TECHNOLOGICAL COMPLEXITY:
THE POLAR ESKIMOS AND THE TAREUMIUT

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Abstract. An analysis of early historic ethnographic accounts indicates that the Polar Eskimos of northwestern Greenland had 157 artifact types composed of 559 parts (technounits), whereas the Tareumiut in the vicinity of Point Barrow, Alaska, had 266 artifact types made of 1178 technounits. These types are evaluated in terms of their comparative complexity and are placed in one of 10 technical spheres denoting the primary purpose of an artifact.

From these data it is established that technounit comparisons are a more sensitive indicator of technological complexity than are type summaries. It also is clear that generalizations about the complexity of "Eskimo material culture" are open to question since the Tareumiut had 619 more technounits than did the Polar Eskimos. Conventional wisdom holds that Eskimo food-getting technology was the most complex aspect, yet in this analysis clothing and shelter forms proved to be more complex. Further, the study shows that Polar Eskimo food-getting forms became less complex as these people adapted to their particular habitat. Finally, and contrary to what might be expected, it appears that tool kit complexity is not a good indicator of nontool complexity for these Eskimos.

INTRODUCTION

Eskimos are the aboriginal hunters commonly considered to have the most complex material culture, despite their relative isolation, constraints posed by the environment, and their pattern of physical mobility. This assessment typically has resulted from the general impressions of ethnologists. To evaluate the material culture of Eskimos or any other indigenous peoples with precision requires the establishment of reasonably objective criteria through which technological components can be identified and their complexity assessed. In this paper such criteria are described and applied to the inventories of two Eskimo groups. The result is a reasonably exact measurement of each group's technological achievements.

To identify the parts used in an item of material culture, the concept of a techounit was proposed previously (Oswalt 1976:38). In essence, a techounit (henceforth, tu singular and tus plural) is a part that makes a distinct contribution to a finished form; a more complete definition appears later. Being complex, according to a pertinent dictionary definition, means "having many varied interrelated parts, patterns, or elements" (Gove 1961:465). Behind the concept of tus and the significance of their numerical representations is the supposition that each tu in a standard artifact type makes a distinct contribution, adding materially to the artifact's efficiency, productivity, durability, convenience, aesthetic appeal, or some other quality relevant to the fulfillment of its purpose. It is assumed further that as its number of tus increases, an artifact type becomes more complex, as does the material culture involved.

In an earlier comparison of nonindustrial societies representing 36 varied technological traditions, a tu analysis of food-getting forms was made. The average number of tus per form was found to be lowest for farmers in deserts (2.4) and highest for foragers in the Arctic (5.5). For Eskimos the averages were as follow: Angmagssalik of East Greenland, 6.1; Tareumiut of northwestern Alaska, 5.9; Iglulik of north-central Canada, 5.4; and Copper Eskimos of northwestern Canada, 4.5 (Oswalt 1976:173, 182). These data suggest that early historic Eskimos, who collectively had the highest complexity index of the peoples sampled, exhibited considerable subcultural variability. This observation led to an interest in determining the comparative complexity of the total material culture inventories for two Eskimo groups in order to

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clarify the variability existing within a single cultural tradition.

Polar Eskimos and Tareumiut

In selecting two early historic Eskimo material culture inventories for analysis, an attempt was made to identify geographically separated populations with distinct technological adaptations. Another criterion was that the inventories be described in comparable detail. The Tareumiut and Polar Eskimos best satisfied these requirements. They arose from a common background in the comparatively recent past, but by the time of historic contact their lifeways clearly were distinct. In addition, ethnographic accounts about both groups are well-rounded, although neither appears to be complete.

Although the early historic Polar Eskimos lived at least 300 mi farther north than did the Tareumiut, the general climatic conditions are similar in both areas; presumably the same was true in early historic times. At Point Barrow, the average yearly temperature is -12°C; the yearly temperature maxima is 19°C, and the yearly temperature minima is -43°C. Comparable temperatures for Thule are -12°C, 14°C, and -38°C (Rudloff 1981:127, 462). These Eskimos differed most in the extent of their contacts with other peoples. The physical isolation of the Polar Eskimos in northwestern Greenland was extreme. The English explorer John Ross (1819:120-124) is credited with their discovery in 1818, and according to him they thought of themselves as the only people in the world. The remarks by Ross and other early observers suggest that the Polar Eskimos had lost any contact they once had with the Eskimos of Canada or those of southwestern Greenland (see e.g., Hayes 1860:193). The Tareumiut, by contrast, had maintained contact with nearby Eskimo groups and were receiving industrial products from Siberia and Hudson's Bay Company posts in the Canadian northwest when first encountered by Europeans (J. Simpson 1875:235-236). Thus, the Tareumiut had been exposed to exotic ideas from near and far even before they were directly contacted by Europeans, whereas the Polar Eskimos were among the most isolated aboriginal populations in North America at the time of their first encounters with Europeans.

Accounts of early contacts with the Tareumiut and Polar Eskimos date from the middle to late 1800s. At this time the Polar Eskimo number, the about 1/4 (Kane 1856 [vol. 2]:108, 211), whereas the population total for the Tareumiut was about 2150. Of the Tareumiut total, 700 were in the Barrow area (Burch 1975:11-12). Living largely in two villages (J. Simpson 1875:237-238), the people in this area represented one of the most concentrated northern Eskimo population clusters. They not only were far more numerous than the Polar Eskimos but were much more sedentary. Typically the Barrow people wintered in substantial wood-framed sod houses, harvesting sea mammals along the adjacent coast, and lived in tents during the summer, traveling considerable distances to fish and hunt caribou. The Polar Eskimos traveled widely during the winter in search of food, moving from one turf and stone house to another or building snowhouses when necessary. Their seasonal mobility was far greater than that of the Barrow people.

Both populations relied on here, polar bear, seals, walrus, and species of small whales for food and raw materials. In addition, the Barrow people harvested bowhead whales, caribou, numerous species of fish, ptarmigan, and migratory waterfowl. Little auks, unavailable at Barrow, were a significant source of food among the Polar Eskimos. The Polar Eskimos did not harvest fish or caribou despite the local availability of both (Hayes 1867:272; Holtved 1967:8, 106, 111; Rasmussen 1908:32); furthermore, they neither hunted nor purposefully snared ptarmigan despite their presence (Holtved 1967:111). Thus, the Barrow people utilized far more of the animals locally available, and in early historic times starvation, unless a consequence of weakening due to European diseases, apparently was unusual. Among the Polar Eskimos, however, times of dire food stress seem to have been reasonably common.

Differences in the equipment the two groups used to obtain food are readily apparent. Especially notable is the absence among the early historic Polar Eskimos of widespread Eskimo artifact types that are well represented among the Barrow people. These include the kayak and umiak (Hendrik 1879:33; Inglefield 1853:49; Kane 1856 [vol. 2]:135, 210; Petersen 1962:103-104; Rasmussen 1908:32; Ross 1819:124), fishing devices (Inglefield 1853:49; Petersen 1962:103-104; Rasmussen 1908:32), the bow and arrow (Kane 1856 [vol. 2]:210; Petersen 1962:103-104; Rasmussen 1908:32), and bird spears (Kroeber 1900:283). Also absent are the barbed harpoon, bolas, the sling and missile, spear, throwing board, specialized harpoons to take seals at their breathing holes or in open water, and nets for sea mammals.

As specialized hunters on sea ice, the Polar Eskimos presumably relied on one toggle-headed harpoon type and one lance type. It has been suggested that one reason they did not make some of the more widespread Eskimo artifact types was that they lacked a reliable source of wood. Ross (1810:124) noted their
"total want of wood," and Elisha Kent Kane (1856[vol.1]:206) wrote, "They had no wood."
In contrast, driftwood was abundant at Barrow, so much so that the Eskimos built their houses of it. Other differences include the absence among the Polar Eskimos of the annual ceremonial round that was well developed at Barrow, where the Whale Cult and Messenger Feast celebrations best typify its expression. The Tareumit built a special structure, the karigi, as a center for ceremonial activities. The dance masks and other ceremonial equipment they used on an annual basis had no counterparts among the Polar Eskimos.

These major differences between the Barrow and Polar Eskimos are reviewed to illustrate the distinctiveness of their adaptations to northern littoral settings. With the contrast in their relative isolation, utilization of edibles, and availability of raw materials—especially wood—we would expect to find differential complexity represented in their material cultures.

**MATERIAL CULTURE EVALUATIONS**

A major impediment in studies of different technologies has been the emphasis on materials, manufacturing methods, techniques, and skill. These aspects of material culture are difficult to compare with equity, which tends to limit the significance of the conclusions drawn. For example, if raw materials are used as a key variable in a cross-cultural evaluation of forms, it is difficult to make meaningful assessments of technological complexity. Because contrasting materials have different inherent use potential, a technology in which artifacts are made primarily from bamboo and leaves cannot be judged in the same way as one utilizing stone and wood or bone and skin. The same type of problem, a lack of parallelism, is faced when evaluations are made on the basis of manufacturing methods, techniques, or skill. To avoid the problems such comparisons raise, my focus is on the number of structural units in the forms created. Because the parts making up a form are definable and readily counted, this technique seems more likely to result in objective results than does a comparison of the other qualities mentioned.

The concept of a technounit was originated to identify a significant common denominator in any artifact. A technounit is defined as a physically distinct and unique part that is integrated into and contributes to the form of a finished artifact. The wooden shaft of a spear, stone blade of an adze, and leather sole of a boot are distinct parts of artifacts and thus are tus; each makes a unique contribution to the finished form. The shaft, blade, and sole cited are judged as comparable separate units, each with its own distinct integrity.

Furthermore, within a particular technological tradition at a given point in time, one standardized artifact is more complex than another of the same or a different type if it includes more tus in its finished form. For example, one type of harpoon dart consists of five tus: barbed point, socket-piece, shaft, socketpiece-shaft binder, and line tied from point to shaft. A similar dart may have these tus plus a finger rest attached to the shaft with a peg, resulting in a seven tu total. The additional tus indicate the greater technological complexity of the form having a finger rest. In like manner, a skin scraper consisting of an unhafted piece of flaked chert is less complex technologically than a scraper made up of a blade, a wooden handle, and a thong binding the two parts together. The larger the number of different kinds of parts constituting a finished form, the greater its complexity.

In counting tus, similar or nearly identical configurations of an artifact require particular attention. For example, if the left and right sleeve panels of a jacket are of the same form, they make a single tu contribution to the jacket. Likewise, multiples of one element constitute one tu if they are used collectively for a single purpose, as in the examples to follow. Handfuls of dried grass may form a boot lining, or separate strands of sinew may be twisted together for a thread. The blades of grass or sinew strands are not counted separately because they are replicative components and in each case combine to make one distinct part of an artifact. A more detailed discussion of the identification of tus and types appears in Appendix I.

For each tu in a given technological tradition to be comparable with all others is an explicit assumption. In an etic analysis, each tu represents a separate and distinct artifact part which is a key aspect of comparability. In these terms, any purported technological "ingenuity" cannot be accommodated. For example, an Eskimo snowhouse had few tus compared with a wood and sod house. The snowhouse often is judged by Westerners as proof of inordinate engineering ability and production skill. Yet, as mentioned previously, skill is difficult to evaluate on a cross cultural basis, and the same is true for engineering ability. Among Eskimos, where snow was commonplace, it came to be viewed as a useful building material that often was available. Among them the snowhouse may have been a pedestrian innovation; however, the snowhouse commonly is regarded by Westerners as an ingenious form, possibly because they did not originate it and seldom if ever were confronted with the Eskimo
situation. Ingenuity is in the eyes of the beholder; it is thus a culture-bound concept and cannot be a cross-cultural guide to artifact assessments. In the case of the snowhouse, it must appear as an uncomplicated form in this analysis because its number of tus is small.

To facilitate comparisons within and between the inventories, each artifact type was classified on the basis of its primary purpose or function and placed in a technical sphere. In Table 1, the technical spheres are listed and described, with examples drawn from the Eskimo inventories. In later tables and in the appendixes, the same technical spheres are used to organize the data.

DATA BASE

POLAR ESKIMOS

To reconstruct the aboriginal baseline material culture for these Eskimos requires the identification of those forms present before the 1850s, when the Canadian Eskimos began introducing other forms (such as the kayak, umiak, and two-pronged fish spear) that were previously unknown to the Polar Eskimos (Petersen 1962). For descriptions of the historic baseline artifacts, we draw on the reports of several early explorers. Ross (1819) visited the Polar Eskimos briefly in 1818 and described them in a superficial manner. In 1853–1855, Kane (1856) lived in the area, but his descriptions were often more tantalizing than informative. Fortunately another member of the Kane expedition, Isaac I. Hayes (1860), provided more detail about the material culture of the Polar Eskimos at that time and supplemented this information after returning to the area in 1860 (Hayes 1867). The first systematic material culture inventory for the Polar Eskimos was compiled by Alfred L. Kroeber (1900) in 1897–1898, after he interviewed Eskimos whom Robert E. Peary had taken to New York City and analyzed a second ethnographic collection made by Peary. Peary's first and smaller artifact assemblage, collected in 1891–1892, was studied later by James VanStone (1972). Erik Holtved (1967), who worked among the Polar Eskimos in 1935–1937 and 1946–1947, wrote the most comprehensive report about them, and in it he often noted whether a particular type was said to predate or postdate contacts with Canadian Eskimos and later with Eskimos from southwest Greenland.

In compiling the present inventory, Ross was consulted first, then Kane, Hayes, Kroeber, Holtved, VanStone, and finally less comprehensive works for the period under consideration. Adjustments were made if a mentioned type seemed incorrect on the basis of other sources or Eskimo ethnographic data in general. For instance, according to Ross (1819:107, 131), and he is quite explicit, sea mammals were hunted with harpoons to which sealskin floats were attached. I question the use of this form since the Polar Eskimos did not have kayaks to pursue, kill, and retrieve an animal; therefore, any sea mammals harpooned presumably would have to be taken with hand-held harpoon lines as described by Kane (1856 [vol.1]:411–414). Since I suspect

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<th>TABLE 1. TECHNICAL SPHERES OF TAKEMIUT AND POLAR ESKIMO ARTIFACT TYPES.</th>
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<tr>
<td><strong>I.</strong> Subsistents are used directly or indirectly in obtaining food or water (harpoon, bird net, fox trap, kayak, net-setting equipment; water bucket).</td>
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<td><strong>II.</strong> Clothing and accessories are used for the physical protection of individuals in their environment (boots, pantaloons, jackets; snow goggles, walking stick).</td>
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<td><strong>III.</strong> Housing and shelters are used to safeguard individuals from the physical environment (log and sod dwelling, tent, karigi, workshop; windbreak).</td>
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<td><strong>IV.</strong> Tools make or maintain other forms (adze, drill, knife, scraper, strike-a-light, and converters prepare or process consumables (bone crusher, frying pan, lamp, cooking pot; pipe).</td>
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<td><strong>V.</strong> Ritual forms are associated with religious activities and/or spirit beings (shroud, charm, mask, drum).</td>
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<td><strong>VI.</strong> Storants protect edibles, substances, materials, or equipment (cache, storage bag, needle case assembly, water tub).</td>
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<td><strong>VII.</strong> Gaming devices and toys are used to develop skills or to entertain (toy harpoon, cat's cradle string, doll).</td>
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<td><strong>VIII.</strong> Domestic equipment enhances living conditions (bedding, drying rack, food dish, drinking cup, meat skewer).</td>
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<td><strong>IX.</strong> Medicines and curing forms treat abnormal body conditions (lancet, bandage).</td>
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<td><strong>X.</strong> Routine body care and adornment forms include grooming aids and adornments to maintain or embellish human anatomy (comb, wash cloth, labret, hair binder, necklace).</td>
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the harpoon Ross noted had been obtained from farther south in Greenland, I do not include it in my inventory. If a particular type was described by one of the early observers and another type was added to it in later reports, the added one was not included. For instance, the strike-a-light and fire drill were reported by Holtved (1867:25) as old methods of fire-making. Hayes (1860:271), Kane (1856:11.7:379-380), and Ross (1819:130) described only the use of a strike-a-light for fire-making; therefore the fire drill is not recorded in the inventory. In another instance Holtved (1867:112) noted that a stringer was sometimes used to secure little auls that had been captured, but since Hayes (1867:392) did not mention this trait in his first-hand account of little auk capture, it was not included in the inventory. It should be noted that the analysis of Polar Eskimo clothing is based on the account by Holtved (1867:379-380), and it is possible, therefore, that some garment types reflect recent Canadian Eskimo influence. Nonetheless, Holtved is the best source in this instance because he alone provides systematic details about garment patterns.

The earliest historical accounts describe ironworking as a well established tradition among the Polar Eskimos. Ross (1819:98, 103-104) noted that they were using meteoric iron when he visited them; they also may have had access to terrestrial iron found in driftwood or acquired through trading contacts with European whaling crews (Barrow n.d.:32). Which type of iron they used in early historic times is not significant for the present purpose. It is only important that cold-hammered iron was used for blades in their early historic technology.

In sum, the Polar Eskimo inventory attempts to present all the standard material culture forms present in the aboriginal baseline culture. For a comprehensive analysis, it was necessary to reconstruct the forms of three artifact types reported but not described. These are the doll, hubber cache, and snow shovel; together they include 16 assumed tus. In addition, 24 other tus were assumed as parts of types that seemed to be described incompletely. The total for the Polar Eskimos is 859, of which 40 or 7.2% have been assumed.

TAREUMIUT

The ethnographic information about these Eskimos is most complete for those living in the vicinity of Point Barrow, and it is their material culture that is examined. Direct European contact dates from 1826-1827 when members of an expedition led by Frederick W. Beechey (1831:307-309) visited Point Barrow; ethnographic materials collected on this voyage were described at a later date by John R. Boeckstoe (1977). Thomas Simpson (1843) visited Barrow briefly in 1837, but his observations are not very helpful. John Simpson (1875), who was at Barrow during 1852-1854, discussed local Eskimo life in considerable detail, but his material culture observations were sketchy. The standard ethnography about the Barrow area people is by John Murdoch (1892) and is based on his findings in 1881-1883, when the people were still comparatively isolated. Observations made by Patrick H. Ray (1885) at the same time as those of Murdoch are relatively poor. In 1952 and 1953, Robert F. Spencer (1959) reconstructed early historic Tareumiut culture with the help of members of the Barrow community and collected systematic information about religious life. Because the reports by Murdoch and Ray are weak in descriptions of ceremonial equipment, Spencer was the primary source for data about the Messenger Feast, Whale Cult, curing forms, charms, and a few other types.

Thomas Simpson (1843:161) suggested that the Barrow people had indirect trade with the Russians, and John Simpson (1875:235-236) noted that they were receiving European manufactures from Siberia and Canada. Despite these trading contacts and others with white whalers, the traditional material culture of the Tareumiut was still dominant when Murdoch made his study about 30 years later. Although he found that iron had replaced stone for most knife blades and weapons points, that imported files and saws were desired tools, and that firearms were important trade items, he was able to obtain satisfactory examples of the traditional types. The mechanical dolls and small ivory figures Murdoch (1892:380-383, 392-390) collected apparently were made for sale and therefore were not entered in the inventory. The umiaks Murdoch (1892:338-339) described had sails and oars that presumably were quite recent introductions of European inspiration and therefore were disregarded in the analysis. Pipes, while clearly a historic introduction, are included because they were integrated into Tareumiut culture by 1837 (T. Simpson 1843:156-157). Because Murdoch did not include snowshoes, those described by Edward W. Nelson (1899:213) for the Tareumiut of Icy Cape are listed in the inventory. The man's rain jacket was described poorly by Murdoch (1892:122) and J. Simpson (1875:243), but a Kotzebue Sound form, which presumably was much the same as the Barrow type, is well described by Boeckstoe (1977:92-94), was analysed. The waterproof sealskin pantaloons of women were reported by Murdoch (1892:128) as being patterned after pantaloons from caribou skin.
but with fewer seams; thus the caribou skin form served as a model for the sealskin form but fewer panels were included. For details about whaling camp windbreaks and beluga nets, I have relied on descriptions of the Point Hope Tareumiut by Froelich G. Rainey (1947:259, 265). Finally, the inclusion of some humble types, such as the sandstone saw and bone wedge, is based on the archaeological work of James A. Ford (1959:74, 185) at the historic Barrow sites of Nuwuk and Utklavik.

In the Tareumiut inventory, all of the tus were assumed for the following artifacts: pemmican bag, rack for snow to drip into water bucket, and grinding stone to process slate blades. The tu total for these types is nine. In addition, I have assumed the existence of 62 tus for types that appear to have been incompletely described. The assumptions represent 71 of the 1178 Barrow tus, or 6% of the total.

The combined totals for the two Eskimo groups were 423 artifact types and 1737 tus. Since it is impractical to list every type with its tus, examples of types and their tus are presented. These appear in Appendix II following the classification in Table 1. Types to illustrate the nature of technological complexity are included for each technical sphere.

TECHNICAL SPHERE SUMMARIES

The accuracy of the comparisons between the two groups depends largely on whether the descriptions underlying the inventories are fully comparable. In general, the ethnographic information seems of much the same quality, but there is one major exception. The Tareumiut ritual forms seem more completely described than those of the Polar Eskimos, especially with reference to charms and amulets. Another factor affecting accuracy is the number of tu assumptions. A high percentage of assumptions clearly would distort the interpretations. For the combined inventories, I have assumed the existence of 111 tus in a total of 1737. This assumption of 6.4% of the tus is relatively high, yet I am reasonably certain that at least half of these tus had to be present.

1. Subsistans, forms used directly or indirectly to procure food or water, represent 28.6% of the tus for the combined inventories, more than in any other sphere. Of the total 496 tus, only 18 are involved in obtaining water. Types for the procurement of water are represented among the Tareumiut by a water-carrying bucket (7 tus) and a tub to catch water processed from snow (6 tus). Among the Polar Eskimos, a water bucket (4 tus) and a water sucking tube (1 tu) are recorded.

The Tareumiut subsistant types with the greatest number of tus are as follow: umiak (35 tus), kayak (28 tus), toggle-headed harpoon and float used against bearded seals or walrus from a kayak (22 tus), toggle-headed harpoon for hunting seals on the ice (18 tus), and a toggle-headed harpoon and floats for hunting whales from an umiak (18 tus). The Polar Eskimo types with the greatest number of tus are the lance (11 tus), sled (11 tus), toggle-headed ice hunting harpoon (10 tus), fox chamber trap (10 tus), little suck (8 tus), and one form of fox deadfall (7 tus).

II. Clothing and accessories represent 24.2% of the tus in the combined inventories. The Tareumiut garments with the greatest number of tus are the dress jacket of women (30 tus), intestine rain shirt of men (28 tus), dress jacket of men (18 tus), dress pantaloons of women (16 tus), and outer caribou skin jacket of men (14 tus). The Polar Eskimo types with the highest number of tus are the fox skin amaut of women (19 tus), outer sealskin coat of women (15 tus) seal skin amaut of women (15 tus), outer sealskin coat of men (15 tus), outer fox skin coat of women (14 tus), and fox skin underpants of women (14 tus).

Accessories have been classified with garments for convenience and account for few tus. The Tareumiut belts, walking sticks, and snow goggies contain a total of 21 tus. For the Polar Eskimos, belts, headbands, protective face masks, snow goggies, baby support thongs used by women, and torches for outdoor use account for a total of 12 tus.

III. Housing and shelters account for 9.4% of the tus in the combined inventories. The most complex Tareumiut types are the winter house of wood and sod (26 tus), temporary snow block house for hunters or visitors (21 tus), summer tent (20 tus), and karig (16 tus). For the Polar Eskimos the most complex forms are the skin tent (16 tus), winter stone-bone-moss house (15 tus), and springsumar stone and sod dwelling (7 tus).

IV. Tools and converters account for 10.4% of the tus in the combined inventories. The Tareumiut types with the greatest number are the tobacco pipe with its attached picker (6 tus), snow shovel (5 tus), scraper to remove ice from an umiak (4 tus), adze (4 tus), and a rack for processing water from snow (4 tus). The Polar Eskimo types with the most tus are as follows: ulu (5 tus), man's knife (4 tus), bow drill (3 tus), cooking pot (3 tus), snow shovel (3 tus), skin-drying rack (3 tus), and a rack for obtaining fresh water from an iceberg (3 tus).

V. Ritual forms account for 10.1% of the tus in the combined inventories. The
Tareumiut types with the largest numbers of tus are the box drum (11 tus), mechanical fox chasing a lemming (11 tus), ceremonial hat (9 tus), ceremonial tree (8 tus), tambourine-like drum (7 tus), and one form of mask (7 tus). The Polar Eskimo types with the greatest number of tus are the drum and stick linked with one another (7 tus), amulets for children (3 tus), amulets for adults (3 tus), shroud (2 tus), and an amulet for dogs (2 tus).

VI. Storums are represented by 7.9% of the tus in the combined inventories. The most complex Tareumiut forms are the quiver (7 tus), tobacco pouch (7 tus), tool bag (7 tus), pipe bag (6 tus), cache marker (6 tus), needle case (5 tus), and antler container for small objects (5 tus). The most complex Polar Eskimo forms are the needle case (5 tus), little auk storage bag (4 tus), bladder container for oil (3 tus), general purpose conical sealskin bag (3 tus), meat cache in pebble area (3 tus), equipment cache (3 tus), and a bag for toys (3 tus).

VII. Gaming devices and toys are represented by 4.8% of the tus in the combined inventories. The Tareumiut forms with the greatest number of tus are the mechanical doll, assumed to be a toy (15 tus), bull-roarer (7 tus), and buzz (4 tus). For the Polar Eskimos they are the doll (11 tus), child’s sled (3 tus), ring-and-pin game (3 tus), gaming ball (3 tus), toy harpoon target (3 tus), and top (3 tus).

VIII. Domestic equipment is represented by 2.0% of the tus in the combined inventories. The Tareumiut forms with the highest tus totals are the general purpose tub (6 tus), drying rack for garments (4 tus), meat container (3 tus), and a dish (3 tus). For the Polar Eskimos, the inventory consists of the drying rack for garments (4 tus), bedding (2 tus), drip bowl beneath a lamp (2 tus), meat serving tray (1 tu), and a meat skewer (1 tu).

IX. Medicines and curing forms are represented by 1.5% of the tus in the combined inventories. For the Tareumiut, the forms with the greatest number of tus are a poultice for boils (3 tus) and a splint for broken bones (2 tus). Those with the greatest number of tus for the Polar Eskimos are a means of infection treatment (3 tus), frostbite (2 tus), and wound bandage (2 tus).

X. Routine body care and adornment forms represent 1.1% of the tus in the combined inventories. The Tareumiut inventory includes a headband for men (4 tus), earrings for women (3 tus), necklace for women (2 tus), comb (1 tu), labret (1 tu), and hair dressing for women (1 tu). The complete Polar Eskimo inventory includes a loose catcher (4 tus), comb (1 tu), woman’s topknot binder (1 tu), and man’s hair band (1 tu).

DISCUSSION

The often striking local and regional variability in Eskimo material culture types is well known, as is the richness of particular assemblages. Inventory comparisons usually have been based on trait lists, which yield assessments of similarities and differences that are comparatively crude but are useful in examining the culture histories of particular groups. Yet, to assess differences in the technological adaptations of Eskimo groups, the relative complexity of artifact types provides a comparative dimension more useful than that based on trait lists. In this presentation, the complexity of material culture inventories for two Eskimo subcultures has been evaluated at two levels, the type and the tu; the conclusions based on these evaluations provide multiple measures of comparative complexity in these respective technologies.

This analysis shows the Tareumiut inventory to be much larger and more complex technologically than that of the Polar Eskimos. The Polar Eskimo type total of 157 is 55% of the 266 Tareumiut total, and the 559 tus total of the Polar Eskimos represents 47% of the 1178 tus of the Tareumiut. A critical summary figure, the average number of tus per form, is 3.56 for the Polar Eskimos and 4.43 for the Tareumiut. Furthermore, the Polar Eskimo tus averages are lower than those of the Tareumiut for nine of the 10 technical spheres, which is additional evidence that the Polar Eskimo inventory is less complex. Only in technical sphere IX, medicines and curing forms, does the Polar Eskimo complexity equal that of the Tareumiut.

Basing evaluations of comparative complexity on the technical spheres and inventories of artifact types provides a gross measure of the complexity in each material culture. However, since many more tus usually are represented in each sphere than are types, tus should provide a more refined measure of comparative complexity. The two-by-two chi-square tests for the spheres (Table 2) compare the complexity represented in each by type and by tu. They indicate that the tu is indeed a more sensitive indicator of technological complexity than is the type. For example, in technical sphere I, subsistents, the Polar Eskimo and the Tareumiut type comparisons have a level of significance at or beyond 0.09, whereas for tus comparisons the level of significance is at or beyond 0.999. Tus proved more sensitive than types for measuring complexity in spheres I, II, IV, VI, VII, VIII, and IX.

A comparison of tu averages among the technical spheres also is insightful: It indicates the areas of technological emphasis for each group (Table 3). If the technological
TABLE 2. RESULTS OF CHI-SQUARE TESTS OF TYPE AND TU DISTRIBUTIONS, COMPARING THE POLAR ESKIMOS (PE) AND TAREUMIUT (T).*

<table>
<thead>
<tr>
<th>TECHNICAL SPHERE</th>
<th>TYPES (n)</th>
<th>X²</th>
<th>LEVEL</th>
<th>TUS (n)</th>
<th>X²</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Subsistants</td>
<td>20</td>
<td>63</td>
<td>6.81</td>
<td>P &lt; .01</td>
<td>101</td>
<td>395</td>
</tr>
<tr>
<td>II Clothing-Accessories</td>
<td>30</td>
<td>21</td>
<td>10.73</td>
<td>P &lt; .01</td>
<td>206</td>
<td>215</td>
</tr>
<tr>
<td>III Housing-Shelters</td>
<td>9</td>
<td>9</td>
<td>0.80</td>
<td>nil</td>
<td>57</td>
<td>106</td>
</tr>
<tr>
<td>IV Tools-Converters</td>
<td>40</td>
<td>56</td>
<td>0.87</td>
<td>nil</td>
<td>68</td>
<td>113</td>
</tr>
<tr>
<td>V Ritual Forms</td>
<td>8</td>
<td>52</td>
<td>15.80</td>
<td>P &lt; .001</td>
<td>20</td>
<td>156</td>
</tr>
<tr>
<td>VI Storants</td>
<td>14</td>
<td>25</td>
<td>0.00</td>
<td>nil</td>
<td>35</td>
<td>102</td>
</tr>
<tr>
<td>VII Gaming Devices-Toys</td>
<td>19</td>
<td>15</td>
<td>4.76</td>
<td>P &lt; .05</td>
<td>43</td>
<td>41</td>
</tr>
<tr>
<td>VIII Domestic Equipment</td>
<td>5</td>
<td>10</td>
<td>0.00</td>
<td>nil</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>IX Medicines-Curing</td>
<td>8</td>
<td>9</td>
<td>0.38</td>
<td>nil</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>X Routine Body Care-Adornment</td>
<td>4</td>
<td>6</td>
<td>0.00</td>
<td>nil</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>

*Test for two independent samples (Siegel 1956:104-111), 1 df, corrected for continuity. Comparison is between the number of types (tus) in a technical sphere for the Polar Eskimos and Tareumiut versus the overall number of types (tus) for the combined technical spheres.

Investment of each people were equal in all spheres, the averages obviously would be the same for each, but this clearly is not the case. The higher and lower sphere averages represent more and less technological investment. For example, among the Polar Eskimos, the technical investment was far greater for spheres II (clothing-accessories), III (housing-shelters), and I (subsistants), in that order, than for all the other spheres. On a statistical basis the three spheres cited represent significant levels of elaboration beyond that expected in overall Polar Eskimo technical efforts (Table 4). These data suggest that the greatest material culture effort was devoted to making forms represented in spheres I, II, and III; therefore, they best represent the adaptive core of Polar Eskimo technology. Within a particular technical sphere, material culture complexity unquestionably builds on itself. If Polar Eskimo life had not been interrupted by outsiders, the greatest elaborations in material culture predictably would have occurred in these spheres.

For the Tareumiut, the same three spheres represent their dominant technological investment, but in a different order. The most complex is sphere III (housing-shelters), followed by II (clothing-accessories), and then by I (subsistants). As illustrated in Table 4, the three spheres cited above represent statistically significant levels of elaboration beyond what was expected in the overall Tareumiut technical effort.

As garments and accessories are examined further, we note that the tu averages are 6.9 for the Polar Eskimos and 10.2 for the Tareumiut. For the Polar Eskimos, as the northernmost aboriginal people in the world, we might expect their garments to have been much more complex than those of the Tareumiut, but this clearly was not the case. Garments often had numerous tus unrelated to the protective needs because of the attention paid to design amplification, meaning tu elaborations beyond basic structural requirements. For example, the everyday jacket of a Tareumiut woman had 12 tus, but her dress jacket, because of its numerous secondary...
TABLE 3. TECHNOUNIT AVERAGES FOR (1) TECHNICAL SPHERES AND (2) % ABOVE/BELOW THE RESPECTIVE AVERAGES.

<table>
<thead>
<tr>
<th>TECHNICAL SPHERE</th>
<th>POLAR ESKIMOS (1)</th>
<th>42% above</th>
<th>TAREUMIUT (1)</th>
<th>43% above</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Subsistants</td>
<td>5.1</td>
<td></td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>II Clothing-Accessories</td>
<td>6.9</td>
<td>92% above</td>
<td>10.2</td>
<td>132% above</td>
</tr>
<tr>
<td>III Housing-Shelters</td>
<td>6.3</td>
<td>75% above</td>
<td>11.7</td>
<td>160% above</td>
</tr>
<tr>
<td>IV Tools-Converters</td>
<td>1.7</td>
<td>53% below</td>
<td>2.0</td>
<td>55% below</td>
</tr>
<tr>
<td>V Ritual Forms</td>
<td>2.5</td>
<td>31% below</td>
<td>3.0</td>
<td>32% below</td>
</tr>
<tr>
<td>VI Storants</td>
<td>2.5</td>
<td>31% below</td>
<td>4.1</td>
<td>7% below</td>
</tr>
<tr>
<td>VII Gaming Devices-Toys</td>
<td>2.5</td>
<td>31% below</td>
<td>2.7</td>
<td>39% below</td>
</tr>
<tr>
<td>VIII Domestic Equipment</td>
<td>2.0</td>
<td>44% below</td>
<td>2.4</td>
<td>45% below</td>
</tr>
<tr>
<td>IX Medicines-Curing</td>
<td>1.5</td>
<td>58% below</td>
<td>1.5</td>
<td>60% below</td>
</tr>
<tr>
<td>X Routine Body Care-Adornment</td>
<td>1.8</td>
<td>50% below</td>
<td>2.0</td>
<td>55% below</td>
</tr>
</tbody>
</table>

Overall averages 3.56 4.43

TABLE 4. YATES' X² TEST OF GOODNESS OF FIT OF OBSERVED WITH EXPECTED TUS FOR THE TECHNICAL SPHERES.*

<table>
<thead>
<tr>
<th>TECHNICAL SPHERES</th>
<th>POLAR ESKIMOS</th>
<th>X² LEVEL</th>
<th>TAREUMIUT</th>
<th>X² LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Subsistants</td>
<td>5%&gt;P&gt;1%</td>
<td>5.78</td>
<td>P&lt;0.2%</td>
<td>27.48</td>
</tr>
<tr>
<td>II Clothing-Accessories</td>
<td>P&lt;0.2%</td>
<td>43.63</td>
<td>P&lt;0.2%</td>
<td>54.68</td>
</tr>
<tr>
<td>III Housing-Shelters</td>
<td>1%&gt;P&lt;0.2%</td>
<td>7.03</td>
<td>P&lt;0.2%</td>
<td>30.85</td>
</tr>
<tr>
<td>IV Tools-Converters</td>
<td>P&lt;0.2%</td>
<td>31.25</td>
<td>P&lt;0.2%</td>
<td>54.74</td>
</tr>
<tr>
<td>V Ritual Forms</td>
<td>P&gt;10%</td>
<td>1.06</td>
<td>P&lt;0.2%</td>
<td>16.51</td>
</tr>
<tr>
<td>VI Storants</td>
<td>P&gt;10%</td>
<td>2.50</td>
<td>P&gt;10%</td>
<td>0.33</td>
</tr>
<tr>
<td>VII Gaming Devices-Toys</td>
<td>P&gt;10%</td>
<td>5.76</td>
<td>5%&gt;P&gt;1%</td>
<td>5.64</td>
</tr>
<tr>
<td>VIII Domestic Equipment</td>
<td>P&gt;10%</td>
<td>1.79</td>
<td>5%&gt;P&gt;1%</td>
<td>5.46</td>
</tr>
<tr>
<td>IX Medicines-Curing</td>
<td>5%&gt;P&gt;1%</td>
<td>5.83</td>
<td>P&lt;0.2%</td>
<td>11.85</td>
</tr>
<tr>
<td>X Routine Body Care-Adornment</td>
<td>P&gt;10%</td>
<td>0.04</td>
<td>10%&gt;P&gt;5%</td>
<td>3.57</td>
</tr>
</tbody>
</table>

*See Langley (1971:285-291). Expected value for each technical sphere is based on the overall average for that Eskimo group.

panels and trim pieces, included 30 tus. Likewise, among the Polar Eskimos, women wore bikini-like underpants as their primary body covering while in a dwelling. The numerous small skin panels and trim pieces on these underpants yield a 14 tus total. In the case of the pants, jackets, and other clothing items, it does not appear that panels were small because of the limitations of the materials involved. Quite to the contrary, small pieces were included as trim, and decorative panels separated, thereby highlighting pieces of skin having different colors and textures.

The average number of Polar Eskimo housing and shelter tus is 6.3 compared with 11.7 for the Tareumut. The far greater complexity among the Tareumut is attributed to three factors in particular: a more sedentary life-style, greater seasonal variability in foods harvested, and more specialized equipment requiring construction space and storage. These circumstances led the Tareumut to build more complicated houses and to supplement them with subsidiary buildings (e.g., karigi, workshop, and birthing structure).

For subsistants, the average number of tus is 5.1 for the Polar Eskimos and 6.3 for the Tareumut. The difference is not statistically significant (P<0.1). Conventional wisdom holds that the most complex technical sphere among Eskimos was subsistants (food-getting forms). Yet the present study concludes that was not the case for either the Polar Eskimos or the Tareumut. Among both peoples, sphere 1, subsistants, ranks third in complexity. The most complex technical spheres (clothing and housing) had nothing directly to do with food procurement.
In the past, the Tareumiut and Polar Eskimos shared the same Thule cultural background dominated by the hunting of great whales. As they increased their capacity to harvest these whales, the Thule people spread eastward from northern Alaska during the tenth and eleventh centuries, and localized adaptations began to emerge. In subsequent years, the climate became cooler, and conditions that favored hunting these whales presumably diminished. Among some groups, previously secondary food sources (caribou, fish, and seals) became increasingly important (Dumond 1977:130-149). After the Polar Eskimos abandoned the quest for great whales, they apparently found walrus, small whales, and seals adequate edibles. Furthermore, by the early 1800s, they had abandoned caribou hunting and fishing. As a result of these developments, the Polar Eskimo subsist- tants used in the middle of the nineteenth century represent a dramatic decrease in technological complexity compared with those of the immediately preceding period.

The Polar Eskimo tool and converter tu average is 1.7 compared with 2.0 for the Tareumiut. The most notable quality of both tool kits is that many types consisted of one tu. The Tareumiut had 26 one-tu types in a total of 56, and the Polar Eskimos had 22 one-tu types in a total of 40. The more elaborate Tareumiut material culture was based on a tool kit that was more extensive but not significantly more complicated than its Polar Eskimo counterpart.

The Polar Eskimo ritual forms average 2.5 tus per form, and those of the Tareumiut average 3.0. A greater contrast is seen in the total number of ritual tus. Among the Tareumiut 156 tus were identified with ritual forms, whereas among the Polar Eskimos 20 tus were involved. Most of the Tareumiut types were identified closely with the Whale Cult (46 tus) and Messenger Feast (33 tus). Masks, at least some of which were associated with the Whale Cult, account for 13 tus (Spencer 1959:294). The Messenger Feast was basically an economic exchange, but the extent of ritual involvement suggests considerable religious association.

The total tu disparity between the Tareumiut and Polar Eskimo ritual forms is dramatic and far exceeds the numerical differences in other spheres. One reason the Tareumiut had so many more tus of this nature is the importance to them of the Whale Cult, which had no counterpart among the Polar Eskimos. In a study of the Whale Cult and its affinities among Eskimos and adjacent peoples, Margaret Lantis (1938) demonstrated that most traits associated with the cult were centered on Kodiak Island Alaska. These traits appeared to the east of Barrow only in small number and in sporadic distribution. The greater number of Barrow Tareumiut ritual forms also may be related to their more reliable food supply and larger stable communities.

The Polar Eskimos had a tu average of 2.5 for storants as opposed to 4.1 for the Tareumiut. The far greater number of Tareumiut tus in this sphere is attributed to the seasonal diversity of their food harvest, which encouraged the development of different storage techniques, and their greater abundance of large and specialized artifact types used on a seasonal basis and requiring storage facilities when not in use (e.g. boats, whaling equipment, and spring sealing equipment).

The four remaining spheres, VII-X, represent 9.4% of the combined tu total. They are broadly similar in their tu averages or are represented by such small numbers that the differences are relatively minor when compared with the other groups.

Technological investments per technical sphere below the overall tu averages for both groups range widely (7% below for Tareumiut storants to 66% for their medicines-curing forms). On the basis of these data (see Table 3), it seems that in historically uninterrupted Polar Eskimo and Tareumiut technology the storants of the latter might increase in complexity more rapidly than the others. The sphere seeming to have the greatest potential for complexity is that of medicines-curing forms.

The Polar Eskimo and Tareumiut material culture inventories on which this analysis is based provide a systematic record of their respective technological achievements. Furthermore, the study undertaken here involves more than trait list comparisons. The number of tus per type is established, and the types are grouped into technical spheres so that the complexity of the spheres can be compared and overall averages for the comparative technological complexity of each group can be established. Thus, and for the first time, the comparative complexity of comprehensive technological inventories has been set forth on a reasonably objective basis. If technology has been a catalyst for human socio-cultural evolution—a prime mover, if you will—then the systematic evaluation of technological accomplishments in precise terms and in categories suitable for cross-cultural comparison is not simply desirable but essential to its study.

**SUMMARY AND CONCLUSIONS**

1. Technounit comparisons provide a much more sensitive indicator of technological complexity than do type comparisons.
2. (a) Subsistants (food-getting forms), clothing-accessories, and housing-shelters represent the adaptive core of Eskimo technology, and (b) in the absence of historical contacts with other peoples, the greatest further elaborations in material culture would have been among these forms.

3. In garment manufacture, limitations on the size of the available skins as the raw material did not play a part in garment design (e.g., large skins were available but were cut up to make small panels or trim pieces).

4. With an increase in residential stability and seasonal variability in edibles harvested, the complexity of structures increases significantly.

5. Clothing and shelters are comparatively more complex than are food-getting forms.

6. As food-getting technology becomes adapted to a particular habitat, it may (a) become increasingly complex, as in the Tareumut case, or (b) become much simpler, as in the Polar Eskimo example. Thus, technological specializations can and do move in opposite directions with respect to their type and tu number for closely related populations of foragers.

7. The tool kit of the Tareumut was not significantly more complex than that of the Polar Eskimos. Yet, the Tareumut produced many other forms that were far more complex than those of the Polar Eskimos. Thus, tool kit complexity is not an accurate predictor of the complexity of nontools among these Eskimos.

8. The far greater number of ritual forms among the Tareumut is best associated with the Whale Cult that had spread from a North Pacific Eskimo center. Thus, relative proximity to other peoples and a compatible socioeconomic environment for diffusion of cultural traits account for most of the Tareumut complexity in ritual forms.

9. Based on the tu averages for both peoples, and assuming that their lifeways would not be interrupted by outsiders, it can be seen that technological complexity would have increased more rapidly in some technical spheres than in others. The greatest increases would have been in housing-shelters, clothing-accessories, and subsistants, in that order. The spheres least likely to increase in complexity would be medicines-curing, routine body care-adornment, and tools converters, in that order.

10. Comparisons show that the Tareumut had nearly twice as many types and tus as did the Polar Eskimos (the Tareumut had 109 more types and 619 more tus than did the Polar Eskimos). These dramatic differences quantify the technological variability for two Eskimo subcultures. Thus, generalizations about the technological complexity of "Eskimo" material culture are suspect.

11. The absence among the Polar Eskimos of caribou hunting and fishing, despite the local presence of appropriate species, is notable as is the presence of only two weapons for hunting sea mammals (toggle-headed harpoon and lance) and the absence of boats. Thus, one might suspect that pre-historic arctic sea mammal hunters could have made similar adjustments that would not be predicted.

12. This study demonstrates that the type-tu analysis of comprehensive material culture inventories for aboriginal peoples, or the analysis of particular technical spheres, yields more insightful conclusions than those based on trait list comparisons. A truism holds that technology is one firm basis for human cultural evolution. If so, the detailed analysis of material culture can expand our understanding of culture history and cultural ecology.

13. Technological forms among peoples everywhere must meet their basic needs, which invites comparisons between tu numbers in the three most technologically complex spheres (subsistants, clothing-accessories, housing-shelters) and the population totals for these Eskimos. Among the Polar Eskimos, the tu average for these spheres was 2.6 tus per person compared with 0.33 for the Tareumut. Thus, the Polar Eskimo technological investment per person was nearly eight times greater than for the Tareumut, and yet the Tareumut supported 15 times as many people. Stated differently, the Polar Eskimos required many more core forms to sustain a much smaller population. One reason is that the resource base utilized by the Polar Eskimos was more limited because of their bias against harvesting caribou and fish.

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APPENDIXES

APPENDIX I. MATERIAL CULTURE

EVALUATION: TYPES, TECHNOUNITS, AND RELATED TOPICS

1. Archaic and extraneous forms. Archaic artifact types known to the Tareumut or the Polar Eskimos, but not used at the time of early historic contact, are excluded as are
those types received shortly before sustained contact from outsiders, be they Eskimos, Europeans, or Euroamericans. Forms that were idiosyncratic, improvised, or used occasionally also are excluded. Attention focuses on the normative, early historic forms as standardized artifact types.

2. Natural and artificial forms. In the analysis of some aboriginal technologies, a useful distinction may be drawn between forms that are used as they exist in nature (naturefacts) and those that are manufactured for use (artifacts). However, so few naturefacts are reported among these Eskimos that they are included with artifacts.

3. Fire and fuels. Fire, as a natural force, is excluded from the analysis although artificial means for producing or controlling it (e.g., strike-a-light, lamp tender) are analyzed. Likewise, and somewhat arbitrarily, fuels such as blubber and driftwood are excluded from the forms with which they may be associated (e.g., lamps, campfires). Tinder and wicks are likewise excluded.

4. Types. A type is defined as a relatively homogeneous group of finished forms that share key attributes in their structural configurations. One type is distinguished from another in its different kinds of parts and their arrangement to form a completed structural unit. An ice hunting harpoon is different from a whaling harpoon in its structural components and the manner in which they are arranged. The configuration of parts for one type always is different from that of another, even though some of the parts (e.g., blades, binders, handles, netting) may be similar or nearly identical.

A. Each type is a separate physical entity. Although forms often are used in intimate association, each represents an individual type if it stands alone as a physical object. For example, a kayak is one type, and a paddle used with it is another type. The same applies to the distinct physical units constituting a bow drill assembly; the bow, the shaft, and the drill bearing are three different types. Similarly a spear and throwing board each represent separate types, as do a bow, arrow, quiver, and wrist guard.

B. Multiple purpose types. A type is entered only once in an inventory. The number of alternative functions it may serve is not significant. A scoop to remove ice from the breathing hole of a seal also might be used as a club to kill a seal, but it is entered only under its primary purpose, as an ice scoop. Likewise a sharpened walrus rib that served as a meat skewer might be used on occasion as a back scratcher; it is recorded as a meat skewer.

C. Differences in size. Differences in size are not considered significant. A large tub or a small one, if made in the same manner with baleen sides and a wooden bottom, represents a single type because it is distinguishable only on the basis of size. The same is true for a child’s bow and larger ones for adults, if they have the same configuration of parts. If the clothing of small children, older ones, and adults is identical in cut and differs only in size, it represents a single type. However, if a child’s jacket has a different number of panels in addition to being smaller than an adult’s jacket, it is considered a distinct garment type.

5. Technounits (tu, singular; tus, plural). As defined in the text, a technounit is physically distinct and unique part that is integrated into and contributes to the form of a finished artifact. Each tu is different from any other tu contributing to a type. A bird bone sucking tube, bone awl, and wooden cutting board are examples of one-tu types. A skin scraper made of a blade wedged into a handle, snow goggles made of a wooden eye protector with an attached thong, or seal blubber bound over a wound with a strip of skin each represent two tu types. Many types have three or more tus. If a part has distinctly different attributes from any other part contributing to a type, there is no difficulty in identifying it as a tu.

If a number of parts have the same or nearly the same form and serve the same function, they are called replicative components and are counted as a single tu. The balls of a bola, side prongs of a bird spear, and the skins forming right or left sleeve of a jacket are replicative components and in each case represent one tu. The same is true for matted grass fibers used to line a boot or mitten.

A. Lashings. Lashings that are repeated in the same context on a type represent a single tu; thus, the lashings for the side prongs of a bird spear are counted once, as are the prongs themselves. Lashings that are in different locations for a type and serve different purposes are counted as separate. The Polar Eskimo sied, for instance, has numerous lashings binding the sections of bone that form the runners; lashings also join the crosspieces to the runners, and still others attach the upstanders to the runners. In this instance, each of the three forms of lashing has a different function and therefore is counted as a separate tu.

B. Structural units and technounits. As mentioned earlier, when one form is obviously distinct from another, such as a bow and an arrow, each physically separate item represents a type. Occasionally a form may be a separate entity, yet be considered an essential part of another form. In other words, it can stand alone but is functionless that way and therefore is not a type. For instance.
the grass lining for mittens cannot stand alone and therefore is called a tu of the mittens.

C. Technounit variability for a type. Varieties of a type pose a special difficulty when they vary in tu number. It often is possible to establish that one variety is the dominant one, in which case it is taken to represent the type. In other instances, the variety with the greater number of tus is entered in the inventory. For example, two garments serving the same purpose may vary in their tu number; in this case the form with the larger number of tus is entered as the type.

D. Decorative features as technounits. Embellishments are included only when they are made with an additional material. Pieces of coal set into the eyes of an animal carving represent a tu, as does red paint applied to a wooden bowl. If a needle case is engraved with a line and dot pattern, the engraving is not considered a tu. If, however, red paint or soot is rubbed into the incised lines, this material represents an additional tu.

E. Materials as technounits. Antler, bone, wood, and stone are typical materials used to produce tus. However, there are other materials used as tus that are more unusual and require comment. For example, a substance such as water may become a tu in a technological type, as when a bird skin is dipped into water to become a medicinal form to be rubbed on a frostbite. Likewise, blubber placed over a wound represents a tu, as does the strap of skin that holds it in place. The same applies to a natural substance such as blood if it is used as glue. If ground ocher and oil are combined to form paint, the combination of materials is regarded as a single tu.

F. Natural configurations disturbed. Whenever a natural feature is physically altered so that it will contribute an essential dimension to a form, the resultant unit is a tu. For example, if the ground is excavated to create a house foundation, or a pit is dug in the snow to make a caribou pitfall, the excavated area represents a tu. Likewise, when whale bones are set upright in holes in the ground to make a frame for stretching newly made thongs, the holes into which the whale bones are set become a tu. It is tempting to exclude this category, but to do so would be to ignore an important technological achievement in the development of nonportable artifacts. Without foundation holes or excavations, many nonportable artifacts could not function.

G. Stitching evaluated. If a type included stitching, the stitching is evaluated as a single tu, irrespective of the variety of stitchea. This is done because ethnographic accounts often are unclear about configurations of stitches, thereby preventing the consistent evaluation of differing varieties. It is likewise presumed that all stitching, unless otherwise noted, was with thread made of sinew.

H. Evaluation of structures. The manner of evaluating the tus for nonportable forms is the same as for all other types, although a number of assessments require a brief explanation. If the logs forming a wall serve a single structural purpose, they are replicative units and are assessed as a single tu. The same is true for roof beams, tunnel supports, or skins sewn together to form a roof; each grouping is counted as a single tu. For a snowhouse, all snow blocks are evaluated as one tu.

6. Artifact repairs. Broken forms were sometimes mended, and because repairs represent a special aspect of technology, the repairs themselves are evaluated as separate units or types. They are not considered parts of artifact types because they do not contribute to a type in its normal, unbroken state. For example, a shaft may be broken and repaired with a mending piece of bone lashed to the shaft. The tu embodied in repairs perform work in the manner of tools and therefore are classified with tools and converters. This violates the type rule (4A), but seems unavoidable.

7. "Assumptions" about types and technounits. Even superior ethnographies may not be sufficiently detailed in certain aspects for my purposes. As a result, assumptions must be made about the parts of some types. A type might be mentioned as common but not be described; in this instance, a tu configuration is assumed based, if possible, on a similar type reported from a nearby Eskimo group. More often, it seems, ethnographers failed to mention all the parts of a type; it appears that binders are the parts most commonly omitted. Omissions of this nature can sometimes be corrected by studying accompanying illustrations, but in most instances, subjective assumptions, based on related information, must be made about the presence of some parts. Obviously, to make many assumptions about types and tu is to create a major source for potential error. Assumptions for the Eskimo inventories are discussed in the text.

APPENDIX II. EXAMPLES FOR THE ANALYSIS OF TYPES BY TECHNOUNITS

The type name is separated by a colon from listings of technounits (tus); each tu is separated from the following one by a plus sign. PE stands for Polar Eskimos; T stands for Tareumiut; A means an assumed tu.
I. Subsistants

1 tus
water sucking tube: bird bone
(Holtved 1867:22-25) PE

3 tus
throwing board for sealing dart
(bird dart): spruce body + ivory shaft-receiving peg + red paint on body (Murdoch 1892:217-218) T

5 tus
spear, bear: chipped stone point + spruce shaft + leather wedges between point tang and shaft end + sinew point-shaft binder + red paint on shaft (Murdoch 1892:242) T

7 tus
bird dart, used with throwing board: barbed ivory head (or heads) + spruce shaft + braided sinew head-shaft binder + barbed ivory mid-shaft side prongs + braided sinew side prong-shaft primary binders + braided sinew secondary prong-shaft binders + red paint on shaft (Murdoch 1892:211-213) T

18 tus
toggle-headed ice hunting sealing harpoon, used at edge of ice: iron blade + ivory head + wood peg as blade-head binder + ivory foreshaft + ivory socketpiece + spruce shaft + thong as foreshaft-shaft binder + wood socketpiece-shaft peg binder + thong as socketpiece-shaft binder + ivory peg as line tension-shaft peg + ivory finger rest + baleen rest-shaft binder + thong as harpoon head lead line + sinew lead line and main line binders + thong as main line + ivory ice pick + thong as shaft-ice pick binder + braided sinew ice pick thong cover (Murdoch 1892:231-232) T

II. Clothing and accessories

2 tus
abdominal belt for cold weather: fox tails + sinew stitching (Holtved 1967:48) PE

5 tus
man's bear skin trousers: leg panels + folded sealskin top edging + drawstring in edging + bottom edging strip + sinew panel edging stitching (Holtved 1967:40-42) PE

14 tus
woman's outer fox skin coat: front center panel + front lateral panels + chest panel + back center panel + back lateral panels + sealskin hood panels + sealskin hood trim + neck panel + sleeve panels + fox tail sleeve cuff + dog skin front, center panel trim + bear skin front, lateral panels trim + sealskin back panels trim + sinew, panel-cuff-trim stitching (Holtved 1901:49) PE

30 tus
woman's dress jacket, caribou skin: lateral front panel + medial front panel + lateral back panel + medial lower back panel + medial back panel extension #1 + back extension #2 + back extension #3 + lateral hood panel + hood panel extension #1 + hood panel extension #2 + upper back-shoulder-front panel + shoulder-lateral hood extension panel + front sleeve panel + back sleeve panel + hood edge trim panel + hood edge trim, mountain sheep skin + hood edge trim, fawn skin + hood border, wolf fur + front-back panels, waist and lower level trim panel, mountain sheep skin + front-back panels trim, fawn skin + front-back panels trim, wolverine fur + front back panel trim, red paint on wolverine fur + shoulder-hood panel trim, thin brown caribou skin + front-back panel, waist level and lower, caribou skin trim + back waist panel, marten fur trim + lower garment border, brown caribou skin + mountain sheep skin border + marten fur border + red paint on marten skin + sinew thread stitching (Murdoch 1892:118-119) T

III. Housing and shelters

4 tus
shelter, temporary: wall stones + turf for walls + sealskin roof + (A) stones to hold down sealskin (Holtved 1967:31-33) PE

7 tus
spring (summer) dwelling: wall stones + turf for walls + cantilever roof edge stone slabs + small stones (bones) wedged between wall and roof stones, to obtain proper roof angle + two layers of walrus hide, roof cover + heather insulation between hides + (A) stones to hold hide cover in place (Holtved 1967:28) PE

20 tus
spring (summer) tent, sealskin: long fent poles + thong binder near pole tops + wood hoop, interior framing + thongs as pole-hoop binder + short poles (spears, paddles, etc.) from ground to hoop + skin panels as covering + sinew cover stitching + thongs to attach cover panels to frame + intestine window in one panel + sinew panel-window stitching + stones (heavy artifacts, gravel) to hold down skin cover + log to separate sleeping area at back + boards on ground + [in cold weather] small block tunnel walls + snow block tunnel roof + snow block
walls for cook structure + snow block
cook structure roof + snow block lamp
block lamp rest + stick to support
cooking pot, in wall + snow block wall
around tent (Murdoch 1892:84-85;
Simpson 1875:260) T

IV. Tools and converters
1 tus
maul: piece of stone used to remove
sections from meteorites (Kroeber
1900:285; Ross 1819:104, 112)
PE
wedge: section of whale rib used to
split wood (Ford 1959:165) T
net (sinew) shuttle: piece of carved
ivory (Murdoch 1892:311-312) T

2 tus
drill bearing, used with bow drill
assembly: stone bearing + wood
mouthpiece (Murdoch 1892:175-176,
179) T

snow knife, to build snowhouse: bone
(ivory) blade + suspension thong in
hole near handle (Holtved 1967:31;
VanStone 1972:52-54) PE

3 tus
adze, direct haft: jadeite blade +
antler handle + thong as blade-
handle binder (Murdoch 1892:167-
168) T

6 tus
smoking complex: antler (stone) bowl
+ wood stem sections + thong to bind
sections and bowl as a unit + sinew
binder at mouthpiece + iron (steel,
copper) picker to clean pipe + thong
to bind picker to stem (Murdoch
1892:66-70) T

V. Ritual forms
1 tu
nose protector: grass stuffed in
nostrils at funeral (Holtved 1967:152)
PE
head-lifter: thong (Holtved
1967:177-178) PE

whaling charm: wolf skull (Murdoch
1892:275) T
charm used with lamp: piece of stone
(bone, ivory, etc.; Spencer
1959:286) T

2 tus
wands for guests at Messenger Feast:
stick + red paint marks (Spencer
1959:224) T

amulet for dog: piece of a particular
type rock + thong tied around stone
dog's neck (Holtved 1967:73)
PE

4 tus
blanket toss for whaling ceremonies:
whale rib tripods + ground holes as
anchor for tripods + walrus thongs
between tripods + walrus skin over
thongs (Spencer 1959:350, 351) T

6 tus
mask, depiction of human face, with
gorget: spruce mask + blacklead
facial markings + fur hood strip +
(A) pegs as mask-hood attachment +
wood gorget as lateral extensions +
(A) sinew cord as mask-gorget-
headband attachment (Murdoch
1892:367-368) T

VI. Storants
2 tus
quill needle case, used with needles:
bird quill base + walrus hide piece
as plug (Murdoch 1892:318) T

3 tus
bag for ivory figures, toys: feet of
sea gulls + (A) sinew stitching + (A)
thong as opening binder (Holtved
1967:160) PE

oil container: bladder + (A) thong
to close base + (A) opening thong
(Hayes 1860:104) PE

4 tus

tool box: one-piece spruce body + red
paint on box + spruce lid + sinew
cord as body-lid binder (Murdoch
1892:185-186) T

5 tus

needle case assembly, used with
needles and thimbles: winged
variety ivory tube + thong to pull
needles through central hole + ivory
thong held at proximal end + ivory
animal carving(s) on split distal end
of thong + anchor-shaped ivory
sewing ring (thimble) holders on
split distal end of thong (VanStone
1972:57) PE

VII. Gaming devices and toys
1 tu
miniatures: animal (human, sled)
figures of ivory, presumably toys
(Holtved 1967:160; VanStone 1972:64)
PE

walrus hunting game: white bones
used as "walrus" (Holtved 1967:156)
PE

pebble hurler: bent piece of baleen
used with pebbles (Murdoch
1892:379) T

2 tus
kick ball, for women (girls): snow +
water to form ball (Murdoch
1892:384) T

VIII. Domestic equipment
1 tu
meat-serving dish: shaped piece of
driftwood (Murdoch 1892:99) T

fish dish: scoop-like tray carved from
spruce (Murdoch 1892:100) T

2 tus
bedding: grass on house platform +
bear (dog) skin covers (Hayes
1860:127) PE
4 tus
clothes drying rack: bear rib frame +
thong frame binder + roof anchor +
(A) thong as frame-anchor suspension
(Hayes 1860:128) PE
IX. Medicines and curing
1 tu
treatment for nosebleed: caribou hair
stuffed in nostril (Murdoch 1892:40) T
2 tu
frostbite treatment: cold water + bird
skin to rub area (Hayes 1860:184-
185) PE
3 tu
infection treatment: section of hare
skin + water to moisten the skin +
(A) sealskin binder (Holtved
1967:151) PE
X. Routine body care and adornments
1 tus
man’s hair band: sealskin strap
(Holtved 1967:59) PE
comb: toothed ivory (Kroeber
1900:281) PE
labret, male: carved stone (Murdoch
1892:145; Ray 1885:pl. V, 3) T
4 tus
louse catcher: curved bone (wood, 
ivory) rod sections + thong(?)
section binders + polar bear skin
fur at one end + thong rod-fur
binder (Holtved 1967:59; Kroeber
1900:280; VanStone 1972:69) PE

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