The Denbigh Flint Complex in Northwest Alaska: A Spatial Analysis

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Abstract: The uniformity of Denbigh Flint assemblages across different ecological zones in northwestern Alaska suggests that the typologies we have constructed for the analysis of lithic remains are insufficiently sensitive to reveal behavioral differences between sites. By integrating typological, materials, and spatial data, however, we are able to detect some differences that relate to ecology, seasonality and external relationships. I focus here on a spatial analysis of multiple Denbigh components from two site areas: Cape Krusenstern and Onion Portage. I employ two different analytical strategies to identify possible toolkits: a factor analysis of artifact clusters within a fixed distance from hearths and within house floors, and a more flexible cluster analysis based on the nature of artifact clusters in a variety of contexts. The factor analysis reveals five types of meaningful clusters, each with assemblages related to different sets of activities. The second, more ad hoc clustering method is based on five spatial variables: house floors; hearths; near hearths; artifact concentrations unassociated with formal features; and areas of randomly dispersed artifacts, and is especially effective in revealing differences in seasonality. This approach reveals sets of activities during snow-free seasons, some specifically late spring/early summer or fall, versus activity sets that occurred in winter. From a more regional perspective, Denbigh implements are seen to have been brought to the sites in finished or near finished form, indicating that the earlier stages in tool manufacture occurred elsewhere. The apparent importation of Denbigh tools in finished form adds fuel to William Irving's argument that the finest of the Denbigh artifacts were produced by itinerant flintknapping specialists. The lithic analysis also informs us about the nature of external contacts, especially between the coast, and the Kobuk, Noatak and Koyukuk rivers. Finally, I demonstrate that these different analytic methods for studying prehistoric activities have their own strengths and weaknesses, and without good spatial data even the best of the methods has major limitations. This is a call to increased attention in our excavations to recording precise provenience of all lithic materials — flakes as well as formal artifacts, a formidable task, but one with rewarding results.

Keywords: Alaska archaeology, Lithic Analysis, Inter-regional contact

The Denbigh Flint Complex, first discovered at Iyatayet in Norton Sound (Giddings 1949, 1964, 1967), is widely distributed throughout northwestern Alaska. Additionally, early cultural remains from southwestern Alaska (Dumond 1981, 1998), northern Canada (Maxwell 1985), and Greenland (Knuth 1967) are so similar to the complex that the same cultural designation, Arctic Small Tool Tradition (Irving 1957, 1962, 1969-1970), has been applied to all.

One of the remarkable features of the Denbigh Flint Complex (hereafter referred to as Denbigh or DFC) is the typological uniformity from Norton Sound northward of both the artifact forms and the makeup of the assemblages belonging to the complex, a uniformity that appears to transcend the differences in the varied ecological settings in which the complex has been found. Of the twenty-six major categories comprising the majority of Denbigh artifacts, most are represented in all sites in similar percentages. For example, the rank order of microblades, burins, burin spalls, weapon-point insets, endscrapers, flake-knives, and microblade cores are similar at the forest-edge site of Onion Portage, the lake-tundra site of Punyik Point, the Chukchi Sea coastal sites of Cape Krusenstern, and the Norton Sound coastal site of Iyatayet (Fig. 1).

Since microhabitat differences ought to have a considerable impact on the makeup of artifactual assemblages, the artifact categories we have created for Denbigh may mask clues about important behavioral differences that other variables can reveal. The following is an attempt to search for these finer distinctions in activities by adding the variable of artifact spatial distributions as it relates to archaeological features.

TYPE/RANK/%	OP	PP	CK	IY	OP%	PP%	CK%	IY%
MICROBLADE	1	1	1	1	36.3%	43.4%	24.2%	38.1%
BURIN SPALL	2	2	3	3	25.5%	14.4%	17.0%	16.9%
WEAPON INSET	3	3	4	2	7.3%	13.8%	11.3%	17.1%
BURIN	5	4	2	4	5.0%	9.9%	17.3%	14.9%
ENDSCRAPER	4	5	6	6	5.1%	2.5%	2.0%	1.9%
FLAKE-KNIFE	6	6	5	5	1.5%	2.3%	9.1%	8.1%
MBCORE	7	7	7	7	0.3%	0.6%	0.7%	0.9%
% OF TOTAL ASSEMBLAGE					81.1%	86.8%	80.5%	97.8%
NUMBER, TOTAL ASSEMBLAGE					2786	355	405	996

Figure 1. Ranking by relative quantity of the 7 most abundant artifact categories at the Denbigh Sites of Onion Portage (OP), Punyik Point (PP), Cape Krusenstern (CK), and Iyatayet (IY).

ORIGINS

Denbigh is one of the most easily recognized archaeological complexes in Alaska. It appears to have arrived in Alaska suddenly during the mid third millennium BC, notwithstanding some unconvincing suggestions of much older precursors in Alaska, yet Denbigh origins are still unknown. One can surmise that the complex was derived from the eastern Siberian interior, where many of the attributes were present 2000 to 3000 years earlier (Dikov 2003; Mochanov 1969; Slobodin 1999), but if so, we should have expected to find traces of its direct predecessors and compatriots in the part of Asia closest to Alaska. Thus far, none have been documented.

The primary subsistence base of Denbigh peoples was year-round caribou hunting, with at least some groups engaged in late spring or summer seal hunting and, apparently, fishing. Their geographical distribution in North Alaska largely coincides with that of modern Inupiat, and includes open tundra areas, lakeshores, wooded riverine areas, and the coasts of the Norton and Chukchi seas (Anderson 1988; Bockstoce 1979; Giddings 1949; Giddings and Anderson 1986; Harritt 1994; Irving 1964; Odess 2003; Stanford 1976). On the other hand, their seasonal rounds differed from most modern Eskimos inasmuch as none of the Denbigh groups wintered on the coast.

As exemplified by the river edge site of Onion Portage on the Kobuk River and at the lake edge site of Punyik Point overlooking Itivlik Lake on the North Slope, Denbigh peoples wintered both in the wooded interior, where their small river-edge settlements consisted of one or two semi-subterranean hemispherical houses three to four meters in diameter (Fig. 2), and in lake-edge tundra areas, presumably also in semi-subterranean houses, though of an undetermined form.

At other seasons Denbigh people, occupying both interior and coastal locations, camped around small, stone-lined hearths, many of which were likely enclosed by tents, and at least at Punyik Point they returned to the same location with sufficient frequency to have built up caribou bone-rich middens that also contained concentrations of artifacts and the remains of summer or fall campfires.

This much about Denbigh lifeways has been established by numerous previous studies. But generally missing in these studies are finer-scale observations on Denbigh activities. The following revisits the issue in an attempt to utilize newer analytical techniques to tease out additional information about Denbigh lifeways.

Considerable attention has already been paid to defining DFC typologically. In particular, Giddings' 1964 monograph on the type site of Iyatayet and William Irving's unpublished Ph.D. dissertation on Punyik Point (1964) outline numerous categories and sub-categories of artifact forms that are sufficiently detailed to give us a clear general picture of the complex. Nevertheless, their aims were to present a composite picture of the complex as a single archaeological unit, internally differentiated by artifact types, but with little consideration of context or, understandably given the nature of the sites, to finer chronological distinctions. Subsequent descriptions of the assemblages from Cape Krusenstern and Onion Portage have added to and somewhat clarified the typological characterization of Denbigh, but do not fully realize the potential for understanding the nature of Denbigh lifeways. This is where spatial studies become key.

SPATIAL ANALYSIS OF DENBIGH REMAINS

The identification of human activities represented by the spatial distribution of archaeological remains became a focus of general archaeological interest in the 1970s and 1980s, although after a period of considerable

Figure 2. Photograph of a circular Denbigh house floor (House 5) at Onion Portage.

enthusiasm began to wane in the 1990s (Clarke 1977; Kroll and Price 1991). More recently, activity studies have been largely confined to sites with good preservation, where the wide range of organic as well as lithic remains allows for more robust conclusions.

But where does this leave sites with poor preservation like that characteristic of Denbigh sites? The numerous methodological studies accumulated in the 1980s, especially from Europe and the North America mid continent, were primarily cautionary, pointing out the confounding actions governing discard, geological and biological disturbances, and so on. But the few suggestions for how to correct for these analytical shortcomings have struck me as rather arbitrary and too site-specific to be much help in the analysis of the kinds of archaeological remains we normally encounter in the north.

On the other hand, northern researchers of lithic sites have shown signs of regrouping, a result of advances in field technologies that promote rapid and precise recording of archaeological materials and in the use of statistical techniques for spatial analysis (Lutz and Anderson 1993; Reanier 1992). These advances are especially welcome in arctic archaeology where scatters of lithics continue to be a major—and often only—source of cultural data available.

The following is a result of my reworking data on Denbigh material from Onion Portage and Cape Krusenstern, along with some comparisons to Iyatayet and Punyik Point. The Onion Portage and Cape Krusenstern assemblages have been analyzed by the same researcher, and so have the greatest degree of typological consistency necessary to reveal subtle but potentially meaningful differences within and between the assemblages.

CAPE KRUSENSTERN

Spatial analysis of the Cape Krusenstern Denbigh materials is based on groups of artifacts associated with forty-six hearths, half of which were stone-lined, the rest unlined, which were located on the inwardmost beach

ridges of the site area as detailed in Giddings and Anderson (1986). Although we noted the associations of all objects with particular features, we did not record finer spatial detail. Our entire corpus of data on Cape Krusenstern Denbigh therefore comes from artifacts associated with hearth areas, where a total of 405 objects were concentrated in tight clusters within one meter of the center of hearths (Fig. 3). We have no information as to the particular arrangements of the objects around the hearths. The largest number of artifacts per hearth is thirty-two, but other hearths have as few as one or two associated artifacts (average less than nine). Since the artifact clusters are too small to allow us to derive meaningful results statistically, we are limited to making general observations based primarily on the presence or absence of artifact types and on the ecology of the region.

Perhaps the most revealing artifact type found in the Denbigh sites at Cape Krusenstern is the harpoon endblade inset, five examples of which are tabulated together with other weapon insets in Figure 3. Clearly, these endblades are related to seal hunting, a conclusion that is reinforced by the fact that the type is only found in Denbigh coastal sites. On the other hand, the majority of weapon-head insets around the hearths were for arrowheads, which suggests that the hunters were also after caribou, the only large land animal that would have frequented the cape at the time.

Considering only the location of the features on the beach ridges, we come up with several possibilities about their nature and season of occupation. First, these features could be the remains of campsites of late spring or early summer seal hunters, although other possible activities in that season include bird hunting and caribou hunting. If occupied in late summer or fall, caribou hunting, berry picking, bird hunting, or fishing (but not sealing) would have been possible. However, it is very unlikely that the Denbigh people would have found sufficient resources to prompt camping at Cape Krusenstern in the dead of winter (Uhl and Uhl 1977). Combining the locational and artifactual data, we thus conclude that the Denbigh campsite locations at Cape Krusenstern were selected primarily for seal hunting, but also served as base camps for caribou hunting.

The presence of other artifact categories associated with the Cape Krusenstern Denbigh hearths, however, provides a more complex picture. Although unutilized flakes are rare in the assemblages, which appears consistent with an interpretation that the features represent brief hunting camps, other artifacts such as burins and flake-knives are also present in numbers that suggest campsites of sufficient duration to accommodate the manufacture and repair of implements. Further, endscrapers are relatively common, and if associated with hideworking, suggest activities that are usually, at least in ethnographic times, carried out by women. In other words, a close inspection of the range of artifact types implies campsites of longer duration, around which more activities took place, carried out by more people than simply short-term camps of seal and caribou hunters.

ONION PORTAGE

By far, the more detailed analysis of Denbigh materials comes from Onion Portage, Kobuk River, where particular attention was paid to microstratigraphic and spatial contexts. At Onion Portage, 2787 artifacts and 161 features were located in eight stratigraphic levels of Denbigh occupation (Fig. 4).

Of the features, seven were house floors, 134 were hearth areas, and, of those unassociated with houses or hearths, six were stone concentrations, seven were bone concentrations, three were antler concentrations, and four were miscellaneous areas. We troweled and screened through a fine mesh all of the excavated deposits of the site, so I am confident that we recovered most, if not all of the artifactual materials present. In addition, we collected all concentrations of tiny chips *in situ* and bagged them within their soil matrix for shipping and later sorting in the laboratory.

Onion Portage Denbigh appears to have undergone a degree of cultural change that I originally categorized as Proto, Classic, and Late. All but the lowermost and the two uppermost Denbigh levels at Onion Portage were assigned to the Classic Denbigh phase. Classic Denbigh comprised assemblages of artifacts that were nearly identical to those from other Denbigh sites in Alaska: the same artifact types; presence of the "Arctic Small Tool" type of flaking (Irving 1964); and presence of a few ground burins and burin spalls. The uppermost levels were designated Late Denbigh. Assemblages from these levels included some artifact attributes that differed from the Classic Denbigh levels, such as the use of the burin blow to modify bifaces and the complete absence of the "Arctic Small Tool" type of flaking—attributes that appeared to anticipate Choris (Anderson 1968). The lowest level, Band 5, Level 1, was labeled Proto-Denbigh. This level also contained assemblages of artifacts with attributes that differed from Classic Denbigh: an absence of "Arctic Small Tool" type flaking; an absence of ground burins and burin spalls; and the presence of atypical Classic Denbigh types such as stemmed endscrapers and large semi-lunar bifaces. Another difference between the Proto- and Classic Denbigh was the sub-rectangular house

Feature	430	431	432	434	436	437	438	439	441	442	488	757	760	761	762	750	751	763	451
microblade	2	1	14						2	1			3	2	11		7		6
burin			3	1	4	1			2	6	1	1	3	2	3		3	1	6
burin spall			4			8	1	6				1		2	1		2		10
weapon inset	1		2					1	1				3	1	1	1	5	1	5
flake-knife			3	1			1				1	1	2	2	1				1
utilized flake							1	1	1		1		1	1	1		1		1
knife biface		1	3								1		1						
endscraper																			2
miscellaneous		1													1				
drill/graver				1									1				1		
mb core			1						1										1
adz blade				1															
Number	3	3	30	4	4	9	3	8	7	7	4	3	14	10	19	1	19	2	32

Feature	453	454	456	619	752	755	768	487	346	428	470	471	472	473	474	475	476	477	479
microblade	5	3	4	2		4		6			1	3	2	1	2	5		2	
burin	1		2	3				1	2		3	2	1	1		4		8	
burin spall	5	1	2	6				1	1	1	6	1		1	1	3		2	
weapon inset	3		3	3			1		2		3	1	1			3			
flake-knife	2		2	1	1			1	1	2	1	1	1			1		2	
utilized flake										5		1	1	1		1		2	1
knife biface											2	2	2	1	1	1	1	1	1
endscraper	1		1													1	1		
miscellaneous	1															1		1	
drill/graver									1		1					1			
mb core																			
adz blade																			
Number	18	4	14	15	1	4	1	9	7	8	17	11	8	5	4	21	2	18	2

Feature	480	482	483	485	753	754	756	1001	Total	%
microblade		1	2				1	5	98	24.2%
burin			1	1	1			2	70	17.3%
burin spall	1		1					1	69	17.0%
weapon inset	1	1	3		1	1	1	1	51	12.6%
flake-knife	4		3		1				37	9.1%
utilized flake	1		6		2	2		1	33	8.1%
knife biface	1					1			20	4.9%
endscraper	1				1				8	2.0%
miscellaneous	1		1			1			8	2.0%
drill/graver						1			7	1.7%
mb core									3	0.7%
adz blade									1	0.2%
Number	10	2	17	1	6	6	2	10	405	100.0%

Figure 3. Count and percentage of artifacts for Cape Krusenstern Denbigh features.

form with a "mid-passage" sectioning of the floor in the former and a circular house form lacking the mid-passage section in the latter (Figs. 5 and 6).

The radiocarbon dates for the Classic Denbigh layers at Onion Portage span the period between 4000 and 3600 years ago; the one date for Late Denbigh is about 3550 years ago (uncalibrated). The radiocarbon dates for the Proto-Denbigh layer are somewhat inconsistent with its stratigraphic position, although by doubling the standard error of all the Band 4 and 5 dates to achieve a 95% confidence level, the series of dates can be fit into a sequence consistent with site stratigraphy. By interpolating between the Band 5, Level 2 dates and the Band 4 dates, the age of Proto-Denbigh is estimated to be about 4100 BP, a date which seems somewhat too recent when com-

Onion Portage Denbigh Levels	Denbigh Phases	Houses	Hearths	Other
Band 3/4 and Band 4, level 0	Late Denbigh	0	21	2
Band 4, level 0, 1, or 2	Late or Classic Denbigh	0	5	3
Band 4, levels 1-4 and Band 4/5	Classic Denbigh	6	92	14
Band 5, level 1	Proto-Denbigh	1	16	1

Figure 4. Classification of Denbigh Flint complex phases at Onion Portage and number of features per phase.

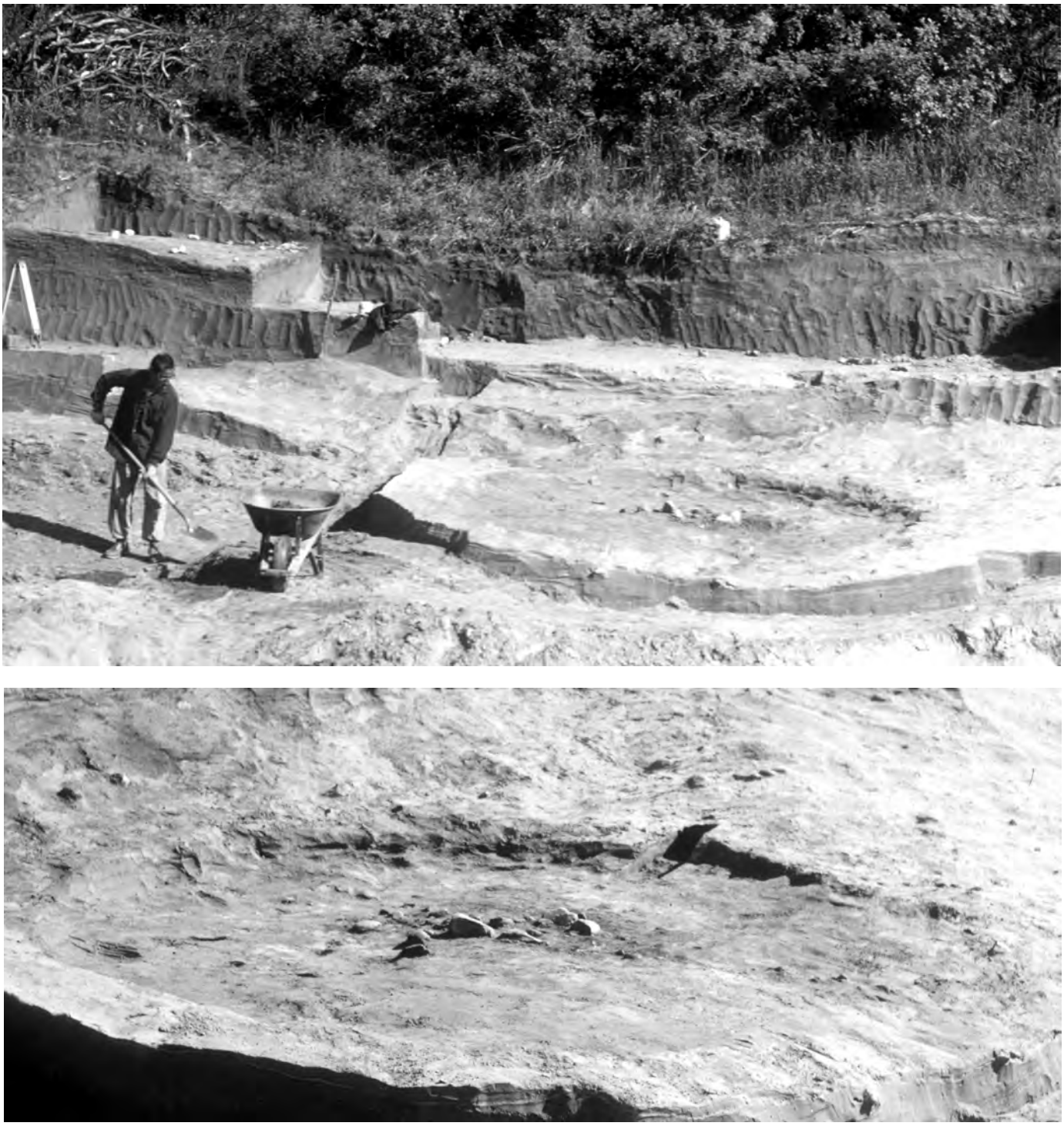


Figure 5. Photographs of Denbigh House 1 at Onion Portage. (Close-up below.)

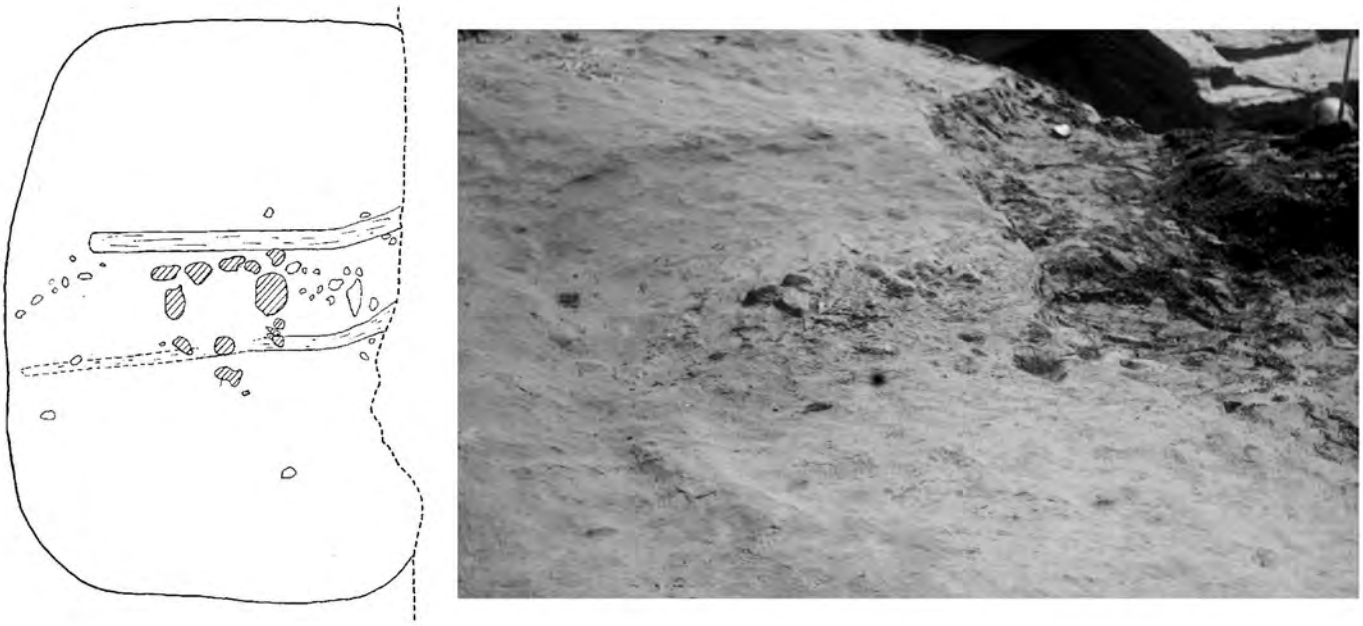


Figure 6. Floor plan and photograph of Proto Denbigh house 1, Onion Portage (Note: front of house had slumped away between excavation seasons).

pared to some ASTt dates from elsewhere in the North American Arctic (Maxwell 1985; Schledermann 1990). It should also be noted that the series of Denbigh dates from Onion Portage is, on the whole, more recent by a couple of centuries than dates from the type site at Iyatayet (Giddings 1964). Also, subsequent finds of Denbigh sites from northwestern Alaska that date Classic Denbigh-like assemblages earlier than our Proto-Denbigh age, prompt a re-examination of this original classification (Harritt 1993), but the issue will likely not be settled without further excavation.

Of the seven Denbigh house ruins at Onion Portage, six were located in the classic Denbigh levels, and one from Proto-Denbigh (Figs 7 and 8). I suspect that Denbigh peoples had constructed two additional houses at the site, but we did not recognize this in our original excavations.

By far most features in the Denbigh levels were stone-lined hearths around which lay a scattering of flakes and artifacts. Nearly all of the Denbigh hearths were circular, lined with waterworn cobbles between fist-size and about fifteen centimeters in diameter (Fig. 9).

Most of the hearth rocks were quartzite, a type of stone that does not easily spall or explode when heated. In some cases the interiors of the hearths were paved with smaller stones. Small spruce branches or willow shoots comprised the primary material burned in the Denbigh hearths. Also associated with hearths were fragments of antler or bone, concentrations of tiny chert and obsidian chips and, infrequently, stains of red ochre. The chip concentrations are clearly byproducts of tool finishing or sharpening.

All but two of the 2,787 Denbigh artifacts recovered from Onion Portage are of stone, over half of which are of gray chert (47.4%) or obsidian (23.0%). The remaining artifacts are of silicified slate (2.8%), micaceous siltstone (1.4%), sandstone (0.5%), fine-grained basalt (1.7%), and a variety of other kinds of chert. Almost none of the stone used for artifact manufacture was derived locally; the only exceptions are waterworn quartzite cobbles, used as boiling stones, and large river cobbles, used as anvil stones or hammerstones.

For the spatial analysis of Onion Portage Denbigh I have employed two different analytical strategies in order to identify possible toolkits, based on their associations in such contexts as houses and hearths. The first is a study of artifact clusters defined by their association within the confines of house floors and around hearths using a factor analysis and described in detail in Anderson (1988). Objects are spatially related to particular hearths on the basis of their provenience within a one meter radius of the center of the hearths. Artifacts that do not meet the one meter distance criterion of hearth association were excluded from the analysis.

The second strategy is a more flexible, *ad hoc* approach based on a visual inspection of the artifact provenience afforded by GIS plots of artifacts on the site's surfaces. I analyzed the locations of the objects with respect to how they cluster together in a variety of contexts, but without the rigid one meter distance-from-feature criterion. Although most of the objects do cluster and are more or less associated with features, others are not. I selected this strategy as a test against the factor analysis to see if meaningful results could be derived from

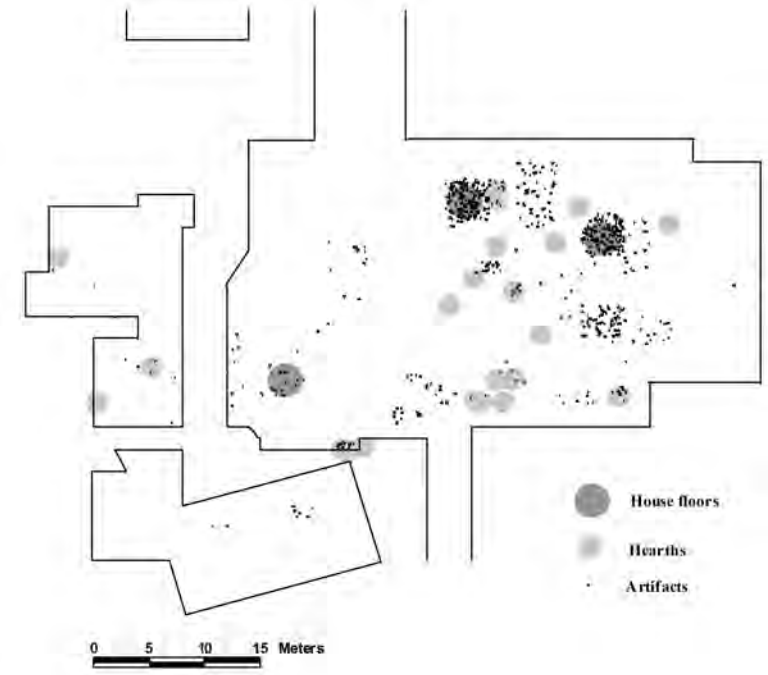


Figure 7. Site plan of Band 4, Level 1, showing the location and layout of Denbigh hearths and three of the Denbigh houses, and associated artifacts.

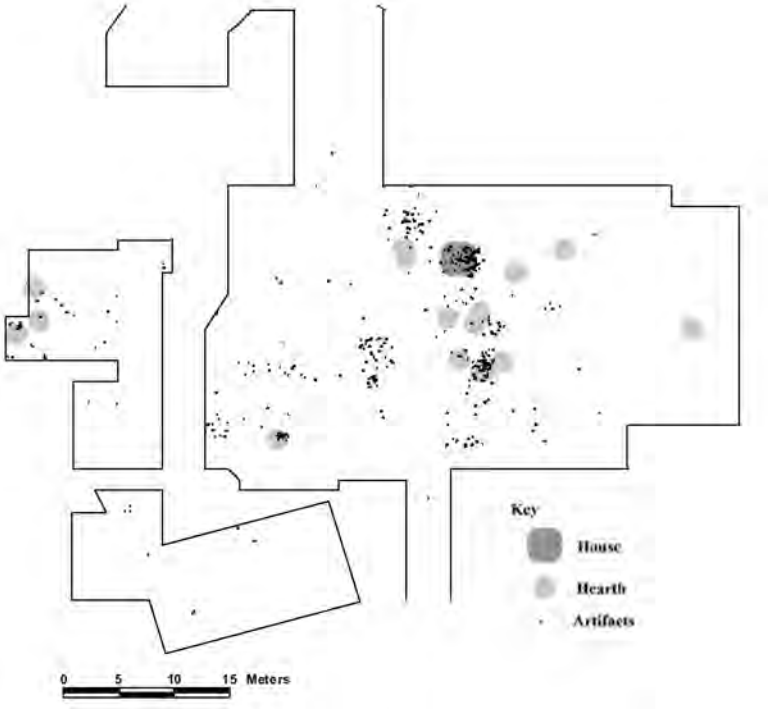


Figure 8. Site plan of Band 5, Level 1, showing the location and layout of Proto-Denbigh hearths, house, and associated artifacts.

an analysis of visually derived data. A further test, not attempted here, would be to compare some additional spatial analytical methods such as Richard Reanier's (1992) refinements to K-means clustering, by which he analyzed the spatial patterning of the Ipiutak Period Bateman Site at Itkillik Lake, arctic Alaska (1992).

TOOLKITS BASED ON A FACTOR ANALYSIS

To confirm the initial observations that most Denbigh artifacts are associated with features, I first counted the artifacts and flakes by type that lay respectively within 1m, 1.5m, 2m, 2.5m, and 3m of the center of each feature. Through this procedure we determined that most of the artifacts lay within one meter of the center of the features. The count drops off sharply beyond that distance, an observation that forms the basis for selecting one meter as distance from the center of hearths within which to group the artifacts associated with that feature. I treat house floors differently from the other features, inasmuch as I assign all cultural materials contained within the border of each floor to the assemblage of that house, irrespective of their distance from the center of the floor.

The factor analysis performed on the Onion Portage data was the Cluster Centroid Factor Analysis method developed by R.C. Tryon, as modified by James M. Sakoda of Brown University (Anderson 1988). I selected this method because it is a simple, yet elegant approach to the problem of selecting the number of factors used for the final solution. The method involves the identification of key variables that are as different from each other as possible. Membership in the clusters is determined by its correlation coefficient; for the clusters in this analysis a lower limit of belongingness of .60 is selected. In addition, a cluster must have a membership of at least three variables, i.e., features, in order to be considered a meaningful factor. The meaningful factors are labeled numerically, starting with factor 1.

On the basis of 1,370 artifacts from sixty-one features and feature-groups that fall within a one meter radius of hearths or are enclosed within the limits of the house floors, the Denbigh materials group themselves around five significant clusters that form the basis of our discussion of toolkits (Fig. 10).

The first factor, which clusters 782 artifacts from seventeen hearths and five of the houses, is characterized by a wide variety of artifact types. In fact, thirty-six

Figure 9. Photograph of a typical stone-lined Denbigh hearth from Onion Portage.

of the forty artifact types included in the factor analysis are present, as compared to twenty-five in cluster 2, twenty in cluster 3, ten in cluster 4, and fourteen in cluster 5. Cluster 1 has a high percentage of microblades (44.4%), and, compared to the other clusters, a relatively high percentage (3.2%) have been used or retouched. Likewise, burin spall artifacts are well represented (10.0%), and although the cluster contains low percentages of straight and convex edged side scrapers (1.8%), these are better represented here than in any of the other clusters. Interestingly, the only adz blades from Onion Portage Denbigh belong to this cluster, even though none were found in the house assemblages. In all, the high percentages of utilized microblades and burin spall artifacts are as one would expect where people were intensively engaged in tool use and fine detail work on materials, such as engraving slots for insets. Also, the number of artifact types indicates a wide range of activities, as would be expected in assemblages from houses where people lived for an extended period of time.

On the other hand, some artifact types that one might expect to be part of the activities in winter houses are surprisingly rare in the house middens, for example burins (3.2%) and unused burin spalls (9.6%). Assuming that at least some burins were used for grooving antler, the rarity of burins in the houses may reflect the fact that the initial stages of antler working were carried out outside the houses, perhaps at the time caribou from the late summer and fall hunt were brought into camp.

The second cluster contains only hearths. Numbering ten hearth areas with 130 artifacts, it contains high percentages of chipped burins (7.7%) and burin spalls (42.3%), but a low percentage of microblades (8.5%). Of the burin spalls and microblades present, very few show signs of use. That these may represent fall camps where initial stages of antlerworking by burins is supported by the presence of a high percentage of weapon parts: endblade insets (6.9%); lance points (2.3%); sideblade insets (2.3%); and end- or sideblade insets (1.5%), respectively. Numerous utilized flakes, likely used in woodworking as would be necessary for manufacturing arrow and spear shafts are also present, although not so frequent as in two of the other clusters. Although the burins and weapon points make sense for fall camps, the abundance of unused burin spalls is more difficult to explain. Since they lack traces of wear, these burin spalls cannot be simply the result of resharpening antler-working burins.

Artifact Type (N=1370)	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Adz blade	0.3%				
Flake with burin blow		0.8%			
Biface fragment	1.3%	0.8%	1.0%	4.3%	
Biface, other	0.1%				
Burin, chipped	2.4%	7.7%	6.2%		1.9%
Burin, polished	0.8%		1.5%		1.9%
Burin spall, chipped	9.0%	42.3%	29.9%	6.4%	21.0%
Burin spall, polished	0.6%	0.8%	1.0%		
Burin spall artifact	10.0%	2.3%	27.3%		4.8%
Core	0.4%				
Hand drill			0.5%		
End blade inset	1.3%	6.9%	2.6%	2.1%	1.9%
Elongate knife side blade	0.6%	2.3%			
Endscraper	2.0%	1.5%	0.5%	4.3%	11.4%
End or side blade inset	1.3%	1.5%	1.5%		
Flake	0.8%	0.8%		10.6%	
Flake-knife	1.4%	2.3%	1.0%	2.1%	1.9%
Graver	0.3%				
Ground slate	0.3%		0.5%		
Grooved stone		0.8%			
Hammerstone	0.3%				
Knife end blade	0.1%	0.8%			
Lance point	0.5%	2.3%	1.0%		
Microblade	44.8%	8.5%	9.8%	2.1%	22.9%
Microblade core	0.6%				
Microblade flake-knife	0.1%				
Microblade graver	0.3%				
Microblade, utilized	3.2%	0.8%	1.5%		2.9%
Notched sinker	0.1%	0.8%			
Other	1.2%				1.0%
Other chipped stone	3.5%	0.8%	3.1%	48.9%	12.4%
Other ground stone	0.1%				
Sideblade inset	2.8%	2.3%	3.1%		4.8%
Sidescraper, compound	0.1%	1.5%			
Sidescraper, convex	0.9%	0.8%			
Sidescraper, straight	0.9%		0.5%		
Sidescraper, concave	0.1%	0.8%			
Slab knife					
Utilized flake	7.4%	9.2%	6.7%	2.1%	10.5%
Whetstone	0.3%	0.8%	0.5%	17.0%	1.0%

Figure 10. Factors associating artifacts with hearths and houses of Onion Portage Denbigh.

A third cluster, containing 194 artifacts from eight hearths, has an unusually high percentage of burin spalls and burin-spall artifacts. As the frequencies of the other artifact categories are neither especially high nor low, the activities associated with these hearths are difficult to interpret. The sizable representation of both unused and used burin spalls suggests that whatever manufacturing activities were being carried out, they included some fine detail work.

Cluster 4 contains only forty-seven artifacts from three hearths, so it is difficult to place much confidence in any interpretation. Burins and burin spalls are underrepresented, whereas flakes, "other" chipped stone objects and utilized flakes are well represented. The activity most readily suggested by this assemblage is stoneworking, but inasmuch as the cluster does not contain primary flakes or even a particularly high number of secondary or tertiary flakes, the activity was likely not flintknapping. An additional aspect of note is that few artifact categories are represented, but this may be a result of the small sample.

Cluster 5, which contains 105 artifacts from six hearths, is also represented by only a few artifact categories, although given the larger sample size relative to Cluster 4, this appears to be significant. Especially noteworthy is that endscrapers are well represented. However, if this represents hideworking (assuming that endscrapers were used to process skins), it is difficult to interpret the presence of the other artifacts around these hearths, especially burins and burin spalls.

In all, the results of the factor analysis, coupled with the nature of the features present, indicate a full range of activities that would have taken place at a settlement occupied in winter and in other seasons. The activities poorly represented at the site include flintknapping and hideworking. The absence of flintknapping materials is likely because quarrying, roughing out stone blanks, and finishing stone tools took place elsewhere. The paucity of hide-working implements is more difficult to explain, since it is difficult to imagine that hides were not prepared there. The most likely explanation for this apparent anomaly is that Denbigh hidescrapers were made of organic materials that have not survived the rigors of time.

TOOLKITS AND ACTIVITIES AS IDENTIFIED THROUGH VISUAL INSPECTION OF GIS PLOTS

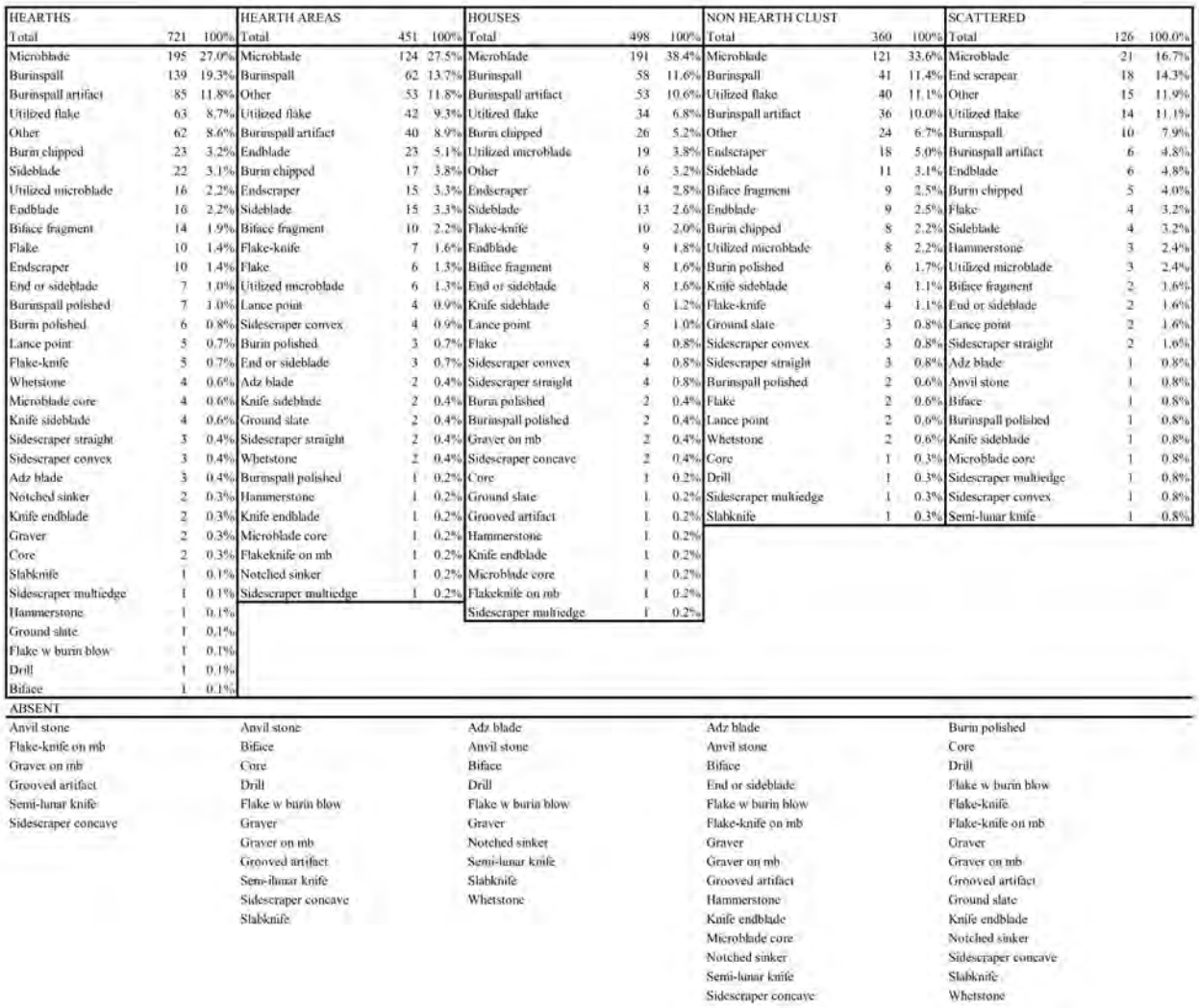
The basic unit of analysis for the second approach to the study of Denbigh toolkits and activities is the set of objects associated or, as the case may be, unassociated with features. As with the factor analysis, the primary archaeological features under consideration are hearths and house ruins. Many artifacts from Onion Portage were not obviously associated with any feature, a situation rather different from that observed at Cape Krusenstern. For the study I have singled out five spatial variables pertaining to features: (1) house floors; (2) hearths; (3) near hearths; (4) artifact concentrations unassociated with formal features; and (5) areas of randomly dispersed artifacts. Some other features—bone, antler, stone, and red ochre concentrations—were also identified in the Denbigh levels at Onion Portage, but initial analysis of these features has yielded so little meaningful information that I have excluded them from the full analysis. Even at a cursory glance, artifact types from the five spatial variables reveal some significant differences (Fig. 11).

INTERPRETATION

To establish the composition of the clusters, I sorted 2156 Denbigh artifacts representing forty-four types according to their associations with respect to one of the five spatial variables noted above. These types include all identified artifacts from the levels for which we have adequate spatial data, and represent 77% of the total 2787 artifacts from the Denbigh occupations at Onion Portage. Three-quarters of the artifacts were directly associated with obvious features—nearly a quarter were from the house floors and over half from the hearth areas. On the other hand, 17% of the artifacts were clustered in areas lacking obvious features and the remaining 6% were scattered as isolated objects over the Denbigh surfaces. The vast majority of artifact types are represented in varying frequencies in all five feature types. As regards temporal considerations, the distribution of artifact types by feature type is more similar on all the Denbigh levels at Onion Portage than I had expected. Thus, notwithstanding the presence of the very small number of attribute differences that informed the original designation of Proto-, Classic, and Late Denbigh, there seems to be very little evidence of change in the majority of artifact types throughout the several centuries of Denbigh occupation at Onion Portage. At the same time, this degree of similarity, which suggests that the toolkits were at once sufficiently specialized and multifunctional, may help explain why Denbigh assemblages seem to be indifferent to habitat.

Although these interpretations suffer sample sizes too small to satisfy minimal statistical standards, I suggest that some spatial patterning appears worthy of note. Most importantly, the feature and artifact associations appear to have a strong seasonal signal. The distribution of artifacts is especially dense within the limits of house floors, with a sharp drop-off in numbers immediately beyond the floor areas. Since the house floors were semi-subterranean, having been excavated to an undetermined depth below the ground level, the dwellings were likely occupied in winter and the activities carried out within the walls of a confined space.

Additionally, as noted above, many artifacts cluster within a one meter radius around stone-lined hearths. This suggests that activities producing these artifacts were carried out within a heated enclosure, such as a tent. Historically in the region, heated tents have been used during all seasons execpt high summer. But at Onion Portage, cold season use of such tents by Denbigh peoples is precluded by the fact that the stones for lining the hearths would have been unavailable during the periods of frozen and snow-covered ground. I therefore conclude that the Denbigh hearths at Onion Portage were most likely used during late spring/early summer or in the fall.



HEARTHS		
Total	721	100%
Microblade	195	27.0%
Burinspall	139	19.3%
Burinspall artifact	85	11.8%
Utilized flake	63	8.7%
Other	62	8.6%
Burin chipped	23	3.2%
Sideblade	22	3.1%
Utilized microblade	16	2.2%
Endblade	16	2.2%
Biface fragment	14	1.9%
Flake	10	1.4%
Endscraper	10	1.4%
End or sideblade	7	1.0%
Burinspall polished	7	1.0%
Burin polished	6	0.8%
Lance point	5	0.7%
Flake-knife	5	0.7%
Whetstone	4	0.6%
Microblade core	4	0.6%
Knife sideblade	4	0.6%
Sidescraper straight	3	0.4%
Sidescraper convex	3	0.4%
Adz blade	3	0.4%
Notched sinker	2	0.3%
Knife endblade	2	0.3%
Graver	2	0.3%
Core	2	0.3%
Slabknife	1	0.1%
Sidescraper multiedge	1	0.1%
Hammerstone	1	0.1%
Ground slate	1	0.1%
Flake w burin blow	1	0.1%
Drill	1	0.1%
Biface	1	0.1%

HEARTH AREAS		
Total	451	100%
Microblade	124	27.5%
Burinspall	62	13.7%
Other	53	11.8%
Utilized flake	42	9.3%
Burinspall artifact	40	8.9%
Endblade	23	5.1%
Burin chipped	17	3.8%
Endscraper	15	3.3%
Sideblade	15	3.3%
Biface fragment	10	2.2%
Flake-knife	7	1.6%
Flake	6	1.3%
Utilized microblade	6	1.3%
Lance point	4	0.9%
Sidescraper convex	4	0.9%
Burin polished	3	0.7%
End or sideblade	3	0.7%
Adz blade	2	0.4%
Knife sideblade	2	0.4%
Ground slate	2	0.4%
Sidescraper straight	2	0.4%
Whetstone	2	0.4%
Burinspall polished	1	0.2%
Hammerstone	1	0.2%
Knife endblade	1	0.2%
Microblade core	1	0.2%
Flakeknife on mb	1	0.2%
Notched sinker	1	0.2%
Sidescraper multiedge	1	0.2%

HOUSES		
Total	498	100%
Microblade	191	38.4%
Burinspall	58	11.6%
Burinspall artifact	53	10.6%
Utilized flake	34	6.8%
Burin chipped	26	5.2%
Utilized microblade	19	3.8%
Other	16	3.2%
Endscraper	14	2.8%
Sideblade	13	2.6%
Flake-knife	10	2.0%
Endblade	9	1.8%
Biface fragment	8	1.6%
End or sideblade	8	1.6%
Knife sideblade	6	1.2%
Lance point	5	1.0%
Flake	4	0.8%
Sidescraper convex	4	0.8%
Sidescraper straight	4	0.8%
Burin polished	2	0.4%
Burinspall polished	2	0.4%
Graver on mb	2	0.4%
Sidescraper concave	2	0.4%
Core	1	0.2%
Ground slate	1	0.2%
Grooved artifact	1	0.2%
Hammerstone	1	0.2%
Knife endblade	1	0.2%
Microblade core	1	0.2%
Flakeknife on mb	1	0.2%
Sidescraper multiedge	1	0.2%

NON HEARTH CLUST		
Total	360	100%
Microblade	121	33.6%
Burinspall	41	11.4%
Utilized flake	40	11.1%
Burinspall artifact	36	10.0%
Other	24	6.7%
Endscraper	18	5.0%
Sideblade	11	3.1%
Biface fragment	9	2.5%
Endblade	9	2.5%
Burin chipped	8	2.2%
Utilized microblade	8	2.2%
Burin polished	6	1.7%
Knife sideblade	4	1.1%
Flake-knife	4	1.1%
Ground slate	3	0.8%
Sidescraper convex	3	0.8%
Sidescraper straight	3	0.8%
Burinspall polished	2	0.6%
Flake	2	0.6%
Lance point	2	0.6%
Whetstone	2	0.6%
Core	1	0.3%
Drill	1	0.3%
Sidescraper multiedge	1	0.3%
Slabknife	1	0.3%

SCATTERED		
Total	126	100.0%
Microblade	21	16.7%
End scrapear	18	14.3%
Other	15	11.9%
Utilized flake	14	11.1%
Burinspall	10	7.9%
Burinspall artifact	6	4.8%
Endblade	6	4.8%
Burin chipped	5	4.0%
Flake	4	3.2%
Sideblade	4	3.2%
Hammerstone	3	2.4%
Utilized microblade	3	2.4%
Biface fragment	2	1.6%
End or sideblade	2	1.6%
Lance point	2	1.6%
Sidescraper straight	2	1.6%
Adz blade	1	0.8%
Anvil stone	1	0.8%
Biface	1	0.8%
Burinspall polished	1	0.8%
Knife sideblade	1	0.8%
Microblade core	1	0.8%
Sidescraper multiedge	1	0.8%
Sidescraper convex	1	0.8%
Semi-lunar knife	1	0.8%

ABSENT				
Anvil stone	Anvil stone	Adz blade	Adz blade	Burin polished
Flake-knife on mb	Biface	Anvil stone	Anvil stone	Core
Graver on mb	Core	Biface	Biface	Drill
Grooved artifact	Drill	Drill	End or sideblade	Flake w burin blow
Semi-lunar knife	Flake w burin blow	Flake w burin blow	Flake w burin blow	Flake-knife
Sidescraper concave	Graver	Graver	Flake-knife on mb	Flake-knife on mb
	Graver on mb	Notched sinker	Graver	Graver
	Grooved artifact	Semi-lunar knife	Graver on mb	Graver on mb
	Semi-lunar knife	Slabknife	Grooved artifact	Grooved artifact
	Sidescraper concave	Whetstone	Hammerstone	Ground slate
	Slabknife		Knife endblade	Knife endblade
			Microblade core	Notched sinker
			Notched sinker	Sidescraper concave
			Semi-lunar knife	Slabknife
			Sidescraper concave	Whetstone

Figure 11. List of artifact frequencies sorted by five spatial variables.

Some less tightly clustered groups of artifacts surround other hearth areas. Following the reasoning outlined above, I suggest that these represent artifact-producing activities carried out in unenclosed spaces, which implies their use during the snow-free seasons.

Weak clusters of artifacts not associated with any observable features were produced by activities that took place beyond the immediate areas of the hearths or houses. For these activities, I cannot suggest a season, since they could just as readily have taken place on snow as on grass.

Finally, as can be seen in Figures 7 and 8, several hearth areas have no associated artifacts. Since most of these are stone-lined, they were likely not used during winter. But what purpose they served at other seasons is unknown, other than that, given the absence also of flaking debitage, they were likely not areas of manufacturing stone implements.

Interpretations of artifact distributions as they relate to non-seasonal variables are more tenuous. For this I focused on comparisons of artifact frequencies of the five feature types as they relate to specific activities.

Complete, or nearly complete microblades represent the largest single category of artifacts in the Denbigh levels at Onion Portage, ranging from 17% to 45% of each individual cluster sorted by feature type. However, despite the abundance of these microblades—most of which appear to have been used or at least were usable—there is very little debitage, such as truncated forms, rejuvenation flakes, etc. that is normally associated with their manufacture. Unless we conclude that the flintknappers were so expert that they rarely made a false step, this suggests that the microblades were made elsewhere, which may also account for the rarity of microblade cores and core debitage in the site as well. The highest percentage of microblades is found in the houses (38% to 43%) and the lowest in the intermediate areas (19%), with moderate

representation within the hearths and near hearth areas (29%). Over half of the microblades show signs of edge-wear, but I have yet to work out the patterns that might reveal details of specific manufacturing activities.

Burins are present in about the same proportion in all feature types (4%), but burin spalls, including burin-spall artifacts, are more commonly associated with the hearths (32%) and least common in the scattered areas (13%), with similar percentages in the other clusters (23%). Burin spalls were scattered about away from clusters in significantly lower percentages (14%), possibly because they would have been too light to have traveled far by "tossing."

Weapon side- and endblade insets are equally common in all artifact clusters. This suggests that weapon manufacture took place in settings in which multiple manufacturing activities were carried out. Adz blades are absent from the house assemblages, although since only four adz blades were located in the Denbigh levels at Onion Portage, this may have little significance. On the other hand, their association with whetstones, which were also absent from the houses, suggests that adzing was indeed an activity that took place in seasons other than winter.

Endscrapers are more frequent in areas unassociated with hearths or houses, and especially abundant as isolated objects. If we accept that endscrapers are hide-scraping implements, one could envision their use some distance from the other activities taking place around the campfires. On the other hand, compared to most of the other cultural complexes at Onion Portage, stone endscrapers are unexpectedly rare in all of the Denbigh layers at Onion Portage, something echoed in most Denbigh sites. This suggests to me that for Denbigh people, the important activity of skin working involved bone or antler scrapers, as was the practice of many other arctic peoples (Mathiassen 1928:110). Further, given that endscrapers are frequently also found in other Alaskan archaeological sites with contexts that seem inappropriate for hideworking, I question the validity of the simple end scraper-to-hidescraping correlation, and suspect that a closer analysis of the individual artifacts will implicate a variety of activities. My own examination of wear patterns on the Onion Portage Denbigh endscrapers has yielded equivocal results: certainly none exhibit the pronounced wear that is characteristic of obvious skin scrapers from later Arctic Small Tool assemblages in Alaska (Anderson 1988:97, 119).

Utilized flakes are underrepresented in the house middens (7%) and hearths (9%), but more common away from the formal features (11%). We had expected to find very high percentages in the houses owing to constant repetition of the manufacturing activities carried out indoors throughout the winter, so this was a surprise. This suggests that utilized flakes, as well as sidescrapers, are more likely *ad hoc* implements, used once as an occasion arises and then tossed away, an eventuality that is compatible with the high frequency of the implement type in areas some distance from the obvious features. I also note that in the houses, the flake-knife, the formal implement most functionally similar to the utilized flake and sidescrapers, is more frequent than elsewhere. It appears that for the usual manufacturing activities, the worker had at hand the full range of specialized implements anticipated for the task, so that there was no need to resort to *ad hoc* implements.

Evidence also indicates that Denbigh implements were brought to the site in finished, or at least in near finished form. Nearly all flake debitage, for example, is from either the final stages of biface reduction or are tiny pressure flakes from the final stages of tool finishing and resharpening. Most of the microblades were also produced elsewhere. This fact is surprising since since the safest way to protect the delicate microblade edges before use is to leave them on the cores until the moment they are needed.

The location of objects designated as "scattered" may well have resulted from the "tossing" factor (Kroll and Price 1991), and thus is the least interpretable.

The flake debitage from Onion Portage Denbigh layers reinforces the evidence from the artifactual remains that most of the implements were manufactured elsewhere. A close inspection of a sample of thirty-nine clusters of flakes from the layers revealed that nearly three-quarters of the flakes were tiny pressure flakes from either the final stages of manufacturing or, more likely, from resharpening tools. The second largest category, slightly over a quarter of the flakes, was comprised of secondary biface reduction flakes produced from late stages of tool manufacture or reshaping broken implements. Primary biface reduction flakes were relatively uncommon, representing only 1.4% of all the flakes in the Denbigh assemblages. We could detect no significant difference in the proportions of flakes sorted by feature type.

The nature of the lithic remains from these major Denbigh assemblages clearly indicates that we are missing at least two other kinds of Denbigh sites: quarry sites and sites where blanks were processed into their finished tool forms.

Based on available information, the importation of Denbigh tools in finished form appears to be duplicated at the other major Denbigh sites in North Alaska. This brings to mind speculation by Irving (1964) that the finest of the Denbigh artifacts may have been produced by itinerant flintknapping specialists.

Finally, the analysis of lithic materials from the Denbigh sites has yielded some insights into the nature of external contacts, either through trade or long-distance raw material procurement. This can best be seen by focusing on Koyukuk River drainage obsidian, since of all the raw materials utilized by Denbigh peoples, obsidian was originally and apparently exclusively derived from outside the currently known distribution of Denbigh (Clark and Clark 1993; Griffin, Wright, and Gordus 1969; Patton and Miller 1970).

Interestingly, although obsidian is a common material in the Onion Portage Denbigh assemblages, it is not found in any sizable quantity on the coast. At Cape Krusenstern, only 1% of the Denbigh objects are of obsidian, despite the fact that in other parts of the Denbigh world obsidian was apparently a highly desired material for certain artifact types. This pattern suggests that, while there was some contact between the forested riverine and coastal areas (as evidenced by the presence of obsidian), those who produced the Denbigh campsites at Cape Krusenstern were not from the Kobuk River area. Had they been, I would expect the proportions of materials used for similar tool types to be more similar.

As for trade routes among Denbigh peoples via the coast and the major rivers of Northwest Alaska, we turn to chert distributions. The majority of lithic artifacts from Denbigh sites everywhere are of chert, including black cherts of several textures and a glassy light gray chert. Although chert sources are more difficult to pinpoint than are obsidian, the work of Natalia Malyk-Selivanova (1998) has provided us with the first useful indications. According to her analysis of a few Denbigh cherts from Onion Portage and Cape Krusenstern the glassy gray chert examples came from outcrops in the lower half of the Noatak River area. If so, the fact that this chert type accounts for more than 70% of the Denbigh materials at Cape Krusenstern suggests that the most direct link between Cape Krusenstern and the interior was via the Noatak River. I might even conclude that the Denbigh peoples responsible for the late spring–early summer camps at Cape Krusenstern wintered in the Noatak Region, even though we have yet to find any sizable Denbigh sites there.

The light gray Noatak cherts were also an important tool source at Onion Portage, which thus links the middle Kobuk with the lower Noatak area. And, given the absence of direct Kobuk - coast connections, the Kobuk-Noatak linkages must have been via the passes, not along the primary rivers. If the lithic materials were carried overland, it is not surprising that considerable attention was paid to carrying only finished – or near finished – objects.

COMPARING THE RESULTS FROM THE TWO ANALYTICAL STRATEGIES: A CAUTIONARY NOTE

A comparison of the two methods used to analyze spatial distributions of Onion Portage Denbigh materials highlights the complexity of archaeological spatial analyses in general, a conclusion underscored by Reanier (1992). Each method produces somewhat different results, even when using the same data set, and each method seems better able to capture information from particular data sub-sets than do others. For example, the factor analysis of artifact clusters associated with hearths, using a one-meter diameter criterion of belonging is ideal for its replicability, but the strict spatial limits imposed on the data exclude many artifacts and types of settings that are important in understanding the behavior of the Onion Portage Denbigh peoples. On the other hand, beginning with a visual clustering of artifacts and features at the site, we are able to incorporate the entire data set into a single analytical framework, but the drawback is the more *ad hoc* nature of the clusters, which reduces the replicability of our categories.

For Arctic lithic sites, each analytic method has strengths and weaknesses. The weaknesses are all too apparent. With few exceptions, we have too little control over the temporal dimension to assume that clusters of artifacts belong to functioning social units. Even where we have reason to believe that multiple artifacts were deposited by people in face to face situations, the number of objects is usually so small that we are limited in the use of statistical techniques to identify toolkits or activity sets. Perhaps even more fundamental, though, there is no assurance that the artifact numbers have any relationship to the intensity or frequency of the activities they represent. On the other hand, by restricting analyses to the archaeological record of a particular time and place, where all materials have gone through a similar "filter" of use and discard, we at least have a basis for comparison. At Onion Portage, for example, the fact that similar feature types from all of the Denbigh levels yield similar proportions of artifacts suggests that there is

a positive relationship between numbers of artifacts and activities and that the spatial categories have some basis in reality. If I had found no correlation between feature types and artifact quantities or types, I would have been alerted to the need to reconfigure the methodology or perhaps abandon the effort. But perhaps even more importantly, greater attention to integrating the spatial criteria with artifactual data can stimulate interest in matters beyond culture history to the degree that recording precise provenience is valued as a matter of routine—something we are still struggling to achieve in the Arctic. With each attempt to identify toolkits and activities of prehistoric peoples, we move ever closer to realizing the goal of breathing life into the thousands of lithic scatters that cover arctic landscapes.

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