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Functional Analysis of Three Unusual Assemblages from the Cape Dorset Area, Baffin Island

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ABSTRACT. A brief survey of the Cape Dorset area, Baffin Island recovered surface collections from three very similar, but unusual quartz assemblages. This paper hypothesizes that these assemblages represent a consistent set of activities. In testing this hypothesis, the author uses an approach to functional analysis that has several important advantages over other methods. This approach can help solve problems in eastern arctic prehistory involving a relationship between environmental change and cultural change.

INTRODUCTION

Where faunal remains, clearly defined structures, or organic artifacts are not always present, archaeologists rely heavily on lithic artifacts to answer many of their questions. Students of Paleoeskimo culture (Maxwell, 1976a) in the eastern Arctic, including Pre-Dorset and Dorset, are frequently faced with this situation. To answer their questions effectively, arctic archaeologists need innovative approaches to understanding and using the variability in lithic items.

In the eastern Arctic, Paleoeskimo remains appear over a long period of time — from sometime around 4000 BP to perhaps as late as 350 BP in some areas (Arundale, in press) — and over a large area — from the western Canadian Arctic eastward into Greenland. Until recently archaeologists studying Paleoeskimo cultures have focused on space-time frameworks (Dekin, 1978) and hence on what lithics could tell them about cultural and temporal placement of sites and assemblages. Most researchers based their single lithic classification primarily on details of form because these attributes tend to have a high stylistic content and are more likely to provide information on cultural and temporal ties. As a result, their analyses concentrated on more highly shaped or formed artifacts and made little use of simpler ones.

In the past few years, however, eastern arctic archaeologists have begun to consider a broader array of problems including questions related to activities, seasonality, settlement and subsistence patterns, and site formation and degradation processes. These problems require looking at a wider range of lithic variability and perhaps using more than one classification. If researchers want to solve these new problems, they must learn how to define and separate variability related not only to style, but also to function and technology. Similarly, they must shift away from an almost exclusive emphasis on shaped tools to a wider range of items and give a larger role to simple expedient tools and debitage.

Recent research suggests a shift has begun in this necessary direction. Arundale (1976) has used a simple functional classification of stone tools from sites in

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the Lake Harbour region to help test hypotheses related to settlement pattern change in that area. In a more sophisticated approach, Steele (1980) examines the intrasite variability of stone tools from the Pre-Dorset Closure Site. From a very different perspective, Gordon (1979) looks at functional variability among Paleoeskimo burins.

This paper continues this new trend, examining still other dimensions of lithic variability in Paleoeskimo material. It describes an unusual set of assemblages from the Cape Dorset area of Baffin Island, looks at some of their technological and functional dimensions, and tests a hypothesis concerning their functional similarity. In performing these tasks, it presents a method of functional classification and analysis that has the potential for very broad application in the Arctic. The paper concludes with some suggestions on how this approach might help solve some important Paleoeskimo problems and with several new questions raised by this research.

RESEARCH BACKGROUND

The relationship between cultural change and climatic change has assumed an important role in recent eastern arctic research (Barry *et al.*, 1978). Although climatic change is certainly not the only force, or perhaps not even the primary source of change, it may be difficult to sort out the roles of other forces until we understand the part climatic change plays. For much of the Paleoeskimo period in most eastern arctic areas, researchers know very little about how people adapted to their environment or how that adaption may have changed over time. However, a sizeable body of research not only tells us that the eastern Arctic has undergone significant climatic change in the past 5000 years, but also strongly suggests that these changes were responsible for significant changes in resource availability (Arundale, 1976; Barry *et al.*, 1978; Dekin, 1972, 1975, 1976; Fitzhugh, 1972, 1976; McGhee, 1970, 1972; Schledermann, 1976a, b). Because the eastern Arctic has a relatively "simple" ecosystem in which only a few alternative food paths are available, these resource changes almost certainly required adaptive responses by Pre-Dorset and Dorset hunters. Archaeologists need to find out more about the character of these responses and how they changed over time. Without such information, they cannot understand the role these responses played in important prehistoric events.

Research in the Lake Harbour region (Arundale, 1976) suggests that the Pre-Dorset to Dorset cultural continuum in that area underwent settlement pattern change in response to these resource changes. I wanted to investigate the phenomenon further in the adjacent Cape Dorset region. Because investigating such a problem requires a regional approach and because extensive excavation demands impractical amounts of time and money, I wanted to base my research on sampling and surface survey methods that have worked well outside the Arctic. Carefully chosen intensive excavation areas would supplement the survey.

However, in 1977, we knew very little about the Cape Dorset area archaeologically. Aside from O'Brien's (1953) brief work on Mill Island, no professional archaeologist had previously worked in the region; the famous collection on which Jenness (1925) brilliantly defined Dorset culture comes from a site that is probably near Cape Dorset, but whose exact location is unknown. Before launching a major research effort, a preliminary reconnaissance of the Cape Dorset region (Fig. 1) seemed in order. Therefore, in 1977 with the help of three field assistants, I conducted a preliminary survey of the area (Arundale, 1977). Although we located 32 site components during the survey, we made only three surface collections large enough for this analysis (Fig. 2, Table 1).

SITES

The Kingait Chipping site (LbFn-2) is a large boulder field strewn with concentrations of flakes, cores, and chipping debris. It appears to be almost entirely a surface manifestation; the only soil occurs in a few places where a few centimeters of moss and lichen have grown over some of the rocks. The sample from this site consists of a complete surface collection from one small concentration about 4 m^2 centered around a large boulder, an area encompassing less than 1% of the site. The collection includes 250 items, of which 175 were used for this study.

The Kingait Scatter site (LbFn-3) is a nearby lithic scatter located in a sandy area along a small stream draining two tarns. In physical size, the Kingait Scatter site is smaller than the Kingait Chipping site. Instead of several scattered loci, it has a larger concentration of material at one end that "smears out" in a thin scatter over the rest of the site. The sample from this site consists of the surface collection from eleven 2-m squares in the heaviest part of the concentration and encompasses approximately 5-10% of the site area. The collection includes 360 items of which 236 were used in this study.

The Paakituuq site (LbFn-5) covers a larger area than the Kingait Scatter site, but a smaller one than the Kingait Chipping site. The lithic scatter covers part of a rocky ridge and an adjacent area. Three Thule houses, clearly identifiable by their form, and two rectangular depressions of unknown cultural association are located in the midst of the scatter while two tent rings, probably Paleoeskimo, are located behind the ridge. Tent ring rocks, almost overgrown with sod, and artifacts from a test pit in one ring strongly suggest the Paleoeskimo association. There is no clear association between any of the structures and the lithic debris.

Some areas of the site are covered with sod and soil in which artifactual remains go to a depth of 0.5 m or more; other areas consist of bare rock with only surface remains. Surface collections encompass between 5 and 10% of the site in an area where surface remains are relatively dense. The collection includes 1215 items taken from three 20 m square and one 10 × 20 m rectangle. Analysis is based on all the cores and a random sample each of chunks, flakes and flake fragments, a total of 236 items.

Although all three sites are lithic scatters, some of the differences among them could be related to differences in activities once carried on there. First, Paakituuq has structural remains; the others do not. But since association between the structures and the lithic scatter at Paakituuq is unclear, we cannot place too

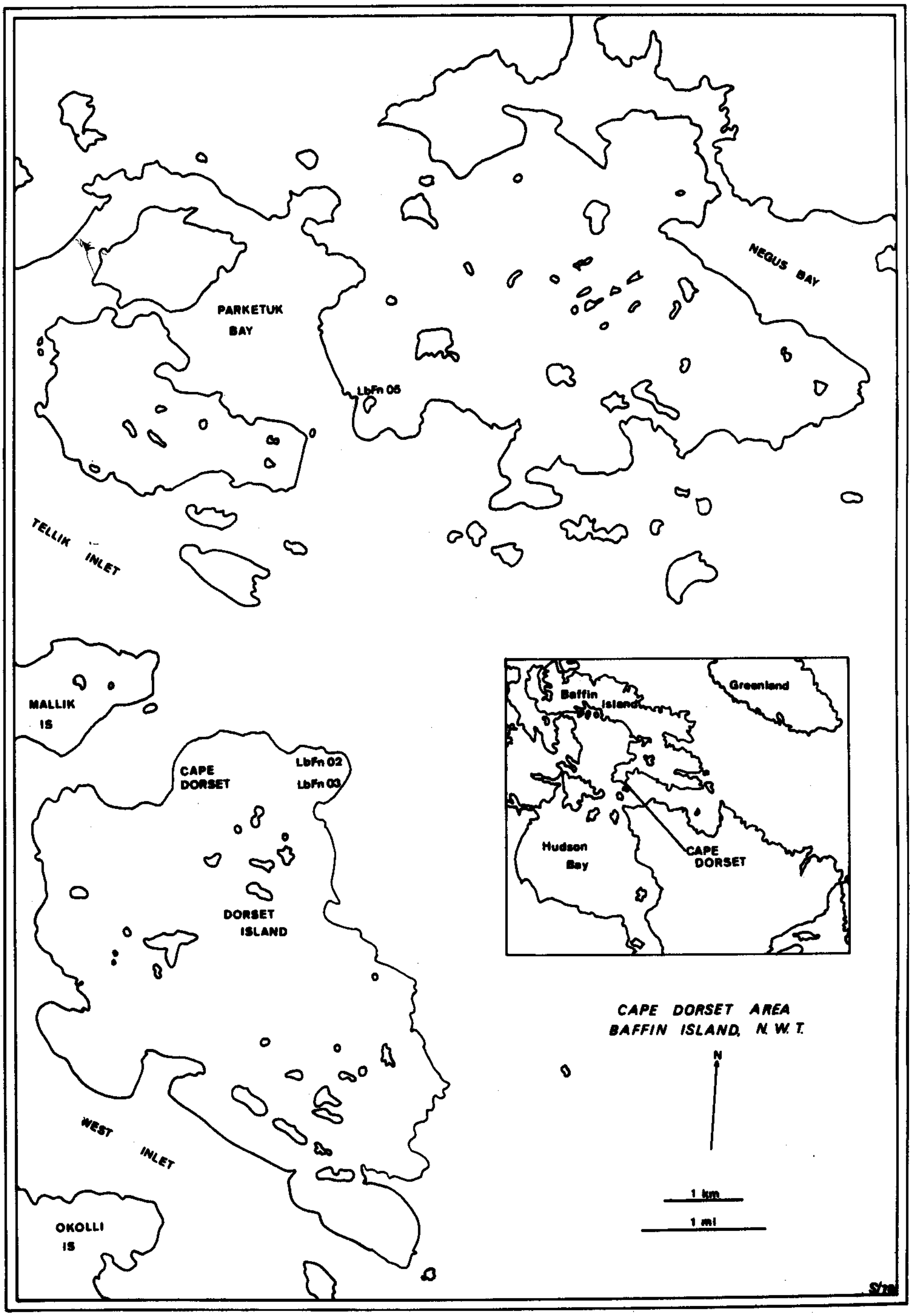

FIG. 1. Map showing location of three assemblages used for analysis.

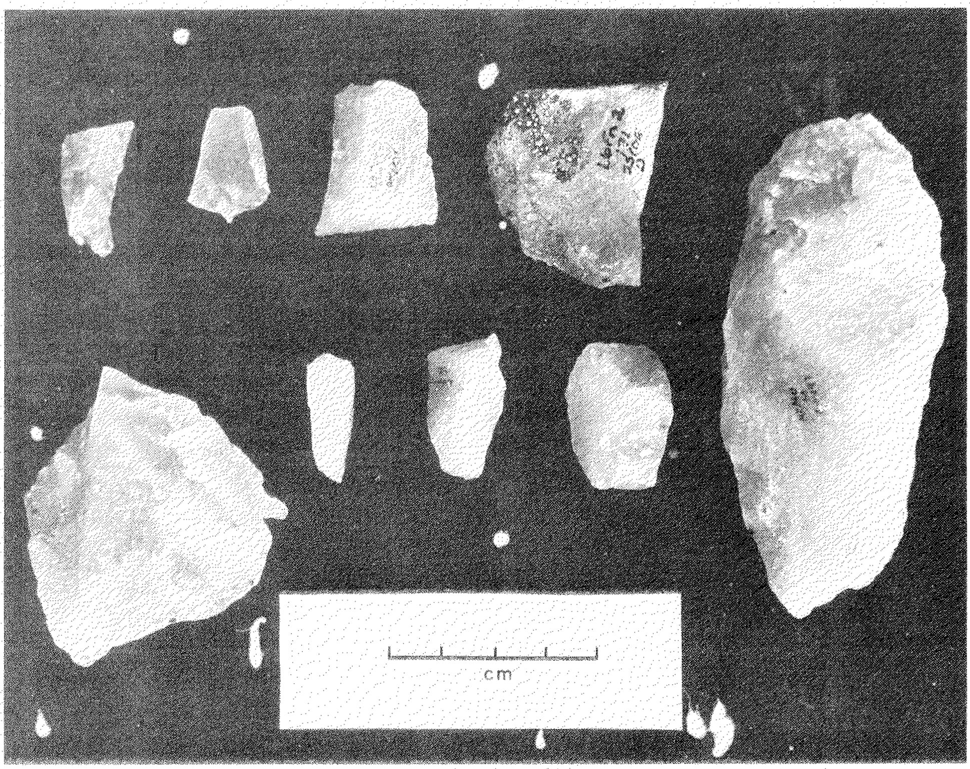

FIG. 2. An example of materials used for analysis.

TABLE 1. Inventory in percents of collections used for analysis.

	LbFn02	LbFn03	LbFn05
Flakes	47.2	43.3	20.7
Flake Fragments	22.4	40.5	53.4
Cores	19.2	10.0	1.9
Chunks	9.2	2.7	12.0
Formed Tools	2.0	3.5	12.0
Total N	250	360	1215

much weight on this evidence. Second, the scatters differ in size. But since size may reflect either intensity of use or availability of raw material, we cannot give it too much weight either. Third, Paakituuq has more formed tools and a wider range of raw materials. But this difference, like the presence of house structures, could merely reflect the addition of some activities rather than entirely different ones. Thus without more careful analysis, we cannot evaluate what these differences mean.

At the same time, these three sites have some important similarities. The most important is the predominant lithic raw material. Unlike the stone in most eastern arctic sites, this material is a vein quarz (Julian Barksdale, pers. comm. 1978) that occurs in outcrops either right on the site or in very close proximity. Similar to what some archaeologists would call quartzite, the stone is brittle and somewhat recalcitrant to work. From the knapper's perspective, it is not easy to make into complex, highly refined shapes. But it is very plentiful in this area, and with basic stoneworking techniques and very little effort, prehistoric residents could have used it to produce simple tools with sharp, useful edges. Thus, most of the items made from this material are not formed tools, but cores, chunks, flakes and flake fragments, simply made items apparently manufactured and used on the spot and then discarded.

DATING

Although the dates for the three Cape Dorset sites are among the pieces of information we would like most to know, two factors make dating particularly difficult. First, there is no material suitable for radiocarbon dating. Second, there is very little material suitable for stylistic dating. These assemblages include only a small percentage, between less than one and twelve percent, of formed tools; they consist primarily of simple, expedient tools. In general, formed tools have stylistically significant shapes and other characteristics that help place a site in time; simple tools often have few or no temporally significant characteristics. With strong cultural continuities over time in the area and relatively few stylistically significant artifacts, dating the sites on stylistic grounds is very difficult.

Even if changing technological patterns in these artifacts proved temporally significant, eastern arctic researchers would have difficulty making meaningful comparisons. For a long time, researchers did not even collect all flakes and debitage. More recently, researchers have collected such materials, but since the majority of publications were written when the primary concern was with the temporal and cultural relationships among assemblages, their authors describe, analyze, and illustrate primarily the formed tools. Precisely because simple and expedient tools may bear less information significant for understanding cultural or temporal association, authors frequently paid little attention to them.

The few comparative opportunities available are not very helpful. A few publications dealing with the Churchill area, the eastern Barren Grounds, and Victoria and Banks Islands describe and illustrate quartzite tools from Paleoeskimo sites (Nash, 1969:77; Taylor, 1972:104). However, from these illustrations alone, it is difficult to determine whether these items bear a significant resemblance to the material found near Cape Dorset. Material with technological characteristics similar to the Cape Dorset assemblages occurs in quarry/workshop contexts in Labrador (William Fitzhugh, pers. comm. 1980). At least one of these contexts is almost certainly Paleoeskimo, but its date is unclear.

Despite these problems, available evidence strongly suggests that the three Cape Dorset assemblages are associated with the Paleoeskimo occupation of Baffin Island's south coast. First, all three sites are located sufficiently high above sea level to have been occupied during Paleoeskimo times. Over the past several thousand years, the south coast of Baffin Island and several other parts of the eastern Arctic have undergone isostatic rebound. Although elevation is by no means a foolproof guide to age, it can provide a valuable general indicator (Andrews *et al.*, 1971).

Second, those stylistically diagnostic artifacts that do occur are all Paleoeskimo. These items include typical Paleoeskimo end scrapers, side scrapers, and a burin-like tool. None of the sites has any surface material readily attributable to the Thule occupations of the area. Although Paakituuq has three Thule houses, they are not associated with the surface artifacts. Paakituuq also has two rectangular depressions of unknown cultural association. But a 50 cm^2 test pit dug to permafrost at approximately 65 cm revealed no conclusive evidence of association between these features and the surface material.

Third, both quartz crystal and vein quartz artifacts occur in many Paleoeskimo sites, including others from Baffin Island's south coast (Arundale, 1976, 1977; Dekin, 1975; Maxwell, 1973), but rarely occur in Thule sites. This situation suggests that Paleoeskimo stone workers would be more likely to exploit a local quartz source than their Thule counterparts.

DEFINITIONS

At this point, we should pause briefly to define a few terms. The distinguishing features of cores, flakes, and flake fragments should be familiar to most readers. "Chunks" are angular pieces of stone, broken in one or more places, that lack the negative bulb of percussion evident on cores. They are distinguished from flake fragments by their shape. Flake fragments have two faces with unbroken edges that consist of two planes that meet at an acute angle. Chunks have more than two faces and their edges may meet at an obtuse angle.

"Simple tools" are items that result from technologically simple stoneworking where the primary goal is to produce a sharp edge for use and not necessarily create items with regular shapes. Cores are relatively unprepared and flakes are removed in a fairly unpatterned sequence. Only a few steps convert raw materials to useful artifacts and the end product is not very different from the original raw material (Stothert, 1974). In these three assemblages, the simple tools include blades and microblades since there are only a few of them and their size and shape do not fit any consistent pattern. "Expedient tools" are items manufactured quickly or selected from raw materials on the spot, used, and immediately discarded where they were used. Expedient tools are likely to be simple tools. In general, expedient tools embody very little stylistic information (Binford, 1973:243), but they may yield important data on function.

By contrast, "shaped" or "formed" tools result from technologically more complex processes that usually include significant modification following detachment and retouch. Although edges or surfaces with certain useful characteristics are very important, achieving a consistent form is also important. Cores are likely to be more carefully prepared, and the products of basic flaking are usually heavily modified before use. Shaped or formed tools include, among others, scrapers, burin-like tools, even unretouched blades and microblades when they are produced with consistent form and size. In general, shaped or formed tools are more likely to embody stylistic information along with some data on function. "Curated tools" are items that are preserved and carried from place to place until they are lost or broken (Binford, 1973:242). Because they require a greater time investment, shaped or formed tools are more likely to be curated. However, the availability of raw material and an item's potential for remanufacture can also affect whether it is curated (Jelinek, 1976:21).

PROBLEM

The classical approach to understanding how people are adapted to their environment and how that adaptation changes through time is an ecological one (Butzer, 1971; Clarke, 1972:7; Coe and Flannery, 1964, 1967). It involves defining subsistence and settlement patterns for the area under study (Brose, 1970; Chang, 1968; Rice, 1975; Trigger, 1967; Willey, 1956; Winters, 1968) and how those patterns change over time. Sites that represent a particular settlement type and thus play a similar role in the subsistence settlement system should reflect a very similar set of activities. Each settlement type in the system reflects a different set of activities, and in general, these activities were carried out in different environmental settings. Over time, changes in the subsistence-settlement system in response to changing resources would bring about changes in settlement patterns and therefore changes in activities carried on in particular environmental settings. Thus, the key to recognizing and understanding the response Paleoeskimo people made to their changing resource base lies in detecting similarities and differences in the activities carried on in particular environmental settings across space and over time. Researchers can solve this problem, in part, through a better understanding of the organizational and distributional variability in lithic assemblages (Binford, 1972). This paper suggests a useful way of approaching this task.

Even though the three Cape Dorset assemblages may be difficult to date to a narrow time span, we can use them to test an interesting hypothesis and ultimately suggest how the approach used in testing this hypothesis can contribute to solving larger problems. As we noted earlier, the three assemblages are quite similar; they have the same predominant raw material and all three include relatively low percentages of formed tools. On the basis of their unusual character and their apparent similarity, we can hypothesize that they represent a similar activity or set of activities. This hypothesis has several test implications.

Primary Test Implication

All three assemblages should contain similar percentages of functional tools.

Secondary Test Implications

The functional types should cluster in a few cells of the functional classification paradigm.

The three sites should show similar breakage patterns.

The three sites should show similar patterns in other functionally related attributes such as house types and especially faunal remains.

The three sites should occur in the same environmental setting.

METHODS

As archaeologists have begun to recognize multiple sources of variability, they have found it more useful to develop analytical methods and classification schemes that separate stylistic, functional, and technological characteristics. Since this study's goal is to demonstrate whether all three assemblages from the Cape Dorset area represent the same activity or set of activities, the research is concerned primarily with the functional properties of the artifacts and only secondarily with their technological and stylistic properties as they impinge on function. Studies focused on artifact function are necessary to distinguish prehistoric activities across an area's environmental settings or identify changes in activities over time.

There are many definitions of function with subtle differences in their meaning. In this study, I have used Dunnell's definitions and approach to functional analysis. According to Dunnell (1971a:9-10), prehistoric function is the artificial relationship between an object and its natural and artificial environment. Where that relationship is motion, the result is prehistoric use identified as wear. Functional forms are "those forms that directly affect the Darwinian fitness of the population in which they occur." By contrast, stylistic forms are those "that do not have detectable selective values" (Dunnell, 1978b:199).

With such definitions, it is important to recognize that no attribute is always functional or always stylistic. Although some attributes are much more likely to be one or the other, the role an atttribute plays depends on the problem under study (Sackett, 1973). Technology pertains to the production of both functional and stylistic forms. It involves selecting and usually modifying appropriate material to make a cultural form.

Some researchers view the eastern Arctic as an area where some stone tools have highly specific uses. Others see the environment in this area as imposing strong constraints on activities, a view reinforced by some of the continuities in technology across vast areas. Partly as a result of these perspectives, archaeologists tend to see Eskimo culture as having strong functional continuities over time. Such assumptions provide a strong temptation to base analysis of stone tool function and hence site activities on ethnographic analogy.

Although intuitively it is very satisfying, ethnographic analogy has some serious weaknesses (S.R. Binford, 1968; L.R. Binford, 1968; Dunnell, 1971a, 1978a; Freeman, 1968; Thompson, 1978a:68-69). The basic problem with ethnographic analogy is that it assumes a constant relationship between form and function, a relationship that we know does not hold (Ahler, 1971; Tringham *et al.*, 1974). Under such an assumption, archaeologists cannot identify prehistoric functions that are not found ethnographically. Ethnographic analogy also requires cultural stability, making the approach ineffective for identifying culture change (Thompson, 1978a:69). Although there may be cases where analogies are correct, researchers have no way of testing so that they can pick them out (Dunnell, 1971a, 1978a; Rice and Cottrell, 1976).

Microwear studies and replicative experiments are another avenue for approaching problems of artifact function, but many of these studies have disadvantages similar to ethnographic analogy. They tell us how artifacts *may* *have been used,* but not how artifacts really *were* used. And like approaches based on analogy, once researchers assign artifact function, they rarely test the hypothesized function against other relevant data (Thompson, 1978a:69).

Nevertheless, microwear (Hayden, 1979; Keeley, 1974; Semenov, 1964) and replicative studies (Johnson, 1978) and studies of fracture mechanics (Faulkner, 1972; Hayden, 1979; Speth, 1972) can be extremely valuable if researchers use their results to learn more about wear and wear-related attributes and not to reconstruct specific prehistoric activities. Although such reconstructions have been the traditional goal of functional analysis, more recently some archaeologists engaged in functional studies have recognized that differentiating among activities is sufficient for solving many problems (Thompson, 1978a:69). Naming specific functions is unnecessary and potentially very misleading (Dunnell, 1971a, 1978a).

One alternative approach that takes this newer point of view is the method of classification and functional analysis established by Dunnell (1971a, 1978a) and his students. It has been used successfully on material from the Northwest (Dancey, 1973; Dunnell and Campbell, 1977; Thompson, 1978a,b), West Virginia (Hewitt, 1973; Thompson, 1969) and the Southwest (Rice, 1975). This approach makes no specific inferences about what caused particular kinds of wear or how particular objects were used, but instead uses the similarities and differences among patterns of wear at a set of sites as indicators of activity differences and changes.

Using Dunnell's approach, researchers can construct functional artifact types, identify those types in their assemblages, and test the types to assure their functional character. They can then manipulate these functional types statistically to identify settlement types and to show how the settlement types change over time without resorting to analogic inferences (Thompson, 1978a:69). Because a large enough data set is not available from the Cape Dorset area, this particular study cannot carry through the entire analysis process. It can, however, introduce the basic approach, use it to test the hypothesis relevant to the three unusual Cape Dorset assemblages, and suggest how researchers might use the approach to resolve large issues in eastern Arctic prehistory.

Aside from avoiding the problems of ethnographic analogy, Dunnell's approach has some other valuable advantages. First, and perhaps most important, this approach assures that the artifact classes are functional by allowing the researcher to test them and thereby demonstrate that they measure up to this all-important requirement. Untested classes that are not entirely functional in character can lead an entire analysis astray.

Second, unlike methods dependent on ethnographic analogy, Dunnell's approach can easily incorporate simple and expedient tools, items that may bear more information about activities than formed tools. As Jelinek (1976) points out, most of the lithic materials left on a site probably represent items that were no longer wanted when the site's inhabitants left the locality. Simple tools are likely to be made, used, and left where they were used. But formed tools, requiring more time and energy to shape, are more likely to be carried from site to site or otherwise curated, complicating their analysis as indicators of site activity (L.R. Binford, 1973; Jelinek, 1976).

Third, and closely related, Dunnell's approach is oriented toward the edge or worn area, not the discrete object, as the basic unit of analysis (Knudson, 1973; Tringham *et al.*, 1974; Wilmsen, 1968). An object may be used for more than one task and as a result display several kinds of wear. If researchers direct their analysis toward the whole object, they may miss subtle but important indications of use. Resharpening may also make tools look quite different at different times during their useful life (Frison, 1968:154). Worn surfaces or edges may well be a more reliable indicator of use.

Fourth, Dunnell's approach has some practical advantages. It is a relatively straightforward technique. Once the basic classification is established, a conscientious person with only minimal skill in lithic technology can learn the procedure and then process relatively large numbers of artifacts efficiently. Many of the newer problems requiring a regional approach are likely to yield large numbers of artifacts per unit of field time. Detailed microscopic studies of use wear patterns, for example, are appropriate and necessary for solving some problems. But even if they were appropriate, they require a very skilled observer and they are too tedious and time-consuming to be practical for the large numbers of items that a researcher must process to obtain data on activity change. Methods such as this one offer a reasonable solution to these practical problems.

Finally, researchers can use Dunnell's approach with equal effectiveness on excavated data or data from surface collections (Dunnell *et al.*, 1973; Dunnell and Lewarch, 1974). In many cases, archaeologists cannot solve problems requiring regional data in a practical manner without using sampling schemes and surface survey. An analytical approach that can accommodate both excavated and surface collected data is a significant asset that should allow researchers to make better use of surface collections in the future.

Dunnell bases his approach on an archaeological unit called a *tool* defined as "the maximal set of co-occurrent functional attributes associated within the boundaries of a single object" (Dunnell, 1971a:13). (In the rest of the paper, italic type denotes this specialized use of the word "tool"). Since the method for identifying *tools* is discussed at some length elsewhere (Dancey, 1973; Dunnell, 1971a; Rice, 1975; Thompson, 1978b), I will describe it only briefly here.

Basically, the researcher examines the lithic material under study for evidence of wear and wear-related attributes. Using paradigmatic classification (Dunnell, 1971b; Spaulding, 1974), the researcher identifies and records those attributes ("modes" in Dunnell's terms) that will provide the basis for constructing functional types. Studies by other researchers who have used Dunnell's approach can be particularly helpful in suggesting useful and appropriate attributes. Microwear and replicative studies are also helpful at this point.

Next the researcher examines the distribution of these functional types across the items under study, looking for types that always occur together on the same object. When two types always co-occur, they are considered one *tool;* when they do not co-occur, each type is considered a separate *tool*. Patterns of *tool* occurrence can indicate site activities and hence site function.

As noted earlier, it is crucial to test the results from the classification to show that the units are functional. Dunnell (1971a, 1978a) indicates four tests that together can show whether the tools produced by the analysis are functional. These tests are embodied in the secondary test implications. First, the units resulting from the analysis should cluster in a few cells of the paradigm. Although this test does not mean the classes are functional, it indicates that the resulting types are not arbitrary.

Second, sites with similar percentages of *tools* should show similar patterns in breakage attributes. Obviously not all artifacts are broken and some breakage occurs from use for unusual or inappropriate activities. Thus, the relationship between wear and breakage is a statistical one. In general, however, we can expect the structural failure of a tool to result from its customary use.

Third, sites with similar percentages of *tools* should show similar patterns in other functionally related attributes, such as house types and especially faunal remains. And finally, sites with similar percentages of *tools* should occur in the same environmental setting. The availability of resources and other environmental constraints play an important part in determining where people conduct many activities.

ANALYSIS

Some students of lithic use wear use scanning electron microscopy, high power magnification, coatings, or other specialized techniques. My goal, however, was not to study lithic use wear as an end in itself, but to use wear and wear-related attributes to answer other questions. For my purposes, these more sophisticated techniques were not practical. Thus, my analysis of the Cape Dorset material began with several pragmatic decisions. Although these decisions impose biases on the results, they also help make the analysis practical and more effective.

First, because it is difficult to handle and to see wear on very small items, I excluded all material with a maximum dimension under 2 mm. Second, because using high power magnification is quite time-consuming, I relied on attributes visible to the naked eye assisted occasionally by a low-power hand lens when distinctions were difficult.

Finally, I eliminated all shaped or formed artifacts from the analysis. Three factors influenced this decision. The formed tools make up a very small percentage of the items in these three assemblages. In some cases, they are not made of vein quartz and I cannot be sure they were part of the assemblages under study. Shaped artifacts, requiring more time and energy to produce than simple artifacts, may well be curated. The presence or absence of curated artifacts is more likely to be influenced by factors unrelated to the conduct of activities than simple artifacts (Binford, 1972; Jelinek, 1976). Thus, I eliminated shaped artifacts to insure that I was looking only at items that really belonged in the assemblages under study and whose character and distribution were likely to be influenced primarily by functional considerations.

I began my analysis by examining each object carefully in good light, getting acquainted with the different kinds of wear and breakage that occurred. Vein quartz is a difficult stone to work with. Because it shatters easily from freezing, very careful observation is essential to distinguish between the patterns resulting from natural breakage and those resulting from human manufacture and use. Further, internal light refraction makes it hard to see surface patterns clearly and causes eye strain. I found this stage of analysis, which I call "tuning the eyeballs," is very important training for seeing patterns and idiosyncrasies in the material. I also found the advice of colleagues working with quartz material from other areas very helpful.

Next, I recorded basic catalog data for each piece as well as breakage (Table 3). Then I oriented each artifact, either by its platform, or by its maximum dimension if it had no platform, and worked systematically around its edges and over its surfaces recording various technological and wear-related attributes (Table 2). For the purposes of this analysis, wear does not occur on surfaces. Once I had recorded the attributes, I transferred the data to punch cards and tape files and analyzed the results on the computer, using packaged programs from SPSS (Nie *et al.*, 1975). Simple descriptive statistics helped me choose the best attributes for the classification. Cross-tabulation provided the basis for forming classes and searching for *tools*. I tabulated breakage by hand, but this task too could have easily been done on the machine.

Technology

Although this study focuses on function, technology is also important because it constrains how functional attributes may be expressed in very specific ways. From an understanding of the technology, one can also begin to separate functional and technological attributes more effectively. The Cape Dorset materials have some advantages that make this task easier; the raw material and technology are virtually identical for all three assemblages, lessening the odds that mechanical factors will confuse the analysis.

For ease in recording technological characteristics, I initially sorted each assemblage into four categories: cores, chunks, flakes and flake fragments. In addition to the functional attributes noted in Table 1 and discussed below, I used polar coordinates to record wear location with respect to the striking platform or my arbitrary starting point. I also weighed each item. For flakes alone, I recorded size, platform attributes, and other technological characteristics not discussed in this paper. Although I could have recorded more attributes, I chose to keep the analysis relatively simple, not only because I had limited time, patience, and eyeball endurance, but also because I wanted the approach to be practical for larger collections.

Perhaps the most striking aspect of the three Cape Dorset assemblages occurs in the technological realm. Attributes such as heavy radiating fracture lines, columnar fractures, proximal flake boundaries that are shattered, flakes with bulbs at both ends, and others indicate that bipolar technique (Bardon and Bouysonnie, 1906; Bonnichsen, 1977:125, 132, 135; Honea, 1965; Kobayashi, 1975; White, 1968) played an important role in the creation of these assemblages.

Bipolar technique would have been valuable for working a recalcitrant material like vein quartz. Further, it would yield exactly the kind of assemblage found, including blocky unshaped forms and items closely resembling *pièces esquillées*. Some archaeologists believe *pièces esquillées* may have been used for wedges or slotting tools associated with the groove and splinter technique for working bone, antler, ivory and wood. *Pièces esquillées* with columnar fractures may have been the functional predecessors of burins in the Old World; they seem to wane with an increase in burins (MacDonald, 1968:85). Such activities would not be out of character for a Paleoeskimo site.

Function

In recording wear-related attributes, I chose the dimensions and their respective attributes shown in Table 2. Quartz does not show the variety of wear expressions often found on other materials (Odell *et al.*, 1979:299) and my decision not to use high magnification probably also limited my choices. Reading the literature on lithic use wear, consulting others who have used Dunnell's method, and carefully observing my own material were all important steps. Even after recording was complete, I refined the final set of attributes used for the paradigmatic classification required by Dunnell's method.

TABLE 2. Dimensions and attributes used in functional analysis

Plan of edge	Edge angle[1]	Presence of retouch
(1) concave	(1) 0-40°	(0) absent
(2) convex	(2) 50-90°	(1) present
(4) point	(3) over 90°	
	(4) indeterminate	
	Type of Wear	
	(3) abrasion with crushing or rounding of edge	
	(4) abrasion with step or hinge flaking	

[1]The "damage angle" measured within 0.5 cm of the edge (See Knudson, 1979).

The basic unit for recording wear is the "wear locus" defined as a continuous segment of edge or surface displaying the same set of attributes. In practice, the wear locus is quite similar to Knudson's (1973) EU (employable unit); but in concept, it is quite different, for the wear locus has no underlying assumption of "employability." The wear locus is also similar to the polar coordinate field used by Tringham *et al.* (1974), except that the segment intersected by each locus is determined by the character of the wear itself, not an arbitrary number of degrees. One wear locus is distinguished from another by a change in one or more of the recorded attributes. In this analysis, most wear loci seemed to have easily distinguishable boundaries. A wear locus corresponds to a *tool* in the same way any artifact corresponds to the class to which it is assigned. However, in some cases, a *tool* may encompass two different kinds of wear loci that always co-occur on the same artifact.

Often one of the crucial questions at this juncture in the analysis is how to distinguish evidence of use from evidence of manufacture. Even if one has an excellent understanding of the manufacturing sequence in the technology under study (and I do not here), such distinctions can be difficult. Careful study of technological characteristics will help the researcher eliminate the most obvious, but some ambiguous cases will always remain.

Dunnell's approach, however, provides an unusual solution to the problem. If a technological attribute has adaptive significance, for the purposes of this analysis, it does not matter whether it results from use or manufacture. If it has no adaptive significance, then it is inappropriate to include anyway. Attributes that should be included will meet the requirements outlined in the secondary test implications. Other attributes will not. In other words, attributes that are not appropriate for this kind of analysis will have different organizational and distributional patterns than those that are and can be distinguished on the basis of those patterns.

RESULTS

With two qualifications, the results of the functional analysis support the hypothesis that the three unusual quartz assemblages represent similar functional activities. When one compares the frequency curve for tools from each site (Fig. 3), one can see that they are very similar. In general, the results of the secondary test implications are also positive.

In the first test, the artifacts do cluster in a few cells of the paradigm. Out of 60 possible types, only 22 occur indicating that the classification is not arbitrary.

In the second test, all three sites show similar breakage patterns (Fig. 4). The breakage results require some discussion. I recorded no breakage attributes for chunks. Chunks have no intrinsic feature, such as a striking platform, that allows the researcher to orient them consistently. Further, it is very difficult to determine what aspects of a chunk's form result from manufacture and what result from breakage. Core sample sizes are too small to yield consistent patterns so they are omitted. Here, too, it is hard to determine what results from manufacture and what results from breakage. As discussed earlier, one cannot expect breakage patterns to correlate perfectly with function (Dunnell, 1971a, 1978a). Not all tools are broken and factors other than use, for example misuse and trampling, can cause breakage. Nevertheless, for the flakes and flake fragments, where breakage is easier to determine and where sample size is sufficient, the patterns are strong and provide positive results for the test.

In the fourth test, all three sites occur in a similar environmental setting, namely at the intersection between a protected inner bay and a more exposed outer coast. Earlier research (Arundale, 1976) suggests that use of these two environments varied over time during the period of Paleoeskimo occupation on Baffin Island's south coast. A location at the intersection of these two environments could have adaptive significance. So far, all the results confirm the expected findings.

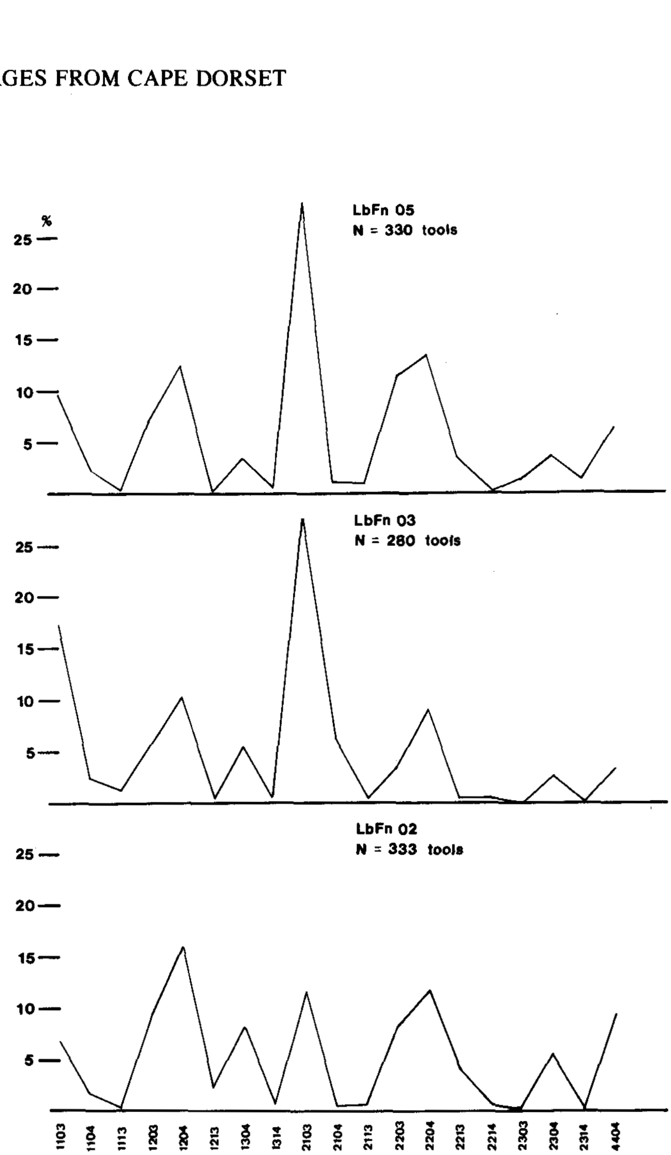

FIG. 3. Percentage frequencies of tools in each assemblage. Numbers at bottom of graph give componential definition of *tools* by attributes listed in Table 2.

TABLE 3. Breakage categories

(1) whole
(2) proximal fragment
(3) distal fragment
(4) medial fragment
(5) lateral fragment
(6) other
(7) indeterminate

Despite these positive findings, the study lacks two important sets of data. The first set would allow me to test the third secondary test implication which says that all three sites should show similar patterns in other functionally related

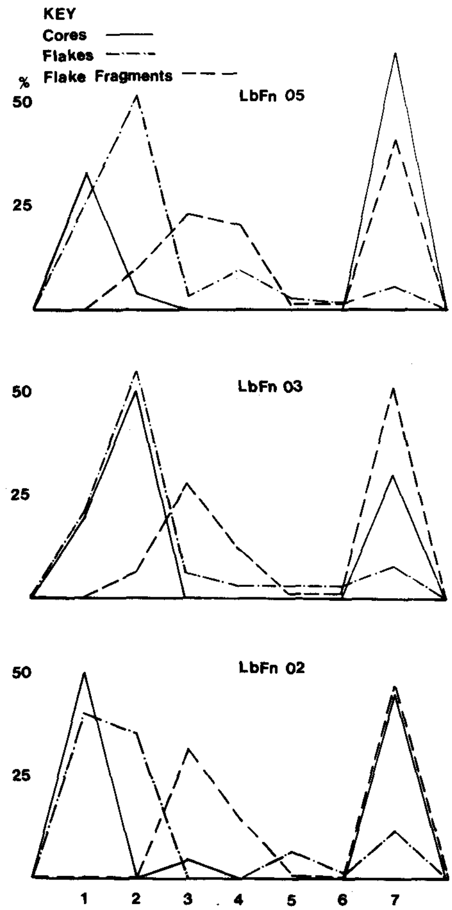

FIG. 4. Percentage frequencies of breakage categories in each assemblage. Numbers at bottom of graph list breakage categories given in Table 3.

attributes such as house types or faunal remains. None of the three sites has yet produced faunal remains nor houses clearly associated with the assemblages under study. The inability to complete this test occurs in other studies using Dunnell's approach (Thompson, 1978a, b). Since these data, particularly faunal remains, are not consistently available from sites in many areas, including the eastern Arctic, this problem may be a disadvantage of Dunnell's approach. However, as long as the researcher is aware of the problem and can complete the other tests successfully, the results of these other studies suggest that this problem does not have a detrimental effect on the results.

The second set of data, however, leaves a more significant gap. In most functional analyses, the researcher had data from several sites in different environmental settings, so that contrasting patterns in both tools and breakage patterns emerge. These contrasting patterns help assure that the functional analysis is sufficiently fine-grained to distinguish significant differences in site

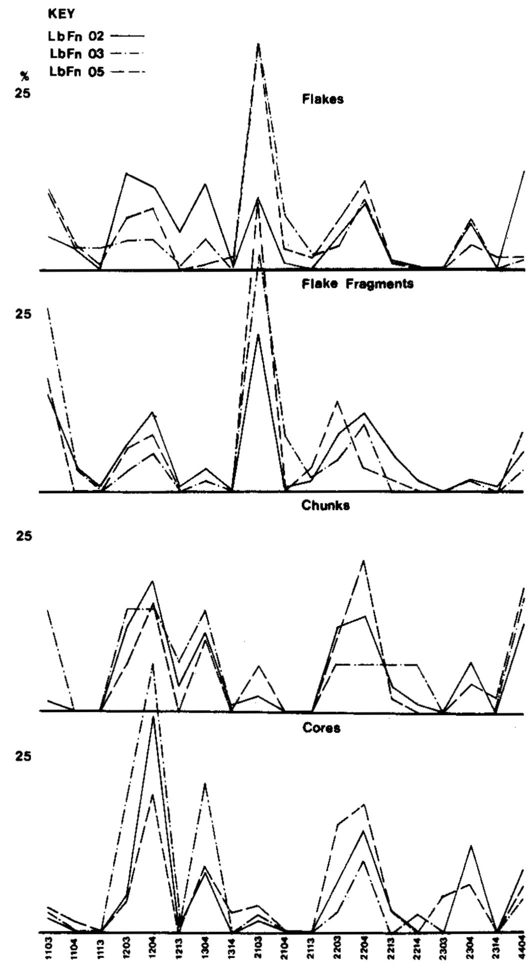

FIG. 5. Percentage frequencies of tools in each assemblage broken down by item. Numbers at bottom of graph give componential definition of *tools* by attributes listed in Table 2.

activities. Because my survey was relatively brief, all the other Cape Dorset assemblages that might provide such contrasting patterns are too small to yield useful results. This analysis uses attributes that have proven successful for this approach in other geographical areas. But since no one has yet performed this type of analysis on a Paleoeskimo assemblage, data providing a contrasting pattern would be particularly valuable.

In addition to the necessary tests, the results suggest some fairly obvious conclusions in terms of use. If we split the totals by item, they indicate that flakes and flake fragments play similar functional roles while cores and chunks play similar functional roles (Fig. 5). This result fits our expectations since flake and flake fragments have more lower edge angles and related features while cores and chunks have more higher edge angles and a slightly different set of related features. It supports Wilmsen's (1968) idea that edge angle is a major determinant of use and it suggests that features like the presence or absence of a striking platform have little to do with how people used artifacts in the activities carried on at these three sites.

CONCLUSIONS AND COMMENTS

In summary, although the results are not conclusive, they strongly suggest that these three Cape Dorset assemblages represent the same functional unit, a consistent set of activities. The supplementary technological studies also suggest that these assemblages were made with a common set of manufacturing processes that relied heavily on bipolar technique. Finally, these results demonstrate a method of functional analysis free from the problems of ethnographic analogy. This method, which has proven so valuable in other areas, could help solve some of the eastern Arctic's most important problems.

Implications

In assessing these results, it is valuable to keep two factors in mind. First, the approach to functional analysis discussed here is usually part of a larger, more extensive process. Before functional analysis can take place, the researcher must carefully plan his or her research, design an appropriate sampling scheme, and carry out the field work in a competent manner. The resulting data must adequately sample a diversity of environmental settings. In the eastern Arctic, diversity may mean sampling both coastal and interior locations; it may also mean considering one physical location as two different environmental settings, one setting in summer and a different one in winter. After the functional analysis is complete, the researcher may need additional analytical steps involving multivariate statistical techniques (Redman, 1978).

Second, although I used Dunnell's approach in this study to solve a rather small-scale problem, it has significant potential for helping to solve much larger problems, including some of the most persistent in eastern arctic prehistory. For example, the relationship between Pre-Dorset and Dorset has attracted much interest over the years. Depending in part on their theoretical orientation and where they have worked, different researchers see this relationship as a smooth transition within a closed cultural system (Maxwell, 1976a) or as a discontinuity affected by outside contact and diffusion (McGhee and Tuck, 1976; Tuck, 1976).

Working on the south coast of Baffin Island, Maxwell (1973, 1976a, b) has suggested that Pre-Dorset and Dorset form a continuum in that area with no significant stylistic or technological change beyond a gradual "drift." Maxwell and others view the transition from Pre-Dorset to Dorset as essentially an economic one, probably caused by marked climatic cooling and its effect on critical fauna and on people's ability to hunt. One suggested change is an increased dependence on sea ice hunting. If Maxwell's hypothesis is correct, we would expect much of the evidence for this change to come from functional data indicating subsistence settlement system change.

Jochim's (1976) work suggests that evidence for changes in site location, demographic arrangement and resource use schedules are key indicators of subsistence settlement model. Since faunal evidence for resource use schedule change is frequently not available for eastern arctic sites, archaeologists will need less direct evidence for resource use changes. Changes in patterns of functional *tools* could be a major asset in showing that subsistence settlement change has occurred. Understanding the Pre-Dorset to Dorset transition is only one of several important problems in eastern arctic prehistory that involve hypotheses relating cultural change to environmental change. Since Dunnell's approach can be very useful in testing these hypotheses, it should have broad applicability to eastern arctic problems.

New Questions

In addition to presenting an approach that can help solve some of the eastern Arctic's long-standing problems, this research raises many new questions. Perhaps the most interesting questions concern the use of bipolar technique. How widespread is its use in the North? It occurs in several northern North American assemblages, including MacDonald's (1968) material from the Debert site, Wright's (1972) material from the Aberdeen site, and Morlan's (1973) material from the Klo-Kut site. Meldgaard (MacDonald, 1968:85) has also noted a bipolar pebble core industry in Greenland. Bipolar technique would be valuable for working not only recalcitrant material like the vein quartz at Cape Dorset, but also the small pebble raw material postulated, for example, for the Lake Harbour area (Maxwell, 1973). Were there certain parts of the typical Paleoeskimo artifact assemblage that were made with bipolar technique? Could items with columnar fractures resulting from bipolar technique have served as functional substitutes for burins at some point during the Paleoeskimo prehistory of the Cape Dorset region or other areas? Did bipolar technique offer any adaptive advantages to those who used it?

How widespread in Paleoeskimo cultures are assemblages of simple, expedient tools such as those found at Cape Dorset? Are they strictly a local phenomenon or do they occur in areas that researchers have not examined? Is it possible that other researchers attuned to finding formed tools have overlooked them? Or have the biases built into past research simply prevented researchers from looking in the right places? Do similar kinds of activities sets occur in other areas, but fashioned from different materials? Now that we have some idea what these assemblages look like, we need to compare them with other collections that include sizeable numbers of simple tools. Are there important differences in the quality of material, for example, that we cannot see from this small set of assemblages? Is there significant internal variation in these assemblages that we cannot see until we view them against one or more contrasting patterns?

Ultimately, of course, we would like to know more about the role these assemblages played in local adaptation. Did having this unusual lithic resource confer any advantages on their user? Do these assemblages represent an industry used for only a short period of time and then neglected? Or do they represent long-term, but small-scale exploitation of a valuable lithic resource?

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