Bifaces, used as specialized tools and as cores, were a primary component of the mobile toolkits employed by prehistoric hunter-gatherer groups in North America. In some toolkits, however, particularly those in the American Arctic, prepared blade cores were also common. The use of blade core technologies has generally been explained in cultural historical terms (e.g., Paleoindian versus Paleo-Arctic) or in terms of a simple functional argument—blade cores offer a more efficient means of utilizing lithic raw materials. Through analysis of debitage assemblages produced from bifacial and prepared blade core reduction experiments, we show that blade cores and bifacial cores are both efficient means of utilizing lithic raw materials, yet they differ in a variety of other ways. These differences are discussed in terms of the costs and benefits presented to prehistoric toolmakers and users. Given this set of costs and benefits, the technological choices favored by prehistoric people may shed light on the situational and organizational contexts in which these technologies were used.

Lithic analysts typically measure a variety of flake attributes and assemblage characteristics in an attempt to understand prehistoric technological behavior. Many of these studies seek to identify processes that prehistoric individuals may have been aware of but to which they gave little attention. For example, our interest in discovering stages of reduction, types of percussors, or reduction strategies would probably have been quite amusing to a prehistoric knapper.

Other parameters, however, that we archaeologists explore would have been very relevant to that individual. The size and shape of detached pieces and the
amounts of usable material produced relative to waste were probably major concerns to prehistoric tool users. It is from this perspective that we examine characteristics of experimental debitage assemblages produced from two comparable core strategies: bifacial cores and blade cores.

While the role of bifaces, as cores as well as specialized tools, in the technologies of mobile hunter-gatherers has been widely discussed (Andrefsky 1991; Boldurian 1991; Goodyear 1979; Hofman 1992; Kelly and Todd 1988; Kelly 1988; MacDonald 1968:65–66; Parry and Kelly 1987), blade cores were also important components of some mobile toolkits. Blade cores are commonly found in Alaskan archaeological assemblages ascribed to mobile hunting and gathering groups, and it is clear that blades were used in some cases by Clovis people—the archetype of highly mobile hunter-gatherers (Collins 1999; Green 1963). The role of blade cores within the technological repertoires of these groups, however, has not received much attention and hence it is not well understood. Though research on core and blade technology abounds, it has largely focused on reconstructing production techniques (e.g., Crabtree 1968; Del Bene 1992; Flenniken 1987a; Kobayashi 1970; Sheets and Muto 1972; Sollberger and Patterson 1976) or on the use of core morphology or production techniques as culture historical markers (e.g., Anderson 1970; Andrefsky 1987; Hayashi 1968; Magne 1996; Mobley 1991; Morlan 1970; Wyatt 1970). Several studies have addressed functional or organizational aspects of blade technologies, but these have generally concentrated on agriculturalists or groups with low residential mobility (e.g., Arnold 1987; Clark 1987; Odell 1994b; Parry 1994; though see Bamforth and Bleed 1997; Bleed 1996; Eerkens 1998; Wenzel and Shelley, this volume).

An interesting issue, then, is how blade core reduction strategies are incorporated into the technologies of mobile foragers, or in other words, why are core and blade strategies sometimes used in place of or in addition to more common bifacial core strategies? We acknowledge that historical factors play a role in determining which technologies are known to a group of people. However, in this case we suggest of greater importance in explaining technological variability in the archaeological record is the fact that blade and bifacial reduction strategies offer different sets of costs and benefits that would have been advantageous in different situational contexts. Prehistoric tool users, therefore, would have selected among these available technologies based on such considerations as immediate and expected task requirements, and the availability and characteristics of lithic raw materials, and within the context of constraints imposed by mobility organization and the structure of subsistence resources. Our goals in this essay are to highlight the unique features of each reduction strategy and then to suggest contexts in which these attributes may have been advantageous to prehistoric tool users.

High-Latitude Foragers and Core Design

One region in North America in which blade cores are especially common among mobile hunter-gatherer groups is Alaska. The use of bifacial technologies is also widespread in the region and we use archaeological assemblages from this area, specifically northwestern Alaska, as a model for our reduction experiments and to provide a starting point for discussion of core design. We emphasize, however, that our goal is not to replicate any specific reduction technology, but rather to explore the economics of core strategies in general. We acknowledge that there are many specific blade production techniques even within this region (Andrefsky 1970; Andrefsky 1987; Owen 1988), as there are a variety of bifacial reduction techniques, yet we are concerned with general characteristics that are more or less common to all techniques within these categories. In comparing the costs and benefits among core strategies at this general level we simply hope to generate some testable predictions for the situational and organizational constraints that influence the selection of reduction strategies.

Blade technology is defined here as a lithic production strategy in which a stone nucleus is shaped, often in a highly patterned manner, to facilitate the purposeful and repeated detachment of blades: long, narrow detached pieces with parallel lateral edges. Many techniques, including pressure, indirect percussion, and direct percussion, have been used in the North American Arctic to produce blades (Owen 1988). Blades come in a variety of sizes and in this region the smallest—usually based on an arbitrary size cutoff—are referred to as microblades. In this paper we are concerned only with these small blades or microblades since larger blades were probably used in different ways.

A biface is defined as a tool that has two surfaces (faces) that meet to form a single edge that circumscribes the object (Andrefsky 1998:76). Both faces contain some flake scars that travel at least halfway across the face. Bifacial cores are considered to be bifaces that functioned, at least occasionally, as a source of usable flake tools or flake blanks targeted for further modification.

Mobile Toolkits

We chose to examine and contrast blade and bifacial cores because these are the two most common core strategies employed in the transported, personal toolkits of mobile foragers. Such mobile toolkits, according to Kuhn (1994:427), are those items that are continuously carried by individuals, as opposed to gear that is made expeditiously, or tools that may be transported but are cached at fixed locations. Such implements are equivalent to what Binford (1979:262–263) labeled personal gear, and which he characterized as being (1) carried in anticipation of future use rather than made in response to tool needs, (2) heavily curated (i.e.,...
manifesting high levels of care in maintenance, recycling, and reuse), and (3) produced through a process of staged manufacture, the stages of which often occur in different places and at different times (Binford 1979). Alaskan blade cores, as well as bifacial cores, should be considered as components of mobile toolkits. They were carefully made, often of the highest quality raw materials (Anderson 1970), and are known to have been transported great distances from the geologic source of the raw material (Malyk-Salivinova 1998). Also, their reduction was often staged, with successive episodes of production, use, and maintenance being performed at different locations.

Because mobile toolkits are transported, their design is constrained to a large degree by considerations of portability relative to potential utility. This concern with portability is critical since, in addition to tools, people must also carry other essentials such as food and shelter. Thus, greater weight transported in the form of tools translates into less weight carried in other necessities. This is an especially relevant concern to logistically organized collectors (Binford 1980), as prehistoric Alaskans most likely were, since food and materials would have been regularly moved to residential camps, rather than moving camps near resource locations.

Portability can be attained in several ways, but all seek to maximize the utility derived from a toolkit in relation to its size and weight. One way to achieve this is to design a single implement for multiple functions. Aspects of this design consideration, in reference to functioning tools rather than cores, have been labeled by Shott (1986) as versatility and flexibility. Versatility refers to the number of functions a tool is designed for and flexibility refers to the ability of a tool to be modified for tasks other than that for which it was designed. Both strategies increase the number of options available to tool users from a given implement and hence can serve to increase utility. We use the term versatility in this paper to refer to the number of different types (sizes and shapes) of blanks a core can produce. A versatile core, for example, can produce blanks that range from large to small, thick to thin, and curved to flat. Following Shott’s (1986) terminology, a flexible core would be one that could be recycled into a tool which functions other than as a core.

Another way to maximize utility derived from tools or cores is through efficient use of lithic materials, which may reduce tool-stone requirements and allow for reduction in the size and weight of toolkits, or prolong periods between quarry visits. We suggest that this latter concern, the frequency of resupply trips, was probably a consideration regardless of how “embedded” resupply trips were, since this task nevertheless entailed some energy and opportunity costs.

While being mindful to considerations of portability, prehistoric people also needed to design toolkits to meet specific functional needs. The most basic function of chipped stone cores is to provide cutting edge in the form of flake tools or tool blanks. Whether an implement acts as a knife, a projectile, scraper, chopper, or drill, the essential function is cutting. Thus, maximizing the amount of cutting edge produced from a given mass of core material should have been an...
important design goal for mobile toolkits. As already mentioned though, there are a variety of cutting tasks, and for each there is an optimum type of cutting edge. A good scraping edge, for example, is morphologically different from an edge well suited to slicing. In some situations a variety of edge types may be desired in a toolkit, and thus flexibility in terms of the types of blanks one can produce from a core may also have been an important design goal. In other situations, consistent production of a specific type of cutting edge may have been ideal (see Tomka, this volume).

In sum, transported cores are expected to entail characteristics that allow them to produce the maximum amount of appropriate cutting edge relative to transport costs. With these design considerations in mind we now discuss the characteristics of detached pieces produced from blade core and biface reduction strategies.

CORE REDUCTION EXPERIMENTS

We replicated a blade core and a bifacial core modeled after artifact types recovered from archaeological sites along the Wrench Creek drainage in the western Brooks Range, Alaska (see Figure 5.1). Several large bifaces, interpreted to have served as cores, were recovered from the Tuluaq site, which is dated to at least 10,000 B.P. In Alaska the use of bifaces as cores, however, occurs until quite recent times. Binford (1979:262) describes their use among the ethnohistoric Nunamiut:

Informants always spoke of carrying “cores” into the field; as they put it, you carry a piece that has been worked enough so that all the waste is removed, but that has not been worked enough so that you cannot do different things with it .... That the items being described by the informants were cores, was made clear by many references to the removal of flakes radially around the disc for use in butchering animals, the manufacture of scrapers from flakes struck from the “long side” of the oval, and the fact that once you had reduced the core down to a very small size you had a “round scraper.”

Several sites in the Wrench Creek drainage have also yielded blade cores. Some of these specimens are small, pressure-flaked, wedge-shaped microcores typical of the American Paleo-Arctic Tradition that is thought to date from 8,000 to 10,000 years ago (Anderson 1984). Other blade cores are larger, oval-platformed specimens, which were probably produced with a percussion technique. Cores of this type are found throughout the Brooks Range (Hall 1975:67; Solecki 1950:67, 1996) though none are from dated contexts. Technologically similar cores elsewhere in Alaska, such as those from the Ugashik Narrows phase on the Alaskan Peninsula, date between 9,000 and 7,500 B.P. (Henn 1978). It is these percussion-flaked, oval-platformed cores that our experiments most closely replicate.

Archaeological specimens from Wrench Creek, both bifacial and blade cores, appear to have been produced with a percussion technique. The archaeological specimens are all made from chert, though of different types. Blade cores are exclusively made with high-quality, fine-grained, glassy cherts. Bifaces, in comparison, are often made with tougher and coarser-grained cherts, though some are also of the fine-grained variety.

The replicated bifacial core was produced from an obsidian cobble with a direct free-hand percussion technique (Crabtree 1972) using either a quartzite hammerstone or a moose antler billet. The replicated blade core was produced from an obsidian flake blank with direct free-hand percussion using a siltstone hammer. In both experiments, the goal was to produce as many usable flakes as possible. Reduction ceased when the knapper could no longer produce usable flakes without a change in reduction strategy, for example using bipolar reduction.

During the experiments, debitage was collected after each blow to the core and was labeled with a corresponding sequence number. The blade core replication was divided into six stages; each consisting of twelve hammer blows, and the bifacial replication was divided into seven stages of ten strikes. This collection technique enabled each piece of debitage to be assigned a specific sequence number or a range of sequence numbers from which it was produced and it allowed us to monitor changes in the character of detached pieces through the reduction sequence.

We divided the debitage set into two major categories. Flakes were defined as detached pieces with a single identifiable dorsal surface and a single identifiable ventral surface. All other specimens were classified as angular shatter. For all specimens large enough to be caught within a hardware mesh, we used a sliding caliper and recorded three simple size attributes to the nearest millimeter: maximum linear dimension, maximum width (the greatest dimension perpendicular to the maximum linear dimension), and maximum thickness. Additionally, we measured weight to the nearest 0.1 g on an electronic balance.

We acknowledge that obsidian fractures differently than does chert and that our experiments most likely did not exactly replicate the variation in debitage produced by the prehistoric knappers who worked the Wrench Creek bifaces and cores. We do not see this as a major obstacle, however, since the purpose of the experiments was not to duplicate the archaeological materials, but rather to compare general characteristics of bifacial and blade core reduction strategies. Additionally, it should also be noted that, when available, obsidian was used prehistorically in Alaska for both bifacial and blade core technologies (see, for example, Clark and Clark 1993).
Alaskan Blade Cores as Specialized Components

EXPERIMENTAL RESULTS

We quantified three aspects of lithic production for both bifacial cores and blade cores: production rate, raw material efficiency, and size and shape of detached pieces. Furthermore, changes in these parameters were monitored through the reduction continuum beginning with fully prepared but unworked cores and progressing to depleted cores from which no additional usable flakes or blades could be gained. The initial core-shaping stages were not included in the following calculations since our interest was in transported cores. We assume that, prehistorically, the initial core-shaping portion of the reduction continuum would be performed at or near the raw material source and only formed cores would be incorporated into the transported toolkit. Table 5.1 lists summary data from the experiments.

RAW MATERIAL EFFICIENCY

We monitored the raw material efficiency of blade and bifacial core strategies three ways and found that both bifaces and blade cores are efficient producers of usable products. Since the sizes of original nodules and formed cores were variable—the blade core is only about half (54 percent) as massive as the bifacial core—we calculated measures of raw material efficiency relative to core mass. Usable items were arbitrarily defined as those flakes measuring at least 25 mm in maximum dimension. Items smaller than 25 mm in maximum dimension and all pieces of angular shatter were classified as waste.

One way to assess the efficiency of a core reduction is by calculating the number of usable items produced relative to the mass of the formed core. By this measure we found the bifacial reduction to be more efficient, producing 0.19 blanks/g compared to 0.16 blanks/g for the blade core. This apparently slight difference may be more meaningful if we consider a hypothetical toolkit made entirely of blade cores or bifaces with a total weight of 5 kg. In such a case, the blade cores would produce 800 usable items compared to 950 usable items from an equal mass of bifaces. It is difficult to judge whether this degree of difference would have been recognized and valued by prehistoric tool users.

Other measures of raw material efficiency favor the blade core strategy. If raw material efficiency is measured by comparing the weight of usable flakes as a percentage of total debitage weight, we see that 90.7 percent of the blade core debitage is usable and only 76.7 percent of the bifacial core debitage is usable (see Table 5.1). Since this measure of efficiency considers only debitage, however, the weight of the exhausted core—which has also been transported—is not taken into account and therefore this may not be the most accurate assessment of core efficiency. A better measure of efficiency considers the weight of the exhausted core...
core. Since the utility of the exhausted blade core is rather limited and should be considered as waste, the “exhausted” bifacial core is now a thinned bifacial implement, and its mass may be considered useful. We considered the exhausted blade core as waste and the exhausted bifacial core as usable. Under these parameters the blade core efficiency is reduced to 70.9 percent compared to the bifacial core at 62.4 percent (see Table 5.1). The blade core is still more efficient though only marginally so. These findings are in accordance with similar studies that have found bifacial cores to be roughly as efficient as blade cores in terms of the useful products they supply (Flenniken 1987a; Morrow 1997).

SHAPE AND SIZE CHARACTERISTICS OF DETACHED PIECES
An obvious, and perhaps the essential difference between blade core products and those from bifacial cores is in the shape of detached pieces. We characterized flake shape by calculating length to width ratios for all usable flakes and found significant differences in the shapes of core products. Figure 5.2 shows that, as one might expect, the highest percentages of detached pieces from the blade core are long and narrow and thus have higher length to width ratios. Bifacial core products, in comparison, tend to be roughly equal in length and width. A chi-square test of the counts of usable flakes in each length to width class for both core types shows a significant pattern ($X^2=27.52$, df=4, $p<0.001$).

The maximum size of usable core products is of course limited by the dimensions of the core. Our experiments, however, suggest that a unique design feature of blade cores is their ability to maximize the size of blanks relative to core size. Consistently larger blanks can be produced from a blade core than from a comparably sized bifacial core. Figure 5.3 shows significant patterning ($X^2=21.26$, df=5, $p<0.001$) in the size distribution of usable flakes from the two core reduction experiments. Although the larger bifacial core did produce flakes larger than the largest flake from the blade core, these were few in number. The greatest proportion of usable blanks from the bifacial core is in the smallest size class, while the greatest proportion of usable flakes derived from the blade core is from a range two size classes larger. This is surprising since one would expect debitage size to be sensitive to core size (Tomka 1989), and therefore, given that the bifacial core in this experiment was nearly twice as large as the blade core, one would expect the larger core to produce greater numbers of larger flakes.
Production Rate

Time was recorded at various stages throughout our reduction experiments and although great differences in production rates between core strategies were noted, the results are presented here with reservations. Production rate was measured as the number of usable flakes produced per minute of reduction time. In several blade core reductions performed for this study, production rates ranged from 7.2 to 10.7 blanks per minute. The single bifacial reduction for which we recorded time produced only 2.5 blanks per minute.

While it is tempting to conclude that blade core reduction is significantly more efficient than bifacial reduction by this measure, experimentally derived production rates should be viewed with caution since a host of factors such as raw material qualities, and the skill and experience of the knapper, particularly his or her familiarity with a given production mode, could drastically influence such estimates. Among prehistoric groups in which the production of chipped stone tools was a regular activity from a young age, the time spent producing blades or usable flakes was perhaps insignificant, especially in comparison to much more time consuming hafting tasks (Keeley 1982:800). Furthermore, staged reduction of toolkits would have allowed tool production to be scheduled so as not to conflict with subsistence or social activities (Binford 1979; Torrence 1983).

Changes in Core Products through the Reduction Sequence

An important design consideration for a transported and curated item such as a core is how its performance will change through its use-life. We assessed this quality in terms of uniformity of detached pieces (the similarity in shapes and sizes of blanks produced during different portions of the reduction continuum) and consistency (changes in these proportions over the course of the full reduction continuum).

One simple way to evaluate the consistency of core products is to chart the total weight of usable blanks produced during each stage of the reduction process. Figure 5.4 shows a significant difference between the core types in this respect ($X^2 = 6.48$, df = 3, $p < 0.05$). The bifacial core shows a steady decrease in total weight of usable flakes produced during successive stages of the reduction process. In contrast, the blade core reduction, although it shows a drop in usable flakes between Stages four and five, exhibits less variability than the bifacial core.

The uniformity of core products among our experimental assemblages differs as well. Size variability among individual blanks is greater for bifacial products than it is for blade core products. Since the mean maximum dimension of flakes from each experiment is very similar, a direct comparison of the standard deviations for the mean maximum dimensions is reasonable. Table 5.2 lists the mean maximum dimensions and standard deviations of maximum flake dimensions for both core types and demonstrates that there is greater variability in flake size within the set of bifacial core products, with standard deviations ranging from 10.82 to 16.02 mm, than in the group of blade core products, in which standard deviations range between 4.87 and 5.43 mm.

Discussion

As might have been predicted before this study was performed, the products of blade core reduction are distinctly different from those derived from bifacial reduction. We hope, however, that some of the specific ways in which they differ, the ways in which the products change through a reduction continuum, and how these differences would have been meaningful to prehistoric people have been elicited. A remaining challenge is to determine how the costs and benefits presented by biface and blade core technologies influenced the technological choices made by prehistoric tool users. These choices are thought to have been made in response to a variety of situational contingencies and organizational constraints faced by prehistoric people. An understanding of the limitations and benefits of
Table 5.2.
Size Variability of Usable Flakes from Blade and Bifacial Core Reductions

<table>
<thead>
<tr>
<th>Stage of Reduction</th>
<th>Mean Maximum Dimension (mm)</th>
<th>Maximum Maximum Dimension (mm)</th>
<th>Minimum Maximum Dimension (mm)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade Core Reduction</td>
<td>39.08</td>
<td>48</td>
<td>29</td>
<td>5.43</td>
</tr>
<tr>
<td></td>
<td>37.16</td>
<td>51</td>
<td>27</td>
<td>6.42</td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>44</td>
<td>25</td>
<td>4.97</td>
</tr>
<tr>
<td></td>
<td>33.80</td>
<td>41</td>
<td>25</td>
<td>4.87</td>
</tr>
<tr>
<td></td>
<td>36.26</td>
<td>51</td>
<td>25</td>
<td>5.68</td>
</tr>
<tr>
<td>Bifacial Core Reduction</td>
<td>39.78</td>
<td>86</td>
<td>25</td>
<td>16.02</td>
</tr>
<tr>
<td></td>
<td>28.82</td>
<td>104</td>
<td>25</td>
<td>12.06</td>
</tr>
<tr>
<td></td>
<td>35.33</td>
<td>68</td>
<td>25</td>
<td>11.14</td>
</tr>
<tr>
<td></td>
<td>34.53</td>
<td>60</td>
<td>25</td>
<td>10.82</td>
</tr>
<tr>
<td></td>
<td>34.62</td>
<td>104</td>
<td>25</td>
<td>12.83</td>
</tr>
</tbody>
</table>

different technologies sheds light on the problems prehistoric people were attempting to solve and in turn provides a more detailed picture of prehistoric life. We first summarize the characteristics of these core strategies and then discuss two sets of factors that may have been important in selecting from among them: lithic raw material constraints and considerations related to tool function and maintenance.

Summary of Blade Core and Bifacial Reduction Characteristics

The blade core reduction in this experiment was found to be an efficient use of raw materials as measured by the number of usable items produced from a given core mass, and as measured by the proportion of usable debitage relative to waste products. It was also found to consistently produce a high proportion of long and narrow detached pieces that were relatively uniform in both size and shape. Furthermore, these characteristics were found to hold true through the entire reduction continuum; the size and shape of the first blades removed were similar to that of blades produced at the end of the reduction sequence. A unique feature of blade cores seems to be the ability to maximize the size of detached pieces relative to the size of the core.

Our bifacial reduction experiment shows that a bifacial core strategy can also be judged an efficient use of raw material as measured by the number of usable flakes relative to core mass. In regard to the shape and size of usable detached pieces, those produced from the entire bifacial reduction sequence were found to be more variable than those obtained from blade core reduction experiment. As well, the size and shape of usable flakes from the bifacial core were more variable during each portion of the reduction continuum when compared to equivalent portions of the blade core sequence.

Raw Material Economy

Our experiments support previous findings (e.g., Flenniken 1987a; Morrow 1997) that demonstrate bifacial and blade core reduction to be a similarly efficient means of utilizing lithic raw materials. This refutes a commonly accepted notion that blade cores are superior to all other reduction strategies in terms of raw material economy (see Bar-Yosef and Kuhn 1999). The use of blade core technology, therefore, cannot be explained simply as a choice in favor of a more efficient technology. We do believe, however, that the size of available lithic raw material packages may be relevant. Since blade cores maximize the size of detached pieces relative to core size they can produce more large blanks than a similarly sized bifacial core. For example, a hypothetical blade core with a height of 4 cm can supply numerous blades that are nearly 4 cm long, while a 4-cm-long biface—the size of a typical dartpoint—would hardly be considered a core since few flakes of usable size, and probably none approaching 4 cm, could be obtained from it. As such, the blade core strategy is one option for supplying cutting edge in situations where suitable lithic raw materials occur only in small nodules. Even in cases where large nodules are available it would seem that smaller pieces of stone are almost always more abundant and more easily procured, thus reducing procurement costs for blade core materials.

Special Purpose and Generalized Core Technologies

An overall picture that emerges when looking at the characteristics of blade and bifacial core reduction strategies is one of a specialized technology compared to a generalized and versatile technology. Small blade and microblade cores are specialized implements. They served one function—a source of usable detached pieces—and these pieces came in a narrow range of shapes and sizes that were useful for a relatively narrow range of functions. The range of uses for which blades can be used or modified for is largely dependent on their size, with larger blades offering more options. With small blades, as used in this study, and more so with even smaller pressure-flaked microblades, the delicate, acute edges would
be useful only for light-duty cutting and graving tasks (Hutchings 1996). While microblades in Alaska are occasionally found to have been retouched into tools (Owen 1988), these items are relatively uncommon, and it is thought that small blades and microblades were typically used without modification (other than sectioning to obtain straight segments) as insets in slotted bone or antler projectile points (Ackerman 1996a, 1996b; Larsen 1968). They may also have been used in hafted cutting implements analogous to the crooked knives used by Alaskan Eskimos into the historic period (Murdoch 1892:160; Nelson 1899:94). Due to their small size and acute edges, however, chopping, scraping, sawing, or heavy graving functions are not efficiently undertaken regardless of the haft design.

In contrast to the narrow role of blade cores, bifaces themselves could serve as cores or tools, and the flakes detached from them could be used in a variety of ways as well. As cores, bifaces provided flakes of various shapes that could be used for diverse tasks. Unlike small blades, these flake blanks could also be further modified into a variety of more specialized tools such as cutting, scraping, boring, and piercing implements (Andrefsky 1988; Frison and Bradley 1980; Kelly 1988; Morrow 1996; Stanford and Broilo 1981; Wilke et al. 1991). Additionally, the bifacial core itself was useful as a relatively massive, durable-edged tool that could be extensively resharpened (Jones 1980; Kelly 1988; Ohel 1987). When the bifacial core has been reduced in size so that it can no longer provide useful blanks, it could be cycled into a formed tool such as a projectile point or hafted knife (Frison and Bradley 1980; Hofman 1992; Wilke et al. 1991).

One aspect of core design raised in this study, and one that illustrates how blade and bifacial cores differ in terms of their specialization, is the way core products change through a reduction trajectory. Numerous studies show that flake size generally decreases through a biface reduction continuum (e.g., Bradbury and Carr 1999; Ingbar et al. 1989; Magne and Pokotylo 1981; Stahle and Dunn 1982). This is the very nature of a reductive technology, and for this reason the ability of a bifacial core to produce flakes large enough to be useful will decrease through its use-life. Thus a biface can only serve the dual purposes of tool and core for a limited portion of its reduction trajectory. Furthermore, compromises must be made in terms of flake removals that produce usable flakes and those that maintain the effectiveness of a bifacial tool. For instance, the removal of a large flake blank may affect the symmetry and edge angle of a biface and hence degrade its suitability for specific tasks. Although its usefulness as a core will diminish over time, the fact that a bifacial core can be laterally cycled into a specialized bifacial implement such as a projectile point or knife, provides the user of that tool with additional options.

In comparison, a blade core has one purpose—the production of useful detached pieces. No compromise in design is required since the core serves a single function. Consequently, the configuration of the core (i.e., the platform shape, overall core morphology, platform to face angles, etc.), once established, can then be maintained with relatively little variation (relative to other reduction strategies) throughout the entire reduction sequence. This allows consistent production of detached pieces, which vary little in size and shape.

General aspects of the context in which cores were used, and which may have affected the types of core strategies chosen prehistorically are (1) the ability to predict specific kinds of tool-using activities, and (2) the types of tasks to be performed. The greater flexibility of the biface strategy would seem to be of value when the exact nature of tasks to be performed is not known. The ability to make blanks of various shapes and sizes from a biface would allow one to cope with a wide variety of tasks. However, the costs of this flexibility may include greater time requirements for production of these items, some cost in terms of portability, and in some situations increased procurement costs of suitable lithic raw materials. These costs would be warranted in situations where people were faced with scarce or unknown lithic resources or when the types of tasks likely to be required were not easily predicted, for example, when people are entering new and unfamiliar territories, when rapid environmental changes are occurring, or when the structure of the resource base is characterized by unpredictable fluctuations in resource availability (Hiscock 1994; Kelly and Todd 1988).

More routinely, the need for a flexible and generalized core strategy, such as the bifacial core strategy, may be dictated by the range of expected tasks during a particular excursion. For logistically organized hunter-gatherers the range of potential tasks that one must be prepared to perform is expected to increase with increases in the duration/distance of a given foray (Binford 1977). A schematic of this relationship is shown in Figure 5.5. On longer or more distant forays, the range of expected activities is wider and specific activities that may be performed are more difficult to predict, hence a more flexible, generalized toolkit, which may have included bifacial cores, would have been useful.

The use of blade cores, on the other hand, because of their specialized nature, would be dictated more by the types of tasks that were expected. The combination of standardized products, production efficiency, and limited function seen with blade technology, would be well suited to activities in which specific activities are reliably predicted, and where processing volumes or time stress place a premium on efficient tool use and tool maintenance (Tomka, this volume). Time constraints on production and tool maintenance are typically of concern when the scheduling of resources is unpredictable and thus opportunities to utilize down time in order to “gear up” are not available (Bledsoe 1986; Torrence 1983). In such situations, blade cores would allow quick production of standardized replacement parts that would facilitate tool maintenance. Under other conditions—for
example, when potential tool uses (and thus required blank forms) varied widely, were unpredictable, or required blank forms not obtainable from blade cores—blade core technology alone would be insufficient.

As can be seen, blade core and bifacial core strategies offer different costs and benefits to tool users, however we see no reason why both strategies would not have been incorporated into a single toolkit. In fact, given the limited range of products derived from blade cores, other types of tools or cores were almost certainly required in all but the most specialized activities. We suggest that the relative proportion of these items may have differed according to a variety of situational and organizational constraints. In the Arctic, where marked seasonal fluctuations in resource availability is the norm, one might expect toolkits to vary according to seasonally specific activities and subsistence strategies. One might envision, for example, one toolkit for mid-summer encounter hunting and another for fall intercept hunting. One implication of this contention is that some of the variability seen in archaeological assemblages—even seemingly fundamental technological variation—may be due to such situational and organizational constraints. Thus, the presence or absence of evidence for basic technologies, such as blade core reduction, in an assemblage is not necessarily a good trait for use as a chronological or cultural marker. Blade cores may be more accurately viewed as specialized components of a toolkit that was possibly used only in very specific situations. It is hoped that additional work along these lines will better isolate just what these situations were.

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