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AN INVESTIGATION OF CLOVIS CACHES:
CONTENT, FUNCTION, AND TECHNOLOGICAL ORGANIZATION

BY

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B.A., Anthropology, Appalachian State University, 1992
M.A., Anthropology, Eastern New Mexico University, 1998

DISSERTATION

Submitted in Partial Fulfillment of the
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Doctor of Philosophy

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ABSTRACT

One of the most striking aspects of the Clovis period is the enigmatic caches that occur throughout the western United States. Clovis caches clearly convey an impressive degree of skill and artistry that often seems to set them apart from other Clovis assemblages, despite the fact that they reflect the same general technology. The fundamental characteristic that differentiates cache assemblages from other Clovis assemblages is that the artifacts from caches do not appear to have been abandoned because they were worn out or broken, but instead appear to have been removed from the system at earlier stages in their potential use-lives. For this reason, Clovis caches have more than aesthetic value; they provide a unique window into Clovis economy and lithic technology. Despite decades of research that incorporates cached Clovis material, little has been done toward systematically comparing these assemblages to one another and to other Clovis sites. The fundamental goals of this dissertation are to undertake such comparisons in order to ascertain the function(s) of caches and to develop a more complete understanding of their role in the organization of Clovis technology.

This dissertation investigates 22 assemblages proposed to be Clovis caches. Sixteen assemblages are identified as meeting both the criteria set forth to define a cache and to assign Clovis affiliation. These 16 Clovis caches are analyzed with regard to artifact form, remnant utility, evidence of use, lithic raw materials, cache context, and associated materials for comparison with specific expectations derived for cache functions identified through ethnographic and archaeological research. Comparable data from Clovis kill and camp sites are integrated with those from caches to determine the forms in which raw materials were transported and to estimate the relative economic value of individual Clovis caches.

The results of this dissertation indicate that no single function is sufficient to explain the existence of assemblages identified as Clovis caches. Clovis caches appear to have served a number of functions for those that placed them. The results do argue for a clear distinction between two primary functional classes: ritual and utilitarian caches. The afterlife cache is the single variety of ritual cache identified here. Utilitarian caches compare favorably to insurance, load exchange, and seasonal/passive gear. Geographic patterning in caches and cache functions further suggests that caching was adapted to meet regionally specific conditions, and was not utilized at all in some regions. Regional variation in cache function, along with trends in the movement of lithic raw material, are used to argue that Clovis caches are not associated with the process of colonization, but instead represent solutions to known environmental conditions.

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CHAPTER 1: INTRODUCTION AND SCOPE

One of the most striking aspects of the Clovis period is the enigmatic caches that occur throughout the western United States. A Clovis cache is a tightly clustered assemblage of Clovis artifacts, often consisting of bifaces, projectile points, blades, flakes, cores or some combination thereof, which does not correspond to other known site types, and does not directly represent any activities other than its own deposition. Despite decades of research that incorporates cached Clovis material, little has been done toward systematically comparing these assemblages to one another and to other Clovis sites. The fundamental goals of this dissertation are to undertake such comparisons in order to ascertain the function(s) of caches and to develop a more complete understanding of their role in the organization of Clovis technology.

While much attention has been focused upon understanding Clovis, many fundamental issues remain strongly debated and largely unresolved (these matters are only introduced here, and are discussed in more detail in following chapters). Foremost among these are concerns surrounding the colonization of the North American continent. The question of whether or not Clovis technology is the hallmark of the first inhabitants of the Americas has been debated to varying degrees throughout the 75 or so years since Clovis was recognized. No direct attempt is made here to resolve questions regarding the possibility of pre-Clovis occupation of the New World. Though the question is not critical to most aspects of this research, this research proceeds from the assumption that Clovis people were the first to inhabit the landscapes under investigation.

Similarly, debate over the nature of Clovis subsistence has continued over a span of decades. Reduced to its simplest form, the debate centers on the degree to which Clovis people can be considered specialized hunters of large mammals, if at all. I argue that, while Clovis probably maintained a relatively broad diet (relative, that is, to later Paleoindian groups such as Folsom), large mammal hunting was important enough that it was the primary factor structuring subsistence-related decisions.

Intertwined with debates over colonization and subsistence ecomony are questions regarding the degree of regional variation in Clovis technology and behavior. Does Clovis, as traditionally envisioned, represent a uniform adaptation that enabled people to sweep across the landscape wielding similar technology and a uniform suite of behaviors? Or, is there a greater range of variation within what we identify as Clovis, with groups adapted or adapting to environmentally distinct environments? Even at first blush, the varied contents, contexts, and distribution of Clovis caches exhibit their potential to address questions regarding regional variation in Clovis adaptions. These questions constitute a consistent thread running throughout this investigation.

Regardless of whether or not Clovis were the original colonists of the New World, and whether or not they did this by specializing in the exploitation of Pleistocene megafauna, there is a general consensus that they ranged across the landscape at scales that are unknown for practically any other known hunter-gatherer groups. This level of mobility doubtlessly placed demands and limitations upon their economy that required special solutions, and require special consideration in reconstructing Clovis adaptations. Among the possible solutions, and those that are easiest to observe archaeologically, are modifications to technology. Caches and the artifacts they contain, as will be elaborated below, provide a window into Clovis technological adaptations that is not afforded by other site types.

Clovis appears to be the only Paleoindian group to have regularly deposited caches of artifacts. This behavior thus far looks to have been conspicuously absent from Folsom, and relatively uncommon for later Paleoindian cultures. It seems clear that Clovis, these highly mobile generalists who emphasized large mammal hunting and colonized a landscape largely, if not entirely, uninhabited by humans, found caching to be a useful component of their adaptation. What were the functions of Clovis caches? Did they all serve the same purpose? Why undertake the risk of losing critical raw material stores? What greater risks may caches have mediated? Why does caching appear to have been regularly practiced in some areas and not in others? The answers to these questions serve to broaden our understanding of the Clovis period, providing insight into the technology, subsistence, mobility, and perhaps the ideology (with regard to treatment of the dead) of Clovis people.

Clovis Caches and the Study of Technological Organization

Many artifacts in Clovis caches clearly convey an impressive degree of skill and artistry that often seems to set them apart from those in other Clovis assemblages, despite the fact that they reflect the same general technology. I argue here that the apparent differences between cached artifacts and those from other Clovis contexts are just that, and with a few exceptions artifacts from caches are comparable to those wielded by Clovis tool users on a daily basis. The fundamental characteristic that does differentiate cache assemblages from other Clovis assemblages is that the artifacts from caches do not appear to have been abandoned because they were worn out or broken, but instead appear to have been removed from the system at earlier stages in their potential use-lives. They stand out because they are not the depleted artifacts that were routinely abandoned at a typical site. For this reason, Clovis caches have more than aesthetic value; they provide a unique window into Clovis lithic technological organization.

Technological organization refers to a collection of strategies for making, using, transporting, and discarding tools and materials (Nelson 1991:57). For lithic tools and materials, these strategies represent a continuum of reduction wherein raw material is acquired, shaped, and reshaped, potentially passing through a variety of stages or forms, until it is discarded or lost. Archaeologists can only observe points along this continuum through artifacts. Because the vast majority of known Clovis sites appear to have been kill or camp sites, the point in this reduction continuum most Clovis artifacts represent is typically the final one -- that of discard. A fundamental problem, then, is that archaeological reconstruction of the artifact forms present in a working toolkit and any corresponding interpretation of technological organization is rendered somewhat narrow or speculative if only such discarded forms are considered. What is needed for a more complete understanding of Clovis technological organization is a type of archaeological assemblage that consists of artifacts at earlier points along the reduction continuum to complement existing data from camp or kill sites. Clovis caches potentially provide this type of assemblage.

Over 20 tightly clustered groups of Clovis artifacts that are spatially separate from other proposed Clovis site types have been proposed as caches. Their designation as caches obscures considerable variability. Included are assemblages ranging in number from a very few to over a hundred items, and in diversity from a single artifact form to multiple forms in various stages of reduction. Given this variation, it is unlikely that all caches served the same purpose. However, by deducing the general function of individual caches, cached artifacts can be systemically linked to abandoned artifacts from non-cache sites, enabling development of a perspective on the Clovis technological system that simultaneously considers early stages through the latest stages of artifact production and use.

Caches potentially provide a window into the Clovis toolkit that we are otherwise lacking, and may allow the most accurate representations of what a Clovis person would have carried in travels across the late Pleistocene landscape. As tools at some point in their use lives between quarrying and discard, cached artifacts also provide tangible evidence of how and in what forms raw material was transported and maintained. In addition to providing a view into the composition of the Clovis toolkit, caches also provide data points on the landscape from which aspects of Clovis land use can be inferred. I argue that the locations of caches that served a utilitarian purpose (i.e. the storage of material for later retrieval) indicate points on the landscape to which Clovis groups planned to return. I further argue that this willingness to invest material in the landscape suggests a degree of confidence on the part of those that placed the cache that future movements were predictable. Further, the specificity of items (for example, formal tools as opposed to early stage cores) provides evidence as to the anticipated activities on those parts of the landscape. The lithic raw material sources represented within the assemblages provide evidence of the overall territories covered by these groups, as well as the directions of their movements. Caches that may be more ritual than utilitarian in function (perhaps not intended for retrieval) can still provide insight into

Clovis lithic reduction and raw material use, and offer rare opportunities for insight into Clovis ritual behavior.

In this dissertation, I review existing assemblages that have been proposed as Clovis caches, and evaluate the accuracy of those interpretations with regard to being cached assemblages that are attributable to Clovis. I then derive a series of expectations based upon ethnographically observed and archaeologically derived caching behavior and use them to interpret the functions of Clovis caches. Informed by these interpretations of cache function, I compare artifacts from the caches to their counterparts from Clovis kill and camp sites to address larger scale issues of Clovis technological organization, including strategies for raw material conservation, mitigation of resource incongruities, and patterns of land use.

Organization of This Dissertation

The following chapters present the background, data collection and analysis, and results of this dissertation. Chapters 2 and 3 situate the analysis in the context of Clovis archaeology, lithic technological studies, and Paleoindian behavior. A review of Clovis research and a perspective on lithic technology and Clovis archaeological sites is presented in Chapter 2. Chapter 3 reviews existing ideas about caches and caching behavior and proposes how cache data relate to the organization of lithic technology. An overview of potential problems inherent in research utilizing data from caches is also presented. The methods used to collect data from cache assemblages and kill and camp sites are presented in Chapter 4.

Chapter 5 provides a background and summary description for each cache assemblage included in this research, as well as three kill and camp site assemblages. The descriptions combine original data with published findings and results of interviews with cache finders, curators/owners, and previous investigators. A determination of the authenticity of each proposed Clovis cache is made based upon this evidence.

Chapters 6, 7, and 8 present a series of analyses aimed at measuring the variables relevant to ascertaining cache function. Artifact classes, remnant utility, and evidence for use are presented in Chapter 6. Chapter 7 traces raw material use. Where possible, raw material sources are identified. Raw material diversity and direction of movement are analyzed. The landscape and archaeological contexts of caches are presented in Chapter 8.

In Chapter 9 I synthesize the results of the analyses and compare the attributes of Clovis cache assemblages to functional expectations derived in Chapter 3, and partition the caches into functional classes. In most cases, caches do not perfectly fit the expectations for any given functional class, but the systematic comparisons provide insight into gross categories of use, and minimally allow an interpretation of ritual versus utilitarian function. Chapter 9 also incorporates the caches into models of Clovis technological organization, addressing the form in which raw materials were typically transported, and what this means with regard to what a Clovis toolkit might look like. The relative economic value of Clovis caches is investigated through comparison with the amount of raw material expended at kill and camp sites. Lastly, Chapter 9 summarizes the results of this research and imbeds them in the context of regional variation in Clovis adaptations, as well as temporal variation in caching behavior.

CHAPTER 2: CLOVIS SUBSISTENCE, MOBILITY, ORGANIZATION, AND TECHNOLOGY

The Clovis culture, best known for its large fluted projectile points found in association with extinct megafauna, occurs extensively in North America, perhaps over the entire continent. The exact age and span of the Clovis period remains rather poorly known relative to many later time periods. A review of reliable dates (all dates are presented herein as radiocarbon years before present, RCYBP) available as of 1993 (V. Haynes 1993; V. Haynes et al. 1984) suggests that we can be confident that Clovis technology was in use between about 11,200-10,900 RCYBP (but see Waters and Stafford 2007 for an alternative interpretation). However, apparently reliable dates expand this time limit from 11,550 RCYBP at Aubrey, TX (Ferring 1995, 2001) to 10,760 RCYBP at Jake Bluff, OK (Bement 2000). Although advances in our understanding of the radiocarbon calibration curve indicate that the relationship between radiocarbon dates and calendar years is complex for this time interval, recent calibrations of the radiocarbon curve suggest this range in radiocarbon dates corresponds to roughly 13,500 and 13,000 calendar years B.P. (Fiedel 1999).

Subsistence

Our interpretations of Clovis subsistence economy are guided by the early discovery of kill sites and the relative archaeological visibility of large mammal bone (Meltzer 1993). Clearly these historical circumstances biased early views of Clovis toward that of specialized big game hunters. While Clovis subsistence is increasingly viewed as more generalized than specialized (e.g. Cannon and Meltzer 2004; Grayson and Meltzer 2002, 2003; Meltzer 2004; Stanford 1991), it is also clear that megafaunal remains are nearly always present at Clovis sites where preservation is adequate (G. Haynes 2002; Waguespack and Surovelle 2003). Most often clearly associated with Clovis sites are proboscideans (*Mammuthus* sp. and *Mammut* sp.) and bison (*Bison antiquus*). Indeed, results of a recent study (Waguespack and Surovelle 2003:342) indicate that proboscideans are present at 79%, and bison at 52%, of all bone-bearing Clovis sites. Less frequent, and less securely associated, are equids, camelids, and other ungulates. Caribou (*Rangifer* sp.) are proposed to have been important in the Great Lakes region and Northeastern North America (Speiss et al. 1984; Meltzer 1988; Johnson 1996).

In cases of exceptional preservation, we have indications that other resources were exploited as well, including smaller mammals, fish, reptiles (especially turtles), birds, and plant resources (Lundelius 1972; Dent 1985; Johnson 1991; Ferring 2001). Clovis hunter-gatherers almost certainly would have exploited a variety of plant resources, but with rare exceptions (e.g. Dent 1985), specific data remain elusive. The relative importance of each of these food items in the Clovis economy has been the subject of ongoing debate (Fiedel and G. Haynes 2004; Grayson and Meltzer 2002, 2004; G. Haynes 2002; Meltzer 1993; Waguespack and Surovell 2003).

This dissertation proceeds from the perspective that, while Clovis hunter-gatherers most likely subsisted on wider range of resources than the meat of mammoth and bison (and possibly caribou), these megafauna were sufficiently important that their distributions were a primary factor in structuring the movements and organization of Clovis people. There are a number of reasons why this might be expected. First, assuming reasonable encounter rates and processing costs (which we may never know with any certainty), large Pleistocene mammals can be expected to rank extremely highly as prey items simply based upon their apparent abundance (given their relative abundance in the paleontological record) and the sheer amount of high-protein calories each kill might yield (G. Haynes 2002; however, see Byers and Ugan 2005). Second, because large prey animals would have had specific biological requirements (e.g. water, a certain quality of grazing or browsing conditions, access to mates, etc.) their distribution and movements were most likely predictable to a degree. Finally, unlike the distributions of many smaller animals and plants, the distribution of these animals was most likely patchy and ever-changing as they moved across the landscape in groups or small herds. A group of hunter-gatherers might expect to be able to procure lower-ranked resources in various locations along the way while structuring their movements according to the observed or predicted movements of the higher ranked large game animals. Thus, I assert that while Clovis might be considered generalists (especially in comparison to later Plains hunters), their organization might best be understood from a perspective that models them as large-game adapted hunters. This perspective is particularly appropriate for the large portions of the North American West, Midwest, and Northeast, but perhaps less useful for the North American Southeast and West Coast where resources appear to have been less patchily distributed.

Mobility and Social Organization

Folsom Paleoindians are convincingly argued to have ranged over territories that are simply huge in comparison to those known among ethnohistoric hunter-gatherer groups (Amick 1996). This interpretation almost certainly applies to Clovis as well. Lithic raw materials were routinely transported hundreds of kilometers from their source areas. For example, the Alibates artifacts in the Drake cache in Colorado were deposited over 700 km from their source along the Canadian River in Texas. Even if the people who deposited these raw materials archaeologically only procured a portion of them directly from the source, these ranges indicated levels of mobility beyond that directly observed for any other hunter-gatherers.

There are a number of reasons why high mobility might be a beneficial strategy for hunter-gatherers during the late Pleistocene. Among these potential benefits are monitoring subsistence resources and patch productivity, interacting with other groups for the exchange of information as well as mates, procuring of lithic and other unevenly distributed raw materials, (Birdsell 1958; Weissner 1977; Kelly 1983; Surovell 2000) and perhaps most importantly, exploration. Clovis may well have been the technology of the first colonists of much or all of the New World. Even if it was not, the world these people inhabited was changing at rates that were perhaps unimaginable until recent history. Groups that were capable of large-scale exploration of the landscape can be expected to have significantly more complete knowledge of the location, abundance, and accessibility of critical resources, even if they were unfamiliar with the immediate area. Further, models of Paleoindian movement indicate, perhaps contrary to expectations, that high mobility is not necessarily a hindrance to reproductive success (Surovell 2000). It may simply be the case that human groups benefit from high mobility and routinely cover very large distances whenever natural and social environmental conditions permit.

The tremendous levels of mobility that characterized Clovis groups logically placed certain constraints upon social organization. Still, among topics about which the least is known, Clovis social organization ranks high. Little direct evidence, aside from the sizes of archaeological assemblages, exists from which to estimate the number of people in Clovis groups, and how much that may have varied among groups and within groups (perhaps seasonally). Much of what we think we know is predicated upon ethnographic studies of recent hunter-gatherers and logical assertions derived from a degree of knowledge concerning environmental and demographic conditions during the Clovis time period. It might be expected that Clovis groups often would have consisted of an extended family group or small number of family groups, but might be characterized by fluctuating numbers resulting from fluidity in group membership. Periodic aggregations have been proposed for early Paleoindians and may have provided opportunities for interaction and exchange, including the exchange of lithic raw material; however, evidence for these aggregations is debated (Hofman 1994).

Clovis Lithic Technology

Clovis hunter-gatherers adapted their lithic technology to meet the challenges of high mobility among diverse environments with varying resource structures, resulting in a generalized and fairly consistent suite of artifacts across the continent (Buchanan 2005). Clovis lithic tool assemblages commonly include fluted projectile points, large bifaces and bifacial cores, blades and blade cores, and a limited variety of smaller bifacial and unifacial tools made on flakes and blades (Boldurian and Cotter 1999; Collins 1999a, 1999b; Ferring 2001; Huckell 2007; Meltzer 1993; Stanford 1991). Bone and ivory tools are less common, but equally geographically widespread components of Clovis assemblages (Bradley 1993; Dunbar 1991; Frison and Craig 1982; V. Haynes and Hemmings 1968; Hester 1972; Jenks 1941; Lahren and Bonnichsen 1974). Clovis lithic assemblages are primarily the products of a heavily curated technology (*sensu* Binford

1978) in which high quality raw materials are procured and conserved through systematic maintenance strategies. Clovis lithic tools are almost always derived from one of three primary reduction strategies: biface, blade, and generalized core.

Clovis technology has been described as first and foremost centered around a bifacial reduction strategy (Bradley 1982, 1993; Huckell 2007; Stanford 1991; Boldurian and Cotter 1999), supporting the proposed link between high mobility logistical foraging and reliance upon bifaces as cores, tools, and by-products of the tool shaping process (Kelly 1988). Large bifaces were initially manufactured from flakes or cores and shaped through systematic removal of thin, wide flakes; in some cases large flakes overshot the opposite margin of the piece (Bradley 1993; Callahan 1979; Huckell 2007; Mallouf 1989; Morrow 1995). For this early flaking careful platform and guide ridge selection and extensive platform preparation were used to thin the core in a well-controlled manner (Bradley 1993; Boldurian and Cotter 1999; Huckell 2007). Huckell (2007) has proposed that these large primary bifaces served as cores from which flakes were removed as needed until they reached a size threshold beyond which they were maintained as cutting implements. At some point the bifacial cutting tool could be further reduced to produce a fluted point, useful as a projectile (Frison 1989; Huckell 1982) and possibly a knife (Kay 1996). When points could no longer be resharpened for continued use as weapons tips, they may have been modified into yet other forms (Collins 1999b; Stanford 1991).

Although not as ubiquitous among Clovis assemblages as bifacial forms, prismatic blades are increasingly recognized as an important aspect of Clovis technology, especially in the south-central and eastern regions of North America (Boldurian and Cotter 1999; Collins 1989, 1999a, 1999b; Green 1964; Huckell 2007; Parry 1994;

Sanders 1990). As suggested for bifaces, blade reduction is considered to be highly conservative of lithic raw material (Nelson 1991; Parry 1994). Collins (1999a, 1999b) recognizes two basic Clovis blade core forms: conical and wedge-shaped. Each was prepared by the creation and maintenance of parallel guide ridges and by bifacial platform preparation. Conical cores were often rejuvenated through the removal of the entire platform with one blow. Micro-wear indicates that blades were either used without further modification or were shaped by retouch into tools such as scrapers and perforators (Collins 1989, 1999a; Boldurian and Cotter 1999; Stanford 1991).

Generalized core reduction is perhaps the least understood mode in Clovis lithic technology, and may represent a relatively more expedient system. Although the informal or unspecialized cores that represent this reduction trajectory are rarely found in Clovis assemblages (but see Hester 1972:107; Huckell 2007:202; Frison and Stanford 1982:155), flakes and other debitage from generalized core reduction are somewhat more common (Huckell 2007). Flakes from generalized core reduction appear to be the result of direct hard hammer percussion and were used without secondary retouch or were modified into laterally retouched flakes, gravers, scrapers, and composite tools (Huckell 2007).

Clovis lithic technology, particularly the biface and blade reduction modes, required consistent access to high quality lithic raw materials in adequate sizes. Accessible sources of high quality materials (e.g. Edwards Plateau chert, Alibates agatized dolomite, and Hartville Uplift chert) appear to have been repeatedly, perhaps systematically exploited. There is little doubt that aspects of group movements were patterned to some degree according to the distribution of raw materials.

Environmental Constraints upon Organization and Mobility: Resource Incongruity

Clovis mobility, organization, and technology were the result of decisions based upon a complex suite of environmental variables, including subsistence resource distribution, raw material resource distribution, as well as social factors, including population density, mating networks, information sharing networks, and social customs. These and other variables would have not only differed across space but fluctuated through time. Arguably the fundamental variables that were under the least human control were the structures of subsistence and raw material resources through time and across the landscape. Fortunately, these are also variables about which we have some degree of knowledge. What is clear from our limited knowledge is that the general distributions of critical resources did not covary across time and space. Instead, lithic raw materials might be scarce in areas of abundant subsistence resources, or vice versa.

That the distributions of subsistence and lithic raw material resources most likely rarely corresponded would have created a fundamental problem. The problem is that certain resources (lithic raw materials) that were absolutely necessary for the procurement of other critical resources (subsistence items) were often not available in the same vicinity. To further complicate matters the primary subsistence resources, those that I argue structured the patterning of the Clovis subsistence economy, were not spatially fixed. From this point on I will refer to this situation as *resource incongruity* (sensu Binford 1980). This problem would have been less severe in environments where subsistence resources were relatively evenly distributed or in close proximity to one another (for example, the North American Southeast), but particularly acute in environments characterized by patchy subsistence resource distributions (such as much of the North American West). Certainly much of the character of Clovis technological organization is in response to substantial resource incongruity. I propose, and will explore in more detail in Chapter 7, that the distribution of Clovis caches as well as other regional variations in Clovis technological organization are a direct result of varying degrees of resource incongruity across the continent.

The remainder of this chapter reviews general classes of archaeological sites that resulted from Clovis movements across the landscape, and introduces the sites from which the data in this investigation are derived.

Clovis Sites

Clovis archaeological sites primarily fall into one of four general classes: kills, camps, quarries, and caches. Current and historical perspectives on Clovis are derived mostly from kill sites, and to a lesser extent from camp sites. Information from caches and quarry sites have guided Clovis archaeology to a lesser degree, but in recent years has begun to be more thoroughly incorporated. Each of these site types represents a particular range of behaviors, and thus stands to contribute different and perhaps complementary information to understanding Clovis adaptations. It is particularly important for this dissertation to clearly differentiate among types of Clovis sites for the sake of comparisons among them. Further, one of the defining criteria for Clovis caches used here (see Chapter 3) is their distinction from other site types.

Kill Sites

Kill sites are locations where prey animals were dispatched and butchered. Fully processing an animal carcass was most likely a procedure that potentially played out across more than one site (for example, initial butchering may have taken place at the location of the carcass, with the resulting meat transported to another site or sites for reduction into manageable units, curing, etc.). Further, a group would most likely have camped somewhere in close proximity to a kill, so in many cases camps and kills are associated with one another. In this study, however, kill sites refer only to the original location of downed prey, as closely as can be determined.

Kill sites are often located around water sources, which would have been attractive locations for both humans and prey animals. These locations can be expected to be more conducive to site preservation than surrounding parts of the landscape, resulting in a potential bias toward kill sites in the record. Further, the preservation is indiscriminate, increasing the likelihood of spurious associations between fauna and archaeological remains. Grayson and Meltzer (2002) reviewed the evidence from 76 sites purported to have yielded evidence of Clovis-age humans killing now-extinct fauna. The authors argue that of these 76 sites, 14 stand up under close scrutiny and can be considered Clovis kills. Of these 14 sites, 12 involve mammoth and 2 involve mastodon. The authors do not consider purported kills involving non-extinct mammals. To Grayson and Meltzer's 14 sites can be added 3 kill sites with clear evidence for bison hunting (Blackwater Draw, New Mexico [Hester 1972], Murray Springs, Arizona [V. Haynes and Huckell 2007], and Jake Bluff, Oklahoma [Bement 2000]). Kill sites are most abundant on the Plains, and are present in lower frequencies in the Rocky Mountains, Great Lakes, Midwest, and Southwest. Despite the lack of direct evidence, it is likely that many of sites in the Great Lakes and Northeastern U.S. that contain caribou remains are also kills.

Kill sites typically contain an array of stone tools including projectile points, bifacial cutting tools, unifacial cutting tools, flakes and blades used as tools, and flakes resulting from the resharpening of cutting tools (Huckell 1999). Projectile points from kill sites are often fragmented or damaged from use, and most likely were discarded due to limited remaining usefulness. Complete points and larger tools that were not damaged beyond repair may have not have been recovered from the carcass or were otherwise lost. Although they are perhaps less likely to be lost, this pattern can be expected to hold true for other artifacts, such as blade and flake tools, as well. Arguably, the majority of tools used in the killing and butchering of a prey animal were transported away from the kill to be used again, with only the worn out or lost tools left behind to become part of the archaeological assemblage. In addition, bone and ivory tools are occasionally found at kill sites, including a mammoth bone tool inferred to be a shaft wrench from Murray Springs (V. Haynes and Hemmings 1968) and a bone rod wedged between mammoth limb elements at Blackwater Draw (Cotter 1937).

Two kill sites, Blackwater Draw and Murray Springs, are incorporated in the present investigation (Table 1; Figure 1). These sites provide examples of typical kill situations at or near water sources. Together, these two sites represent eight mammoth kills and two bison kills. They are discussed in detail in Chapter 5.

Table 1. Clovis Kill and Camp Sites.

Site Name	Site Type	Number of Clovis artifacts	References
Blackwater Draw, NM	multiple kills and camps	ca. 500	Hester 1972; Sellards 1952; Stanford et al. 1990; Boldurian and Cotter 1999
Murray Springs, AZ	kills and camp	ca. 14,000	Haynes and Hemmings 1968; Hemmings 1970; Huckell 2007
Sheaman Site, WY	Camp	ca. 2,800	Frison and Stanford 1982; Bradley 1982

Figure 1. Locations of kill, camp, and quarry sites (1. Blackwater Draw; 2. Murray Springs; 3. Sheaman; 4. Gault).

Camp Sites

Camp sites are locations where a Clovis group stayed, presumably for a period of several days or more, to carry out domestic tasks necessary for daily living, process recently procured resources, and prepare for future resource forays. As stated above, camp sites often are (and might be expected to be) located adjacent to kills. In these cases, however, the activities carried out at camp sites and the resulting artifact assemblages are distinct from kills.

Camp sites are slightly less visible archaeologically than are kills, partly because the faunal components of well-preserved kill sites have drawn attention to them. Also, because they are commonly found on stable ridges and hilltops, camp sites are more likely to be more poorly preserved or obscured by later occupations. To complicate matters further, later site occupants may "scavenge" raw materials from pre-existing sites accessible from the surface, reducing the number of diagnostic artifacts available to the archaeological observer. Of course, they may also add artifacts of their own to the assemblage.

The wide range of activities carried out at camp sites can be expected to have resulted in the deposition of a wide range of artifact types (Bamforth 2002). Camp sites typically include projectile point fragments, resulting both from the removal of impact-damaged points from their hafts and those broken during refurbishment, and projectile point perform fragments broken during manufacture. In addition, the processing of foods and the working of hides, wood, bone, and other materials resulted in the loss and discard of scrapers, bifacial tools, unifacial tools, and expedient flake tools. Further, the production and maintenance of these tools produced unused reduction debris.

For this dissertation, camp sites are represented by assemblages from Blackwater Draw, Murray Springs, and the Sheaman site (Table 1, Figure 1). Together these provide examples of at least four separate camps. Three of these (two from Blackwater Draw and one from Murray Springs) are extensive camp areas adjacent to kill localities (Cotter 1937; Hester 1972; Haynes and Hemmings 1968; Hemmings 1970; Huckell 2007). The Murray Springs camp is directly relatable to the bison kill by refitted artifacts. The Sheaman site camp may represent a smaller, short-term camp (Frison 1982).

Quarry Sites

Quarry sites refer to localities where lithic raw materials were extracted and initially reduced for transport. Although it is clear from the range of raw material types present in assemblages from other classes of sites that Clovis groups quarried stone from a great number of geological sources, and presumably numerous outcrops of these sources, only three have been thoroughly investigated. The Adams site is located in southern Kentucky (Sanders 1990), while both Yellow Hawk (Mallouf 1989) and the Gault site (Collins 1999a:185-190) are located in central Texas. Quarry visits were clearly common for Clovis groups, but the typically undiagnostic nature of quarrying debris and the use of the quarry by later groups make Clovis quarry assemblages difficult to identify. In cases where quarrying debris can be assigned to Clovis, typical artifacts tend to be the result of early stage reduction of the locally quarried material, or discarded artifacts at the end of their usefulness from distant raw material sources.

Quarry sites provide examples of the initial stages of reduction of lithic forms, such as early stage biface and blade cores, while kill and camp sites provide insight into artifacts near the end of their usefulness that were lost or discarded, along with flakes or blades from cores that continue to be useful. What none of these sites regularly exhibit, however, are the forms of lithic tools that remained in use and thus were carried away from the sites when the group moved on. Clovis caches potentially provide this type of assemblage. Data from quarry assemblages, specifically the Gault site (Figure 1) are only minimally incorporated into this investigation, although they represent a fruitful avenue for future research.

Cache Sites

Throughout the last 50 years, material caches attributed to the Clovis culture have been reported from throughout much of the United States. The first reported find was Sailor-Helton from Kansas (Helton 1957). As both hallmarks of Clovis technology (e.g. overshot flaking on bifaces and blade technology) and characteristics of Clovis caches have become better understood in the last few years, more collections are recognized and proposed as potential Clovis caches. I should note that I was not able to include every proposed cache in this analysis, particularly those that came to light as this research progressed. The caches that are included are described in detail in Chapter 5, along with determinations as to which of these can be confidently identified as Clovis caches.

Table 2 lists the 21 reported Clovis caches included in this research; their discovery locations are presented in Figure 2. Some interesting distribution patterns are evident. Despite relatively extensive survey of land and collections (e.g. Brennan 1982; Anderson 1990; Anderson and Faught 1999), none are reported from the Eastern Woodlands (but see Gramly 1988 for a possible exception), the Southwest, Canada, or Mexico. Clovis cache discoveries are concentrated along an arc from the northwestern United States through the Rocky Mountains to the Southern Plains and south-central United States.

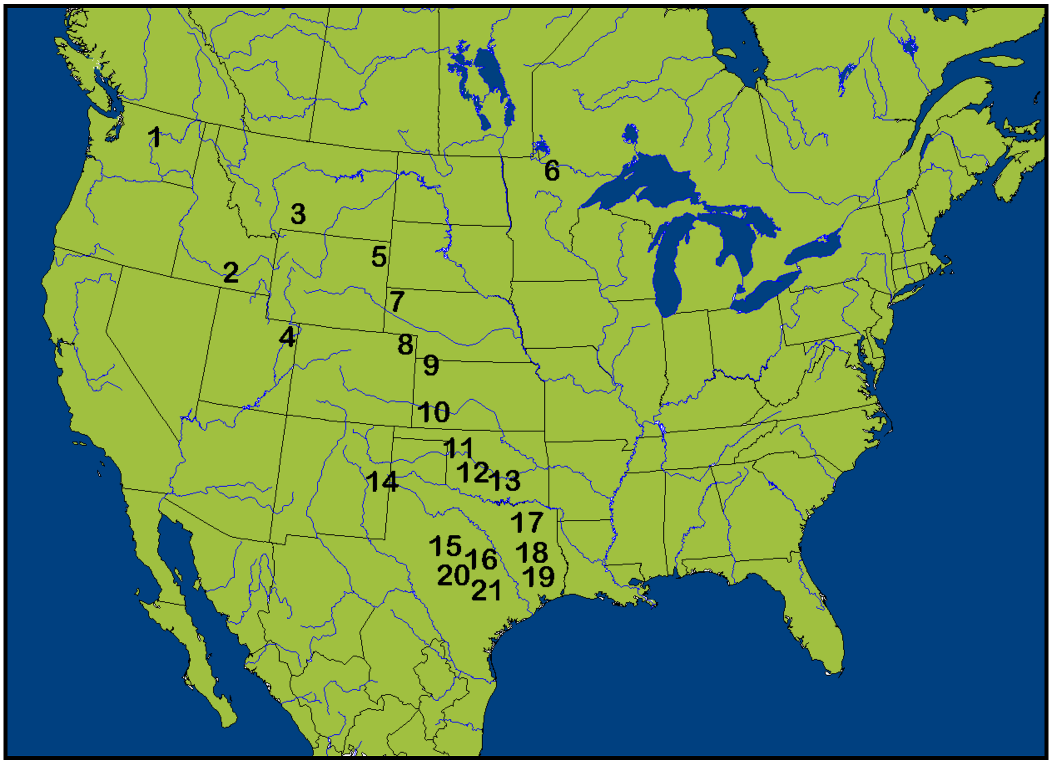

Figure 2. Discovery locations of potential Clovis caches investigated in this analysis. Numbers are keyed to Table 2.

Those caches from the Northwest and Rocky Mountains contain a relatively consistent variety of artifact forms including finished points, point preforms, bifaces, prismatic blades, other stone tools, and bone rods. East Wenatchee, Simon, Anzick, and Fenn are so similar in content and technology that they have been argued to represent a coherent technological adaptation among the initial colonizers of the New World (Wilke et al 1991:243-244). Due to the elaborate workmanship evident in these same caches (including distinct flaking patterns and overall large artifact size), along with the occurrence of red ochre on artifacts from some and skeletal material at Anzick, they have also been interpreted as burial assemblages. The occurrence of use-wear on some of the artifacts within them, however, suggests that some artifacts served utilitarian purposes before being included in the caches.

Table 2. Potential Clovis Caches.

Name	Map #	Number of Artifacts	References
East Wenatchee, WA	1	58	Gramly 1993; Huckell et al in press; Lyman et al. 1998; Mehringer 1988
Simon, ID	2	35	Bonnichson 1977; Butler 1963; Butler and Fitzwater 1965; Muto 1971; Woods and Titmus 1985
Anzick, MT	3	112	Jones and Bonnichsen 1994; Taylor 1969; Wilke at al. 1991
Fenn, WY/UT?	4	56	Frison 1991;Frison and Bradley 1999
Crook County, WY	5	9	Tankersley 1998
Pelland, MN	6	9	Stoltman 1971
Franey, NE	7	74	Grange 1964
Drake, CO	8	14	Stanford and Jodry 1988
Busse, KS	9	78	Hofman 1995
Sailor-Helton, KS	10	165	Mallouf 1994; Helton 1957
Cedar Creek, OK	11	7	Hammatt 1969
Anadarko, OK	12	32	Hammatt 1970; Mckee 1964
Garland, OK	13	41	Duncan et al. 1994 (1994 Plains Conference)
BWD Green, NM	14	17	Green 1963
BWD West Bank, NM	14	5	Montgomery and Dickenson 1992
Eisenhauer, TX	15	1	Chandler 1992
Evant, TX	16	3	Collins 1996; Goode and Mallouf 1991
Keven Davis, TX	17	14	Young and Collins 1989; Collins 1996
Crockett Gardens, TX	18	2	Collins 1996; McCormick 1982
Comanche Hill, TX	19	2	Collins 1996; Collins and Headrick 1992; Kelly 1992
Bastrop County, TX	20	13	Unpublished
De Graffenried, TX	21	5	Collins et al. in prep.
Watts, CO	8	6	Unpublished

Some Clovis caches reported from the Southern Plains and south-central United States (e.g. De Graffenreid, Bastrop County) contain a similar variety of artifact forms to those from farther north. However, most are exclusively, or nearly exclusively, comprised of blades and blade cores. Based upon the association of true blades with Clovis technology (Green 1963; Stanford 1991) and the identification of typical Clovis blade attributes (Collins 1999a), these caches are interpreted to be of Clovis age. Caches that consist of a single artifact type such as blades, or projectile points in the case of the Drake cache (Stanford and Jodry 1988), may represent a specialized toolkit for a particular activity or activities, or may represent a specialized cache.

Despite the growing number of reported Clovis caches, in-depth analyses have been infrequent. Those caches from the Northwest and Rocky Mountains as a group are the most thoroughly analyzed. Technological analyses of both lithic (e.g. Woods and Titmus 1985; Frison 1991; Wilke et al. 1991; Huckell et al. in press) and osseous (Lyman et al 1998; Wilke et al 1991) materials have been reported for most of these. To the south, a few Clovis caches have been subjected to technological analyses (Green 1963; Collins 1996; Collins 1999a), but most reports consist of announcements of discovery along with general descriptions. With the exception of Collins (1999a), comparisons, when they have been made, have been relatively cursory at best in both areas.

This dissertation is primarily focused upon cache sites and assemblages, and their relationship to other sites. In the following chapters I explore caches and caching in greater detail.

CHAPTER 3: CACHES AND CACHING IN THE ARCHAEOLOGICAL RECORD

Unusual artifact assemblages are often described as caches, and caches are often unusual archaeological assemblages. By this I mean that in its archaeological usage, the term "cache" is often assigned to various anomalous collections of artifacts that do not fit expectations for other site types, and that these collections thus require unique consideration. Strictly speaking, a cache describes materials that are placed aside for future use. The archaeological usage has been implicitly expanded to include this meaning as well as other behaviors that result in placing together artifacts into a discrete deposit. This chapter reviews archaeological approaches to caching behavior, with particular attention given to those behaviors expected for hunter-gatherers. It also presents some of the difficulties inherent in research involving caches, and describes how data derived from caches can be used to shed light on lithic technological organization and land use.

Previous Interpretations of Clovis Cache Function

Caching appears overall to be unusual among Paleoindians. Though some form of caching is evident among late Paleoindian cultures such as Agate Basin (Carr and Boszhardt 2003), Plainview (Hartwell 1994), Cody (Ingbar and Frison 1987), and Dalton (Morse 1997), it is thus far not known among Folsom, and appears to be rare overall among less-well dated fluted point horizons. Thus, the relative frequency of caching during the Clovis period stands in contrast to other Paleoindian groups. The reasons for this are not currently known with any degree of certainty. Under what conditions might early Paleoindians be expected to undertake caching as a behavior? What function or functions might Clovis caches have served? The answers proposed for these questions have varied as new cache assemblages came to light and as trends in archaeological thought have changed.

As the database of Clovis caches expanded, frameworks for interpretation progressed. At first caches were treated as anomalies – rather unusual assemblages to be inspected individually (e.g., Grange 1964; Green 1963; Hammatt 1970), and indeed they vary substantially in content. However, a watershed of sorts occurred in the early 1990's, and caching began to be recognized as a regular part of Clovis adaptations. In 1991 George Frison noted that caches could be considered an "institutionalized part of Clovis," and Stanford (1991), in summarizing what was known of Clovis at that time, addressed biface- and blade-oriented caches as fundamentally characteristic of Clovis.

By 1991 five major caches (Anzick, Drake, East Wenatchee, Fenn, and Simon) had become well known and were consistent enough with one another that they appeared to represent, as Wilke (1991:243-244) put it, "a coherent technological adaptation among the initial colonizers of the New World." Anadarko (Hammatt 1970), Franey (Grange 1964), and Sailor-Helton (Mallouf 1994) are argued to be specialized toolkits. Due to the elaborate workmanship evident in East Wenatchee, Simon, Anzick, and Fenn, along with the occurrence of red ochre on artifacts from some and skeletal material at Anzick, these four have also been interpreted as burial assemblages (Frison 1991; Stanford and Jodry 1988; Wilke et al. 1991; Woods and Titmus 1985). The occurrence of use-wear on some of the artifacts within them, however, suggests that those artifacts served utilitarian purposes before being included in the caches.

While these functional interpretations may be accurate, Clovis caches are increasingly seen not as anomalies to be addressed on an individual basis, but as a particular site type that holds keys to organizational strategies that are not easily addressed using data from other sites. More recently, researchers including David Meltzer (2002), Gary Haynes (2002), Michael Collins (1999), and Bruce Huckell (1999) have increasingly viewed caches in relation to other sites, and in the context of organizational strategies.

One perspective is that caches represent the precautions of initial colonizers that are new to the landscape and unfamiliar with local resource distributions. Recall Wilke et al.'s (1991) characterization (quoted above) of Clovis caches as an adaptation of the New World's initial colonizers. Additionally, David Meltzer (2002; 2004:128) proposed that caches represent "transport of stone (in the form of caches) into areas where stone sources had not been located. The cache thus became a fixed and predictable spot on the landscape…that would make it possible to venture farther into unknown terrain and explore it in greater depth." Gary Haynes (2002:247) argues that, if caches represent a strategy associated with colonization, they are single-event phenomena with limited potential for aiding in the understanding of colonization as a process. A simple model aimed at evaluating this perspective is presented later in this chapter, and is tested as a part of this investigation.

Other approaches to understanding caches view them in the context of the more stabilized adaptations of hunter gatherers that were at home on the landscape they occupied. Huckell's (1999) findings indicate that caches may differ primarily from kill and camp sites with regard to what gets left behind; in other words, though they may appear spectacular, the artifacts and technology in Clovis caches may not be so different from those regularly utilized by Clovis people in the contexts of their daily activities.

Michael Collins (1999:182) suggested that the reasons for caching may lie in the generalized subsistence economy of Clovis people, in contrast to the specialized bison hunting economy of later groups (specifically Folsom, but the same might be argued for other groups such Plainview, Midland, Cody, etc.). He argues that caches are consistent with other information that suggest that Clovis were generalized foragers with a regular subsistence round which allowed them to predict future movements. Collins distinguished the Keven Davis cache (along with Anadarko and those from Blackwater Draw) from Anzick, East Wenatchee,Fenn, and Simon, as being utilitarian in the sense that they functioned to store material in regions that are impoverished with regard to lithic raw materials.

In sum, there is no clear consensus on what function these collections of Clovis tools may have served for those that deposited them. However, whether Clovis caches represent specialized toolkits, burial assemblages, strategies for reducing risk during colonization, the stocking of raw-material poor parts of the landscape, or some other function(s) should be evident in data derived from the caches themselves. The primary goal of this dissertation is to ascertain the functions of Clovis caches by comparing cache data with expectations derived for a suite of cache functions appropriate for Pleistocene hunter-gatherers. The relative emphasis placed by Clovis groups on these functions in turn, has implications for understanding Clovis economies.

Archaeological Approaches to Caching

Caches are believed to have served multiple functions for hunter-gatherers (Binford 1979; 1980; Frison and Todd 1986; Schiffer 1987; Schlanger 1981; Thomas 1985). Early approaches to prehistoric caching behavior emphasized the function of caches as hidden storage facilities or spaces (e.g. Green 1963; Tunnell 1978). A single utilitarian function was implied, and understanding the role of caches in prehistoric systems was thus seemingly straightforward. However, ethnographic research (Binford 1979; 1980; Schlanger 1981) has since indicated that caching behavior is more complex. Different kinds of caching behavior have been demonstrated to serve different or multiple functions within a single system. Binford (1980; 1993) differentiates between the caching of material (tools and essential supplies) and food, asserting that the latter should not be expected among foraging groups. However, Clovis food caching in the form of frozen meat has been postulated by Frison and Todd (1986), Frison (1993), and Gramly (1982). Arguments for or against food caching in prehistory are difficult to resolve from archaeological evidence, due to the low probability of preservation of organic material.

Material caches have been further divided based upon their function within an economic system. Binford (1979) defined two types of material caching as derived from his observations of the Nunamuit. *Passive gear* is used seasonally for particular pursuits, is cached during those seasons that it is not in use, and is most common among organized collectors (Binford 1980). In contrast, *insurance gear* is cached throughout a group's territory regardless of seasonality of use and is typically more general, consisting of "what might be needed at the location at some time in the future" (Binford 1979:257). Both foragers and collectors may cache insurance gear.

Based upon a wider range of ethnographic data from the Human Relations Area Files, Schlanger (1981) described five material caching strategies: (1) *moving day caching* refers to the short-term storage of goods to be collected at a later date and is common among groups who make frequent, short, residential moves; (2) *load-exchange caching* consists of storing materials at their place of use in order to free up transport space for other collected items and occurs more frequently among groups who make frequent logistical forays; (3) *storehouse caching* refers to the use of outbuildings for storage among relatively sedentary groups; (4) *seasonal caching* and (5) *insurance caching* follow Binford's (1979) definitions for passive and insurance gear respectively.

Neither of the above studies addresses material caches that have less utilitarian functions. Schiffer (1987) draws a distinction between secular functions (analogous to those described above) and ritual functions. *Ritual caching*, from the perspective of Schiffer (1987), can take the form of dedicatory caches in complex societies, or votive caches among groups at any level of organizational complexity. Thomas (1985) defined a single ritual class of cache for the Great Basin. According to Thomas (1985:35-36), the *afterlife cache* (a ritual cache as opposed to his more utilitarian resource, tool, and communal caches) consists of a specialized anticipatory storage of tools as key items "for subsequent use by somebody" in the afterlife. Burial or afterlife caches, the latter of which is used here, would fall within Schiffer's definition of votive caches. Both Schiffer (1987) and Thomas (1985) assert that differentiation between ritual caches and secular caches is based upon specific context and assemblage characteristics.

Expectations for Interpreting the Function of Clovis Caches

As a specific case of hunter-gatherer caching, Clovis caching is best investigated in the context of generalizations derived from what is known of hunter-gatherer behavior. Many of the functions proposed for hunter-gatherer caches are logically related to particular ranges of group mobility and organization. As summarized in Chapter 2, Clovis groups are modeled as having exploited large territories through both frequent residential moves and long-distance logistical forays (Kelly 1983; Kelly and Todd 1988; Shott 1986). Paleoindian territory size and level of mobility are argued to have exceeded any historically known hunter-gatherer analogues (Amick 1996). This pattern has been described as a “high technology forager” system (Spiess 1984; Todd 1983; Kelly and Todd 1988), in which aspects of forager and collector strategies (as defined by Binford 1980) are combined into a strategy that emphasizes generalized knowledge of prey behavior over detailed knowledge of place. Organization at such an extensive geographic scale renders some proposed functions of caches more likely than others.

Assuming that such ideas concerning the organization of Clovis groups are generally correct, insurance, load exchange, and seasonal/passive gear functions are most likely for utilitarian caches. These three cache functions have immediate economic implications for their users and thus the attributes of corresponding assemblages are expected to be the result of rational decision-making. A fourth functional class, the votive/afterlife cache, is less likely to have been guided by economic rationales. The attributes of these assemblages are affected to a greater degree by religious and ideological beliefs and are expected to be more variable. Expectations for how these four functions might be expressed in the archaeological record (Table 3) provide a way of assigning particular caches to functional categories.

Table 3. Archaeological Expectations for Four Cache Functional Types.

Attribute	Cache Type			
	Insurance	*Seasonal/Passive*	*Load Exchange*	*Afterlife*
Raw material diversity	low	high	high	high
Artifact diversity	low	high	low	high
Utility	high	variable	variable	variable
Use wear	low	high	variable	variable
Distance to raw materials	high	variable	variable	variable
Distance to subsistence resources	variable	low	low	variable
Site context	variable	base camp	activity areas	variable
Other	permanent landmarks?	specialized tools?	--	human skeletal remains? red ochre?

Cache function should be manifested in raw material diversity, artifact diversity, remnant utility, use wear, distance to raw materials, distance to subsistence areas, and site context. In a scenario where the caching of surplus material is planned in advance for the purpose of insurance, raw material diversity can be expected to be low, assuming recent acquisition led to raw material abundance. Because generalized forms (e.g. bifaces) that are useful for a variety of purposes would be desired, artifact diversity is expected to be low and remnant utility high, with a low incidence of use-wear. To be effective, insurance caches should be placed far away from sources of raw materials and might be associated with landmarks or marking features to facilitate their recovery.

Both seasonal/passive and load exchange caches are temporarily removed from the economic system in the forms in which they were being used and maintained. They are thus expected to have relatively high raw material diversity (i.e., richness), as do most assemblages from Clovis activity sites. Because seasonal/passive caching involves tools for a variety of activities and load exchange involves a subset of tools for a specific activity, artifact diversity should be high and low, respectively. Implements cached after a season of use should exhibit a higher degree of use wear than those cached after performing a single activity (use wear on these should vary with individual implements), but both should retain some degree of remnant utility. Because both of these kinds of caches are expected to have been deposited near their places of use, they should occur close to major subsistence resource areas (such as playas, streams, etc) and within or near other Clovis sites. Seasonal/passive caches are expected to be associated with base camps and load exchange caches should occur on special activity sites.

Votive/afterlife caches can be expected to consist of the possessions of the deceased at the time of death, possibly augmented by offerings from what was being carried by other individuals. Both raw material diversity and artifact diversity are thus expected to be high. Remnant utility should be high if the implements were intended to be useful to the deceased, but use wear might vary according to the histories of individual artifacts. Human skeletal remains and red ochre coatings on artifacts might also be expected with votive/afterlife caches in contexts that permit their preservation.

These expectations are used as the basis for evaluating the functions of individual Clovis caches in Chapter 6. Though every cache cannot be expected to fall neatly into one of these functional categories, due in part to the complexities of investigating Clovis caches described below, the expectations provide a means of partitioning the range of variation in cache assemblages based upon variables that are relevant for the investigation of the organization of technology, and provide a basis for proposing and evaluating alternative functions.

As discussed above, a more specific proposal for the function of Clovis caches is as a form of security while exploring and colonizing new areas. Whether or not caches are primarily a phenomenon associated with colonization will be addressed simultaneously with other models of cache function described above. Assuming that the origin of colonizing Clovis populations was in the Northern Plains or far Northwest, the model should result in the movement of people, and thus raw materials, in generally southerly and easterly directions. While particular areas (say, on the scale of a drainage basin) may have been initially explored and colonized from some other direction, an overall pattern of southerly and easterly movement of raw material at a regional scale can be expected to prevail. Further, if caches represent emergency stores of material for wandering explorers, we can expect them to be generalized and diverse – capable of supplying someone with materials necessary for meeting a range of conditions that cannot be fully predicted. They can be expected to consistently include a diverse array of tools useful for carrying out a wide range of tasks. An alternative perspective is that materials were cached by people who already knew the landscape and corresponding resource distributions quite well, and moved raw materials in accordance with this knowledge. In this scenario, the movement of raw materials in a particular direction was done by design. In sum, if caches are a colonization phenomenon, they are expected to reflect general northwest-to-southeast movement of raw materials and to consistently contain a diverse (generalized) array of artifact classes. These expectations are evaluated in Chapters 6 and 7, and summarized in Chapter 9.

Challenges Inherent to Research Involving Caches

Caches are a class of archaeological assemblage that differs in several important ways from more typical assemblages from archaeological sites. Thus, the investigation of caches poses some unique challenges to the researcher, as well as some traditional archaeological challenges that are magnified by the nature of the cache assemblage. The primary problematic issues for the archaeological investigation of caches include defining "cache" as an assemblage class and assigning cultural-temporal affiliation to a collection of items identified as a cache. In addition to these primary issues, additional matters regarding context and recovery, assemblage size and completeness, and authenticity provide challenges to archaeological research involving caches.

Defining "Cache"

An initial and fundamental problem lies in defining precisely what does and what does not constitute a cache. As traditionally defined, a cache is expected to represent storage of goods for use at some later time. As used in the Clovis archaeological literature, however, the term cache has been used to represent a variety of concepts regarding collections of artifacts. At present there is no single satisfactory definition of what constitutes a Clovis cache, and even less agreement as to what role these assemblages played in the lives of Clovis hunter-gatherers. Collins (1999a:173) summarizes well the traditional implicit criterion for caches as "tightly clustered groups of artifacts identified as Clovis." That all of these do not necessarily represent the result of caching behavior in a technical sense is a nagging issue recognized by Collins and others (e.g. Frison 1991; Huckell in press; Meltzer 2002; Wilke et al 1991). It is particularly those that may represent burial or other ritual assemblages that complicate a simple scenario of artifact storage for "cached" assemblages. If, however, burial assemblages represent collections of essential resources to accompany the dead into an afterlife, they may not be so different from caches intended for later retrieval by the living. This is more or less what was proposed for afterlife caches by Thomas (1985), and specifically for Clovis burial caches by Wilke et al. (1991) and Huckell (1999:5), and is discussed in more detail below.

A relatively broad definition of the Clovis cache is adopted here, because an understanding of the character and function of tightly clustered assemblages of Clovis artifacts is a goal, as opposed to a presumption, of this research. Caches are to some extent defined by default; that is, they do not appear to correspond to other proposed site types for Clovis groups, such as kill, camp, or quarry sites (although they may occur as discrete clusters within these). In addition, they are composed of implements and materials that are tightly clustered in space, the residue of their manufacture or maintenance is usually not present, and the only activities they directly reflect are those associated with the act of their deposition.

Assigning Cultural-Temporal Affiliation

Caches of lithic artifacts are not entirely uncommon in the North American archaeological record, particularly among mobile populations. Caches of Archaic period lithic tools and materials are well known from the Plains (e.g. Tunnell 1978; Hurst 2002; Wiseman et al. 1994). Paleoindian groups that post-date the Clovis period, particularly Agate Basin (Carr and Boszhardt 2003), Plainview (Hartwell 1994), and Cody (Ingbar and Frison 1987) are known to have deposited lithic artifact caches as well (but at much lower frequency). Because contextual information is often poorly known or entirely unavailable for cache assemblages (as discussed below), cultural-temporal affiliation is best ascertained through technological and stylistic hallmarks when diagnostic artifacts are not present.

The attribution of caches to the Clovis culture is ideally based upon diagnostic Clovis artifacts, such as fluted projectile points and beveled bone or ivory rods, and supported by chronometric dating. Lacking these, Clovis affiliation is supported by technological hallmarks, such as systematic overshot flaking on bifaces (Bradley 1993; Huckell in press) and prismatic blades produced from prepared cores (Collins 1999a).

For many potential Clovis caches that lack projectile points, blades and blade-like flakes are the artifacts that are most suggestive of Clovis affiliation. Blades are a regular component of assemblages from secure Clovis contexts; however, these artifacts are known from later prehistoric contexts in some areas as well. Most notably, blade reduction technology is recognized in Upper Republican sites (Roper 2001), and these overlap geographically with Clovis caches. Similarly, a number of potential Clovis caches contain only bifaces and preforms that are not entirely reliable as diagnostics. In both of these cases, the assignment of Clovis affiliation is based upon an assessment of whether a greater number of technological features is consistent with artifacts from secure Clovis contexts or those from secure non-Clovis contexts.

Context and Recovery

The circumstances of cache discoveries vary, but generally involve industrial earth removal or erosional events and recovery by avocationals; recovery during professional archaeological excavation is a rare exception. Of the 21 cache assemblages considered here, nine were discovered at the surface and have limited stratigraphic information. Nine were discovered during industrial activity (plowing, grading, construction, etc.) and the conditions under which two (Fenn and de Graffenried) were found are unknown. With regard to recovery, only in the case of East Wenatchee was the majority of the assemblage recovered through professional excavation. Professionals recovered three from the surface. Recovery was through a combination of amateur and professional activity in four cases, where amateurs excavated the majority of the assemblage and professionals carried out subsequent excavations in attempts to recover some information about the stratigraphic context of the find and search for additional items. The remaining nine were recovered from surface or shallowly buried contexts by amateurs.

The result of the conditions under which these assemblages were discovered and recovered is typically very limited information concerning the stratigraphic context of the assemblage, the spatial relationships of items within it, and the possibility of related features. While some of this information can be gleaned from interviews with the finders of the assemblages or their current owners, it is often incomplete or in some cases contradictory. Lacking notes from professional investigations, the best way to proceed is to rely upon that information that is consistently supported by numerous informants or by additional observations.

Assemblage Size and Completeness

It is difficult, and perhaps impossible, to ascertain to what extent a cache assemblage as it currently exists accurately represents what was originally deposited. Several factors affect cache completeness. Perhaps the most obvious limitation is the decomposition of organic artifacts. Bone or ivory is occasionally preserved; however, it may never be known what amount of bone, wood, leather, or plant material may have once accompanied a cache. Some items originally relating to the cache may never have been recovered. Post-recovery processes that potentially affect assemblage completeness include the loss or trade of particular items by the assemblage owners. Perhaps they were overlooked or transported away from the majority of the assemblage by natural (e.g. fluvial or eolian action, erosion) or cultural (e.g. industrial equipment, construction) processes. Further, the possibility always exists that some portion of the original assemblage was removed by those who created it or by other discoverers at any point in prehistory.

In addition to the loss of items, caches may actually gain items through time. The simplest way this might happen is that items that are coincidentally deposited near the cache might be added in during recovery. Another (and perhaps more likely) scenario is that items may get mixed into the cached assemblages as larger collections are donated or traded, or original owners pass away and their heirs do not know exactly which specimens in the collection belong to the cache. This appears to be the case with the Watts cache, in which four artifacts donated along with the cache do not appear to belong with it.

Even if complete, cache assemblages tend to be small. The number of artifacts in the potential Clovis caches investigated here range from 3 to 165 items. Theoretically a cache assemblage (or at least its inorganic contents) could be considered for comparative purposes a population as opposed to a sample. Because a cache may never be confidently regarded as complete, however, they are most conservatively viewed as samples of some once-larger assemblage. These small frequencies frustrate robust statistical comparisons and require the use of techniques that account for small sample sizes.

Authenticity

Antiquities draw remarkable prices among private collectors; Paleoindian projectile points are often valued in the thousands of dollars even as individual artifacts, and complete Clovis caches have been valued in the millions. The monetary value placed on these items has unfortunately resulted in the occasional forgery of artifacts – the manufacture of artifacts with the intention of passing them off as authentic. Clovis flintknapping skill is by no means easy to duplicate, but a handful of modern flintknappers with exceptional skill and knowledge of Clovis lithic technology can produce specimens that are extremely difficult to differentiate from prehistoric artifacts. An example of a nearly perfect attempt to pass off a collection of modern replicas as an authentic Clovis cache is reported by Preston (1999). In this case, the replicator carefully left projectile points slightly imperfectly finished, ground the bases, simulated edge damage and surface weathering, and even broke and resharpened tips. The points were successfully sold, but did not pass in-depth examination due to plastic residue and red clay (rather than red ochre) on their surfaces.

Perhaps the only way to address the issue of authenticity is to be aware of the possibility that not all reported Clovis caches are authentic and to remain vigilant of both the small details of manufacture and weathering as well as the reliability of information on the origin of the collection. That stated, I have not found convincing reasons to believe that any of the assemblages investigated in this research are not authentic, and am proceeding under the assumption that they are indeed of Clovis age. It is apparent that many of these issues cannot be resolved with absolute certainty. Decisions in some cases come down to subjective judgment on the part of the investigator. Perhaps the best procedure is to be explicit about the available evidence in support of that judgment and to acknowledge uncertainties where they exist.

CHAPTER 4: DATA COLLECTION METHODS

To carry out the two primary goals of this dissertation, two distinct but interrelated data sets are needed. The evaluation of cache function requires data on the contents and contexts of the caches themselves. These data provide the basis for measuring raw material diversity and distance to source, artifact class diversity, remnant utility, use wear, distance to subsistence resources, and site context (as presented in Table 3). To compare cache assemblages to those from kill and camp sites requires data on lithic reduction from the latter assemblages that are capable of linking them technologically to caches. It bears mentioning that opportunities to analyze some of the assemblages herein are rare (due to issues including permission to access collections, widely scattered private collections, items in sealed museum displays, etc.); even so an effort was made to collect as much data as possible (though not all of it is utilized in this dissertation). The methods used to collect these data are presented in this chapter.

Data Collected For All Specimens

For the purposes of data collection, artifacts are identified by technological/functional categories, such as projectile points, bifaces, cores, flakes and tools made from flakes, blades and tools made from blades, bone or ivory rods, or other. The last class is a catch-all category that includes specimens that do not fit in the other categories (e.g. hammerstone, shell, etc.). Artifact classes are more specifically defined below. Certain data are collected for all lithic artifacts, regardless of artifact class (Table 4). Data specific to a particular artifact class are described individually below.

The primary equipment used for data collection includes a PaleoTech digital caliper with 200 x 0.01 mm scale and digital interface, an Ohaus 1200 x 0.1 g portable digital balance, a Bausch and Lomb stereo light microscope with 10-70x magnification, and an Epson PhotoPC 3100z digital camera with 4.8 megapixel resolution and macro lens capability. Additional specialized tools are described below where appropriate.

Table 4. Data Collected from All Lithic Artifacts.

Measurement	Description	Device
Portion	Complete, or proximal, medial, distal fragment	Visual
Weight	Weight in grams to nearest 0.1	Balance
Lmax	Maximum dimension of longest axis	Caliper
Wmax	Maximum dimension perpendicular to long axis	Caliper
Thmax	Maximum thickness	Caliper
Midpoint	Width and thickness at the midpoint of Lmax	Caliper
Edge Damage/Breakage	Breaks, chips, striae, polish	visual, 70x magnification
Raw Material	Rock type, source, cortex	visual, UV lamp
Images	High resolution from three perspectives	digital camera

Raw Material

Raw material identification and sourcing provide the basis for measuring raw material diversity and the distance to sources. Identification of raw materials proceeded according to the steps recommended by Luedtke (1992:109-111) for identifying chert sources. First, possible sources for a material were determined based upon regional archaeological and geological literature, along with consultations with archaeologists familiar with regional raw materials. Visible properties (including those visible under magnification) were used to narrow down the range of possibilities. Ideally, these would not be the only criteria of source identification. But, given the inability to physically sample artifacts for compositional analyses, reliance upon visual characteristics and nondestructive analytical methods provides the best alternative (Banks 1990). Certain raw material sources, due to their elemental composition and structure, respond differently to x-ray and ultra-violet (UV) wavelengths, emitting unique reflective signatures. X-ray fluorescence (XRF) reveals differences in chemical composition, while use of UV light reveals the general response of stone to radiation exposure (Banks 1988; Shackley 1988). X-ray and ultra-violet examinations are both nondestructive; however, because XRF requires shipment of the specimen to a laboratory, a portable shortwave/longwave UV light system was used most often as a complement to visual inspection for differentiating raw materials.

As expected, some artifacts could not be attributed to a specific geological source, but the methods outlined here allowed assessment of how many individual sources are represented in each assemblage and in what proportions. Where possible specific, named lithic raw material sources (e.g., Edwards Plateau chert, Knife River flint, etc.) were identified. Both identified and unidentified raw materials were described qualitatively. In some cases, these descriptions allowed the minimum number of nodules represented in an assemblage to be estimated.

When present, the extent and nature of cortex was measured to provide information on material procurement and consumption. For blades and flakes, cortex was recorded as absent, constituting less than 50% of the exterior surface, or greater than 50% of the exterior surface. In the case of cores, cortex was estimated as a percent of the entire surface (including all sides of the object). The nature of the cortex, specifically whether it is primary (reflecting the bedrock matrix of the material) or secondary (reflecting the effects of weathering and fluvial transport processes), was recorded in order to distinguish the acquisition of raw material from bedrock outcrops or from naturally transported contexts.

Portion

Because some analyses incorporate only complete artifacts, each specimen was recorded as complete or as a fragment. Fragments are recorded as proximal, medial, or distal. Proximal is defined as the portion of hafting or prehension for most tools (e.g., the basal area for projectile points), the end containing more mass for assymetrical bifaces, and the initiation (i.e., platform, if present) for flakes and blades. Cores are considered complete. Distal is defined as the opposite end from the proximal, typically consisting of either the working end of a formal tool, or the termination of a flake or blade. A medial fragment lacks both the proximal and distal ends.

Dimensional Measures

Measurements of size are important for basic comparisons of artifact classes, especially with regard to comparing artifact classes from caches to those from kill and camp sites. In addition to weight in grams, each item was measured for maximum length (Lmax), width (Wmax), and thickness (Thmax) (Figure 3). Length is defined as the maximum distance along the proximal-distal axis of the specimen. Width is the maximum distance perpendicular to length, and thickness is the maximum distance across the third dimension perpendicular to both length and width. For complete artifacts, width and thickness measurements are also taken at the midpoint of the length of the specimen.

Use Wear and Breakage

The degree to which items in caches have been used before being cached is one of the variables used to distinguish among cache functions. Lithic tools were examined for wear and breakage resulting from use, as well as from prehistoric transport (Huckell et al. 2002) and damage. Prehistoric damage may also include cases of ritual or accidental burning. In many cases, the circumstances of discovery, recovery, and recent storage of assemblages have resulted in damage to artifacts. Recent damage was in some cases discernible through differential surface weathering along breaks, distinctive breakage patterning resulting from heavy equipment (Odell and Cowan 1987), and by visible residues (for example, metallic residue resulting from plow damage in the Keven Davis cache [Kay 1999:131-138]).

Inspection of artifact edges was carried out at 10-70x magnifications utilizing a binocular microscope. Low-power techniques have been demonstrated to be reliable for the identification of the presence and location of use-wear (Odell and Odell-Vereecken 1980; Shea 1987). Microscopic examination focused upon measuring the placement, orientation, dimensions, and frequency of breaks, chips, striae, and polishes. The point of these observations is not to identify the ways tools were used or the materials on which they were used, only to identify those artifacts used as tools. Further, the recognition of transport wear provided information on the forms in which items were transported.

Red Ochre

Earthy hematite, or red ochre, is found adhering to artifacts in some Clovis caches. This mineral pigment has been found in a variety of early Paleoindian archaeological contexts including habitations, caches, burials, tools, and kills (Roper 1991), and is incorporated here into expectations for distinguishing afterlife caches from other types of caches. I inspected artifacts for the presence of red ochre residue during the microscopic examinations. The time and cost of performing electron microscopic and X-ray diffractometric analyses for sourcing (e.g., Tankersley et al. 1995) outweigh their usefulness for this research, due in part to the small number of red ochre sources in the western U.S. that have been sufficiently characterized (Erlandson et al. 1999). Simply observing the presence or absence of red ochre and its distribution on the surface of artifacts highlights differences among individual caches and imply differences in their functions.

Data Collected for Specific Artifact Classes

In addition to the data described above, other specific data were collected for individual artifact classes. Data specifically collected from projectile points, bifaces, cores, flake and blade tools, flakes, blades, and bone or ivory rods are described below. These classes were chosen because they are primarily technologically defined and therefore require no interpretation of tool function. An obvious exception is the projectile point class (technically a subclass of bifaces); however, the traditional definition of this tool type, along with its frequency in assemblages, warrants its consideration as an individual artifact type.

Projectile Points and Bifaces

Additional data for projectile points and bifaces consists primarily of basal attributes (for projectile points) and flaking attributes (for projectile points and bifaces). The projectile point class includes only finished projectile points; preforms are not included. Finished projectile points are identified primarily upon the presence of basal and lateral grinding. In addition, basal thinning or fluting, and retouching of blade edges to produce overall symmetrical and even margins, support the assignment of an artifact to the projectile point class. For projectile points, the base is the portion defined by the extent of external marginal grinding. Basal characteristics include shape, basal width (Wb), maximum basal width (Wmaxb), length of grinding (Lgr) on both margins, length of flute (Lfl) scars on both faces, maximum basal thickness (Thmaxb), thickness within flute (Thbfl), and depth of basal concavity (Db) (Table 5; Figure 3). In addition, evidence for repair and maintenance of the projectile point, including the type of repair, location, and extent, was recorded.

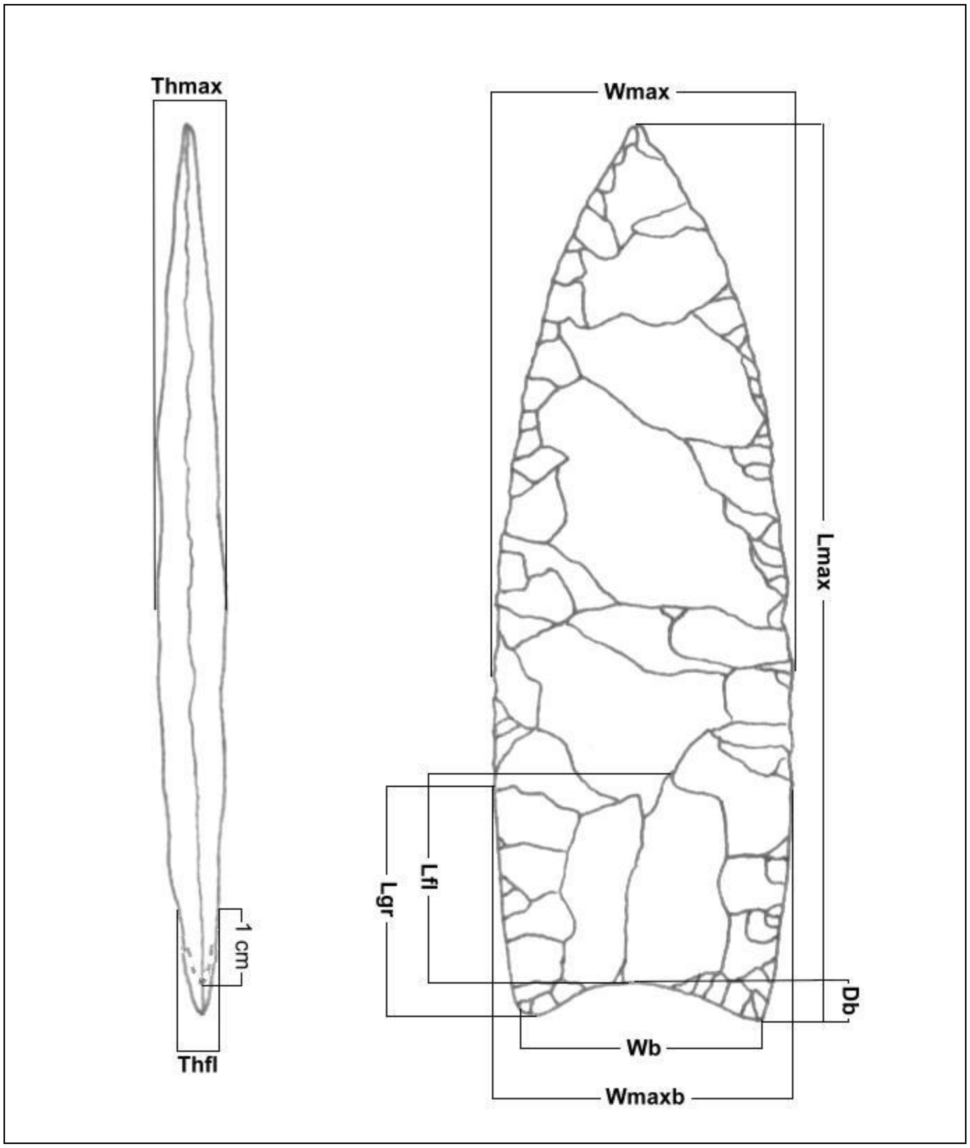

Figure 3. Measurements taken from projectile points. Also illustrated are measurements taken from all specimens (Lmax, Wmax, Thmax).

Table 5. Additional Data Collected from Projectile Points.

Measurement	Description	Device
Shape	Basal shape: flat, concave, or convex	Visual
Lfl	Length of flute scar from initiation to termination (both faces)	Caliper
Lgr	Length of edge grinding if present	Caliper
Wmaxb	Maximum basal width	Caliper
Wb	Basal width at proximal end	Caliper
Thmaxb	Maximum basal thickness	Caliper
Thbfl	Thickness at 1 cm from initiation of channel flake	Caliper
Db	Depth of basal concavity, if present	Caliper
No. of overshots	Flake scars that extend to the margin opposite from the margin from which the flake initiated	Visual
No. past midline	Flake scars that extend beyond the midline of the artifact	Visual
Repair	Location, length, description of repair	visual/caliper

Non-projectile point bifaces may have served a variety of purposes, ranging from cores for flake production to cutting tools (Boldurian 1991; Kelly 1988; Wilke et al. 1991); however, due to similarity in form and approach to reduction, they are conceived of here as belonging to a general analytical group. Bifaces are defined as artifacts with two distinct worked faces, both of which contain flake scars that extend at least one third of the way across each face. This arbitrary criterion serves to distinguish between bifacial reduction as a strategy and bifacial retouch resulting from resharpening a large flake or other piece of raw material. Artifacts traditionally interpreted as projectile point preforms are included in this group. For both bifaces (Table 6, Figure 4) and projectile points, two additional flaking attributes were recorded for each face. The number of overshot flakes is the number of flake scars, complete or partial, that terminate at or beyond the opposite margin. The number of flakes past the midline is the count of flakes that extend distally of the midline of the biface.

Table 6. Additional Data Collected from Bifaces.

Measurement	Description	Device
No. of overshots	flake scars that extend to the margin opposite from the margin from which the flake initiated	visual
No. past midline	flake scarst that extend beyond the midline of the artifact	visual

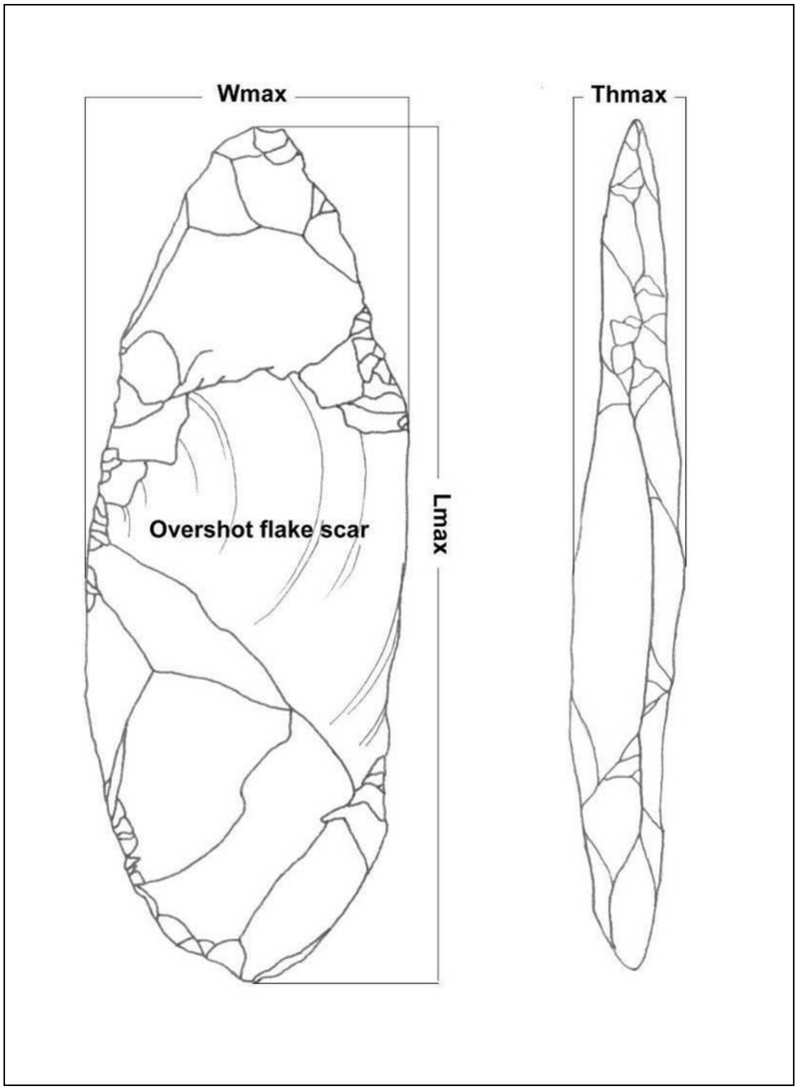

Figure 4. Measurements and landmarks taken from bifaces.

Cores

The core artifact class includes all specialized (i.e., blade cores) and unspecialized core forms (generalized cores). Core attributes, as with those recorded for flakes, are directly related to reduction technology and have been successfully utilized to interpret and reconstruct lithic reduction strategies (Baumler 1994; Kuhn 1995). Clovis blade cores may be conical or wedge-shaped (Collins 1999a), but shapes that allow systematic detachment of roughly parallel-sided removals that follow the ridges left by previous detachments characterize both forms. Consistently producing blades requires relatively precise platform preparation, shaping of guide ridges, and maintenance of core shape (Collins 1999a).

Generalized cores are characterized by more opportunistic and less systematic reduction than blade cores. Although characteristics of some generalized core detachments indicate that they were planned in advance, there may be wide variation in the shape and size of these removals. Accordingly, the sizes and shapes of generalized cores vary widely, but have in common a less systematic reduction strategy than that reflected in blade cores.

Additional measurements for cores describe their platforms and faces (Table 7; Figure 1), and include the number of platforms from which flakes or blades have been detached, the orientation of those platforms; the angle created by the intersection of the platform and the core face (PfA), and the number of flake or blade scars visible.

Table 7. Additional Data Collected from Cores.

Measurement	Description	Device
No. Plat	Number of platform surfaces	visual
Platform Orientation	Orientation of secondary platforms relative to primary platform	visual
Platform Angle	Exterior platform angle	goniometer
No. Scars	Number of flake or blade scars	visual

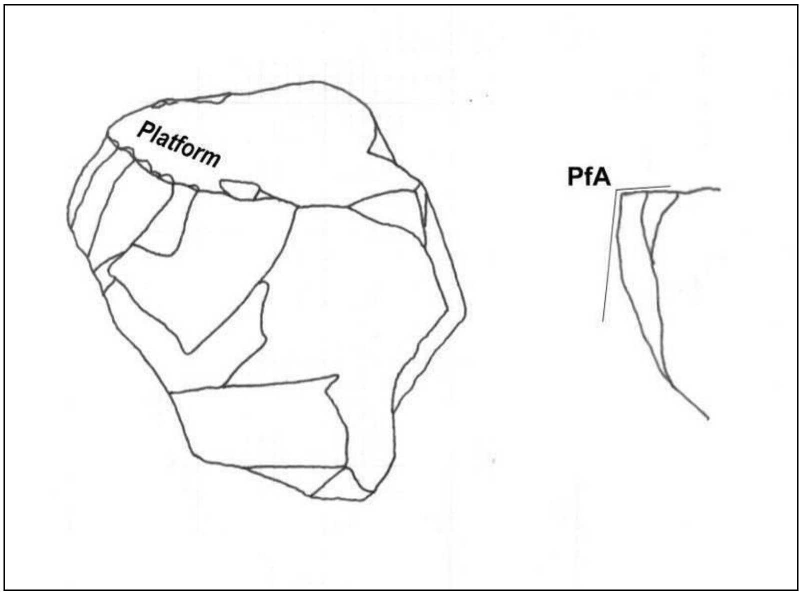

Figure 5. Additional measurements and landmarks for cores.

Flakes and Blades

Flakes are removals from a core, whether bifacial or generalized. Blades have been variously defined, (e.g., Bordes 1961, 1967; Collins 1999:7-9; Crabtree 1972:16). A flake that is at least twice as long as it is wide has served as a traditional definition (Bordes 1961), but a more specific definition of a blade is needed. Here they refer to products of the systematic reduction of specialized core forms. Because blades are a specialized form of flakes, there is potential overlap between the two definitions. As is the case for any reduction technique, aspects of the detached piece reflect the character of the core from which it was derived. For the purposes of this research, in order to be considered a blade a detachment must meet at least three of the following five criteria:

1. Platform is small, isolated and/or ground, with an angle of 60-90 degrees
2. Relatively parallel non-wavy lateral margins
3. Parallel flake scars present
4. Profile curvature skewed to distal end
5. Cross-section is triangular, prismatic, or trapezoidal

These criteria are designed to reflect characteristics of the reduction strategy and the core, and allow the assignment of even a fragment (i.e., lacking a platform and/or termination) to the blade or flake class in a replicable and consistent manner. Furthermore, they are conceived with regard to technological strategies as opposed to morphology. For example, flakes that are simply twice as long as they are wide (a definition proposed by Bordes [1961]) might be produced by a variety of reduction strategies. It is proposed here that the combination of characteristics listed above monitor the technical aspects of blade core reduction more directly than those based upon gross morphology.

Additional data collected for blades and flakes (Table 8; Figure 6) include observations describing the platform (PfW, PfTh, and PfA), lipping at the juncture of the platform and interior surface, the prominence of interior surface features (bulb and ripples), and the number and angle of flake scars on the exterior surface. Exterior platform angle (PfA) is preferred to interior platform angle because the former corresponds to the angle measured from cores. Each of these attributes is linked to general technological parameters regarding flake production and to the degree of reduction they represent (Collins 1996, 1999; Cotterell and Kamminga 1990; Dibble 1985; Magne 1985; Shott 1994; Teltser 1991, among others). In addition, an index of curvature is calculated for blades, based upon maximum depth from a straight line between the proximal and distal ends, as described by Collins (1996, 1999) and demonstrated by him to be effective for the description and comparative analysis of blade assemblages.

Table 8. Additional Data Collected from Blades and Flakes.

Measurement	Description	Device
Dc (blades)	Maximum depth (see Collins 1999) (complete specimens)	caliper
Curvature (blades)	Longitudinal curvature (Depth/Max. L x 100)	calculated
PfW	Maximum width of platform	caliper
PfTh	Maximum thickness of platform	caliper
PfA	Exterior platform angle (nearest 10^o)	goniometer
Platform type	Cortical, simple, dihedral, faceted	visual
Grinding	Presence of absence of platform grinding	visual
Lip	Presence or absence of lip at platform juncture	visual
Bulb	Absent, weak, or strongly formed	visual
Ripples	Absent, weak, or strongly formed	visual
Scars	Number and angle of exterior flake scars	visual

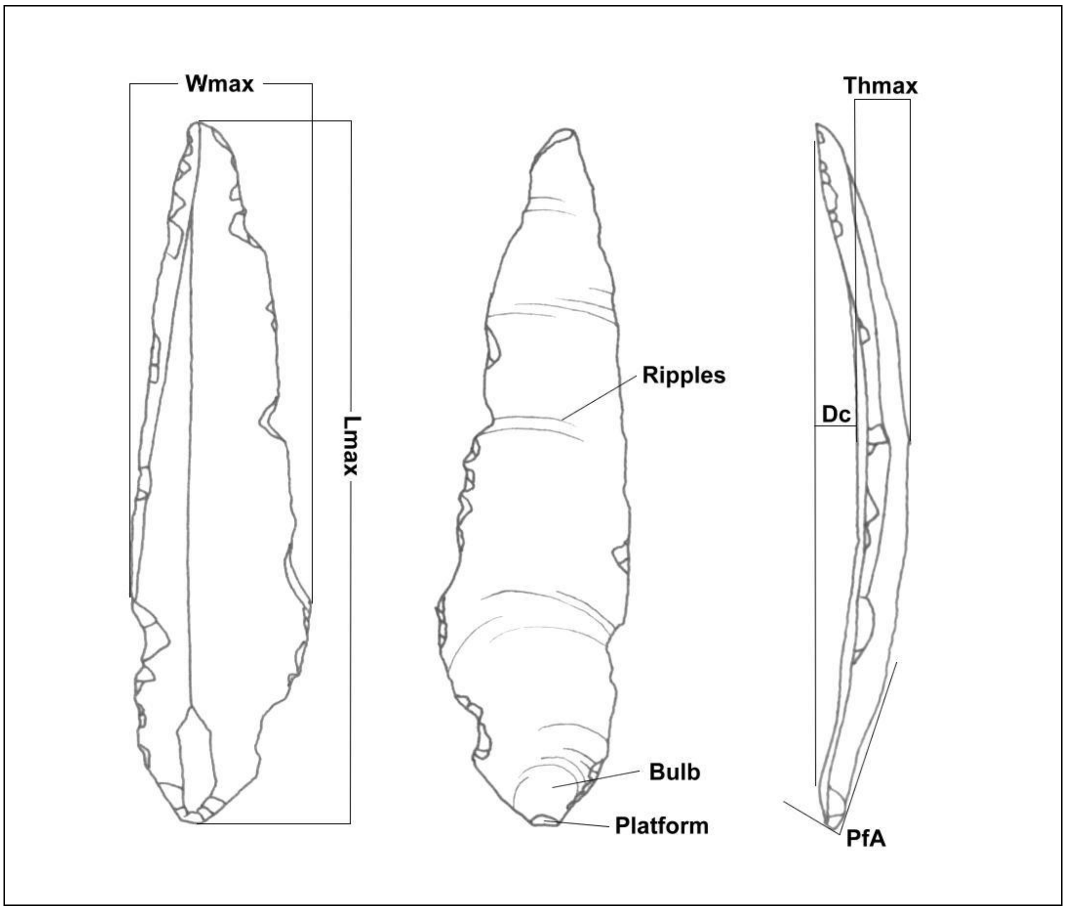

Figure 6. Additional measurements and landmarks for blades and flakes.

Tools Made on Flakes and Blades

The technological data described above were collected for all tools made on flakes or blades as appropriate. Flake and blade tools were identified based upon patterned edge retouch or clear use-wear. For tools, in addition to the technological data, the number, length (EgL), edge angle (EgA) and shape of working edges was recorded (Table 9; Figure 7). Edge angles of the working edges were measured with a goniometer. In addition, tools were identified according to traditional functional categories (e.g., end-scraper, graver, etc.).

Table 9. Additional Data Collected from Tools Made on Flakes and Blades.

Measurement	Descripton	Device
No. Working Edges	Number of discernible working edges	visual
EgL	Maximum length of working edge	caliper
Shape	Straight, sinuous, concave, convex	visual
EgA	Angle of working edge	goniometer
RT	Presence and type (unifacial or bifacial) of retouch	visual

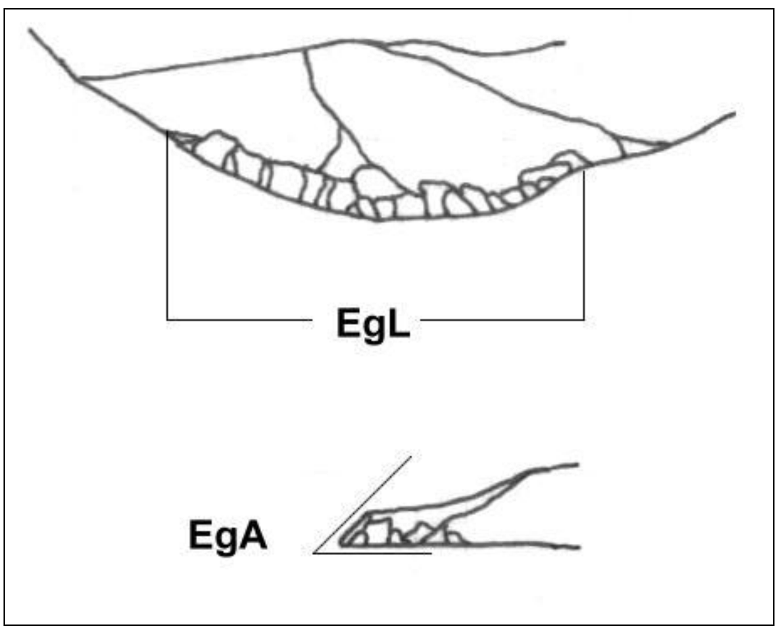

Figure 7. Additional measurements taken from blade and flake tools.

Bone or Ivory Rods

Rods of bone and ivory are reported from Clovis caches and other Clovis sites (e.g., Frison and Craig 1982; Hester 1972; Jenks 1941). The rods may be pointed or beveled and often exhibit incised lines or cross-hatching on their surfaces (particularly on bevels). The function of these artifacts has been the subject of much research and speculation (Lyman et al 1998; Lahren and Bonnichsen 1974; Wilke et al. 1991; Gramly 1993; Boldurian and Cotter 1999). Although bone and ivory rods do not play a central role in this research, data that help to determine their method of manufacture and use may aid in the interpretation of the function of those caches in which they occur. Data collected for bone and ivory rods include raw material, dimensions, embellishments, modifications, and morphology (Table 10; Figure 8), paralleling those for lithic artifacts, with some additions. These attributes follow and complement those found by Lyman et al. (1998) to be useful in evaluating variation in the form and function of rods from the East Wenatchee cache.

Table 10. Additional Data Collected from Bone or Ivory Rods.

Measurement	Descripton	Device
X-sec	Cross section morphology: oval, circular, subrectangular	visual
EnL	End morphology: pointed, beveled, rounded	visual
Length	Length of end alteration	visual
EnA	Angle of bevel or point	goniometer
Embellishments	Presence of patterned incisions or scratches	visual

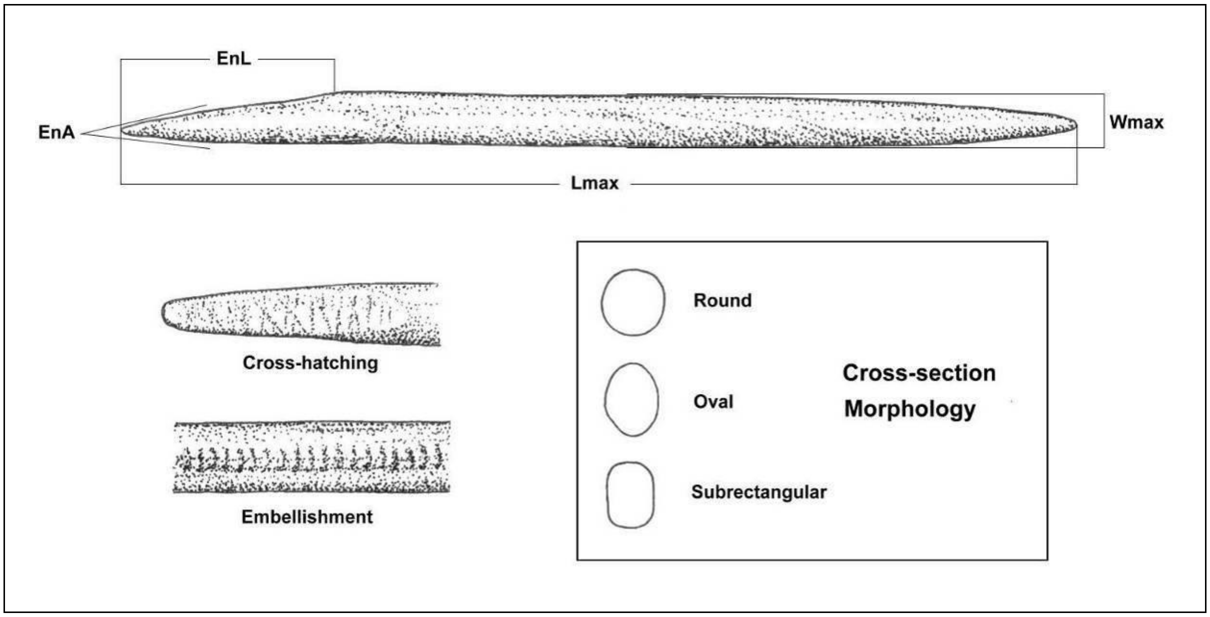

Figure 8. Additional measurements and landmarks taken from bone and ivory rods.

Site Context

Data collected from each site context included information as to whether a cache occurs within or adjacent to a broader activity site or subsistence area, the character of such areas when present, and additional contextual information that relates to the expectations outlined in Table 3, including cache location, treatment, and associated features. Archaeological and geographic data were collected from cache site visits (when possible), maps, archaeological reports, and interviews with cache discoverers and owners. Archaeological data include stratigraphic context or surface location, evidence for associated human remains, and location relative to other Clovis sites and isolated finds. Geographic data consist of topographic location, distance to raw material sources, relationship to water sources, relationship to suspected topographical corridors of travel (for example, river valleys and upland passes), and relationship to prominent landforms and features that might serve as markers. Distances are measured as linear distance in kilometers from the cache location to the object of interest.

CHAPTER 5: CLOVIS CACHE, KILL, AND CAMP ASSEMBLAGES

Clovis caches and caching behavior were recognized as early as 1963, when F. E. Green reported a cache of blades from Blackwater Draw Locality 1 (Green 1963), and B. Robert Butler published a report on a cache of Clovis points and bifaces from the Simon site in south-central Idaho (Butler 1963). These publications introduced at least two important concepts to archaeologists working in the Paleoindian period in North America. First, Green proposed that Upper Paleolithic style blades in general were characteristic of Clovis technology. Second, while Butler initially interpreted Simon as a camp site, Green suggested that the collection of blades had been cached near a small stream at the Blackwater Draw site. Since that time many other artifact assemblages, some composed of blades and some composed of bifaces, points, and a variety of other artifacts, have been proposed as Clovis caches.

Caches, especially the relatively spectacular Anzick, East Wenatchee, Fenn, and Simon caches, have attracted considerable attention from archaeologists. These four in particular have been considered extensively, with particular attention given to what their artifacts can tell us about Clovis lithic technology. Yet, few formal attempts to examine them in comparison to one another have been undertaken. Part of the reason for this lies in the difficulty of securely attributing a Clovis origin to cache assemblages that lack clearly diagnostic Clovis artifacts. Another difficulty lies in discerning the economic and social context (and in some cases the simple archaeological context) of the assemblages, or in other words, their function.

Analyzing Clovis caches requires securely attributing these assemblages to Clovis and discerning their function. This dissertation first seeks to answer these fundamental questions in order to incorporate the caches within a broader understanding of Clovis technological and economic organization.

This chapter introduces each of the potential cache assemblages considered in this research. Each cache synopsis includes a history of its discovery and a summary of past research. Next I present a review of general observations obtained from analyzing the assemblage. Finally, I offer a statement concerning my confidence that the assemblage can be considered a cache of Clovis age. The descriptions combine published findings, results of interviews with cache finders, curators/owners, and previous investigators, and first hand observations. Summary information for the caches is presented in Table 1, Figure 1, Table 11, and Table 12. The remainder of the chapter similarly reviews the kill and camp sites used in this analysis. Raw materials mentioned in this section are described in more detail in Chapter 7.

Cache Assemblages

Anadarko

The Anadarko cache (a.k.a., McKee cache) was discovered in 1964 by Ray McKee and family while walking through a horse corral on their way to a historic site along the Washita River, about 3.2 km northeast of Anadarko, Oklahoma. The corral is situated on a southwesterly sloping hill with an ephemeral drainage in which the artifacts were found. The location overlooks the Washita River to the south (only about 90 m away) and the Sugar Creek floodplain to the east. The artifacts consisted of cores stacked on one another and a series of blades roughly surrounding them as if they had been in a container (Hammatt 1970). In investigating the cache, I heard a rumor that the collection may actually have been found in Texas, but could not substantiate it. At the time of my investigation, the assemblage could not be located and is therefore included here based solely on published data and illustrations. The cache was apparently inherited by a descendant upon Ray McKee's death. Some family members report that the assemblage has since been sold.

Hammatt reported that the cache consisted of 32 items. My interpretation of his report and pictures indicate 2 blade cores, 2 blocky flake cores, 2 bifacial cores, and 26 blades and flakes. Twelve of these were considered "classic" prismatic blades. Hammatt reported that all except two were of gray flint (probably Edwards Plateau chert); one blocky flake core and one bifacial core were of Alibates agatized dolomite. McKee (1964) indicated that three material types were present including an unstated number of artifacts of Kay County (Flint Hills) chert.

All of the artifacts are illustrated in Hammatt's article and it is possible to make some reliable measurements based upon the published scales. He noted a refit along the cortical edges of the two blade cores. He also reported a refit between two of the blades, but judging from the photos, this refit is not entirely convincing. Evidence for use of the cores for chopping was noted, but this evidence may instead be possible ridge preparation. None of the blades or flakes were modified into formal tools.

Based upon Hammatt's description of the cache location, I believe I was able to relocate the area of the find, although the current horse corral is not located on a steep slope as described. If my relocation of the find spot is correct, the cache was located at the base of a slope where the floodplain meets the uplands.

Anzick

The Anzick cache (Figure 9) from western Montana is among the better known and more thoroughly reported Clovis caches (Jones and Bonnichsen 1994; Owsley and Hunt 2001; Taylor 1969; Wilke at al. 1991). Anzick is unique in that it is associated with human remains. Originally, it was believed that two human burials (a “bleached” juvenile and a partially cremated infant) might have been associated with the cache; however, detailed investigations demonstrate that infant remains were not cremated (Owsley and Hunt 2001), and the remains of the juvenile most likely represent an unrelated burial (Owsley and Hunt 2001; Stafford 1994). The presence of red ochre on both the Anzick artifacts and the remains of the infant provides strong evidence that these two are directly associated. Radiocarbon dating of the infant produced an average age of 10,680+/-50 BP (Stafford 1994), potentially consistent with Clovis dates given the tendency for radiocarbon dates on bone to underestimate true age (Stafford et al. 1987).

The Anzick artifacts include 83 biface fragments, 8 projectile points, 7 flake tools, 2 unmodified flakes, 1 blade, and 11 bone rod fragments. They were discovered in 1968 as two men were excavating talus at the base of a sandstone cliff along Flathead Creek in Park County, Montana. Investigation has since revealed that the talus represents a collapsed rockshelter in which the cache and burials were originally located. An initial investigation was carried out by Dee Taylor (1969), but he was unable to find any evidence to associate the artifacts with the burials. Later testing by Lahren and Bonnichsen (1971) revealed a red ochre lens in which additional artifacts and another human bone fragment were found.

Figure 9. The Anzick cache, selected items (photo courtesy of Dennis Stanford).

Wilke et al. (1991) carried out an extensive examination of a large portion of the Anzick collection and provided a detailed description of Clovis lithic technology. They argued that all stages of Clovis lithic reduction are represented in the cache. Based upon the refitting of two bifaces (Wilke et al. 1991: Figure 4) and the occurrence of flat remnant breaks along the margins of numerous bifaces, Wilke and coauthors describe the rejuvenation of smaller bifaces from fragments resulting from the intentional breakage of large leaf-shaped bifaces. The smaller bifaces were further reduced through blank, perform, and projectile point stages. The authors also point out that consistency of overshot flaking, diversity of high-quality raw materials, and careful maintenance of cores and flakes is evident in Anzick, and with the Simon, East Wenatchee, and Fenn caches.

A portion of the collection is curated at the Montana Historical society in Helena, MT. Other portions are reportedly in the possession of the finders of the cache and their descendents (George Oberst, personal communication 2002). I had the opportunity to study casts of the majority of the artifacts that are available at the Smithsonian Institution. The 83 biface fragments from the cache refit to form a minimum of 68 bifaces (62 of which were available to me for study). The bifaces range from 75 mm to over 315 mm in length. At least two bifaces (SIC-273-1 and SIC-357-1, not pictured) stand out as unusually large (315.6 mm and 252.9 mm long, respectively), while two more (SIC-387-1a&b, not pictured) are derived from a single comparatively large biface (222 mm long). Other bifaces are either leaf-shaped or lanceolate ("preforms"). All exhibit exceptionally well-controlled flaking with occasional overshot flaking. Inter-flake ridge abrasion and polish are common on biface surfaces.

The Anzick cache includes 8 complete and partial fluted projectile points. Most of these have straight bases with ground edges; two have concave bases. Although at least one appears repaired or reconfigured, ridge abrasion and polish is rare among the points. Others appear unused. Nearly all of the projectile points fall within the size range one might expect for utilitarian points from kill or camp sites, although one (SIC-256-1, not pictured) is over 15 cm in length.

The majority of the 7 flake tools are unifacially retouched flakes, often exhibiting multiple working edges. One flake tool is bifacially retouched; another is not retouched but appears to be damaged from use. One flake tool (SIC-366-1, pictured) is an end- and sidescraper fragment. The single blade has a crushed platform but its remaining features are consistent with Clovis blade technology. It has multiple unifacially retouched working edges on the margins.

Lithic raw materials in the Anzick assemblage are varied; 19 different varieties of raw material were apparent from observing the color cast specimens at the Smithsonian Institution. Jones and Bonnichsen (1994) divided the raw materials into three groups: chalcedony (39 specimens), moss agate (30), and porcellanite (1). Wilke et al. (1991) argue that many of the items at Anzick were heat treated, based upon waxy texture, luster, and potlidding.

The two complete bone specimens and nine fragments are estimated to represent from 5-7 (Jones and Bonnichsen 1994) or from 4-6 (Jones 1996) complete bone rod-like implements. Only three of the eleven bone artifacts found with the Anzick cache were available for study. Each is oval in cross section, with deep cross-hatching on the beveled ends. One specimen (SIC-330-1, Figure 9) has one beveled and one rounded end, with scratches along the length of the shaft. Wilke et al. (1991) experimented with replicas of these rods and demonstrated that they can be successfully used as pressure tools for fluting of Clovis points. They argued that the rods are a component of a composite pressure flaking tool.

The association among the artifacts, skeletal material, and red ochre at the Anzick site all suggest that this assemblage may represent ritual behavior associated with a burial, as opposed to a purely utilitarian cache. However, it is clear that some of the artifacts were taken from a functional context where they had been used and maintained for apparently utilitarian purposes.

Bastrop County

The Bastrop County cache (Figure 10) was found relatively recently, possibly in 2004, however the details of its discovery are not particularly clear and no information about the cache has been published. The following information was gleaned from conversation in 2006 with Mark Mullins and Michael Waters, who shared the information that had been passed along to them through word of mouth. The collection, consisting of 13 bifaces, apparently derives from a sand quarry along the Colorado River near the town of Bastrop, Texas. The artifacts were excavated by heavy machinery used to collect sand. Quarry workers recovered the artifacts from mechanical screens through which the sand is size-graded. The cache was initially divided among the finders and was mostly reunited by Mark Mullins of Colorado. Waters reports that two additional preforms or projectile points remain in the possession of one of the quarry workers. The collection, also known as the Hogeye cache and the Texas cache, is currently owned by Mark Mullins.

The collection consists of 13 artifacts, including 6 early stage performs, 4 late stage performs, and 3 bifaces. All of the artifacts are made from Edwards Plateau chert, which is available locally within a few kilometers of the find location. The variety of Edwards represented ranges from opaque light to dark gray with occasional clouds of very light gray or off-white. Dark gray and reddish speckles are occasionally present on some specimens, as are small crystalline vugs. One specimen (No. 11) is distinctly banded. It is difficult to discern whether or not all the specimens are derived from the same outcrop. They do not appear to be from the same nodule; it appears that as many as three different nodules are represented.

Figure 10. The Bastrop County cache.

The early stage performs (No. 2, 3, 7, 9, 10, and 11) are characterized by squared to slightly concave bases and typically are thinned or fluted on one or both faces. Late stage performs (No. 4, 5, 8, and 12) exhibit straight to concave bases, fluting on both faces, and generally lack only grinding and marginal retouch to be finished into projectile points. One specimen (No. 8) is noticeably waisted in outline. Central Texas is roughly at the western limit of this characteristic, which may be more typical of Southeastern fluted projectile points. This specimen also exhibits crushing on the tip and a chipped basal corner consistent with damage sustained from impact. It is not clear whether this damage occurred through use prehistorically or during the recovery process at the quarry. The bifaces display a considerable range in morphology. No. 1 is relatively small (smaller than the performs) with a squarish base, No. 6 is ovoid, and No. 13 is leaf-shaped and slightly assymetrical. Further, No. 13 is bifacially retouched along the left margin of Face A and this edge is lightly stepped and polished, presumably from use as a cutting edge. No. 1 is manufactured from a large flake, and retains some curvature as well as a portion of the interior surface on Face B. There is substantial variation in the sizes of all the artifacts, with maximum length ranging from 71 mm to 155 mm, and this variation occurs across all artifact classes. Maximum thickness is less varied, ranging from 8.1 mm to 11.4 mm across all artifact classes. Overshot flaking is common among all of the specimens, with only No. 2 lacking at least one overshot flake scar. Remnant facets are present on 3 specimens, but are not present on any of the late stage performs.

Ridges and flake scar interiors are almost devoid of the polish and abrasion that characterizes most artifacts from caches. Where it is present it is very light. Further, the surfaces of each of the specimens exhibit no patination or other weathering. Both of these conditions might relate to the recent excavation of the collection. Mike Collins (personal communication 2006) notes that Keven Davis exhibited no patination and little surface abrasion when it was first recovered, but developed it with exposure to air and handling after recovery. Occasional metallic streaks are present on several of the artifacts, presumably from contact with quarry equipment. A series of gold colored (the others are silver) streaks are present within the proximal area of a short, deep flake scar on the distal right margin of Face B, raising the possibility that a copper pressure flaker was used in the manufacture of the artifact. The likelihood that the artifacts came into contact with a variety of metal surfaces during recovery makes it difficult to judge the significance of this attribute. Further, and admittedly more subjective, the characteristics of artifact forms represented in the assemblage stand apart from those I have observed in other Clovis assemblages.

In short, there at least four conditions (lack of patina, lack of significant surface wear, presence of metal striations, and unusual forms) that raise the possibility that the Bastrop County cache is not authentically Clovis in origin; however, the first three of these might be explained by the circumstances of recovery. The fourth might easily be a result of manufacture by someone not commanding perfect knowledge of variation in Clovis technology. Supporting its authenticity is the characteristically Clovis reduction technology. A modern flintknapper would have to be well versed in current academic perspectives on Clovis reduction to produce the items. Of further note are the hanging step fractures and other "imperfections" (*e.g.* asymmetrical edges and outlines, cortical remnants, etc.) that a modern flintknapper might be expected to resolve. Mike Waters reports that a student with ties to the local flintknapping and collecting communities inquired widely about the collection and could find no evidence that it is anything but authentic. Due to the uncertainties regarding the Bastrop County cache, I have chosen not to include this assemblage in the analysis of Clovis caches until further information comes to light. The Bastrop County cache is acknowledged as a potential Clovis cache but it does not contribute further to the analyses or conclusions of this dissertation.

Blackwater Draw

Perhaps the most celebrated Clovis site, Blackwater Draw Locality No. 1 (BWD) is located between the towns of Clovis and Portales on the Llano Estacado of eastern New Mexico. Although artifacts had been collected from the site for years, it was discoveries of fluted points and mammoth remains during gravel mining operations in 1932 that led to BWD becoming the type site for the Clovis cultural complex (Cotter 1937; Hester 1972). Because BWD consists of multiple caches, kills, and camps that can be confidently attributed to Clovis, collections from BWD figure prominently in this research. The two caches, referred to here as the "Green cache" and the "West Bank cache," are presented below. The kill and camp components are described later in this chapter.

F. E. Green cache

The first cache from BWD, reported by F. E. Green (1963), consists of 17 complete and fragmentary blades and is referred to here as the Green cache (Figure 11). The artifacts were exhumed by earthmoving equipment and redeposited in an "overflow ridge" (Green 1963:148). After Green observed one blade on the surface of the berm, he recovered 21 more fragments representing 15 additional blades by troweling through the backdirt.

Figure 11. The Green cache. Numbers correspond to artifacts discussed in text.

Sediments representing the original matrix adhered to some of the blades and indicated that they originated from the Gray Sand, one of the BWD strata that contains Clovis artifacts. By retracing the movements of the loaders, Green was able to pinpoint with some confidence the general location from which the blades had been removed. The cache appeared to have originated in a 5-8 cm thick portion of the Gray Sand that lapped onto a caliche bench at the edge of the basin (see Haynes 1995, Hester 1972, and Holliday 1997 for detailed descriptions of Blackwater Draw stratigraphy). Carbonaceous Silt, the lateral equivalent of the Diatomaceous Earth, overlaid the Gray Sand. Portions of some of the blades were encrusted with Carbonaceous Silt in addition to Gray Sand, indicating that they had been partially exposed on the surface when the former stratum began to be deposited. Based on his observations (1963:148-149), Green proposed that:

> These artifacts were located in the Gray Sand on the basinward margin of the caliche bench near the point where this bank began its abrupt slope off into the lowermost part of the basin, and this location was approximately 40 feet northwest of the point where the bank turned southward into the pond outlet.

This description places the location of the cache about 160 m south-southeast of a camp area (Hester's 1962 excavations), and about 120 m west of bison and mammoth kills (1935 amateur excavations reported to Cotter [Hester 1972]). Regarding the nature of the original cache deposit, Green (1963:150) concluded that,

> …the blades were restricted to a vertical thickness of not more than 3 inches. Although these blades had undoubtedly been very close together when they were first placed or lost on the bank of the pond, the enclosing matrix and the lateral variation of lithology indicate that the implements were not in contact with each other and had probably been slightly scattered by natural causes before being covered by Gray Sand…There was no other evidence of human occupation on the caliche shelf or along the contact of basin fill…The unity of the blades is certain; it not only contains tools manufactured from the same cores, it also contains two examples of overlapping and contiguous blades struck from the same core in successive operations.

Having argued that the blades were part of the "Llano Complex," Green proceeded to use the blade cache in conjunction with blades from other sites to provide the initial description and definition of Clovis blade technology.

The cache is currently curated at the Museum of Texas Tech University in Lubbock. A full set of casts is available at the Blackwater Draw Museum in Portales, NM. My observations are derived from both of these collections, with weight and raw material observations made on the original specimens.

The Green cache consists of 7 complete blades, along with 10 fragments: 4 medial, 5 distal, and 1 proximal. All are made from Edwards Plateau chert; however, natural light and long-wave UV inspections suggest four varieties representing at least 3-4 different nodules of raw material. The complete specimens range from 97 to 152 mm in length and exhibit substantial curvature. Where present, platforms are small, heavily ground and, with the exception of one specimen (#3), faceted. Primary cortex is present on the exterior surfaces of nine specimens, suggesting that the blades were derived from cores at relatively early stages of reduction. Core maintenance in the form of ridge straightening is common.

Edge damage is common on all of the specimens, and is probably derived from damage by earth moving machines. None of the specimens exhibit patterned damage or flaking that would suggest intentional retouch. Areas of polish or abrasion are present on four specimens (#6, #9, #14, and #17), in some cases on both the interior surfaces and exterior ridges. If they are the result of transport wear, these patterns suggest that the specimens were manufactured elsewhere and carried to the site in the form of blades.

The Green cache can confidently be considered Clovis in origin based upon its inferred stratigraphic context (Green 1963) and distinctive technology (Collins 1999). The location of the cache adjacent to areas of known Clovis camps and kills suggests that it may have been utilitarian in nature.

West Bank cache

A second cache of blades was discovered at BWD in 1990 (Montgomery and Dickenson 1992), and is referred to here as the West Bank cache (Figure 12). This cache was discovered by Joanne Dickenson. She was monitoring erosion along a buried arroyo in the west bank of the north gravel pit, just south of the Folsom-age Mitchell Locality (Boldurian 1991). Montgomery and Dickenson (1992:1) describe the discovery as follows:

> …two blades were discovered in sediment from a collapsed portion of the west wall. The largest blade had the tip missing. Two months later, three blades were discovered that had been exposed in the same area, although two were further downslope. A month later the tip of blade #1 was discovered partially exposed slightly downslope and north of the first two blades' location.

As with the Green cache, sediments adhering to the artifacts indicated that they are derived from the Gray Sand (Condon 2000). Although a 1 x 1 m excavation unit was excavated at the find location and the location continues to be monitored (Joanne Dickenson, personal communication 2004), no further artifacts have been recovered.

The cache consists of 5 blades, all of which are characterized by small, ground, and usually faceted platforms, weak bulbs, and 1-3 previous blade removals. The blades are technologically and morphologically very similar to those from the Green cache. Peter Condon (2000) found them to be statistically indistinguishable from the Green cache blades. I would suggest that Blade 1 is different in scale and morphology than the other blades in the cache. Condon (2000) suggested Blade 1 may have resulted from the reduction of a large biface (and thus eliminated it from his statistical comparison). Though it is possible that it corresponds to what have been termed “large blades” at Murray Springs (Huckell 2007), I believe the orientations of the exterior flake scars, the platform morphology, and the longitudinal curvature, all support interpretation of this particular specimen as having been derived from a large biface. All of the West Bank specimens are heavily damaged along much of their margins. Blade 1 and Blade 3 both exhibit edge retouch.

Figure 12. The West Bank cache. Numbers correspond to artifacts described in text.

All of the blades are made from Edwards Plateau chert from at least two different nodules (which may represent two different sources). Some primary cortex remains on four of the blades, suggesting that the cores from which they came may not have been heavily reduced.

The cache was located along the margin of a Pleistocene arroyo approximately 40 m north-northwest of a buried spring deposit (the “ENMU spring conduit”), and a Clovis camp (Locus 15), and about 90 m west of mammoth and bison kills (the El Llano digs) (Hester 1972). Like the Green cache blades, the West Bank cache blades appear to represent a utilitarian Clovis cache intended for later retrieval.

Busse

Dan Busse discovered the Busse Cache (Figure 13) in 1968 as he was inspecting a newly placed fence in northwestern Kansas. The fence reclaimed an area of pasture that had been farmed by a neighbor for several years. After the land was reclaimed, the area that had been under cultivation began to erode, exposing a small portion of one of the bifaces that made up the cache. Busse noticed the stone and, thinking it was a flake, bent to pick it up. It turned out to be a surface of Biface 2, the second largest in the cache. Busse began digging with a shovel, exposing several other artifacts (resulting in some metallic streaks on artifacts). He then shifted to a hand spade. The collection has remained in the possession of the Busse family and has been carefully protected. The artifacts have been washed with a hose but are otherwise unaltered.

The cache was spread over an area of less than 2 m^2 and appeared to Mr. Busse to have been lying on a buried surface that is not parallel with the current slope. Its depth ranged from 0-45 cm. The find spot lies about 50-100 m northeast of an unnamed tributary drainage of the Beaver River. The confluence of this tributary and the Beaver lies about 1.6 km to the southeast. The Beaver is the largest drainage in the area. Several other Clovis finds are known within an 8 km radius, including a Clovis point found less than 0.8 km away, and a blade of comparable material was also found about 0.8 km to the southeast (Dan Busse, personal communication, 2003).

Figure 13. The Busse cache. Numbers correspond to artifacts described in text.

Dennis Stanford initially inspected the collection and believed it to be “as old as anything he has seen“ (quoted by Busse), but did not follow up on it. Jack Hofman became interested in the 1990’s and did some test excavation at the find site, revealing additional artifacts. Vance Haynes placed a series of auger holes in the area and found a gravel lens representing either an older meander of the drainage or a spring deposit. Rolfe Mandel identified its location as the remnants of the third terrace, a geomorphic surface appropriate for a late Pleistocene age. Hofman carried out additional testing in 2004 and found small chips from damaged tools that confirmed the find location, but no further complete artifacts (Hofman, personal communication, 2004).

The collection currently consists of 13 bifaces, 33 blade and blade-like flake tools, 30 flakes and flake fragments, a cortical chert abrader, and a large piece of tested raw material. The majority of the artifacts (n=68) are made of Niobrara jasper, with as many as six different nodules represented based upon visible patterns of banding, coloration, luster, etc. Eight artifacts are of Hartville Uplift (Spanish Diggings) chert and merit comparison to the Sheaman Site and Franey cache artifacts described later in this chapter, one is of moss agate, and one is of an unidentified fossiliferous chert. In addition to raw material, the flake and blade tools compare well to Franey, and the biface thinning flakes (and thus bifaces) to Sheaman.

The bifaces are generally large (ranging in length from 91-301 mm) and exhibit well-controlled flaking. Two (#1 and #3) clearly exhibit one overshot flake scar each, and another (#2) exhibits possible remnant portions of overshot scars. No overshot flakes are in the collection. Two bifaces in particular (#2 and #10) exhibit large notches created by the removal of short, steep flakes punched into the margin (margin removal flakes). Some flakes in the collection refit these notches. In some cases it appears that these notches were intended to facilitate the controlled splitting of bifaces (cf. Wilke et al. 1991); in other cases, particularly where refitting flakes are present, they may be the result of plow damage. Margins of some of the intermediate-sized bifaces are retouched and appear to have been used as cutting tools. Red ochre traces are evident on seven bifaces and five stone tools.

The blades and blade-like flakes include at least 6 true blades by conservative definition and 15 by my criteria (presented in Chapter 4); Hofman identified 16 (personal communication, 2004). These tools are extensively retouched, especially on the lateral margins, with steep marginal and distal retouch and notching. Most exhibit multiple use edges and chipping and polish, also presumably from use. Despite some compelling similarities in raw material patterns, no production refits could be found among the blades and flake tools.

The large number of flakes and flake fragments indicate substantial reduction of the bifaces at or near the find location. Portions of biface exteriors exhibit some ridge abrasion and polish; however, most transport wear appears to have been removed by recent flaking, although it is not particularly abundant on flakes in the collection. This suggests that initial flakes were either carried away or removed and used somewhere relatively nearby. Red ochre streaks occur on 7 of the bifaces, 4 of the flake tools, and the abrader. I attribute the Busse cache to Clovis, based upon the technology represented by the bifaces, blades, and blade-like flakes.

Comanche Hill, Eisenhauer, Evant

The Comanche Hill, Eisenhauer, and Evant assemblages each consist of conical blade cores from central Texas. Collins (1999) tentatively identifies them as caches. Blade cores of Edwards Plateau chert were discovered at Comanche Hill, Bexar County (n=2), Eisenhauer, Bexar County (n=1), and Evant, Hamilton County (n=3) near sources of this raw material. It is unclear whether or not these cores were cached for later retrieval, or discarded near workshops in close proximity to raw material sources. These sites are acknowledged as potential Clovis caches, but are not included in this analysis due to the uncertainty about whether they truly can be considered caches.

Crockett Gardens

The Crockett Gardens site is a multi-component (primarily late Paleoindian and Archaic) site near the North San Gabriel River in central Texas. Three prismatic blades were found stratigraphically below the late Paleoindian component; two more blades and a Clovis point fragment were found nearby, but on the modern surface. The site was heavily damaged by a borrow pit before being professionally investigated, and the archaeological work that was carried out there was limited (Collins 1999).

Collins (1999:164-165) reported that these blades are morphologically and technologically comparable to Clovis. Unfortunately I was unable to track down the current location of the collection, and no metric data exist. It remains unclear whether the artifacts are all Clovis, and if they represent a cache or some other site type. For these reasons, this assemblage is not included in this analysis.

Crook County

The Crook County cache (Figure 14) was discovered in 1963 when Harold Erickson was performing a petroleum survey in northeastern Wyoming (Byrd 1997; Tankersley 1998, 2002). While looking for artifacts on his lunch break, Erickson dug into a band of red ochre exposed on a road cut and uncovered two large bifaces. He returned later with a shovel and tire iron and uncovered six more artifacts. One additional large biface and a heavily reworked Clovis point were found in the backdirt from the road grading.

The collection remained in private hands, mostly unknown to academia until the late 1990's, when Ken Tankersley became interested in tracing the source of the red ochre on the artifacts (Tankersley 2002:109). At this time, the collection was in the possession of Forrest Fenn. Tankersley, Fenn, C. Vance Haynes, and Jack Holland were able to relocate the spot where Erickson had found the cache, based upon geographic and geologic information. The cache appears to have been placed in a naturally occurring band of red ochre on a grassy knoll overlooking a broad coulee to the south. The location provides a broad southeastern view that includes Devil's Tower, the Missouri Buttes, and several mountain ranges.

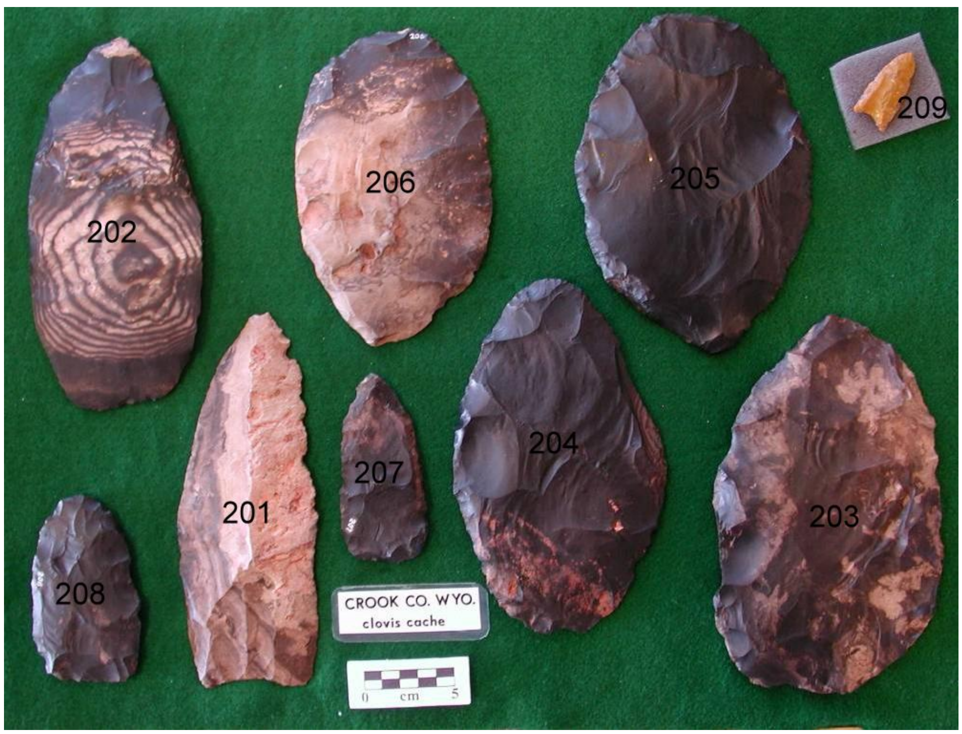

Figure 14. The Crook County cache.

The cache consists of 5 large ovate bifaces, 2 early stage performs, 1 retouched blade or blade-like flake, and 1 Clovis projectile point. The 5 bifaces range in length from 185-221 mm. All of them exhibit large expanding flake scars; 3 bifaces (#202, 204, and 205) exhibit overshot flaking. Remnant facets occur on 2 bifaces (#202, 203).

Two additional bifaces appear to represent early stage performs. Both are leaf-shaped with squared bottoms. The outlines are mostly symmetrical, but large irregular flake scars remain on their faces. One (#208) exhibits a single overshot flake scar; invasive flakes from the opposite margin terminate several possible overshots on the other (#207).

One large blade or blade-like flake (the platform is obliterated by flaking) is retouched along one margin and end-thinned on both faces (#201). The exterior of the flake has one flake scar parallel to the axis of flaking; the remaining original exterior surface is cortex. The interior right margin is pressure retouched for a little over half of its length. It is not entirely clear whether this artifact is a knife as suggested by Tankersley (1998, 2000), or simply a flake blank intended for a projectile point.

The single projectile point (#209) is heavily reworked. The lack of grinding on the base along with the position of the flute scars appear to indicate the refurbishment of a previous base. The edges are somewhat irregular, and the point is heavily reduced to what appears to be a nearly exhausted state. It was found in spoil from road grading and exhibits a frosted, wind blasted appearance. Sediments, including red ochre, in the flake scars support the notion that the point was once part of the cache, however (Tankersley 1998).

With the exception of the projectile point, all of the artifacts are manufactured from Green River formation chert (“tiger chert”). Many of the bifaces exhibit a pattern of circular bands of light and dark material that indicates that they were reduced from a single large nodule. The projectile point is made from a yellow chert comparable to material from Hartville Uplift.

The artifacts were buried in naturally occurring red ochre, and this material is present on the surface of most of the artifacts. The ochre is present in a diagonal pattern on one face of biface #204, suggesting that this biface, and perhaps the others, were once wrapped in strips of leather or textile. Erickson reported that cylindrical bone artifacts occurred with the bifaces. It remains unknown whether these were bone or ivory rods or if they were merely examples of naturally occurring fossilized bone (unidentified), which are noted to occur in abundance within the local sandstone (Tankersley 2000:106,129); however, it seems unlikely that Erickson would have left behind distinctively beveled rods if they were present.

The Crook County cache clearly appears to be of Clovis origin. The function of the cache (utilitarian, ritual, or other) remains unclear.

De Graffenried

The de Graffenried cache (Figure 15) was part of Gaines de Graffenried's extensive collection of primarily historic, and to a lesser extent prehistoric, items from central Texas. What is known of the history of the cache has been investigated and compiled by Collins and others (2007), and is summarized here. It appears most likely that Erich Pohl excavated the cache from the Gault site sometime prior to the 1950's. Two lines of evidence support this. First, Pohl is known to have carried out extensive amateur excavations at Gault beginning in the 1930's or 1940's and continuing for many years. Second, limonite groundwater staining on the surface of each of the artifacts in the de Graffenried cache matches that found on Clovis age artifacts at Gault and Wilson-Leonard in Bell County, Texas. Apparently de Graffenried obtained the cache from Pohl in a trade. Michael Speer purchased the cache at auction upon de Graffenried's death in 1991 (later reuniting with it a piece that was accidentally sold separately). Speer brought the cache to the attention of Michael Collins in 1999 at the Clovis and Beyond Conference in Santa Fe. The collection is currently owned by Mark Mullins of Colorado.

Figure 15. The de Graffenried cache.

The cache consists of four large bifaces and a fluted preform, all of Edwards Plateau chert. The chert is opaque bluish gray with lighter gray to cream colored clouds, speckles, and dots, and is stained reddish brown by groundwater. It compares very favorably with the chert outcropping locally at the Gault site. Unlike much of the material at the Gault site, which commonly exhibits abundant cortex, only minute amounts of cortex are exhibited on two of the de Graffenried specimens.

All of the artifacts are complete and unbroken. The bifaces are large, ranging from 170 mm to 219 mm in maximum length, and thin, ranging from 12.4 mm to 14.7

mm in maximum thickness. They are roughly ovoid to bipointed in overall shape. Overshot flaking is common, with at least one overshot flake scar exhibited on each face of each artifact. Remnant facets, one partially cortical, are present on the margins of two of the bifaces. The preform is nearly completed, lacking only edge finishing and basal grinding to become a finished projectile point. It exhibits no overshot flake scars, but retains a remnant facet on the right margin of Face B. Light to moderate abrasion and polish occurs both on the ridges and within flake scars on both faces of all specimens. This pattern corresponds well to the pattern produced by transport of the specimens, suggesting the possibility that the artifacts were transported away from the source before being brought back and deposited. The wear might also have resulted from the historic storage and handling of the assemblage since its discovery. Hematite residue is visible in step fractures and pockets in the surfaces of all of the artifacts.

A Clovis age and affiliation for the collection is supported stylistically, technologically, and by the groundwater staining present on the surface of the artifacts. The consistency in surface weathering and the presence of hematite supports the association of the artifacts with one another as a cache. If the find location of the de Graffenried collection is correct, it is unusual among Clovis caches in that it was deposited at or very near a major source of excellent lithic raw material, perhaps the same source from which the items were manufactured. The cache may have been manufactured at the Gault site or somewhere else in the local area, and was either immediately cached at the site or transported away from the site and brought back on a subsequent visit. The possibility of transport wear on the surfaces of artifacts lends some support to the latter interpretation. A comparison of the sizes of the bifaces in the cache to the sizes of those being manufactured at Gault might shed further light on their transport history.

Drake

Orvil Drake discovered the Drake cache (Figure 16) in northeastern Colorado in 1978. Mr. Drake was an artifact collector looking for artifacts in a plowed wheat field near the town of Stoneham, south of the Pawnee Grasslands. He found three projectile points disturbed by plowing and exposed through eolian processes. Drake returned with two associates and proceeded to dig with a shovel, uncovering nine additional complete points and one basal fragment. Stanford and Jodry (1988:21) report that Drake described the assemblage as being clustered and shallowly buried, with tiny osseous fragments associated. Thin-section analysis of the latter carried out by Stanford later resulted in the identification of the fragments as ivory. The Drake cache was found on a low ridge with no obvious natural landmarks. The ridge probably represents a third or higher terrace of the Pawnee River (Stanford, personal communication 2004).

Bruce Lutz, an archaeologist from the University of Northern Colorado, investigated the site and submitted a site inventory record to the Colorado Archaeological Survey. Lutz described a small (5x5 ft) pit that resulted from Drake's digging. He excavated a 1 x 2 m unit directly east of the pit, recovering a point midsection from Drake's backdirt within the unit. The midsection refits to the base and tip fragment found by Drake (Artifact 4). Lutz encountered a hard whitish "C soil horizon" (perhaps a Bk?) at a depth of about 15 cm and excavated no deeper. He excavated a second 1 x 1 m unit 14.6 m northeast of the first; it yielded no further artifacts and Lutz did not encounter the whitish horizon within 1.25 m of the surface. Lutz noted the presence of a point or knife fragment on the surface about 19 m northeast of the find location, and one chert and one quartzite flake nearby, but did not believe them to be associated with the cache.

Figure 16. The Drake cache. Numbers correspond to artifacts described in text.

Dennis Stanford revisited the site with Drake and collected a chert hammerstone and additional ivory fragments. Stanford arranged to have casts made of the entire collection. Eight of the original points and the original hammerstone now reside at the Smithsonian; casts at the Smithsonian represent five of the points. Stanford (personal communication, 2004) generously provided to me weights and raw material descriptions for the five casts based upon the original specimens.

Eleven of the projectile points are made of Alibates dolomite, located about 584 km to the south. One (#7) is of gray chert macroscopically consistent with Edwards Plateau chert located some 955 km to the south. The gray chert fluoresces a pumpkin orange color with light green mottles (the latter corresponding to the translucent portions of the material), consistent with cherts from the Edwards Plateau. The UV fluorescence serves to distinguish the material from Flattop chert, a potential lookalike that occurs nearby. The remaining point (#13) is made of an unidentified yellowish gray chalcedony. The point is represented by a cast, so no UV examination was possible. The hammerstone is made of a locally available chert (Stanford and Jodry 1988:21).

All of the projectile points are finished and complete or nearly complete. Some exhibit metallic streaks and breaks consistent with plow and/or shovel damage. Seven of the points show indications of having been used and resharpened or reconfigured. These indications include resharpening flakes that impinge on the ground basal edges, basal asymmetry, and overall asymmetry. One point (#1) has damage to the tip that, while it may be a result of recent plowing/shoveling, is consistent with impact damage. Polish is common within in the hafting area, and is occasionally present on major ridges, suggesting transport.

Overall, the cache appears to represent a collection of ready-to-use Clovis weapons tips. It represents a combination of newly manufactured points and used points in good repair. Ridge polish on both new and refurbished points suggest they were manufactured at some distance away and transported to the cache location.

East Wenatchee

The East Wenatchee cache (a.k.a. Richey-Roberts or Richey Clovis cache) is one of the better reported Clovis caches (Mehringer and Morgan 1988; Gramly 1993; Lyman et al. 1998; Huckell et al. in press). The cache was discovered in 1987 by workers excavating a series of trenches for sprinkler irrigation of an apple orchard just east of the town of East Wenatchee, Washington (Mehringer and Morgan 1988). The workers dug up 21 artifacts, including 7 points, 11 bifaces, 3 other lithic artifacts, and parts of bone rods. The apple orchard in which the cache was found is located on a high terrace on the northeast side of the Columbia River. No evidence of springs, buried stream channels, or other natural landmarks was encountered in later professional excavations or on the current landscape surface.

Peter Mehringer of Washington State University investigated the site at the request of the landowner, Mack Richey, and his partner, John Roberts, in the spring of 1988. His test excavations revealed additional artifacts *in situ* and demonstrated that they lay flat on current-bedded loess deposits from late Pleistocene floods. A more extensive investigation was planned for 1990 but did not come to fruition. Richey then invited Michael Gramly of the Buffalo Museum of Science to continue excavations. Gramly's excavations recovered 21 additional lithic artifacts and portions of up to 12 more bone rods. Gramly reported that additional artifacts were not collected and remain in the ground at the site. Gramly reported the existence of a pit (Feature 1) within which the artifacts were located (Gramly 1993); however, subsequent unpublished sediment analyses at Washington State University do not support the existence of such a feature (Jim Gallison, personal communication 2003; also see Mierendorf 1997). In 1992 the State of Washington acquired both the collection and future excavation rights. The Washington State Historical Society now curates the collection, portions of which are on loan to the University of Washington Burke Museum.

Gramly (1993) interprets the cache as being utilitarian, and describes it as a toolkit for killing and butchering animals that was intended for retrieval. He identified blood residue on many of the specimens and carried out preliminary residue analyses on some samples. Gramly reports positive results for deer family, bison, hare family, and human. He further suggests that the cache may have been covered by a sled (upon which the bone rods were used as runners) within a pit.

Lyman et al. (1998) also perceived the East Wenatchee cache as primarily utilitarian. Through comparisons with other assemblages and experimental replication, these authors propose that the bone rods and oversized fluted points with undulating edges are each portions of composite butchering tools that served as saws or knives.

In an intensive technological evaluation of the East Wenatchee lithic artifacts, Huckell et al. (n.d.) argue that the cache contains a mixture of utilitarian and ritual artifacts and may not have been intended for retrieval. The "large, thin, fluted points manufactured almost exclusively by direct percussion using a risky, physically demanding technique" (Huckell et al. n.d.:36) are argued to represent non-utilitarian artifacts that might relate to Clovis ritual behavior. Further, they suggest that the bone rods may also have served as portions of a collapsible staff for ritual use. Utilitarian artifacts are characterized by potentially use-related edge damage, retouch, and overall similarity to artifacts from Clovis kill and camp sites. Their technological analysis points out the importance of systematic overshot flaking in Clovis biface reduction and projectile point manufacture.

The East Wenatchee collection currently consists of 58 stone and bone tools. It is probable that more artifacts remain unexcavated. The collection consists of 20 bifaces, 14 projectile points, 4 blades, 3 flakes, 5 flake tools, and 12 bone rods. In addition, there exists at least 61 pieces of very small debitage (some of which are more recent and may not relate to the cache). The bifaces are large, ranging in length from roughly 11-20 cm, and commonly exhibit overshot flaking. They represent very early (initial bifacial reduction of large flakes) through late (projectile point perform) reduction. Remnant facets on the margins and ridge polish are common. Many bifaces appear to have been made on flakes struck from the same large nodule. In particular, specimen numbers .24, .26, and .38 appear to have been derived from large flakes struck from a single large piece of raw material (Figure 17).

Figure 17. Bifaces .24, .26, and .38 (L-R) from the East Wenatchee cache.

Of the 14 projectile points, two (.2 and .14) show some indications of use. The remaining points are large with overshot flaking left prominently visible by minimal subsequent retouch. At least one pair of chert points (.5/.7) and three chalcedony points (.4/.6/.27) are matched through raw material, size and reduction technique. Many of the points exhibit polishing in the haft area and on high ridges on faces, suggesting that even if they were not used in a utilitarian fashion, they may have been hafted and manipulated in some other manner.

The 5 flake tools consist of 3 laterally retouched blade-like flakes, one unifacially retouched flake, and one graver. With the exception of the graver, these tools appear to have been well used but are complete and retain considerable utility. The graver appears unused. Four complete blades and three flakes (two complete and one distal fragment) are also present.

The 12 bone rods associated with the cache are well preserved and exceptional. They are most likely made from proboscidean long bones and are unusually thick compared with those from other Clovis contexts. Where terminations are present, the rods are typically beveled and extensively cross-hatched both on the beveled surface and occasionally around the circumference of the termination. At least one rod is incised with a zipper-like pattern adjacent to an incised groove along its entire length. Others show striations and grooves sporadically along their surfaces.

Overall, the East Wenatchee cache appears to represent a collection of both utilitarian and non-utilitarian artifacts. Ridge polish on many artifacts suggests they were transported some distance in their final form before they were deposited. It remains unknown if the assemblage was intended for retrieval, and whether it represents a primarily utilitarian or ritual (burial or otherwise) cache. Additional excavation may shed light on these questions in the future.

Fenn

The Fenn cache (Figure 18) is among the best-known Clovis caches, although the details of its discovery and history are largely uncertain. It is believed that the cache was found around the turn of the century, perhaps in 1902. While one report indicates that the cache was plowed up in a field and another that it was found in a bag within a cave, the lack of plow damage led Frison and Bradley (1999:22) to believe that the latter story is more likely. It is thought that the collection was found somewhere in the vicinity of the shared borders of Utah, Wyoming, and Idaho. The original finder mounted the artifacts on a board using copper wire and most likely displayed it; however, it eventually was tucked away in a basement for many years. It came to light when a family member, who had received it as a gift, sold the collection to Forrest Fenn. Although the Fenn collection has been the subject of only a single intensive study (Frison and Bradley 1999; see also Frison 1991a), it has served as a point of comparison for a number of investigations.

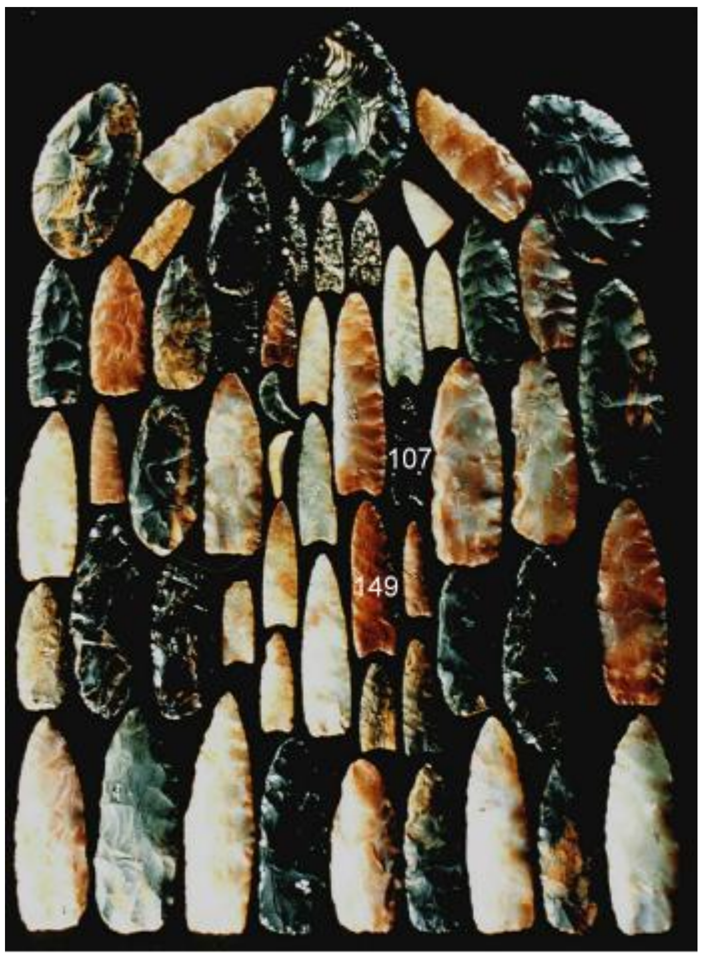

Figure 18. The Fenn cache (photo courtesy of Forrest Fenn). Length of biface at top center of this arrangement is 21 cm. Numbers correspond to artifacts described in text.

The collection consists of 34 bifaces, 20 projectile points, 1 blade, and 1 crescent, yielding a total of 56 items. The 34 bifaces include 19 large ovate bifaces and 15 preforms (distinguished from other bifaces by their generally squared bases, mostly symmetrical outlines, and occasional fluted or thinned bases). The large ovate bifaces range in length from 15-22 cm. Overshot flaking is common and some remnant breaks occur on the margins. Bifaces interpreted as performs range in length from 13.5-21cm. Overshot flaking on the preforms is common, but is often obliterated by subsequent retouch.

The 20 projectile points range from large, newly manufactured artifacts through broken and repaired ones. Five are represented only by broken fragments, including three proximal and two distal fragments. Projectile point lengths range from 8-21 cm. Several exhibit regular parallel oblique and overshot flaking. The morphology of the points is quite variable. Overall blade outline varies from tapering to nearly straight to considerably excurvate. Bases range from nearly straight (mostly on used points) to two with unusually deeply concave bases similar to points from the Colby site (Frison and Todd 1986). One obsidian projectile point (#107) exhibits vertical striations within the hafting area, within which traces of amber mastic have been identified (Frison and Bradley 1999:19).

The crescent, although technically a biface, is sufficiently atypical to warrant separate discussion. This artifact form is better known from Great Basin Paleoindian sites (Willig 1988) and is not represented in any other known Clovis cache.   It is tempting to consider the crescent as a possible trade item from the Great Basin; however, it is manufactured from the same Green River Formation chert from southwestern

Wyoming of which several Clovis points are made. The single blade is small relative to other Clovis blades, but is otherwise technologically comparable to them.

Artifacts in the Fenn cache are manufactured from a minimum of six raw materials: obsidian (8), Green River Formation chert (17), red jasper (2), quartz crystal (3), Utah agate (25), and another chert (1) that may be from the Amsden Formation in Wyoming. Most of these raw materials are available in the Wyoming and Utah area. The obsidian has been chemically sourced to southeastern Idaho (Frison and Bradley 1999:79). With the exception of a single large obsidian biface, only projectile points are made from red jasper or obsidian. The results of obsidian hydration dating suggested only that the obsidian artifacts are "several thousand years old" (Frison and Bradley 1999:80).

Red ochre is abundant on nearly all of the artifacts, to the extent that it appears that they may have been packed in it or smeared with it. I observed no traces of ochre, even under magnification, on what is perhaps the most photographed point (#149) in the collection. Along with the lack of substantial ridge abrasion or polish compared to other items in the cache and the fact that it is one of only two items made from red jasper (the other, #148, is technologically more typical and heavily reworked) led me to question whether or not it truly belongs in the assemblage. While some recall observing ochre on the specimen previous to repeated casting (Kenneth Tankersley, personal communication, 2005; Mark Mullins, personal communication, 2005), Frison and Bradley (1999:22) state that, of the specimens in the Fenn cache "all but one retained traces of red ocher" when Fenn acquired it. It is not clear if they are referring to #149. Although I remain concerned about the association of #149 with the cache, barring any information to the contrary, I consider it to be an authentic part of the cache.

Ridge abrasion, possibly transport wear but surely to some extent the result of historic storage and handling, is common and substantial on the ridges of many of the artifacts. It is particularly noticeable on the large obsidian bifaces.

The Fenn cache consists of both newly manufactured and used artifacts. The diversity of artifact forms is also high. It is not clear whether this collection represents a true cache intended for retrieval, a burial accompaniment, or some other type of deposit. Although the opaque history and anomalous aspects (e.g. the crescent) of the collection warrant skepticism, the distinctively Clovis technology (including some distinctive attributes not yet appreciated by scholars at the time of its purchase) and perhaps the obsidian hydration testing support its authenticity. I consider Fenn an authentic Clovis cache.

Franey

Ed Franey discovered the Franey cache (Figure 19) in the late 1950's as he plowed a pasture for planting wheat. Franey observed several flakes in the plowed soil and began digging with a screwdriver, soon uncovering a cluster of blades and flakes in a "scooped out area in the soil." The majority of the collection is currently held by Ed's son, Mel Franey of Crawford, Nebraska. Mel's brothers also have several artifacts found in the immediate area of the cache in later years. The cache was described by Roger T. Grange of the Nebraska State Historical Society, as a preceramic cache of scrapers of unknown cultural affiliation (Grange 1964).

Figure 19. The Franey cache. Numbers correspond to artifacts described in text.

In all the cache consists of 76 artifacts including 35 blades, 10 flake tools, 26 unmodified flakes, 1 biface, 1 core, 1 large mollusk shell, a tiny chip (recovered from the surface on my visit to the discovery location), and 1 piece of angular debris (which, along with one of the flake tools, may not have originally been associated with the cache).

The blades range from classic Upper Paleolithic-style, long, narrow blades with substantial longitudinal curvature to stubbier blades with less curvature. Flakes and blade-like flakes are generally shorter with less curvature and less regular exterior scar patterns. Platforms for blades and flakes vary in width and thickness, but nearly all are faceted and ground. The variation in the blades and flakes suggests that they were produced from several cores in various stages of reduction, and may represent a continuum of production from blade-like flakes through true blades. Although many pieces appear to have been removed from adjacent areas of the same core, only two blades (#3 and #48) were found to refit one another.

Retouch and edge damage are very common on blades and flakes. All retouch is unifacial and it occurs on both the lateral and distal edges. Multiple retouched edges on a single tool are common. Edge damage, with or without retouch, is common and generally consists of light to moderate chipping and polish. In many cases carbonate encrustation covers portions of the edge damage, indicating that the damage predated discovery and excavation. Despite retouch and edge damage, the tools do not appear to have been significantly reduced in mass, and appear to retain considerable utility. Ten flakes showed little modification and were not classified as tools.

A single small biface was included in the cache. It appears to have been substantially reduced; a small, flat, remnant facet on the distal end suggests it may have been produced by the splitting of a large biface. Several large flake scars characterize the interior of both faces. A working edge may have been created through light percussion flaking along the lateral margin.

The core is mostly unidirectional, with a single extensive plain platform. Although not conical, the core exhibits a series of removals around a circular platform. Scars from at least 8 removals are present, and these appear to represent blade-like flakes similar to those found in the collection, although no refits were identified. Max Franey recalls a second core found with the cache that was “mound-shaped” (flat on one side and peaked on the other) but that has since been misplaced.

The marine shell is enigmatic. It is not fossilized, and so appears to have been obtained from a recent marine environment. It is a West Indian Top Shell (*Cittarium* *pica*) native to subtidal rocks with high wave energy near the open ocean in the Caribbean (specimen identification by Thomas Waller, Smithsonian Institution Department of Invertebrate Paleontology, personal communication, 2004). Native Caribbean groups commonly carried it as a portable food source in the early historic period. The association of the shell with the cache is suspect, although Max Franey recalls that his father found it in direct association with the stone artifacts. The Clovis use of exotic marine shell has not been previously reported.

The stone tools appear to consist primarily of Niobrara and Hartville Uplift cherts. The artifacts can be divided into groups based upon color, texture, inclusions, and florescence that appear to represent a minimum of 11 separate nodules. All of the artifacts are heavily encrusted with calcium carbonate – in some places more than 1 mm thick – on one side. The encrustation patterns suggest that the artifacts were buried and undisturbed for a considerable amount of time, and indicate the general orientation of the individual pieces when buried.

Overall, the cache appears to represent a collection of lightly used tools and raw materials intended for future retrieval. No diagnostic tools are present, but the technology, particularly the blades, is consistent with Clovis. The heavy carbonate encrustation supports the cache having been buried for a considerable time, perhaps on the order of several thousands of years.

Garland

The Garland cache (Figure 20) was discovered around 1982, when John Garland and his son were hunting around a stock pond on his property, roughly 6.4 km south of Anadarko, Oklahoma. The cache had apparently been displaced by earthmoving equipment during the construction of the pond. The artifacts were brought to the attention of the Oklahoma Archeological Survey in the spring of 1994. Archaeologists from the Survey screened several tons of sediment from the pond and dam, recovering three artifacts from the east side of the pond and 12 artifacts from the west and northwest sides. A local collector has provided additional pieces since these investigations. Most of the pieces are fragmentary, but 4 cores and a few complete blades exist.

Figure 20. The Garland cache, selected items.

The pond is located in a shallow draw on a hillside just a few meters below a ridge. There is no indication of a spring in this location. The adjacent ridge is among the highest in the local area and provides a 360-degree view of the surrounding area, including a prominent bluff located about 6.4 km to the south-southeast. The headwaters of a tributary of Tankowa Creek, a tributary of the Washita River (located about 5.6 km to the north) are located just downhill to the west of the site about 0.8 km away. There are no clear landscape features in the immediate find area of the find location that would serve as markers.

As of March 2003, the Garland cache consists of 41 items, including 3 flake cores (one of which appears prepared for blade reduction), 1 crude bifacial core, 23 blades and blade fragments, and 14 flakes, flake tools, and flake fragments. This number is probably a poor reflection of the original number of items cached due to extensive breakage and incomplete recovery. Two cores and 16 blades and flakes were unavailable for study: 2 cores and 6 blades were on display, 10 blades and flakes are supposedly in possession of a local collector (although he denies having any, he does claim to have once lost two of the blades). Data for many of these items were generously provided by Marjorie Duncan of the Oklahoma Archaeological Survey.

The 3 flake cores are each large (134 to 215 cm in length) and in relatively early stages of reduction. One is not reduced at all, and one appears to be a split nodule with a few parallel flakes removed haphazardly. The third is set up for blade removal, with three ridges that appear to be prepared as guides and a series of 3-4 blades removed from a single platform. A flaw in the nodule resulted in the step termination of each of these removals. A second face on this core also appears to have a prepared ridge, with three deeply hinged flakes removed from it. The bifacial core is thick and characterized by numerous severely stepped flake removals on one face. The edges have high angles and appear flat at the ends of the core. All of the cores seem poorly worked, perhaps by an inexperienced knapper. Alternatively, this collection of relatively poor quality cores was deemed unworthy of further transport, but still worthy of stashing for harder times.

The removals range from characteristically Clovis blades with small platforms and weak bulbs and ripples to blade-like flakes and flakes with simple and cortical platforms and prominent interior features. A great many of the platforms I was able to observe were of the latter type, lacked evidence of grinding, and may reflect hard hammer percussion. A few were marginally retouched and most exhibit edge damage, although it is difficult to tell how much of this relates to disturbance by heavy machinery and subsequent trampling by cattle. None of the blades or flakes appears to have been derived from any of the cores from the cache. All artifacts are made from Edwards Plateau chert, although more than one variety may be present.

This cache deviates in many ways from others I have examined. The cores are generally at very early stages of reduction and their state does not suggest particular skill in blade core reduction. The biface is thick, heavily step-fractured, and does not have much promise for further useful reduction. Little investment appears to have been made in platform preparation on blades and flakes. These characteristics are not consistent with technology from secure Clovis contexts and create some doubt as to whether the collection should in fact be considered Clovis. While some blades that were unavailable for direct study appear to compare well with Clovis blade reduction technology, the majority of the assemblage appears as if someone relatively unfamiliar with Clovis blade and biface manufacture techniques discovered a Clovis cache and reduced many of the artifacts in a less systematic manner. This may actually be the case; it is the result that one might expect if an Archaic or later period flintknapper scavenged a Clovis cache. Given that the cache as a whole cannot confidently be attributed to Clovis, I have chosen not to include this assemblage in the analysis of Clovis caches until further information comes to light. The Garland cache is acknowledged as a potential Clovis cache but it does not contribute further to the analyses or conclusions of this dissertation.

Keven Davis

Keven Davis, a property surveyor, discovered the Keven Davis cache (Figure 21) in 1988 when he found three blade fragments exposed by earth-moving equipment in a field. Davis and several others, including Bill Young of the Texas Archaeological Stewardship Network (Young and Collins [1989], and Collins [1999] provide detailed histories), continued investigating the site. Their investigations ultimately resulted in the discovery of 39 artifacts (11 of which are less than 1 cm in maximum dimension) representing 14 prismatic blades. The site is located near Cedar Creek in Navarro County, Texas. The inferred cache locality is on a subtle hill slope between Little Cedar Creek to the south and a small tributary of Cedar Creek to the northeast. The area overlooks the floodplain of Cedar Creek.

Davis and Young excavated a series of 13 1 x 1 m test units around the original discovery. Patterns in both the dispersion of artifacts and the relationships of refitted fragments indicate that the artifacts had been first disturbed by plowing and then exposed and disturbed again by heavy equipment used for borrowing sediment. In addition to spreading the contents of the cache over an approximately 2 m area, the heavy equipment caused a great deal of damage to the artifacts.

Michael Collins (1999) carried out an intensive analysis of the Keven Davis blades and concluded, through comparisons with other blades, that the former are Clovis in origin, and used them to describe Clovis blade technology. Microwear analysis by Marvin Kay (1999) demonstrated that the majority of damage to the artifacts is attributable to mechanical impacts. However, he found evidence for use-related damage to blades 10, 11, and possibly 9, and transport wear on both the interior and exterior surfaces (indicating transport of the individual blade) of Blade 10. His results indicate that the blades were minimally used prior to deposition.

Figure 21. The Keven Davis cache, showing interior surfaces of blades. Numbers correspond to artifacts described in text.

The blades typically exhibit ground platforms, 7 of which are faceted. Bulbs are subtle and ripples are widely spaced. Exterior scars indicate from as few as 1 to as many as 5 previous blade removals on each blade. The artifacts consist of two distinct varieties of chert. Ten, and possibly 11, are made of the Georgetown variety of Edwards Plateau chert. The remaining blades are made of an unidentified, high quality, faintly banded brown chert, which may also be a variety of Edwards Plateau chert. Artifacts from both raw materials exhibit substantial cortex that, along with the low number of exterior scars on some, may suggest relatively early stage reduction of the cores from which they were produced.

The Keven Davis cache appears to represent a deposit of unused and lightly used blades from two raw material sources. The artifacts are morphologically and technologically consistent with those from secure Clovis contexts. The collection thus appears to represent a utilitarian cache of Clovis blades.

Pelland

The Pelland family discovered the Pelland cache (Figure 22) in their garden after tilling it sometime in the 1950's. Ross Pelland of International Falls, Minnesota, currently keeps nine of the blades. His nephew, while hoeing or playing in the garden, discovered the first blades. Seven more were later found by Ross' mother, who was hoeing and found them together in a bunch. Dr. Jacek Misciewicz, a visiting Polish archaeologist, investigated the site along with James Stoltman and Elden Johnson of the University of Wisconsin, found an additional artifact (Stoltman 1971). At least two artifacts were given away to cousins who, according to Ross' son, now live in the Seattle area. Other items in the Pelland's small collection are two fluted points (one of which may be a Gainey point) and several other bifaces. Two bifaces are of the same raw material as the blades, and one of these shares some technological affinity to Clovis. Ross Pelland believes this latter biface was recovered from the garden sometime after the blades.

All nine blades and blade fragments in Ross Pelland's collection appear to be manufactured from Knife River Flint. Ultraviolet tests, revealing greenish yellow fluorescence, support this identification. The platforms, where present, are small, simple to faceted, and usually lightly ground. Bulbs are small and ripples are relatively low amplitude. At least two blades show signs of guide ridge preparation on their exteriors.

Figure 22. The Pelland cache, showing exterior surfaces of the blades. Numbers correspond to artifacts described in text.

All are either extensively unifacially retouched or are heavily damaged (or both) along their lateral margins, presumably from use. One (No. 2) exhibits distinct parallel oblique retouch that obscures most of the exterior surface. While this attribute is not a recognized characteristic of Clovis, it is present on another blade in a private collection in Colorado, which is apparently from Blackwater Draw (Figure 23). The latter blade is made of Alibates chert and is labeled "Blackwater Draw 1936" with ink. It reportedly is derived from a collection made by Marie Wormington (Mark Mullins, personal communication, 2005).

Figure 23. Parallel oblique flaked blade possibly from Blackwater Draw.

Another Pelland blade is broken and unifacially retouched along the broken margin. Ridge abrasion is present on some blades but is generally subtle; no indications of ridge abrasion along the margins or areas of polish on the interior were present.

Although many of the blades were similarly curved longitudinally and shared similar raw material patterns, no production refits were found, although blades 1 and 7 are particularly close in curvature and raw material properties. Three blades retain small remnant cortical surfaces. These three could conceivably have been produced from a single core, but subtle differences in the hue, cortical differences, and patterning in cream-colored streaks and whorls suggest that two cores might be involved.

Two large Knife River flint bifaces are in the collection. One of these has Clovis affinities and may be part of the cache. It is roughly ovoid with a possible large overshot flake on one face (this flake is difficult to define because of a weathered plane of weakness that the flake followed), and a definite overshot near the distal end on the opposite face. A wide flat remnant is located on the margin of the proximal end and one margin has been bifacially retouched. I cannot be certain whether this item was originally part of the cache, although I suspect that it might have been, but I do not include it in any further analyses involving the Pelland cache.

The cache was located on the west side of the Little Fork River about 0.4 km above its confluence with the Rainy River – the largest river in the area. The garden is about 150 m from the current channel of the Little Fork, but otherwise there are no landmarks or natural features that might serve to mark the location. Hematite was not observed within cracks, steps, or crevices on any of the artifacts. A red area on the cortex of one blade does not appear to be ochre. Based upon my inspection of the Pelland cache, I consider it to be a cache of Clovis artifacts, the northernmost Clovis cache so far identified.

Sailor-Helton

Raymond Sailor found the Sailor-Helton cache (Figure 24) in 1957 on land leased by Jack Conover near Satanta, Kansas. Conover guided me to the find location in 2004, and indicated that Sailor had noticed from horseback artifacts eroding out of the slope. Sailor asked Bill Helton (deceased husband of Ima June Helton, the current owner of the cache) to assist in digging up the artifacts. Conover recalls that the artifacts were clustered in an area about one yard in diameter. The find location lies about 1.6 km northwest of the Cimarron River at the upper ends of two shallow tributary drainages. The area consists of gently rolling uplands covered in grass, prickly pear, yucca, and sage. The soils are deep sand and loess with no surface indications of a spring or other feature. The cache was located on a southeast-facing knoll with a ca. 10 degree slope overlooking the Cimarron valley.

Figure 24. The Sailor Helton cache.

The cache consists of a large mass (13.8 kg) of raw material, composed of 40 blades, 115 flakes and bladelike flakes (3 of which are retouched), and 10 large cores. All of these are of Alibates agatized dolomite, located at least 166 km to the south. Macroscopic differences in raw material patterns indicate at least eight different pieces of raw material. Eight of the cores (lower two rows of Figure 24) exhibit cortex, two of which feature secondary (cobble) cortex. The cores are mostly large (14-20.4 cm) in maximum dimension and in an early stage of reduction, with some parallel blade-like removals taken, but not yet taking on formal blade-core morphology. Six blades and flakes refit to one another or to the cores. I believe that many more refits could be identified with extensive effort. The blades are variable in morphology but are mostly consistent with blades from secure Clovis contexts. Platforms are commonly lightly ground and mostly simple or dihedral, but occasionally faceted or cortical. There is a great range in longitudinal curvature. Five show indications of use. The flakes are even more variable, and include typical core reduction flakes, blade-like flakes, and five flakes that may be derived from bifaces (none of which were present among the cached items). Five blades and three flakes show indications of having been used. Surface abrasion is common, and is mostly limited to ridges and other exterior surfaces.

Unlike many blade and flake dominated caches, Sailor-Helton represents a very large amount of raw material moved a considerable distance. Further, the material retains a great amount of mass and utility. It is most likely a Clovis utilitarian cache.

Simon

The W.D. Simon family found the Simon cache (Figure 25) in the autumn of 1961 while Mr. Simon was grading a vehicle entrance into an alfalfa field on his farm near Fairfield, Idaho (Butler 1963; Butler and Fitzwater 1965; Woods and Titmus 1985). Thirty-two artifacts are at the Herrett Center and five more (one composed of 3 refitted pieces) are in the collections of the Idaho Museum of Natural History. The family donated their collections to the Herrett Center, while B. Robert Butler gathered the IMNH collection through excavation (two pieces, one of which I do not consider to be an artifact) and from residents of Fairfield during 1967 and 1968. Most of the artifacts were disturbed and broken by machinery, but a few remained "lying undisturbed in a small depression" (Swanson et al. n.d.). All were abundantly covered with hematite, but most of this has been washed off because it stained children's hands when taken to schools (W.

D. Simon, personal communication 2003). The reconstructed specimens are currently glued together.

Figure 25. The Simon cache, selected items.

Butler's excavations at the find location consisted of trenching and troweling remaining areas of yellowish silt that matched sediments on the artifacts (Swanson et al. n.d.). A piece of banded chalcedony was found in situ and interpreted as a spokeshave. Much of the stratigraphic interpretation of the cache context hinges on this item. Although it is of material similar to some of the cache specimens, it is cortical on both faces and the retouch is questionable. I do not consider it an artifact, and suspect that it is derived from naturally occurring gravels that are very common in the sediments. It does make me wonder if it is raw material from the same source as some of the artifacts; if so, this source must occur in or near the Soldier Mountains from which the gravels are derived. The other artifact found in situ is a heavily damaged partial base of a point. Although the channel flakes scars are broad and subtle, the lateral and basal margins are distinctly ground. This item more clearly supports the stratigraphic interpretations. Geologic investigations by Swanson et al (n.d.) and Haynes (1971) indicate that the cache was deposited on a terrace of a small tributary near its junction with Deer Creek which is now located about 1.6 km to the west of the site. The cache was located adjacent to a narrow reach of the stream just downstream from a wider channel that graded into a marsh. There are currently no landmarks or features that would aid in relocating the site, but it is unknown whether some organic marker such as trees may have existed in the past.

Raw material diversity is relatively high (at least 14 different materials), but few potential sources are known. The cache consists entirely of bifaces, ranging from a huge flake (28.5 cm in maximum dimension) in the earliest stages of bifacial reduction, 14 large ovoid bifaces, 10 smaller ovoid bifaces, 4 point performs, and 7 finished points. Ridge abrasion and intra-scar polish suggestive of transport wear are particularly evident on the largest bifaces, but are minor or lacking among points and preforms. Overshot flaking is common (occurring on 66% of bifaces), but not ubiquitous. Fifteen earlier stage bifaces retain flat remnants along their margins. Evidence for use damage is minor – one potlidded specimen has been retouched along one margin to form an asymmetrical "knife." One of the smaller points may have been broken and resharpened.

One, and possibly two, sets of points appear to be paired. The two largest points are almost identical in size and shape and incorporate natural bands in the raw material at the same angle relative to their long axes. The two smaller points are of similar size but are less strikingly paired (although one is damaged). A fifth point, intermediate in size between these two pairs, has no counterpart, although it could not be directly compared to the tip and base fragments from the IMNH.

I suspect that other items may have originally been part of the cache. Phyllis Oppenheim (personal communication, 2002) of the Herrett Center, College of Southern Idaho, says that the family was frustrated that some Fairfield residents who visited the site took "souvenirs." Several broken items are missing portions and these may remain undiscovered at the site, in the possession of locals, or in other places. A remaining question is whether or not large bifaces that were broken roughly in half were broken by machinery or were deposited in that condition, having been intentionally broken by their makers. I consider the Simon cache to be an authentic Clovis cache.

Watts

Ira Watts discovered the Watts cache (Figure 26), which consists of 3 bifaces and 3 projectile point preforms, as he plowed a field along the Cache La Poudre River near Fort Collins, Colorado. The cache, along with several unrelated items, was donated to the Fort Collins Museum in 1941. Four additional specimens were donated along with the cache, but do not appear to be part of it. Bob Patten recognized the collection as a potential Clovis cache and presented a summary analysis on the web (Patten n.d.).

Two of the bifaces (Biface 1 and 2) are over 30 cm long. Both exhibit widely spaced large flake scars that plunge toward the center, resulting (especially on Biface 1) in even thickness throughout. Biface 2 consists of two pieces, and at least one smaller piece is missing. The damage appears to be the result of contact with a plow blade. The third biface is about half the size of the others and exhibits wide flake scars that travel almost all the way across each face. A remnant facet on Biface 3 indicates that it may represent a portion of a larger biface that was intentionally broken.

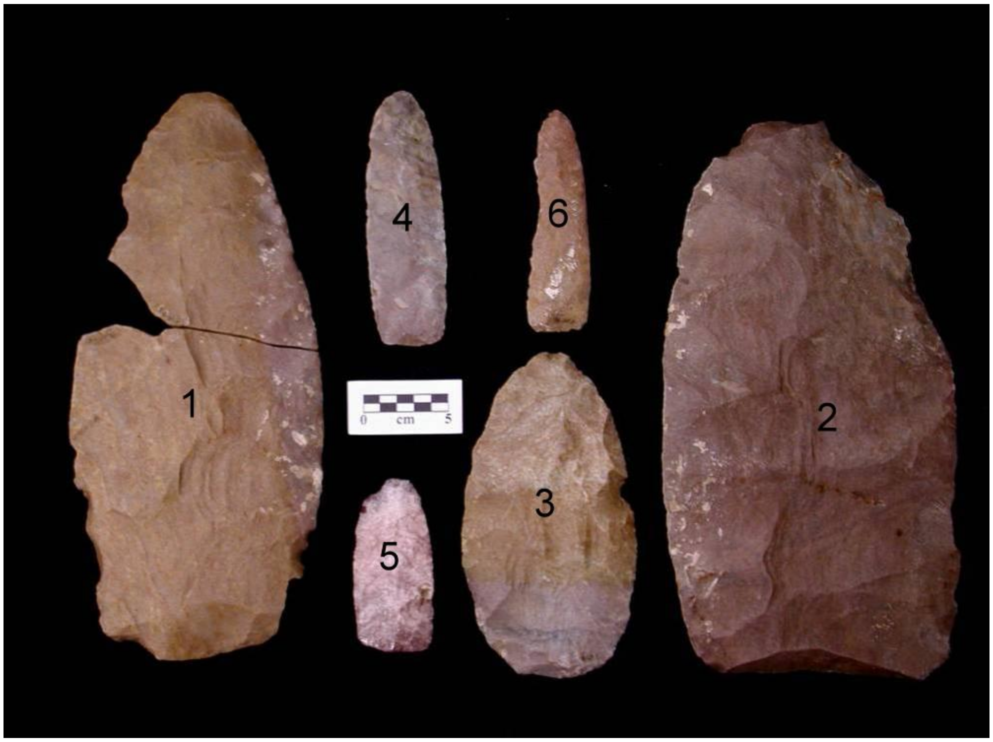

Figure 26. The Watts cache.

The preforms (Bifaces 4-6), one of which is fragmentary, are consistent with Clovis preforms in outline and technology. Biface 4 is complete and symmetrical. Biface 5 is somewhat shorter and has steep unifacial retouch along one margin, resulting in a slight asymmetry. This preform appears to have been converted into a scraping tool, but could still be reduced into a small Clovis point if desired. Biface 6 is a fragment that has primary cortex toward the distal end. Minor patination on the interior of the break suggests that it may have been broken before being placed in the ground.

All of the bifaces are of fine-grained quartzite comparable to Hartville Uplift, with the exception of Biface 6, which is made of lustrous reddish purple chert (comparable to Biface 47 in the Simon cache). Patination is heavy on all of the artifacts, especially Bifaces 1, 2, and 6, and variations in the degree of patination suggest that Biface 1 may have covered the others. Ridge abrasion is minor on the artifacts and difficult to differentiate from curation damage (they were stored in a wooden drawer for over 50 years) or plow damage. No traces of red ochre were observed on any of the Watts cache artifacts.

The remaining four artifacts that were donated along with the cache are large flakes of coarse gray chert, Niobrara chert, and a very lustrous speckled agate. The flakes are variously reduced on one or both sides and typically exhibit short, stepped flake scars. None of the four are patinated. All of the bifaces (with the exception of Biface 6) are marked with "Watts" in red crayon or soft pencil, but the four flakes are not. The four additional flakes differ in technology, raw material, and markings, and thus I do not consider them part of the cache.

The technology represented in the Watts cache artifacts is consistent with Clovis, and the large bifaces in particular are reminiscent of those in other caches with fluted points. The heavy patination suggests substantial age. These attributes support the interpretation that the artifacts represent a Clovis cache.

Summary of Cache Assemblages

This investigation of 22 potential Clovis caches has resulted in the identification of 16 assemblages (Table 11) that meet both my definition of cache assemblage and my criteria for assigning Clovis cultural-temporal affiliation (as discussed in Chapter 2). From these I have been able to collect first-hand data, or derive data from sources I deemed reliable, that represent a total of 663 Clovis artifacts. These artifacts are overwhelmingly composed of flaked stone (642), but also include non-flaked stone (2), bone or ivory (18), and shell (1).

Table 11. Assemblages Determined to Represent Clovis Caches.

Assemblage	Artifact Class							
	Bifaces	*Points*	*Cores*	*Blades*	*Flakes*	*Rods*	*Other**	**Total**
Anadarko	2		4	26				32
Anzick	62	8		1	9	6		86
Green				17				17
West Bank				4	1			5
Busse	13		1	33	30		1	78
Crook County	7	1		1				9
De Graffenried	4	1						5
Drake		13					1	14
East Wenatchee	20	14		4	8	12		58
Fenn	35	20		1				56
Franey	1		1	35	36		1	74
Keven Davis				14				14
Pelland				9				9
Sailor-Helton			10	40	115			165
Simon	28	7						35
Watts	6							6
Total	178	64	16	185	199	18	3	**663**

*Busse - abrader, Drake - hammerstone, Franey - marine shell.

Six assemblages, representing 66 artifacts, are not accepted as Clovis caches (Table 12). These assemblages either do not meet the criteria for a cache assemblage, do not meet the criteria for Clovis affiliation, or their authenticity as prehistoric specimens is in doubt. It is possible that information will become available in the future that supports the identification of one or more of these assemblages as a Clovis cache; however, the data from these six assemblages do not further contribute to this dissertation. In the course of investigating these assemblages, I have become aware of additional collections that may represent Clovis caches, but I was unable to include them in this study. It is my belief that more examples of Clovis caches will come to light as both archaeologists and lay people become more aware of their existence and identifying traits.

Table 12. Assemblages Not Accepted as Clovis Caches.

Assemblage	Artifact Class							
	Bifaces	*Points*	*Cores*	*Blades*	*Flakes*	*Rods*	*Other*	**Total**
Bastrop	9	4						13
Comanche Hill			2					2
Eisenhauer			1					1
Evant			3					3
Crockett Gardens		1		5				6
Garland	1		3	23	14			41
Total	10	5	9	28	14	0	0	**66**

Clovis Kill and Camp Sites

Artifact assemblages from three Clovis kill and camp sites are included in this analysis: Blackwater Draw, New Mexico; Murray Springs, Arizona; and the Sheaman Site, Wyoming (Table 1; Figure 1; Table 13). These three sites correspond geographically with the distribution of Clovis caches; they are single component or have multiple components that are distinguishable stratigraphically. Each has relatively well-provenienced and cataloged specimens.

Blackwater Draw

Blackwater Draw Locality No. 1 (or simply Blackwater Draw) is the type site for the Clovis culture and includes several activity areas associated with Pleistocene and early Holocene springs and ponds that are in most cases stratigraphically separate from younger archaeological deposits (Boldurian and Cotter 1999; Haynes 1995; Hester 1972; Holliday 1997; Sellards 1952; Stanford et al. 1990). In addition to the kill and camp assemblages at Blackwater Draw, two Clovis caches were recovered from this site, as already discussed.

Blackwater Draw is located on the Llano Estacado of east-central New Mexico. Gravel mining operations first unearthed mammoth remains and artifacts in 1932, soon after the Pleistocene occupation of North America was established at the Folsom site. Excavations by the University of Pennsylvania between 1932-1937 revealed the remains of several bison and two mammoths associated with artifacts. The two fluted points associated with the mammoths became the type specimens for the Clovis point (Cotter 1937). Excavations have continued intermittently at Blackwater Draw from the 1930's to the present, often just ahead of or in the midst of ongoing gravel mining operations (which ceased in the mid-1970's). Among the institutions that have excavated at the site are the Texas Memorial Museum, the Museum of New Mexico, the University of Chicago, Texas Technical College (Texas Tech), Eastern New Mexico University, and the Smithsonian Institution (Hester 1972; Katz 1998).

Clovis activity areas at Blackwater Draw include at least the remains of eight individual mammoth kills, two bison kills, and two camp areas (Hester 1972; Holliday 1997:64/68). The camp areas are both located near spring conduits in the uplands along the western margin of the basin. The camp site near the North Bank conduits contributed the majority of Clovis camp artifacts; however, Holliday (1997:67) believes these to be redeposited. The eight mammoths each appear to be individual kills made near the springs, the interior basin, and the outlet channel. The two bison kills include a group of at least seven *Bison antiquus* individuals associated with a Clovis point (Hester 1972:46-47), and a group of four excavated by Jelinek and originally interpreted as a mammoth kill (Hester 1972:52-53). The latter was later identified as a bison kill by Johnson and Holliday (1996).

With the exception of the Jelinek bison kill (which was either within the Brown Sand Wedge or at its contact with the underlying gray sand), all of the Clovis remains occur in the gray sand strata [a.k.a. Units B and C (Haynes 1995)]. These strata constitute a series of spring- and hillsope-deposited sands that were reworked by stream action toward the center of the basin, and separated by an eolian erosional discomformity at around 11,500 B.P. (Haynes 1995; Holliday 1997:59-62). Combined, these strata are radiocarbon dated between 13,000-11,000 B.P. These data indicate that active springs and streams, more than ponded water, characterized Blackwater Draw during the Clovis occupation. In addition to mammoth and bison, horse, camel, deer, dire wolf, peccary, turtle, muskrat, saber-tooth cat, and other vertebrates have been recovered from the Gray Sand.

Eastern New Mexico University curates the majority of the professionally excavated Clovis artifacts from Blackwater Draw. Some private collections from the site have been donated as well. The ENMU collection contains over 450 Clovis artifacts including projectile points, bifaces, end and side scrapers, knives, flake tools, blades, cores, hammerstones, pebbles, a possible grinding stone, as well as rods and other modified fragments of bone and ivory. A note is warranted concerning FB-7, a large biface of Edwards Plateau chert recovered from the primarily-Folsom Mitchell Locality at BWD (Stanford and Broilo 1981). Though this biface has been interpreted as Folsom and incorporated into models of Folsom technological organization (Boldurian 1991; Hofman 1992), I believe a Clovis affiliation is more likely. The biface is unique among known Folsom assemblages, but is statistically comparable to other Clovis bifaces (LeTourneau 2000). Further, it exhibits morphological attributes, including overshot flaking and a substantial remnant facet, typical of Clovis technology. FB-7 is thus included in this analysis as a Clovis biface.

Stone tools are overwhelmingly manufactured from Alibates chert and Edwards Plateau chert. Tecovas jasper, Dakota quartzite, quartz, obsidian, and other materials are present in lesser amounts.

The University of Pennsylvania Museum of Archaeology and Anthropology curates at least 15 additional Clovis artifacts collected from the gravel pit by Edgar Howard (Boldurian and Cotter 1999:48-55). These include projectile points (n=7), biface thinning flakes (n=2), blade tools (n=2), beveled bone tools (n=2), and a channel flake tool. Data for 5 projectile points, 2 beveled bone tools, and a side scraper made on a blade are available in Boldurian and Cotter (1999). Some additional material resides at the Smithsonian Institution and Texas Tech University. All available tools and all debitage with platforms that can be attributed to the Clovis components of Blackwater Draw are included in this analysis.

Murray Springs

The Murray Springs Clovis site is a single-component Clovis site (although there is evidence for a minor Archaic period occupation in the surface camp area) along a tributary of the San Pedro River in southeastern Arizona. It contains deeply buried mammoth and bison kills and an associated surface camp (Haynes and Hemmings 1968; Haynes and Huckell 2007; Hemmings 1970). With over 14,000 associated artifacts, Murray Springs is the single largest sample of Clovis lithic technology in the western United States (Huckell 2007:2). The Murray Springs site was discovered in 1966 when C. Vance Haynes, Jr. and Peter J. Mehringer, Jr. found mammoth bones eroding from Curry Draw. Subsequent excavations from 1966-1971 by Haynes and resulting geochronological investigations revealed that mammoth and bison had been killed along a small stream eroded into pond and marsh sediments. Eight radiocarbon dates on charcoal from apparent hearths and the occupation surface yielded an average age of about 10,900 B.P. (Haynes 1993). An organic layer (the “black mat”) that resulted from a rising water table quickly buried the occupation surface (Haynes 1974). The black mat allowed for excellent preservation of the fauna, artifacts, features, and even prehistoric footprints (possibly mammoth) along the bank. In addition to the kills, a shallowly buried Clovis campsite was discovered south of the arroyo. Fragmentary artifacts from the campsite conjoin with those from a multiple bison kill, linking the two occupation areas.

The Murray Springs site contains a series of nine excavation areas, all but three of which contain clusters of artifacts. The black mat quickly buried Areas 1, 3, 4, and 5 and it preserved remarkably intact clusters of animal bones, tools, and reduction debris (Haynes and Huckell 2007; Hemmings 1970). Areas 6 and 7, the camp, were never deeply buried and preserve relatively less spatial integrity. Area 1 yielded 64 pieces of debitage in three clusters; Area 8 yielded a single flake; Areas 2 and 9 contained no artifacts.

The mammoth kill (Area 3) lies just west of a buried stream channel. The remains of a young adult mammoth with disarticulated hind limbs are associated with fragments of three projectile points, 4 flake tools, a biface, a blade, a core, and over 11,000 pieces of debitage in 24 clusters. In addition, bone artifacts, including the well-known “shaft wrench,” a bone shaft with an aperture at one end (Haynes and Hemmings 1968), were recovered from Area 3.

Area 4 is known as the bison kill area, and contains the remains of at least eleven bison (probably *Bison antiquus*) associated with 9 projectile points, 2 flake tools, a biface, a blade, a core, a hammerstone, and 1,551 pieces of debitage in five clusters.

Area 5, an occupation surface that included a horse (*Equus* sp.) located west of Area 4, yielded a projectile point, 2 bifaces, a flake tool, and 1002 pieces of debitage in six clusters.

The camp area (Areas 6 and 7) is buried by thin Holocene deposits on a surface southwest of the Areas 1-5. Conjoined artifacts between the camp and bison kill areas indicate that the camp was certainly occupied in association with the bison kills. Areas 6 and 7 are perhaps the least thoroughly investigated, but excavation and surface collection has yielded 6 projectile points, 2 bifaces, 16 flake tools, 11 blades, and about 750 pieces of debitage in eight clusters.

Lithic artifacts from Murray Springs are derived from at least 20 different lithic raw materials (Huckell 2007). St. David Chalcedony, a locally available material, accounts for over 10,000 artifacts (about 70%). The next most abundant materials are pinkish gray chert and reddish brown cherts (sources unknown) that together account for over 3,000 artifacts (about 20%). Other raw materials are present in much smaller amounts (<2% each). Materials known to be non-local can be traced to east-central Arizona (Cow Canyon obsidian) and the Little Colorado River valley (petrified wood). The distinctive character of the raw materials at the site, along with the spatial integrity of the lithic reduction clusters, renders the Murray Springs assemblage especially informative with regard to Clovis reduction technology. The majority of debitage at Murray Springs is the result of biface reduction (Hemmings 1970; Huckell 2007).

Refitting analysis has resulted in reconstructed minimum biface widths and thicknesses for five bifaces.

Artifacts from the Murray Springs site are curated by the University of Arizona's Arizona State Museum. All tools, cores, and all debitage greater than 1 cm that possesses platforms and were available for examination were included in this analysis.

Sheaman Site

The Sheaman site is a single-component camp adjacent to the Agate Basin site in northeastern Wyoming (Frison 1982; Bradley 1982). Although the single projectile point recovered at the Sheaman site is morphologically unusual in comparison with other Clovis projectile points, the presence of systematic overshot flaking on a reconstructed biface, a possible channel flake, and an ivory rod support the interpretation of this assemblage as Clovis.

The Sheaman site is adjacent to a small spring that is currently almost perennial, and which may have been one of the attractions to Clovis people. The erosion of a minor arroyo associated with the spring exposed the site. Much of the original site may have been lost to erosion, as well as to unauthorized digging (Frison 1982:143). The Clovis artifacts were located in what was the bottom of a gently sloping, flat-bottomed arroyo. An intense fire radiocarbon dated to ca. 10,000 BP affected many of the artifacts, especially those higher in the profile.

Thousands of stone and bone artifacts were recovered from the site. In addition there was a red ochre feature consisting of a ca. 2.5 by 3 m stain about 5 cm thick. Within this stained area, and also coated with red ochre, were found several whole bison elements and fragments. Additional bison bones, mostly cranial elements, were found outside of the stain. A cut pronghorn (*Antilocapra americana*) metatarsal and a mammoth ivory rod were also recovered.

The University of Wyoming excavated the Sheaman site between 1977 and 1979. Over 2,800 lithic artifacts were recovered from the excavation and are curated at the University of Wyoming. Included in this total are 1 Clovis projectile point, 7 flake tools, 4 channel flakes, 2,792 pieces of debitage, 1 hammerstone, 1 flake core, and several specimens of red ochre. Many of the flakes can be refitted (Bradley 1982) to provide some insight into the cores and the biface from which they were produced. Refitting provides minimum width measurements for 9 bifaces and minimum thickness measurements for 7 bifaces that had been reduced on site. The vast majority of artifacts at the Sheaman site were manufactured from Hartville Uplift chert, available a few hundred kilometers to the south. The remaining artifacts are made from banded quartzite comparable to that found at Spanish Diggings and mossy agate, a raw material of moderate quality found in the vicinity of the site (and the nominal referent for the Agate Basin site). The ivory rod is comparable to those recovered from other Clovis contexts, with a one end beveled and cross-hatched and the other forming a point, which in this case is damaged. All tools, cores, and all debitage that possesses platforms (n=849) are included in this analysis.

Together the assemblages from these three sites represent the production, use, maintenance, and discard of tools at Clovis camps and at kills of both mammoth and bison, from the Northern and Southern Plains and the Southwest. The data from these sites are used as a baseline for comparison of data from caches. Analysis of the sites includes all formal and expedient tools and, because assemblage sizes range into many thousands of specimens, a sample of debitage. Debitage samples included flakes, blades, and orientable fragments thereof (unorientable fragments, or angular debris, have limited information potential for this research) selected randomly from each activity area of the Murray Springs and Sheaman sites. Due to their limited numbers, all Clovis specimens from Blackwater Draw were analyzed.

Summary of Kill and Camp Assemblages

Three Clovis kill and camp sites were investigated to provide a comparative basis for understanding the Clovis caches (Table 13). Each of these can be attributed to Clovis with some confidence, based upon diagnostic artifacts, radiocarbon dates, faunal associations, or a combination thereof. While Sheaman most likely represents a single camp, Blackwater Draw and Murray Springs both represent multiple kills and camps, some of which can be clearly distinguished from one another. Together these three sites include at least eight mammoth kills, two bison kills, and four camps.

Table 13. Analyzed Clovis Camp and Kill Assemblages.

Assemblage	**Artifact Class**							
	Bifaces	*Points*	*Cores*	*Blades*	*Flakes*	*Rods*	*Other*	**Total**
Blackwater Draw	14	33	1	47	376	3	7	481
Murray Springs	6	18	4	13	79		1	121
Sheaman	0*	1	1	1	838	1	7	849
Total	20	52	6	61	1293	4	15	**1451**

*refit flakes provide partial measurements for 9 bifaces.

The same methods were used to collect data from the three kill and camp assemblages as from the cache assemblages. Analysis of Blackwater Draw, Murray Springs, and the Sheaman site resulted in data representing 1451 artifacts. These artifacts provide comparative examples for each artifact class represented in the cache assemblages, with the exception of shell. The artifacts include flaked stone (1432), non-flaked stone (13), and bone or ivory (6).

CHAPTER 6. ARTIFACT FORM AND FUNCTION

The considerable variation among the assemblages presented in Chapter 5 suggests that they most likely did not all serve the same function. Indeed, some of them may not represent caches at all; they may never have been intended for retrieval. The goals of the following chapters are to partition the variation in the assemblages according to comparable attributes, and to utilize these attributes to provide possible evidence on function. Toward these ends, Chapters 6, 7, and 8 explore variation in artifact form and interpretations of function, raw materials, and site context, respectively.

General artifact form and function are addressed in this chapter. First, an overall review of the artifact classes in the caches is presented, resulting in the identification of two broad categories of caches. I then compare caches with regard to artifact diversity. Artifact remnant utility and evidence of use are addressed in the second half of the chapter. The results of these analyses are used in subsequent chapters to address the expectations for cache function presented in Chapter 3.

Artifact Classes

It is difficult - perhaps in many cases impossible - to identify all of the items that were originally placed in Clovis caches. Perishable items in particular - including artifacts made of bone, ivory, hide, wood, or vegetal matter - are very rarely preserved. A few caches, including East Wenatchee and Anzick, and possibly Crook County and Drake, are known to have included bone or ivory rods. There is currently no way to discern how many others may once have included rods, or other organic items. The vagaries of preservation therefore make it difficult to compare assemblages based upon the presence or absence of perishable materials. For this reason, only lithic artifacts are examined in these cache comparisons; which are based upon artifact classes.

For comparative purposes, I divide lithic artifacts into five basic classes: projectile points, bifaces, cores, flakes, and blades (as defined in Chapter 4). Formal and informal tools made on flakes and blades (such as scrapers, gravers, retouched flakes, etc.) are classified as flakes or blades as appropriate. As stated previously, these classes are constructed so as to maintain a focus upon technology, rather than solely on functional interpretations. Additional isolated artifacts, such as a hammerstone (Drake), an abrader (Busse), and a shell (Franey), are not considered in this chapter (but see Chapter 8).

The distribution of artifact classes for each cache is presented in Table 14. While most are composed of multiple artifact classes, a few consist of items pertaining to only a single artifact type. Drake (excluding the hammerstone) consists entirely of finished projectile points. Watts is composed entirely of bifaces. Green, Keven Davis, and Pelland consist solely of blades. While one can never be certain that these assemblages are complete with regard to original cache contents, it seems reasonable to assume that these constitute only subsets of what were once more diverse toolkits, and perhaps represent either the anticipation of specific activities or a surplus of items within one technological component of the available toolkit. Other caches, for example Busse and Franey, appear less specialized and include a wider variety of artifact classes. Diversity will be explored in more detail below.

Table 14. Composition of Caches by Artifact Class.

Assemblage	*Bifaces (n)*	*Bifaces (%)*	*Points (n)*	*Points (%)*	*Cores (n)*	*Cores (%)*	*Blades (n)*	*Blades (%)*	*Flakes (n)*	*Flakes (%)*	**Total**
Anadarko	2	6.3	0	0.0	4	12.5	26	81.3	0	0.0	32
Anzick	62	77.5	8	10.0	0	0.0	1	1.3	9	11.3	80
Busse	13	16.9	0	0.0	1	1.3	33	42.9	30	39.0	77
Crook County	7	77.8	1	11.1	0	0.0	1	11.1	0	0.0	9
De Graffenried	4	80.0	1	20.0	0	0.0	0	0.0	0	0.0	5
Drake	0	0.0	13	100.0	0	0.0	0	0.0	0	0.0	13
East Wenatchee	20	43.5	14	30.4	0	0.0	4	8.7	8	17.4	46
Fenn	35	62.5	20	35.7	0	0.0	1	1.8	0	0.0	56
Franey	1	1.4	0	0.0	1	1.4	35	47.9	36	49.3	73
Green	0	0.0	0	0.0	0	0.0	17	100.0	0	0.0	17
Keven Davis	0	0.0	0	0.0	0	0.0	14	100.0	0	0.0	14
Pelland	0	0.0	0	0.0	0	0.0	9	100.0	0	0.0	9
Sailor-Helton	0	0.0	0	0.0	10	6.1	40	24.2	115	69.7	165
Simon	28	80.0	7	20.0	0	0.0	0	0.0	0	0.0	35
Watts	6	100.0	0	0.0	0	0.0	0	0.0	0	0.0	6
West Bank	0	0.0	0	0.0	0	0.0	4	80.0	1	20.0	5
Total	178	27.7	64	10.0	16	2.5	185	28.8	199	31.0	**642**

Matters of quantitative diversity aside, it is apparent that individual caches tend to emphasize either biface or blade/flake technology. These tendencies become even more apparent when the data are presented as cumulative percentages of assemblage composition (Table 15; Figure 27). The data in both Table 15 and Figure 27 are arrayed from specialized bifaces (projectile points) on the left, specialized flakes (blades) on the far right, with more generalized technology (cores) in the middle. Figure 27 is set up so that a perfectly uniform assemblage should be represented by a straight line bisecting the graph at a 45^{o} angle. None of the caches display such uniformity. Instead, the cumulative percentage graphs for every cache are either sharply convex or sharply concave, a pattern that divides the caches into two general categories of biface-dominated caches and blade/flake-dominated caches. It should be noted that assemblages in each of the categories contain other artifact forms, i.e., blade/flake caches may contain bifaces and *vice versa*, but the majority are clearly dominated by artifacts derived from one reduction trajectory or the other (with the possible exception of Busse, as described below).

The biface-dominated category includes the Drake, Simon, Watts, De Graffenried, Crook County, Anzick, Fenn, and East Wenatchee caches. All except Drake are associated with red ochre and all except De Graffenried are from the northern Plains or Rockies. The blade/flake-dominated category includes Pelland, Green, West Bank, Keven Davis, Sailor-Helton, Franey, Anadarko, and Busse. In contrast to the biface-dominated caches, all except Pelland and Franey are from the southern Plains, and none except Busse are associated with red ochre. Busse is perhaps the poorest fit in this category in that it includes several large bifaces, is from a more northerly location, and is associated with red ochre. The Busse cache shares more in common with the biface-dominated category.

Table 15. Artifact Class Cumulative Percentages for Cache Assemblages.*

Assemblage	*(%Points)*	*+(%Bifaces)*	*+(%Cores)*	*+(%Flakes)*	*+(%Blades)*
Green	0.0	0.0	0.0	0.0	100.0
West Bank	0.0	0.0	0.0	20.0	100.0
Keven Davis	0.0	0.0	0.0	0.0	100.0
Pelland	0.0	0.0	0.0	0.0	100.0
Sailor-Helton	0.0	0.0	6.1	75.8	100.0
Drake	100.0	100.0	100.0	100.0	100.0
Franey	0.0	1.4	2.7	52.1	100.0
Anadarko	0.0	6.3	18.8	18.8	100.0
Busse	0.0	16.9	18.2	57.1	100.0
East Wenatchee	30.4	73.9	73.9	91.3	100.0
Fenn	35.7	98.2	98.2	98.2	100.0
Anzick	10.0	87.5	87.5	98.8	100.0
Crook County	11.1	88.9	88.9	88.9	100.0
De Graffenried	20.0	100.0	100.0	100.0	100.0
Simon	20.0	100.0	100.0	100.0	100.0
Watts	0.0	100.0	100.0	100.0	100.0

*Each column represents the sum of all previous columns plus the artifact class identified.

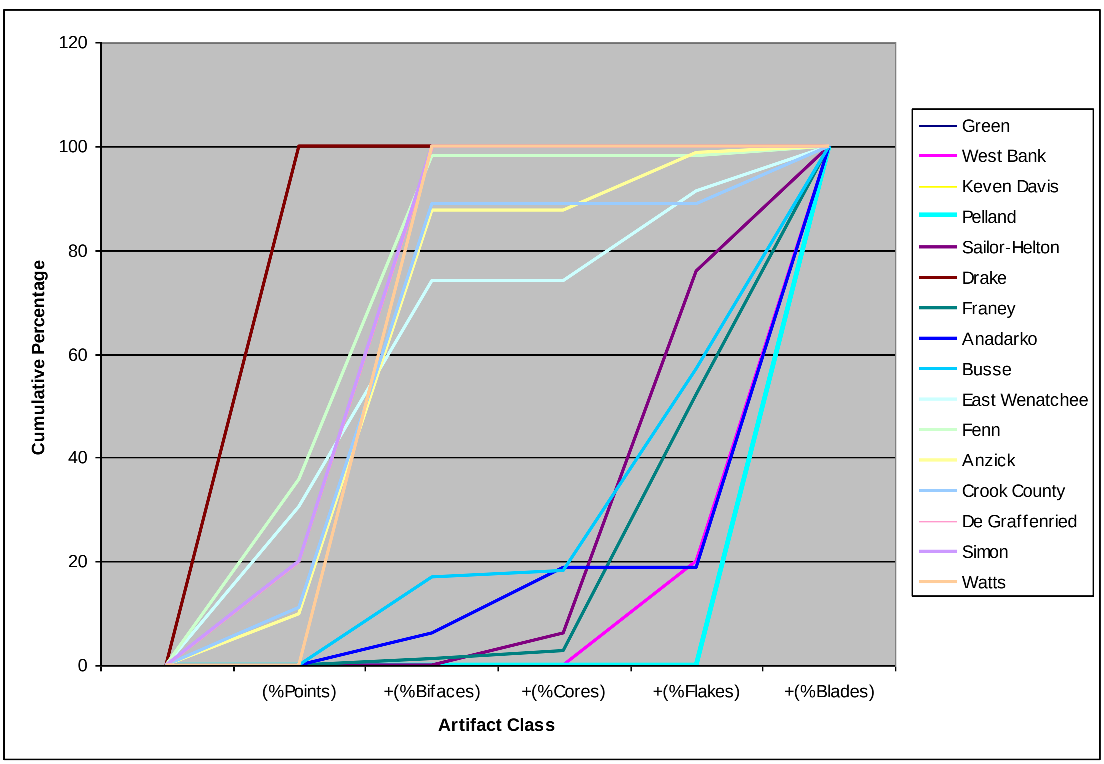

Figure 27. Cumulative percentage graph of artifact classes for cache assemblages.

In sum, even a cursory examination of the variation in artifact forms present in the caches highlights some clear, and perhaps consistent, differences. Biface-dominated caches tend to be associated with red ochre and tend to occur in the northern portion of the overall distribution of caches. In contrast, blade/flake-dominated caches are not associated with red ochre and tend to occur in the southern portion of the geographic distribution. These patterns are explored more closely as the individual caches are examined in relation to other attributes in this and the following chapters.

Artifact Class Diversity

The measurement of artifact diversity is based on the number of flaked stone artifact forms present in a cache. As above, bifaces, projectile points, blades, flakes, and cores are the artifact forms defined for use in measuring artifact diversity. Non-flaked lithic artifacts (e.g., hammerstones, abraders) are not included in this analysis.

The term *diversity* as used here refers to a general concept as opposed to a specific statistical measure. Of fundamental interest is identifying variation in the range of artifacts selected for caching in the different assemblages. Even at first glance, it is clear that some cache assemblages contain a great variety of forms, while others consist of a number of artifacts of the same general form. The diversity of cache assemblage contents is one of the essential attributes used here to evaluate cache function. In addition, diversity relates to the specificity of cache function; for example, a collection of tools suited to a single task or suite of tasks (e.g., projectile points) suggests the anticipation of meeting more specific task requirements than a collection of various tools and masses of raw material. This variation is potentially informative with regard to the predictability and the relative variability or specificity in tasks anticipated to be critical on specific parts of the landscape or at particular points in the movement of groups around that landscape.

Artifact diversity comparisons are made using the Simpson's index (*D*), a measure that characterizes diversity as the proportion of items relative to the total number of classes (p_i), squared. The squared proportions for all classes are summed, and the reciprocal is taken:

$$D = \frac{1}{\sum_{i=1}^{N} p_i^2}$$

Diversity values for each of the caches are presented in Table 16. Without further manipulation, the Simpson's *D* values have no upper limit, but serve as relative points of comparison for quantifying variation among the caches.

Table 16. Artifact Class Diversity (Simpsons D) for Caches.

Assemblage	*pi (bifaces)*	*pi (points)*	*pi (cores)*	*pi (blades)*	*pi (flakes)*	*D*	*Relative Diversity*
Anadarko	0.06	0.00	0.13	0.81	0.00	1.469	Low
Anzick	0.78	0.10	0.00	0.01	0.11	1.604	Diverse
Busse	0.17	0.00	0.01	0.43	0.39	2.746	Very diverse
Crook County	0.78	0.11	0.00	0.11	0.00	1.588	Low
De Graffenried	0.80	0.20	0.00	0.00	0.00	1.471	Low
Drake	0.00	1.00	0.00	0.00	0.00	1.000	Homogenous
East Wenatchee	0.43	0.30	0.00	0.09	0.17	3.130	Very diverse
Fenn	0.63	0.36	0.00	0.02	0.00	1.929	Diverse
Franey	0.01	0.00	0.01	0.48	0.49	2.112	Diverse
Green	0.00	0.00	0.00	1.00	0.00	1.000	Homogenous
Keven Davis	0.00	0.00	0.00	1.00	0.00	1.000	Homogenous
Pelland	0.00	0.00	0.00	1.00	0.00	1.000	Homogenous
Sailor-Helton	0.00	0.00	0.06	0.24	0.70	1.824	Diverse
Simon	0.80	0.20	0.00	0.00	0.00	1.471	Low
Watts	1.00	0.00	0.00	0.00	0.00	1.000	Homogenous
West Bank	0.00	0.00	0.00	0.80	0.20	1.471	Low

Artifact class diversity is represented by Simpson's D values ranging from 1.0 to 3.2. These values facilitate dividing the caches into four categories, consisting of homogenous, low diversity, high diversity, and very high diversity. Divisions among diversity classes are mostly arbitrary, but are based upon patterning within this set of values. Five caches (Drake, Green, Keven Davis, Pelland, and Watts) are entirely homogenous, and are thus characterized by a Simpson's D value of 1.0. Green, Keven Davis, and Pelland consist of only blades; Drake consists of projectile points, and Watts consists of bifaces. These caches each represent collections of relatively small numbers (6-14) of the same item. As such, they represent a specific portion of the overall toolkit, and it is logical to see them as being geared toward specific tasks or activities.

The low diversity category consists of five caches with values between 1.4 and 1.59 because these represent the lowest values that exceed 1.0. Anadarko, Crook County, De Graffenried, Simon, and the West Bank cache are included in this category. The Anadarko and West Bank caches consist primarily of blades, while the Crook County, De Graffenried, and Simon caches consist mostly of bifaces.

Caches with Simpson's *D* values that surpass 1.6 are considered here to be diverse, and caches with values above 2.7 stand out as very diverse because they are outliers in this range of values. Four caches - Anzick, Fenn, Franey, and Sailor-Helton - can be considered diverse. Of these, Anzick and Fenn are biface-dominated, with projectile points and other items included, and Franey and Sailor-Helton are blade/flake-dominated, with cores included. Though either biface or blade reduction trajectories are clearly emphasized in each of these diverse caches, there are a variety of forms present. In both cases early-stage forms (i.e. bifaces and cores) are present, suggesting that a degree of flexibility was being maintained with regard to later reduction options.

Busse and East Wenatchee stand out as very diverse. Busse is characterized as a blade/flake-dominated cache, though it also includes 13 bifaces and a core. In addition, it is worth noting that the Busse cache includes an abrader, though this item is not included in the calculation of diversity among flaked stone artifacts. East Wenatchee is biface-dominated, but also includes projectile points, blades, and flakes. In addition, East Wenatchee includes bone rods, though, like the abrader, these are not used in the calculation of artifact diversity due to the inability to control for preservation bias (i.e., it cannot be known with any certainty if bone implements were once associated with other caches). Busse and East Wenatchee may come closest to representing the full range of the typical Clovis toolkit, including a wide range of both lithic forms and reduction stages represented among the artifacts. If these caches are demonstrated to be utilitarian in nature, they likely represent the most generalized assemblages, and thus reflect the least certainty on the part of their creators regarding the activities for which they would be utilized.

In Chapter 3, I modeled caches that relate to the initial colonization of the New World as reflecting general northwest-to-southeast movement of raw materials and as consistently containing a diverse array of artifact classes. Without a benchmark for what exactly is "diverse" and what is not for Clovis toolkits, it is difficult to know exactly how diverse the cache assemblages are relative to anything other than one another. However, it seems clear that the five caches containing a single artifact type (with a Simpson's *D* value of 1.0) are decidedly non-diverse, as is arguably the case for another five caches with Simpson's *D* values less than 1.59. Further, this investigation of diversity in artifact classes among Clovis caches demonstrates considerable variability, as opposed to consistency, among artifact diversity values for caches. The colonization model's expectations are thus not well supported by patterns in artifact diversity.

Remnant Utility

Two fundamental concepts of utility have been put forth by recent studies (Ballenger 2001; Shott and Ballenger 2007). Maximum utility refers to the greatest degree of reduction that a tool can undergo (presumably the maximum one can undergo and still remain useful). Realized or expended utility is the degree of reduction that a tool actually undergoes. Thus, realized utility must be less than or equal to maximum utility. Two related concepts, remnant utility and minimum acceptable utility, are used here to characterize caches and individual items within the caches.

In terms of the definitions summarized above, minimum acceptable utility can be thought of as an estimate of maximum utility that is derived from measurements of expended utility from discarded tools. Remnant utility in this study refers to the amount of useful mass remaining on an item given its apparent reduction trajectory; in other words, the degree to which an item exceeds minimum acceptable utility. In contrast to the approaches to measuring utility referred to above, the approach developed here has the advantage of utilizing direct measurements from existing artifacts, rather than utilizing estimations of the original sizes of artifacts. Two fundamental remnant utility measures are developed here. Individual remnant utility (IRU) refers to the remaining usefulness of an individual flaked stone item. Assemblage remnant utility (ARU) is the sum of IRU of the flaked stone items in an individual cache assemblage.

Measuring Utility

Both IRU and ARU are based upon a comparison to minimum acceptable utility for a particular artifact class. The same technological tool classes used in the measurement of artifact diversity are used in the investigation of remnant utility (points, bifaces, blades, flakes, and cores). From a technological perspective, bifacial reduction strategies and blade or flake core reduction strategies differ. I recognize that for this reason, the use life for tools produced from one or the other of these strategies may fundamentally differ due to their geometry; however, these differences are largely overcome by estimating remnant utility in comparison only to other artifacts of the same technological category (e.g., comparing tools made on blades to blades). Minimum acceptable utility (MAUt) refers to the point in the use life of a tool where it is no longer useful and it is discarded. Because loss must have been a common occurrence, and therefore must have been consciously or unconsciously taken into account in organizational strategies, artifacts that may have been lost rather than discarded are considered equivalent to discarded artifacts. Minimum acceptable utility for each artifact class is derived from artifacts from kill and camp sites. As previously argued in this dissertation, artifacts remaining at kill and camp sites after a human group has moved on remain there because they were lost, worn out, or broken. Thus, most artifacts abandoned at kill and camp sites provide examples of artifacts that do not meet minimum acceptable utility. Artifacts left behind due to being misplaced or not recovered should exceed minimum acceptable utility, but reduction of raw material stores due to tool loss can be expected to have been factored, either consciously or subconsciously, into strategies of tool maintenance and discard. The mean weights of points, bifaces, blades, flake tools

(Table 17), and cores from these sites serve as measurements of minimum acceptable utility for use in comparisons with cached artifacts.

Table 17. Minimum Acceptable Utility (MAUt) Derived from Kill and Camp Site Artifacts.

Artifact Class	*n*	*MAUt (Avg. Weight (g))*
Projectile Points	51	11.18
Bifaces	19	32.95
Cores	4	75.13
Flake Tools	81	16.31
Blades	63	13.54

Many flakes from kill and camp assemblages may represent discarded waste resulting from various reduction endeavors. For this reason, only formed tools or flakes that exhibit clear use-wear are included in the calculation of mean discard weight for the flake artifact class. This does not apply to blades, as blades are assumed to be the goal of blade reduction rather than the by-products.

Weight is considered here to be preferable to volume (L x W x Th) for characterizing minimum acceptable utility, due to its greater precision. There may be some variation in weight relating to variation in the composition of different raw material types; however, this discrepancy can be considered insignificant compared to that resulting from the estimation of volume from metric dimensions.

The IRU of cached artifacts is estimated by comparison to the average weight of discarded artifacts for the appropriate artifact class. In order to minimize the affects of post-depositional breakage, which would have the effect of underestimating the utility of the complete artifact, IRU is calculated only for complete artifacts from caches. Complete artifacts include complete technological units (blade, flake, point, etc.) or complete tools (e.g. end scraper on proximal blade fragment). Furthermore, items from caches are regarded as having been intended for eventual use as tools. All complete flakes from caches are compared to discarded flake tools, regardless of whether or not a cached item has been modified or utilized as a tool. In other words, complete items from caches are compared to a measure representing both complete and incomplete discarded tools from kill and camp sites.

The IRU calculation represents the proportion of an item that exceeds minimum acceptable utility for that item's artifact class. It is calculated as follows:

$$IRU = \{(wt_i - MAUt_c)/wt_i\}100$$

where wt is weight, MAUt is minimum acceptable utility (mean *discard* weight), *i* is individual item from a cached assemblage, and *c* is the appropriate artifact class. The resulting value is the percentage of the item that exceeds minimum acceptable utility. For example, a value of 72 for a blade from a cache assemblage indicates that 72% of the blade is in excess of the mean discard weight of blades from kill and camp sites; in other words, 72% of the blade remains useful. An IRU value is calculated for each complete artifact from each cache.

The calculation of ARU is based upon the IRU values. ARU is simply the mean IRU for all complete items in a cache assemblage. The ARU value is an average of percentages, and is thus of no further use for statistical analyses; however, it provides a series of ordinal scale values for comparative purposes. The strengths of the IRU and ARU measurements are that they control for both size differences among artifact classes and size differences (i.e. number of items) among assemblages.

Results

Assemblage remnant utility provides a means to compare caches according to the amount of useful material remaining in each assemblage. The ARU values for each cache are presented in Table 18, and Figure 28.

Table 18. Assemblage Utility for Caches.

Assemblage	*ARU*	*Relative Assemblage Utility*
Anadarko	58.70	High
Anzick	65.83	High
Busse	49.98	Low
Crook County	72.79	High
De Graffenried	88.88	High
Drake	68.90	High
East Wenatchee	71.76	High
Fenn	73.97	High
Franey	34.38	Low
Green	70.08	High
Keven Davis	47.74	Low
Pelland	28.73	Low
Sailor-Helton	39.98	Low
Simon	74.62	High
Watts	85.57	High
West Bank	75.95	High

The distribution of ARU values is roughly bimodal, facilitating the assignment of caches to low and high remnant utility categories. Based upon the break in this distribution, caches with an ARU value of 50 or less are considered low in remnant utility; caches with an ARU value of more than 50 are considered high in remnant utility. It should be noted that "low" utility as used here is in reference to other caches, and should not be taken to indicate that low remnant utility caches are low in comparison to other kinds of Clovis assemblages.

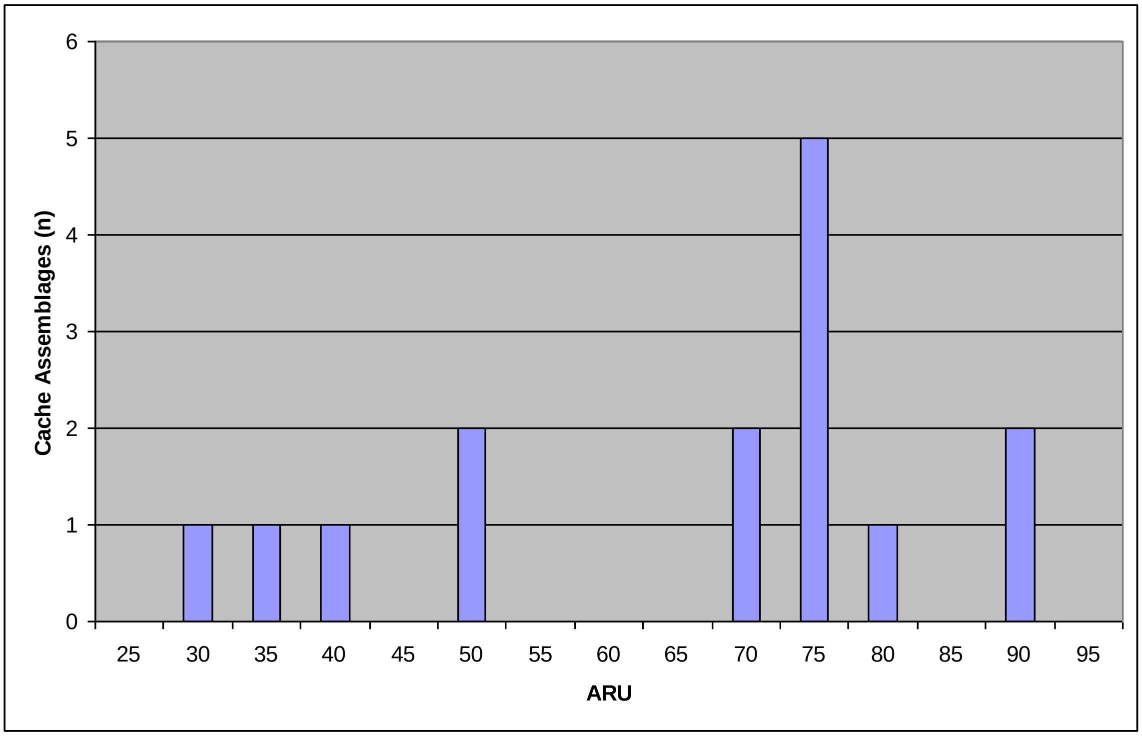

Figure 28. Frequency distribution of ARU values for cache assemblages.

The low remnant utility category includes five caches: Busse, Franey, Keven Davis, Pelland, and Sailor-Helton. Franey, Keven Davis, and Pelland are collections of low IRU blades and flakes. Both Busse and Sailor-Helton consist of a series of high IRU items (bifaces in the case of Busse, cores in the case of Sailor-Helton), associated with large numbers of low IRU flakes and blades.

The high remnant utility category consists of the remaining 11 caches: Anadarko, Anzick, Crook County, De Graffenried, Drake, East Wenatchee, Fenn, Green, Simon, Watts, and West Bank. This group includes both biface- and blade/flake-dominated caches.

Evidence of Use

As put forth in Chapter 3, the degree to which items in caches have been used before being deposited is expected to vary along with cache function. The methods for examination of evidence use of were presented in Chapter 4. Macroscopic examination focused upon recognizing chipping, breakage, and resharpening. Microscopic examination focused upon measuring the placement, orientation, dimensions, and frequency of breaks, chips, striae, and polishes. The point of these observations was not to identify the specific ways in which tools were used or the materials they were used on, but only to identify those artifacts actually utilized as tools at some point prior to being incorporated into the cached assemblage.

Because of the simple requirements of this analysis, the approach is relatively conservative. Clear evidence of patterned edge damage (e.g., chipping, striations, and heavy polish) or edge retouch is identified as evidence of use for blades and flakes. Clear evidence for breakage, resharpening, or repair is identified as evidence for use among projectile points. Because the primary purpose of cores, and to a large degree bifaces, was presumably not as tools, these artifact classes are not included here. Evidence of use is interpreted either to be present or absent on each individual item from a cache, and the number of items exhibiting evidence of use is summed for each artifact class within a cache, as well for the cache as a whole. These data are presented in Table 19. It should be noted that values for Anadarko and Watts are not included due to the use of published data, in the case of Anadarko, and to the cache consisting solely of bifaces, in the case of Watts.

The frequency of used implements in caches ranges from zero to 100 percent, with 50 percent providing a suitable, if arbitrary, cut off point for distinguishing low from high rates of used tools in an assemblage. This makes empirical sense not only due to its central position within the range, but it also occupies a nearly median position among the assemblages.

Less than 50 percent of projectile points, flakes, and blades exhibit evidence of use in seven cache assemblages. These consist of the de Graffenried, Drake, Fenn, Green, Keven Davis, Sailor-Helton, Simon, and West Bank caches. This category includes almost equal numbers of both biface-dominated and blade/flake-dominated caches.

Greater than 50 percent of the above artifact classes exhibit evidence for use in six cache assemblages. These can be considered to have a high incidence of use prior to deposition, and consist of Anzick, Busse, Crook County, East Wenatchee, Franey, and Pelland.

In addition to the observed patterns for entire assemblages, some discernable patterning exists with regard to specific artifact classes. In every case where projectile points are present, some minor proportion of them have been used before being included in the cache. Regardless of the cache functions, some of the projectile points had been used before being included as part of the cache. The sole exception is de Graffenried, in which the sole projectile point represents most closely what is commonly recognized as a preform. Evidence for use is even more frequent among flakes, where in all but one case the majority of flakes exhibit use traces, suggesting that when they are included in caches they most often had a history of use. Only Sailor-Helton appears to have been oriented toward the storage of large numbers of mostly unmodified flakes. Blades are more variable with regard to use prior to deposition in a cache. In some cases (e.g., Franey, Pelland) the majority of them show signs of use, while in others (e.g., Green, Keven Davis) the vast majority appear to have been cached as unused blades.

Table 19. Evidence of Use for Cache Assemblages.

Assemblage	**Points**		**Flakes**		**Blades**		**Total**			
	Total (n)	*Evidence for Use (n)*	*Total (n)*	*Evidence for Use (n)*	*Total (n)*	*Evidence for Use (n)*	*Total (n)*	*Evidence for Use (n)*	*Evidence for Use (%)*	*Relative Frequency*
Anadarko	0	0	0	n/a	26	n/a	26	n/a	n/a	n/a
Anzick	8	2	9	6	1	1	18	9	50.0	High
Busse	0	0	30	15	33	18	63	33	52.4	High
Crook County	1	1	0	0	0	0	1	1	100.0	High
de Graffenried	1	0	0	0	0	0	1	0	0.0	Low
Drake	13	4	0	0	0	0	13	4	30.8	Low
East Wenatchee	13	4	8	5	4	4	25	13	52.0	High
Fenn	20	6	0	0	1	1	21	7	33.3	Low
Franey	0	0	36	22	35	28	71	50	70.4	High
Green	0	0	0	0	17	2	17	2	11.8	Low
Keven Davis	0	0	0	0	14	3	14	0	21.4	Low
Pelland	0	0	0	0	9	9	9	9	100.0	High
Sailor-Helton	0	0	115	3	40	5	155	8	5.2	Low
Simon	7	2	0	0	0	0	7	2	28.6	Low
Watts	0	0	0	0	0	0	0	0	n/a	n/a
West Bank	0	0	1	1	4	1	5	2	40.0	Low

CHAPTER 7. LITHIC RAW MATERIALS

Linking individual artifacts to specific lithic raw material sources provides a key avenue to understanding the organization of Clovis lithic technology, as well as the movement of groups of Clovis people across the landscape. In cases where a particular raw material can be identified to source, its presence in an assemblage provides a limited area on the landscape, in addition to that provided by the location of the assemblage itself, to which movements of people can be traced. Furthermore, because the raw material sources must have been visited before sites containing those raw materials were occupied, the locations of the source and the site provide a glimpse of the overall directionality of human movements.

This chapter examines variation in lithic raw materials (hereafter simply referred to as raw materials). First, raw materials used for making artifacts in Clovis caches are identified as to their lithology, and then to probable source, where possible. This information is then used to compare cache assemblages in terms of distances and compass directions to sources, and raw material diversity.

Raw Material Identification

Wherever possible, raw materials are identified to known raw material sources. In some cases, these identifications can be made with a fair amount of confidence because the raw material is distinctive in regard to some particular attribute (e.g., color variations, fossil inclusions, UV fluorescence, etc.) or because thorough descriptions of the named raw material source have been published. In other cases specific raw material identifications are made with less confidence, and represent best estimations based upon current information. I assume that these identifications are correct, although it is admitted that they are tentative. More accurate or precise identifications may be made in the future that could modify some of my conclusions. In still other cases, a raw material cannot now be associated with any named sources with any confidence. In these cases, raw materials are simply referred to by their color and lithology (i.e., "brown chert"), rather than by probable source location.

The most important reason for identifying specific raw material sources is to have the ability to measure the distance and direction that the materials have been transported. This too is a complex issue, because specific raw materials may outcrop continuously or sporadically over a large area, may be displaced as secondary occurrences over significant distances by geological processes (e.g., running water, glacial ice), and may be easily confused with materials with similar characteristics. Also, the actual distance a particular material has been transported is impossible to determine; usually straight-line distance from source to recovery site is employed instead. For this analysis, straight-line distance is measured from the cache find location to the nearest documented source that corresponds to the characteristics of the raw material in question. In some cases (e.g., Edwards Plateau chert), distance is measured to the location of a specific variant of the material that is represented in the cache. In cases where considerable natural transport of a raw material has been documented (e.g., Alibates dolomite), distance is measured from each cache to the closest location where raw materials of appropriate quality (especially with regard to nodule size) are found. Measurements are estimated to the nearest kilometer using the straight-line measuring tool available in Google Earth® software. It should be noted that the Fenn cache presents a special case because its exact find location is not known. For Fenn, measurements are made from the point where the boundaries of Utah, Idaho, and Wyoming meet. While raw material identification, source area recognition, and measurement are clearly complex, and the methods used here to address them are admittedly simple, I believe that this approach makes the best use of the information at hand and enables the detection of some general patterns by means of standard comparisons.

Table 20 presents the raw materials that make up each cache in order of abundance by weight. The raw materials represented in the caches are summarized below, with particular attention given to named and published sources. Center points for source locations are presented in Figure 29.

Figure 29. General locations of raw materials identified to source discussed in text.

Table 20a. Lithic Raw Material Data for Cache Assemblages.

Cache	Primary Raw Material Type				Secondary Raw Material Type				Tertiary Raw Material Type				Quaternary Raw Material Type				Quinary Raw Material Type				Nearest Other	
	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)
Anadarko	Edwards Plateau chert (Sweetwater)	352	4123.9	72.00	Alibates dolomite	135	1603.9	28.00													Alibates	135
Anzick*	Hartville Uplift chert	590	11082.5	66.60	moss agate	618	5225.1	31.40	Phosphoria chert	197	166.4	1.00	porcellanite	377	166.4	1.00					Big Horn Mtns	197
Busse	Niobrara Jasper	100	7798.9	99.79	fossiliferous chert	unk.	13.2	0.17	moss agate	408	1.9	0.02	Hartville Uplift chert	387	1.6	0.02					Niobrara Jasper	100
BWD Green	Edwards Plateau chert (Abilene)	392	678.9	100.00																	Alibates	209
BWD West Bank	Edwards Plateau chert (unspecified)	310	448.1	100.00																	Alibates	209
Crook County	Green River Formation chert	588	2697.5	99.78	Hartville Uplift chert	261	6.0	0.22													Porcellanite	65
de Graffenried	Edwards Plateau chert (Georgetown)	1	1284.2	100.00																	Edwards Plateau chert (Georgetown)	1
Drake	Alibates dolomite	584	417.0	81.48	Edwards Plateau chert (unspecified)	955	49.8	9.73	chalcedony (Laramie Fm)	140	45.0	8.79									chalcedony (Laramie Fm)	140
East Wenatchee	Agate	50	4342.9	80.56	white chalcedony	unk.	603.1	11.19	gray chalcedony	unk.	245.1	4.55	brown chert	unk.	199.8	3.71					Ephrata agate	50
Fenn	Utah Agate	358	3481.6	41.2	Green River fmtn chert	130	2772.8	32.8	obsidian (SW Idaho)	150	1942.6	23.0	Big Horn mtns /red jasper	360	107.8	1.3	crystal	unk	83.6	1.0	Green River fmtn chert	130
Franey	Hartville Uplift chert	120	1022.5	52.01	yellow jasper	22	903.7	45.97	green chert	unk.	39.8	2.02									yellow jasper	22
Keven Davis	Edwards Plateau chert (Georgetown)	205	313.8	86.00	tan chert	unk.	51.1	14.00													Edwards Plateau chert (Georgetown)	205
Pelland	Knife River chalcedony	670	156.5	100.00																	Knife River chalcedony	670
Sailor-Helton	Alibates dolomite	155	13763.1	100.00																	Alibates dolomite	155
Simon	unidentified gray chert (Amsden?)	585	4026.0	50.49	quartz crystal	unk.	1124.9	14.11	Big Horn Mtns /Phosphoria chert	593.0	778.4	9.76	Green River fmtn chert	461	310.4	3.89	Other	unk	1733.7	21.74	Idaho obsidian	216
Watts	Spanish Diggings quartzite	230	4385.9	98.28	Phosphoria chert	390	76.7	1.72													chalcedony (Laramie Fm)	75

*Because casts from Anzick were analyzed, weights are estimated from size and raw material percentages are based upon number of specimens rather than weight.

Table 20b. Lithic Raw Material Data for Kill and Camp Assemblages.

Site	Primary				Secondary				Tertiary				Quaternary				Quinary				Nearest Other	
	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)	Weight (g)	Percentage	Source	Distance (km)
Blackwater Draw	Edwards Plateau chert	310	2228.2	54.87	Alibates dolomite	209	614.20	15.13	Tecovas jasper	207	111.7	2.75	Jemez (obsidian/Pedernal)	330	28	0.69	other	unk.	1078.70	26.56	Alibates dolomite	209
Murray Springs	St. David fmn.	38	520.67	65.33	Pinkish gray chert	unk	240.31	8.48	Cow Creek obsidian	205	37.97	0.53	Silicified wood	225	3.65	0.02	Other	unk.	636.39	25.65	St. David fmn.	38
Sheaman	Hartville	104	1198.5	66.44	Moss agate	1	406.20	22.52	Spanish Diggings	108	128.4	7.12	Gray chert	unk.	28.6	1.59	Other	unk.	42.30	2.34	Moss agate	1

Alibates Agatized Dolomite

Sometimes referred to as Alibates chert, this raw material outcrops along the Canadian River of Texas and is actually an agatized dolomite that occurs geologically within the Quartermaster formation of Permian age (Banks 1990; Holiday 1997). Its color is typically variegated, with bands of various shades of white, red, and purple. The material is of high quality, occuring in large nodules and clasts, and is one of the preferred raw materials on the Southern Plains throughout prehistory. Portions of the primary source area north of Amarillo, Texas, have been preserved as a National Monument. The source appears to have been regularly exploited by Clovis groups and occurs in several caches, including Sailor-Helton, Drake, and Anadarko, and kill/camp sites, including Blackwater Draw. Alibates might be confused with raw materials from Tecovas in Texas (Banks 1990) and Baldy Hill in New Mexico (Meltzer 2006:51-52) but, given the frequent use of the Alibates source by Clovis groups, it is assumed that raw materials identified in the caches are from the primary Alibates source near Amarillo, or downstream (east) from secondary alluvial deposits along the Canadian River. Alibates nodules of appropriate size for artifact production have been identified in secondary deposits along the Canadian River as much as 180 km east of the National Monument (Wycoff 1988). Distances from caches to the Alibates source are measured to the National Monument or to the closest portion of the Canadian River 180 km downstream.

Big Horn Mountains/Phosphoria

Multiple varieties of chert and jasper outcrop from the late Paleozoic strata of the Bighorn Mountains of northeast Wyoming. Perhaps the best recognized are Phosphoria chert, a lustrous burgundy to purple chert that fluoresces green under shortwave UV light

(Miller 1991:464), and Amsden chert, an off-white to gray chert found in the southern part of the range (Francis 1983).

Several materials from the Simon cache compare favorably with jasper and chert from the Bighorn Mountains, including Phosporia, jasper, and chert from the Amsden formation (Jim Woods, personal communication 2002). Likewise, specimens from the Fenn cache are reportedly derived from jasper and Amsden formation cherts from the Bighorn Mountains (Frison and Bradley 1999). Materials that appear to correspond to Phosphoria chert are also present in the Anzick cache (Jones 1996) and the Watts cache. Measurements are taken from these caches to the closest margin of the Bighorn Mountains.

Edwards Plateau Chert

Cherts from the lower Cretaceous Edwards formation of central Texas together may represent the most widely utilized raw material source on the Southern Plains. Despite this, there has been surprisingly little synthesis of the variation within what is considered Edwards Plateau, or simply Edwards, chert (Banks 1990; Fredrick and Ringstaff 1994). Varieties of Edwards Plateau chert outcrop sporadically across a large area of central and southern Texas, and perhaps into northern Mexico. The chert typically ranges from gray to blue to brown, is opaque to semi-translucent, and emits a distinctive orange fluorescence under shortwave UV light. Local variants of Edwards Plateau chert are recognized by those with firsthand experience, but often are poorly reported or described in the published literature.

The BWD West Bank cache has been linked to the Edwards Plateau source near Abilene, Texas (Montgomery and Dickenson 1992). The de Graffenried cache (Collins *et al.* 2007) and Keven Davis cache (Collins 1999a) are reportedly derived from the Georgetown variant northeast of Austin, Texas. Raw materials in the Anadarko cache are reported to be from another variant that occurs near Sweetwater, Texas (Hammatt 1969). Materials in the Green and Drake caches, as well as materials from kills and camps at Blackwater Draw, are not identified as to a particular variant. Measurements are made from caches to the town associated with the variant, or otherwise to the closest outcrop of Edwards Plateau chert.

Ephrata Agate

Agate that compares favorably in color, consistency, and size to the material found in the East Wenatchee cache was identified immediately north of Ephrata, Washington. Archaeological surveys identified the source and noted evidence of prehistoric quarrying activity and debris (Gramly 1991); however, the geological context of the source is not reported. Agate in the East Wenatchee cache is primarily yellowish pink and opaque, with blue-gray, salmon, reddish brown, and cream bands. Some specimens exhibit a bubbly yellow “egg drop soup” pattern; others exhibit red speckles. Crystalline vugs (cavities) up to 6mm in diameter are occasionally present. Distance is measured from the East Wenatchee cache find location to the proposed source area north of Ephrata, Washington.

Green River Formation Chert

Cherts from the Eocene Green River formation outcrop over a large area of southwestern Wyoming, and adjacent parts of Colorado and Utah (Miller 1991:467). The chert is opaque and dark brown to black in color. In the mountains northeast of Lone Tree, Wyoming, occurs a distinctive banded variety that is present in Clovis contexts

(Love 1977). This variety, sometimes known as "Tiger chert," consists of alternating parallel, thick bands of dark brown to black with lighter tan to cream.

Banded chert from the Green River formation is identified in the Fenn cache (Frison and Bradley 1999), the Crook County cache (Tankersley 1998), and the Simon cache. Distance is measured from the cache locations to the Pine Mountains northeast of Lone Tree, Wyoming.

Hartville Uplift Chert

Cherts from the Mississippian Madison and Guernsey formations that occur in the Hartville Uplift of eastern Wyoming are known as Hartville chert, or Hartville Uplift chert (Craig 1983; Miller 1991:462). Hartville Uplift chert is typically even yellow-brown in color, opaque, and commonly exhibits dark speckles and dendrites. The base color occasionally grades to shades of brown, purple, red, and green.

Hartville Uplift chert constitutes the majority material in the Franey cache. The majority material in the Anzick cache is reportedly derived from the Hartville Uplift area as well (Bonnichsen, in Jones 1996:80), and though Jones describes it as chalcedony, the descriptions are consistent with chert from the Hartville Uplift. Hartville Uplift chert also is identified in the Crook County cache (Tankersley 1998) and the Busse cache (Hofman, personal communication 2004), though it occurs in small amounts in both of these. In addition, it is the majority material identified at the Sheaman camp site. Measurements are taken from the cache locations to the center of the Hartville Uplift north of Guernsey, Wyoming.

Knife River Flint

Knife River flint, more correctly a chalcedony, occurs in the Dunn and Mercer Counties of west-central North Dakota in secondary deposits of Tertiary age (Root 2000). The material is rich brown to orange-brown in color with occasional cream-colored swirls, bands, or specks, and it is semitranslucent. Identification is aided by the fact that it fluoresces bright orange under long-wave UV light.

The Pelland cache is made entirely of material from the Knife River source. Distance is measured from the cache location to the primary source area identified by Root (2000).

Niobrara Chert

Niobrara chert, or Niobrara jasper, is a yellowish brown opaque material of upper Cretaceous age that outcrops in northwestern Kansas. It often exhibits light colored speckles. Hofman (1995) indicates a source of Niobrara jasper about 100 km east of Bird City, Kansas, that is the likely source of raw material found in the Busse cache.

Moss Agate

Sources of moss agate are the namesake for Moss Agate Creek, along which the Agate Basin site in east-central Wyoming is located (Frison and Stanford 1982). Moss agate is translucent to semi-translucent and white to gray in color with distinct dark gray to black opaque dendritic inclusions. It occurs in secondary alluvial contexts, and appears to be Pliocene in age. Moss agate occurs in the Sheaman site, and artifacts from the Anzick and Busse caches compare well with the specimens from Sheaman. Though numerous potential sources of moss agate are reported from the Plains, given the known use of this source by Clovis groups, and the use of other raw materials from this general area of Wyoming in the Anzick and Busse caches, it is postulated that the moss agate from those caches is derived from this source. Distance is measured from the cache to the Agate Basin site.

Spanish Diggings Quartzite

Outcrops of Lower Cretaceous quartzite and chalcedony east of Glendo, Wyoming are locally known as "Spanish Diggings" (Holmes 1919:210-213). This source occurs in close proximity to the Hartville Uplift cherts. Spanish Diggings quartzite is medium to fine grained and is typically tan in color with bands or variegations of yellow, purple, red, and brown hues. Extensive quarry pits characterize many parts of the source area, attesting to its importance throughout prehistory. Embedded within the massive beds of quartzite are nodules of chalcedony and agate, which were also utilized.

Spanish Diggings quartzite is the majority material in the Watts cache, and also occurs in the assemblage from the Sheaman site. Measurements for Spanish Diggings are taken from the cache location to the area east of Glendo, Wyoming, identified by Holmes (1919:211) and Reher (1991).

Utah Agate

The most abundant raw material in the Fenn cache is an agate that has been traced to east-central Utah (Frison and Bradley 1999), though no indication of geologic context or age is provided. The material ranges from pinkish to orange and exhibits a red-within-green pattern ("stuffed olive") that Bradley (personal communication, 2006) believes is distinctive to a source a few miles east-southeast of Green River, Utah. Distance is measured from the Fenn cache to this source.

Yellow Jasper (Nebraska)

Much of the raw material in the Franey cache consists of a yellow to yellowish brown chert or “jasper.” The material is opaque and commonly exhibits dark gray to black speckles and dendrites, often patterned to form parallel lines. This material may very well be equivalent to Mississippian Hartville Uplift chert, but it is reported to be available in the badlands immediately north of Crawford, Nebraska (Grange 1962; Mel Franey, personal communication 2002). The geological context and age of this latter source is not clear, nor is it clear if the source is primary or secondary. Distance is measured from the cache location to the area of northwest Nebraska indicated on a map by Mel Franey.

Idaho Obsidian

Fenn and Bradley (1999:79-80) report that trace element analysis indicates that obsidian from the Fenn cache is derived from southeastern Idaho. They do not identify the specific source, but they are possibly referring to the Malad source (Paul Santarone, personal communication 2006). Distance is measured from the estimated location of the Fenn cache to the southeasternmost (nearest) area of volcanic extrusives in Idaho shown by Miller (1991:459), in the mountains southeast of Pocatello, Idaho.

Additional Raw Materials and Sources

Artifacts made of quartz crystal occur in the Simon cache in the form of bifaces, and in the Fenn cache as projectile points. Quartz crystal points also occur in the Lehner site in southeast Arizona, where their location with mammoth carcasses clearly indicated that they served as projectile points (Haury et al. 1959). Although it may be tempting to view quartz crystal as a special raw material, it was clearly used in typically functional ways as well. Quartz crystal bifaces in the Simon site exhibit heavy abrasion on the ridges separating flake scars. While such abrasion is potentially attributable to transport (Huckell et al. 2002), Jim Woods (personal communication, 2002) demonstrated that rubbing the faces of experimental quart crystal bifaces together readily produces striking greenish sparks, and produces a similar wear pattern. Woods believes that one of the few sources of quartz crystal of adequate size for the bifaces in the Simon cache is near Atlanta, Idaho. It may be that this is the source of the Anzick artifacts, and possibly the Fenn artifacts, but neither can be attributed to that source with any confidence.

A projectile point made of white chalcedony in the Drake cache compares well to chalcedony available in adequate sizes in the Laramie formation on the flanks of the Laramie Mountains of Wyoming (Dennis Stanford, personal communication, 2006). Jones (1996) assigns porcellanite in the Anzick cache to the Powder River valley of southwest Montana; however, porcellanite is widely distributed across the northern Plains.

Several materials are identified at kill and camp sites that are not found in the caches. In addition to the Edwards Plateau chert and Alibates chert found in the Blackwater Draw assemblages, Tecovas jasper from the area around Quitaque, Texas, and obsidian from the Jemez Mountains in north-central New Mexico are identified. The majority material at Murray Springs is a white translucent to clear chalcedony from the Plio-Pleistocene St. David formation that outcrops within the San Pedro Valley (Huckell 2007). In addition, Cow Canyon obsidian from east-central Arizona and silicified wood from northern Arizona are identified at Murray Springs (Huckell 2007).

The remaining raw materials could not be assigned to sources. The Simon cache in particular includes a variety of raw materials that currently cannot be assigned to particular sources with sufficient confidence, though the green chert may be from alluvial cobbles near Ellis, Idaho (Woods, personal communication, 2002). In addition, it is unclear from where the tan chert in the Keven Davis cache is derived (Collins 1999), and the source for fossiliferous chert present in the Busse cache also remains unknown.

Distance to Raw Material Sources

A series of expectations for how distance to raw material sources should vary according to cache function was presented in Chapter 3. In particular, distance to raw materials sources helps distinguish insurance caching (expected to be characterized by large distances) from other cache functions (expected to be variable). This section attempts to analyze variation in distance to minimally delineate "low" and "high" categories as specified for the cache function expectations, and to shed additional light on the movement of raw materials, and the Clovis people who carried them, across the landscape. The range in distances to raw material sources is great (Table 20). The de Graffenried cache is unique in that it occurs practically at the source of its raw material (it is estimated to be at a distance of 1 km both to account for the uncertainty of its find location and to give it a positive value for mathematical purposes). Evidence for the greatest distance for raw material transport comes from the Drake cache, where material from the Edwards Plateau chert source was transported over 950 km. The variation between these two extremes appears to be continuous, with no clear breaks that might indicate different processes by which raw materials were transported.

A simple measure of distance to raw material sources for any specific cache is complicated by the number of raw materials present, the degree to which they contribute to assemblages, and the proximity of each cache location to sources that do not appear in the cache. For example, while 81 percent of the Drake cache is made of stone from the Alibates source located 585 km away, and 10 percent is made of Edwards Plateau chert 955 km distant, 9 percent is made from chalcedony available only 140 km away. Accordingly, it is difficult to estimate, based on any single source, whether the distance between cache location and raw materials should be considered relatively low or relatively high. Part of the answer lies in the reasons for asking the question. In this case there are two fundamental questions being asked. The first is, *do some assemblages represent longer distance transport of materials relative to others?* The answer for this question is important with regard to partitioning variation according to the expectations outlined in Chapter 3. The second is, *how far are the cache locations from important sources of raw materials*? This question relates to whether or not raw materials are simply being moved to resource-poor areas, or if other factors must be incorporated into the explanation of cache locations.

Average Transport Distance

In order for a single value to account for the variation in distances to multiple raw material sources within an individual cache, the measure must be based not only upon the distances to the sources, but also the proportion of the assemblage that source represents. Thus, the value needs not only to be an average of the distances, but an average weighted by proportion. The following formula is used to weight the averages:

$$\mathrm{ATD} = (D_{rm1} * P_{rm1}) + (D_{rm2} * P_{rm2}) \ldots / \Sigma P$$

where ATD is average transport distance, *D* is distance (km), *P* is the proportion (percentage by weight), and *rm* is the material source. It should be noted that the formula only takes into account raw materials identified to source (i.e., raw materials for which there are distance measures). Accordingly, the sum of *P* does is always 100. Relative transport distance is thus calculated by ignoring artifacts of raw materials unidentified to source. The validity of this measure is supported by the fact that, in each case but one (Simon), raw materials identified to source represent greater than 80 percent of the assemblage. The calculation of average transport distance for each cache assemblage is presented in Table 20.

Table 20. Calculation of Average Transport Distance for Caches and Kill/Camp Sites.

Cache	$(D_{rm1}*P_{rm1})$	$(D_{rm1}*P_{rm1})$	$(D_{rm1}*P_{rm1})$	$(D_{rm1}*P_{rm1})$	ΣP	ATD (km)	Relative Distance
Anadarko	25343.3	3780.0	0.0	0.0	100.00	291.2	Low
Anzick	39294.0	19405.2	197.0	377.0	100.00	592.7	High
Busse	9978.6	0.0	9.9	7.9	99.83	100.1	Low
BWD Green	39200.0	0.0	0.0	0.0	100.00	392.0	Low
BWD West Bank	31000.0	0.0	0.0	0.0	100.00	310.0	Low
Crook County	58669.5	57.9	0.0	0.0	100.00	587.3	High
de Graffenried	100.0	0.0	0.0	0.0	100.00	1.0	Low
Drake	47582.6	9292.5	1230.9	0.0	100.00	581.1	High
East Wenatchee	4028.0	0.0	0.0	0.0	80.56	50.0	Low
Fenn	14748.2	4265.2	3447.9	459.2	99.00	231.5	Low
Franey	6241.1	1011.3	0.0	0.0	97.98	74.0	Low
Keven Davis	17629.2	0.0	0.0	0.0	86.00	205.0	Low
Pelland	67000.0	0.0	0.0	0.0	100.00	670.0	High
Sailor-Helton	15500.0	0.0	0.0	0.0	100.00	155.0	Low
Simon	29538.3	0.0	5787.7	1794.6	54.39	682.5	High
Watts	22604.7	670.3	0.0	0.0	100.00	232.8	Low
Blackwater Draw	17010.0	3161.1	569.4	227.5	73.44	285.5	Low
Murray Springs	2482.6	109.1	4.5	0.0	65.88	39.4	Low
Sheaman	6909.3	22.5	768.7	0.0	96.07	80.2	Low

Average transport distances range from 1 km in the case of de Graffenried, where all the artifacts are made of Edwards Plateau chert that outcrops nearby, to 682 km in the case of Simon, where artifacts are made from several distant raw materials. It should be pointed out, however, that only 54 percent of the Simon materials are identified to source, and the high average transport distance probably reflects a bias toward identifying more distant sources. A more reliable maximum of 670 km is found in the case of Pelland, where all artifacts are made from Knife River flint found at that distance.

Unlike the distribution of distances to the most abundant raw material, a histogram of average transport distances for caches presents a bimodal distribution (Figure 30). A group of 10 caches is characterized by average transport distances of less than 400 km, while a group of five caches is characterized by distances of greater than 500 km. While it is not entirely clear what this pattern may mean in terms of the processes behind transport, it enables a group of relatively low transport distance (0-450) to be defined relative to a group of high transport distance (greater than 450) for the purposes of evaluating cache function.

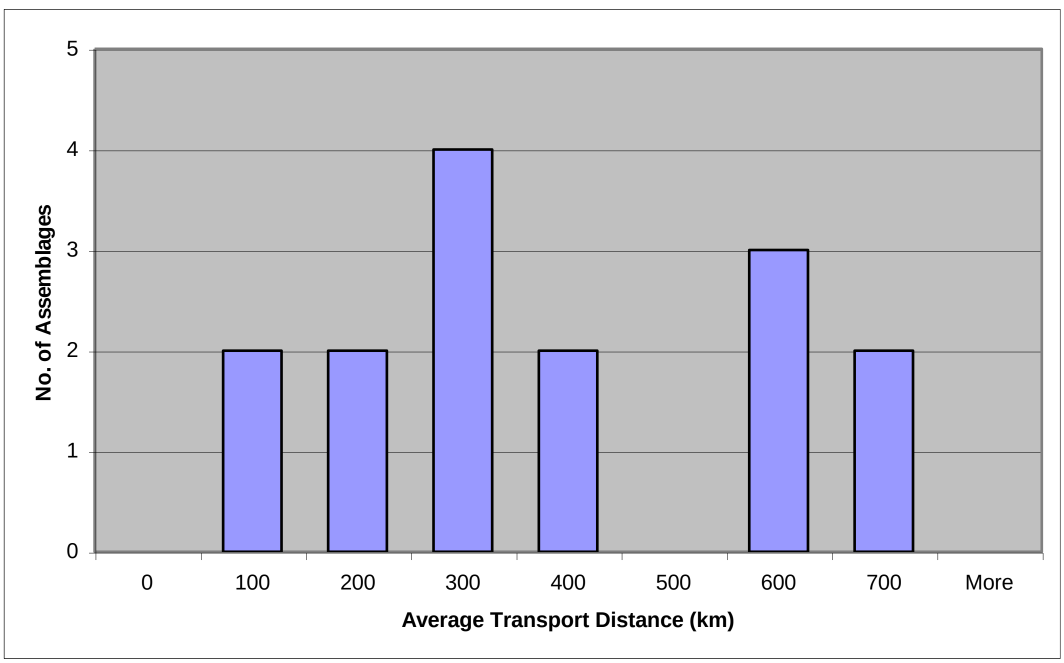

Figure 30. Histogram of average transport distances for caches.

The high average transport distance group consists of Anzick, Crook County, Drake, Simon, and Pelland. Each of these caches is from more northern latitudes (north of 40 degrees). Further, with the exception of Pelland, each consists primarily of bifaces.

The low average transport distance group consists of a combination of assemblages from the north and the south, and includes assemblages that emphasize bifaces and those that emphasize blades and flakes.

Average raw material transport distances for Clovis kill and camp sites range from 39 to 286 km, and overlap those for caches toward the lower end of the distribution (Table 20). Each of the three sites falls into the low average transport distance group. One factor driving this difference may relate to the timing of raw material acquisition associated with kills versus that associated with caching. Clearly, caches represent raw materials procured in advance of the activity in question (i.e., depositing them on the landscape). Likewise, assemblages from kills represent raw materials procured in advance of the activity in question (i.e., killing animals), but perhaps supplemented with additional raw materials procured immediately following the kill, if they are available nearby. Because of the extensive processing activity that necessarily follows a successful hunt, plus the attrition of existing raw material stores during the hunt, groups would most likely supplement their supply with additional local raw material if it were available, perhaps even before or during the processing. Thus, in terms of raw material transport, kills may be seen as consisting of raw material procured in advance that is comparable to that found in caches, with an added proportion of local raw material acquired to meet the increased demand following a kill. This situation would have the effect of decreasing the average transport distance for sites where nearby raw materials were available (e.g., Murray Springs), but would have less effect for sites lacking nearby raw materials (e.g., Blackwater Draw).

Distance to Nearest Source

In addressing the possibility that caching provides a means of moving stone from known locations to locations where either stone is not available or available stone sources are not known, it is useful to investigate the distance from a cache to the nearest available source, whether or not the material from that source is identified in the cache. Proceeding with such an investigation requires estimating what sources Clovis groups knew. For sake of simplicity, the population of known raw material sources is taken to be those that are present in any assemblage, cache, kill, or camp, considered in this dissertation. It is clear that Clovis people were using stone from these sources and, assuming that acquisition was not by long-distance trade, that they knew their locations. Certainly these groups can be expected to have been aware of and utilized other sources as well, but the recurring use of many of the sources present in the Clovis assemblages analyzed here suggests that they were commonly used and preferred resources.

Distance to nearest source is thus a measure of distance from a cache to the nearest raw material source known to be utilized by the occupants of all sites considered here, regardless of whether or not it occurs within the particular cache in question.

If caches are for moving stone to stoneless areas, the distance to nearest source should be relatively high. The ratio of nearest source distance to average transport distance associated with a cache provides a measure of the distance to the nearest source relative to the distances to other sources within a given cache (Table 21). For caches that functioned to move stone to stoneless areas, we can expect that distance to nearest source accounts for a higher proportion of the ATD, thus resulting in a ratio with a higher value. Under the simplest conditions, if the sole function of caches were to move stone to stoneless areas, the distance to the closest source and the ATD should be the same, resulting in a value of 1.

Table 21. Ratio of Distance to Nearest Raw Material Source to Average Transport Distance.

Assemblage	Distance to Nearest Source (km)	ATD	Distance/ATD
Anadarko	135	291.2	0.464
Anzick	197	592.7	0.332
Busse	100	100.1	0.999
BWD Green	209	392.0	0.533
BWD West Bank	209	310.0	0.674
Crook County	65	587.3	0.111
de Graffenried	1	1.0	1.000
Drake	140	581.1	0.241
East Wenatchee	50	50.0	1.000
Fenn	130	231.5	0.562
Franey	22	74.0	0.297
Keven Davis	205	205.0	1.000
Pelland	670	670.0	1.000
Sailor-Helton	155	155.0	1.000
Simon	216	682.5	0.316
Watts	75	232.8	0.322

The relationship between distance to nearest source and ATD is presented in Figure 31, along with the hypothetical 1:1 (y=x) expectation. The patterns evident in the figure and in Table 21 indicate that a group of five caches (Busse, East Wenatchee, Keven Davis, Pelland, and Sailor-Helton) conform precisely to the expectation for moving stone to stoneless areas.

In contrast, four caches (Anzick, Crook County, Drake, and Simon) deviate substantially from this expectation, suggesting that their existence is not easily explained in these simple terms of supplying areas of low abundance. In these four cases, it appears that stone has been moved long distances and placed in areas where adequate stone is available relatively close by.

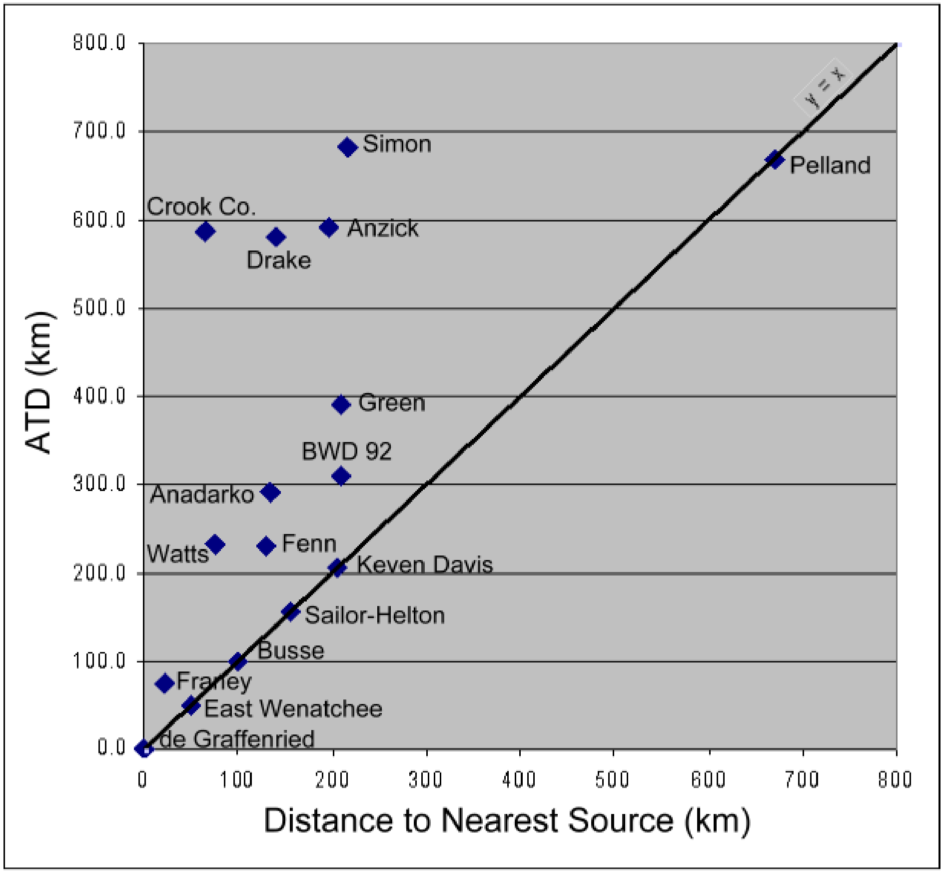

Figure 31. Relationship of distance to nearest source to average transport distance, with line representing hypothetical 1:1 ratio.

The remaining six caches (Anadarko, West Bank, Fenn, Franey, Green, and Watts) conform more closely to the expected relationship, but do not match it precisely. These latter cache locations are not entirely explained as simply the movement of raw materials to areas that otherwise lack them. They may, however, represent the movement of *greatly preferred* raw materials to areas where they are otherwise lacking. Preferences may not have been uniform, that is, individual groups may been partial to certain raw materials for a number of reasons, perhaps including color and pattern as well as technical attributes of workability.

Direction of Transport

Identification of raw material sources provides the rare opportunity to track the direction of movement of stone, and those of the people carrying it, across the landscape. The geographic relationships between raw material sources and Folsom sites have been used to estimate the directions in which the groups were traveling before reaching a site (Huckell and Kilby 2002:21-27; Meltzer 2006:273-274). Viewing the geographic patterns from the perspective of cache assemblages can shed light upon directionality of transport prior to the deposition of Clovis caches. Observation of these patterns from the perspective of the raw material sources provides a sense of the areas they served.

Figure 32, Figure 33, and Figure 34 illustrate the direction of movement of raw materials from sources to caches for all raw materials identified to source. In the area from Texas to northeastern Colorado there is a consistent pattern that represents the transport of Edwards Plateau chert and Alibates chert in northerly and northwesterly directions from their sources. Only in the case of the Anadarko and Drake caches is there evidence of raw materials (Alibates chert and chert from the Laramie formation, respectively) being moved southward. In both of these cases, the raw materials carried south comprise a smaller portion of the assemblage relative to those moved northward. The caches in this region thus represent the transport of southern raw materials northward onto the Plains and, in the case of the Drake cache, along the Rocky Mountain front. In each case it appears that materials are being moved from their sources to areas of relatively low raw material abundance. This suggestion is strengthened by the fact that there are caches in roughly all directions north from the Edwards Plateau source area, except in the direction of the Alibates source, where additional raw material could be anticipated as one moved north. It also bears noting that while both Edwards Plateau and Alibates chert were cached as far north as northeastern Colorado, none of the materials from that region (e.g., Hartville Uplift chert, Laramie formation chert, Niobrara chert) appears to have been transported and cached to the south.

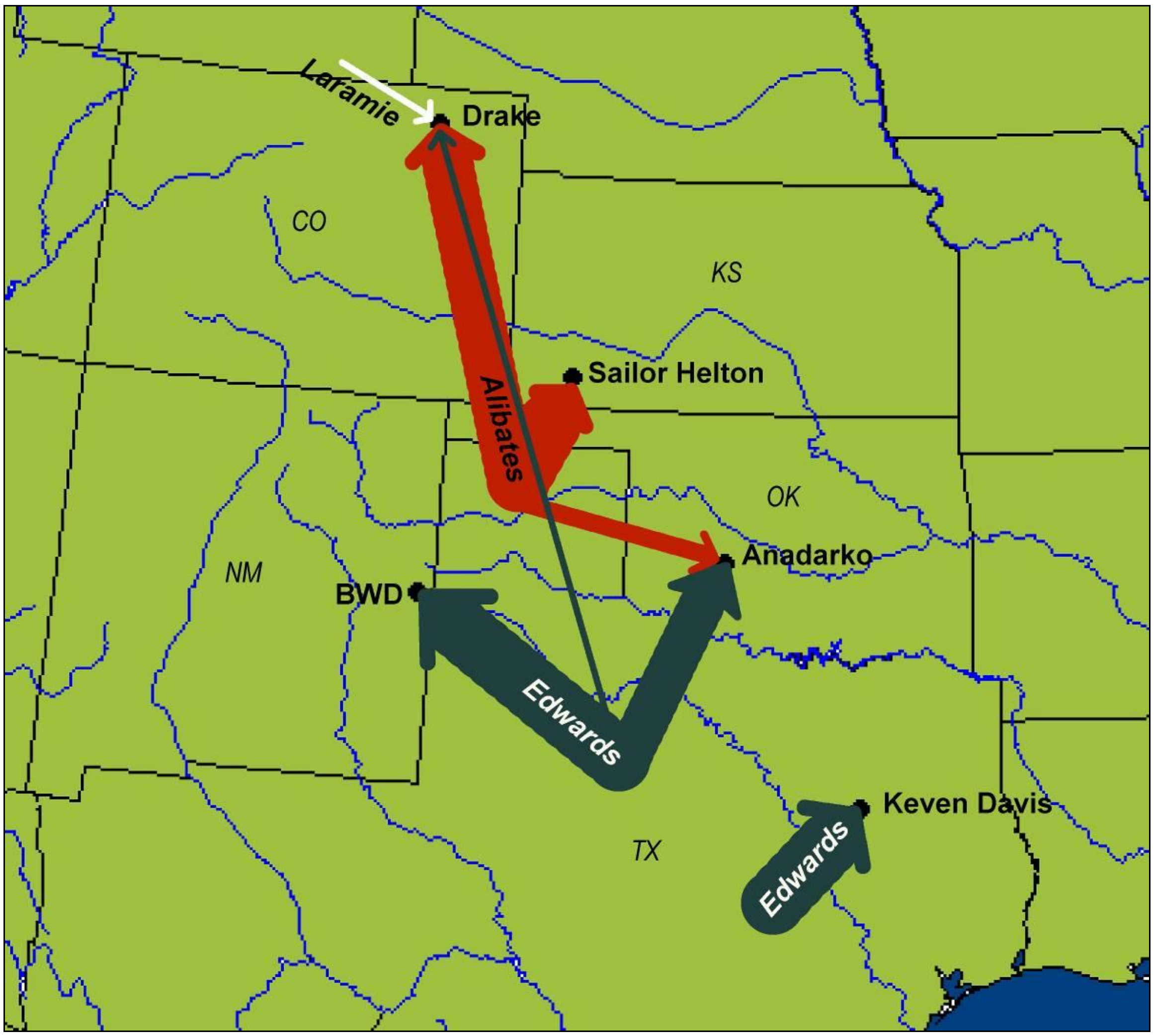

Figure 32. Direction of transport for raw materials identified to source in the southern area. Line width reflects proportion of cache assemblage from that source.

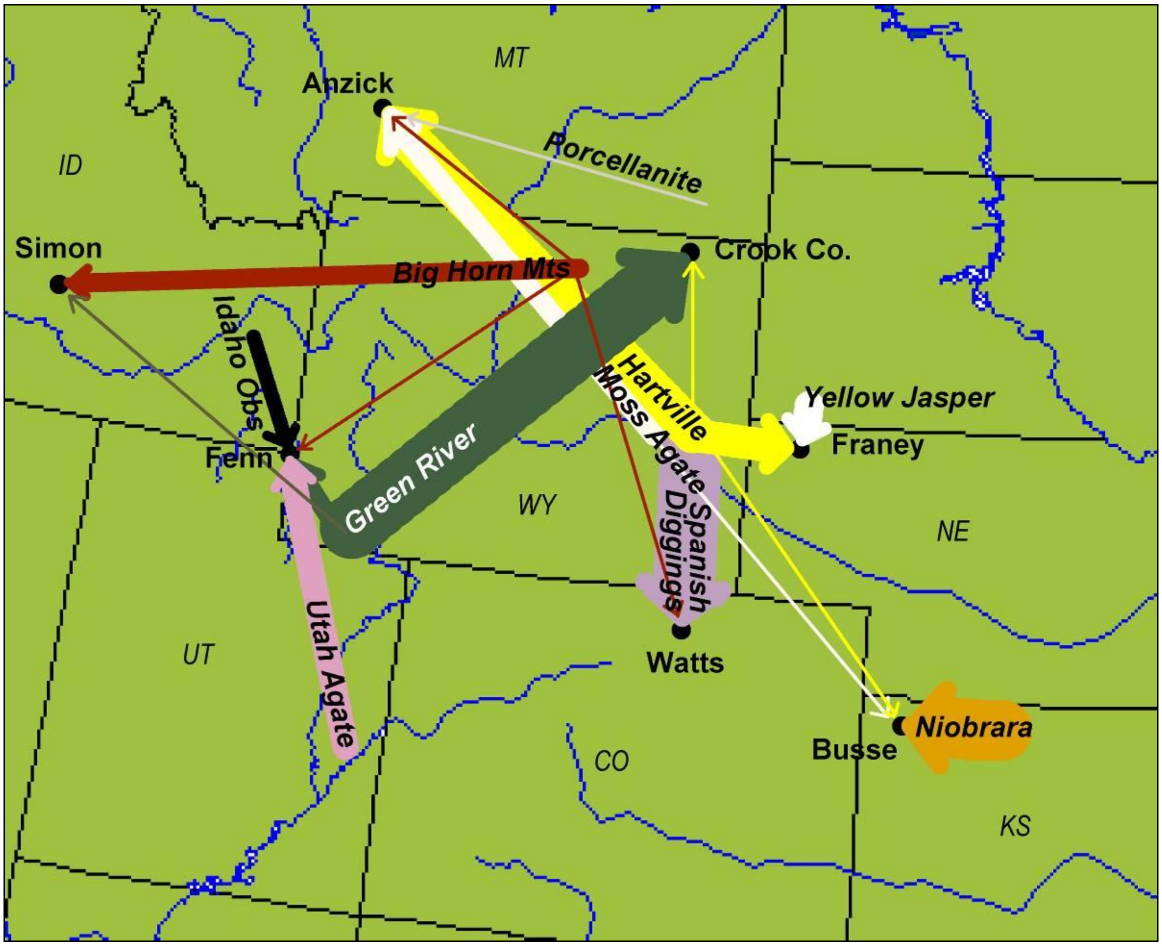

Figure 33. Direction of transport for raw materials identified to source in the northern area. Line width reflects proportion of cache assemblage from that source.

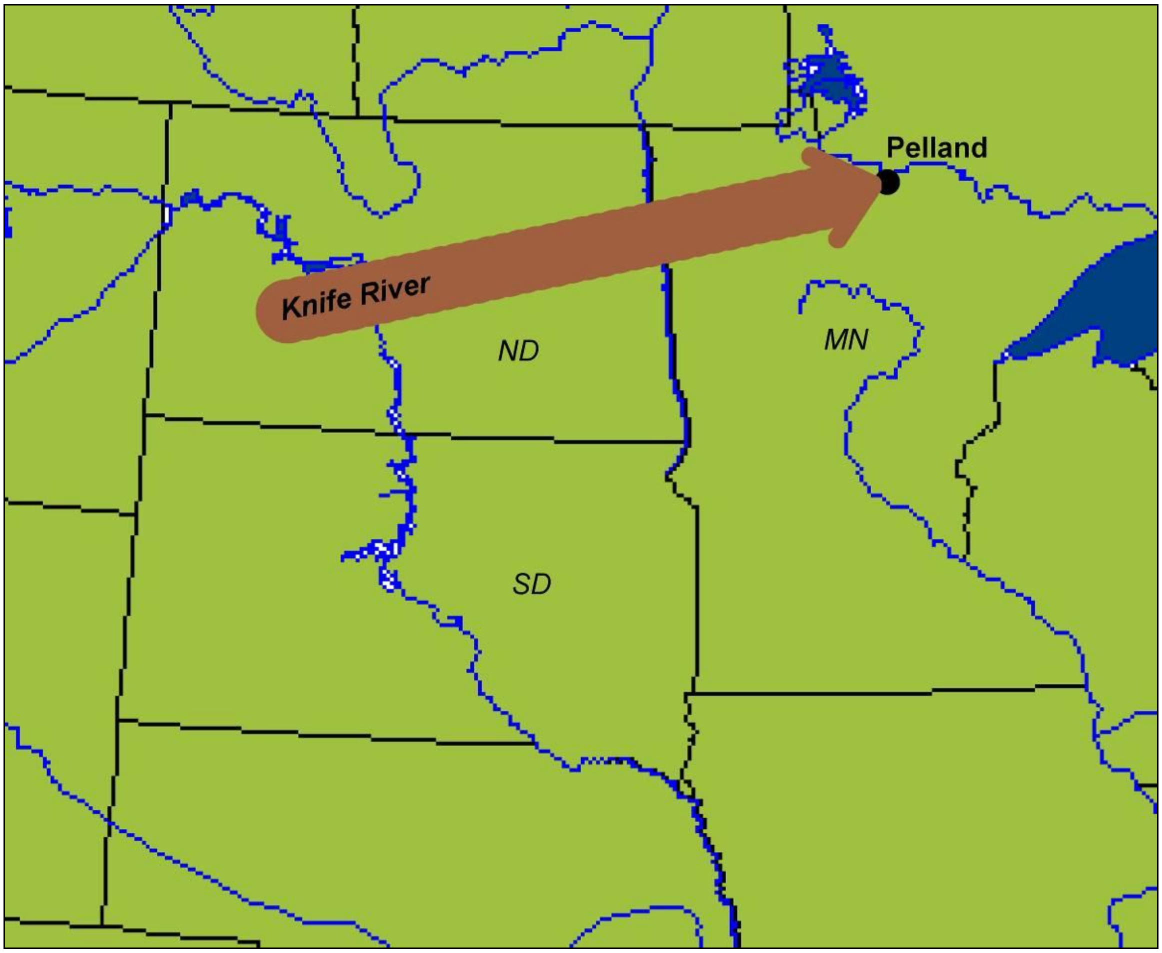

Figure 34. Direction of transport for raw materials identified to source in the far northern area. Line width reflects proportion of cache assemblage from that source.

To the north, in the central and northern Rocky Mountain area, the pattern is more complex. The multiple directions from which materials in each assemblage originate clearly suggest more cyclical patterns of movement across the landscape. For example, based upon the relative abundances of raw materials in the Anzick cache, it is not too difficult to envision a route leading northeastward from the Bighorn Mountains (Phosporia chert) to the Powder Basin (porcellanite), then southward to the Hartville Uplift (Hartville Uplift chert and moss agate), before turning back to the northwest toward the Anzick cache location where these materials were ultimately deposited.

Despite the greater variability in direction of transport relative to areas to the south, two patterns remain consistent. First, while some materials were transported southward before being cached, there remains a clear trend of raw material movement to the north and west. The Watts cache represents an exception, and records the transport of a substantial amount of quartzite from the Spanish Diggings source, along with a small amount of Phosphoria chert, almost directly southward before being cached. Additionally, the Pelland cache records the transport of Knife River flint primarily eastward, albeit slightly northward. Second, while materials are clearly transported through other source areas, the cache locations indicate that materials were deposited when moving away from areas of abundance. Like the southern region, no caches are located in the areas between the major raw material sources.

The northerly and westerly trend in the transport of raw materials in caches is clearly demonstrated by measurements of the bearing from raw material sources to cache locations (Table 22; Figure 35). Indeed, Figure 35b illustrates that only around 13 percent by weight of raw material identified to source is associated with bearings between 60-240^{o}; the remaining 87 percent was transported to the north or west.

Table 22. Direction of Transport for Raw Materials in Caches.

Raw Material Source	Cache	Weight (g)	% of Total Weight	Bearing from Source to Cache
Alibates	Drake	417.0	0.6	330
Alibates	Anadarko	1603.9	2.2	100
Alibates	Sailor-Helton	13763.1	18.9	20
Big Horn Mtns	Watts	76.7	0.1	155
Big Horn Mtns	Fenn	107.8	0.1	230
Big Horn Mtns	Anzick	166.4	0.2	305
Big Horn Mtns	Simon	4804.4	6.6	260
Edwards Plateau	Drake	49.8	0.1	340
Edwards Plateau	Keven Davis	313.8	0.4	50
Edwards Plateau	BWD 92	448.1	0.6	305
Edwards Plateau	BWD Green	678.9	0.9	305
Edwards Plateau	Anadarko	4123.9	5.7	30
Ephrata	East Wenatchee	4342.9	6.0	270
Green River fm	Simon	310.4	0.4	300
Green River fm	Crook County	2697.5	3.7	45
Green River fm	Fenn	2772.8	3.8	325
Hartville Uplift	Busse	1.6	0.0	135
Hartville Uplift	Crook County	6.0	0.0	360
Hartville Uplift	Franey	1022.5	1.4	85
Hartville Uplift	Anzick	11082.5	15.2	310
Idaho obsidian	Fenn	1942.6	2.7	145
Knife River	Pelland	156.5	0.2	75
Laramie fm.	Drake	45.0	0.1	115
Moss agate	Busse	1.9	0.0	135
Moss agate	Anzick	5225.1	7.2	310
Niobrara chert	Busse	7798.9	10.7	265
Porcellanite	Anzick	166.4	0.2	280
Spanish Diggings	Watts	4385.9	6.0	185
Utah agate	Fenn	3481.6	4.8	345
yellow jasper	Franey	903.7	1.2	360

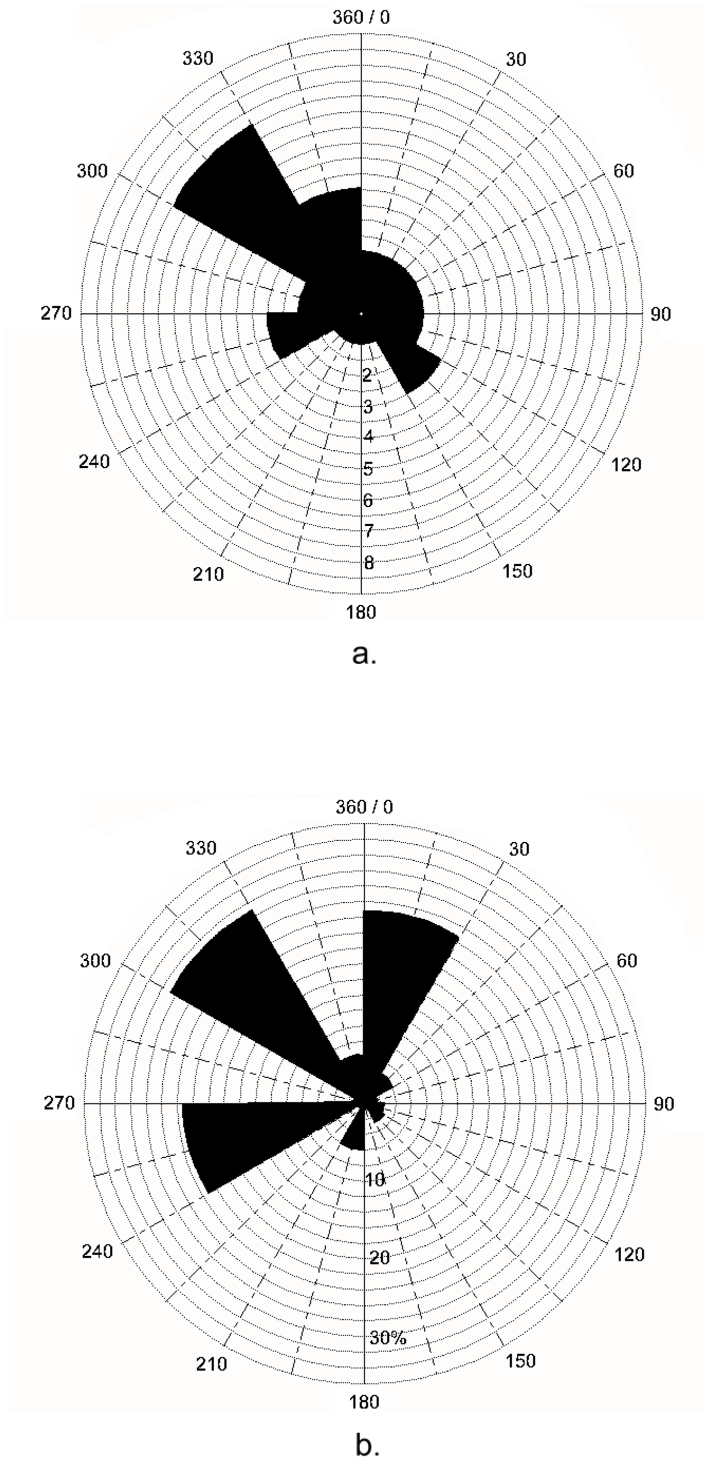

Figure 35. Rose diagrams depicting the bearing in degrees from raw material sources to cache locations; (a) measurement frequency (n=30); (b) percentage of all identified raw material by weight (72,898 g).

Raw Material Diversity

Among the primary reasons for the identification of raw material sources in this analysis is to enable the comparison of cache assemblages with regard to raw material diversity. Raw material diversity monitors the number of discrete lithic sources represented in a cache assemblage relative to the size of that assemblage. As outlined in Chapter 3, I expect that variation in cache function will be reflected in the diversity of raw materials present within that cache. For example, if an individual cache represents a calculated repositioning of stone from the source to some other location (e.g., insurance caching), a surplus can be expected to have been deliberately procured at a single source. On the other hand, if an individual cache is more opportunistic (e.g., load exchange caching), it can be expected to include a sample of a variety of raw materials that are already in possession, perhaps comparable to the diversity of raw materials found at kill and camp sites.

As described above, in many cases the specific lithic source for an artifact could be identified with some confidence based upon visible attributes and UV reaction. In other cases it was possible only to identify an artifact or group of artifacts from a distinctive source, but not necessarily possible to assign it or them to a specific geologic source. For the purposes of raw material diversity this is not a problem, because the goal is simply to identify the number of different raw materials present in the assemblage. It is acknowledged that there may be considerable variation within any given lithic source and thus some misidentification may occur at the artifact level. There is no practical way around this problem, and "lumping" or "splitting" raw material groups within an assemblage is to some extent necessarily a subjective process.

Because raw material classes are not consistent across assemblages, unlike the case with artifact classes (Chapter 6), the Shannon-Weaver diversity index is used to measure and compare assemblages with regard to raw material diversity. The Shannon-Weaver index (SW) is calculated for each assemblage as follows:

$$SW = -SUM[(P_i)*(\log P_i)]$$

where P_i = number of individuals within group/grand total number of individuals. The SW values for each assemblage are presented in Table 23. Thus, SW takes into account not only the occurrence of a particular item in an assemblage, but its frequency relative to overall assemblage size. This is especially important given the relatively small sizes of cache assemblages. Results of regression analysis comparing sample size and SW raw material diversity values for all assemblages indicate that the relationship between the two variables accounts for less than half the variation (r^2=0.4141; Figure 36).

Table 23. Raw Material Diversity (Shannon-Weaver) for caches and sites.

Assemblage	N (Items)	N (Raw Materials)	S-W Diversity	Relative Diversity
Anadarko	32	2	0.261	High
Anzick	101	4	0.314	-
Busse	77	4	0.199	-
BWD 92	5	1	0.000	Low
BWD Green	17	1	0.000	Low
Crook County	8	2	0.164	High
Drake	14	3	0.328	High
de Graffenried	5	1	0.000	-
East Wenatchee	46	4	0.217	High
Fenn	56	6	0.585	High
Franey	74	3	0.409	High
Keven Davis	14	2	0.226	High
Pelland	10	1	0.000	Low
Sailor-Helton	165	1	0.000	Low
Simon	40	9	0.850	High
Watts	8	2	0.164	High

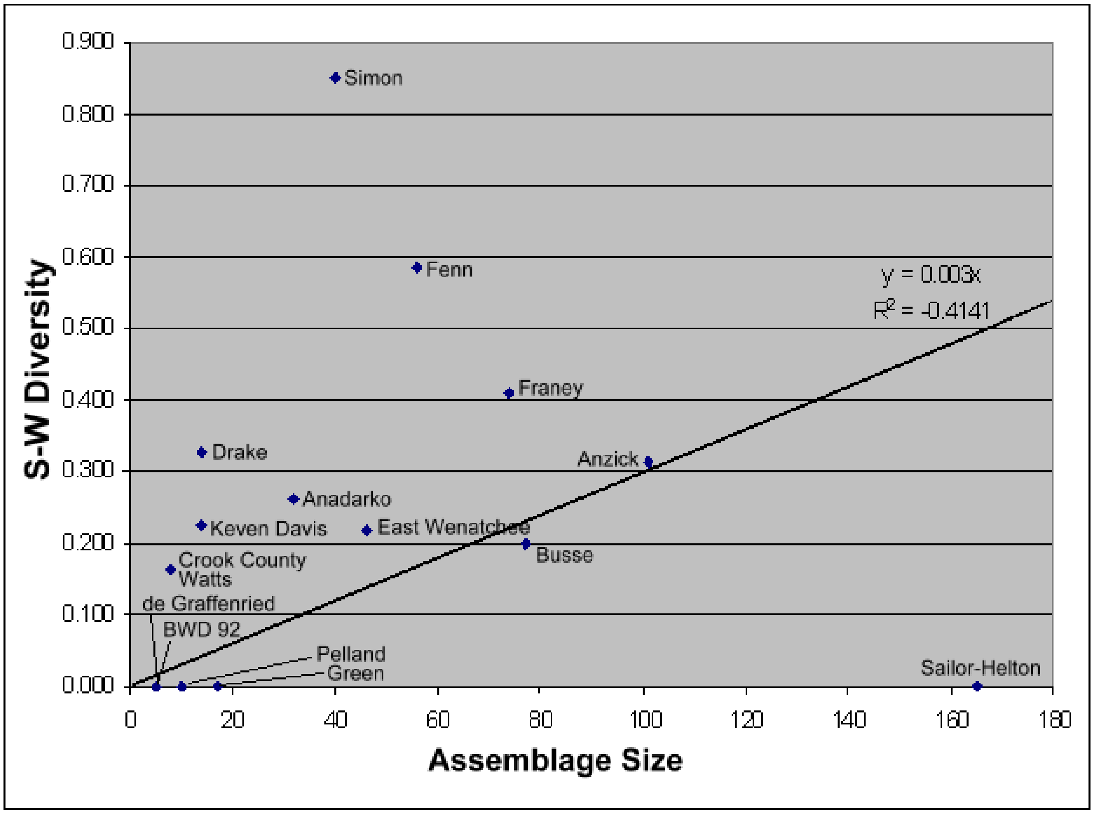

Figure 36. Shannon-Weaver values and sample sizes for caches.

The raw material diversity for a number of the assemblages, specifically Anzick, Busse, West Bank, and de Graffenried, is predicted by the relationship between these two variables. In other words, their raw material diversity does appear to be a function of sample size. For the remaining assemblages, Green, Pelland, and Sailor-Helton are less diverse than expected given their sizes; Anadarko, Crook County, Drake, East Wenatchee, Fenn, Franey, Simon and Watts are more diverse than expected. These results allow for the definition of low and high raw material diversity classes relative to one another (Table 23).

Variation in raw material diversity among caches appears to some extent to be governed by geography. While those caches that conform to expected sample size-diversity relationships are from all areas, the low and high raw material diversity groups are strongly geographically patterned. With the exception of Pelland, members of the low diversity group are all from the southern Plains. Members of the high diversity group are all from farther north, either the northern Plains or the Rocky Mountains. I believe this geographic patterning is most likely a product of raw material distributions rather than of variation in landscape use or cache function.

CHAPTER 8. CACHE CONTEXTS AND ASSOCIATIONS

Though Clovis caches typically occur in relative isolation, full understanding of their locations requires consideration of their position on the landscape, their proximity to other Clovis sites, and consideration of the items associated with them and other aspects of their treatment (e.g., use of red ochre). This chapter explores the variation in the archaeological and landscape contexts of caches, as well as the presence of associated items or features, including red ochre and artifacts other than flaked stone tools.

Cache Context

Site context includes location, as well as information as to whether or not a cache occurs within or adjacent to an activity site or a broader subsistence area, the character of such an area when present, and additional contextual information that relates to the expectations outlined in Chapter 3. Archaeological and geographic data were collected during cache site visits when possible, as well as from maps, archaeological reports, and interviews with cache discoverers and owners. The greatest number of cache discovery locations (6) is on open landscapes – geomorphic surfaces that are currently characterized by little in the way of distinctive topography – including plains and gradual slopes. Five more were found on slopes and plains that are not open, but are instead adjacent to a draw or stream, or in a rocky upland. Two are from constructional terraces adjacent to major watercourses, one was found in a rockshelter, and the find spots for the Fenn and de Graffenried caches are disputed and may never be known. These data are summarized in Table 24.

Table 24. **The Contexts of Cache Assemblages.**

Assemblage	Discovery Context	Landmarks Within 1 km	Archaeological Associations
Anadarko	Slope	stream	Isolated
Anzick	Rockshelter	stream	Isolated
Busse	open slope	none obvious	Isolated
West Bank	Plain	spring/stream	kills/camps
Green	Plain	stream	kills/camps
Crook County	Slope	none obvious	Isolated
Drake	open plain	none obvious	Isolated
de Graffenried	Unknown	unknown	Quarry
East Wenatchee	Terrace	none obvious	Isolated
Fenn	Unknown	unknown	Unknown
Franey	upland slope	Crow Butte	Isolated
Keven Davis	open slope	none obvious	Isolated
Pelland	Terrace	river confluence	Isolated
Sailor-Helton	open slope	none obvious	Isolated
Simon	open slope	Spring	Isolated
Watts	open plain	playa	Isolated

Landscape Context and Landmarks

Perhaps the most striking "pattern" concerning the discovery locations of caches is the apparent lack of patterning - with few exceptions, Clovis caches have been found in unremarkable locations. By unremarkable, I mean that there are no features obvious to the modern observer that differentiate the find locations from the surrounding landscape. While the locations of isolated Clovis finds and limited activity sites are difficult to predict, Clovis kills (e.g. Blackwater Draw, Colby, Domebo, Kimswick, Lehner, Miami, Murray Springs, Naco) and Clovis camps (e.g. Aubrey, Blackwater Draw, Mockingbird Gap, Murray Springs, Sheaman) are consistently associated with water in the form of springs, streams, or playas. This association does not consistently hold true for cache locations, with only 7 (the Anzick, Busse, Green, Pelland, Simon, Watts, and West Bank caches) of 16 caches directly associated with water features. The 9 remaining caches were found in relatively indistinct locations.

An exception to this is the Anzick cache that was found in a low rockshelter along a stream. The discovery locations of the de Graffenried and Fenn cache, and to some degree the Green cache (found in a secondary context), are unknown. Each of the remaining caches was found in the open, typically in indistinct contexts. Furthermore, aside from often being found within a kilometer of stream courses (typically in first or second order tributaries of major drainages), their locations do not correspond to any obvious routes of travel across local terrain or between resource areas. Keeping a cache from being discovered and plundered by a group other than the person or persons that deposited it might provide a reason to place it in an inconspicuous location; however, a utilitarian cache would be rendered useless if it could not be relocated when it was needed.

A handful of caches appear to be located adjacent to landscape features that might aid in their relocation. The Franey cache was found among the foothills near the base of Crow Butte, a prominent landmark visible for great distances across the western Nebraska plains. The Pelland cache is located within sight of the confluence of the Rainy and Little Fork Rivers. The West Bank and Green caches from Blackwater Draw and the Simon cache were discovered near springs that would have been active in the late Pleistocene.

It is possible that locations were marked with perishable landmarks as well, either natural ones such as trees, or by minor landscape features that have since been modified, or by artificial means such as upright posts, cairns, or other markers. Dennis Stanford (personal communication) suggested a form of the latter with regard to the Drake cache, posing the possibility that ivory fragments might represent the remains of an upright tusk used to mark the location of the cache. Certainly late Pleistocene hunter-gatherers had a profound understanding of their landscapes and a sophisticated ability to navigate the land, even if they were new to that particular place. The locations of many Clovis sites do not necessarily fit modern expectations as to where sites might be found. At this point in Clovis archaeology we know very little about preferred routes of travel and choices of areas to stop for rest or activity. Beyond kills and large camps, which are strongly associated with springs and drainages, Clovis site locations appear to defy prediction. What appears to be an unremarkable location to the eye of a 21st century Westerner may have been quite obviously situated to such keen ancient observers of the environment.

Archaeological Context

The great majority of Clovis caches occur in relative isolation from other traces of Clovis activity (Table 24); thus their relationships to other sites and to subsistence resources are difficult to ascertain with any certainty. Three caches, however, are clearly associated with further evidence of Clovis activity. Both the Green and West Bank caches from Blackwater Draw are located in an area that was repeatedly used for camping, hunting, and kill processing. Such a location is directly in line with expectations for caches that were meant to be retrieved for later use in an area otherwise lacking in available lithic raw material.

The de Graffenried cache is reported to have been recovered from the immediate area of, and perhaps within, the Gault site, an area repeatedly used for camping as well as for quarrying and reducing Edwards Plateau chert (Collins 1999a). Its placement within a quarry area is curious, and calls into question a utilitarian interpretation for the cache.

Associated Materials

Several of the caches are associated with materials other than flaked stone artifacts, including red ochre, human remains, osseous rods, and shell. Also presented here are specialized tools that occur within individual caches.

Red Ochre

Red ochre, or earthy hematite (Fe_2O_3), occurs sporadically through time with archaeological assemblages from both the New and Old World, and the association of this mineral with North American Paleoindian assemblages is not altogether uncommon. It occurs in a variety of contexts, including habitations, caches, burials, tools, and kills (Roper 1991), and may have served a variety of ritual and utilitarian functions. Associations of Clovis artifacts with red ochre sources occur in at least two localities. Powars II (Stafford et al. 2003) and the Sunrise Mine (Tankersley 2002:136-149) in Wyoming, both appear to be areas where red ochre was mined by Clovis groups. Attempts to chemically characterize red ochre sources toward identifying the sources of the pigment found on archaeological examples have proved largely unproductive (e.g., Tankersley et al. 1995), due in part to the small number of red ochre sources that have been sufficiently characterized (Erlandson et al. 1999).

Red ochre has been detected on artifacts from seven of the 16 caches: Anzick, Busse, Crook County, de Graffenried, East Wenatchee, Fenn, and Simon (Table 25; Figure 37). All of the artifacts from the Anzick cache are reported to exhibit red ochre, and indeed the unexcavated portion of the assemblage was relocated partially due to the recognition of a lens of red ochre surrounding the deposit. The ochre is also associated with the remains of an infant, suggesting that the Anzick assemblage may represent an afterlife cache.

Certain artifacts from the Busse cache exhibit traces of red ochre. Twelve artifacts, including seven bifaces, four flake tools, and the single abrader, have streaks of the mineral pigment on their surface. Notably, red ochre was not identified on any of the blades or unused flakes.

The Crook County cache was apparently buried in a natural vein of red ochre. Two color shades of the mineral originally appeared possibly to represent different sources. One of the shades was ultimately found to be a result of iron oxide naturally occurring on the cortex of the lithic raw material from which the artifacts were made (Tankersley 2002). Linear, diagonally oriented areas that do not exhibit red ochre on two of the bifaces (No. 204 and 206) suggest the presence of some form of strap wrapped around the artifacts when they were buried.

Red ochre is present on each of the artifacts in the de Graffenried cache. It is particularly visible within step fractures on the four bifaces and the one nearly complete projectile point. The de Graffenried cache is both the southernmost biface cache and the southernmost association of red ochre with a cache assemblage.

In the East Wenatchee cache, red ochre occurs primarily on the bases of three large projectile points (No. 4, 19, and 27) in what would have been the hafting area. Minor traces of red ochre also occur on one flake tool (No. 43). It is not clear whether the traces on this latter artifact are derived from contact with the three projectile points, from some common container they may have all shared, or from direct application to the flake tool.

Table 25. Occurrence of Red Ochre in Cache Assemblages.

Assemblage	Red Ochre Present	Comments
Anadarko	No	red sediment on artifacts attributed to local soil conditions
Anzick	Yes	artifacts and bone recovered from lens of ochre-stained sediments
Busse	Yes	streaks on seven bifaces and five stone tools
West Bank	No	
BWD Green	No	
Crook County	Yes	buried in a lens of natural red ochre
Drake	No	
de Graffenried	Yes	in step fractures and pockets on all artifacts
East Wenatchee	Yes	streaks and in fractures on three projectile points, traces on one flake tool
Fenn	Yes	streaks and in fractures on all artifacts
Franey	No	
Keven Davis	No	
Pelland	No	
Sailor-Helton	No	
Simon	Yes	artifacts washed, residue on most artifacts
Watts	No	

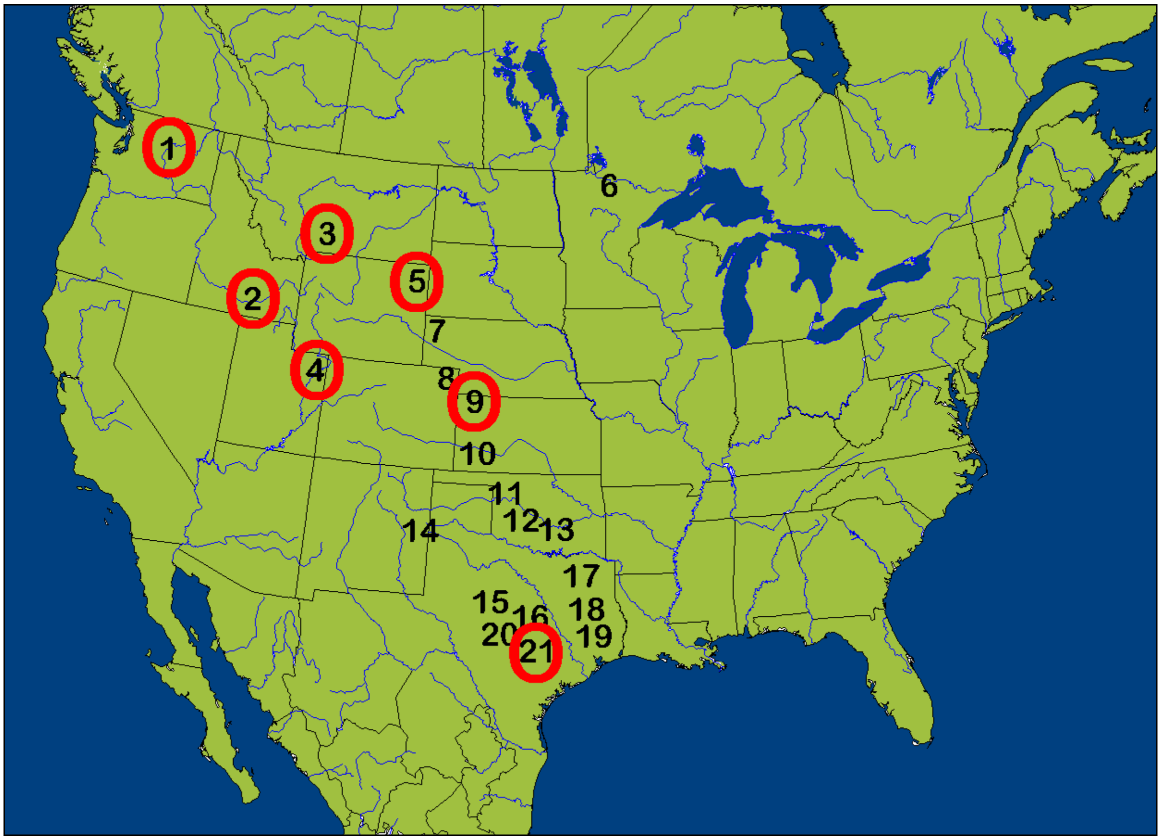

Figure 37. Locations of caches with red ochre; numbers are keyed to Table 2.

Red ochre is abundant on the artifacts of the Fenn cache, to the extent that it appears that they may have been packed in it or smeared with it. One projectile point (No. 149) lacks traces of red ochre, but this may be explained by repeated casting of the artifact. Like artifacts from the Crook County cache, a linear diagonal pattern possibly representing straps is present on some of the chalcedony projectile points.

Artifacts in the Simon cache are reported by the owner to have been smeared liberally with red ochre. Although the majority of the red ochre was said to have been scrubbed off with a brush and water, evidence of red ochre remains in abundance.

The associations among the artifacts, skeletal material, and red ochre at the Anzick site all suggest that this assemblage may represent ritual behavior associated with a burial. However, it is clear that some of the artifacts were taken from a context in which they had been used and maintained for apparently utilitarian purposes. This pattern led Jones (1996:170) to conclude that Anzick represents a functional toolkit used as an heirloom burial assemblage. The association of red ochre with this - the only known Clovis burial - renders it tempting to regard all caches associated with red ochre as potential burials. However, the preservation of osseous material in the East Wenatchee cache begs the question of why human remains are not present there. Perhaps further excavation will clarify this matter. Furthermore, East Wenatchee, Crook County, Busse, and de Graffenried are best characterized as having traces of red ochre, while Fenn and Simon are both more comparable to Anzick in that they appear to have been liberally smeared or packed in the mineral. Solely on the basis of red ochre associations, Fenn and Simon may be the best candidates for burial (afterlife) assemblages comparable to Anzick, though there is no evidence for surviving human remains at Simon, and there is no reliable contextual information regarding Fenn.

Two patterns are clear with regard to the use of red ochre in cache assemblages. First, red ochre is more common in caches from the northern plateaus and mountains (Figure 37) than those from the southern plains. Second, the occurrence of red ochre corresponds neatly with the presence of bifaces in caches, a trend noted also by Huckell (1999). Indeed, bifaces are present in every cache in which red ochre occurs, and red ochre occurs with each cache that includes bifaces, with the exception of two assemblages (Anadarko, in which Hammatt [1970:142] attributes a reddened patina to "having been buried in a red, Permian-derived soil," and Watts). This association between red ochre and bifaces (Table 26) is not duplicated for any other artifact class, and is statistically significant (X^2=9.68, df=1, p=0.002). Conversely, red ochre has not been found to occur with blades or flakes (with the exception of flakes used as tools). This latter pattern holds true even for caches that are associated with red ochre (with the exception of the Fenn cache). In the Busse cache, red ochre is present on bifaces, flake tools, and the abrader, but it was not identified on any of the blades or unused flakes. In the East Wenatchee cache red ochre was identified on one flake tool, but on none of the blades or unused flakes. The single blade present in the Fenn cache exhibits traces of red ochre, which may be the result of contact with other items in the cache.

Table 26. Contingency Table Comparing Occurrence of Red Ochre and Occurrence of Bifaces in Clovis Caches.

	Bifaces Present	Bifaces Absent	Total
Red Ochre Present	7	0	7
Red Ochre Absent	2	7	9
Total	10	6	16

These patterns indicate a consistent association between bifaces and red ochre, and a consistent lack of association between blades or flakes and red ochre. It is worth noting that a portion of the surface of the Sheaman site, a camp associated with extensive biface reduction, is liberally coated with red ochre, as are bison remains that rest on this surface. Nodules of red ochre are also common at the site, suggesting that it was being processed for some purpose that remains unclear. These technological associations may very well indicate that red ochre has a utilitarian function associated with biface technology and not blade technology, perhaps associated with edge grinding as proposed by Titmus and Woods (1991). Conversely, the possibility remains that both bifaces and red ochre were associated with some ideological phenomenon with which blades and flakes are not. Either way, I propose that the apparent pattern of ochre caches being a northern phenomenon (Kilby and Huckell 2003) is better described as a biface-oriented cache phenomenon, related in some cases to biface manufacture and maintenance, and in at least one case with human burial.

Human Remains

Only the Anzick cache is associated with identifiable human remains. The remains of two individuals were present in the rockshelter. One is that of a juvenile and the other is the remains of an infant, primarily consisting of a cranial fragment and a number of small postcranial bone fragments. Both of these individuals were originally believed to have been associated with the cache; however, a thorough chronometric analysis (Stafford 1994) demonstrates that the remains of the juvenile most likely represent a younger, unrelated burial. The presence of red ochre on both the Anzick artifacts and the remains of the infant provides strong evidence that these two are directly associated. The remains of the infant were radiocarbon dated and produces an average age of 10,680+/-50 BP (Stafford 1994), potentially consistent with Clovis age given the tendency for radiocarbon dates on bone to underestimate true age (Stafford et al. 1987). If the Anzick burial is representative of Clovis burial practices, one might expect Clovis caches to be more common, particularly if such assemblages of non-perishable items typically accompanied the interment of the dead. Because Anzick is a single example, and we have no way of discerning how typical it is of Clovis burial traditions, such quandaries remain difficult to address.

Osseous Rods

Cylindrical rods of bone and ivory are reported from Clovis caches and other Clovis sites (e.g., Bradley 1997; Frison and Craig 1982; Hester 1972; Jenks 1941; Tankersley 1997). The rods may be pointed or beveled and often exhibit incised lines or cross-hatching on their surfaces (particularly in the area of bevels). The function of these artifacts has been the subject of much research and speculation (Lyman et al 1998; Lahren and Bonnichsen 1974; Wilke et al. 1991; Gramly 1993; Boldurian and Cotter 1999), with suggested uses including bone points, foreshafts, components of composite pressure flakers, and sled runners.

Osseous rods are present in at least two caches. There are 12 rods manufactured from proboscidean bone in the East Wenatchee cache. The Anzick cache contains 10 rods, also manufactured from proboscidean bone. Two more caches, Drake and Crook County, exhibit some evidence for the presence of osseous materials as well. Splinters of osseous material excavated from a test unit at the Drake find locality were identified microscopically as mammoth ivory (Stanford and Jodry 1988). Erickson, the finder of the Crook County cache, reported that cylindrical bone artifacts, described as cigar-shaped, occurred with the bifaces. It remains unknown whether these were bone or ivory rods or rather that they were merely examples of the naturally occurring fossils noted to occur in abundance within the local sandstone (Tankersley 2000:106,129); however, it seems unlikely that Erickson would have left behind distinctively beveled rods if they were present. Due to the widely varying preservation conditions characterizing the cache locations, it is difficult if not impossible to discern whether or not osseous rods originally were associated with other caches.   In addition, osseous rods are known from two other Clovis sites in the west: two from Blackwater Draw and one from the Sheaman site.

Comparison of rods from these assemblages indicates that those from East Wenatchee deviate from the others in two important aspects: size and embellishment. Complete rods from the East Wenatchee cache are of similar length of those from Anzick, Blackwater Draw, and Sheaman, but are noticeably wider. Comparison of maximum width and thickness measures (width defined simply as greater of the two dimensions) reveals that all but one of the East Wenatchee rods form a cluster differentiated from those of the other assemblages (Figure 38).

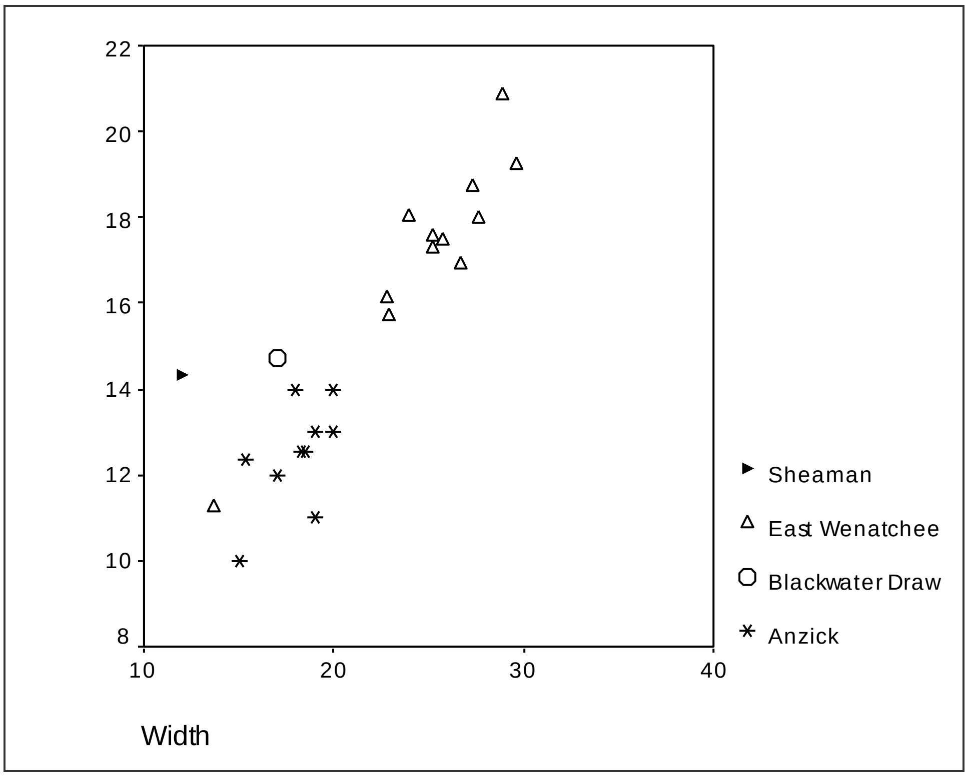

Figure 38. Plot of width versus thickness (mm) for osseous rods from western Clovis sites.

Several of the East Wenatchee rods exhibit decorative embellishments (i.e., more than the cross-hatching and striations typical of all Clovis bone rods) that are not exhibited on other specimens from the western Clovis assemblages (Table 27). Despite greater surface weathering among specimens from the East Wenatchee cache, three out of 12 rods are embellished. Two rods exhibit a pattern of parallel elongated notches resulting in a zippered appearance along the shaft on the beveled side of the rod, and one exhibits a series of curved incisions extending up from the end on the side opposite of the beveled portion of the rod (Figure 39). It is difficult to discern if similar decorations once existed on the surfaces of the more fragmentary and eroded specimens from East Wenatchee, but I suspect they may have. Incised decorations are known from a specimen from Ohio (Tankersley 1997) and two from Florida (Bradley 1997), but have not been identified in other assemblages in the American West, besides East Wenatchee.

a.

Figure 39. Embellishments on osseous rods from the East Wenatchee cache; (a) zipper pattern on No. 53; (b) crescent-shaped incisions on No. 58.

Buchanan et al. (n.d.) argue that these differences, along with differences in projectile points and bifaces, set the East Wenatchee cache apart from the other assemblages. The authors argue that these differences in size and form between osseous rods from the East Wenatchee cache and those from Anzick, Blackwater Draw, and Sheaman are associated with costly signaling on the part of the maker(s) of the East Wenatchee cache.

Table 27. Attributes of Osseous Rods from Clovis Caches and Sites (size in mm).

Assemblage	Cat. #	Length	Width	Thickness	Embellishment
Anzick	11	281	18	14	None
Anzick	37	NA	17	12	None
Anzick	38	NA	19	13	None
Anzick	67	224	15.3	12.4	None
Anzick	94	54.4	18.3	12.5	None
Anzick	95	257.5	18.5	12.6	None
Anzick	117	NA	15	10	None
Anzick	120	NA	19	11	None
Anzick	122	NA	20	13	None
Anzick	123	NA	20	14	None
Blackwater Draw	9-10	252	15	NA	None
Blackwater Draw	9-9	234	17	14.7	None
East Wenatchee	47	189.1	25.2	17.3	None
East Wenatchee	48	170.8	25.7	17.5	None
East Wenatchee	49	115.2	13.6	11.3	None
East Wenatchee	50	230	26.7	16.9	None
East Wenatchee	51	251	22.9	15.7	None
East Wenatchee	52	230.3	28.9	20.8	None
East Wenatchee	53	263	24	18	zipper pattern of notches along beveled side
East Wenatchee	54	176.8	25.2	17.8	None
East Wenatchee	55	207.7	22.8	16.1	zipper pattern of notches along beveled side
East Wenatchee	56	214.5	29.6	19.2	None
East Wenatchee	57	241.3	27.7	18	None
East Wenatchee	58	192.7	27.3	18.7	crescent-shaped incisions on exterior of bevel
Sheaman	E1052	203.4	12	14.3	None

Shell

A single cache, the Franey cache, has a large mollusk shell possibly associated with it (Figure 40). The marine shell is enigmatic. It is not fossilized, and so appears to have been obtained directly from a marine environment. It is a West Indian Top Shell (*Cittarium pica*) native to subtidal rocks with high wave energy near the open ocean in the Caribbean (specimen identification by Thomas Waller, Smithsonian Institution Department of Invertebrate Paleontology, personal communication, 2004). Native Caribbean groups commonly carried these mollusks as a portable food source in the early historic period. Clovis use of exotic marine shell has not been previously reported. For this reason, association of the shell with the cache is suspect, although Max Franey recalls that his father found it in direct association with the stone artifacts.

Figure 40. Marine mollusk (*Cittarium pica*) associated with the Franey cache.

Specialized Tools

Three caches contain tools that, while not unprecedented among Clovis assemblages, do not exist in other caches. The Fenn cache contains a crescentic biface or "crescent" (Figure 41). This artifact form is better known from Great Basin Paleoindian sites (Willig 1988) and is not represented in any other known Clovis cache or other

Clovis site type. It is tempting to consider the crescent as a possible trade item from the Great Basin; however, it is manufactured from the same Green River Formation chert from southwestern Wyoming of which several Clovis points in the Fenn cache are made.

Figure 41. Crescent biface from the Fenn cache (No. 151).

A tabular, cortical piece of Niobrara jasper from the Busse cache appears to have been used as an abrader (Figure 42). Numerous striations occur at various angles, criss-crossing one another on both faces. Red ochre staining is present on one face. The tool may have been used for grinding platforms on other artifacts within the cache.

Figure 42. Abrader from the Busse cache (No. 15).

A visit to the location of the Drake cache resulted in recovery of a black chert hammerstone in the immediate location of the cache (Stanford and Jodry 1988). The hammerstone is an alluvial cobble of fossiliferous chert with black secondary cortex fading to a pinkish interior (Figure 43). It is battered heavily at both ends. While it is clear that the rock was used as a hammerstone, it would not necessarily be an appropriate percussor for the manufacture or maintenance of the projectile points that make up the rest of the cache.

Figure 43. Hammerstone associated with the Drake cache (No. 14).

Examination of the context and associations of these assemblages highlights the the substantial variation in Clovis caches. Although they may occur within other types of archaeological sites, they are typically found in isolation. The characteristics of the landscape in the locations where they have been found, while perhaps exhibiting a weak tendency to be associated with water features, vary considerably. Further, association with osseous rods, human remains, red ochre, and other items differs greatly among assemblages, perhaps suggesting corresponding differences in cache function.

CHAPTER 9. CONCLUSIONS: CLOVIS CACHING AND TECHNOLOGICAL ORGANIZATION

In this chapter, information discussed in the preceding chapters is synthesized to address variation in cache functions, the forms in which Clovis stone supplies were transported, and the potential relative economic value of Clovis caches. First, the results of analyses carried out in the previous chapters are summarized. The attributes of Clovis caches derived from these analyses are compared to expectations for different cache functions in order to address the fundamental question of this dissertation – what function(s) did these assemblages serve for the groups that placed them? Next data derived from caches are brought to bear on the forms in which raw material was transported, and the composition of the corresponding tool kit carried by a Clovis individual. In the final section, cache contents are compared to the raw material requirements of making and processing a kill in order to estimate their relative value in Clovis subsistence economy.

Analytical Results

The goals of the analyses presented in Chapters 6, 7, and 8 were both to partition the variation within and among the cache assemblages into meaningful units for comparison, and to generalize these units so that they can be weighed against expectations derived in Chapter 3 concerning cache functions. In the case of the former, simply organizing the variability among the assemblages contributes to a better basic understanding of Clovis caching as a phenomenon. The latter stands to contribute more directly to the goals of this dissertation by facilitating the evaluation of cache function.

Artifact Form

Chapter 6 focused upon variation in artifact form and function within caches. In order to maintain comparability among assemblages, given the impossibility to control for preservation and other post-depositional issues, only chipped stone artifacts were considered in these comparisons. Artifacts were assigned to one of five general categories: projectile points, bifaces, cores, flakes, or blades. These categories are conceived of as primarily technological, as opposed to functional. In other words, they emphasize the results of different chipped stone reduction trajectories (e.g., flake) rather than classes defined based upon interpretations of function (e.g., graver).

The first section of Chapter 6 examined the array of artifact classes present in each of the caches. The results indicate that caches can be divided into two broad categories of either biface-dominated caches or blade/flake-dominated caches. With few exceptions (e.g., Busse) individual caches fall clearly into one of these two categories. Furthermore, these categories roughly correspond to two other variables. First, biface-dominated caches tend to occur in the mountains and plains of the northern portion of the distribution of caches. The de Graffenried cache is an obvious exception to this pattern. Blade- and flake-dominated caches tend to occur primarily on the Southern Plains, with the Pelland cache as a clear exception. Second, biface-dominated caches are usually associated with red ochre, whereas blade/flake dominated caches are not.

Artifact class diversity was investigated using Simpson's *D* index. The index values were used to divide the cache assemblages into four diversity categories: homogenous (Green, Drake, Keven Davis, Pelland, and Watts), low diversity (Anadarko, Crook County, de Graffenried, Simon, and West Bank), diverse (Anzick, Fenn, Franey, and Sailor-Helton), and very diverse (Busse and East Wenatchee). These categories cut across the biface-dominated and blade/flake-dominated distinction drawn above, and also do not clearly correspond to any geographic patterns. It is proposed that this variation reflects the functional specificity of the assemblages, with lower diversity corresponding to greater specificity of activities for which the cache was intended. For the purpose of functional comparisons, the homogenous and low diversity categories are combined into a single low diversity category, and the diverse and very diverse categories are combined into a high diversity category.

Artifact Use

The utility of the artifacts from caches was examined from the perspective of a remnant utility index that is based upon comparisons to artifacts from kill and camp sites. The index uses discarded, broken, and lost artifacts from kill and camp sites to estimate minimum acceptable utility for each artifact class. Artifacts from caches were then compared to these values and the difference in weight used to calculate remnant utility for each artifact, or individual remnant utility (IRU). Overall remnant utility for each cache, or assemblage remnant utility (ARU), is taken to be the average remnant utility of each item within the cache. The results enable the partitioning of cache assemblages into two categories based upon the relative amounts of remnant utility in each. The low remnant utility category includes Busse, Franey, Keven Davis, Pelland, and Sailor-Helton. The high remnant utility category consists of Anadarko, Anzick, Crook County, de Graffenried, Drake, East Wenatchee, Fenn, Green, Simon, Watts, and West Bank. These groups include both biface- and blade/flake-dominated caches.

The last section of Chapter 6 summarizes the evidence for use exhibited by artifacts from caches. A simple and conservative approach was utilized to identify the presence or absence on flakes, blades, and projectile points of evidence for use previous to being deposited in a cache. It was found that nearly every cache contains some items that have been used to some degree. Only the de Graffenried cache contains no artifacts that exhibit evidence for use prior to deposition (based upon the single projectile point). At the other extreme, every artifact in the Pelland cache shows evidence for use. Examination of evidence of use enabled the creation of a low use group of caches consisting of the de Graffenried, Drake, Fenn, Green, Keven Davis, Sailor-Helton, Simon, and West Bank caches, and a high use group consisting of the Anzick, Busse, Crook County, East Wenatchee, Franey, and Pelland caches. As with artifact diversity and remnant utility groups, the groupings based upon evidence for use cross-cut the biface- and blade/flake-dominated categories.

Lithic Raw Materials

Chapter 7 examined the raw materials present in the cache assemblages, as well as those from kill and camp sites. The attribution of raw materials to specific geologic sources is challenging for a variety of reasons. However, utilizing published information, personal communications, and direct observations, raw material designations could be made with some confidence for over 80 percent of most of the caches by weight. Raw material data were used to address transport distances, distance to nearest source, direction of transport, and raw material diversity.

Distance is addressed through the calculation of average transport distance (ATD) for a cache, which takes into consideration the distance to a given source as well as the degree to which that source contributes to the overall assemblage. The resulting values range to over 600 km. A group of of high ATD caches was clearly distinguished from low ATD caches and all kills. This group consists of Anzick, Crook County, Drake, Simon, and Pelland. Each of these caches is in the northern latitudes of the Clovis range and, except for Pelland, each of them consists primarily of bifaces. The low average transport distance group consists of a combination of assemblages from the north and the south, including assemblages that emphasize bifaces and those that emphasize blades and flakes, as well as Clovis kill and camp sites.

The distance from most caches to the nearest raw material source indicates that supplying resource-poor areas was a factor in the placement of most caches. However, four caches (Anzick, Crook County, Drake, and Simon) deviate substantially from this expectation, and represent stone being moved long distances to areas where stone is available relatively close by.

Examination of the directionality of transport revealed a strong pattern of movement of raw materials to the north and west from source areas. This pattern is evident in both the frequency and volume of material transported.

Diversity of lithic raw material sources present in a given assemblage was found to be widely variable. Raw material diversity appears to be a function of sample size for some assemblages; however; for the remaining assemblages diversity is geographically patterned. I suspect that this patterning reflects differing regional distributions of raw material resources. Deviation from expectations based on sample size allowed the identification of high and low diversity groups for comparison to cache function expectations.

Anzick, Crook County, Drake, and Simon consistently stand apart from other caches with regard to raw materials. These four caches all exhibit high average transport distances, high distances relative to nearest source, and moderate-high raw material diversity. Further, they are generally northern caches, ranging from northeastern

Colorado to central Idaho. While these differences may reflect something distinct about the functions of these caches (discussed below), the directionality of their transport is largely consistent with the others.

Clovis groups clearly invested in the transport and utilization of a select variety of high-quality raw materials. The redundancy with which many of the sources appear among the caches and sites - given the variety of other lithic resources available - suggests that Clovis flintknappers displayed strong preferences for these resources in particular. It does not appear that these materials were simply preferred because they were the only sources known. That Clovis groups were aware of and willing to utilize other sources of raw material when necessary is reflected in the lower average transport distances for kill and camp sites. Taken together, raw material data suggest that caches do not simply reflect the movement of adequate raw materials to areas that lack them or are unknown, but to a large degree represent the relocation of *preferred* raw materials to areas in which it was known that they did not occur.

Cache Context

Perhaps the most surprising thing about cache locations is that in most cases they do not appear to have been placed at points associated with obvious landmarks. Furthermore, it found no consistent pattern in location with regard to major landscape features. Assuming that the majority of caches were intended for eventual retrieval, these results are not expected. It is possible that locations were intentionally discrete, serving to hide the cache from potential competing groups, or that the owners of a cache possessed some ways of relocating it that are not apparent from the modern landscape.

Three caches are associated with other archaeological manifestations of Clovis activities. The Green and West Bank blade caches from Blackwater Draw both occur within an extensive, most likely repeatedly occupied area of camp and kill localities. The de Graffenried biface cache perhaps occurs within or adjacent to a camp and quarry location (Gault) that was almost certainly repeatedly occupied as well. In each of these cases, as might be expected, caches were placed in areas where Clovis groups may have planned to return in the future.

Materials Associated with Caches

Red ochre is associated with seven caches: Anzick, Busse, Crook County, de Graffenried, East Wenatchee, Fenn, and Simon. The association occurs in three different forms: packed in or smeared with abundant red ochre (Anzick, Fenn, and Simon); red ochre present in trace amounts on all or a few artifacts (Busse, de Graffenried, and East Wenatchee); or buried within naturally occurring red ochre (Crook County). The Anzick cache clearly represents a Clovis burial, and based upon patterns in red ochre treatment, Fenn and Simon might be interpreted that way as well. Strikingly consistent among all of the caches with red ochre, however, is the association of red ochre with biface technology. Bifaces are present in every cache in which red ochre occurs, and red ochre occurs with each cache that includes bifaces, with the exception of only two assemblages (Anadarko and Watts).

Anzick is the only cache - and the only Clovis assemblage - directly associated with human remains. The artifacts were found with the remains of an infant, and red ochre was applied liberally to both the artifacts and the remains. As the single example of a Clovis burial, it is difficult to ascertain how typical or atypical the Anzick cache might be of Clovis mortuary practices.

Osseous rods of bone or ivory are components of the Anzick and East Wenatchee caches, and may have once been present in the Crook County and Drake assemblages.

Their occurrence at Blackwater Draw, NM, and the Sheaman site, WY, testifies to their use at camp and kill sites as well. These tools were probably common components of Clovis assemblages, as they are not unusual at sites with adequate conditions for bone preservation, and they may very well once have been present in a greater number of the caches. A comparison of osseous rods from western Clovis sites demonstrated that those from the East Wenatchee cache are distinct from the others with regard to size and embellishments.

A marine mollusk shell was reportedly found in the same location as the artifacts from the Franey cache. This shell does not appear to be fossilized and its closest modern natural source is the Caribbean coast. Its presence is enigmatic, and it is not clear if it represents an unprecedented Clovis period trade item, or an item unrelated to the cache.

Three caches are associated with tool types that are not found among other caches. The Fenn cache contains a crescentic biface. This artifact form is more commonly found farther west, and potentially in slightly younger contexts, than the location at the Great Basin – Northern Rocky Mountain interface where the cache was reportedly found. The raw material of which the crescent is made, however, is consistent with other typical Clovis artifacts in the cache. A cortical piece of jasper was found with the Busse cache, and exhibits abundant striations. The artifact is interpreted as an abrader, and could possibly have been used in the preparation of platforms on the bifaces in the cache. Both the abrader and the bifaces exhibit traces of red ochre. The Drake cache includes a small chert hammerstone. The hammerstone has clearly been used, but does not seem appropriate for use in the manufacture or maintenance of the finished projectile points that make up the remainder of the cache assemblage.

Cache Functions

In this section these data are evaluated against the expectations for Clovis caches as signatures of colonization, and as insurance, load exchange, seasonal/passive gear, and afterlife caches.

One explanation proposed for the occurrence and locations of Clovis caches is that they facilitated the colonation of new lands by pioneering populations moving across a relatively unknown landscape. Wilke (1991:243-244) argued that caches represent, "a coherent technological adaptation of the initial colonizers of North America…." Meltzer's (2002:38) explanation for the Clovis caching phenomenon is "that Clovis groups were so *new* to the landscape they didn't know and could not predict where or when they were next going to find vital resources. By leaving caches scattered about the landscape, as they moved away from known sources, they created artificial resupply depots, and thus anticipated and compensated for their lack of knowledge." I predicted that if caches were primarily associated with colonization, the result should be the movement of people, and thus raw materials, in a generally southward and eastward direction as populations swept across the continent, and that caches should be expected to be ideal for meeting a variety of unforeseen needs, in other words consistently generalized or diverse with regard to artifact classes. With regards to the latter, numerous caches are conspicuously homogenous, with some consisting of a single specialized artifact form (e.g., Drake, Keven Davis). Further, the investigation of diversity in artifact classes among Clovis caches demonstrates considerable variability, as opposed to consistency, among artifact diversity values for caches. The model's expectations are thus not well supported by patterns in artifact diversity.

Nor is the model supported by raw material evidence for the direction of movement across the landscape. Meltzer (2008, personal communication) has pointed out (and I believe rightly) that, even if the the populations were colonizing in a generally southeastward direction, exploration of any given area might have been from some other direction. Still, even if it is accepted that exploration and colonization occurred in a less linear fashion, it is difficult to imagine that the northern Rockies and northern Plains remained unexplored until after the southern Plains had been colonized. Because the opposite of this predicted southward and eastward movement is evident in raw material distributions, explanations for Clovis caches as a colonization phenomenon must be reconsidered.

The direction of movement evidenced by the cached raw materials might be seen as supporting an argument that Clovis technology actually developed in the Southeast and then spread westward from there (e.g, Mason 1962). This argument is primarily based upon the greater number and greater variety of fluted points in the Southeast, but demonstrating it is hampered by the paucity of chronometric dates from that area. One of two conditions is necessary for this argument: either the origin of colonizing populations lies somewhere in the East (Bradley and Stanford 2002), or Clovis technology was developed among some pre-existing population (Waters and Stafford 2007, but see G. Haynes *et al*. 2007). Though both of these possibilities are debated, neither is clearly supported by current data, and I do not consider either scenario a satisfactory explanation of the direction of movement evident in Clovis caches.

An alternative perspective is that materials were cached by people who already knew the landscape and corresponding resource distributions quite well, and moved raw materials in accordance with this knowledge. In this scenario, the movement of raw materials northward was done by design. I suggest that raw material needs for a given group that moves cyclically around a region may have been different when moving north than when moving south. Furthermore, one might expect this difference, like the movements themselves, to have been seasonally patterned. I envision a situation in which it was important to transport surplus raw materials when moving northward in the spring, perhaps following forage and game animals northward as the weather warmed. Patterns in the seasonality of early Paleoindian kills indicate a preponderance of kills in the warm season (Todd *et al*. 1996). Surplus materials could be cached in order to sustain raw material needs throughout the season (presumably summer and early fall) spent on that portion of a group's range. If supplies ran low toward the end of a long season in that range, caches would provide surplus material to draw upon as the preferred hunting season continued, or as the group backtracked at the end of the season.

If the function of caches was not to enable the exploration and colonization of new landscapes, then what was their function(s) for Clovis groups who were already "settled in" to the landscapes they occupied? In Chapter 3, four functions derived from ethnographic and archaeological perspectives on caching are argued to be the most relevant to highly mobile hunter gatherers. The theoretical expectations for attributes of insurance, load exchange, seasonal/passive gear, and afterlife caches (as defined in Chapter 3) are reproduced in Table 28.

Table 28. Archaeological Expectations for Four Cache Functional Types.

Attribute	Cache Type			
	Insurance	*Seasonal/Passive*	*Load Exchange*	*Afterlife*
Raw material diversity	Low	High	High	High
Artifact diversity	Low	High	Low	High
Remnant utility	High	Variable	Variable	Variable
Use wear	Low	High	Variable	Variable
Distance to raw materials	High	Variable	Variable	Variable
Distance to subsistence resources	Variable	Low	Low	Variable
Site context	Variable	Base camp	Activity areas	Variable
Other	permanent landmarks?	specialized tools?	--	human skeletal remains? Red ochre?

This list is not intended to be exhaustive with regard to the variety of functions caches may have served in Clovis economies, and no cache is necessarily expected to meet any of these suites of attributes perfectly. However, these proposed expectations serve as basic models for partitioning the variation in cache assemblages in a way that sheds light upon their function(s). Table 29 describes each cache according to attributes that correspond to these expectations.

Table 29. **Attributes of Clovis Caches Pertaining to Function.**

		Anadarko	Anzick	Busse	Crook County	Drake	de Graffenried	East Wenatchee	Fenn
Raw material diversity		High	Medium	Medium	High	High	Medium	High	High
Artifact diversity		Low	High	High	Low	Low	Low	High	High
Utility		High	High	Low	High	High	High	High	High
Use wear		n/a	High	High	High	Low	Low	High	Low
Distance to raw materials		Low	High	Low	High	High	Low	Low	Low
Distance to subsistence resources		n/a	n/a	n/a	E	n/a	n/a	n/a	n/a
Site context		Isolated	Isolated	Isolated	Isolated	Isolated	Quarry	Isolated	Isolated
Other	*Red Ochre*		Yes	Yes	Yes		Yes	Yes	Yes
	Specialized Tools			Yes		Yes			Yes
	Human Remains		Yes						
	Landmarks	Yes	Yes						

Table 30, cont. Attributes of Clovis Caches Pertaining to Function.

	Franey	Green	Keven Davis	Pelland	Sailor-Helton	Simon	Watts	West Bank
Raw material diversity	High	Low	Low	Low	Low	High	High	Low
Artifact diversity	High	Low	Low	Low	High	Low	Low	Low
Utility	Low	High	Low	Low	Low	High	High	High
Use wear	High	Low	Low	High	Low	Low	n/a	Low
Distance to raw materials	Low	Low	Low	High	Low	High	Low	Low
Distance to subsistence resources	n/a	Low	n/a	n/a	n/a	n/a	n/a	Low
Site context	Isolated	Kills/Camps	Isolated	Isolated	Isolated	Isolated	Isolated	Kills/Camps
Other: *Red Ochre*						Yes		
Other: *Specialized Tools*								
Other: *Human Remains*								
Other: *Landmarks*	Yes	Yes		Yes		Yes	Yes	Yes

As expected, none of the suites of cache attributes corresponds perfectly to theoretical expectations; however, each cache conforms reasonably closely to a particular suite of expectations, enabling that cache to be assigned a particular function. The greatest number of caches (6) corresponds closest to expectations for insurance caching. Two correspond to seasonal/passive gear caching, and four each correspond most closely to load exchange and afterlife caches. These comparisons are discussed in more detail in the following sections.

Insurance Caches

The Drake, Green, Keven Davis, Pelland, Sailor-Helton, and West Bank caches fit well with expectations for insurance caching. Comparisons of each of these caches with the theoretical expectations for insurance caching are presented in Table 30.

Insurance caches are expected to be characterized by low raw material diversity because the cache, and thus the acquisition of the raw material for the cache, was planned in advance as a strategy for reducing the risk of resource shortage on a particular part of the landscape. Each of the caches in this group is characterized by low raw material diversity except the Drake cache. Contrary to expectations, raw material diversity in the Drake cache was found to be high relative to the number of items in the cache. This measure is perhaps misleading, in that while there are three varieties of raw material among the 13 projectile points, two raw materials are represented by only a single artifact; the remaining 11 projectile points are all of a single raw material: Alibates agatized dolomite. The cache can be viewed as consisting primarily of artifacts from a single raw material source.

Table 30. Comparison of Cache Attributes to Expectations for Insurance Caches.*

		Expectation	Drake	Green	Keven Davis	Pelland	Sailor-Helton	West Bank
Raw material diversity		**Low**	High	**Low**	**Low**	**Low**	**Low**	**Low**
Artifact diversity		**Low**	**Low**	**Low**	**Low**	**Low**	High	**Low**
Utility		**High**	**High**	**High**	Low	Low	Low	**High**
Use wear		**Low**	**Low**	**Low**	**Low**	High	**Low**	**Low**
Distance to raw materials		**High**	**High**	Low	Low	**High**	Low	Low
Distance to subsistence resources		**Variable**	n/a	**Low**	n/a	n/a	n/a	**Low**
Site context		**Variable**	**Isolated**	**Kills/Camps**	**Isolated**	**Isolated**	**Isolated**	**Kills/Camps**
Other	*Red Ochre*							
	Specialized Tools		Yes					
	Human Remains							
	Landmarks	**Yes**		**Yes**		**Yes**		**Yes**

*Attributes in bold face correspond to expectations.

Artifact diversity in insurance caches is predicted to be low, as the cache is not expected to represent a toolkit, but instead to consist primarily of early stage or unused items. The Sailor-Helton cache is the only assemblage in this group that has high artifact diversity. The Sailor-Helton cache does not technically meet the low artifact diversity criterion, but it fits the concept well. The difference between this cache and the other blade/flake-dominated caches in the group is that Sailor-Helton, in addition to consisting of blades and flakes, also includes 10 cores that, while they are indeed early stage artifacts, increase the artifact diversity.

Because insurance caches are planned, they are expected to consist of high remnant utility items. The Drake, Green, and West Bank caches bear this out; however, the Keven Davis, Pelland, and Sailor-Helton caches do not. The Sailor-Helton cache consists of a small number of high remnant utility items (10 cores) dominated by a large number of low-utility flakes and blades; the Keven Davis and Pelland caches both include some relatively small complete blades that reduce their overall remnant utility. Similarly, artifacts from insurance caches are expected to exhibit little use-wear, and this is borne out in each of the insurance caches except Pelland, in which each of the nine blades appear to have been used before the cache was deposited.

Distance to raw material sources is expected to be high for insurance caches, as they are thought to represent a planned provisioning of a landscape otherwise impoverished of lithic raw material. As measured here, this only applies to the Drake and Pelland caches; however, the average distances from the Green, Keven Davis, Sailor-Helton and West Bank caches to their raw material sources are all greater than 150 km.

Distance to subsistence resources proved difficult to measure, but for insurance caches they were expected to vary, as it would have been logical to place such caches both near resources or along routes between them. Both of the caches from Blackwater Draw, the Green and West Bank caches, are located in the immediate vicinity of camps and kills and thus appear to have been placed in the immediate area of subsistence resources. Distance to subsistence areas could not be ascertained for other caches in this group. Similarly, site context was predicted to be variable, and aside from the Green and West Bank caches, the insurance caches appear to be isolated deposits.

Because insurance caches are modeled to have been placed at various locales around the landscape, it is expected that they might often be associated with landmarks to aid in their retrieval. Such landmarks might not be as important for load exchange or seasonal/passive gear caches because they would more often be associated with camps or resource areas that are well known. The same is expected for afterlife caches because they were likely never intended for retrieval. Three of the six caches (Green, Pelland, and West Bank) that compare well to insurance caches are associated with potential landmarks. The two caches from Blackwater Draw are located in the draw itself, and possibly near springs along that draw. The Pelland cache is associated with a major river confluence.

Seasonal/Passive Gear Caches

Seasonal/passive gear caches represent the storage of items that are temporarily removed from the active technological system, such as the winter storage of summer hunting gear. Two caches - the Busse cache and the Franey cache - correspond most closely to expectations for seasonal/passive gear caches. Comparisons of both of these caches with the theoretical expectations for seasonal/passive gear caching are presented in Table 31.

Table 31. Comparison of Cache Attributes to Expectations for Seasonal/Passive Gear Caches.*

		Expectation	**Busse**	**Franey**
Raw material diversity		**High**	Medium	**High**
Artifact diversity		**High**	**High**	**High**
Utility		**Variable**	**Low**	**Low**
Use wear		**High**	**High**	**High**
Distance to raw materials		**Variable**	**Low**	**Low**
Distance to subsistence resources		**Low**	n/a	n/a
Site context		**Base camp**	**Isolated**	**Isolated**
Other	*Red Ochre*		Yes	
	Specialized Tools	**Yes**	**Yes**	
	Human Remains			
	Landmarks			Yes

*Attributes in bold face correspond to expectations.

As portions of working toolkits, the contents of seasonal/passive gear caches are expected to reflect the state of that toolkit at the time of deposition. Therefore, raw material diversity is expected to be relatively high, as it is with the Franey cache. Raw material diversity in the Busse cache is as expected given the number of items it contains. Artifact diversity for both caches is high, as expected for seasonal/passive gear caches.

Because they are subsets of working toolkits, seasonal/passive gear caches are expected to have variable degrees of remnant utility and high incidences of use wear. Both the Busse and Franey cache are characterized by relatively low remnant utility (though like the Sailor-Helton cache, Busse contains a few high utility bifaces and a greater quantity of low utility flakes and blades). Evidence for use in both caches is high, indicating the most of the artifacts had seen some use as tools before being cached.

Distances to raw material sources are predicted to be variable for seasonal/passive gear caches, but they are expected to be found close to subsistence resource areas that correspond to their use. In the case of both the Busse and Franey caches average distances to raw material sources are relatively low, which is not unexpected given the fact that they were apparently not specifically designed to move raw material to resource-poor areas. Distances to subsistence resources could not be ascertained for either cache.

The expected location for seasonal/passive gear caches would be at archaeological sites that were probably base camps. However, both the Busse and Franey caches appear to be isolated deposits. Specialized tools are expected, and in the case of the Busse cache there is one present, an abrader. However, this abrader would be useful for all lithic reduction activities that presumably would be ongoing during any season.

Load Exchange Caches

Load exchange caching occurs when some expendable portions of the toolkit are left behind in order to increase the ability to carry some recently acquired resource. For example, portions of a butchering kit might be stashed in order to free up space to transport portions of a kill. Four caches - Anadarko, Crook County, de Graffenried, and Watts - correspond best to expectations for load exchange caches (Table 32).

Like seasonal/passive gear caches, load exchange caches represent a portion of an existing toolkit and thus are expected to reflect its use state. Raw material diversity is expected to be high, and artifact diversity low. All four caches meet these expectations, with the exception of the de Graffenried cache. Raw material diversity was consistent with expectations given the number of items in that cache, but can probably be considered low (it is made entirely of Edwards Plateau chert). Given its proximity to the source and the typically more homogenous raw material composition of Southern Plains lithic assemblages, this is not surprising. Artifact diversity is low for each of the caches, suggesting that in each case a specific and limited array of tools was left behind.

Table 32. Comparison of Cache Attributes to Expectations for Load Exchange Caches.*

		Expectation	**Anadarko**	**Crook County**	**de Graffenried**	**Watts**
Raw material diversity		**High**	**High**	**High**	Medium	**High**
Artifact diversity		**Low**	**Low**	**Low**	**Low**	**Low**
Utility		**Variable**	**High**	**High**	**High**	**High**
Use wear		**Variable**	n/a	**High**	**Low**	n/a
Distance to raw materials		**Variable**	**Low**	**High**	**Low**	**Low**
Distance to subsistence resources		**Low**	n/a	n/a	n/a	n/a
Site context		**Activity Areas**	Isolated	Isolated	**Quarry**	Isolated
Other	*Red Ochre*			Yes	Yes	
	Specialized Tools					
	Human Remains					
	Landmarks		Yes			Yes

*Attributes in bold face correspond to expectations.

Remnant utility and evidence of use are expected to be variable among load exchange caches as they may include items in different stages of their useful lives. In opposition to expectations that it should be variable, remnant utility was found to be consistently high among each of the caches in this group. This pattern suggests that either it was not necessarily the least useful items in a toolkit that were jettisoned to make these caches, or that all of the items that were deemed appropriate to cache were characterized by relatively high remnant utility.

Distance to raw material sources is expected to vary, because it should not have been a strategic factor in the placement of load exchange caches. Average distance to raw material sources was low for the Anadarko, de Graffenried, and Watts caches, and high for the Crook County cache. While distance to subsistence resources is expected to be low, it could not be measured for any of these caches.

Because load exchange caches are modeled to have been put aside in favor of some other resource, they are expected to occur adjacent to or within activity areas. This appears to be the case with the de Graffenried cache, which was reported to have been found adjacent to a quarry and camp site. The bifaces in the de Graffenried cache may have been jettisoned in favor of some other raw material or some subsistence resource that was deemed more import to transport. The Watts cache was placed adjacent to a playa, and may have been left behind in favor of transporting some subsistence resource procured there.

Two of the load exchange caches, the de Graffenried and Crook County caches, contain artifacts with red ochre, which (as discussed in Chapter 8) is commonly associated with cached bifaces.

Afterlife Caches

Afterlife caches are perhaps the most poorly defined type with regard to perceived function, but they are modeled as accompanying the dead. The Anzick cache is the only Clovis assemblage known to be associated with a human burial, and so has served as the point of reference for both afterlife caches and Clovis burial practices. Because it is not known if they are intended to have been used by the dead in the afterlife, to serve as an offering to the dead, to have served as a blueprint for stone tool making, or some other purpose, the expectations for this type of cache are relatively imprecise. Furthermore, the configurations of these caches may not be constrained by the same economic considerations as were other caches, allowing for greater variation among attributes.

Despite the expected lack of rigid constraints on variation, the Anzick, East Wenatchee, Fenn, and Simon caches compare well with both expectations for afterlife caches (Table 33), and with one another.

Table 33. Comparison of Cache Attributes to Expectations for Afterlife Caches.*

		Expectation	***Anzick***	***East Wenatchee***	***Fenn***	***Simon***
Raw material diversity		**High**	Medium	**High**	**High**	**High**
Artifact diversity		**High**	**High**	**High**	**High**	Low
Utility		**Variable**	**High**	**High**	**High**	**High**
Use wear		**Variable**	**High**	**High**	**Low**	**Low**
Distance to raw materials		**Variable**	**High**	**Low**	**Low**	**High**
Distance to subsistence resources		**Variable**	n/a	n/a	n/a	n/a
Site context		**Variable**	**Isolated**	**Isolated**	**Isolated**	**Isolated**
Other	*Red Ochre*	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
	Specialized Tools				Yes	
	Human Remains	**Yes**	**Yes**			
	Landmarks		Yes			Yes

*Attributes in bold face correspond to expectations.

Despite the almost complete lack of information concerning Clovis beliefs and burial practices, the expectations for afterlife caches proceed from at least one important assumption. It is assumed here that burials are not the result of much advance planning, and thus the items in an afterlife cache are the products of materials that are already being carried by members of the group. In other words, while multiple people may contribute to the cache, the items are selected or manufactured from existing materials already in the possession of members of the group. Based upon this assumption, it is expected that afterlife caches mirror active toolkits in the sense of being characterized by high artifact and raw material diversity, with other attributes varying with the particular histories of individual items. Anzick, East Wenatchee, Fenn, and Simon each are characterized by high raw material diversity. Artifact diversity is also high for each assemblage except Simon. Simon consists entirely of bifaces in various stages of reduction and projectile points.

Though expected to vary, remnant utility was calculated to be high for each of the caches in this group. While it is possible that this happens to represent the state of toolkits among these groups at the time, it would appear more likely that this represents intentional selection of high remnant utility items to place with the cache. This suggests that it was important for the items to be useful, and perhaps valuable in the sense of utility, to the deceased. It further suggests considerable sacrifice on the part of the donor.

Despite high remnant utility, evidence for use is also high for the Anzick and East Wenatchee caches, indicating that while useful items were selected for caching, many of these had seen some use before being donated. This is not the case for the Fenn and Simon caches, for which evidence of use is low. This low incidence of use suggests that many of the items in these caches may have been specifically manufactured for the occasion.

Because economic considerations are not expected to have played a large role in the locations of afterlife caches, distances to raw material sources are expected to vary. Distance to sources is low for the East Wenatchee and Fenn caches, and high for the Anzick and Simon caches. Distances to subsistence resources could not be discerned for any of the caches in this group. While site contexts for afterlife caches are expected to vary, each of the caches in this group appears to have been isolated.

Red ochre and human remains are expected to be associated with afterlife caches. The Anzick, Fenn, and Simon caches exhibit abundant evidence of red ochre, and many artifacts appear to have been smeared with or packed in it. Red ochre does not appear to have been applied so liberally to items in the East Wenatchee cache, being limited to streaks of red ochre on some individual specimens.

Only Anzick is associated with actual human remains; where are the human remains with other Clovis caches? What was being done with the bodies? Poor preservation of organic materials in the cache locations is a possible explanation, and this may be the case for both the Simon and Fenn caches. No organic materials are associated with either of those caches. The East Wenatchee cache, however, is associated with numerous well-preserved osseous artifacts that suggest that human osseous elements should have been preserved as well, had they originally been present. If there are human remains associated with East Wenatchee, they have yet to be discovered. Another possibility is that the close association of the cache with human remains at Anzick is an exception, and that afterlife caches were not typically placed in direct association with bodies. In such a case, bodies may have been buried nearby or not buried at all. On a landscape characterized by low human population density, it is not difficult to imagine that bodies may have been left at the surface or positioned on some burial structure (perhaps similar to scaffolds and trees used historically by Native Americans on the Northern Plains), perhaps with afterlife caches buried underneath them. The association of the Anzick cache with an infant or the decision to utilize a rockshelter may actually be atypical for Clovis.

Regional Variation in Cache Function

Insurance, load exchange, seasonal/passive gear, and afterlife caches do not appear to be evenly distributed throughout the area of their collective occurrence.

Conversely, a degree of regional patterning emerges when caches are mapped by functional category (Figure 44).

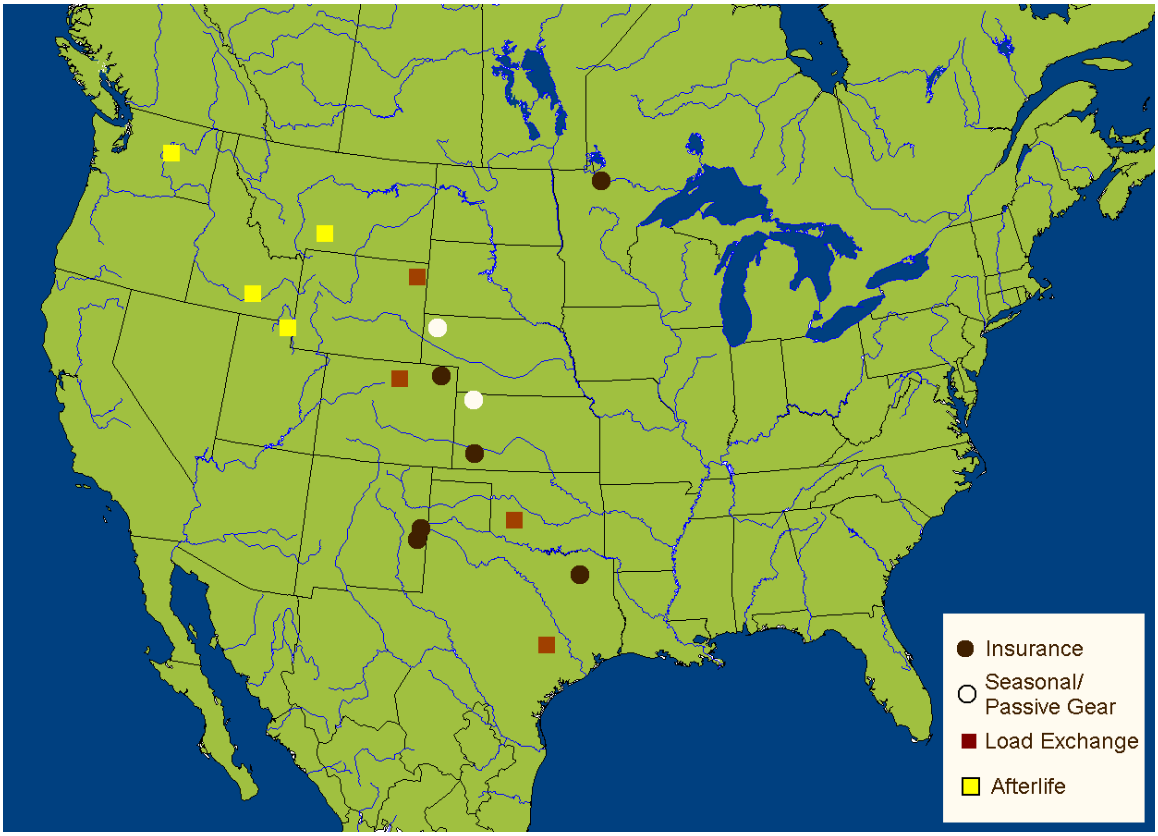

Figure 44. Distribution of cache functional categories in North America.

Four of six insurance caches are located on the Southern Plains. A fifth, the Drake cache, is located on the Central Plains but is made primarily of Southern Plains raw materials. The Pelland cache is the only insurance cache located away from the Plains. Given the patchiness of raw materials on the Southern Plains, this pattern might be expected. By definition insurance caches represent an intentional strategy for provisioning the landscape with scarce resources. These insurance caches appear to represent the provisioning of the raw material-poor parts of the Southern Plains (and perhaps Great Lakes area) landscape with raw materials, typically in the form of blades and flakes, and in one case (Drake) in the form of projectile points.

Both of the Clovis seasonal/passive gear caches are from the Central Plains states of Kansas and Nebraska. Under what conditions the bifaces, blades, and flakes of the Franey and Busse caches would be something other than a component of the active toolkit is not clear. The possibility remains that these caches represent some function other than passive gear caching (perhaps insurance or load exchange), but their contents correspond to the attributes of seasonal/passive gear cache expectations for reasons as yet unclear.

Load exchange caches occur sporadically throughout most of the range of utilitarian Clovis caches. The jettisoning of extraneous materials in favor of more critical resources may have been a common behavior among Clovis groups. Given the great size of Clovis prey, particularly mammoth and bison, the yield of a successful hunt might be expected to have required considerable effort to transport. Setting aside some part of one's possessions may have been the most parsimonious way to reduce effort expenditure.

Afterlife caches appear to be the most geographically limited category of caches. They are restricted to the Northwest Plateau and Northern Rockies, and do not overlap with the distribution of any of the other functional categories. If not the product of sampling bias, it appears that the placement of afterlife caches represents a geographically restricted behavior and may represent a unique regional burial tradition that was not characteristic of Clovis groups as a whole. If so, afterlife caches may signify regional differentiation within the seemingly monolithic Clovis tradition.

A remaining question is why Clovis caches occur where they do - only along a trajectory reaching from the Southern Plains through the Northern Plains and Rocky

Mountains, and spilling eastward into the Great Lakes area?[1] It is curious that these material storage caches occur only across a limited portion of the Clovis range. Proceeding from the assumption that most of these caches represent a solution to resource incongruities - that is, that they functioned to insure the availability of lithic raw material at or along the way to important subsistence resource areas - their limited range may indicate that such incongruities were particularly pronounced in this portion of the Clovis range. While caching lithic resources is always one option for solving resource incongruities, the risk of the loss of material (through failure to return, inability to relocate the cache, theft of the cache, etc.) may be tolerable only above some threshold of incongruity in the local environment. A particularly patchy late Pleistocene resource structure in the Southern Plains region may have exceeded such a threshold. The Pelland cache from Minnesota suggests that the northern Great Lakes area may have at some time exceeded this threshold as well. The environments of other areas of the North American continent, including the Middle Atlantic, Southeast, and the far Southwest, where cache assemblages are thus far conspicuously absent may have remained below this hypothetical threshold throughout the Clovis time period. In other words, the distributions of lithic raw material resources and subsistence resources in these areas may have been more uniform, or at least consistent enough that material caching was not warranted.

[1] This latter pattern would be strengthened by the inclusion of such assemblages as Hatt, a biface cache from Wisconsin (Thomas Loebel, personal communication 2002), Rummells-Maske, a fluted point cache from Iowa (Morrow and Morrow 2002), and the Lamb site, a collection of fluted points from New York (Gramly 1999). These assemblages were not included in this analysis due to uncertainty as to their being associated with Clovis, or in the latter case, their interpretation as a cache.

Form of Transport

Earlier in this dissertation it was proposed that caches provide a snapshot of the active toolkit that is not available through the study of kill, camp, or quarry assemblages alone. Cache assemblages preserve examples of artifacts in their useful state, as opposed to artifacts that have been discarded because they were worn out, broken, or lost. As such, these artifacts provide a unique window into the forms in which lithic raw material was transported.

Blades, Flakes, and Cores

Flakes and blades are the first and second most common artifacts cached by Clovis hunter-gatherers, together accounting for 60 percent of artifacts from all caches combined (Table 34). It is not immediately clear if cores were transported to the cache location and flakes and blades removed immediately prior to being cached, or if they were transported to the cache location already as flakes and blades. Though inconsistencies in data collection limit the ability to more systematically explore this issue, observations made during data collection suggest that there are differences in the transport histories of flakes and blades.

Table 34. Frequency of Lithic Artifact Forms from All Clovis Caches Combined.

Form	*n*	%
Bifaces	178	27.7
Points	64	10.0
Cores	16	2.5
Blades	185	28.8
Flakes	199	31.0
Total	642	100.0

Areas of polish or abrasion were noted on the interior faces of several blades (wear on adjacent to margins is not taken into account, as this might relate more to use than transport). Experimentation has demonstrated that transport is capable of producing characteristic patterns of polish and abrasion on the surfaces of artifacts, and that these patterns compare favorably with those observed on prehistoric specimens from Paleoindian contexts (Huckell et al. 2002). For transport wear to form on the interior surfaces of blades requires that they were transported in that form, as opposed to having been carried to the cache location in the form of a core. Polish or abrasion that compares favorably to experimentally generated transport wear was observed on the interiors of four blades, one each from the Green cache (No. 9), the Fenn cache (No. 152), the Keven Davis cache (No. 10), and the Sailor-Helton cache (No. 181), suggesting that prior to being cached, these items were transported as blades as opposed to blade cores. The nearly complete lack of blade cores in any cache, kill, or camp site investigated here further supports the idea that blades were the primary object of transport, and blade cores were not typically transported long distances. Only the Anadarko cache contained blade cores. The site type where blade cores do commonly occur in abundance is quarries (e.g., Gault, TX [Collins 1999a] and Adams, KY [Sanders 1990]), suggesting that blades may have been produced in bulk at quarries and select ones then carried away to be used or cached at other locations.

The patterns observed for blades do not hold true for flakes. While exterior wear is common, damage comparable to transport wear was noted on the interior surface of only one flake from a cache context. The large and extensively retouched flake tool from the Crook County cache (No. 201) exhibits an area of polish on its interior. Other flakes, both those derived from generalized cores and from bifaces, did not exhibit transport wear on their interiors, suggesting that they were not transported in the form in which they were cached. It is unsurprising that biface thinning flakes were removed from bifaces, which were the transported objects. Generalized cores, however, appear relatively bulky and inefficient for transport compared to bifaces. Despite this, flakes from generalized cores seem to be derived from transported cores as well. This suggestion is supported by the presence of generalized cores in small frequencies in several assemblages investigated here. Generalized cores account for just under 3 percent of cached artifacts (Table 34), and occur in the Sailor-Helton cache (n=10), the Busse cache (1), and the Franey cache (1), as well as one each at Blackwater Draw, Murray Springs, and the Sheaman site. Taken together, it appears that while blades were typically transported as such, flakes were typically derived from bifaces or generalized cores that were objects of transport.

Bifaces

Clearly, bifaces were a preferred form for transporting raw material, and their frequency in cached assemblages reflects this. Bifaces account for around 27 percent of cached artifacts (Table 34). Cached bifaces range in size from the small (192 x 94.9 x 14.2 mm) chert biface in the Anzick cache (No. 47) to the seemingly outsized (343.4 x 175.0 x 24.3 mm) quartzite biface from the Watts cache (No. 76.29.2). The largest bifaces - such as those found in the Watts, Fenn, Anzick, Busse, and Crook County caches - are of such great size that it is tempting to view them as unusual, perhaps specially manufactured for the cache. However, when compared to the total array of bifaces from caches, the largest bifaces represent the upper end of a continuous (albeit skewed) distribution (Figure 45). Biface sizes, for reasons that will become clear below, are represented in this examination by maximum width.

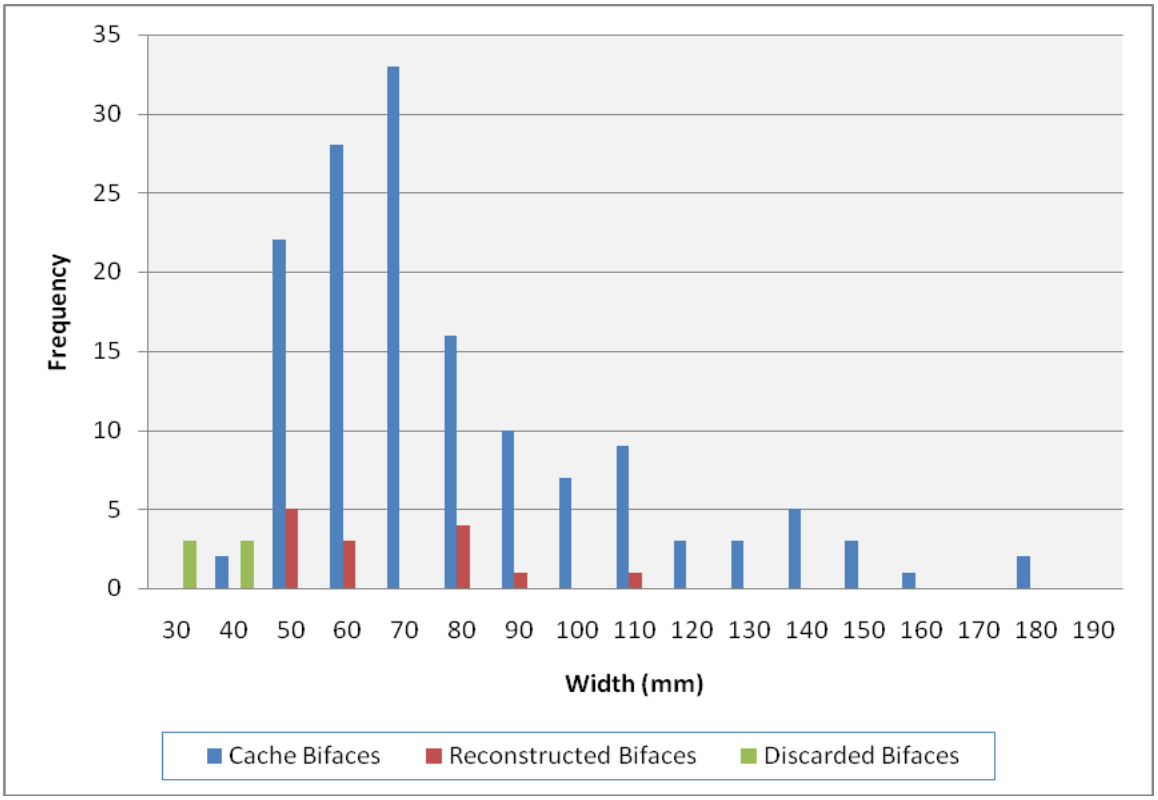

Figure 45. Distribution of biface widths for cached bifaces, reconstructed bifaces, and discarded bifaces.

Bifaces equal in size to the largest ones found in caches are not known from non-cache Clovis sites. This should not be a surprise. Because camp and kill sites consist of artifacts that were discarded due to being worn out, broken, or lost, bifaces of such high utility should not be expected to have been discarded or abandoned. It should more reasonably be expected that large bifaces would have been brought to the site, perhaps reduced as needed, and then transported away from the site. Only those bifaces that retained little or no utility would have been abandoned at a site. Indeed, complete bifaces recovered from kill and camp sites investigated here are substantially smaller (Figure 45; Table 35).

Table 35. Complete Bifaces Discarded at Kill and Camp Sites.

Site	Catalog #	L (mm)	W (mm)	Th (mm)
Blackwater Draw	EL114	58.15	32.1	9.35
Blackwater Draw	EL203	41.99	31.36	9.3
Blackwater Draw	G75	81.51	43.37	16.52
Murray Springs	A47,170	95.2	41.41	13.66
Murray Springs	A-33,923	63.3	35.35	8.76
Murray Springs	A33,918	90.07	40.02	12.96

Overshot flakes and distally refitting flakes (Figure 46) at kill and camp sites provide evidence of bifaces that passed through the site without being left behind (Huckell 1999, 2007). If complete bifaces recovered from kill and camp sites represent artifacts deemed not to be worth keeping, overshot and refitted flakes may provide the only indications of the sizes of bifaces in the active toolkits of the site occupants. Though it is in many cases not entirely possible to know the orientation of the flakes relative to the biface from which they were removed, given the typical pattern of biface reduction, the measures from these reconstructed bifaces can be expected to most often correspond best to widths. Because the complete biface cannot be known, these measurements can best be considered minimum widths. In order to further ensure that a valid minimum width of a reconstructed biface is measured, the measurement is taken as nearly as possible to perpendicular to the two biface edges represented on the refit (platform-to-platform) or overshot (platform-to-margin), and does not necessarily represent the longest axis of the specimen. Reconstructed minimum widths of bifaces from kill and camp sites are presented in Table 36.

Figure 46. Refitted flakes from the Sheaman site (No. OA444). Such refitted flakes provide proxy measures for the widths of bifaces reduced at the site.

Table 36. Reconstructed Bifaces from Kill and Camp Sites.

Site	Catalog #	Basis for Reconstruction	W(mm)
Murray Springs	A-43019	overshot flake	86.17
Murray Springs	A-43051	refitted flakes	62.32
Murray Springs	A-44412	refitted flakes	49.92
Murray Springs	A-45078	refitted flakes	47.84
Murray Springs	A-45137	refitted flakes	47.18
Murray Springs	A-45196	refitted flakes	45.64
Sheaman	8	refitted flakes	59.34
Sheaman	E1055	refitted flakes	73.83
Sheaman	E1059	refitted flakes	106.69
Sheaman	OA442	refitted flakes	73.41
Sheaman	OA443	refitted flakes	43.84
Sheaman	OA444	refitted flakes	75.88
Sheaman	OA445	refitted flakes	57.22
Sheaman	OA447	refitted flakes	58.95
Sheaman	OA448	refitted flakes	75.89

In addition to bifaces from caches, which are argued to represent useful bifaces in the active toolkit (perhaps deposited at relatively early stages of their use lives), and bifaces from kill and camp sites, which represent artifacts removed from the active toolkit through discard, these reconstructions provide measurements for a third group of bifaces. Like cached bifaces, this third group represents useful bifaces in the active toolkit. Unlike cached bifaces they were retained and transported away from the site, most likely to undergo continued reduction at other locations before eventual discard. These three groups are summarized in the Table 37.

Table 37. Comparison of Mean Widths for Biface Groups.

Sample	Site Type	N	Mean Width (mm)
Cached bifaces	Cache	144	74.72
Discarded bifaces	Kill/Camp	6	37.26
Reconstructed bifaces	Kill/Camp	14	64.41

If this scenario is correct (i.e., if cached bifaces only appear unusually large because they are utilized but not deposited at other types of sites) then we should expect reconstructed bifaces to be similar in size to those from cache contexts. Furthermore, we should expect discarded bifaces from kill and camp sites to be significantly smaller than both cached bifaces and reconstructed bifaces from kill and camp sites. These expectations appear to be borne out, as shown in Figure 45. Due to the small sample sizes for both discarded and reconstructed bifaces, a single-factor ANOVA test is used to make these comparisons. ANOVA tests the hypothesis that each sample is drawn from the same population by comparing within-group variation to between-group variation. Results indicate that cached bifaces and reconstructed bifaces from kill and camp sites are statistically indistinguishable at the 0.05 confidence interval ($p=0.197$, $F=1.676$, $F_{crit}=3.902$). Conversely, discarded bifaces from kill and camp sites are statistically distinguishable at the 0.05 confidence interval from both bifaces from caches ($p=0.0002$, F=9.811, F*crit*=3.905) and reconstructed bifaces from kills and camps (p=0.0002, F=12.42, F*crit*=4.414).

These results support a model in which large Clovis bifaces such as those seen in caches are not technological anomalies, but instead represent regular, perhaps even typical, early stage bifaces carried by Clovis groups (Wilke et al. 1991). They are not recovered from kill or camp sites simply because they were too useful to be discarded. Large tools made on biface thinning flakes that have been recovered from both caches and kill and camp sites lend further support to this model. Some of the variation in biface sizes from caches (and from reconstructed bifaces from kill and camp sites), likely represents varying degrees of reduction that the bifaces have undergone. In other words, the largest bifaces probably represent bifaces that are at the very beginning of their use lives. Without a doubt, maximum biface size is also restricted by raw material characteristics (e.g., maximum piece sizes, degree of homogeneity, etc.), and some upper limit for what can be transported with reasonable ease. The largest bifaces may provide the best examples of that upper size limit.

The Clovis Toolkit

Taken together, these observations provide some insight into the configuration of a Clovis toolkit in transport. The variation in cache composition and function suggests that no single cache necessarily represents a "typical" Clovis toolkit. As might be expected, the items carried by a Clovis hunter-gatherer probably varied by circumstance, and perhaps by season. Patterns of both cache contents and the occurrence of transport wear do indicate that to varying degrees the transported toolkit might consist of some combination of bifaces of various sizes, including very large ones, projectile points, blades and blade tools, generalized cores, and occasional flakes, particularly those serving as tools. Unmodified flakes and blade cores appear to have been transported with less frequency. These patterns stand in sharp contrast to assemblages recovered from Clovis kill and camp sites, which (using Murray Springs as a representative example) consist primarily of unmodified flakes (99.56%) and far lesser amounts of flake tools (0.16%), projectile points (0.13%), blades (0.09%), bifaces (0.05%), and cores (0.01%).

The Economic Value of Clovis Caches

One issue that remains unclear is the relative economic value of Clovis caches. What do they represent in terms of raw material needs? What degree of planning on the part of those who placed them do they reflect? In other words, just how useful were they to bands of Pleistocene hunter-gatherers whose economy was largely reliant upon stone tools? In Chapter 2 it was argued that Clovis people might best be considered to have been generalized foragers, but that their movements and planning, particularly in the western United States, were primarily guided by the pursuit of large mammals. One way of gauging the economic value of caches is thus to consider them in relation to the material costs of known subsistence activities (i.e., killing and processing bison and mammoth) with the goal of estimating how many such events an individual cache might provision. It should be emphasized that there is no assumption that all caches were intended for some use related to killing or butchering Pleistocene megafauna. The procurement and processing of meat, however, are critical activities for which we have clear archaeological examples, and these activities provide an empirically known baseline with which to compare caches.

The cost, in terms of lithic raw material, of making a kill and carrying out the associated processing and camping activities can be estimated utilizing lithic tool and debitage data from Clovis kill and camp sites. These costs are calculated in terms of total weight and weight by artifact class. Each cache is then examined in relation to these costs to provide a measure of its economic value relative to the raw material requirements of Clovis hunting.

Calculating Cost Per Kill

In order to make such comparisons, the material costs of a kill can be measured in terms the amount of lithic raw material expended at non-cache Clovis sites. Artifacts recovered from the kill sites examined here provide six reasonably discrete examples of Clovis kills. Four mammoth kills (El Llano Dig No. 1, MI-MIV) and the associated artifacts are provided by Blackwater Draw. Whether each mammoth represents a separate kill event remains uncertain, but they are treated here as separate kills. Murray Springs provides an example of a mammoth kill (Area 3) and a bison kill (Area 4), which are here also assumed to represent separate events. This investigation proceeds as if all artifacts from each of these sites were recovered and collected, a dubious assumption in each case if only for the fact that the entire site has not been excavated, and parts of Murray Springs have been lost to erosion. Still, each example can be thought of as providing a minimum estimate of the lithic raw material costs associated with a kill.

Raw material was of course not lost in bulk, but was lost in a variety of forms. Thus it is useful to examine not only the total raw material lost, but the amount lost in the form of tools such as projectile points, bifaces, cores, blades, and flakes. In this way, more specialized caches (for example, the Drake cache) can be compared to raw material costs specifically in the form of projectile points. Further, because many artifacts can be refurbished and used repeatedly, simply measuring the number of artifacts lost in the act of killing and processing might be misleading. For example, the possibility (if not probability) exists that serviceable points and other tools were recovered from kills when possible. In the case of broken but reparable projectile points, non-reparable portion is discarded, but the reparable portion is not. For this reason, raw material loss is measured by weight rather than by count.

While estimating the loss of material by artifact classes is relatively straightforward, flakes found at kill and camp site present a unique problem. The results of transport studies (above) indicate that flakes were not commonly transported, but instead were removed as needed at an activity area. It follows that the raw material expended in the form of flakes at kill and camp sites most likely does not reflect the direct loss of flakes from the toolkit, but instead reflects the loss of mass from cores and bifaces in the toolkit. Thus, the cost of raw material measured in the form of flakes is more appropriately applied to weight lost from transported bifaces and cores.

Because an analysis of each individual flake from the kill and camp sites in this study is not feasible, the proportion of raw material in the form of flakes to be applied to bifaces and to generalized cores is estimated based upon a simplified analysis of platforms on debitage from the Sheaman site. Every piece of debitage exhibiting a platform (n=838) recovered from the Sheaman site was analyzed. Debitage was partitioned based upon platform type and degree of lipping present. These characteristics are foremost among a suite of attributes found to be useful for distinguishing generalized core from bifacial reduction at the Murray Springs (Huckell 2007). Sheaman debitage that exhibited dihedral or faceted platforms and lipping was identified as resulting from biface reduction. Debitage that exhibited cortical, simple, or dihedral platforms and no lipping was identified as resulting from generalized core reduction. Debitage that exhibited other combinations of these attributes was not taken into consideration. Of the 675 flakes that fell into these two categories, 82% were identified as resulting from bifacial reduction and 18% were identified as generalized core reduction. Raw material recovered from kills and camps in the form of flakes is applied to weight loss estimations for bifaces and generalized cores proportionately based upon this rough estimate.

Table 38 presents the amount of raw material lost at the six kills examined here. It should be noted that this table reflects only those artifacts associated directly with the animals. Specifically, clusters of debitage from tool manufacture and resharpening found away from the animals in Murray Springs Areas 3 and 4 are considered here to be associated with processing, and are assigned to the weight totals for the camp.

Table 38. Lithic Raw Material Weight (g) by Artifact Class Recovered From Kills at Blackwater Draw and Murray Springs.

Kill Site	Points	Bifaces	Cores	Blades	Total
BWD MI	1.9	21.5	4.7	33.4	*61.6*
BWD MII	0.0	3.8	0.8	161.3	*165.9*
BWD MIII	0.0	0.0	0.0	4.8	*4.8*
BWD MIV	99.2	103.9	13.3	76.5	*292.9*
BWD MI-MIV*	35.6	93.3	9.1	32.1	*170.1*
MS Bison	128.7	154.4	6.5	42.5	*332.1*
MS Mammoth	18.4	58.7	6.4	14.0	*97.5*
Total	*283.7*	*435.7*	*40.8*	*364.6*	*1124.8*
Average	*47.3*	*72.6*	*6.8*	*60.8*	*187.5*

*uncertain provenience, but incorporated into calculation of averages.

Not all artifacts necessary for making a kill are deposited with the carcass. For example, projectile points are noticeably absent from Mammoth II and III from Blackwater Draw. In many cases artifacts (particularly projectile points) may be recovered for reuse, and in other cases artifacts may be taken to the associated camp along with parts of the kill. This latter problem is overcome by considering the combined loss of material from a kill and a camp.

The raw material costs associated with making a kill are minimal compared to those associated with butchering and processing the animal. Aside from initial skinning and butchering, much of this processing can be expected to have taken place in a processing area or camp located nearby. In addition to processing the kill, daily subsistence and living activities as well as equipment repair and manufacture probably took place at the camp. Thus, the cost per kill in terms of lithic raw materials would be grossly underestimated if only the kill itself were taken into consideration.

Camps are associated with Blackwater Draw, Murray Springs, and the Sheaman site. The Sheaman site is interpreted as a camp and may or may not once have been associated with a kill. The bison and pronghorn elements recovered at the site suggest that it may have been. The Murray Springs camp area (Areas 6 and 7) was most likely occupied at least twice, assuming that the mammoth and bison kills were separate events; however, if so, the components are indistinguishable from one another. For this reason, Murray Springs is presented as a single camp, but in the process of estimating raw material costs it is counted as two camps (in other words, the totals are divided in half, and averages are calculated as if there are two Murray Springs camp assemblages). In addition, as indicated above, tool sharpening and manufacturing clusters from Areas 3 and 4 are reassigned to the camp assemblage. The Clovis camp area at Blackwater Draw, the North Bank, is not included in the examination for two primary reasons. First, it is not clear to which or to how many of the kills it may relate. Second, the excavation and recovery methods used for excavating the area are not entirely clear. Table 39 presents the raw materials lost at the camps represented by the Sheaman site and Murray Springs.

Table 39. Lithic Raw Material Weight (g) by Artifact Class Recovered From Camps at the Sheaman Site and Murray Springs.

Camp Site	Points	Bifaces	Cores	Blades	Total
Sheaman	16.9	1208.8	616.0	4.8	*1846.5*
Murray Springs	95.4	21190.4	4727.3	228.5	*26241.6*
Total	*112.3*	*22399.1*	*5343.4*	*233.3*	*28088.1*
Average*	*37.4*	*7466.4*	*1781.1*	*77.8*	*9362.7*

*average is calculated as if Murray Springs represents two camps.

Table 40 bears out the expectation that camping and processing costs vastly more in terms of lithic raw material than the kill itself. Camp site activities require an average of 9,363 g of raw material, compared to an average of 188 g required for the kill. Projectile points, as expected, constitute a far greater proportion (25%) of total raw material loss at kills than they do for camps (0.4%). Perhaps more surprisingly, blades also constitute a far greater proportion (32%) of expended raw material at kills than at camps (0.8%), suggesting that in these cases blades may have seen more use as cutting and primary butchering tools than as hide scrapers or other secondary processing tools. Conversely, the reduction and use of bifaces accounts for the greatest expenditure of lithic raw materials by far (80%) at camps, while it accounts for about 39 percent of raw material used at kills. Generalized cores appear to play a more important role at camps, where they account for 19 percent of expended raw material, than at kills (7%).

Most importantly for the purposes of this investigation, Table 40 combines the average lithic raw materials costs of kills and the average raw material costs of camps, resulting in an average cost per kill of 9,550.2 g of lithic raw material.

Table 40. Average Cost Per Kill by Weight (g) of Lithic Raw Material at Murray Springs and Blackwater Draw.

Site Type	Points	Points (%)	Bifaces	Bifaces (%)	Cores	Cores (%)	Blades	Blades (%)	Total
Kill	47.3	*25.2*	72.6	*38.7*	6.8	*3.6*	60.8	*32.4*	*187.5*
Camp	37.4	*0.4*	7466.4	*79.7*	1781.1	*19.0*	77.8	*0.8*	*9362.7*
Total (Cost Per Kill)	84.7	*0.9*	7539.0	*78.9*	1787.9	*18.7*	138.5	*1.5*	***9550.2***

Estimating the Economic Value of Caches

Though stone was certainly expended in a variety of tasks, the procurement and processing of game and the technology associated with these tasks may have been the single costliest aspect of the Clovis lithic raw material economy. The cost per kill (CPK) value provides an estimation of the average cost of a kill and associated processing in terms of raw material expended. As such it provides a baseline against which to evaluate the relative economic value of Clovis caches.

Because they are most directly related to economic issues, caches with utilitarian functions are most appropriate for comparison to the raw material costs of game procurement. Insurance, load exchange, and seasonal/passive gear caches can all be seen as utilitarian in the sense that they were presumably cached with the intention of recovering and using them at some point in the future. Afterlife caches may not have been intended for future use in the present world, and thus assigning them an economic value might miss the point (though comparison of afterlife caches to CPK values yields some interesting results, as discussed below). Table 41 presents the weight of raw material from each of the utilitarian caches and compares it to CPK values. Viewed from the perspective of total weight (not partitioned by artifact class), only the Sailor-Helton cache contains enough raw material to provision more than one kill event. Busse, Anadarko, and Watts are each capable of provisioning over 0.5 events. The remaining caches do not contain enough raw material by gross weight to provide even half of the material required to make and process a kill.

Closer examination of caches reveals that most of them do not appear to be intended to provide raw material in generalized forms, but instead appear to emphasize specific artifact classes. Thus, the total weight of raw material in the cache may not be as informative as raw material weights associated with individual artifact classes. Blades are particularly emphasized, with eight of the 12 utilitarian caches providing enough raw material in the form of blades to carry out more than one kill. Sailor-Helton, Busse, and Anadarko contain enough to blades to provision over seven kills apiece. Sailor-Helton and Anadarko also contain sufficient raw material in the form of cores to provision multiple kills. Similarly, the Franey cache contains enough blades and flakes for multiple kills. Other blade caches, including Green, Keven-Davis, Pelland, and West Bank, specifically provide raw material to provision from 1.1-4.9 kills. In addition to providing blades for multiple kills, the Busse cache contains enough weight in bifaces to provision 0.7 kills, and Anadarko to provide for 0.1 kills. Lacking projectile points and emphasizing blades and flakes, the Anadarko, Busse, Franey, Green, Keven Davis, Pelland, Sailor-Helton, and West Bank caches appear to contain raw material in forms appropriate for butchering as opposed to killing game. Hallett Hammatt (1970:141) may have had it exactly right when he referred to Anadarko as “A Paleoindian Butchering Kit.”

Table 41. Lithic Raw Material by Weight (g) from Utilitarian Caches Compared to Cost Per Kill (CPK) Estimates.

Cache	Total	Total/CPK	Points	Points/CPK	Bifaces	Bifaces/CPK	Blades	Blades/CPK	Cores	Cores/CPK
Anadarko	5727.8	0.6	0.0	0.0	564.2	0.1	1031.3	7.4	4132.2	2.3
Busse	6425.1	0.7	0.0	0.0	5120.0	0.7	983.2	7.1	321.9	0.2
West Bank	448.1	0.0	0.0	0.0	0.0	0.0	448.1	3.2	0.0	0.0
Green	678.9	0.1	0.0	0.0	0.0	0.0	678.9	4.9	0.0	0.0
Crook County	2948.2	0.3	6.0	0.1	2697.5	0.4	0.0	0.0	244.7	0.1
de Graffenried	1284.2	0.1	136.1	1.6	1148.1	0.2	0.0	0.0	0.0	0.0
Drake	505.7	0.1	505.7	6.0	0.0	0.0	0.0	0.0	0.0	0.0
Franey	1966.0	0.2	0.0	0.0	33.2	0.0	657.1	4.7	1275.7	0.7
Keven Davis	364.9	0.0	0.0	0.0	0.0	0.0	364.9	2.6	0.0	0.0
Pelland	156.5	0.0	0.0	0.0	0.0	0.0	156.5	1.1	0.0	0.0
Sailor-Helton	14619.6	1.5	0.0	0.0	0.0	0.0	982.4	7.1	13637.2	7.6
Watts	4462.6	0.5	0.0	0.0	4462.6	0.6	0.0	0.0	0.0	0.0
CPK	9550.2		84.7		7539.0		138.5		1787.9	

Seemingly large caches of bifaces, including de Graffenried, Crook County, and Watts, do not actually appear to contain substantial economic value. None of them would have been large enough to provision an entire kill, ranging instead from 0.2 to 0.6. In addition, Crook County and de Graffenried contain projectile points (with enough mass in the latter to provision 1.6 kills). The Drake cache consists entirely of projectile points, and contains enough weight in points to provision up to six kills. These four caches appear to contain raw material in forms appropriate to provisioning actual hunting rather than butchering or processing.

Perhaps the least expected result is that the blade and flake caches contain the greatest value with regard to the number of kill events they might provision. Sailor-Helton, Anadarko, and Busse are each capable of sustaining a group through up to seven kill events. The most modest blade cache, Pelland, is capable of provisioning more than one kill. The one projectile point-dominated cache, Drake, is also of high economic value, capable of providing points for up to six kill events. Caches with raw material in the form of bifaces, on the other hand, hardly make a dent in the material needs for a kill event, with only Busse and Watts capable of provisioning for even half the requirements for a single kill. While surely many cached bifaces were intended to ultimately provide projectile point performs (as discussed below), these results suggest that Clovis hunters may have been more concerned with provisioning the landscape with adequate raw materials to butcher and process kills once they were carried out, than with provisioning the weaponry systems themselves. Highly mobile groups of hunters may have typically come into an area equipped with ample hunting weaponry, but may have benefitted from the availability of caches of less easily transported material for butchering.

In comparison with utilitarian caches, afterlife caches display an entirely different pattern (Table 42). In general they are larger, capable of provisioning from 0.6 to 1.7 kills based upon total weight. More specifically, they are conspicuously heavy with regard to projectile points. Anzick, East Wenatchee, Fenn, and Simon each contain enough weight in projectile points to provision multiple kills. The East Wenatchee cache contains sufficient raw material in the form of projectile points to provision up to 21 kill events. Similarly, afterlife caches contain far greater amounts of raw material in the form of bifaces than found in utilitarian caches. Only East Wenatchee does not contain enough weight in bifaces to provision multiple kills. Conversely, raw material in the form of blades and cores is consistently underemphasized, with only East Wenatchee contributing a significant amount of material in the form of blades to a kill event. In sum, in contrast to utilitarian caches, afterlife caches are conspicuously valuable in terms of the amount of raw material they contain. Further, they conspicuously emphasize the weaponry aspect of the kill event. Both of these patterns are consistent with expectations for grave offerings and for costly signaling as is specifically proposed for the East Wenatchee cache (Buchanan et al. n.d.).

Table 42. Lithic Raw Material by Weight (g) from Afterlife Caches Compared to Cost Per Kill (CPK) Estimates.

Cache	Total	Total/CPK	Points	Points/CPK	Bifaces	Bifaces/CPK	Blades	Blades/CPK	Cores	Cores/CPK
Anzick	16640.5	1.7	182.8	2.2	15645.6	2.1	19.0	0.1	793.1	0.4
East Wenatchee	5390.9	0.6	1775.2	21.0	2663.3	0.4	105.0	0.8	847.4	0.5
Fenn	8459.1	0.9	833.1	9.8	7618.2	1.0	7.8	0.1	0.0	0.0
Simon	7973.4	0.8	309.8	3.7	7663.6	1.0	0.0	0.0	0.0	0.0
CPK	9550.2		84.7		7539.0		138.5		1787.9	

The results of this examination, assuming that it is appropriate to compare them to kill and camp sites, indicate that many caches are, perhaps surprisingly, less valuable than might be expected. Specifically, requirements for raw material in the form of bifaces are substantial enough for both kill and campsite activities that hardly any utilitarian caches put a dent in them. In other words, bifaces appear to have been so important that biface caches could only have provisioned a fraction of a Clovis groups needs. Still, it was apparently perceived to be worthwhile to cache bifaces. One reason for this might be that bifaces are useful not only as tools and sources of flakes, but they can be used to produce blanks from which other tools, including projectile points, can be manufactured (Kelly 1988). Thus, while perhaps not contributing substantially to the biface requirements for butchering and processing a kill, they might provide a means for contributing to other necessary classes of artifacts. Further, it bears keeping in mind that a given cache may represent materials belonging to an individual, and thus may have been intended to provision only a fraction of the needs of an entire group.

Considerable investment is reflected in blade and core caches, however. Several of these caches indicate advance planning to support up to seven or more anticipated kill events. These caches may represent an investment in provisioning butchering activities over hunting activities, suggesting that the former may have carried more risk with regard to raw material shortage.

Conclusions

This dissertation research has examined 22 collections of artifacts proposed to be Clovis caches. Through close inspection of artifact forms present in the collections, their technological attributes, and the contexts of their discovery, I have identified 16 collections as meeting both the criteria for a Clovis cultural affiliation and for a cache. The assemblages from Anadarko, Anzick, Busse, Crook County, de Graffenried, Drake, East Wenatchee, Fenn, Franey, Green, Keven-Davis, Pelland, Sailor-Helton, Simon, Watts, and West Bank are each found to represent Clovis caches.

The term "cache" has enjoyed vague and perhaps semantically liberal usage among Clovis researchers, and to some degree that tradition is retained here. I do not propose changing the use of this term. It is well entrenched in the literature and language, and archaeologists appear to be in agreement that the term is used to identify a collection of artifacts that was intentionally set aside (as opposed to being discarded, abandoned, or lost), regardless of doubts that some of them (afterlife caches, as they are defined here) may ever have been intended for retrieval. I do, however, propose that caches be more specifically defined with regard to functional class.

One of the fundamentally important conclusions of this research is that no *single function is sufficient to explain the existence of Clovis caches*. Clovis caches appear to have served a number of functions for those that placed them. The results of this investigation argue for a clear distinction between two primary functional classes: ritual and utilitarian caches. The afterlife cache is the single variety of ritual cache identified here. Utilitarian caches compare favorably to insurance, load exchange, and seasonal/passive gear; however, these interpretations will undoubtedly benefit from refinement with continued investigation.

Not only do caches appear to have varied in function, some geographic patterning is evident in their distributions. With the exception of Drake, all insurance caches (including Green, Keven Davis, Pelland, Sailor-Helton and the West Bank cache) are blade/flake-oriented caches, suggesting that blades were essential to some series of tasks, most likely butchering. They (with the exception of Drake and Pelland) occur mostly on the Southern Plains, a pattern that may be explained due to the patchiness of raw material sources in that region. Seasonal/passive gear caches are the least common class of Clovis caches, represented only by the Busse and Franey caches. The two caches occur in what is now Kansas and Nebraska, suggesting that this class of cache may be related to some economic condition specific to the Central Plains. The Anadarko, Crook County, de Graffenried, and Watts caches are identified as load exchange caches, probably jettisoned in favor of transporting some other resource, and occur on both the Northern and Southern Plains.

Comparison of the four afterlife caches - Anzick, East Wenatchee, Fenn, and Simon - reveals some attributes that are consistent, or at least typical, for Clovis burial assemblages. First, afterlife cache assemblages are diverse in terms of both raw materials and, in each case except Simon, in terms of artifact form. Second, while many of the items show evidence for previous use, and thus appear to be derived from one or more working toolkits, they typically are characterized by high remnant utility, suggesting that the most useful items were selected for inclusion. Other items appear to have been manufactured for the occasion. Third, afterlife caches occur in isolated contexts and are not known to occur in association with camps, kills, or other site types. The practice of afterlife caching appears to have been a component of a burial tradition limited to the northern Rocky Mountains of what is now the United States. Their distribution does not overlap with that of any other kinds of Clovis caches.

This regional variation in the functions of Clovis caches further decreases the likelihood that they were a phenomenon associated with colonization. If caches were a strategy used by colonizers to facilitate the exploration of new lands, we might expect them to be ubiquitous. After all, at some point every part of the continent had to have been explored for the first time. Instead, caching behavior appears to be an adaptation to regional conditions. The fact that the locations of caches defy prediction (as do many camp locations) indicates that we still know very little about specific Clovis land use patterns within these regions. Not only do cache functions vary geographically, but caches are only known to occur throughout a limited portion of the range of Clovis artifacts. As hypothesized above, the distribution of caches may correspond to regions that surpass some threshold of incongruity among subsistence and raw material resources, and that incongruity would be apparent only to people with prior knowledge of such areas.

Regional heterogeneity in the functions and in the distribution of caches suggests that, despite a degree of technological uniformity across the North American continent, Clovis adaptations were not uniform. Regional differentiation was occurring within the Clovis period, the process of "settling in" to local environmental conditions was underway. That this process was underway so soon on the heels of colonization bespeaks great adaptive flexibility on the part of Clovis groups, and may explain the difficulty of resolving simple questions regarding Clovis subsistence and economic patterns. As argued by Meltzer (1993), there may not have been any single adaptation that adequately describes Clovis.

An important implication of the apparent willingness of some Clovis groups to regularly invest in these storage measures is that Clovis groups not only knew the landscape well, but also knew with some certainty where they were likely to be, and what they were likely to need in the future. It has proved tempting to apply evidence of range familiarity among Clovis groups to ideas of colonization, i.e. to argue that because there is evidence that Clovis occupants of a particular site or of a particular area were knowledgeable of local conditions, that Clovis groups must not have been the original colonists; or *vice versa*, that Clovis must have been first people on the landscape because there is evidence from a particular Clovis site that the occupants were wide-ranging and did not exploit the full range of locally available resources. It is important to bear in mind that while the Clovis period lasts at least 300 years (a conservative estimate), and perhaps as much as 800 years, only the initial colonizers were new to the landscape. Assuming that the fundamental characteristics of an area can be learned in a generation or two of hunting and gathering, it follows that less than 1/10th of the Clovis period relates to initial landscape learning. Thus, while a given Clovis site may represent a group of Clovis colonizers unfamiliar with the area, it should not be expected that each Clovis site should reflect this situation regardless of whether or not Clovis was first. On the contrary, the Clovis record that reflects colonizing behavior would likely be swamped by the more abundant Clovis record of inhabitants that were familiar with the landscape. Likewise, evidence for caching behavior that suggests intimately familiarity with the landscape does not provide evidence relevant to whether or not the initial colonizers of the New World possessed Clovis technology.

Not only does early Paleoindian caching have spatial limits, but the behavior is limited in time as well. If caching was an effective solution to resource incongruity for Clovis groups in the Plains, Rocky Mountains, and Great Lakes regions, why was it not practiced by Paleoindian groups that immediately succeeded Clovis? Folsom succeeds Clovis throughout the majority of the range of Clovis caching, and yet there is no evidence for caching behavior among Folsom groups. Certainly Folsom people experienced a comparable degree of resource incongruity on this same range. What may have varied is the degree of risk that caching raw material represented. The risk of caching lies in the possibility that the materials will not be recovered - through loss, theft, or the failure to return to the cache location. The risk of loss can be expected to decrease with increasing landscape familiarity, which if anything should be greater among Folsom groups. The risk of theft can be expected to be constant, though perhaps increasing slightly with population density. Differences in the risk of not returning to the cache location might vary substantially, however, with the degree of predictability of future movements, and this predictability can be expected to be directly tied to subsistence resources. In other words, if the future distributions of primary subsistence resources (bison in the case of Folsom) were difficult to predict, then the risk of failing to return to the location of cached materials is increased. Conversely, if Clovis groups were better able to predict their future movements, as envisioned by Collins (1999), due to more predictability in their resource base, caching becomes a viable strategy. If this explanation is correct, future research should find more evidence for serial landscape use on the part of Clovis groups compared to Folsom groups. Clovis sites should more often have been reoccupied, while Folsom sites should more often show evidence for a single occupation.

The various assemblages that have come to be known as caches among Clovis archaeologists cannot be considered atypical relative to other Clovis assemblages. To put the rate of occurrence of cache assemblages in perspective, note that at least 16 such assemblages have been identified. For comparison, recent studies have identified at least 14 (Grayson and Meltzer 2002) and as many as 22 (Haynes 2002:184-185) clear kill site associations of Clovis artifacts with probiscideans, suggesting that caching (as it is inclusively defined here) might be considered as regular a part of the Clovis way of life as mammoth and mastodon exploitation.

The majority of assemblages examined here (12 of 16, representing 428 of 663 artifacts) appear to represent material storage. That these assemblages remained in place to be found in the 20th century indicates that they were not recovered. It is uncertain how many caches were made and then successfully recovered by their makers, but we can speculate with some certainty that recovery must have been the case for the great majority of utilitarian caches. It follows that vastly greater numbers of Clovis caches must once have existed and that the assemblages that remained buried until the present are but a small sample of the original population.

It is expected that Clovis caches will be identified with increasing frequency as we become more aware of them and their identifying characteristics. While many "discoveries" consist of identifying existing collections as Clovis caches, it seems inevitable that new assemblages will be discovered in place. Given the paucity of information reflecting the archaeological context of Clovis caches, it is critical that caches discovered in place are subjected to careful and controlled excavation, with attention focused upon recovering information on both the landscape and stratigraphic contexts of the assemblage, as well as on spatial associations among the lithic artifacts themselves and other items that may be associated. For assemblages identified in existing collections, efforts should be focused upon reconstructing and recording such information as well as is possible, ideally through interviews with their discovers or their descendents. With an increasing sample of Clovis caches available for analysis, progress can be made toward refining the gross categories of cache function considered here, and toward better understanding their distribution in both time and space.

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