade is a function of the shape and structure of the original ivory blank that was removed from the tusk.

Blade slots must be carved in the point of the harpoon head in such a way that the ivory structure at the point can best withstand the compression and shearing forces applied to the artifact during use. The laminar structure of the ivory provides greater strength and flexibility than a completely homogeneous material would, as noted earlier.

For an ivory harpoon head blank, the end blade slot must be carved such that the ivory will withstand the compressive forces that on impact tend to split the ivory apart at the end blade slot, as well as the lateral forces applied when the harpoon head "toggles" and is pulled sideways against the inner surface of the hide of the prey animal (Figures 38 and 51).

The curved, layered structure of ivory is ideal for withstanding this combination of forces. As can be seen in Figure 52, a slot carved parallel to the layers of the ivory tends to separate the laminar structure of the ivory reducing its structural integrity. A slot carved at right angles to the ivory layers cuts across the laminations, resulting in a form that resists splitting and separation.

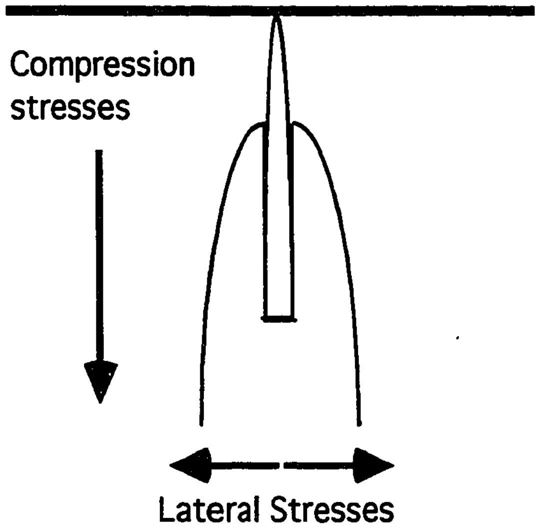


Figure 51 - Stresses acting on harpoon head structure

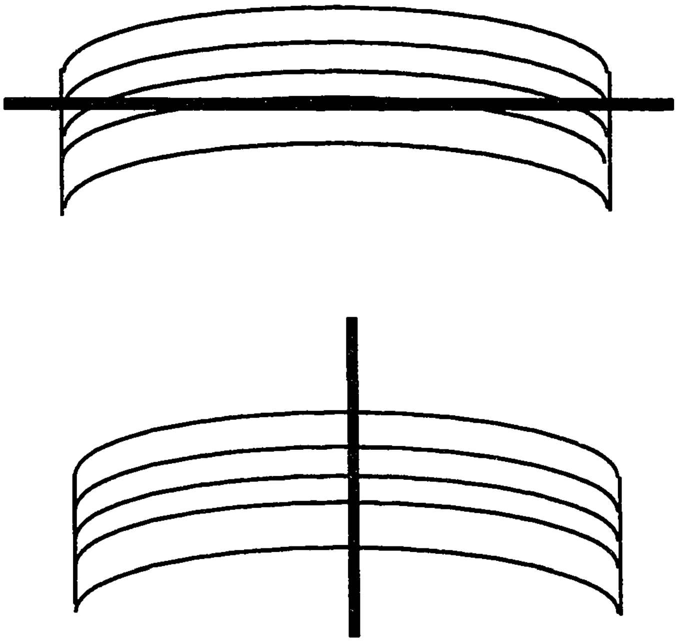


Figure 52 - Orientation of end blade slot

Chapter 6 - Kukulik Harpoon Head Classification

Purpose

The purpose of this classification is to produce a typology of harpoon heads from the Kukulik and Okvik sites on St. Lawrence Island and Punuk Island that accounts for variability in harpoon head morphology and provides explanations for the relationships among Okvik, Old Bering Sea, Punuk, Birnirk and Thule occupations of these sites and other sites in the Bering Straits region.

The Collections

The University of Alaska Museum holds 520 accessions from St. Lawrence Island, numbering approximately 85,000 catalogued and numerous uncataloged objects. The collections were obtained through purchase, gifts and excavation between 1926 and 1960 by Otto Geist, Louis Giddings, Ivar Skarland and Wendell Oswalt. The St. Lawrence Island accessions include 267 collections from the Kukulik mound, numbering 58,000 catalogued and numerous uncataloged objects, including the 1614 toggle harpoon heads in this study.

Documentation for the Kukulik excavation is minimal when it is available at all. Geist and Rainey published *Archaeological Excavations at Kukulik* in 1937 (Geist and Rainey 1937) but it contains little apart from summary provenience data and no catalog numbers for artifacts appearing in the figures. Some of Geist's and Rainey's field notes have been maintained in the University of

Alaska Archives, but these notebooks cannot be correlated with catalog entries in the University of Alaska Museum Archeology Department. Field numbers and provenience data were not transferred from field notes to catalog records. Paper tags remain attached to 122 of the artifacts themselves, indicating field numbers and provenience data.

The lack of provenience data from the Kukulik excavation is puzzling, since Geist and Rainey extensively surveyed the site even to the point of developing an elaborate system for recording provenience in the 1931-1933 test cut. Geist designed a system of movable wires over the excavation to aid in the measurement of artifact locations. This provenience system is documented on charts in the University of Alaska Museum collection and is referred to several times in *Archaeological Excavations at Kukulik*. However, any data recorded in this manner has not survived.

Despite the loss of this important data set, the artifacts from the Kukulik excavations can be analyzed to compile a considerable amount of data relevant to the culture history of St. Lawrence Island. Statistical analysis of relevant variables of the artifacts can reveal significant clustering of attributes that may then be used to infer patterns of interrelationships between occupations of St. Lawrence Island and the Bering Straits region.

Although the relationship among Okvik, Hillside and Old Bering Sea artifacts is pivotal in the understanding of the early culture history of St. Lawrence Island, there is only one artifact in the

Kukulik material associated with the Okvik decoration style. For this reason harpoon heads from the Okvik site on Punuk Island, excavated by Geist in 1934, are included in this study, as are four harpoon heads from the Hillside site excavated by Giddings in 1939.

Observations

I recorded data from 1614 harpoon heads from the Kukulik and Okvik sites for this study, including measurements of length, width and depth in millimeters. I calculated a value for the depth to width ratio as a measure of the "flatness" of the harpoon heads. All measurements were recorded in a relational database, ordered by catalog number for each harpoon head (Appendix A)

I measured depth with a dial caliper at the midpoint of the line hole, parallel to the axis of the hole (Figure 53). I measured width at the same point at a right angle to the axis of the line hole. In the case of harpoon heads with double line holes, I measured depth and width at a point midway between the holes. I measured length from the tip of the spur to the tip of the point, not including the end blade, where present. Eight hundred and eighty-one of the 1614 harpoon heads were not measured in at least one dimension due to the lack of diagnostic measuring points due to breakage or incomplete carving of the harpoon head.

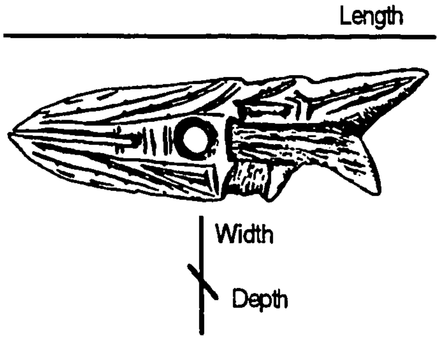


Figure 53 - Harpoon Head Measurement Points for Length, width and Depth.

Figure 54 presents histograms for the distribution of ordinal data from the 733 measured harpoon heads. I analyzed the data using the Kolmogorov-Smirnov statistic to determine goodness-of-fit between the observations and the expected normal curve.

The Chi Square and z values for the measurents of length, width, depth and depth-to-width ratio indicate that these data are not normally distributed and therefore cannot be compared using parametric statistics.

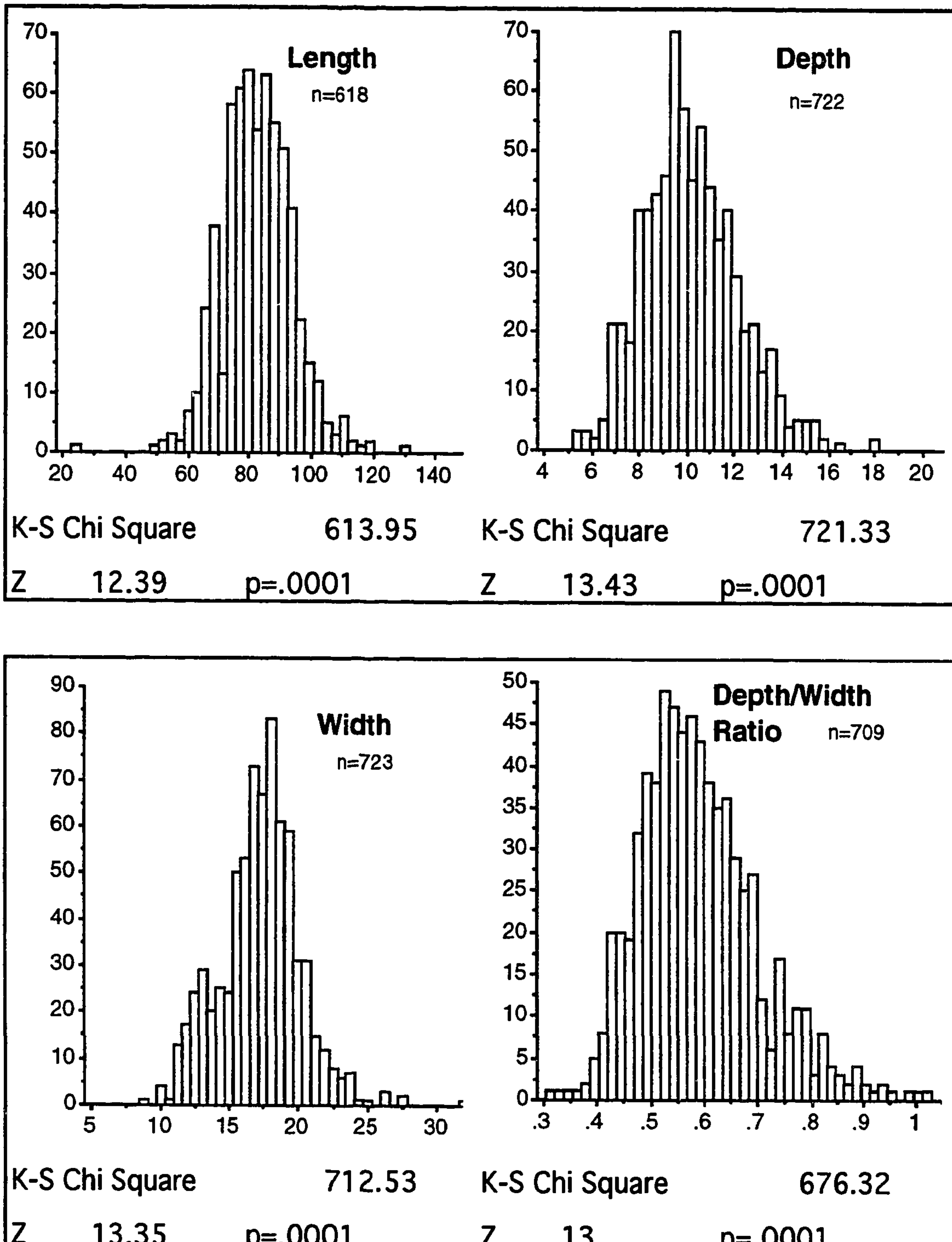


Figure 54 - Histograms for the Distributions of length, depth, width and depth to width ratio, with Chi Square and Z values derived from the Kolmogorov-Smirnov test.

Preliminary Analysis

In his classification of St. Lawrence Island harpoon heads, Collins divided all harpoon heads into major classes on the basis of three variables: (1) socket design, with the attributes of open or closed socket; (2) end and side blade orientation, with the attributes of parallel to the axis of the line hole or right angle to the axis of the line hole; (3) decorative style, with the attributes of Okvik, Old Bering Sea, Punuk and Thule.

As the basis for deriving a new typology of St. Lawrence Island harpoon head, I first assessed the study collection on the basis of Collins' three major classes. My working hypothesis for this assessment is that blade orientation and socket design are functions of raw material structure rather than cultural preferences and, as such, may be considered as inessential attributes (Clarke 1968) and therefore unsuitable for consideration in the formulation of a typology of harpoon heads based on structure and function..

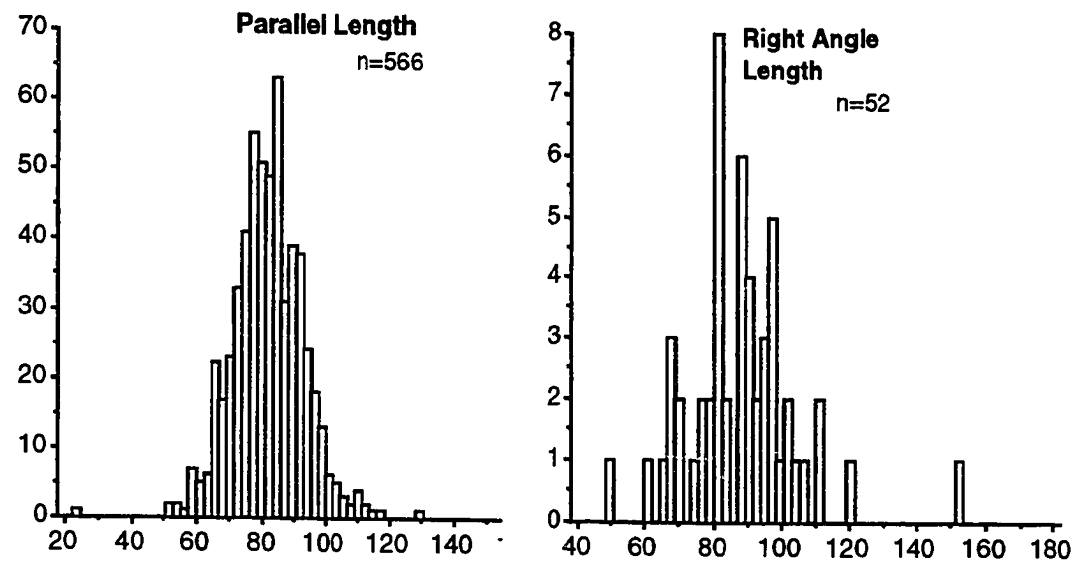
Blade Orientation

I sorted the 733 measured harpoon heads in the study collection by Collins' classes of blade orientation into two groups, right angle and parallel orientation. Table 7 compares the mean, standard deviation, minimum value, maximum value,value range and frequency for the measures of length, width, depth and depth to width ratio for harpoon heads with end and side blades oriented parallel and at right angle to the line hole.

Measure	Mean	Std. dev.	Min.	Max.	Range	n=
Length						
Right Angle	87.77	16.31	48.00	152.00	104.00	52
Parallel	82.29	11.05	22.70	130.00	107.30	566
Width						
Right Angle	17.84	4.60	10.00	38.70	28.70	69
Parallel	17.20	2.83	8.40	27.80	19.40	654
Depth						
Right Angle	11.94	2.82	8.30	22.70	14.40	67
Parallel	9.99	1.90	5.20	16.30	11.10	655
Depth/Width						
Right Angle	0.68	0.15	0.43	1.11	0.68	67
Parallel	0.58	0.11	0.30	1.12	0.81	642

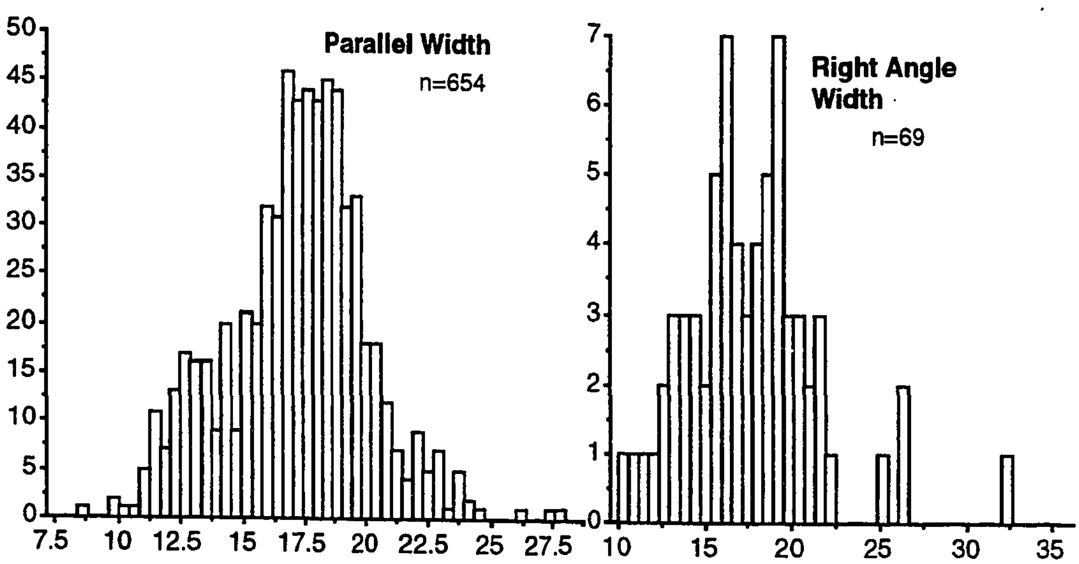
Table 7 - Comparative statistics for the measurements of length, depth, width and depth-to-width ratio for right angle and parallel blade orientation

Figures 55 through 58 compare the distribution of values between parallel and right angle blade orientation for the measurements of length, depth, width and depth-to-width ratio, using the non-parametric Mann-Whitney test of the equality of means. The U and Z values derived from this test indicate that the harpoon heads in this study differ significantly between parallel and



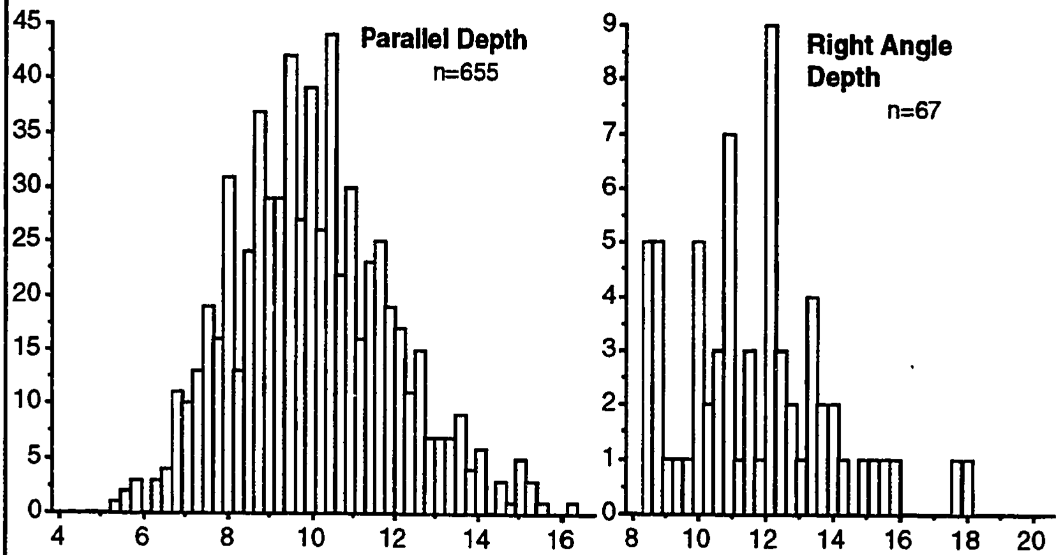
Variable	U	Z (corrected for ties)	p=
Length	18091	-2.74	.0061

Figure 55 - Comparison of length measurements between the attributes of parallel and right angle blade orientation.



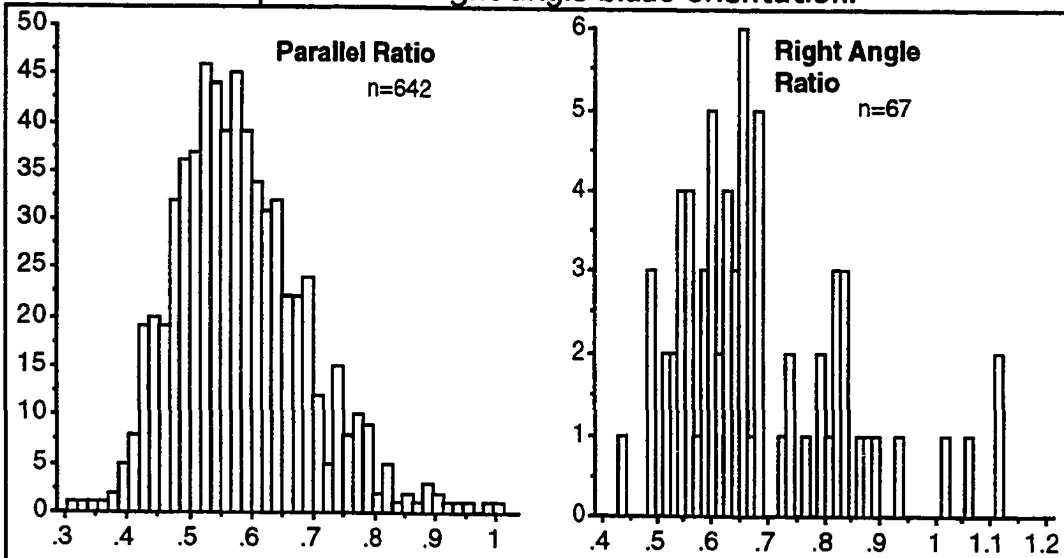
Variable	U	Z (corrected for ties)	p=
Width	21847.5	-.43	.6645

Figure 56 - Comparison of width measurements between the attributes of parallel and right angle blade orientation.



Variable	U	Z (corrected for ties)	p=
Depth	12374	-5.88	.0001

Figure 57 - Comparison of depth measurements between the attributes of parallel and right angle blade orientation.



Variable	U	Z (corrected for ties)	p=
Depth/Width	12572	-5.6	.0001

Figure 58 - Comparison of depth-to-width ratio between the attributes of parallel and right angle blade orientation.

right angle blade orientation in the means of the measurements of length, depth and depth-to-width ratio, but the means do not differ significantly in the measurements of width.

This comparison suggests that length, depth and depth-to-width ratio vary in relation to blade orientation but that width of the harpoon heads is a constant between the two attributes. I infer from this that width of the ivory blank is not a determining factor in end blade orientation, but the depth-to-width ratio, or “flatness” of the blank does influence the orientation of the end or side blades in relation to the laminar structure of the raw material. The association of length with end blade orientation may be a function of stylistic or functional differences.

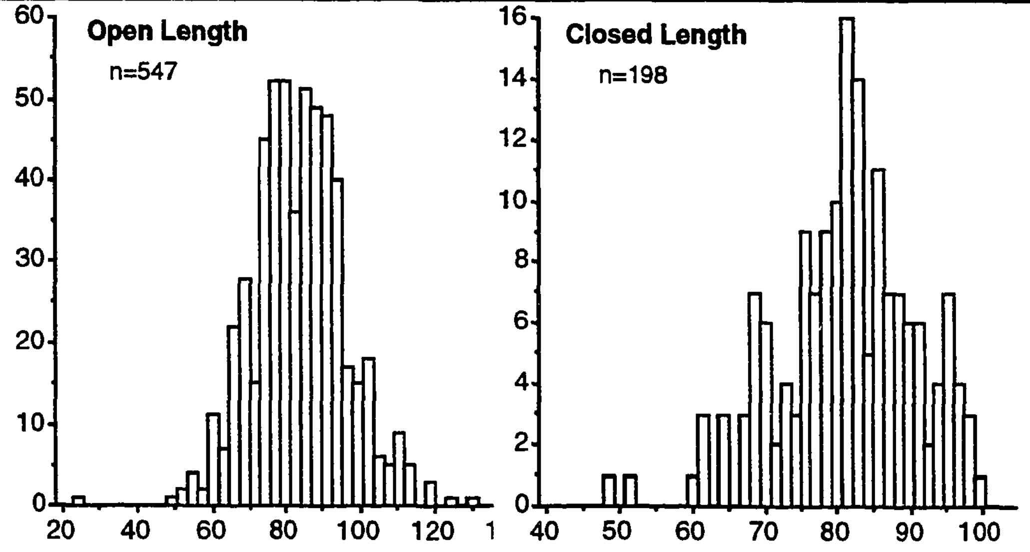
Socket design

To evaluate Collins' class of socket design , I sorted the 733 measured harpoon heads in the study collection by the attributes of closed socket and open socket. Table 8 compares the mean, standard deviation, minimum value, maximum value,value range and frequency for the measures of length, width, depth and depth to width ratio for harpoon heads with closed socket and open socket.

Variable	Mean	Std. dev.	Min	Max	Range	p=
Length						
Closed	81.53	9.92	48.00	118.00	70.00	163
Open	83.75	12.89	22.70	152.00	12.30	241
Width						
Closed	17.11	3.78	8.40	38.70	30.30	198
Open	17.03	2.90	9.50	27.40	17.90	342
Depth						
Closed	11.35	2.09	6.50	22.70	16.2	190
Open	9.63	2.02	1.00	18.00	17.00	346
Depth/Width						
Closed	0.67	0.11	0.38	1.11	0.73	190
Open	0.57	0.11	0.09	1.17	1.09	339

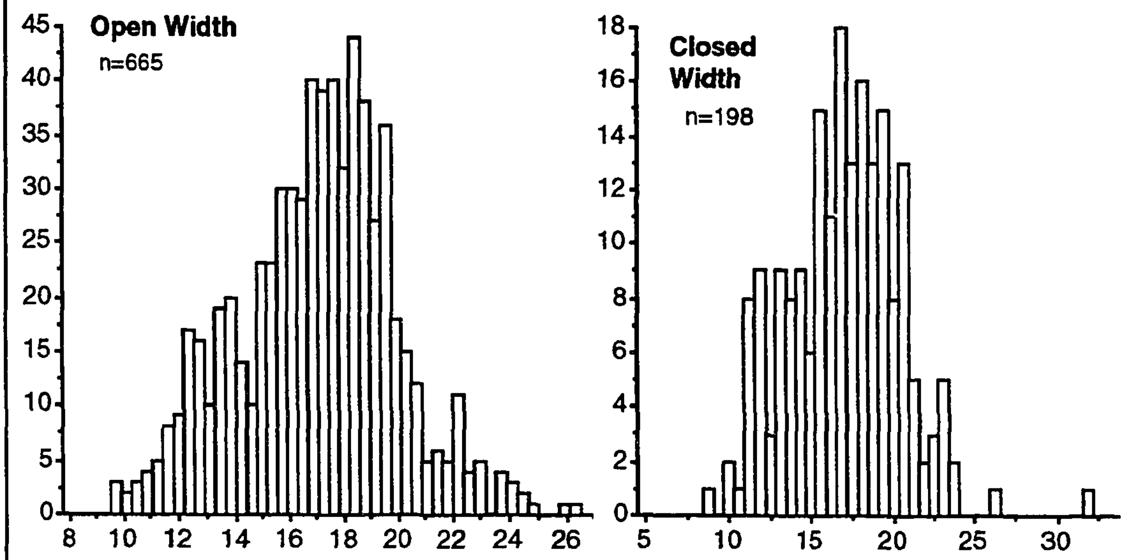
Table 8 - Comparative statistics for the measurements of length, depth, width and depth-to-width ratio closed socket and open socket.

Figures 59 through 62 compare the distribution of values between open socket and closed socket attributes for the measurements of length, depth, width and depth-to-width ratio, using the non-parametric Mann-Whitney test of the equality of means. The U and Z values derived from this test indicate that the harpoon heads in this study differ significantly between open socket and closed socket attributes in the means of measurements of depth



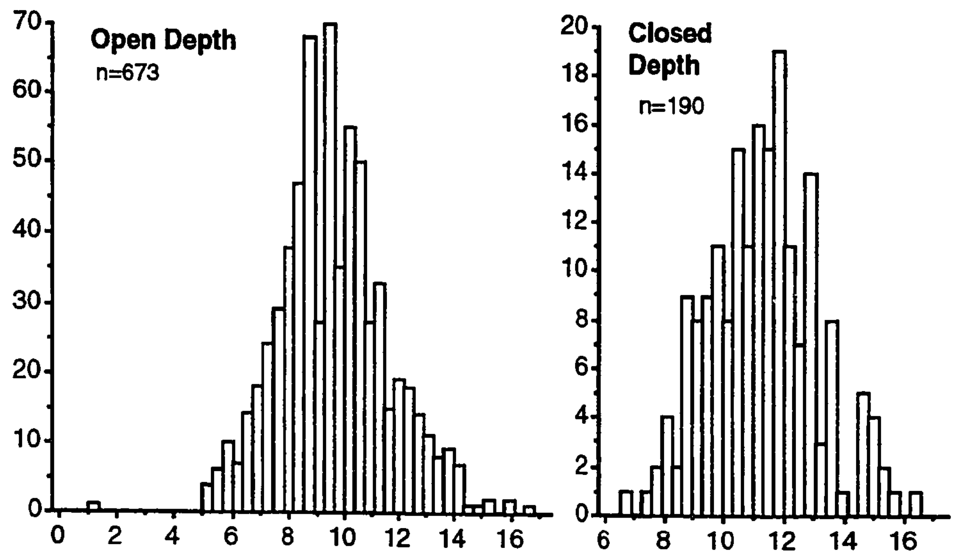
Variable	U	Z (corrected for ties)	p=
Length	40509	-1.77	.0763

Figure 59 - Comparison of length between the attributes of closed socket and open socket.



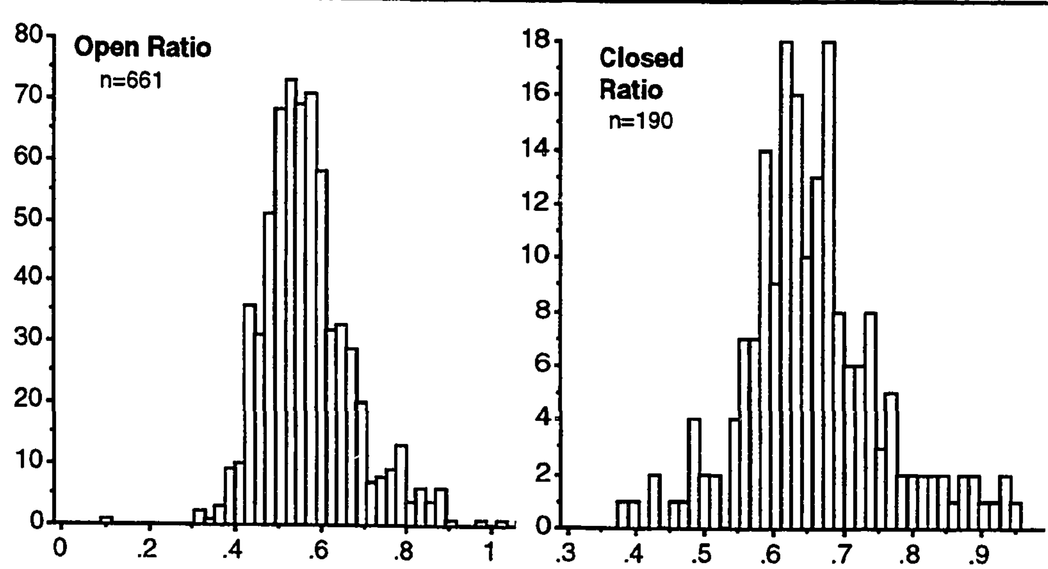
Variable	U	Z (corrected for ties)	p=
Width	65693	-.05	.9632

Figure 60 - Comparison of width between the attributes of closed socket and open socket.



Variable	U	Z (corrected for ties)	p=
Depth	33842	-9.92	.0001

Figure 61 - Comparison of depth between the attributes of closed socket and open socket.



Variable	U	Z (corrected for ties)	p=
Depth/Width	29216	-11.25	.0001

Figure 62 - Comparison of depth-to-width ratio between the attributes of closed socket and open socket.

and depth-to-width ratio, but the means do not differ significantly in the measurements of length and width. The comparison of measurements between the attributes of socket design indicates that depth and depth-to-width ratio vary in relation to socket design but that length and width of the harpoon heads are constants between the two attributes. I infer from this that length and width of the ivory blank are not determining factors in socket design, but depth and depth-to-width ratio of the blank does influence the choice of socket design.

The comparison of ordinal data from harpoon heads from the Kululik and Okvik sites, combined with the structural analysis of ivory and the functional analysis of harpoon head elements in Chapter 5, suggests end and side blade orientation is primarily influenced by the thickness of the raw material used for carving the harpoon head. In the case of ivory, my observations of harpoon heads and walrus tusk morphology indicate that the thickness of the blank is determined by its location on the tusk and its relationship to the shape and curvature of the outer dentine layer (Figure 63). An ivory blank cut from the tusk in position A in Figure 63 is thicker and has a more pronounced curvature to the laminations in the ivory structure, than a blank cut from position B. The more pronounced curvature of the blank from position A may allow greater freedom in placement of the end or side blade slots than that afforded by the blank from position B, in which the thin cross section and parallel laminations requires that an end or side blade slot be carved at a right angle to the plane of the laminations.

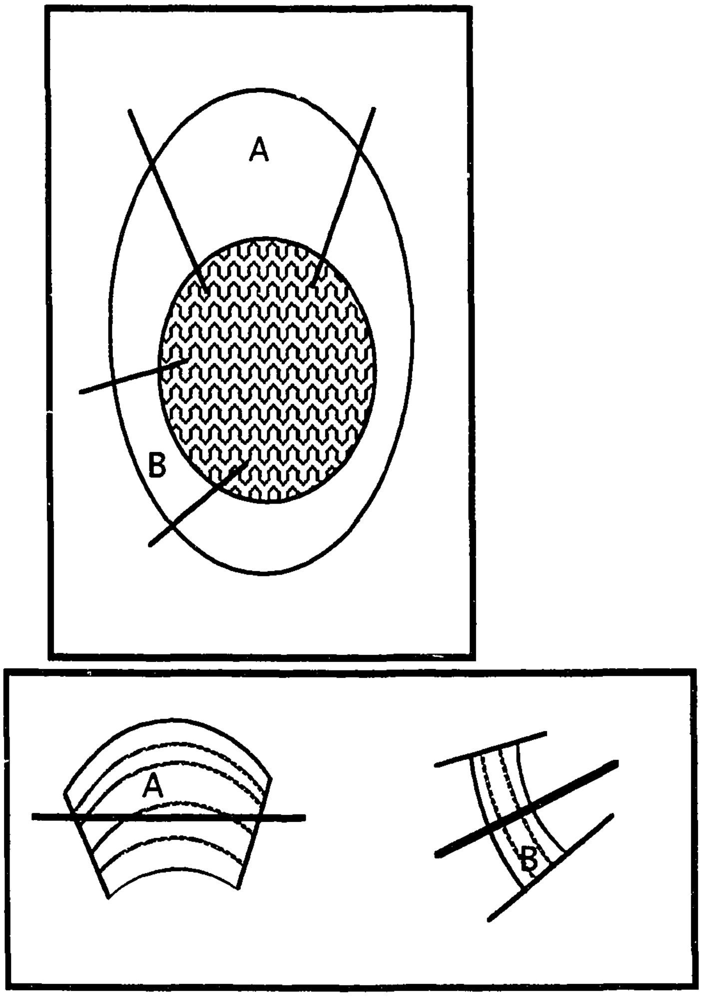


Figure 63 - Comparison of the difference in ivory structure between A) relatively thick ivory removed from a sharply curved surface of the tusk; B) relatively thin ivory removed from a less curved surface of the tusk.

The statistical comparison between open and closed socket designs suggests that choice of socket design is a function of the depth and depth-to-width ratio of the ivory blank. This statistical association supports my subjective impression that closed socket harpoon heads are preferentially carved from the tip of the walrus tusk, where the depth-to-width ration approaches unity, or, in other words, where the ivory is more nearly symmertical in cross section and structure.

The association between blade orientation and ivory structure and between socket design and the place of origin of the ivory blank is useful in understanding the choice of attributes in the formulation of the following classification of St. Lawrence Island harpoon heads. Collins (1937) and subsequent researchers used the variables of blade orientation and socket design to determine major classes in their typologies, assuming that these attributes are culturally determined and responsive to mechanisms of culture change.

Decoration Styles

Many of the the harpoon heads from the Kukulik and Okvik sites are carved with decorative styles associated with those identifed and described by Collins from the Gambell sites. The 1614 harpoon heads in this study from the University of Alaska Museum collections were sorted by the descriptions of Collins (1937), Geist and Rainey (1936) and Rainey (1941), with the following observed frequencies:

Decoration Style	n=
Okvik	82
Hillside	7
Old Bering Sea	21
Punuk (Line only , line and dot decoration)	244
Birnirk	20
Ipiutak	7
Late Prehistoric, Protohistoric, Modern	1258
Total Harpoon Heads in the Study	**1614**

Table 9 - Frequency of Collins' decoration classes in the Kukulik and Okvik collections

Since Collins' Punuk Styles and Phases are difficult to correlate with harpoon heads excavated from the Kukulik mound, I sorted those harpoon heads in this stylistic category into Line Only and Line and Dot decorative styles. Unavoidably, the category of Plain (no decoration) contains harpoon heads that would be classed as Punuk if provenience data were available. The Plain category also contains Late Prehistoric, Protohistoric, Thule and Modern harpoon heads.

To assess Collins decoration classes for their application in the study collection, I compared the measurements of length, depth, width and depth-to-width ration among the groups identified with Collins' stylistic classes. Figures 64 a, b, c and d compare the means of the four measurements among the identifed stylistic classes.

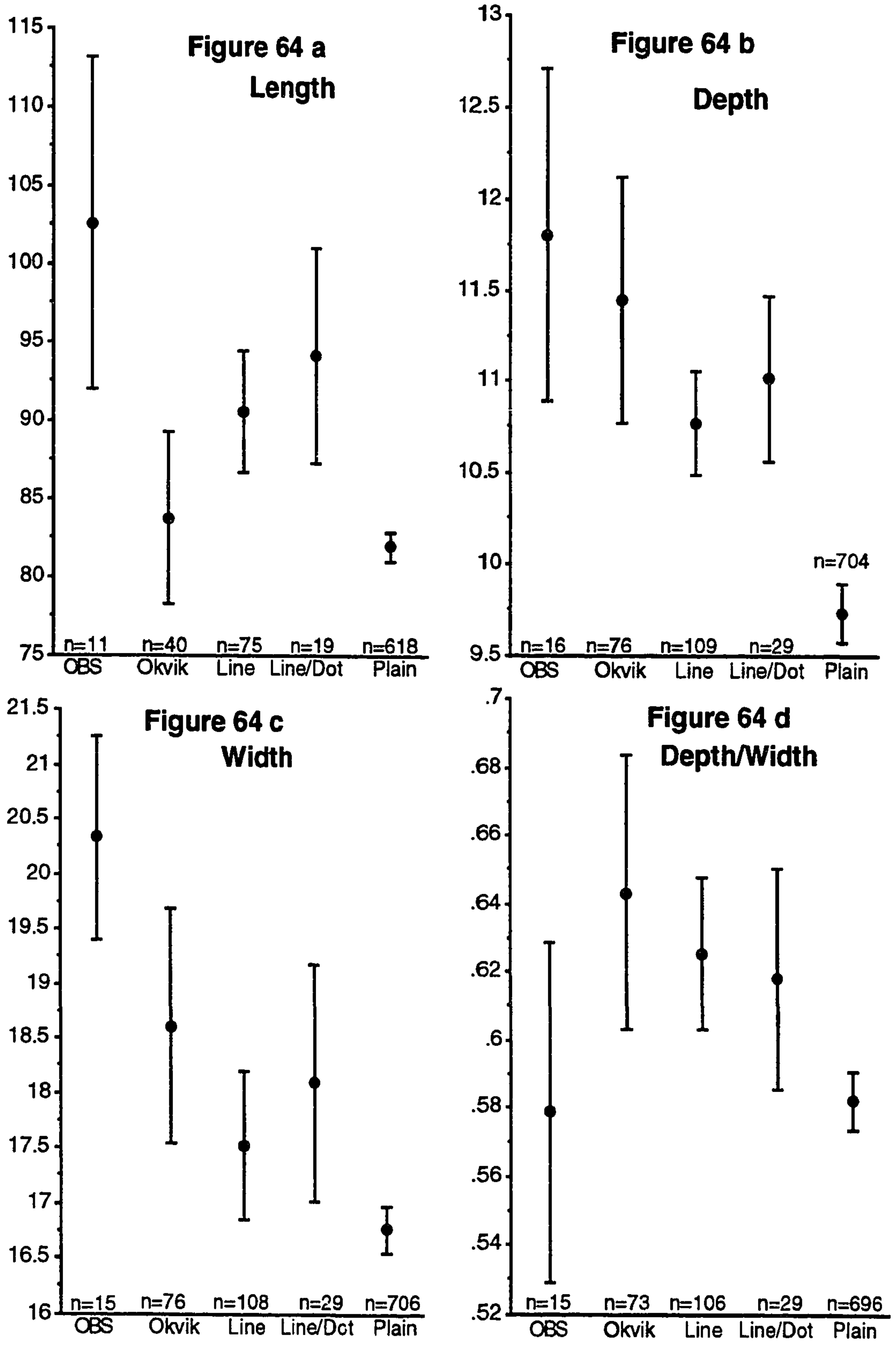


Figure 64 a
Length
115
110
105
100
95
90
85
80
75
n=11 OBS
n=40 Okvik
n=75 Line
n=19 Line/Dot
n=618 Plain
Figure 64 b
Depth
13
12.5
12
11.5
11
10.5
10
9.5
n=16 OBS
n=76 Okvik
n=109 Line
n=29 Line/Dot
n=704 Plain
Figure 64 c
Width
21.5
21
20.5
20
19.5
19
18.5
18
17.5
17
16.5
16
n=15 OBS
n=76 Okvik
n=108 Line
n=29 Line/Dot
n=706 Plain
Figure 64 d
Depth/Width
.7
.68
.66
.64
.62
.6
.58
.56
.54
.52
n=15 OBS
n=73 Okvik
n=106 Line
n=29 Line/Dot
n=696 Plain

The analysis of ordinal variables of Collins' and Rainey's harpoon head classes demonstrates little significant difference between the measurements of length, depth, width and ratio of depth to width among the five classes. Entities in the undecorated class are generally smaller than those in the other four classes, while the Old Bering Sea class is generally larger in dimensions. However, these differences are not consistently significant.

I conclude that the harpoon heads from the Okvik and Kukulik sites cannot be sorted into Collins' and Rainey's classes without consideration of provenience data. Stylistic analysis alone is insufficient to produce types that can be used to compare artifacts between sites. This analysis also supports the interpretation that the classes derived by Collins and seriated to create the chronology of harpoon head development are not entirely discrete classes and thus do not meet the expectations for a typology.

To formulate a typology of Bering Straits harpoon heads that has significance and meaning, it is necessary to classify these artifacts using variables other than idiosyncratic decoration styles and particularistic provenience. Essential and key attributes must be determined through a process of structural and functional analysis and a determination of statistical significance of attribute association.

Secondary Analysis

The following analysis of the 1614 toggle harpoon heads from the Kukulik mound of St. Lawrence Island is designed to discover patterns of attribute association that can be grouped into statistically significant categories that are meaningful to the problem of the culture history of the Bering Straits, taking into consideration the function of the artifact and the structure of its raw materials.

Data Recording

Table 10 presents the attributes recorded on 1614 toggle harpoon heads from the Kukulik mound. I recorded all data in a 4th Dimension relational database on a Macintosh Quadra 900 computer for storage and analysis. I recorded accession, catalog and provenience data in separate files of the relational database as part of the general catalog inventory of the archeology collections of the University of Alaska Museum. These files are then linked to the harpoon heads files by accession and catalog number.

The use of the relational data base allows the files to be sorted by any combination of attribute, accession or catalog data. I sorted the harpoon head records by attribute and recorded the observed frequency of each attribute occurrence in a spread sheet, using Excel on the Macintosh Quadra 900 . I used raw counts of observed attribute frequencies to determine statistically

Decoration
- Old Bering Sea
- Line Only
- Line and Dot
- Okvik
- Plain (undecorated)

Spur
- Single, symmetric
- Single, with one barb
- Single, with two barbs
- Single, with multibarbs
- Single, asymmetric
- Bifurcate, symmetric
- Bifurcate, asymmetric
- Trifurcate, symmetric
- Trifurcate, asymmetric

Line Hole
- Round, drilled
- Round, drilled, double
- Triangular

Raw Material
- Ivory
- Antler
- Bone

Lashing
- One slot and one notch
- Two slots
- Groove
- None
- Drilled

Socket
- Closed
- Open
- Triangular

Side Blades
- Parallel to line hole
- Right angle to line hole

End Blade
- Self
- Parallel to line hole
- Right Angle to line hole

Blade Material
- Slate
- Chipped Stone
- Shell
- Metal

Table 10 - Harpoon Head Attributes

significant attribute clusters, using Spaulding's Chi-square attribute clustering method (Spaulding 1953).

I sorted the database for each combination of the attributes in the matrix and recorded the observed frequency. From this data set, I calculated Expected Frequencies, Deviation from Observed Frequencies, Proportion of Observed to Expected Frequencies, Standard Deviation and Chi-Square for each of the combinations of attributes, using the following formula for Chi-square:

$$\chi^2 = \left[\frac{d}{\sigma}\right]^2 = \left[\frac{d}{\sqrt{pqk}}\right]^2 = \frac{d^2}{pqk}$$

where d is the deviation, p is the proportion expected to show the combination, q is the proportion not expected to show the combination (1-P), and K is the total number of objects in the study population.

Those attributes associated with values for Chi-square greater than 3.84 (95% confidence level at 1 degree of freedom) and associated with a positive deviation indicate that the combination of attributes occurs more than would be expected by chance.

The Chi-square analysis results in the following 64 first order significant attribute combinations at the 95% confidence level (Table 11).

This first level of significant attribute co-occurrence contains many combinations of attributes that are duplicated or lack meaning in terms of structure or function. In order to further refine the analysis, I created a 28 X 64 matrix using the observed frequencies of the original single attributes and the sixty-four observed frequencies of the significant attribute combinations determined in the previous step. Chi-square was again calculated for this matrix and significant occurrence of this second level combination of attributes was calculated. Table 12 lists 58 second order significant attribute associations.

OBS/Two Barb Spur
OBS/Bifurcate Asymmetric Spur
OBS/Trifurcate Symmetric
OBS/Trifurcate Asymmetric
OBS/Double Drilled Line Hole
OBS/Two Lashing Slots
Line Only/Two Barb Spur
Line Only/Bifurcate Symmetric Spur
Line Only/Bifurcate Asymmetric Spur
Line Only/Drilled Line Hole
Line Only/Bone
Line Only/Two Lash Slots
Line Only/Open Socket
Line and Dot/Drilled
Line and Dot/Two Lash Slots
Okvik/Single Spur One Barb
Okvik/Single Spur Two barbs
Okvik/Single Spur Multiple Barbs
Okvik/Trifurcate Symmetric
Okvik/Drilled Line Hole
Okvik/One Lash Slot, One Notch
Okvik/Open Socket
Plain/Single Spur
Plain/Asymmetric Single Spur
Plain/Triangular Line Hole
Plain/Ivory
Plain/No Lashing
Plain/Triangular Socket
Single Spur/Drilled Line Hole
Single Spur/Triangular Line Hole
Single Spur/No Lashing
One Barb Spur/One Slot One Notch
Two Barb Spur/Drilled Line Hole
Two Barb Spur/One Slot One Notch
Two Barb Spur/Closed Socket
Multi-Barb Spur/One Slot One Notch
Multi-Barb Spur/Open Socket
Single Spur Asymmetric/Triangular Line Hole
Single Spur Asymmetric/Antler
Single Spur Asymmetric/Bone
Single Spur Asymmetric/One Slot, One Notch
Single Spur Asymmetric/One Groove
Single Spur Asymmetric/Triangular Socket
Drilled Line Hole/One Slot, One Notch
Drilled Line Hole/Two Slots
Drilled Line Hole/Open Socket
Drilled, Double Line Hole/Two Slots
Triangular Line Hole/Antler
Triangular Line Hole/Bone
Triangular Line Hole/No Lashing
Triangular Line Hole/Closed Socket
Triangular Line Hole/Triangular Socket
Antler/One Slot, One Notch
Antler/One Groove
Antler/Drilled Lash Holes
Antler/Triangular Socket
Bone/One Slot, One Notch
Bone/One Groove
One Slot, One Notch/Open Socket
One Slot, One Notch/Triangular Socket
One Groove/Triangular Socket
No Lashing/Closed Socket
No Lashing/Triangular Socket
Drilled Lash Holes/Triangular Socket

Table 11 - First Order Significant Attribute Associations

Style	Spur	Line Hole	Material	Lashing	Socket
1			Antler	Drilled	Triangular
2			Antler	Drilled	Triangular
3	Single, 2 barb			None	Closed
4	Single, asymmetric	Antler		slot/notch; groove	Triangular
5	Single, asymmetric		Antler	Groove; None	Triangular
6	Single, asymmetric		Antler Bone	slot/notch; groove	Triangular
7	Single, asymmetric		Antler Bone	slot/notch; groove	Triangular
8	Single, asymmetric		Antler Bone	Groove	Triangular
9	Single, asymmetric		Bone	slot/notch; groove	Triangular
10	Single, asymmetric	Triangular	Antler	slot/notch	Triangular
11	Single, asymmetric	Triangular	Antler	slot/notch; Groove Drilled	Triangular
12	Single, asymmetric	Triangular	Antler	Groove	Triangular
13	Single, asymmetric	Triangular	Antler Bone	slot/notch; groove	Triangular
14	Single, asymmetric	Triangular	Bone	Groove	Closed
15	Single, asymmetric trifurcate, asymmetric		Bone	Groove	Triangular
16	Single, asymmetric; bifurcate symmetric; bifurcate asymmetric; trifurcate asymmetric		Bone	slot/notch	
17	Single, asymmetric; Trifurcate, asymmetric		Antler	slot/notch	Triangular

Table 12 - Second Order Significant Attribute Associations

Decoration	Spur	Line Hole	Material	Lashing	Socket
18	Single, multi-barb Open		Drilled		slot/notch
19	Single, multi-barb Open		Drilled		slot/notch
20	Single; Single, 2 barb	Triangular		None	Closed
21	Trifurcate symm.	Double drilled		2 slots	
22 Line/Dot		Drilled		Two slots	
23 Line/ Dot	Bifurcate symm. Bifurcate asymmetric	Drilled		Two slots	Open
24 Line	Bifurcate asymmetric		Antler; bone		Two slots
25 Line	Bifurcate symmetric		Bone		
26 Line	Bifurcate symm. bifurcate asymm. trifurcate asymm.	Drilled	Bone	One slot one notch	
27 Line	Single	Drilled	Ivory	2 slots	Open
28 Line	Single, 2 barbs bifurcate asymmetric	Drilled		Two slots	
29 Line	Single, 2 barbs; bifurcate asymmetric; trifurcate asymmetric	Drilled	Antler Bone	Slot and notch; two slots	Open
30 Line	Single, 2 barbs; bifurcate symmetric; bifurcate asymmetric	Drilled	Bone	Two slots	Open
31 Okvik	Single, 1 barb; Single, 2 barb; Single, multi-barb; bifurcate, symmetric; trifurcate, asymmetric	Drilled		slot/notch	Open

Table 12 - Second Order Significant Attribute Associations

Decoration	Spur	Line Hole	Material	Lashing	Socket
32 Okvik	Single, 2 barb; multi-barb; bifurcate asymmetric; trifurcate asymmetric	Drilled		slot/notch	Open
33 Okvik	Single, 1 barb Multi-barb; Bifurcate asymmetric; Trifurcate asymmetric	Drilled	Bone	slot/notch; 2 slots	Open
34 Okvik				slot/notch	
35 Okvik	Bifurcate symm. trifurcate symmetric	Drilled		slot/notch	Open
36 Okvik	Single, 1 barb; single 2 barb	Drilled		slot/notch	Open
37 Okvik	Single, 1 barb; single 2 barb; single, multi-barb	Drilled		slot/notch	Open
38 Okvik	Single, 2 barb	Drilled		slot/notch	Closed
39 Okvik	Single, multi-barb	Drilled		slot/notch	Open
40 Okvik	Trifurcate symm.	Double drilled			
41 OBS		Triangular	Antler		
42 OBS	Bifurcate Asymm. Trifurcate Symm. Trifurcate Asymm.	Double Drilled		Two slots	
43 OBS	Bifurcate symm.	Drilled double		Two slots	
44 OBS	Single spur, 1 barb; Single spur, 2 barbs; Bifurcate symmetric; Trifurcate, symmetric; Trifurcate asymmetric	Double drilled		Two slots	

Table 12 - Second Order Significant Attribute Associations

Decoration	Spur	Line Hole	Material	Lashing	Socket
45 OBS	Single, 2 barb	Drilled		slot/notch	Closed
46 OBS	Trifurcate Asymm.	Double Drilled			
47 OBS	Trifurcate symm.	Drilled Double		Two Slots	
48 OBS	Two Barb			Two Slots	
49 OBS	Single, 2 barb	Drilled		2 slots	Open
Plain					
Line					
Line/Dot					
50 Okvik	Single			None	Closed
Plain					
51 Plain	Single	Triangular		None	Closed;
					Triangular
52 Plain	Single	Triangular	Antler		Closed;
					Triangular
53 Plain	Single	Triangular	Antler	None;	
				drilled	
54 Plain	Single, asymm.	Triangular		None	Closed;
				Triangular	
55 Plain	Single, asymm.	Triangular		None	Triangular
56 Plain	Single, asymm.	Triangular	Antler	Groove;	Triangular
				None;	
				drilled	
57 Plain	Single, asymm.	Triangular	Antler	One groove;	Triangular
				None	
58 Plain	Single;				
	single, asymm.	Triangular	Antler	None	Closed;
			Bone		Triangular

Table 12 - Second Order Significant Attribute Associations

The second order significant attribute associations still have many duplications and redundancies that are eliminated by combining attribute associations into clusters with like attributes. This process results in the following list of twelve attribute clusters that occur at frequencies greater than what would be expected by chance. (See also Table 13).

Cluster 1 single asymmetric spur, antler or bone, groove or 1 slot and 1 notch lashing, triangular socket, n=11

Cluster 2 single asymmetric spur, triangular line hole, antler or bone, groove or 1 slot and 1 notch lashing, triangular socket, n=9

Cluster 3 undecorated, single symmetric spur, triangular line hole, antler or bone, groove or drilled lashing, triangular socket, n=11

Cluster 4 single symmetric spur, triangular line hole, no lashing, closed socket, n=54

Cluster 5 Old Bering Sea decoration, bifurcate or trifurcate spur, drilled, double line holes, 2 slots lashing, n=8

Cluster 6 trifurcate symmetric spur, drilled, double line holes, 2 slots lashing, open socket, n=6

Cluster 7 line only decoration, bifurcate or trifurcate spur, drilled line hole, antler or bone, 1 slot, 1 notch or 2 slots lashing, open socket, n=12

Cluster 8 line and dot decoration, bifurcate spur, drilled line hole, 2 slots lashing, open socket, n=3

Cluster 9 single symmetric spur, drilled line hole, ivory, 2 slots lashing, open socket, n=162

Cluster 10 Okvik decoration, symmetric spur with barbs, drilled line hole, ivory, 1 slot and 1 notch lashing, open socket, n=56

Cluster 11 multi-barb spur, drilled line hole, 1 slot and 1 notch lashing, open socket, n=22

Cluster 12 drilled line hole, 1 slot and 1 notch lashing, open socket, n=93

Table 13 is a seriation of the twelve clusters, grouped according to patterns of attribute occurrence. Group A consists of Clusters 1 through 4 with single spurs, triangular line holes, are made of antler or bone, triangular or closed sockets and have end blades and no side blades. Group C consists of Clusters 10, 11 and 12 with single spurs, drilled line holes slot and notch lashing and open sockets. Group B includes Clusters 5 through 9 with single or furcated spurs, drilled line holes slot and notch or two slot lashing and open sockets. This group shows less homogeneity than the other two groups, though they are, as a group, more similar to each other than they are to the other two identified groupings.

Attribute clusters in groups A, B and C in Table 13b roughly approximate those in the descriptions of Collins' and Geist's stylistic classes (Geist and Rainey 1936; Collins 1937; Rainey 1941). Group A consists of undecorated antler or bone harpoon heads

Harpoon Head Groups
Statistically Significant Attribute Clusters

Cluster	Decoration: OBS	Decoration: Line Only	Decoration: Line and Dot	Decoration: Okvik	Decoration: Plain	Spur: Single	Spur: Single Symmetric One Barb	Spur: Single Symmetric Two Barb	Spur: Single Symmetric Multi Barb	Spur: Single Asym	Spur: Bifurcate Sym	Spur: Bifurcate Asym	Spur: Trifurcate Sym	Spur: Trifurcate Asym	Line Hole: Drill	Line Hole: 2 Drill	Line Hole: Tri	Material: Ivory	Material: Antler	Material: Bone	Lashing: slot Notch	Lashing: 2 slots	Lashing: Groove	Lashing: Drill	Lashing: None	Socket: Closed	Socket: Open	Socket: Tri	Blade: End	Blade: Side
1 (11)										X									X	X	X		X					X	11	
2 (9)										X							X		X	X	X		X					X	9	
3 (11)					X	X											X		X	X			X	X	X			X	11	
4 (154)						X											X								X	X			154	
5 (8)	X										X	X	X	X		X						X							3	6
6 (6)													X			X						X					X		2	4
7 (12)		X									X	X	X	X	X				X	X	X	X					X		7	2
8 (3)			X								X	X			X							X					X		3	
9 (162)						X									X			X				X					X		162	
10 (56)				X			X	X	X						X			X			X						X		55	1
11 (22)									X						X						X						X		22	
12 (93)															X						X						X		71	13

Table 13a

Cluster	Decoration: OBS	Decoration: Line Only	Decoration: Line and Dot	Decoration: Okvik	Decoration: Plain	Spur: Single	Spur: Single Symmetric One Barb	Spur: Single Symmetric Two Barb	Spur: Single Symmetric Multi Barb	Spur: Single Asym	Spur: Bifurcate Sym	Spur: Bifurcate Asym	Spur: Trifurcate Sym	Spur: Trifurcate Asym	Line Hole: Drill	Line Hole: 2 Drill	Line Hole: Tri	Material: Ivory	Material: Antler	Material: Bone	Lashing: slot Notch	Lashing: 2 slots	Lashing: Groove	Lashing: Drill	Lashing: None	Socket: Closed	Socket: Open	Socket: Tri	Blade: End	Blade: Side
Group A																														
1 (11)										X									X	X	X		X					X	11	
2 (9)										X							X		X	X	X		X					X	9	
3 (11)					X	X											X		X	X			X	X	X			X	11	
4 (154)						X											X								X	X			154	
Group B																														
5 (8)	X										X	X	X	X		X						X							3	6
6 (6)													X			X						X					X		2	4
7 (12)		X									X	X	X	X	X				X	X	X	X					X		7	2
8 (3)			X								X	X			X							X					X		3	
9 (162)						X									X			X				X					X		162	
Group C																														
10 (56)				X			X	X	X						X			X			X						X		55	1
11 (22)									X						X						X						X		22	
12 (93)															X						X						X		71	13

Table 13b

with single, symmetric and asymmetric spurs, triangular line holes, triangular or closed sockets, and end blades. This description corresponds closely with Collins' Modern III(a) and III(b) classes (Collins 1937:216-217, Plate 71) and Geist and Rainey's A, B and Thule classes (Geist and Rainey 1936:89-90, Plates 15, 16, 41, 52).

Group B includes Old Bering Sea, Line Only and Line and Dot decorated ivory, antler or bone harpoon heads with single, bifurcate or trifurcate spurs, drilled line holes, 2 slot lashing with open sockets and both end and side blades. This group parallels Collins' I, II and III classes (Collins 1937:216-217, Plates 23, 24, 25, 26, 28, 70, 71) and Geist and Rainey's classes C, D, E, F, G, H, I, J, and K (Geist and Rainey 1936:172-179, Plates 17, 52, 58,60, 61,63, 67,68, 69, 70, 71, 75, 76).

Group C consists of ivory harpoon heads with Okvik decoration, single spurs with one or more barbs, a single drilled line hole, slot and notch lashing on an open socket and both end and side blades. This group most closely approximates Collins' Hillside Site find with Old Bering Sea Type 1 decoration, (Collins 1937:40-52, 82, 216-217, Plate 12) and Rainey's A, B, C and D classes (Rainey 1941:476-487).

This statistical process of category determination closely approximates the results obtained by Collins and Geist to develop their artifact classes. The technique used here affirms an otherwise intuitive process in the perception of attributes patterning.

Although the attribute clusters that make up the classes are statistically significant, they cannot yet be considered types. As discussed in Chapter 4, in order for classes to be considered as types, they must be mutually exclusive, meaningful, and they must address the purpose of the classification (Adams & Adams 1991:184-186).

It is obvious from examination of the above list of categories that Groups A through D are not mutually exclusive. Presence of multiple attributes of the same variable in the description of a class is a good indication that the categories being described are stylistic classes and not discrete types (Adams and Adams 1991:45-47). In addition, as indicated by the relatively small frequencies for each category, these groups are particularistic and not useful in sorting the entire collection of 1614 harpoon heads (Ford 1954).

The attribute clusters in this classification can be interpreted to reflect patterned human activity (Spaulding 1953). However, for the clusters to have meaning in this classification, they must be related to the previously defined functional elements of the toggle harpoon head: the point, the line hole, the socket and the spur. Although individual attributes of the clusters apply to these functional elements, the variables do not correspond with those previously determined to be functionally significant.

Groups selected for type definition must be applicable to the purpose of the classification, which, in this case, is to produce a typology of harpoon heads from St. Lawrence Island that provides an explanation for influences from the various occupations of the

Kukulik site, and other sites in the Bering Straits region. The groups of attribute clusters identified in this preliminary classifcation are too particularistic to compare site to site in order to trace influences between site occupations. This is the same criticism of Spaulding's statistical technique for type formation (Ford 1954:390-393, Clarke 1971:169-175, Doran and Hodson (975:167-169).

The categories in this preliminary classification do not meet the expectations of a typology, since they are not mutually exclusive and they do not address the stated purpose of the classification. Therefore, the preliminary classification, even though formulated from attribute clusters that are statistically significant, is not a typology by Adams and Adams' (1991) definition.

Deriving the Typology

To derive a typology from the previous list of statistically significant attribute clusters, it is necessary to go a step beyond Spaulding's attribute association and reorganize the list of statistically significant variables and attributes in light of the functional elements defined in Chapter 5.

Choice of Variables

Decoration need not be considered in this typology, since it is an idiosyncratic variable that is not applicable in a classification concentrating on functional and structural elements. Concentration on decorative similarity produces stylistic classes, as exemplified by Collins' and Geist and Rainey's classifications.

Spur design was identified as a functional element of the toggle harpoon head. The nine attributes associated with spur design were grouped into two major functional forms suggested in Table 13: single spur, composed of symmetric and asymmetric forms, and furcated spur, either bifurcate or trifurcate forms.

The two major functional forms of the line hole are drilled and triangular. Though the double drilled line hole of some harpoon heads was probably functional, the specific function of this design is not ethnologically known, nor is it structurally apparent. I thus group the two types of line hole into one category

Raw material, though related to structure and function of harpoon heads, is considered an inessential variable for this classification since it is inherent in the artifact and cannot be changed by human action (Clarke 1968).

Lashing style and socket design function together as a means of attaching the harpoon head to the foreshaft. Following the groupings suggested in Table 13, the eight attributes of Lashing and Socket designs are combined into the category Foreshaft Attachment, consisting of four categories: 1) closed socket; 2) open socket, 2 lash slots; 3) open socket, slot and notch lashing; and 4) triangular socket with slot and notch, groove, drilled or no lashing.

Blade design is divided into end blade or side blade. As demonstrated in the statistiocal analysis of ordinal variables, orientation of the end and side blades is a function of part of the ivory tusk from which the harpoon head is carved and is not here considered as an essential variable (Clarke 1968). Although the self blade is a distinct category of blade design, it does not appear statistically associated with other attributes, so it is not included here.

Table 14 summarizes these categories and arranges them into Variable, Type, Attribute and Attribute of Attribute (Attribute^2):

Variable:	Spur					
Type:	Single		Furcated			
Attribute:	Symmetric	Asymmetric	Bifurcate		Trifurcate	
Attribute^2 :	Unbarbed	Barbed	Symm.	Asymm.	Symm.	Asymm.

Variable:	Line Hole		
Type:	Drilled		Triangular
Attribute:	Single	Double	
Attribute^2 :			

Variable:	Foreshaft Attachment						
Type:	Closed	2 slot	Slot and Notch	Triangular			
Attribute:	Closed	Open 2 slot	Open Slot/Notch	Groove	slot/notch	Drilled	None
Attribute^2 :							

Variable:	Blade			
Type:	Side		End	
Attribute:	Right angle	Parallel	Right Angle	Parallel
Attribute^2 :				

Table 14 - Categories for the Harpoon Head Typology

Definition of Type

The term "type" is used here in a different manner than has been used in the past, but which is necessitated by the definition of the concept as proposed by Adams and Adams (1991). The type in this classification is the presentation of a variable in one and only one aspect consisting of one or more attributes. The type is mutually exclusive within the definition of the variable to which it applies, is an aspect of one of the defined functional elements of the harpoon head, and can be used to trace influences between occupations of sites throughout the Bering Strait region, as will be demonstrated in Chapter VII.

For example, the variable, Spur, is a functional element of the harpoon head distinguished by two types, Single and Furcated. The type, Single Spur, is characterized by two attributes that are functionally identical but morphologically distinct, symmetric and asymmetric. The attribute, symmetric, is again subdivided into attributes of barbed and unbarbed. Nevertheless, a barbed harpoon head can be identified as, and only as, a Single Spur type harpoon head.

Cluster Analysis

The next step in the analysis is to determine patterns of occurrence and co-occurrence of the nine harpoon head types in the study population from St. Lawrence Island. The database records were sorted by the ten categories and the following frequencies recorded in Table 15:

Variable	Spur		Line Hole		Foreshaft Attachment				Blade	
Type Side	Single	Furcated	Drilled	Triangular	Open 2 slots	Open slot/Notch	Triangular	Closed	End	
Count 44	1374	56	944	597	281	118	338	262	125	

Table 15 - Frequencies of Type Occurrence

Using the same statistical technique as in the previous preliminary classification, groups of statistically significant co-occurrence of types can be developed. I designed a 9 X 9 matrix and calculated Chi-Square values for each combination of attributes. The following fourteen type combinations were determined to occur at frequencies greater than would be expected by chance:

I sorted the database for these groups and recorded their frequencies. I arranged the fourteen clusters in Table 16 and seriated them to group like types, producing three groups with consistent characteristics that can be related to Collins' stylistic classes.

1 Single spur-Triangular line hole
2 Single spur-Triangular foreshaft attachment
3 Furcated spur-drilled line hole
4 Furcated spur-open 2 slots attachment
5 Furcated spur-open slot and notch attachment
6 Furcated Spur-side blade
7 Drilled line hole-open 2 slots attachment
8 Drilled line hole-open slot and notch attachment
9 Drilled line hole-end blade
10 Drilled line hole-side blade
11 Triangular line hole-Triangular attachment
12 Open 2 slots attachment-Side blade
13 Open slot and notch attachment-Side blade
14 Triangular attachment-end blade

Group A consists of harpoon heads with furcated spurs, drilled line holes, open-2 slot lashing and side blades. This encompasses Collins' Old Bering Sea and Birnirk classes (Collins 1937:216-217), Geist and Rainey's G, H, I, J, and K classes (Geist and Rainey 1941:175-179, Plates 69, 70, 71), Ford's Birnirk, Alilu, Oopik and Naulok classes from the Birnirk sites (Ford 1959:75-96) and Larsen and Rainey's Types 1 and 3 (Larsen and Rainey 1948:68-73, Plates 1 and 3).

Variable		Spur		Line Hole		Foreshaft Attachment			Blade	
Type Side		Single	Furcated	Drilled	Triangular	Open 2 slots	Open slot/Notch	Triangular	End	
Count		1374	56	944	597	281	118	338	125	44
Cluster				Group A						
6	7		X							X
12	26					X				X
4	37		X			X				
3	47		X	X						
7	226			X		X				
				Group B				Group BX		
1	552	X			X					
2	326	X						X		
11	184				X			X		
14	297							X	X	
				Group C						
9	790			X					X	
8	99			X			X			
10	41			X						X
13	13						X			X
5	9		X				X			
6	7		X	Group D						X

Table 16 - Groups of Significant Attribute Associations

Group B contains harpoon heads with single spurs, triangular line holes, triangular foreshaft attachments and end blades. This is consistent with Collins' Modern and Late Punuk harpoon head classes (Collins 1937:216-217) and Geist and Rainey's B and C classes (Geist and Rainey 1936:173).

Group C consists of harpoon heads with furcated spurs, drilled line holes, open-slot and notch foreshaft attachment and both end and side blades. This is most consistent with Rainey's Okvik class

(Rainey 1941) and Larsen and Rainey's Types 1, 2 and 3 (Larsen and Rainey 1948:68-73, Plates 1, 2 and 3).

Group D demonstrates a continuity between Group A and Group C, represented by Clusters 6 and 5 respectively, with single spurs, slot and notch foreshaft attachment and side blades. This group is characteristic of Ipiutak harpoon heads identified by Larsen and Rainey (1948) and various forms from the Birnirk site, identified by Ford (1959).

Group B frequencies are considerably greater than those of all but two of the clusters in Groups A and C, cluster 7 and cluster 9. This is understandable in that the collections from Kukulik are heavily weighted in favor of recent harpoon head forms from the preferential excavation of the upper layers of the site. The frequencies of clusters 7 and 9 are also considerably greater than those of other clusters within their groups. The types represented by clusters 7 and 9, drilled line holes, open-2 slot lashing and end blades are also found within the harpoon heads of the recent forms described by Geist and Rainey, notably classes A and C (Geist and Rainey 1936:88-89, Plate 18). The gray area designated BX covering Group B and extending to clusters 7 and 9 in Groups A and C respectively indicates this overlap in group constituents.

Table 16 can be interpreted in terms of the stylistic classes proposed by Collins (1937), Geist and Rainey (1936), Rainey (1941), Larsen and Rainey (1948) and Ford (1959). Group A contains functional elements characteristic of Old Bering Sea, Birnirk and

Ipiutak harpoon heads. Group B contains elements found on modern and Late Punuk harpoon heads, as well as elements included in both Groups A and C. Group C contains elements of Okvik and Ipiutak. Group D contains elements characteristic of Ipiutak and Birnirk harpoon heads.

At the beginning of this chapter, I tested Collins' stylistic classes for internal consistency by comparing the means of the ordinal variables of length, width, depth and width to depth ratio. To test the validity of the groups derived in this classification as discrete classes, ordinal attributes of the variables of length, depth width and depth to width ratio were sorted from the database and the means plotted with 95% confidence intervals (Figure 58).

In Figure 65, mean values for length, width and depth show consistently patterned differences between Groups A, B, BX and C. Overlaps occur in the 95% confidence interval between Groups BX and C, expressing the presence of Group C harpoon heads included in Group BX. Group D is composed of harpoon heads from both Groups A and C and therefore shows no significant difference from the other Groups.

The depth to width ratio shows no significant difference between any of the groups, indicating that the relationship between depth and width is not independent and is a constant in the construction of all functional harpoon heads.

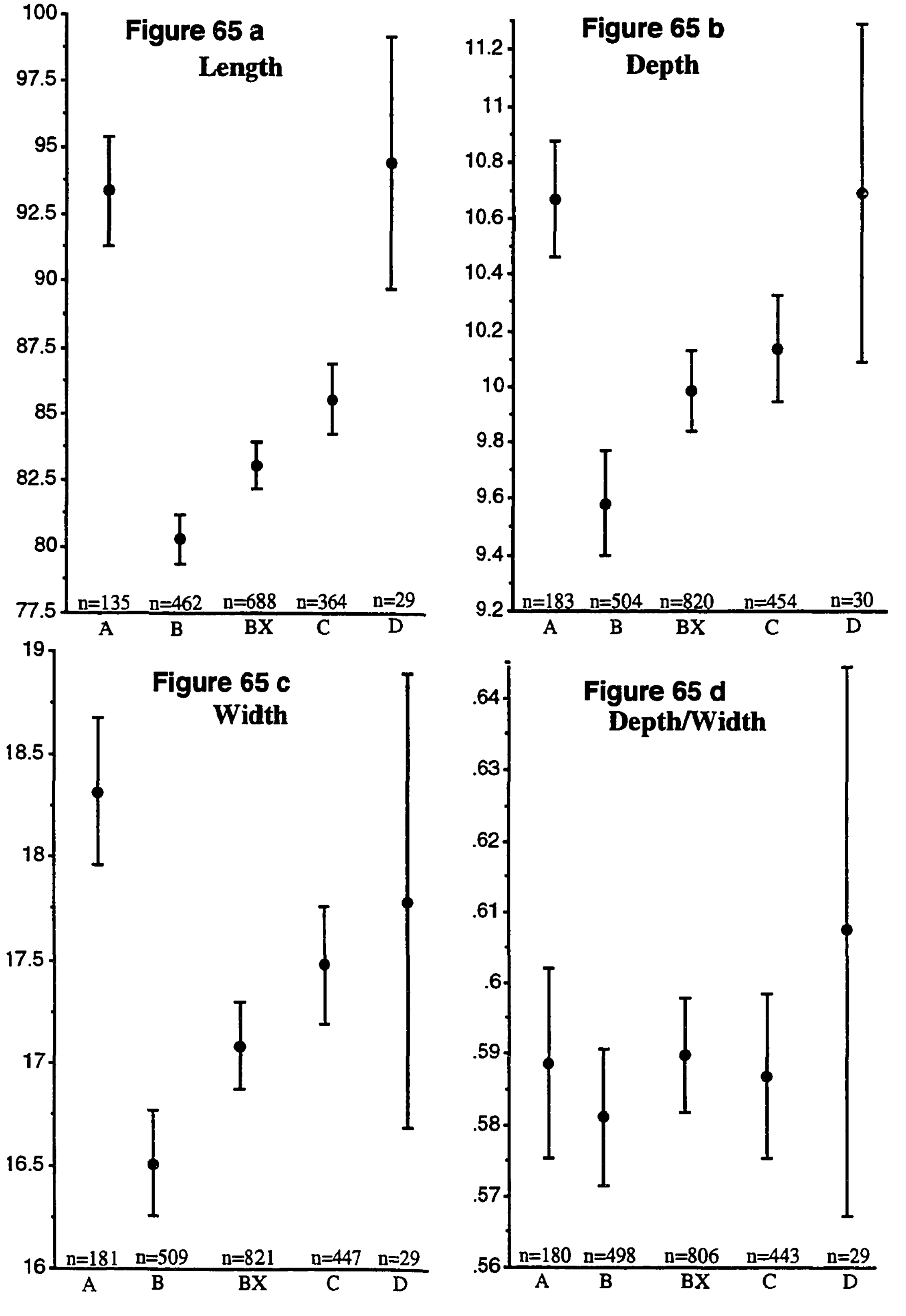


Figure 65 a
Length
100
97.5
95
92.5
90
87.5
85
82.5
80
77.5
n=135 n=462 n=688 n=364 n=29
A B BX C D
Figure 65 b
Depth
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
9.2
n=183 n=504 n=820 n=454 n=30
A B BX C D
Figure 65 c
Width
19
18.5
18
17.5
17
16.5
16
n=181 n=509 n=821 n=447 n=29
A B BX C D
Figure 65 d
Depth/Width
.64
.63
.62
.61
.6
.59
.58
.57
.56
n=180 n=498 n=806 n=443 n=29
A B BX C D

This comparison demonstrates that Groups A, B, BX are internally consistent and vary significantly in the variables of length, width and depth. There is no significant difference in the variable of depth to width ratio, suggesting that the "squareness" of the harpoon heads is consistent among all groups and therefore is an inessential variable for purposes of classification.

Group C is significantly different from the other groups in length, but exhibits some overlap at the 95% confidence interval in the variables of width and depth. The overlap may reflect the predominantly open socket foreshaft attachment of this group, which is found in both Groups A and C. Group D is a small group (n=29) and therefore the 95% confidence interval is quite large. The lack of significant variation between this group and the other groups is not surprising, since it represents a combination of attributes derived from Groups A and C.

Open socket foreshaft attachment exhibits no significant association with any other functional strategy in this classification. This finding is consistent with the lack of significant difference among the groups in the depth to width ratio, which is interpreted as a measure of "squareness" of the harpoon head cross-section. This statistical analysis confirms my conclusion that closed socket harpoon heads are produced as a function of ivory structure rather than as a function of stylistic choice.

In summary, the statistical analysis of the groups of significant attribute association derived from a Chi-square analysis of attribute frequencies demonstrates that these groups have internal consistency and can be validated by comparison with patterns of ordinal variables. Compared to the analysis of the stylistic categories proposed by Collins' and used by subsequent researchers, the groups derived through Chi Sqaure analysis of the Kukulik and Okvik harpoon heads appear to have greater validity as representations of patterned human behavior resulting in the production and use of these artifacts.

Chapter 7 - Chronometrics

Background

Since Collins' original seriation of St. Lawrence Island harpoon heads in 1937, chronology building for the culture history of the Bering Strait region has relied on stylistic comparison, relative stratigraphy, tree ring counts and comparison, and loosely interpreted radiocarbon dating. Unfortunately, the situation is not unique to the Bering Strait. Interpretation of Arctic archeological sites is characterized by questionable practices of dating and inference that have become imbedded in the literature and through circular reasoning and self-reference have tended to obscure patterns of population movement and cultural influence that would be self-evident if supported by an accurate chronology.

Stylistic interpretation relies on subjective perceptions of similarity among widely varying and potentially idiosyncratic decorative styles. Most of the artifacts from Arctic sites are lightly decorated, if at all, focusing inordinate attention on those materials with elaborate decorations, such as those identified as Old Bering Sea and Okvik. Although seriation of such identified types can be used to infer culture change through time and space, without independent chronological evidence, the direction of change cannot be determined.

Stratigraphy in Arctic sites is characteristically thin to non-existent, or where substantial, sequences are confused by taphonomic processes, cultural practices, post-depositional geomorphic processes and/or highly variable excavation techniques.

Dendrochronology and radiocarbon dating offer the greatest potential for precise and accurate dating of materials from Arctic archeological sites. While both methods have been employed extensively in the past in Alaska and adjacent regions (Gerlach and mason 1992), compiling an impressive database of dates from throughout the region, interpretation has failed to keep pace with investigation due to a failure to address problems of accuracy and precision in sampling, assay and reporting procedures.

Interpretation of radiocarbon and dendrochronological dates is adversely affected by factors influencing the accuracy and precision of the results. Precision is a function of the method employed to take the measurement, while accuracy is a function of the interpretation of the measure, which takes the precision of the measure into account..

Factors that affect the precision of a radiocarbon date include sample contamination, laboratory pretreatment, laboratory assay procedure and reporting format. Factors that affect accuracy of the date include sampling procedure, differential fractionation, differences in ^{14}C reservoir sources, calibration for differential rates of ^{14}C production through time, archeological context and reporting format (Stuiver and Pearson 1986).

Dendrochronological dating is obviously the most precise form of dating available. Counting tree rings potentially can provide the calendar year of the death of the tree from which the sample was taken. Precision in dendrochronology depends on the quality of the sample taken, the skill of the dendro laboratory personnel in counting and cross-dating rings and the depth of the comparative master chronology used to compare against the sample.

Precision in radiometric dating has improved enormously in recent years. Techniques of sample pretreatment, component selection and isolation, half-life determination and the availability of refined techniques such as AMS dating have improved precision and lowered error ranges by a factor of 50% over early techniques such as solid carbon assays. Analytical reports from radiocarbon labs can, in most cases, be relied on to deliver a precise assessment of the results obtained from current techniques.

Unfortunately, accuracy in the interpretation of dendrochronological and radiocarbon dating has improved very little since Collins' and Geist's time. Sampling procedures have been improved and standardized, but fractionation and old carbon reservoir factors, so vital to the interpretation of radiocarbon dates derived from Arctic archeological sites, continue to be ignored. Calibrated dates are appearing with much greater frequency, but the majority of site reports and regional syntheses, including the Smithsonian series, *Handbook of North American Indians* (1984), generally perceived of as the state of "received knowledge" in archeology and anthropology of the Arctic and Subarctic regions, continue to report radiocarbon assays as if they were calendar dates (cf. Geist and Rainey 1936; Collins 1937; Rainey 1941; Larsen and Rainey 1948; Ford 1959; Bandi 1969; Stanford 1973; Dumond 1984; Staley 1994).

Wendy Arundale's (1981) pioneering article assessed variability in radiocarbon dates in terms of fractionation and old carbon reservoir factors in marine mammal samples. More importantly she challenged analyses such as that of McGhee and Tuck (1976), who advocated the rejection of samples from difficult sources such as marine mammal biological material and driftwood rather than attempt to understand and control for the physical processes responsible for the variation.

Fractionation refers to differential metabolism of molecules with carbon of different molecular weights, e.g. ^{14}C, ^{13}C and ^{12}C, which can affect the $^{14}C/^{12}C$ ratio. Arundale has demonstrated procedures to control for this effect and has determined fractionation factors for many materials encountered and dated in archeological sites (Arundale 1981).

Marine carbon reservoirs contain proportionately less ^{14}C to ^{12}C than aerial reservoirs due to old carbon held in the remains of carbonaceous organisms encorporated in marine sediments. Organism that have metabolised marine carbon thus appear too old in ^{14}C analysis by a factor that is variable both geographically and biologically. For example, bottom feeding animals such as some whales and walruses metabolize proportionately greater or lesser amounts of mollusk shells and therefore exhibit differing old carbon reservoir effects. Arundale lists old carbon correction factors for several areas in northern Arctic waters. Although these are not directly applicable to Alaskan sites, they provide a guide as to their derivation and utilization. Gerlach and Mason (1992) cites evidence for the use of a -400 year old carbon correction factor for Bering Strait sea mammal material.

Morrison (1989), Gerlach and Mason (1992) and Mills (1994) provide excellent examples of reporting formats and levels of critical analysis that have contributed to significant reinterpretations of major cultural sequences in Canada. northwestern Alaska, the Bering Strait region and on Kodiak Island and the Alaska Peninsula.

Morrison's (1989:60-62) analysis of radiocarbon dates from Thule materials from across northern North America, though disturbing in its rejection of problematic sea mammal and driftwood dates, nonetheless contains an analysis and discussion of how raw material and contextual considerations figure in interpretation. The date list is presented in an uncalibrated calendar date format, but source material is listed and designated as sea mammal or terrestrial in origin. Graphs within the text of the article are based on calibrated dates. It should be relatively easy to calibrate Morrison's date list with old carbon reservoir and fractionation factors where applicable and present the results in a graphic form that compares date ranges among the various Thule and Birnirk phases (cf. Gerlach and Mason 1992; Mills 1994).

Driftwood dates are more difficult to justify with the non-driftwood dates, though Morrison's presentation does graphically show their relative ranges. Further investigation into the dynamics of driftwood movement and use in these areas would be useful.

Gerlach and Mason (1992) presents a large database of calibrated dates for the Bering Strait area between approximately 2000 and 1000 BP. The dates are presented in a graphic form that allows easy comparison among the cultures to which the dates are attributed. The text contains a thorough discussion of the issues of calibration, old carbon reservoir correction and context. The date list contains both uncalibrated dates and calibrated intercepts in both A.D./B.C. and B.P. formats, and lists source material and, in many cases, archeological context.

Unfortunately, the -400-year old carbon reservoir correction is not applied to the dates in this date list, which, in the aggregate is probably not critical, but which becomes increasingly important when considering dates from such sites as those on St. Lawrence Island where there are few dates and most raw materials are sea mammal or are contaminated with sea mammal oil. When issues of context are addressed for these individual sites, the relative application of old carbon correction can also be applied.

The comparative graphs compiled from the calibrated date list suggest relative contemporaneity of at least some of these previously identified culture units and are therefore used to call to question the unilineal development model of occupation of the Bering

Strait sites originally proposed by Collins in 1937 and accepted as rote but subsequent researchers.

Mills (1994) calibrate dates from the Gulf of Alaska and the Alaska Peninsula area and proposes a re-analysis of the relevant culture sequence for the past 10,000 years. The analysis is used to propose significant patterns of culture change within the time period and is correlated with theories of cultural interaction proposed by other researchers. The graphic presentation of the derived date ranges, while not as clear as in Gerlach and Mason (1992) or Morrison (1989), is nonetheless interesting and informative and graphically demonstrates the proposed cultural discontinuities.

The attribution of dates to particular culture units is a problem that is not fully addressed in these chronological analyses. In these three cases the cultural attribution of the original researcher is accepted as given, with reservation and explanation. This, of course, is a matter of expediency and practicality at this level, but it is a potential problem that must be addressed in a more detailed analysis of specific culture areas. All three analyses either implicitly or explicitly call to question commonly accepted prehistoric cultural identities, and further analyses should refine the boundaries of these questions and possible reveal new relationships and commonalties.

The two analyses by Gerlach and Mason (1992) and Mills (1994) set the standard for chronological work that must be undertaken for all sites in Alaska, particularly for those on the Bering Strait coast. In addition to this thorough calibration and analysis, dates must be examined site by site for contextual interpretations that may affect the overall picture of culture history.

An additional problem in assessing any dates from the St. Lawrence Island material involves the identification of Old Bering Sea and Punuk as cultural units. Collins' classification of harpoon heads and other materials from St. Lawrence Island depended on a loosely defined and not explicitly stated set of criteria for inclusion in each class. Punuk, particularly, is totally undefined, since the type site has never been reported. My research on the harpoon heads of St. Lawrence Island suggests that Punuk consists of a combination of elements from two separate cultures that co-existed on St. Lawrence Island, derived from an Old Bering Sea/Birnirk base and heavily influenced by an intrusive Okvik presence. This makes the contextual association of any dates on St. Lawrence Island extremely important in any attempt to correlate Old Bering Sea, Okvik, Birnirk and Punuk materials from other areas of the Bering Strait region.

Dating the St. Lawrence Island Sites

Punuk Island

The Punuk type site, excavated by Collins in 1928, has never been reported nor dated. The Okvik site on the same island was excavated by Geist in 1931 and briefly reported by Rainey in 1941, and again never dated.

Gambell Sites

The Gambell sites have received the most attention in terms of radiocarbon dating (Collins 1937; Geist 1936; Giddings 1960,1967; Bandi 1967; Staley 1994). Gerlach and Mason (1992) provide the calibrated intercepts for these dates, which form a major part of their comparison of Old Bering Sea and Punuk sites. A detailed contextual analysis will help put these date ranges into perspective.

Hillside Site

The earliest date reported for the St. Lawrence Island sites is 2258 ±230 (C-505) C-14 B.P., from structural wood excavated by Giddings from a house pit reportedly associated with Okvik materials at the Hillside site above the Mayughaaq mound at Gambell (Rainey 1941; Giddings 1960, 1973, Gerlach and Mason 1992). On this basis, Giddings, and subsequently Collins, propose that Okvik is older and ancestral to Old Bering Sea (Collins 1954, 1973; Giddings 1960, 1973). This temporal relationship has been accepted by all subsequent researchers and has appeared in the literature with reference to Rainey's anecdotal description of Giddings' excavation (Rainey 1941, Larsen and Rainey 1948; Collins 1954; Ford 1959; Giddings 1960, 1973; Ackerman 1961, 1962; Bandi 1969; Stanford 1973; Bradley 1974; Crowell 1984; Staley 1994).

Examination of the harpoon heads on which the Okvik identification was made reveals that they are not Okvik in origin in the first place. The Hillside decorative style is somewhat similar to Okvik, but much more closely resembles a harpoon head discovered by Jeness in 1926 on Diomede Island (Collins 1937:Plate 27, Figure 5). The association of the harpoon heads with the dated house post is not at all established since Giddings discovered the harpoon heads in an uncontrolled excavation between the floor stones of the house pit (Giddings 1973).

In 1961, Ackerman redated the same wood sample from the Hillside site, receiving a date of 1461 ± 65 (P-325) C-14 B.P., a date which is more precise, but which is as inaccurate as Giddings original date, since Ackerman did not address the contextual implications of the sample (Ackerman 1962). On this basis, Ackerman proposed that Okvik and Old Bering Sea were contemporaneous regional variations of the same culture.

In 1995, Don Dumond dated two pieces of unmodified wood from the Hillside site, identified as willow by Dave McMahan from the Alaska Office of History and Archaeology. Both dates are corrected by C13/C12 ratio (Dumond, personal communication, March 1995).

1800 ± 90 (Beta-78213) C-14 B.P.

1160 ± 70 (Beta-78214) C-14 B.P.

The remainder of the dates from the Gambell sites suffer from the same lack of contextual analysis. Of the twenty dates reported for these sites, eighteen are taken from unprovenienced wood artifacts (Gerlach and Mason 1992). All of the wood is driftwood of unknown origin and unknown history of use and re-use in the Gambell mounds. The dates, regardless of their precision, are accurate only in dating the death of the tree from which they came, and cannot be closely correlated with cultural activity. The remaining two dates are from walrus and whale bone, which have not been corrected for old carbon reservoir effect.

Ayveghyaget

Two dates from wooden artifacts from Ayveghyaget are reported by Gerlach and Mason (1992):

1070 ± 210 (P-69) C-14 B.P. (Solid Carbon)

910 ± 145 (P-92) C-14 B.P.

Mayughaaq

Mason and Ludwig (1990:356) provide seven uncalibrated C-14 dates from materials in the Miyowagh mound. Although depths for these samples are given, with one exception, more detailed provenience data is not offered. All but one of the dates are from wood, three from logs or roof beams, two from unspecified wood sources, and two from wood objects, presumably culturally manufactured objects. The remaining date was taken from walrus hide and is offered without marine old carbon reservoir correction.

Calibration and grouping of these seven dates yields the date ranges in Table 17. Depth is given in depth below surface. Since exact provenience is not available, these data cannot be converted to height above sterile gravel.

Depth below surface	Date Range
83.2 cm	1540----------1060 B.P.
98.8 cm	2036-----------1310 B.P.
130 cm	2112-----------------------1074 B.P.
150.8 cm	1410-------------------970 B.P.

Table 17 - C-14 Dates from the Mayughaaq mound

These date ranges are extremely broad, as a result of the high standard deviation of the original assays, coupled with the tendency of the calibration process to produce a broad range of intercepts. Since no other provenience data are available, it is not possible to use these date ranges to compare cultural levels within the site.

<u>Old Gambell Cemetery</u>

A further collection of dates attributed to Old Bering Sea and Punuk burials was obtained from excavations by Bandi (Bandi 1967, 1969, Mason and Ludwig 1990, Gerlach and Mason 1992) in the Old Gambell area (See Figure 2, page 31). Figure 66 presents the two sigma calibrated date ranges for the Old Gambell burials. Radiocarbon dates were taken from whale bone and driftwood included in the graves and are calibrated using the CALIB program from the University of Washington (Stuiver and Pearson 1986).

Whale bone calibration used a 400 year old carbon reservoir correction factor.

Table 18 provides uncalibrated dates from the burials in the Old Gambell cemetary, indicating dates taken from wood and whalebone sides and covers of the graves. Figure 66 presents calibrated date ranges for the dates in Table 18, with two sigma error bars indicating 95% confidence levels for the means of the date ranges. Figure 66 reveals a considerable overlap in date ranges between graves with Old Bering Sea and Punuk attribution, with the mean of Old Bering Sea associated ages approximately 200 years older than those with Punuk decorated artifacts.

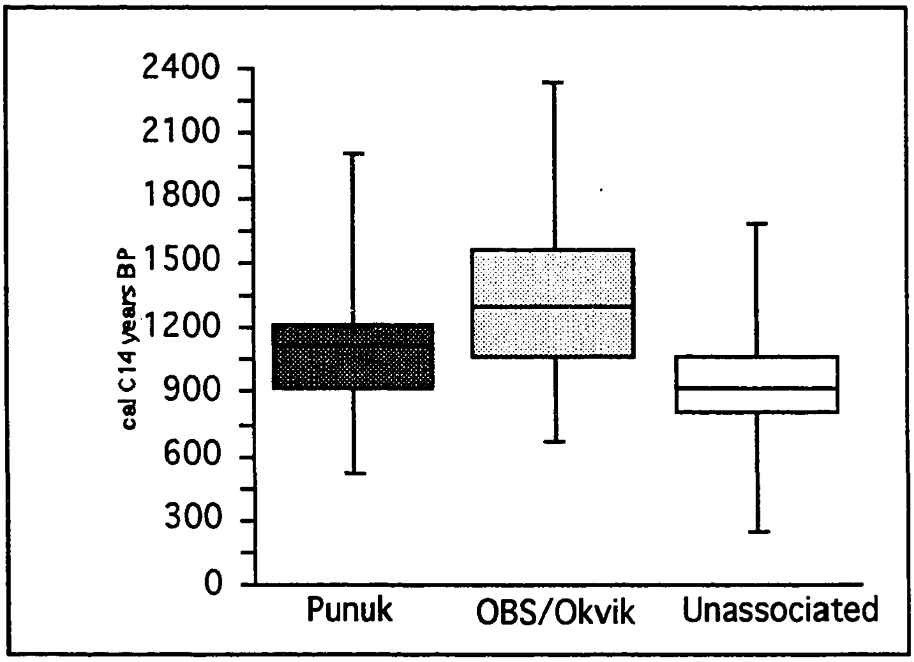


Figure 66 - Two Sigma Calibrated Date Ranges from Gambell Burials

Lab Number	Wood		Whalebone	
B-3204	460 ±70	B-2433	1100±70	
		B-2432	650 ±80	
B-894	780±50			
B-2434	850±70	B-2443	1400±90	OBS
B-890	840±70			
B-3209	880±80			
B-2862	940±60	B-2870	1340±60	
B-2856	940±70			
B-2860	950±90			
B-2855	970±50			
B-2850	980±60			
B-3207	990±70			
B-2858	990±70	B-2857	1110±60	
B-3208	1000±70			
		B-2441	1010±60	
B-2431	1040±90			
B-3213	1040±70			
B-3218	1070±70			
B-3210	1130±70			early Punuk
B-3214	1150±80			
B-3219	1160±80			
B-3211	1260±70			
B-2852	1270±70	B-2853	1760±50	OBS/early Punuk
B-3206	1310±60			
B-3205	1410±60			Okvik
B-2859	1530±80	B-2875	1720±50	
B-2876	1550±60			early Punuk
		B-2869	1820±80	
		B-2877	2450±40	Okvik

Table 18 - Old Gambell Cemetery C-14 Dates (Bandi 1984)

Bandi's (1967) dates from graves around the Gambell sites and from other more distant sites are particularly questioned in their cultural association, since Bandi does not explain in detail how the association was determined. He cites a small number of decorated objects found in some graves and visual comparison with descriptions of Siberian graves of Old Bering Sea and Punuk attribution (Bandi 1964, 1969).

Kialegak

Three dates from St. Lawrence Island that are interesting and potentially illuminating were derived from muscle tissue from a frozen body found in a collapsed house structure at Kialegak on the southeast shore of St. Lawrence Island (See Figure 1, page 27). Three uncalibrated dates are reported by Bradley (1976):

1661 ± 81 (I-7584) C-14 B.P.

1610 ± 80 (P-2090) C-14 B.P.

1545 ± 70 (SI-1656) C-14 B.P.

The range of these dates prompted the authors to propose the body to be of Old Bering Sea origin. However, pre-contact occupants of St. Lawrence Island metabolized most, if not all, of their carbon from marine sources. Therefore, these dates should be calibrated with a marine old carbon reservoir correction approximating that of sea mammal material. Using the calibrated dates listed by Gerlach and Mason (1992) corrected for their suggested -400 year old carbon correction yields a two sigma date range of 1415 to 910 C-14 B.P.

This places the Kialegak human remains contemporary with C-14 dates from

Kukulik

The Kukulik site on St. Lawrence island, the largest midden site in the Bering Strait region has been partially dated by Giddings (Rainey n.d.) (Geist and Rainey 1936).

In 1939, Giddings dated house posts and wooden artifacts from the Kukulik mound, cross-dating to his established chronology of Interior Alaska tree-rings (Rainey n.d.; Giddings 1938, 1940, 1941, 1952, 1966).

Figure 67 presents the tree-ring chronology Giddings developed for the upper levels of the Kukulik mound. He dated driftwood logs from the 1st House between A.D. 1779 and 1829 and the 2nd House between A.D. 1150 and 1456. The + indicates that this is the year of death of the tree and the earliest date that can be attributed to the log. Cultural use of driftwood may occur up to 250 years after the death of the tree (Giddings 1952).

Giddings also established a master chronology from wooden artifacts from the test Trench in the Kukulik mound from A.D. 950 to 1938, with a 360 year floating chronology that he could not connect to the oldest continuous sequence (Rainey n.d.).

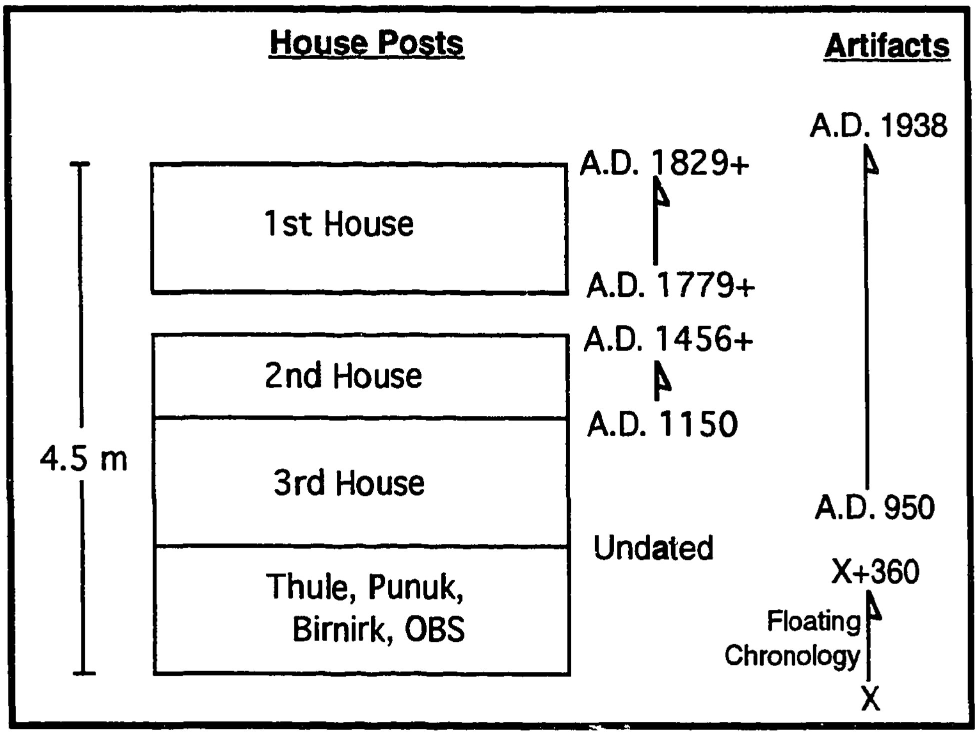


Figure 67 - Giddings' Kukulik Tree-Ring Chronology

St. Lawrence Island Chronology

Figure 68 compares the dates from the St. Lawrence Island sites detailed above. All dates are calibrated, corrected for marine old carbon reservoir where necessary, and expressed as calendar dates to allow comparison with the dendrochronological dates from Kukulik.

The earliest dates from the Kukulik mound overlap with the date range from Ayveghyaget and the Gambell Cemetery Old Bering Sea and Punuk burials. The floating chronology of dates from wooden artifacts would extend this date range at least to cal A.D. 600, the earliest date range for Punuk materials from Mayughaaq and Ayveghyaget.

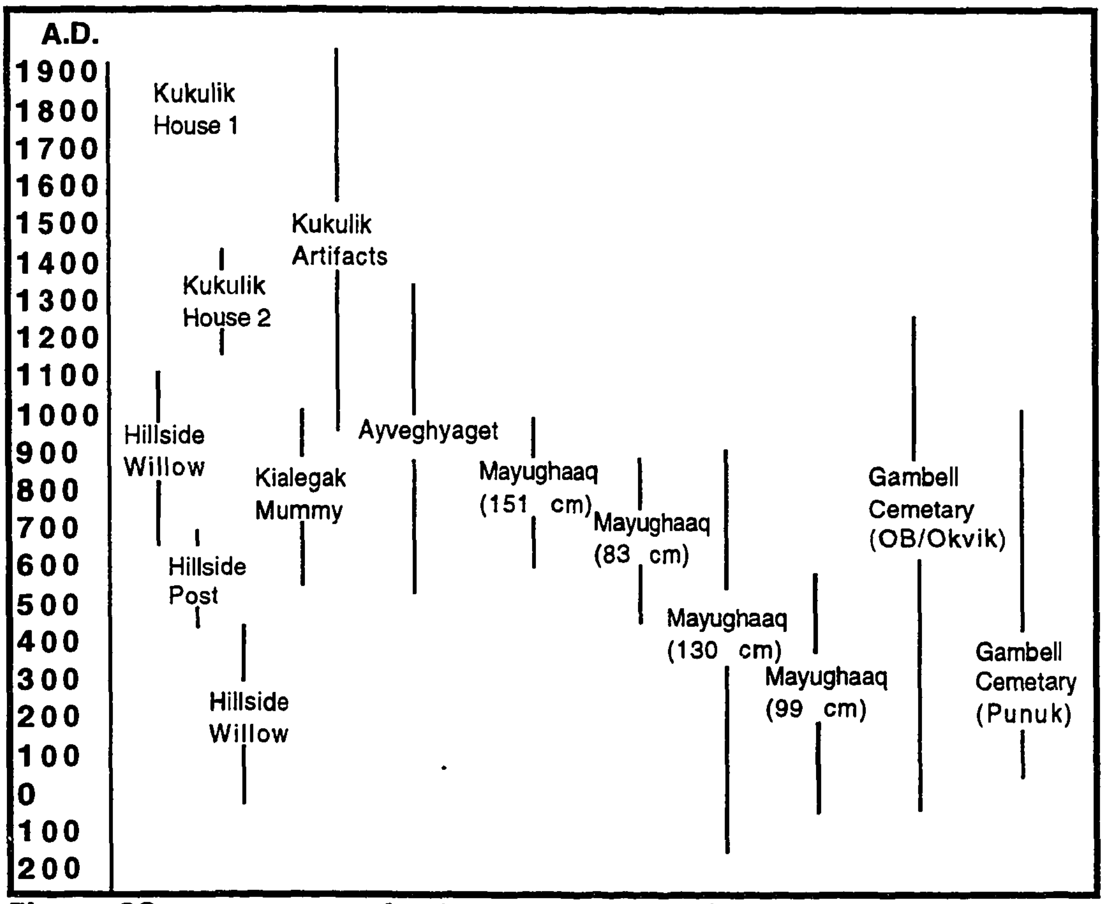


Figure 68 - Date ranges for St. Lawrence Island sites

The Kialegak human remains are contemporaneous with the Ayveghyaget date range and the two latest date ranges from the Mayughaaq mound. This burial should be associated with Punuk occupation rather than Old Bering Sea, as originally interpreted (Bradley 1974).

The Hillside house post re-dated by Ackerman falls midway between Dumond's two willow dates. The Hillside date range straddles the Old Bering Sea to Punuk transition at around cal A.D. 600 (1350 cal C-14 B.P.)

The Mayughaaq dates show significant reversals in vertical distribution indicative of the extremely mixed nature of the site. Since no detailed provenience is available for these samples, it is difficult to associate these dates with Old Bering Sea or Punuk occupations. The oldest dates of cal 10 B.C to cal A.D. 0 correspond with the oldest dates from the Old Gambell Cemetery.

The Old Gambell burial Old Bering Sea and Punuk dates completely overlap. This is probably due to difficulty in associating these burials with either occupation, due to the lack of decorated associated funerary objects and difficulties in interpretation of decorative styles. The dates attributed to Punuk occupation are considerably older than any other Punuk dates on St. Lawrence Island or anywhere in the Bering Strait region.

Chronology of Bering Strait Archeological Sites

The date ranges presented for St. Lawrence Island sites are compromised by problems of context, accuracy and precision. I have difficulty in interpreting the patterns of relationships among the sites on the island due to my general mistrust of the accuracy of the data set.

However, the dates do not exist in isolation. Patterns of dates from other areas of the Bering Strait can be compared to patterns of St. Lawrence Island dates to test their adequacy as a measure of the relationships among the occupations of the region. Based on the calibrated C-14 assays presented by Gerlach and Mason (1992) and new dates presented here, I propose the following chronology for occupations of the Bering Strait region.

Date ranges from the Mayughaaq mound and from the Old Gambell Cemetery extend to 2000 cal C-14 B.P. and beyond, but are compromised by problems of interpretation. Since other dates associated with Old Bering Sea decorated materials in the Bering Strait region approximate 1500 to 1600 cal C-14 B.P. for the eastern coast of Chukotka (Gerlach and Mason 1992), I am reluctant to consider earlier dates for St. Lawrence Island. Calibrated date ranges for Old Bering Sea and Birnirk sites are generally younger farther north, such as at Cape Krusenstern, Walakpa and Barrow (Figure 69). Consequently I suggest a date range for Old Bering Sea and Birnirk sites in the Bering Strait region from approximately 1600 to 1000 cal C-14 B.P

The Okvik site on Punuk Island is undated and has been considered ancestral or at least contemporary to Old Bering Sea only as a result of Rainey's description of Giddings' excavation at the Hillside site (Rainey 1941). The Okvik material is undated at present, but the artifacts other than harpoon heads bear a striking resemblance to materials from the Near Ipiutak site at Point Hope (Larsen and Rainey 1948). I include Okvik here in comparison with the Near Ipiutak and coastal Ipiutak dates pending radiocarbon dating of the actual Okvik materials. Gerlach and Mason (1992) provides the coastal Ipiutak calibrated date range from 1500 to 1150 cal C-14 B.P., making it roughly contemporaneous with Old Bering Sea.

Figure 70 presents the distribution of Okvik and Near Ipiutak dates for the Bering Strait region.

The Punuk occupations on St. Lawrence Island and Kirigitavik are whole carbon assays with large standard deviation, from driftwood artifacts with uncertain context. Bandi's dates from the Old Gambell Cemetery are older than those from Ayveghyaget and overlap those from his Old Bering Sea associated burials calling to question the cultural association. Consequently, the Punuk dates shown in Figure 72 are largely conjectural, indicating a range 1300 to 1000 cal C-14 B.P.

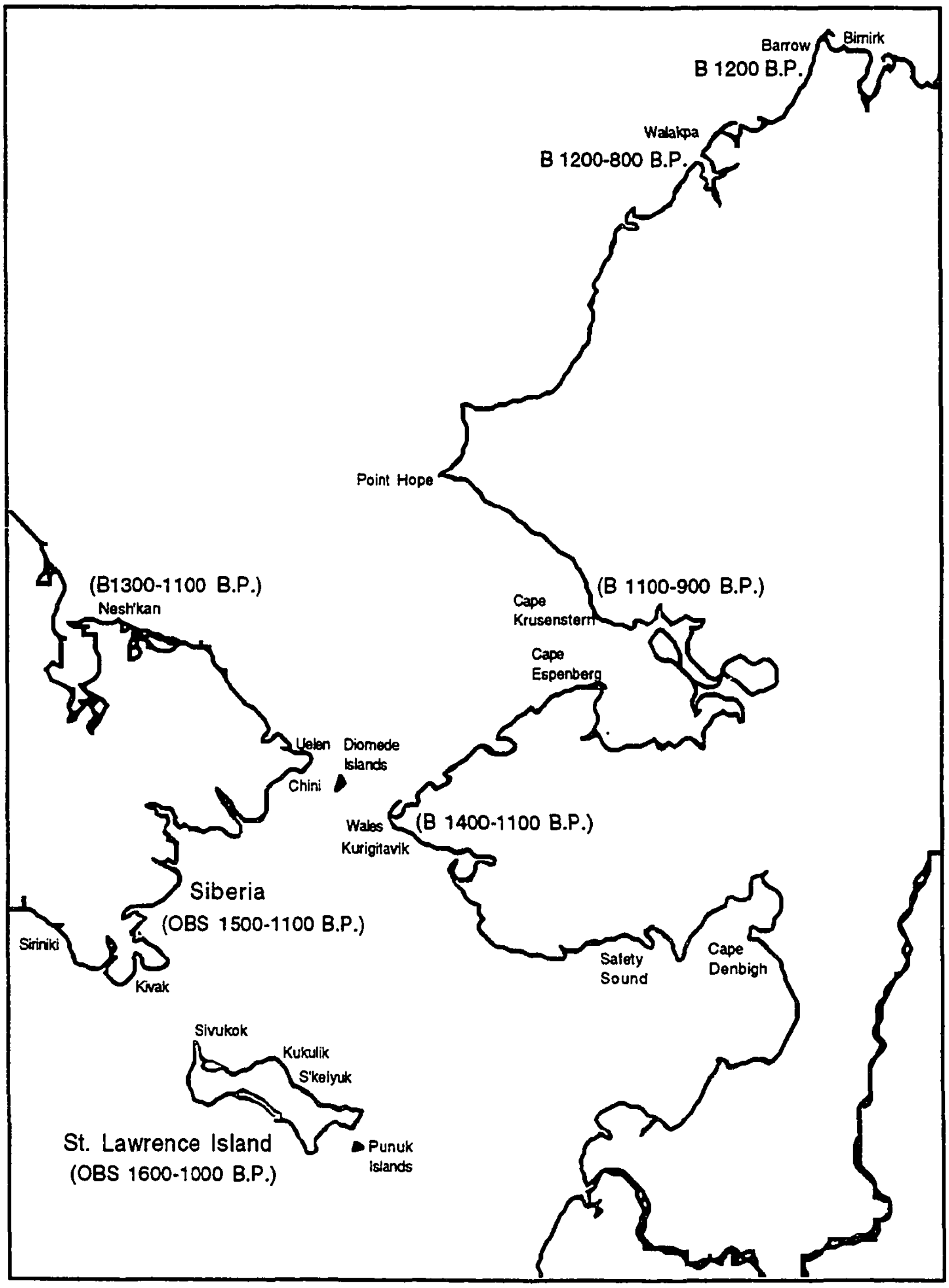


Figure 69 - Old Bering Sea/Birnirk Date Distribution

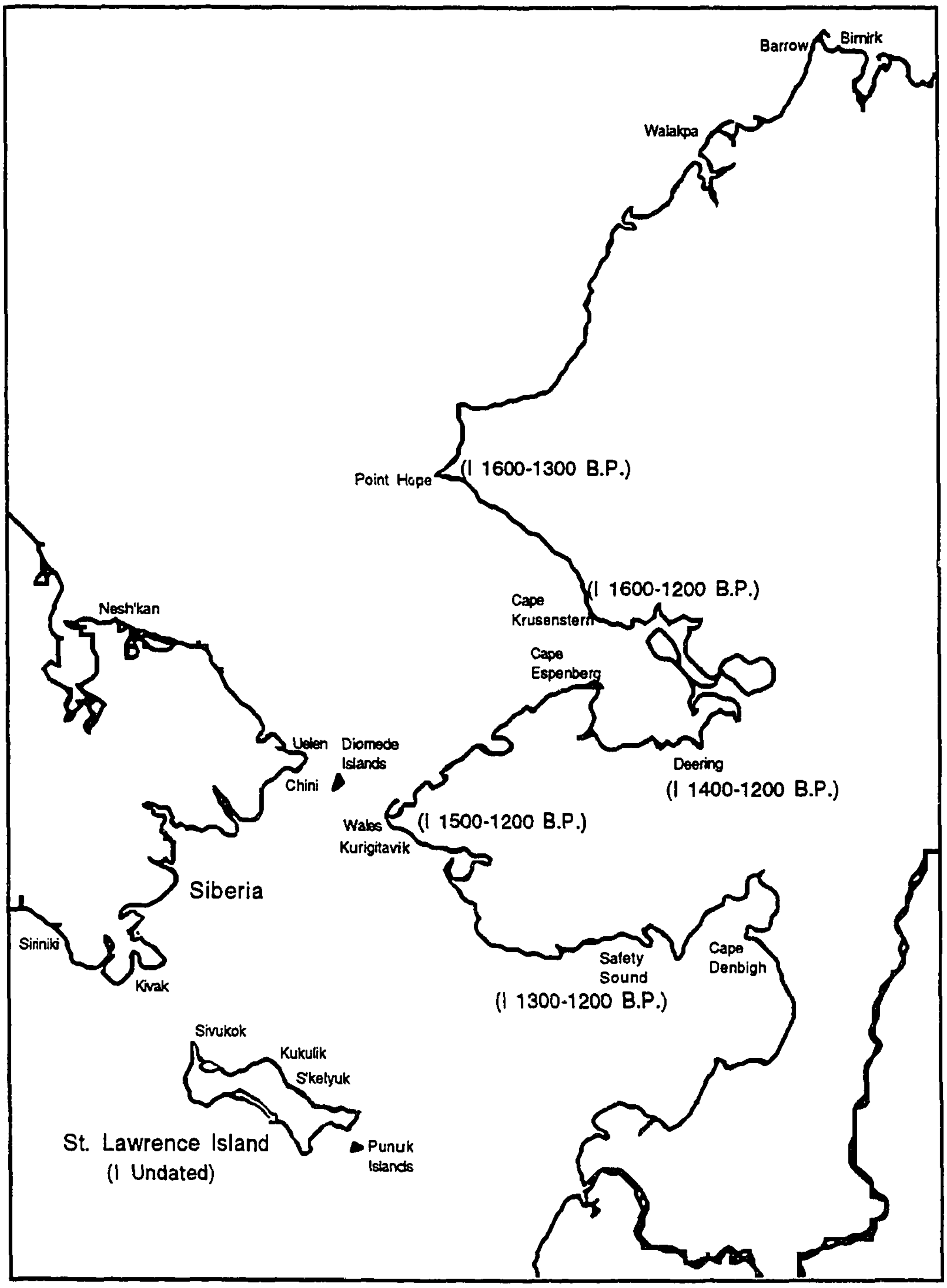


Figure 70 - Okvik/Near Ipiutak Date Distribution

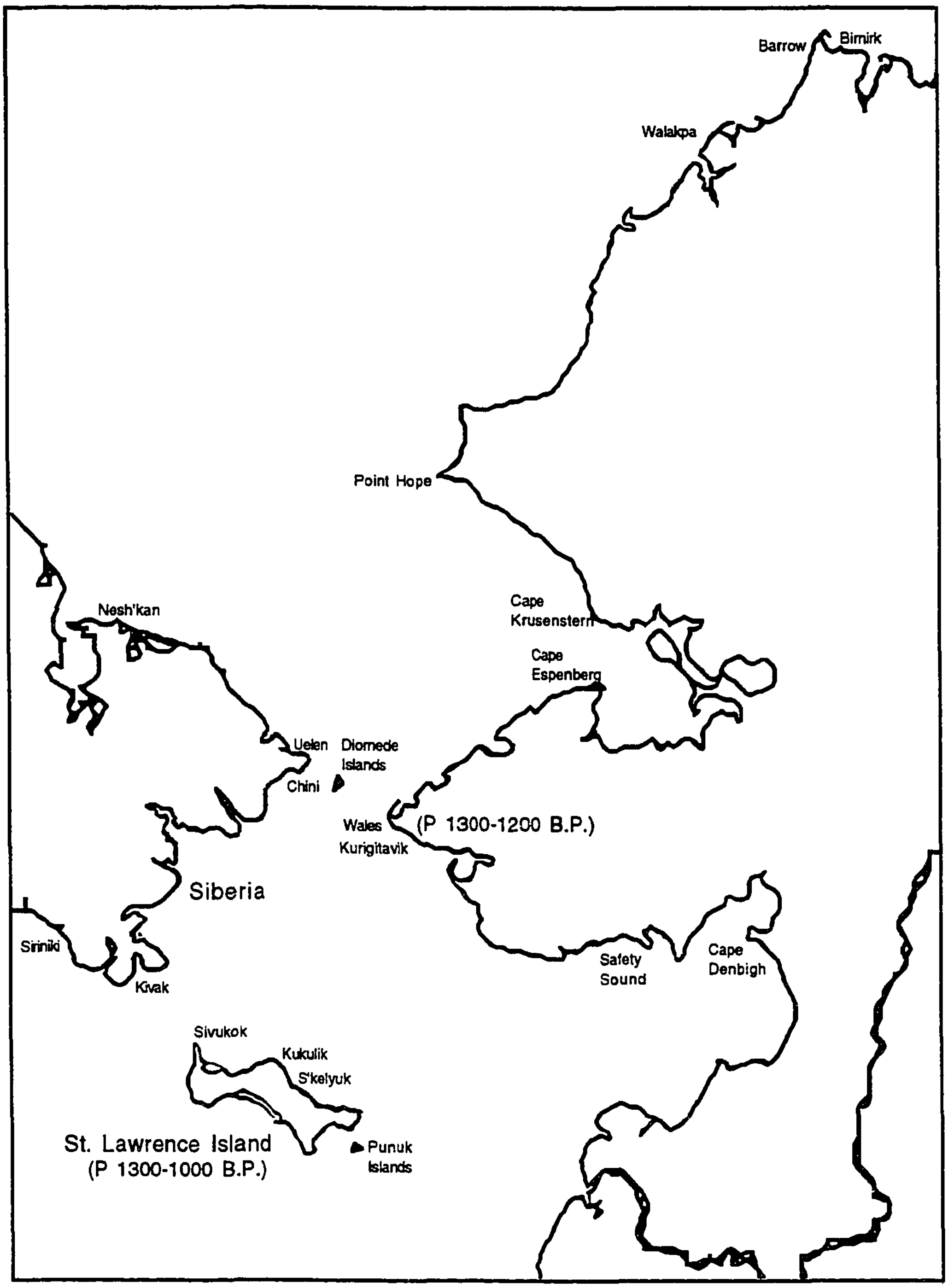


Figure 71 - Punuk Date Distribution

Figure 72 presents the earliest occurrence of the occupations of the Bering Strait region arranged geographically and chronologically by calibrated date ranges. Old Bering Sea on St. Lawrence Island and the Chukotkan coast is contemporaneous with Okvik, Hillside, Near Ipiutak and the earliest expression of Birnirk, on the Alaskan coast, extending from 1600 to 1300 cal C-14 B.P. Birnirk on the Chukotkan and Alaskan coasts and Punuk on St. Lawrence Island continue from 1300 to 1000 cal C-14 B.P. at the earliest expression of Thule on the Alaskan coast and Late Prehistoric on St. Lawrence Island.

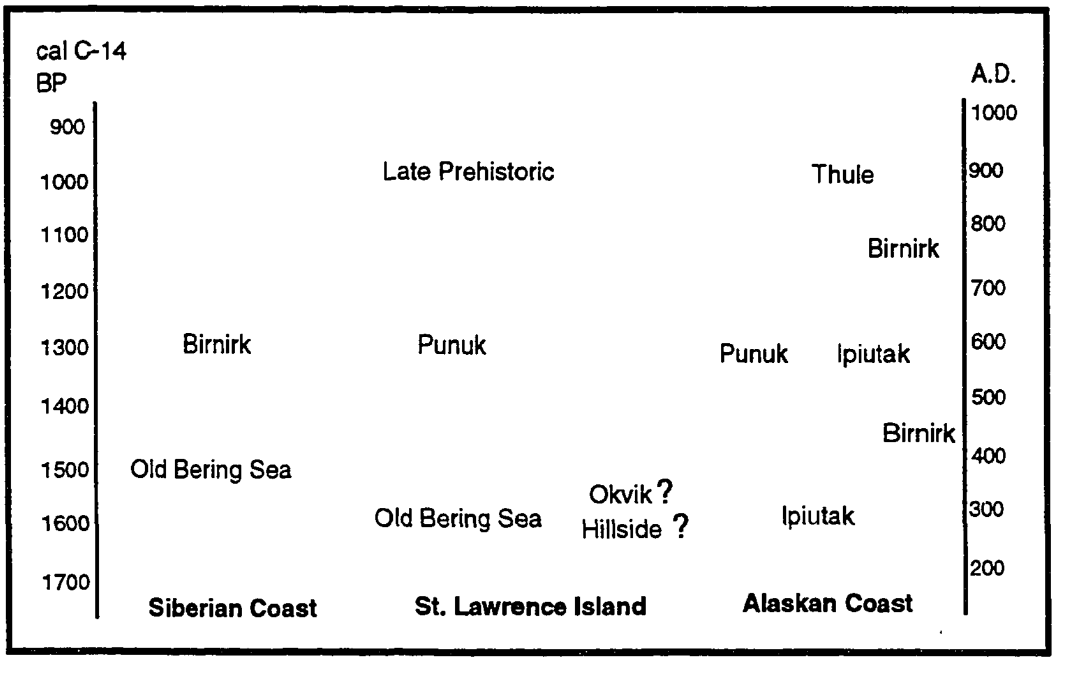


Figure 72 - Chronology of Occupations of the Bering Strait Region

Chapter 8 - Discussion

Chapter 6 developed a classification that demonstrates continuities between the classes of harpoon heads originally defined by Collins (1937). Rather than the lineal developmental model proposed by Collins and adopted by later researchers, the relationship appears to be more complex, involving repeated interactions between at least two major occupations.

In order to fully develop the evidence for these interactions, it is necessary to further examine the concept of type as it applies to the classification of Bering Strait harpoon heads presented in Chapter 6.

Fuzzy Types

Over the years of rather loose usage of the type concept, the word "type" has come to represent a physical object rather than an abstract mental construct. For example, the phrase, "Old Bering Sea Type harpoon head" brings to mind a representative example from a physical collection of harpoon heads, rather than a process of classification of the collection, or a complex of cultural behaviors resulting in the collection of physical objects.

However, as I compare the concept of type, in its physical or abstract manifestation, with cultural processes that result in patterns of variation among physical artifacts, the type concept appears to be decreasingly useful in the interpretation of patterning as a function of cultural interaction. The type represents a frozen moment in a complex process, ill equipped to represent the interplay of changing environmental influences that resulted in the gestalt of variables I characterize as a specific type.

Further, it must be recognized that the variables used to define differences among types change through time at different rates. For example, the single, symmetric, two-barbed spur may be used on harpoon heads across a long time span, while the foreshaft attachment and/or point design undergo several generations of changes either individually or in various combinations. Segregating physical harpoon heads into concrete categories such as types may obscure differential rates of change among the variables of the objects. Such an approach leads to battleship diagrams and discussions of artifact types being born, maturing and dying out, or even worse, migrating across the geography and/or evolving into other forms.

Clarke (1968:202) has written extensively of a systems approach to artifact and attribute analysis that takes into account the context of environmental influences that affect the form and development of artifact types, suggesting that archaeological entities can be viewed as dynamic systems of attributes.

Clarke defined the concept of type in terms similar to those in a body of theory called "fuzzy sets." One of the primary authors in the field, L.A. Zadeh (1965:338 in Adams and Adams 1991:73), writes:

"More often than not, the classes of objects encountered in the real physical world do not have precisely defined criteria of membership. Yet, the fact remains that...imprecisely defined 'classes' play an important role in human thinking, particularly in the domains of pattern recognition, communication of information, and abstraction."

The dialectic between rigorous systematic classification resulting in rigidly defined, mutually exclusive types and flexible human behavioral patterns responding to constantly changing environmental influences has generated the debate between emic end etic interpretations of classification schemes.

Variability

An imaginary scenario of a St. Lawrence Island resident contemplating the construction of a harpoon head may serve to illustrate the situation with regard to variation in harpoon head attributes.

The ivory carver, whether he (presumably) is a specialized artisan or a hunter who also carves his own tools, has a mental picture of the finished product of his harpoon head carving project. This picture is a product of norms received from his father, uncle, grandfather or other teacher, as well as a general perception of "harpoon headness" from having grown up within the culture. He also is knowledgeable about how the harpoon head must function in order to be an effective tool and he has a certain degree of knowledge, based on his level of experience, of the properties of the raw material he will be carving.

This ideal image of "Harpoon Head" is bounded by the limitations and opportunities of the environment existing at the time the carving takes place. The choice of raw material is influenced by the relative success of previous hunting efforts resulting in a variable availability of young, female walrus tusks, the preferred material for harpoon heads. Hunting success is influenced by weather, health of the hunter, success in other forms of hunting, opportunities for trade and sociocultural dynamics. Intercultural contacts present additional choices of raw materials, exposure to alternative techniques for designing and carving, new tools and exotic decorative styles.

The final form of any individual artifact results from a cascading series of choices made by the living carver as an active participant in a dynamic culture. The seemingly unlimited possibilities for variability are constrained by the limitations of raw material and function of the artifact, which produce eddying pools of stasis in a continuously changing stream of human activity. These areas of stasis are what we recognize as patterned human activity, which we organize in classification and typology schemes.

The task then is to detect those aspects of variability within the attributes of the artifacts under study that maintain a steady state within the study population. For example, this classification uses the structure of the raw materials and functions of harpoon head elements as relatively inflexible criteria for the selection of variables to be considered. It is for this reason that point design, line attachment, foreshaft attachment and spur design are used as variables in this classification. These variables will be traced, singly and in combination among the occupations of the Bering Strait region to demonstrate cultural influences resulting in harpoon head variability through time.

Functional Strategies

I demonstrated that the groups of harpoon head attributes identified in Chapter 6 cannot be identified as types by the defintion proposed at the beginning of Chapter 4. As defined by Adams and Adams (1991), types must be mutually exclusive in order to be used to sort the entire study collection. Although the various expressions of functional elements in these groups are indeed exclusive within their classes, they are not exclusive in the aggregate and therefore cannot to be used to sort the collection as a whole. In other words, a single spur harpoon head could also be placed in the drilled line hole, open 2 slot foreshaft attachment or side blade piles.

Rather than viewing these categories as discrete types, I will refer to them as functional strategies. The functional elements of an artifact are individually a product of environmental factors current at the time of their manufacture, each contributing to the shape and function of the artifact as a whole. Each element of the artifact has a function it must perform, is made of a raw material with specific properties and is shaped by a human agent with a preconceived idea of the appearance of the finished element as a functioning part of the whole artifact. The same factors that influence the appearance of the finished product also operate at the level of the functional element and these factors may change independently of those affecting other elements of the same piece. The dynamics of culture change may affect the individual elements of the artifact at different rates or not at all.

The approach that the ivory carver takes to produce the functional element of the harpoon head "system" defines the strategy employed to solve the problem addressed by each element. "How to build a spur" is addressed by the functional strategies of single or furcated spurs and their sub-attributes. "How to build a foreshaft attachment" is addressed by the functional strategies of open socket 2 lash slots, open socket slot and notch, triangular socket and closed socket, and so on. All four of the functional strategies here defined contribute to asolution of the problem of "How to build a harpoon head."

In attempting to trace these functional strategies from site to site and occupation to occupation, I make the assumption that the functional strategy is closely associated with a specific occupation. I equate the shared presence of a functional strategy as evidence of cultural influence and as I trace the strategies across space and time I assume cultural continuity. Differing combinations of functional strategies are assumed to represent combinations of influence from different occupations.

It may be argued that the functional strategy, as an emic interpretation of archeological evidence, cannot be proven to be associated with a specific occupation in exclusion of any other approach to harpoon head construction, since we cannot see into the heads of the makers of the artifacts. Specific physical characteristics of the artifacts may be idiosyncratic expressions of the changing esthetic tastes of the makers, much as Collins' stylistic comparisons of decorative styles.

However, in this case, the strategies are based on consistent structural and functional characteristics of the artifacts, rather than potentially idiosyncratic decorative styles and uncertain stratigraphy. Unlike decorative styles, the functional strategies are specific and unvarying in a single component occupation. On St. Lawrence Island, what has become known as Punuk "culture" is in reality a combination of elements derived from two culturally distinct occupations of the island, each contributing to the functional strategies of the resultant harpoon heads.

The Typology

Table 16 in Chapter 6 is reproduced here replacing the term "type" with "functional strategy."

Element		Spur		Line Hole		Foreshaft Attachment			Blade	
Functional Strategy		Single	Furcated	Drilled	Triangular	Open 2 slots	Open slot/Notch	Triangular	End	Side
	Count	1374	56	944	597	281	118	338	125	44
Cluster				Group A						
6	7		X							X
12	26					X				X
4	37		X			X				
3	47		X	X						
7	226			X		X				
				Group B				Group BX		
1	552	X			X					
2	326	X						X		
11	184				X			X		
14	297							X	X	
				Group C						
9	790			X					X	
8	99			X			X			
10	41			X						X
13	13						X			X
5	9		X				X			
6	7		X	Group D						X

Table 19 - Functional Strategies

Group A is characterized by the attributes of furcated spurs, drilled line holes, open socket-2 lash slot foreshaft attachments and side blades, represented by Collins' Old Bering Sea class and several of Ford's Birnirk classes.

Harpoon heads of Group A are found on St. Lawrence Island, along the eastern and northern shore of Chukotka, on the Diomede Islands, at Kurigitavik on the Seward Peninsula, at Cape Krusenstern, and at Walakpa, Utkiagvik, Birnirk and Anderson Point on the north shore of Alaska.

Group C harpoon heads are characterized by the attributes of drilled line holes, open socket, slot and notch foreshaft attachments and side blades. The furcated spur of cluster 5 and the end blade of cluster 9 are anomalous attributes that are connected to Group C by their associated line holes and foreshaft attachment designs. The combined attributes of these two clusters are shared by Groups C , D and A.

The most important attribute combination in Group C is the open socket, slot and notch foreshaft attachment. This functional strategy is found only on Okvik and Ipiutak harpoon heads and is consistently different from the foreshaft attachment strategy of Groups A and B.

The furcated spur and side blades in Group C represent Ipiutak harpoon heads that are made of antler rather than ivory. The end blade of cluster 9 in Group C represents Okvik and Ipiutak harpoon heads, made of ivory.

Group C harpoon heads are found on St. Lawrence Island, to a lesser extent on the eastern shore of Chukotka, on the Seward Peninsula, at Cape Krusenstern and at Point Hope in Alaska.

Group B is characterized by the attributes of single spurs, triangular line holes, triangular sockets and end blades. This group is represented by Geist and Rainey's Punuk, late prehistoric, Thule and modern classes from Kukulik. However, the levels in the Kukulik site that contain harpoon heads with these functional strategies also contain harpoon heads with drilled line holes and open-2 slot foreshaft attachments, which are shared by Groups A, B and C . The harpoon heads of Group B are almost exclusively ivory, with some appendicular bone used in the most recent artifacts.

Group D contains Birnirk harpoon heads from Group A and Ipiutak harpoon heads in Group C. There are harpoon heads pictured by Ford (1958) from the Birnirk site that appear identical to harpoon heads from Uelen and Ekven on the Siberian coast pictured by Rudenko (1964) and Okladnikov (1964). Whether this is Birnirk or Old Bering Sea influence is diificult to determine, since there are no dates associated with these artifacts. But there is no doubt that there was a flow of materials across the Bering Strait in both directions during this time period, whether or not we accept a cultural continuity between the continents.

Figure 73 combines the four Groups from Table 18 with the timeline presented in Figure 72 in Chapter 7.

Figure 73 organizes Group A and Group C as the result of two separate occupations of the Bering Strait region in the time period beginning approximately 1600 cal C-14 B.P. Group B, identified by Collins as the Punuk culture, represents the combination of functional strategies from Groups A and C on St. Lawrence Island from 1300 to 1000 cal C-14 B.P. Groups A and C gradually merge into Group B, leading ultimately to the Late Prehistoric and Modern forms from 1000 cal C-14 B.P to European contact. Group D represents the combination of functional strategies of Groups A and C at Point

Hope, leading to Thule forms on the northwest coast of Alaska at approximately 1000 cal C-14 B.P.

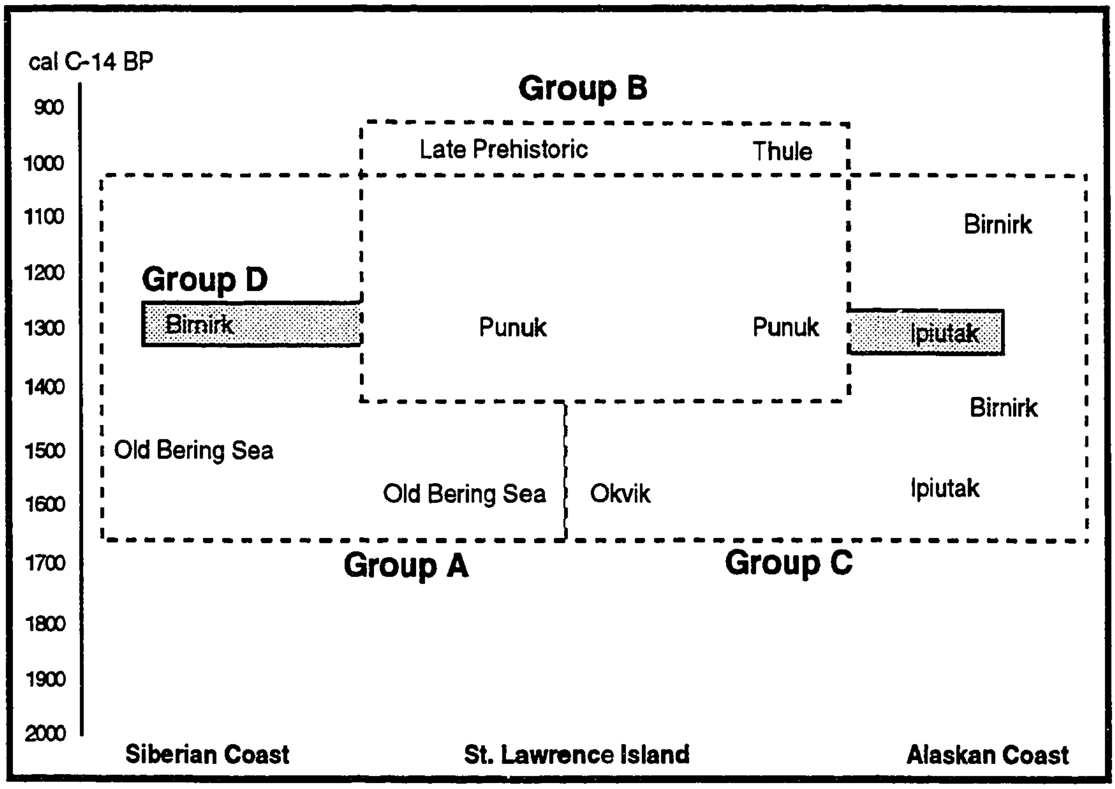


Figure 73 - Chronology of Occupations of the Bering Strait

Chapter 9 - Summary and Conclusions

Summary

Chapters I, 2 and 3 present data derived from 70 years of archaeological investigation on St. Lawrence Island and other areas of the Bering Strait region. I describe five archaeological sites on St. Lawrence Island and the Punuk Islands and critically analyze Collins' excavation in the Mayughaaq mound at Gambell. I present Collins' seriation chronology of St. Lawrence Island harpoon heads and compare it with my stratigraphic reconstruction of the mound.

I examine the excavation by Louis Giddings at the Hillside site in the light of Giddings' and Collins' interpretation of the Hillside material as representive of an Okvik presence on St. Lawrence Island. I describe the Okvik site on Punuk Island and suggest that the materials excavated resemble those from the Near Ipiutak site at Point Hope, excavated by Larsen and Rainey (1948).

Chapter 4 presents a summary of classification theory and practice, including recent evaluations of the type concept.

Chapter 5 analyzes the structure of raw materials used in harpoon head construction and their relationship to harpoon head functions. I describe and define the functional elements of the harpoon head, and explore the interrelationships between structure and function in the morphology of harpoon heads.

In Chapter 6, I explained and formulate my typology for harpoon heads from the Kukulik and Okvik sites. I compare my typology with the stylistic classifications of Collins and others. I use statistical comparisons to demonstrate the validity of the resulting categories as discrete and statistically significant groups.

Chapter 7 reviews the history of radiocarbon dating of sites in the Bering Strait region. I examine the context of radiocarbon dates for the five sites at Gambell and other sites on St. Lawrence Island. I present previous radiocarbon dates for the sites and provide dates for Kukulik and the Hillside site for the first time in print. I summarize the dates for the St. Lawrence Island sites and present a chronology of occupation of the Bering Strait region.

I introduce and define the concept of Functional Strategies in Chapter 8 and use this concept in my typology to trace influences among cultures in the Bering Strait region over the past 1600 years, as evidenced by the presence of specific functional strategies among the harpoon heads of the sites in the study.

Conclusions

The conclusions of this study are presented as they address the problems explained in Chapter 1.

Problem 1: Collins' classification of St. Lawrence Island toggle harpoon heads does not account for Old Bering Sea, Punuk and undecorated closed socket forms.

In Chapter 5, I demonstrate that socket design is a function of ivory structure rather than a stylistic preference on the part of the maker. Closed socket harpoon heads are preferentially produced from the tip of the walrus tusk, rather from the side, as are open socket harpoon heads. In my typology, closed socket is considered as one of four functional strategies for the production of the foreshaft attachment. Closed socket foreshaft attachment drops out of the typology in the final statistical analysis, demonstrating that the closed socket has no significant association with other functional strategies.

The closed socket harpoon head is not a separate category of the artifact, but merely an expression of the efficient use of all parts of the walrus tusk by the ivory carver. The symmetrical structure of the tip of the tusk allows the carver to produce a socket design that capitalizes on the increased structural integrity of this part of the ivory.

Therefore, I conclude that the closed socket design is not a stylistic variation separate from the open socket designs of the same cultural origin. Closed socket harpoon heads are included in each of the four groups of my classification and do not appear as a distinct functional strategy.

Problem 2: Collins' interpretation of a lineal relationship between Old Bering Sea and Punuk decorated artifacts is called to question by recalibration of radiocarbon dates indicating at least some degree of contemporaneity between dates associated with the two decoration styles (Gerlach and Mason 1992).

My classification of St. Lawrence Island harpoon heads demonstrates the influence of two culture groups co-resident on St. Lawrence Island resulting in the archaeological presence interpreted by Collins as the Punuk culture. The curvilinear decorations and harpoon head shapes of Old Bering Sea and Birnirk styles are linked by their shared functional strategies of open socket, two lash slot foreshaft attachment, furcated asymmetric spurs, side blades and bone and ivory raw materials. In contrast, Okvik harpoon heads are characterized by linear decorative designs, single spurs, slot and notch foreshaft attachments, and single end blades.

Punuk harpoon heads exhibit characteristics of both these styles, which I interpret as the combination of functional strategies derived from two co-resident population groups on St. Lawrence Island. The apparent contemporaneity between Old Bering Sea and Punuk decorated artifacts indicated by calibrated radiocarbon dates is a function, on the one hand, of the lack of contextual analysis of the dated materials and, on the other hand, the continuing influence of the Old Bering Sea/Birnirk culture group interacting with the Okvik/Ipiutak culture group through time. Rather than a linear pattern of culture development on St. Lawrence Island, Punuk and modern harpoon head styles can be viewed as the continuing interaction between these two larger co-resident groups.

Problem 3: The relationship between Birnirk harpoon heads and Old Bering Sea and Punuk harpoon heads on St. Lawrence Island has never been adequately explained.

In my classification, Birnirk harpoon heads are viewed as the northern expression of the Old Bering Sea/Birnirk culture group. The presence of Birnirk style harpoon heads on St. Lawrence Island is evidence of the continuing presence of this group on the island and on the shores of the Bering Strait. Rather than a discrete culture unit, Birnirk is here viewed as the technological expression of a culture group extending from St. Lawrence Island to Barrow.

Problem 4: The relationship among the Okvik material from Punuk Island, the Old Bering Sea decorated material from St. Lawrence Island and the Hillside material from the Hillside site near Gambell has never been established stratigraphically or temporally.

In Chapter 2, I demonstrate that Giddings' and Collins' initial identification of the harpoon heads from the Hillside site as Okvik has been perpetuated in the literature through a lack of analysis of existing collections of archaeological materials from these two sites. Comparison of the morphology and decorative styles of artifacts from these two sites clearly shows their unique character.

Harpoon heads from the Okvik site are characterized by the open socket, slot and notch lashing style, which places them in Group C of the classification, in company with harpoon heads associated with the Near Ipiutak site at Point Hope. This lashing style is distinctly different from that of Group A and distinguishes these harpoon heads from Old Bering Sea and Birnirk styles and from modern artifacts. Based on this association with Near Ipiutak materials, I would tentetively place Okvik contemporaneous with Ipiutak at approximately 1500 cal C-14 B.P.

Date ranges from the Hillside site are broad and difficult to interpret. Ackerman's (1962) redated sample falls midway between the two date ranges of willow provided by Dumond (personal communication, March 1995). Based on Ackerman's date range, the Hillside site may be contemporaneous with the Ayveghyeget mound on the Gambell plain, which Collins associated solely with Punuk decorated artifacts. If future radiocarbon dates from the Hillside site remain consistent with these dates, Collins' original assumption of the relative age of the gambell sites will be questioned.

I conclude that Collins' class of Punuk decorated harpoon heads is derived out of influence from both Okvik/Ipiutak and Old Bering Sea/Birnirk antecedents. What Collins defined as the Punuk culture unit is the result of two culture groups co-resident on St. Lawrence Island. Figure 66 in Chapter 8 illustrates the combination of Groups A and C that Collins interpreted as the single culture unit he called Punuk. Although exact temporal sequence is not now established, I propose that Punuk decorated objects are the result of two contemporaneous cultures of Okvik/Ipiutak and Old Bering Sea/

Birnirk, whose influences were felt on St. Lawrence Island and the surrounding coasts until European contact.

In summary, the harpoon head typology formulated in this dissertation demonstrates the presence of two distinct culture groups interacting in the Bering Strait region over the past 1600 years. Figure 67 presents my model of cultural influences in the Bering Strait region. The model proposes Okvik/Ipiutak and Old Bering Sea/Birnirk as two contemporaneous cultures derived from the same generalized Paleo-Eskimo base. Old Bering Sea/Birnirk is characterized by a generalized coastal/interior subsistence dichotomy, and Okvik/Ipiutak is characterized by an intense specialization on sea mammal hunting, including whaling.

Birnirk has been identified as a separate culture in northwestern Alaska that spread its influence to Punuk occupations on St. Lawrence Island and the coasts of Siberia and Alaska (Ford 1958). In my model, I view Birnirk as the northern expression of the Old Bering Sea/Birnirk culture group continuously present throughout the Bering Strait region from 1300 to 1000 BP.

I interpret the Okvik site on Punuk Island as evidence of an occupation related to the Near Ipiutak presence at Point Hope. I distinguish between Ipiutak proper and Near Ipiutak, which I explain as an occupation of the northward expanding Paleo-Eskimo whaling focus, interacting with the Norton-derived Ipiutak in place at Point Hope. The Okvik/Ipiutak group spread northward to Barrow, where it interacted with the Birnirk expression of the Old Bering Sea/Birnirk

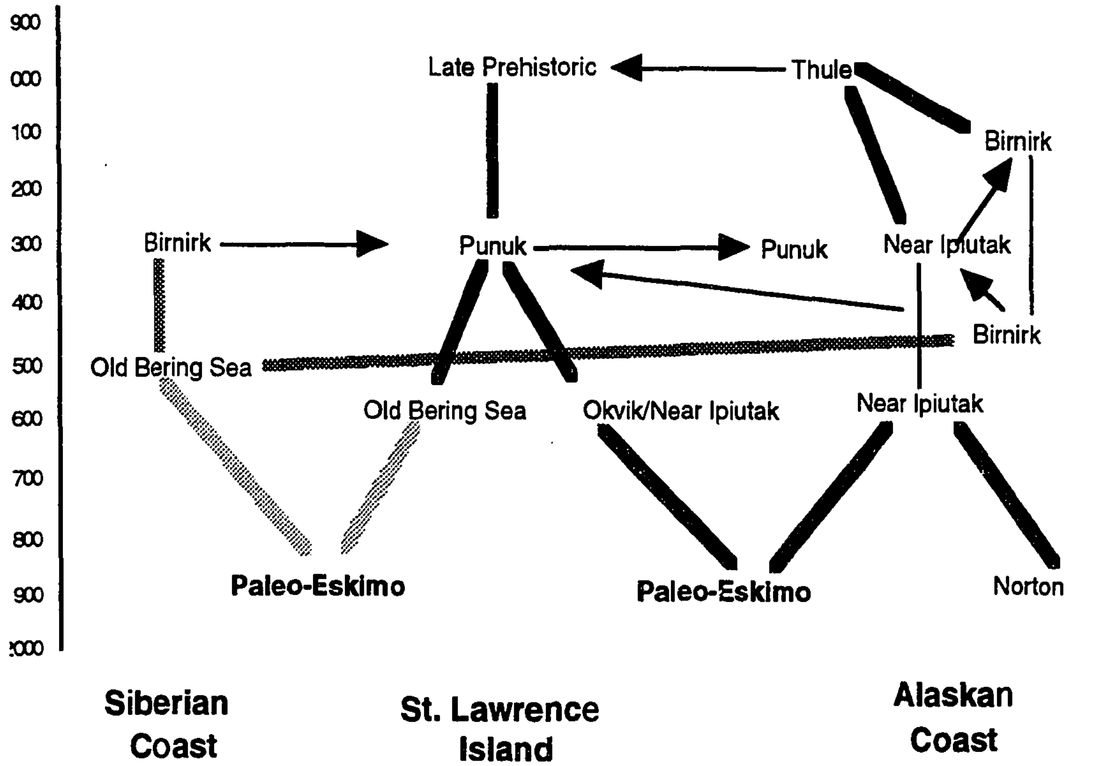


Figure 74 - Bering Strait Cultural Interactions

group. The resulting culture complex is known archeologically as the Thule culture, which continued the whaling-based expansion of the Okvik/Ipiutak whaling group as the Thule expansion to Greenland.

The co-occupation of St. Lawrence Island and the resulting mixture of culture traits was interpreted by Collins as a separate culture he named Punuk. In my model, I consider Punuk not as a separate culture but as evidence of the mixture of the functional strategies employed by two cultural groups occupying of the island and the shores of the Bering Sea. Over time, the two culture groups merged into the culture group occupying St. Lawrence Island at the time of the 1878-1879 famine.

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APPENDIX A

Accession No	Site Name	Date Assigned	Total # Cataloged
0199	Kukulik	1930	97
0231	Kukulik	1939	2
0250	Kukulik Mound	01/01/37	2
0254	Kukulik Mound	01/01/35	3
0259 (01)	Kukulik Mound	01/01/34	1
0412 (01)	Kukulik Mound	01/01/48	15
0760	Kukulik	09/13/57	2
0776	Kukulik	7/27/58	3
1-1927 (003)	Kukulik	01/01/27	5
1-1927 (006)	Kukulik	01/01/27	12
1-1927 (009)	Kukulik	01/01/27	10
1-1927 (010)	Kukulik	1/1/27	1
1-1927 (012)	Kukulik	01/01/27	3
1-1927 (055)	Kukulik	01/01/27	1
1-1927 (057)	Kukulik	01/01/27	2
1-1927 (059)	Kukulik	01/01/27	1
1-1927 (071)	Kukulik	01/01/27	27
1-1927 (075)	Kukulik	01/01/27	68
1-1927 (090)	Kukulik	01/01/27	1
1-1927 (107)	Kukulik	01/01/27	1
1-1928 (06)	Kukulik	01/01/28	674
1-1929 (02)	Kukulik	00/00/00	6
1-1931 (04)	Kukulik	01/01/31	52
1-1931 (08)	Kukulik	01/01/31	17
1-1931 (09)	Kukulik	01/01/31	1
1-1931 (10)	Kukulik	01/01/31	1
1-1931 (14)	Kukulik	01/01/31	8
1-1931 (16)	Kukulik	01/01/31	2
1-1931 (19)	Kukulik	01/01/31	6
1-1932 (01)	Kukulik	01/01/32	269
1-1932 (02)	Kukulik Second House	01/01/32	1041
1-1932 (03)	Kukulik Bottom of Second House	01/01/32	810

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Accession No	Site Name	Date Assigned	Total # Cataloged
1-1932 (04)	Kukulik - Test Cut	01/01/32	1781
1-1932 (05)	Kukulik	01/01/32	54
1-1932 (06)	Kukulik Bottom of Recent House	01/01/32	493
1-1932 (07)	Kukulik within Recent House	01/01/32	35
1-1932 (08)	Kukulik Outside level of Recent House	01/01/32	936
1-1932 (09)	Kukulik Random Diggings	01/01/32	262
1-1932 (10)	Kukulik Random Eskimo diggings, mostly from Recent Houses	01/01/32	584
1-1932 (11)	Kukulik Second House	01/01/32	699
1-1932 (12)	Kukulik Recent House	01/01/32	3
1-1932 (13)	Kukulik Second House	01/01/32	75
1-1932 (14)	Kukulik Bottom of Second House, between stakes 47 and 70	01/01/32	17
1-1932 (15)	Kukulik Bottom of Second House, north half of cut	01/01/32	494

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Accession No	Site Name	Date Assigned	Total # Cataloged
1-1932 (17)	Kukulik - Test Cut, Second House, near bottom of cut	01/01/32	172
1-1932 (18)	Kukulik - bottom of second house or top of third house	01/01/32	22
1-1932 (19)	Kukulik - Recent House in test cut	01/01/32	661
1-1932 (20)	Kukulik - East Slope 75' to 85' to middle of test cut	01/01/32	27
1-1932 (21)	Kukulik - Bottom of Second House	01/01/32	75
1-1932 (22)	Kukulik - Third House	01/01/32	50
1-1932 (23)	Kukulik - Random Pickings from Kukulik Beach	01/01/32	47
1-1933 (01)	Kukulik - Recent Meat Cellar, east slope	00/00/00	201
1-1933 (02)	Kukulik - East slope	01/01/33	426
1-1933 (03)	Kukulik - Recent Meat cellar, East Slope	01/01/33	81

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Accession No	Site Name	Date Assigned	Total # Cataloged
1-1933 (04)	Kukulik - East Slope, depth of more than 11 feet	01/01/33	4
1-1933 (05)	Kukulik - East slope	01/01/33	307
1-1933 (06)	Kukulik - Recent House	01/01/33	98
1-1933 (07)	Kukulik - Second House	01/01/33	2
1-1933 (08)	Kukulik - Second and Third House debris	01/01/33	6
1-1933 (09)	Kukulik - Third House	01/01/33	1082
1-1933 (10)	Kukulik - Southwest corner, depth of 10 feet 8 inches	01/01/33	10
1-1933 (11)	Kukulik - Between Third and Fourth Houses	01/01/33	126
1-1933 (12)	Kukulik - Fourth House	01/01/33	20
1-1933 (13)	Kukulik - between Third, Fourth and Fifth Houses, around Fourth Meat Cellar	01/01/33	83
1-1933 (14)	Kukulik - between Third and Fourth Houses	01/01/33	412

APPENDIX A

Accession No	Site Name	Date Assigned	Total # Cataloged
1-1933 (15)	Kukulik - Fifth House	01/01/33	5
1-1933 (16)	Kukulik	01/01/33	483
1-1933 (17)	Kukulik - Fourth House	01/01/33	4
1-1933 (18)	Kukulik - Lot Number 1	01/01/33	331
1-1933 (19)	Kukulik - Lot Number 2	01/01/33	73
1-1933 (20)	Kukulik - Lot Number 3	01/01/33	105
1-1933 (21)	Kukulik - Lot Number 4	01/01/33	267
1-1933 (22)	Kukulik - Lot Number 5	01/01/33	36
1-1933 (23)	Kukulik - Lot Number 6	01/01/33	222
1-1933 (24)	Kukulik - Lot Number 7	01/01/33	89
1-1933 (25)	Kukulik - Lot Number 8	01/01/33	47
1-1933 (26)	Kukulik - Lot Number 10	01/01/33	34
1-1933 (26)	Kukulik - Lot Number 9	01/01/33	5
1-1933 (27)	Kukulik - Lot Number 11	01/01/33	29
1-1933 (28)	Kukulik - Lot Number 12	01/01/33	9
1-1933 (29)	Kukulik - Lot Number 13	01/01/33	223
1-1933 (30)	Kukulik - Lot Number 14	01/01/33	226
1-1933 (31)	Kukulik - Lot Number 15	01/01/33	146
1-1933 (32)	Kukulik - Lot Number 16	01/01/33	20

APPENDIX A

Accession No	Site Name	Date Assigned	Total # Cataloged
1-1933 (33)	Kukulik - Lot Number 17	01/01/33	323
1-1933 (34)	Kukulik - Lot Number 18	01/01/33	4
1-1933 (35)	Kukulik - Random Eskimo Diggings, Lot Number 1	01/01/33	467
1-1933 (36)	Kukulik - Random Eskimo Diggings, Lot Number 2	01/01/33	504
1-1933 (37)	Kukulik - Random Eskimo Diggings, Lot Number 3	01/01/33	74
1-1933 (38)	Kukulik - Random Eskimo Diggings, Lot Number 4	01/01/33	131
1-1933 (39)	Kukulik - Random Eskimo Diggings, Lot Number 5	01/01/33	478
1-1933 (40)	Kukulik - Random Eskimo Diggings, Lot Number 6	01/01/33	114
1-1933 (41)	Kukulik - East Slope (Test Cut), Indeterminate depth	01/01/33	122
1-1933 (53)	Kukulik - Recent Meat Cellar	01/01/33	243

APPENDIX A

Accession No	Site Name	Date Assigned	Total # Cataloged
1-1933 (54)	Kukulik - Test cut	01/01/33	134
1-1933 (55)	Kukulik - Random diggings	01/01/33	4
1-1933 (58)	Kukulik - Test Cut	01/01/33	62
1-1933 (60)	Kukulik - Test Cut	01/01/33	7
1-1933 (61)	Kukulik - Random Diggings	01/01/33	140
1-1933 (65)	Kukulik - Test Cut	01/01/33	3
1-1934 (01)	Kukulik - West mound, outskirts of mound, no depth data	01/01/33	766
1-1934 (02)	Kukulik - West Mound, east end	01/01/33	555
1-1934 (03)	Kukulik - West Mound, west end - no more than 20' deep	01/01/33	133
1-1934 (04)	Kukulik - West Mound	01/01/34	92
1-1934 (04a)	Kukulik - West Mound	01/01/33	92
1-1934 (05)	Kukulik - West Mound	01/01/33	13
1-1934 (06)	Kukulik - Main Midden	01/01/33	180
1-1934 (07)	Kukulik - Main Midden	01/01/33	166
1-1934 (08)	Kukulik	01/01/33	3096

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1-1935 (01)	Kukulik - N.E. Beach Slope	01/01/35	120
1-1935 (02)	Kukulik - N.E. Beach Slope	01/01/35	22
1-1935 (03)	Kukulik - House No. 6, Recent	01/01/35	595
1-1935 (04)	Kukulik - Main Midden, west end	01/01/35	146
1-1935 (05)	Kukulik - Section 5	01/01/35	435
1-1935 (06)	Kukulik - House No. 4	01/01/35	18
1-1935 (07)	Kukulik - Random specimans sent to Danish National Museum	01/01/35	14
1-1935 (08)	Kukulik - Main Midden, east end	01/01/35	561
1-1935 (09)	Kukulik - Main Midden, Sect. 3 & 4	01/01/35	668
1-1935 (10)	Kukulik - Main Midden, Sect 3 & 4, 5 & 6	01/01/35	311
1-1935 (11)	Kukulik - Main Midden, Sect 3 & 4	01/01/35	80
1-1935 (12)	Kukulik - Main Midden, Sect. 3 & 4-5-6	01/01/35	842
1-1935 (13)	Kukulik - Main Midden, Sect. 3-4-5	01/01/35	77

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1-1935 (14)	Kukulik - Main Midden, Sect. 3-4-5-6	01/01/35	7
1-1935 (15)	Kukulik - Main Midden, Sect. 3 & 4	01/01/35	93
1-1935 (16)	Kukulik - Main Midden, Sect. 3-4	01/01/35	28
1-1935 (17)	Kukulik - Main Midden, Sect. 3-4-5-	01/01/35	580
1-1935 (18)	Kukulik - Main Midden, Sect. 5-6	01/01/35	295
1-1935 (19)	Kukulik - Main Midden, Sect. 3 & 4	01/01/35	100
1-1935 (20)	Kukulik - Main Midden, Sect. 5 & 6	01/01/35	712
1-1935 (21)	Kukulik - Main Midden, Sect. 1 & 2, Beach Slope	01/01/35	188
1-1935 (22)	Kukulik - Main Midden, Sect. 3 & 4	01/01/35	100
1-1935 (23)	Kukulik - Main Midden, East end random	01/01/35	134
1-1935 (24)	Kukulik - Main Midden, Sect. 1 & 2, beach slope	01/01/35	50

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1-1935 (25)	Kukulik - Main Midden, Sect. 5 & 6	01/01/35	524
1-1935 (26)	Kukulik - House 6	01/01/35	85
1-1935 (27)	Kukulik - selected objects	01/01/35	26
1-1935 (28)	Kukulik - Meat Cache 20, recent	01/01/35	13
1-1935 (29)	Kukulik - Meat Cache 2	01/01/35	2
1-1935 (30)	Kukulik - Meat Cache 9	01/01/35	26
1-1935 (31)	Kukulik - uncatalogued	01/01/35	41
1-1935 (32)	Kukulik - Main Midden, Sect. 3 & 4	01/01/35	48
1-1935 (33)	Kukulik - Main Midden, under House 5	01/01/35	88
1-1935 (34)	Kukulik - Main Midden, Meat Cache 35	01/01/35	368
1-1935 (35)	Kukulik - Meat Cache 24	01/01/35	101
1-1935 (36)	Kukulik - Shed to House 6	01/01/35	165
1-1935 (37)	Kukulik - House 3	01/01/35	139
1-1935 (38)	Kukulik - Sect. 3-4-5-6	01/01/35	320
1-1935 (39)	Kukulik - Random	01/01/35	157

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1-1935 (40)	Kukulik - Meat Cache 36, Meat Cache 38, House 7	01/01/35	134
1-1935 (41)	Kukulik - House 7	01/01/35	30
1-1935 (42)	Kukulik - House 4	01/01/35	85
1-1935 (43)	Kukulik - Main Midden, east end, random	01/01/35	12
1-1935 (44)	Kukulik - Main Midden, east end, selected specimans	01/01/35	259
1-1935 (45)	Kukulik - Main Midden, east end, Sec. 3 & 4	01/01/35	46
1-1935 (46)	Kukulik - Random Specimans	01/01/35	16
1-1935 (47)	Kukulik - misc. locations	01/01/35	6
1-1935 (48)	Kukulik - 1933 Test Cut	01/01/35	32
1-1935 (49)	Kukulik - Random	01/01/35	72
1-1935 (50)	Kukulik -	00/00/00	0
1-1937 (02)	Kukulik	01/01/37	10
1-1937 (03)	Kukulik - Main Midden, east end	01/01/37	13
1-1937 (07)	Kukulik - Main Midden base, east end	01/01/37	185
1-1937 (08)	Kukulik - Section N	01/01/37	151

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1-1937 (09)	Kukulik - Section T	01/01/37	81
1-1937 (10)	Kukulik - unspecified location	01/01/37	1463
1-1937 (12)	Kukulik -	01/01/37	2
1-1939 (06)	Kukulik - Test Cut, east end, 1st level	01/01/37	81
1-1939 (07)	Kukulik - Test Cut, east end, 2nd level	01/01/37	58
1-1939 (08)	Kukulik - Test Cut, east end, 2nd level	01/01/37	26
1-1939 (09)	Kukulik - Test Cut, east end cut, 3rd level	01/01/37	63
1-1939 (10)	Kukulik - Test cut, east end cut, 4th level, 4'-5'	01/01/37	26
1-1939 (11)	Kukulik - Test Cut, east end cut, 5th level, clay bottom	01/01/37	46
1-1939 (12)	Kukulik - Test Cut, east end cut, debris at base of cut	01/01/37	25
1-1939 (13)	Kukulik Purchase, east end of mound	01/01/37	36
1-1939 (14)	Kukulik - Test Cut, northeast beach cut, 1st level, 0'-2'	01/01/37	21

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1-1939 (15)	Kukulik - Test Cut, northeast beach cut, 2nd level, 2'-3'	01/01/37	23
1-1939 (16)	Kukulik - Test Cut, east end cut, 3rd level, 3'-4'	01/01/37	37
1-1939 (17)	Kukulik - Northeast Beach cut, 4th level, 4'-5'	01/01/37	44
1-1939 (18)	Kukulik - Northeast beach cut, 5th level, 5'-9', frozen bank intruding	01/01/37	18
1-1939 (19)	Kukulik - Northeast beach cut, debris at base	01/01/37	50
1-1939 (20)	Kukulik - Test Cut, walls of House 4, 6'-9'	01/01/37	229
1-1939 (21)	Kukulik - Test Cut, Wall of House 4	01/01/37	29
1-1939 (22)	Kukulik - Test Cut, walls of House 4, 6'-9'	01/01/37	6
1-1939 (23)	Kukulik - Test Cut, below House 4, 9th level, 9'-10'	01/01/37	32
1-1939 (24)	Kukulik - Test Cut, walls of House 8, 9'-13'	01/01/37	170

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1-1939 (25)	Kukulik - Test Cut, walls of House 8, 9'-10'	01/01/37	4
1-1939 (26)	Kukulik - Test Cut, Meat Cache (7'-9')	01/01/37	59
1-1939 (27)	Kukulik - Test Cut, below Meat cache, level 9, 9'-10'	01/01/37	36
1-1939 (28)	Kukulik - Test Cut, meat cache, 10th level, 10'-11'	01/01/37	102
1-1939 (29)	Kukulik - Test Cut, meat cache, 11th level, 11'-12'	01/01/37	106
1-1939 (30)	Kukulik - Test Cut, below House 4, 10th Level 10'-11'	01/01/37	45
1-1939 (31)	Kukulik - Test Cut, west end, 1st level 3' above clay	01/01/37	48
1-1939 (32)	Kukulik - West Mound, west beach, shallow bench	01/01/37	58
1-1939 (33)	Kukulik - Test Cut, west end, 3rd level, 1' to clay	01/01/37	81

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1-1939 (34)	Kukulik - Test Cut, weste end, 2nd level, 2'-1' above clay	01/01/37	76
1076	Kukulik Mound- St. Lawrence Island	4/01/62	1
2-1933	Kukulik	01/01/33	1182
2-1934 (01)	Kukulik - Main Midden	01/01/34	1260
2-1934 (02)	Kukulik - Main Midden	01/01/34	3740
2-1934 (03)	Kukulik	00/00/00	1
3-1934 (01)	Kukulik	01/01/34	775
3-1934 (02)	Kukulik - Test Cut	01/01/34	9
3-1934 (03)	Kukulik	01/01/34	1716
3-1934 (04)	Kukulik - Meat Cache 7	01/01/34	124
3-1934 (05)	Kukulik - Meat Cache 19	01/01/34	48
3-1934 (06)	Kukulik - Meat Cache 2	01/01/34	188
3-1934 (08)	Kukulik - Meat Cache 17	01/01/34	245
3-1934 (09)	Kukulik - Meat Cache 10	01/01/34	201
3-1934 (10)	Kukulik - Meat Cache 8	01/01/34	72
3-1934 (11)	Kukulik - Meat Cache 24	01/01/34	45
3-1934 (12)	Kukulik - Meat Cache 7	01/01/34	156
3-1934 (13)	Kukulik - Meat cache 22	01/01/34	156
3-1934 (14)	Kukulik - Meat Cache 1	01/01/34	121

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3-1934 (15)	Kukulik - General Surface level, Section 375-625	01/01/34	25
3-1934 (16)	Kukulik - General Surface Level, Section 500-625	01/01/34	394
3-1934 (17)	Kukulik - General Surface Level, Sect. 375-625	01/01/34	440
3-1934 (18)	Kukulik - General Surface Level, Sect. 500-625	01/01/34	287
3-1934 (19)	Kukulik	01/01/34	0
5-1934 (01)	Kukulik - Main Midden, east end, from surface to 18" (Modern)	01/01/34	1382
5-1934 (02)	Kukulik - Beach slope 6 inches above clay	01/01/34	3
5-1934 (03)	Kukulik - Main Midden, east end, from surface to 18" (Modern)	01/01/34	1110
5-1934 (04)	Kukulik - Main Midden, east end, Meat Cache 6, surface to 18"	01/01/34	229

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5-1934 (05)	Kukulik - Main Midden, east end, meat cache 12, surface to 18"	01/01/34	236
5-1934 (06)	Kukulik - Main Midden, east end, Meat Cache 5, surface to 18"	01/01/34	71
5-1934 (07)	Kukulik - Main Midden, east end, Meat Cache 17, surface to 18"	01/01/34	197
5-1934 (08)	Kukulik - Main Midden, east end, Meat Cache 9, surface to 18"	01/01/34	211
5-1934 (09)	Kukulik - Main Midden, east end, Meat Cache 3, surface to 18"	01/01/34	286
5-1934 (10)	Kukulik - Main Midden, east end, Meat Cache 23, surface to 18"	01/01/34	417
5-1934 (11)	Kukulik - Meat Cache 13	01/01/34	138
5-1934 (12)	Kukulik - Meat Cache 22	01/01/34	280
5-1934 (13)	Kukulik - Recent Meat Cache	01/01/34	40

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5-1934 (14)	Kukulik - Meat Cache 14	01/01/34	138
5-1934 (15)	Kukulik - Meat Cache 18	01/01/34	23
5-1934 (16)	Kukulik - Meat Cache 21	01/01/34	159
5-1934 (17)	Kukulik - House 5	01/01/34	336
5-1934 (18)	Kukulik - House 4	01/01/34	51
5-1934 (19)	Kukulik - east end of mound, section 500-625, surface	01/01/34	193
5-1934 (20)	Kukulik - West Mound, east end, random specimans	01/01/34	166
5-1934 (21)	Kukulik - West mound, east end, under intermediate meat house	01/01/34	68
5-1934 (22)	Kukulik - West Mound, east end, random speciamns	01/01/34	59
5-1934 (23)	Kukulik - West Mound, east end, from clay bottom	01/01/34	33
5-1934 (24)	Kukulik - West Mound, east end, recent house	01/01/34	432
5-1934 (25)	Kukulik - West Mound	01/01/34	11

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5-1934 (26)	Kukulik - West Mound, east end, recent house	01/01/34	42
5-1934 (27)	Kukulik - West Mound, east end, recent house	01/01/34	27
5-1934 (28)	Kukulik, West Mound, east end, recent house	01/01/34	30
5-1934 (29)	Kukulik	01/01/34	0
UA65-042	Kukulik	00/00/00	4
UA66-007	Kukulik	00/00/00	1
UA68-018	Kukulik	00/00/00	2
UA68-070	Kukulik	00/00/00	1915
UA71-017	Kukulik	00/00/00	1
UA73-001	Kukulik	00/00/00	1
UA75-006	Kukulik	1975	510
UA75-010 (01)	Kukulik	01/01/75	798
UA75-010 (01a)	Kukulik	01/01/75	748
UA75-010 (02)	Kukulik	01/01/75	8
UA75-010 (03)	Kukulik	01/01/75	2
UA75-010 (13)	Kukulik	01/01/75	48
UA75-010 (16)	Kukulik	01/01/75	1
UA75-010 (18)	Kukulik	01/01/75	620
UA75-010 (29)	Kukulik	01/01/75	305
UA78-063	Kukulik	6/13/78	265
UA82-051 (05)	Kukulik	01/05/82	2
UA90-065	Kukulik	05/08/90	6
UA90-068	Kukulik	06/12/90	6