BIFACE REDUCTION AND BLADE MANUFACTURE AT THE GAULT SITE (41BL323): A CLOVIS OCCUPATION IN BELL COUNTY, TEXAS

A Dissertation

by

WILLIAM A. DICKENS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2005

Major Subject: Anthropology

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ABSTRACT

Biface Reduction and Blade Manufacture at the Gault Site (41BL323):

A Clovis Occupation in Bell County, Texas. (December 2005)

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This dissertation is a technological study that deals with those techniques employed by the Gault Clovis people in the manufacture of both bifaces and blades. The materials studied were recovered during the 2000 and 2001 field seasons conducted by the Anthropology Department of Texas A&M University. The study involves an analysis that deals with raw material selection, blank production, reduction methods, and problems encountered, and includes a definitive description and metric calculations for each of the various artifact types analyzed. The results are then compared to similar artifact assemblages from known Clovis sites. The conclusions derived from this analysis show that the Gault Clovis people utilized a number of different strategies in both biface and blade reduction. It was found that some of these strategies, previously felt to be restricted to one reductive procedure, were connected and utilized in both procedures. In addition, it was discovered that some techniques thought to be limited to use only within the initial reduction sequence were, in fact, utilized throughout.

DEDICATION

This dissertation is dedicated to my late father, William Robert Dickens of Cincinnati, Ohio. He was a strong believer in higher education. Without his support and encouragement it would have been much more difficult for me to successfully pursue this level of education.

ACKNOWLEDGMENTS

I wish to express my thanks and appreciation to those individuals who provided assistance and encouragement of this dissertation study.

I am especially indebted to Lynne O’Kelley, James E. Wiederhold, Charlotte Pevny, and Bradley F. Bowman whose for their Herculean efforts in assisting me with the illustrations. I would also like to express my thanks to J. B. (Solly) Sollberger, William B. Carroll, Dwain Rogers, and the rest of the Belton Knap-in who were instrumental in teaching me the skills of flintknapping, an essential aspect of understanding lithic technology. I would like to thank William E. Moore for assisting with the editing of this manuscript.

This dissertation could not have been written without the encouragement of Harry J. Shafer and Michael R. Waters who served on my committee. Their interest in the Gault site and their beliefs in my abilities provided the impetus for me to complete this study. I am especially grateful to them for taking time from their busy schedules to answer my many questions and assist me with the technical aspects of this dissertation.

TABLE OF CONTENTS

Page

CHAPTER

Page

LIST OF FIGURES

Page

Page

CHAPTER I

INTRODUCTION

Archaeological sites containing abundant isolated Clovis-aged materials are rare. Recently, one such site located in southern Bell County was excavated. This site, known as the Gault site (41BL323), was extensively investigated during the summers of 2000 and 2001 by several teams under the direction of Texas A&M University (TAMU) and The University of Texas at Austin (UT). Initially, the archaeological division of UT, located at the Texas Archeological Research Laboratory (TARL) on the UT campus was given permission for a three year excavation at this site by the landowners, Rickey and Howard Lindsey. This work was performed under the direction of Michael B. Collins and Thomas R. Hester. Harry J. Shafer and Michael R. Waters of TAMU were invited to be co-directors of the excavation. The excavations consisted of two field schools and were concentrated in an area dubbed the “Lindsey Pit" in honor of the landowners who first encountered the Clovis materials. The excavations by UT archaeologists were spread out at various locations over the site and continued for a year after work by TAMU ceased. This dissertation presents the results of a technological analysis of the bifaces, blades, cores, and selected debitage recovered from the Clovis levels at the Gault site. The primary objectives of the study are (1) to determine those methods employed in the manufacture of bifaces beginning with the acquisition of the raw material to the finished form; (2) to determine the process of blade production through a study of the cores, core

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This dissertation follows the style of *American Antiquity*.

preparation, as well as the recovered blades; and (3) to evaluate what role the local raw material types and forms may have played in directing the reduction and manufacturing strategies employed in biface and blade manufacture.

The Gault Site

The Gault site is located in southwestern Bell County near the Williamson-Bell County line in central Texas (Figure 1). The site lies within a small valley encompassing approximately 140,000 square meters that borders both sides of the headwaters of Buttermilk Creek. Much of the site is clustered around a number of springs situated near the creek's headwaters and it is surrounded by low bluffs and hills composed of limestone**.** One of the varieties of Edwards chert is abundant on the slopes and tops of the bluffs and hills. This chert is often of excellent quality and exists in the form of tabular chunks and nodules. During Paleoindian through Late Prehistoric periods of Texas prehistory, people were attracted to the site because of the combination of dependable water and regional plant and animal resources.

In 2000, archaeologists from TAMU and UT conducted the first of two field seasons at the site**.** These field schools concentrated on a series of units that had been previously excavated by the UT under the direction of Michael B. Collins in 1998 and 1999. The 2000 field school excavation was located approximately 150 yards downstream from the creek's headwaters. This area is adjacent to the eastern slope of the valley and is about 75 yards from where Buttermilk Creek makes an eastern turn and parallels the main midden area of the site.

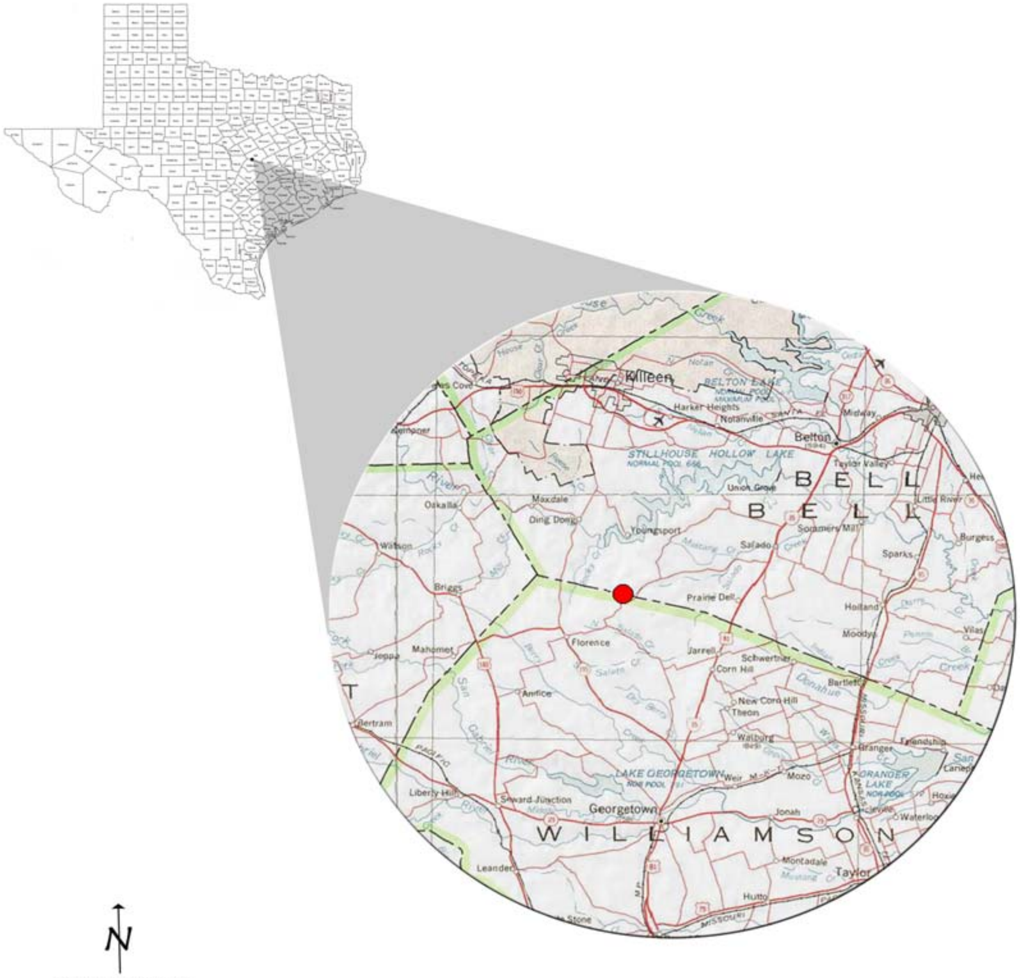

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Figure 1. Location of the Gault Site (41BL323).

The excavation area was first opened by the Lindsey's who began digging for "arrowheads" by utilizing a Bobcat in an attempt to speed up their digging activities. During this procedure, they encountered a mammoth mandible in association with a number of lithic artifacts. Thinking this would be interesting to the archaeological community, they brought these finds to the attention of Michael B. Collins at UT. This prompted his 1998 and 1999 excavations of the area, which became known as the "Lindsey Pit."

The Clovis material occurs within two geological units (Figure 2). These are Clovis soil (Geologic Unit 3a) and Clovis clay (Geologic Unit 3b). Over time, these units were sealed by overburden soils that effectively isolated the Clovis materials from subsequent mixing. Geologic units 3a and 3b overlay two older units (Geologic Unit 1 and Geologic Unit 2) formed by colluvial soils. Geologic Unit 1 is the oldest such unit and consists of limestone gravels originating from the slope. Geologic Unit 2 consists of a cherty gravel alluvium from Buttermilk Creek. These gravels formed from various types of chert that originated on the slopes and later gravitated into the stream system. The Clovis clay overlays both of these units, but the Clovis soil only comes into contact with Geologic Unit 1 near the base of the slope. Clovis technology has been discussed by many individuals (Bradley 1982; Callahan 1979; Collins 1999a, 1999b; Frison and Bradley 1999; Gramley 1995; MacDonald 1968; Painter 1965, 1974; and Sanders 1990), and their work has added greatly to our present knowledge of Clovis lithic technology. However, as new sites are discovered, it is not improbable that new ideas could yet be

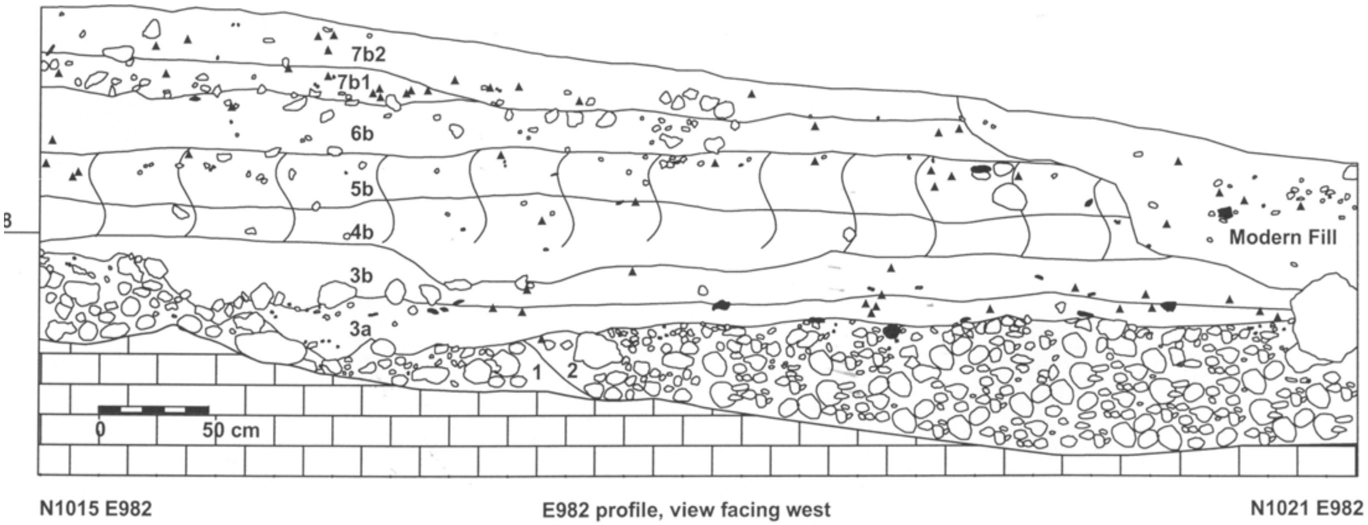


Figure 2. Geologic Profile.

developed. The large amount of Clovis artifacts recovered from Gault is unlike any assemblage recovered thus far. This site was used as a primary quarry and lithic workshop in which large numbers of artifacts, such as projectile points, blades, and other tool forms were made. Because of the large amount of reductive debris (cores, failures, and exhausted tools), this assemblage is ideal for a technological study. Therefore, a study centered on a technological analysis of biface and blade manufacture at Gault should add greatly to our understanding of Clovis lithic technology.

As mentioned above, Clovis technology has been the subject of a number of studies. These studies were based on assemblages ranging from individual projectile points (isolated finds) to large occupational areas, mostly multi-component sites. Since many of these studies were conducted on small, mixed, or often-questionable Clovis assemblages, a number of differing views concerning Clovis technology have been developed. In some cases, it was believed that a particular conclusion was considered universal within Clovis technology. Floyd Painter (1965, 1974), for example, constructed a model of the fluting process at the Williamson site in Virginia that involved the use of an anvil to support the blank from which multiple flutes were removed via indirect percussion. According to Painter, this was how all classic Clovis or Clovis-like points were manufactured and fluted.

Currently, researchers are beginning to realize that Clovis knappers were more flexible in the strategies employed for point and tool manufacture than previously accepted (Patten 1999:93). This has led to a number of ideas and models proposed for Clovis point and/or tool manufacture. Michael B. Collins (1998:138; 1999a:46), for example, suggests that biface reduction was performed on large blade-like flakes and cores. Collins theorizes that initially only a few flakes were removed via hard hammer percussion. These flakes were generally large, often terminating in overshot flakes. Platforms were prepared by the rough beveling of an edge with edge grinding increasing as thinning progressed. This same beveling procedure was performed for setting up the base for basal fluting. Final thinning was accomplished through soft hammer percussion.

This theory is typical of many current views; however, others see variations in the process of manufacturing projectile points. For example, some (including Collins) believe that overshot terminations were a primary reduction technique, especially in later stages. Bruce Bradley (1982:203-208) describes a method for Clovis biface manufacture utilizing overshot terminations which he calls "alternating opposed biface thinning." This technique is performed by removing a flake first from one margin near either end and then alternating the next removal from the opposite margin on the same face. Subsequently, the biface was turned over and the remaining flakes removed from that face also alternating each margin. Bradley believes that overshot flaking will substantially thin a biface rapidly with few problems. Also, he has refined this method and has recently stated that as few as four overshot removals would be sufficient to thin a biface (Bruce Bradley, personal communication 2000). Others, however, believe that overshot terminations are too difficult to accurately control and therefore are nothing more than a failed removal. Callahan (1979:109,111) discovered from experimental replications that overshot terminations frequently occur as a result of placing the platform too far below the median line and striking too far inward combined with excessive force and inadequate support.

Thus, he concluded overshots were the result of failure and represent unsuccessful thinning.

At the Adams site in Kentucky, Thomas Sanders (1990:34-37,40,45-47) found a flaked stone manufacturing site, evidence that supports Callahan's ideas. Based on an examination of numerous bifaces from the Adams site, Sanders discovered that overshot terminations were one of the factors causing biface failures**.** He noted that overshot numbers were not particularly high, but were constant during all reduction stages. This accounted for no more than 17% of the unsuccessful executions in any given stage (Sanders 1990:65).

If overshot terminations are not an intentional strategy, then why are they so prominent in the manufacture of bifaces? The answer may lie in the idea that Clovis knappers were intent on a quick reduction and that this was most easily accomplished through large, often thick flake removals. In removing such flakes, large platforms set low on the edge are struck with considerable force. Such a removal strategy can easily result in mistakes. Bob Patten (1999:93-94) describes a method of Clovis reduction that involves the removal of large flakes across the face of a blank which terminate near the opposite edge. Realizing possible problems in this method, he cautions that one should take special precautions to prevent overshot terminations from occurring while removing these large flakes. Like Bradley, Patten also feels that as few as three or four large flakes removed from each face are all that may be required to produce a flat even surface.

In reviewing the various Clovis reductive models, it appears that most researchers tend to agree that rapid reduction occurred with large flake removals. Therefore, if not properly accomplished, as Patten warns, the attempt to produce these flakes could easily result in an overshot termination. Thus, the result would be that a number of overshot flakes could be produced which would accumulate within the manufacturing debris. If the workshop was utilized for extended periods of time, large numbers of overshots could accumulate, and as such, be easily interpreted as the result of an intentional strategy.

Another issue that is often discussed involves the fluting process. Most researchers describe fluting as occurring during the final basal thinning process. However, an alternate view has been proposed by Callahan (1979) that involves a series of flute or channel flakes that are removed from either end of a biface during the various stages of reduction, a process he terms **“**end thinning**.”** Others have noted this strategy within archaeological contexts. Sanders (1990:33-41) noted this strategy on his Stage II-IV bifaces from the Adams site. Some bifaces having end thinning scars were also recovered from the Thedford II site along with three end thinning flakes (Deller and Ellis 1992:29).

As mentioned above, most views tend to restrict fluting only to basal thinning and preparation (Bradley 1982; Collins 1998:138; 1999a:46; Ellis and Deller 2000:6; Patten 1999; Witthoft 1952:12). Some (Ellis and Deller 2000:79: Witthoft 1952:12; Sanders 1990:25) describe a strategy involving multiple flute removals from the base that serve as "guide flakes" for the final flute or channel flake removal. The preparation of platforms for the final flute removal also vary. The prepared platforms vary, ranging from little more than a simple rounded edge, a beveled edge, to one with a carefully prepared nipple (Sanders 1990:25).

Views on the initial blank manufacture and selection also vary. As previously stated, Collins (1999a) describes initial blanks as being either large blade-like flakes or cores. At the Gault site, large blade-like flakes were being removed, but some very large thick flakes were also recovered that could also easily serve as biface blanks. At the Parkhill site in Ontario, large blades were removed from thick blocks of chert that served as blanks for fluted points (Ellis and Deller 2000:48-49). A similar strategy was also described at the Shoop site in Pennsylvania (Witthoft 1952:29).

The strategy of blank selection or production may be dependant upon material type and form. For example, the large blade removals noted at the Parkhill site may be the most effective method of blank production in dealing with large, thick, blocks of chert. However, thinner chert tabs or chert having excellent flaking qualities may be best reduced by bifacial reduction via large thinning flakes. It may be more difficult to remove large flakes from varieties of chert having poor flaking qualities, thus requiring the use of an alternate strategy. Bradley (1982:207), for example, describes such a method he calls "opposed diving biface thinning." This method involves the purposeful flaking from one edge that terminates at mid-line in a purposeful hinge. These hinges are subsequently removed from the opposite edge. It is also well known that gravels often require different reduction methods, at least during initial preparation. Therefore, the type of raw material could easily have a significant role in which Clovis reduction strategy is employed.

Another reduction strategy involves the production of blades. Blades are an accepted component of most Clovis assemblages. However, it is obvious from studies of Clovis technology that the strategy of blade manufacture is not just restricted to primary blade production, but was also applied in other reductive tasks such as end thinning, fluting, and initial blank production.

Although blades are considered a part of the Clovis lithic technology, their occurrence varies. They are more common in the South and Southeast, virtually absent in the northeast, and scarce in the western portions of the United States (Collins 1999a:4). The most inclusive study of Clovis blades was conducted by Collins (1999a). For this study, he reviewed data from 42 sites and concluded that the principal attributes of Clovis blades are minute platforms, almost no bulbs, minimal ripple marks on the interior surface, and a strong curvature.

Blades were removed from two types of cores; the conical-type and the wedge-type. At the time of the publication of his book, Collins felt that the most common form (from the Gault site) was the conical type. These have platforms that are oriented at right angles to the long axis of the core. Successive blade removals were performed around the circumference of the core, thus giving them the conical appearance. The platform angles produced by these removals average between 60E and 70E (Collins 1999a:51).

Wedge-shaped cores, however, have an acute angle between the platform and core face. They have a more narrow face due to the use of thinner or more irregular chert tabs. The platforms are multifaceted and are prepared by trimming an acute, bifacial edge. In addition, blades may be removed from opposing platforms (Collins 1999a:51). Collins also believes that the blades were removed primarily by either indirect percussion or soft hammer, especially from the conical type.

Clearly, many studies of Clovis lithic technology have been conducted at a number of sites in North America. These studies have resulted in the development of many opinions and ideas concerning the manufacture of Clovis bifaces and blades. However, the sheer size of the assemblage recovered and the fact that the layers containing Clovis artifacts were sealed and isolated from later occupations, offer an opportunity to produce a clear picture of Clovis technology, at least within central Texas if not the Central Plains. It should be stressed that the direction of the analysis was not designed to simply refute or agree with current views, but to ascertain how and to what extent any particular reductive strategy was applied at Gault. Thus, the findings presented in the following paper not only substantiate some current views, but also present a number of previously unknown strategies.

CHAPTER II

BIFACE REDUCTION

Bifaces, regardless of culture, constitute one of the more informative artifact categories available for understanding manufacturing sequences, techniques, and the use context of stone tools. Within the framework of bifacial technology are a host of multi-functional forms that range from crude expedient types to finely crafted examples. These forms are not only made from a single bifacial reduction sequence. Bifacial fragments are from flakes that have been removed and modified for an immediate need. Thus, bifaces serve in three primary roles: as cores, providing an efficient raw material source for flakes having multiple useful edges, as tools constructed for a long use-life based on resharpenable edges, and as tools shaped for preexisting hafts (Kelly 1988:719). Considerations for biface production, therefore, should include the following factors. These are raw material availability, material versatility and flexibility for tool use and manufacture; time constraints for material acquisition, and tool manufacture and portability for mobile groups (Hayden et al. 1996:10). Keeping such thoughts in mind, past cultures adapted these considerations to their specific cultural constraints and needs. This creates specific changes over time and regional variation.

Stone tools accumulate on sites due to discards that result from manufacturing failures, caching activities, artifact loss, and intentional discards resulting from normal tool use. As a result, many of these tools are left in varying states of manufacture and use enabling researchers to reconstruct individual manufacturing strategies, sequences, and use-life histories of these tools.

Conclusions derived from such studies are often based on single or multicomponent sites that often contain varying amounts of artifactual materials, rely on comparisons of sites having regional affinities or (occasionally) from isolated finds. A clear picture of specific cultural sequences and attributes, especially in multicomponent sites, are often "clouded" due to problems resulting from a lack of artifacts and/or bio-turbational and natural activities. As a result, many of the technological trends currently accepted for specific cultures are based on small, widespread, and sometimes vague samples. As new sites are found and excavated, many of the older ideas are refined or dismissed. The Clovis assemblage from Gault is unique in that it was sealed by sediments that effectively separated it from subsequent occupations. Therefore, the results of the Gault biface analysis should add significantly to our current interpretation of Clovis lithic technology.

Clovis Biface Technology

Over the past 40 years, a number of Clovis sites and artifact assemblages have been reported giving us the basis for much of our current knowledge on Clovis technology (Butler 1963; Ferring 2001; Gramley 1993; Mehringer 1988; Woods and Titmus (1985); Wilke, Flenniken, and Ozbun 1991). Clovis lithic technology is currently described as being a consistent widespread pattern that contains some regional variations, generally noted in projectile point form (Collins 1999a:45, 1999b:14-21; Kooyman 2000:108-109; Frison and Todd 1986:91-114; Morrow and

Morrow 2002:315-319; Stanford 2000:5-10; Willig 1991:92-93;). However, a literature review of Clovis lithic technology reveals that, in addition to projectile point form variations, there have been a number of different models proposed for biface reduction (Bradley 1982:203-208, 1991:369-371; Callahan 1979; Sanders 1990). Like projectile point variation, most of these models are regional differences that vary with material selection and blank production (Whitthoft 1952:464-495; Painter 1965:12, 1974:24-32; Bradley 1982:203-208; Collins 1999a:46; Deller and Ellis 1992:13-24; Ellis and Deller 2000:47-66).

Some of these variations are attributed to regional material types and/or forms having morphological constraints that only allow for specific type blanks to be produced or require alternate strategies for blank thinning (Bradley 1982:203-208, 1991:369-374; Sanders 1990:31-49) and final fluting methods (Witthoft 1952:464-495; Painter 1965:12-16, 1974:24-32; Kraft 1973; Bradley 1982, 1991; Sanders 1990; Storck 1997). Although material variation is not the only reason for creating technological changes within a single culture, it is one that can have significant implications over the direction that individual lithic reduction strategies take.

Currently, there are two primary reductive strategies accepted as part of the Clovis chipped-stone industry (i.e. bifacial reduction and prismatic blade production) (Sanders 1990, Boldurian and Cotter 1999; Collins 1999a, Kooyman 2000:109). Clovis tools are described as being made primarily from the byproducts of biface and blade manufacture (Collins 1999a:45). Usually, these two reductive strategies are considered as separate strategies. However, as the analysis of the Gault material progressed, it became increasingly clear that many of the techniques employed in blade production were also utilized in bifacial manufacture.

A new view that is gaining some acceptance is that Clovis knappers were more flexible in the strategies they employed for projectile point and tool manufacture than was previously thought (Patten 1999:93). This idea was developed from a number of models that have been proposed for Clovis reduction strategies that have been derived, not only from intensive studies of Clovis materials, but also an increased interest in flintknapping which has enabled some researchers to test these models experimentally.

Reductive Models

One of the more prominent reduction models was developed by Bruce Bradley. Based on observations made on bifaces from the Anzic (Lahren and Bonnichsen 1974) and Simon (Butler 1963) sites in Idaho and the San Jon site in New Mexico (Roberts 1942), Bradley noted a patterned sequence of reduction. His ideas were further reinforced from his analysis of flake debitage from the Sheaman site in eastern Wyoming. From these, Bradley noted a distinctive flaking process that involved a flake removal in which flakes were detached completely across the face of the biface ending in an overshot type termination. Applying this to his skill in flintknapping, he found this technique to be very effective in the thinning process (Bradley 1982:206-207; Frison and Bradley 1999:65). This has led many to accept the application of overshot termination as a primary reduction technique, especially in later stages (Collins 1998:138, 1999a:46; Kooyman 2000:109).

Through his observations, Bradley formulated two models: (1) the *alternating opposed biface thinning method* and (2) the *opposed diving biface thinning method*. The *alternating opposed biface thinning method* involves initial shaping and thinning by removing large thinning flakes in a patterned sequence. This begins with the removal of a large flake from a margin near one end of the biface. This is followed by the removal of another flake from the opposite margin near the other end of the same face. The next step is the removal of another flake from the original margin of the same face but between the first two removals. Additional flakes could then be removed from the central portion if further thinning is required. Many of these flake removals terminate in overshot flakes. This same pattern is then repeated on the opposite face (Bradley 1982:207).

Bradley realized that this pattern was not always followed. Once the biface became narrow and more regularized, a second method (the *opposed diving biface thinning method)* was employed. This method was applied near the end of the thinning process and allowed for maximum thinning without the danger of overshot terminations. In this method a sequence of flakes were removed from one margin on the same face and intentionally terminated in a hinge fracture near the mid-line of the biface. These hinge terminations were then removed by the removal of a series of flakes originating from the opposite margin. Problems in regularity increase, however, as additional flakes are removed from the same face (Bradley 1982:207).

The methods described by Bradley seem to work best when the raw material is relatively thin, such as small tabs. In addition, Bradley's model obviously does not involve reductive stages other than switching from the *alternating opposed biface thinning* technique to the *opposed diving biface thinning* technique after the biface was narrowed and regularized (Bradley 1982:207); nor, does he address cortical removal.

This is not surprising as reductive stages can be very subjective and, as such, may not reflect a true strategy or be the intention of the knapper. Muto (1971), for example, offered a reductive model he called "blank-preform-product" for Clovis-like bifaces. The analytic scheme of this model was based on a reductive process that did not involve specific stages but was dependant upon type of percussor and the diagnostic attributes of flakes and preforms (Muto 1971:48, 76-83). Regardless of whether or not the reduction process was an uninterrupted continual process, the establishment of reductive stages is very helpful in understanding the process of reduction in an orderly and organized manner. Thus, the idea of recognizing reductive stages can be very useful when analyzing the manufacturing sequences derived from thick or chunky forms of raw material.

A model utilizing reductive stages through replication experiments was developed by Errett Callahan (1979). Callahan's model was developed from his expertise in flintknapping involving a wide range of materials as well as years of studying various reductive strategies. The model consists of nine reductive stages. They begin with (1) obtaining the blank (which consists of the procurement of spalls) from large cores or the selection of a cobble, nodule, or chunk of material; (2) initial edging; (3) primary thinning stages; (4) secondary thinning stages; (5) a shaping stage he terms the "rough perform;” (6-8) three fluting stages which consist of a preparation stage and fluting of each face; and (9) ending with a retouching stage for the final edge straightening and shaping process of the fluted preform. In addition, he developed optimal size ratios for spalls and width/thickness ratios for the various reductive stages (Callahan 1979: 36-37, 154-155).

To many, nine stages seems a little excessive but, in Callahan's defense, he is describing each step within the process in an explicit manner, such as dividing each fluting sequence into a preparation stage and two removal stages. In addition, he also realized that biface reduction may be an uninterrupted continuum from start to finish with no major shifts in knapping strategy (Callahan 1979:38).

The blanks described in Callahan's model were produced from three material forms (1) unmodified raw material (utilized as is or split into more usable blanks); (2) double blanks (split pieces, chunks or nodules, split or sheared cobbles, and split cores), and (3) block cores defined by Crabtree (1972:20, 39, 55) as being conical, cylindrical, rectangular, tabular, or polyhedral. Interestingly, Callahan's illustrations (1979:43) show some of these block cores to closely resemble blade cores, albeit with wider flake scars than typical blade cores. He terms flakes removed from these cores as being "blade flakes" which resemble prismatic blades. Similarities include longitudinal ridges and prepared platforms (near parallel sides) and may be twice as long as wide, but they are much wider and longer than true blades (Callahan 1979:53). Thinning is conducted initially by hard hammer followed by soft hammer removals utilizing antler billets as thinning continues. Throughout the thinning processes, flakes are detached in lateral removals either across the face of the blank or to approximately midline.

However, when hinge or overshot terminations occurred, these were determined to be mistakes or failures rather than a purposeful intent incorporated into the thinning process (Callahan 1979:84-86, 108-112,). In addition, a process termed "end thinning," which flakes, that were often long and blade-like, were removed from both the proximal and distal ends throughout the thinning stages, was practiced. Flakes removed in this end thinning process also often failed in plunging or deep hinge type terminations. Pressure flaking was utilized in some edge straightening/thinning, platform preparation and final shaping processes and indirect percussion was preformed in some of the end thinning removals (Callahan 1979:83-153).

Although Callahan's model is based on his observations from fluted point sites, such as the Williamson and Flint Run sites, the Cattail Fluting Tradition developed by Floyd Painter (1970), and his replication experiments, it was not applied to any particular site. However, it was utilized in a recent study of the Adams site, an excellent Clovis manufacturing site in Christian County, Kentucky (Sanders 1990). Although based on Callahan, Sanders condensed Callahan's nine reductive stages to seven with Stages 0 to 5 being equivalent to Callahan, and Stage 6 condensed from Callahan's stages 6 to 9. Since Callahan did not address finished points, Sanders included a seventh stage that would represent finished points (Sanders 1990:22-23).

Although not found on the site proper, the raw material utilized at the Adams site was Genevieve chert that occurred in the form of nodules and tabular chunks. Cores are represented by a variety of forms which include block cores, spherical cores, biface cores, and miscellaneous core fragments thought to be shattered nodules. Similar thinning strategies to Callahan's model involving both lateral and end thinning processes were also noted in the Adams stages 2 through 4. Rejections and failures were attributed to step fractures, deeply hinged and overshot terminations, as well as some material flaws (Sanders 1990:33-44).

Fluting

Flutes are the single most recognizable diagnostic attribute of Paleoindian fluted point complexes. The process of fluting has been one of a great deal of study, both from actual archaeological materials and from experimental replications. As a result, numerous models have been developed.

One of the earliest models was the "Enterline" technique (Whitthoft 1952:475, 481-483) in which lateral flakes were removed from either side of the primary channel flake that served both as "guide" flakes for the removal of the central channel flake and to further thin the basal end. This technique was noted at the Adams site (Sanders 1990:4567), although considered rare, as well as at other functionally similar Paleoindian sites such as the Williamson site in Dinwiddie County, Virginia (McCary 1975:60-61, 77).

Another technique describing the fluting process was described by Floyd Painter (1974). This technique, called the “Cattail Creek Fluting Tradition,” was developed from a Clovis-like fluted point site in Dinwiddie County, Virginia. The technique is characterized by placing a preformed blank flat over the edge of an anvil of wood or stone with the basal end projecting approximately one-quarter of an inch over the edge. A sharp blow from a hammerstone was applied snapping off a small section of the basal end that was often a perfect 90E or sometimes snapping off a short hinge or flute on the opposite face from the blow. The break would occasionally snap off an inch or so from the edge severely shortening the blank. Painter (1974:24) noted such snapped-off bases present at the Williamson site.

The blank was then set upright on the anvil and a flute struck off by means of a punch held at or very near the center of the base. A second flute was removed from the opposite face if enough of the platform remained; otherwise, a new platform was prepared. The flutes removed often resembled a bottle shape in outline. When this occurred, small flutes were removed from each side of the central flute. After the initial fluting sequence, both faces of the blank were percussion flaked to further thin the blank. This obliterated all previous flake scars. At this stage, if it was thought to be too thick in the middle, it was again placed over the anvil, the basal edge was snapped off again, and the fluting process was again repeated (Painter 1974:24-28).

Although both the Enterline and the Cattail Creek Fluting techniques have been noted at several eastern Clovis and Paleoindian sites, a number of other techniques for preparing the basal edge for fluting have also been described. For example, at the Adams site, Sanders (1990:64) describes several techniques that include the formation of slight to well defined projections or nipples at or near the center of a beveled basal edge, fluting from a wedge-shaped base, or an unmodified, slightly convex base. Occasionally, multiple flutes from one or both faces were noted. It was determined that, in some cases, indirect percussion was utilized; however, the most common technique was determined to be by direct percussion.

McCary (1975:61-67) describes four techniques for preparing the basal edge and striking platform from the Williamson site. These are:

1. The technique for forming the striking platform in this method is equivalent to Whitthoft's Enterline technique.
2. The platform was prepared by simply removing a slightly beveled flake transversely across the base and grinding the entire edge. A punch for the flute removal could be placed at any point near the center of the edge.
3. The striking platform in this method was made by removing two transverse flakes from each end of the obverse face with the juncture forming the striking platform. On the reverse face two lateral flakes were removed that isolated the central flute.
4. The striking platform in this method was prepared on an oval or straight base by removing a series of small, slightly beveled flakes along the entire basal edge which was subsequently ground. A flute was removed by placing a punch at the juncture at or near the center of the edge of any two of these flakes. Fluting the reverse side was accomplished by forming a projection or semi-nipple in the approximate middle of the edge. This projection could be further isolated by removing a small guide flakes adjacent to and angling away from each side of the projection.

A method termed "piggy-back fluting" from New Jersey (Mounier et al. 1993:16-20) begins with a biface formed with a flat or lenticular surface on one face and a ridged or angular face on the other with nipples (for each face) that have been isolated and ground. A single flake is removed from the flat face and multiple superimposed flakes (primary and secondary) are removed from the ridged face.

The discussion on fluting techniques was presented to emphasize that a wide range of fluting strategies exist within fluted point industries. Although these examples are all from the eastern Paleoindian and Clovis industries, the primary difference between Eastern and Western Clovis styles is within the length and width of the flute. Long fluting scars similar to Folsom flutes are indicative of the Eastern tradition, while the flutes on Western Clovis are shorter (Patten 1999:94).

Sanders (1990:68) argued that even though the basic fluting techniques seen within Eastern Paleoindian assemblages are technologically similar, when large assemblages occur, a range of fluting techniques is evident. Sanders explains that even though Clovis knappers, such as those at the Adams site, were working under their own particular cultural tradition, they were aware of a wide range of fluting techniques from which individual knappers could utilize, on an as needed basis, to overcome some of the technological difficulties presented by individual preforms. This argument can also be used in understanding Clovis biface reduction strategies. The earlier discussion of biface reduction reviewed several of the more prominent reduction technique, such as Bradley's *alternating opposed biface thinning* and *opposed diving face* techniques and Callahan's multiple stage reduction sequence incorporating end thinning and overface flake removals that are presently considered relevant within Clovis lithic technology. It can, therefore, be argued here that Clovis knappers were also aware of a number of reduction techniques which could be applied in biface reduction and, like the variations in fluting techniques, were utilized on an as needed basis. The specific technique chosen would be dependant on a number of different factors that include material type and form or from difficulties that often occur during the manufacturing process.

Gault Bifaces

In all, four finished projectile points (three complete and one basal half) and 55 bifaces in varying stages of manufacture were recovered. Fourteen of the bifaces are whole (four were refitted from broken specimens forming two complete specimens) and 38 are fragmented.

Unless otherwise noted, all specimens utilized in this study were recovered from the Clovis soil or Clovis clay geologic units. The majority of the bifaces (N = 33) and finished points (N = 3) were found within the Clovis clay (Geologic Unit 3a) (Appendix A, Table 1). Twelve additional specimens were recovered from units where the Clovis clay and Clovis soil (geologic units 3a and 3b) were indistinguishable during excavation. These artifacts came from either geologic units 3a or 3b, but specifically where, cannot be established with absolute certainty. Ten bifaces and the fourth finished point were recovered from the Clovis soil (Geologic Unit 3b).

The method for assigning reduction stages to the Gault bifaces will basically follow the reductive sequence used by Sanders (1990:23) for the Adams site. Sanders' sequence was modified from Callahan's (1979) model that included a procurement stage and nine reductive stages. Because Callahan's model deals primarily with the reductive stages prior to fluting, Sanders felt it necessary to adapt his model to include the small number of fluted specimens recovered at the Adams site. In addition, Sanders collapsed three of Callahan's stages into one. These stages are as follows:

Stage 0. Procurement

Stage I. Obtaining the Blank

Stage II. Initial Edging of the Blank

Stage III. Primary Thinning of the Blank

Stage IV. Secondary Thinning of the Blank

Stage V. Final Shaping of the Preform

Stage VI. Fluting and Finishing the Point

Stage VII. The Finished Clovis Point.

Rather than define each of the individual stages utilized in this report here, the definitions of each will be included within the following discussion in the analysis section below.

Stage 0, Procurement of the Raw Material

At one time a variety of chert, (Figures 3 and 4) derived from one of the chert bearing units within the Edwards Formation (Banks 1990:59), covered the slopes and tops of the hills that surround the Gault site. This chert ranged in grades from those difficult to flake to an excellent grade that, in many respects, have many of the qualities of Georgetown, a high quality form (Figure 3) that also occurs in the same region (Banks 1990:60). It is this form of chert that was so attractive, not only to the Clovis peoples, but to later groups as well. However, over the last 20 years or so, modern flintknappers have combed the surrounding hills removing and spalling most of the better grade chert. Today, there is little, if any, of this chert left in an unaltered form on the site, other than thousands of flakes and small chunks left from their spalling activities. Fortunately, a survey of some of the surrounding region revealed that this chert also occurred in the near vicinity of Gault from which a small sample was obtained.

Most of the artifacts recovered from the Clovis layers of the site have been stained an orange-brown to (in some cases) a greenish-brown color from dissolved minerals present within the deep groundwaters of the creek. This staining is so prominent that it became a marker for chert found in most of the Clovis levels. It was through recently broken and damaged artifacts and pieces of chert that identification of the specific type of chert was made.

The high grade form is an opaque light to dark gray (Munsell 10YR5/1) chert that occurred mostly in thick rectangular tabs having square to occasional rounded edges. Most of the lateral edges represent old breaks created from pressures exerted from overburden deposits on the original chert layers before the chert weathered out. This chert originally formed as large plate or pancake-like tabs, thicker in the middle and rounded on their edges, within large seams of the local limestone. Overburden pressures caused these large tabs to fracture into various sized square to rectangular shaped chunks. Thus, chunks originating from the interior portions of the parent tab will have vertical or "square" edges, while those from near the edge will have one or more edges that are rounded and covered with typical cortex. Over time, the square

Figure 3. Tabular Forms of Gault Chert.

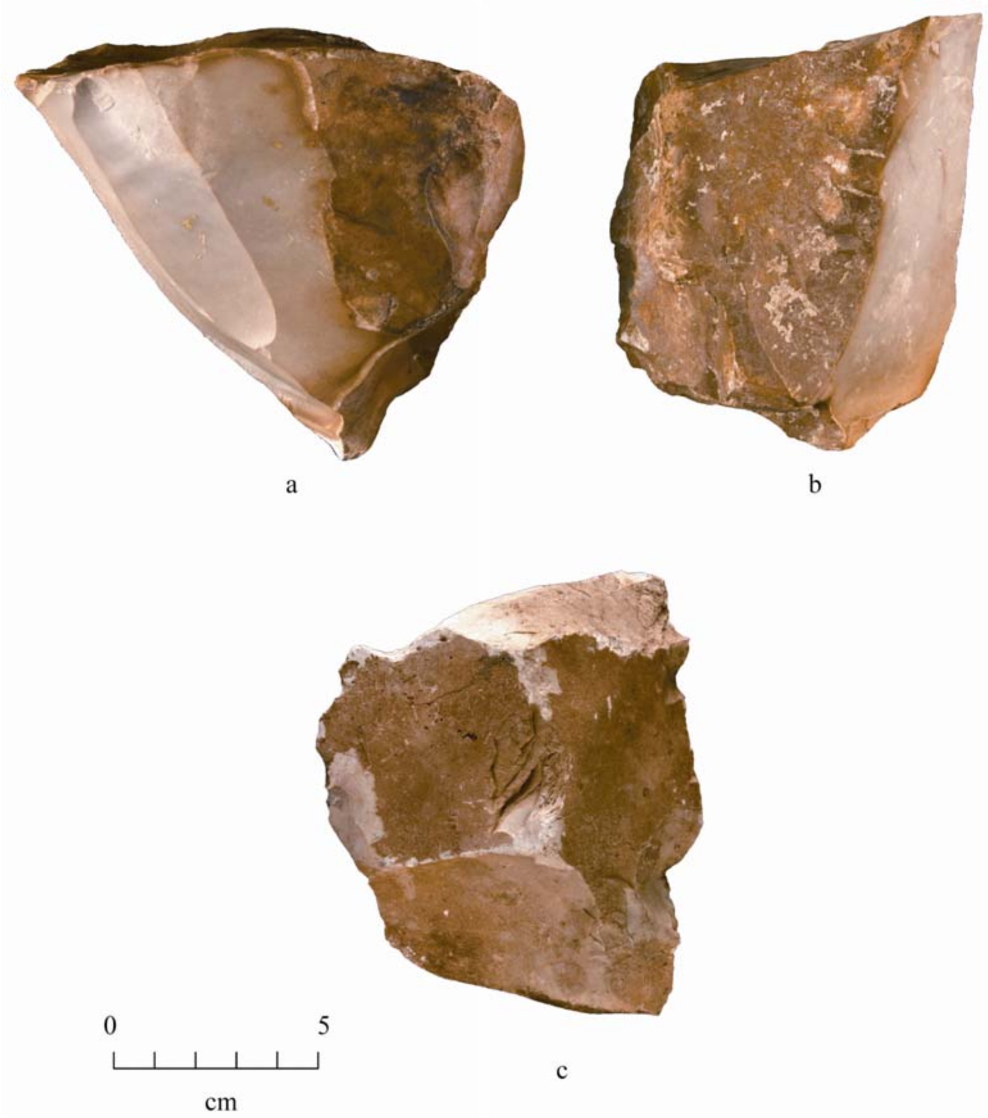


Figure 4. Stream Cobbles of Gault Chert.

edges patinated into a thick whitish patina that provides an excellent signature for distinguishing the original shapes and orientation of the tab.

Some of the chert found on the slopes has gravitated into the streamwash of the valley floor where, through the natural effects of alluvial action, they became mixed, abraded, and rounded into various sized nodules and cobbles (Figure 4). In the lower levels of the streamwash area, the surfaces of these nodules have had their surfaces stained orange-brown.

Even though some of the poorer grades of chert (those that are grainy, contain material flaws or flake with difficulty) are still very common, presently occur in fairly large tabs (some observed are several feet across), it is not exactly known what the total size range of the original preferred forms of chert were. Interviews with some of the flintknappers who actively collected chert from Gault in the 1980's indicated that the better grade forms often occurred in large and relatively thick tabs. This is supported by the many large flakes and spalls that still litter portions of the hills and slopes where they were reduced.

It was possible, however, to determine the approximate sizes that seem to be preferred for biface manufacture by the Gault Clovis knappers. This was established by measuring some of the early stage bifaces still retaining cortical edges and surfaces, the lengths of complete primary and secondary overshot flakes, and some of the larger decortication flakes.

The results from the biface measurements showed that most of the tab lengths ranged between 100 mm and 150 mm with widths between 50 mm and 85 mm.

However, some of the overshot and large flake widths were in the 140 mm and 150 mm range, suggesting that larger bifaces were also made. Although, none of these large bifaces were recovered by TAMU archaeologists, one was noted in the UT collection from Gault.

Tab thickness was more difficult to ascertain as none of the early stage bifaces have cortex on both faces. The thickest biface measured was 48 mm thick, with most between 20 mm and 25 mm. Some of the knappable sized samples collected from the near vicinity were between 50 mm and 55 mm thick. These, however, may represent a more realistic measurement of the maximum thickness used, thinner tabs would also have been utilized when found.

Stage I, Obtaining the Blank

A blank is a usable piece of lithic material of an adequate size and form for making a lithic artifact (Crabtree 1972:42) and occurs as flakes, cobbles, nodules, or slabs. Blank forms utilized at Gault were made from thin to thick tabular chunks and nodules of chert, un-modified macroflakes, and blade-flakes. Unfortunately, no definite examples of Stage I bifaces were identified from the TAMU excavation; however, a strategy for the initial biface reduction sequence was reconstructed through an analysis of the large flake debris. The usage of large macroflakes, blades and/or blade-flakes as blanks is supported by several later stage bifaces that are made on large flakes and blade-flakes.

As mentioned above, some of the flake debris was used to help reconstruct the initial reduction sequence. One of the principal flake forms used in this determination is the overshot flakes (Figure 5). However, before we proceed further, the use of the term "overshot flake" should be clarified. The definition for an overshot or *outrepassé* flake is one that occurs as the force of impact and the resulting crack travels to the end of the core. Instead of exiting the on the core surface, it bends downward removing part of the end of the core (Whittaker 1994:19). One usually visualizes this type of termination as occurring on thinned preforms where both the ventral and dorsal surfaces have merged into a sharp edge and little or no vertical remnant of the blank's edge remains.

The same fracture occurs on thick, chunky tabs having square vertical edge. Rather than plunging completely to the opposite face, the tab's thickness causes the fracture to terminate at different positions on the vertical lateral edge; thus, removing only a part of the opposite edge. This type of overshot is termed here as a *partial overshot* (Figure 5 e-j). One that, more typically removes both the dorsal and ventral surfaces is termed a *full overshot* (Figure 5 a-d). Of the 185 overshot flakes recovered from Gault, 121 are classed as partial overshots. Twenty-four of the full overshots were recovered from Geologic Unit 3a, 19 from Geologic Unit 3b, and 3 are from geologic units 3a or 3b. Sixty-nine partial overshots came from Geologic Unit 3a, 16 from Geologic Unit 3b, and 12 are either from geologic units 3a or 3b (Appendix A, Table 2). Partial overshots (Appendix A, Table 3) are represented within all three of the flake categories. These are primary (N = 23), secondary (N = 48), and interior or tertiary (N = 54). Most of these flakes were removed from across the surface, with some also retaining one or more ends of the tab. Since many of the interior partial overshots

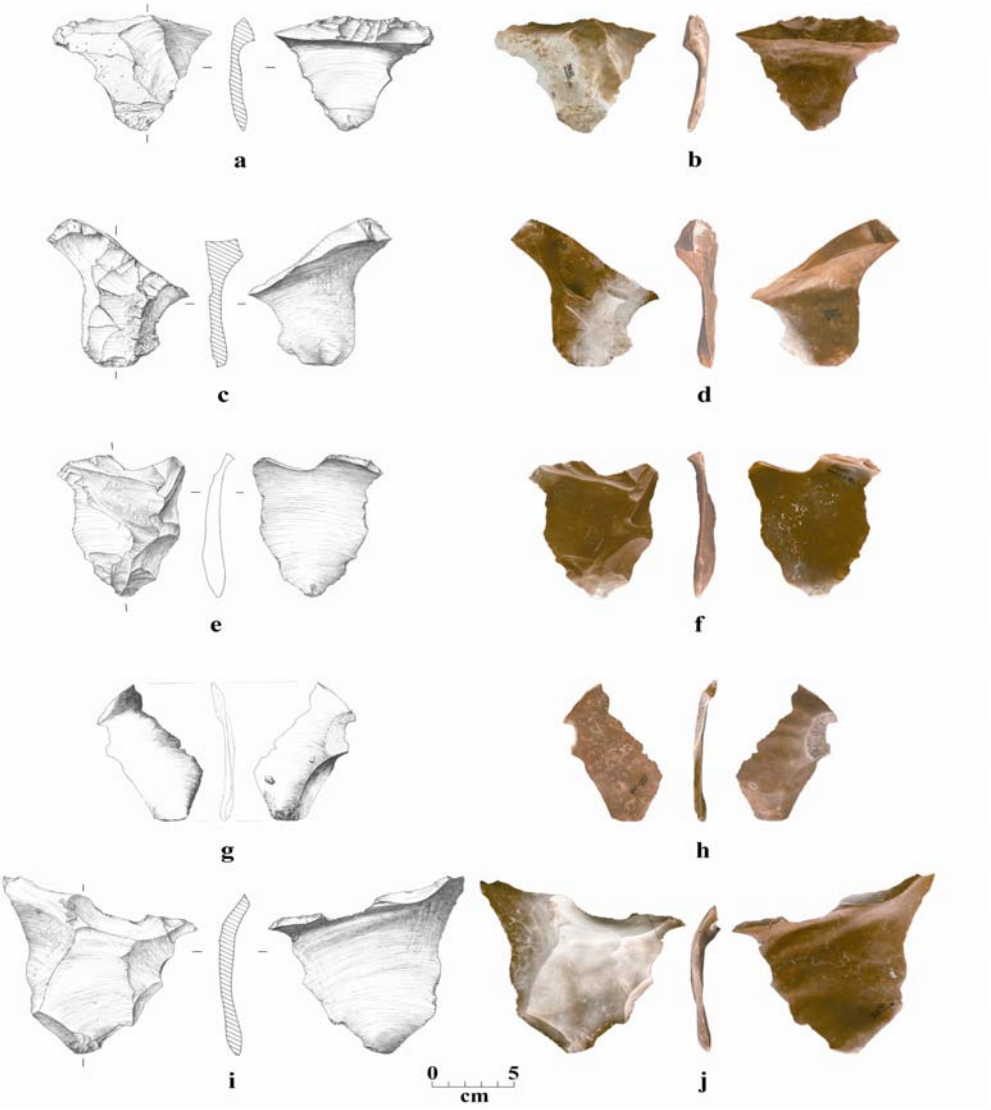


Figure 5. Overshot Flakes.

retain heavy patina and/or cortex on one or more of their lateral edges, it is evident that these flakes continued to be produced even after the cortical surface had been removed.

The idea of continued partial overshot flaking from the lateral edges is supported by looking at the platform types (Appendix A, Table 4). All three partial overshot flake types have examples containing both natural and plain type platforms. Natural platforms are dominant on the primary and secondary overshots while plain platforms become dominant on the interior overshots. In addition, dihedral and polyhedral platforms begin to appear on secondary flakes and are equally represented on the interior flakes. This suggests that, as the lateral removals continue, some platform modifications of the platform edge became necessary in order to continue overface flaking. The platform angles also remain essentially constant for all three flake types with the primary reduction of edge angle occurring between natural and plain platforms.

Three sets of primary partial overshots were refitted together (Figure 6). The morphology of the termination edges indicated that all sets were flaked from thick chert tabs having square or rounded sides. The flaking sequence on two of the sets are alternate removal (i.e., having the first flake struck from one of the lateral edges, the tab was then rotated, and the second flake struck from the opposite edge of the same face). The lateral edges of both of the flakes on both sets also retain the unmodified distal or proximal ends of the parent tabs. One specimen was removed from a tab 89.1 mm wide, and a second specimen depicted (Figure 6f) was removed from a tab 65.7

mm wide. The last set (Figure 6a) broke in half during detachment and was removed from a tab having a width of 121 mm. A study of the large flakes shows that the partial overshot removals are not the only strategy employed during initial reduction and core preparation. These flakes show that many of the initial flakes did not end in an overshot but terminated somewhere between mid-line and the opposite edge. As mentioned previously, some of these flakes rival the size of the largest overshot flakes (Figure 7). The average size of the flakes analyzed is as follows: primary flakes (69.5 mm x 82.7 mm), secondary flakes (67.9 mm x 85.3 mm), and interior flakes (61.5 mm x 73.9 mm) (Appendix A, Table 5).

The dorsal flake scar patterns (Appendix A, Table 5) on the secondary and interior flakes indicate a trend from a dominant uni-directional flaking on the primary and secondary flakes to a bi-directional and radial dominance on the interior flakes. Admittedly, some of these flakes could have been removed during later reductive stages as well.

Termination types also show that, as the cortex was removed, hinging and stacking began to increase. This meant that flaking from other directions became necessary to clear these problems. However, natural and plain platforms are still present on some interior flakes, albeit in fewer numbers, indicating that even after the cortex was removed interior flakes were still being removed from across the surface of the blank without significant edge modification.

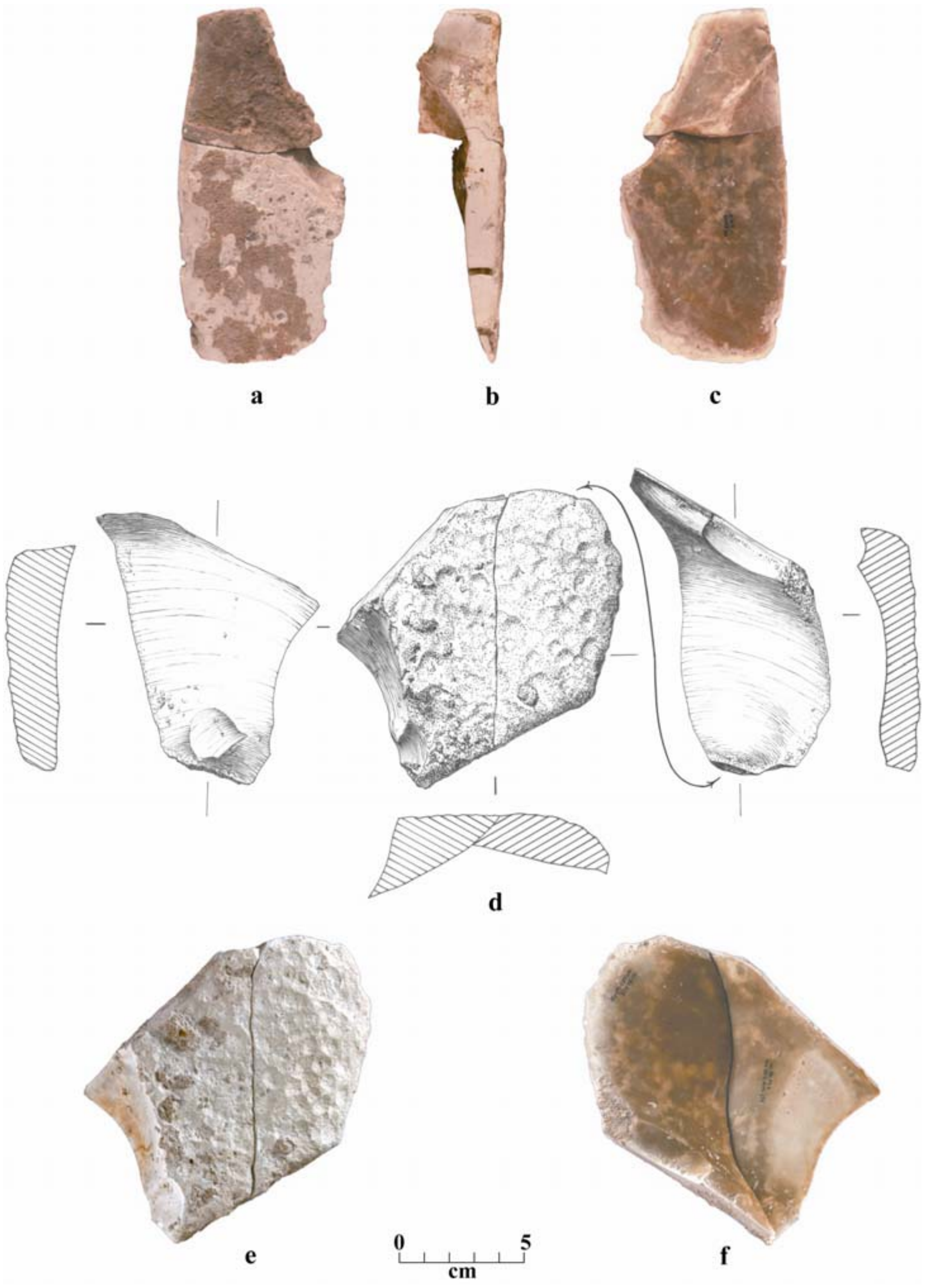


Figure 6. Refitted Partial Overshot Flakes.

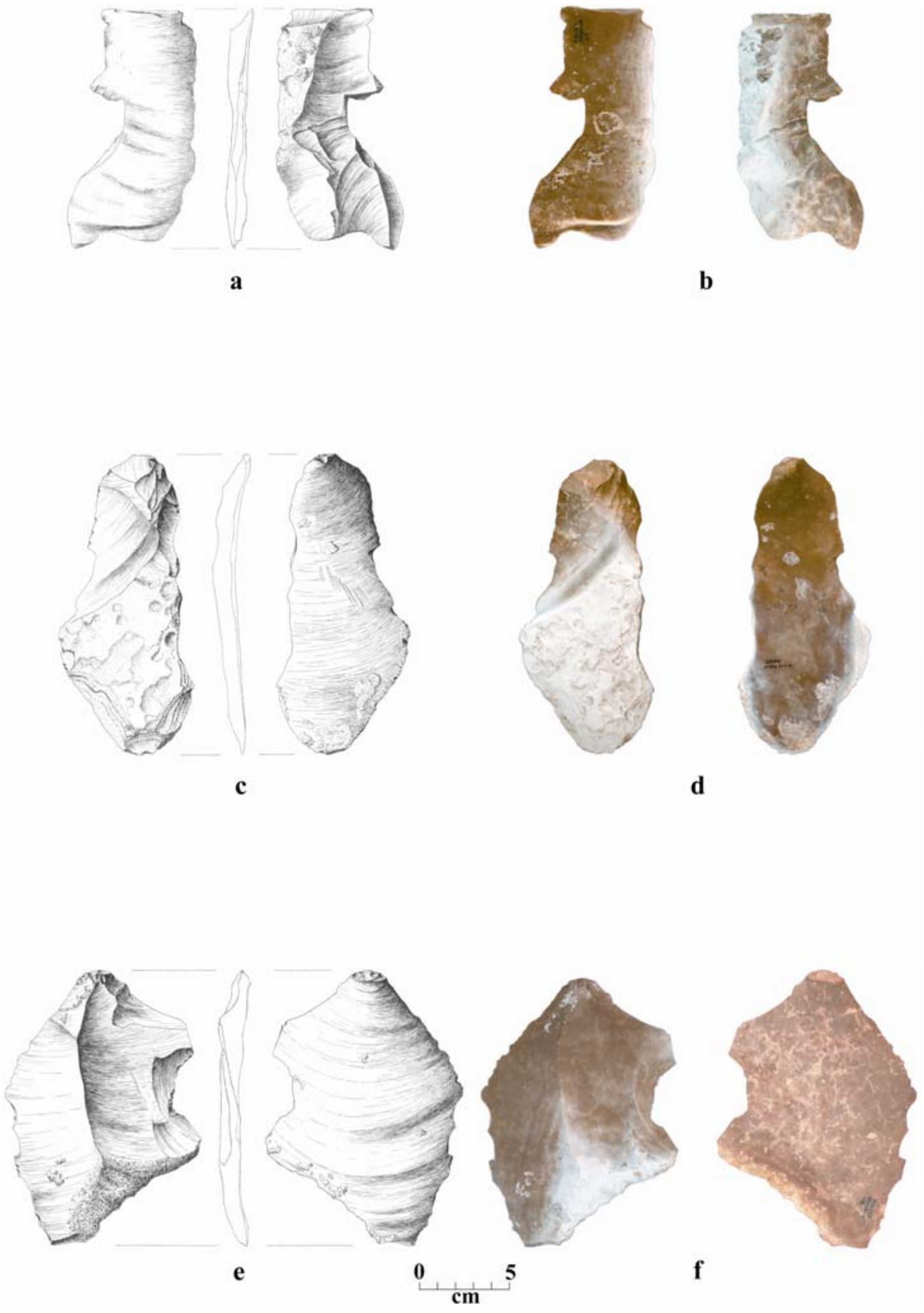


Figure 7. Large Flakes.

A third strategy is also apparent that was used in conjunction the other two. This is a lateral thinning technique that involved the removal of a blank's lateral and corner edges in a manner akin to blade production. It was noted that some of the partial overshots contained bladelike scars on their distal ends (Figure 8). These scars suggest that the corners or the extreme lateral surfaces (square side) of some tabs or blanks had been removed by blade-like flakes prior to overshot removal. The resulting scars occur in both unidirectional and bi-directional directions and are present on all three of the flake types (i.e., primary, secondary, and interior). Admittedly, some were only partial scars making it difficult to ascertain exact flake width (especially on the blank's lateral surface), but those present on the corners are typical blade scars.

Among the lithic artifacts recovered from the Gault site are a large number and variety of blades and blade-flakes. Included within this assemblage are 18 primary blades whose morphology indicates they had been removed from the corners of a tabular blank. Fourteen of these had been removed from the lateral edge and four from either the proximal or distal end. In addition, five secondary corner removal blades were identified, of which four are lateral edge removals and one is from the proximal/distal end. Typically, such blades are considered as being part of a blade core preparation or rejuvenation process. This belief is undoubtedly true, but the presence of blade scars on the distal ends of partial overshot flakes suggests that corner/edge blade flaking was also a strategy for lateral thinning in biface reduction

There are several probable reasons for these removals. One is to begin the process of bringing the lateral edges together. This lateral thinning technique would be

Figure 8. Overshot Flake with Corner Removal Blade Scars.

one of the first steps employed in reducing the sides of thick tabs without removing too much of the lateral edge. Another reason would be to remove any irregularities or damage present on a tab's or blank's lateral edges. Besides natural disconformities, chert exposed on the surface for some time often develops damage resulting from erosional activities, frost, or fire, that (unless removed) could impede reduction.

A third reason would be to establish a good platform angle. If, for example, one of the lateral edges along one face of a tab greatly exceeds 90°, it may be necessary to remove one or more flakes from the edge on the opposite face of the same edge to create a good platform with a knappable angle less than 90°. Since the average of the platform angles on the partial overshots ranged between 76° and 82° and on the large flakes between 76° and 79°, it would not take many removals to obtain these angles.

The last reason may be to establish some contour of the surface along an edge. Contouring can help guide flake fracture to terminate, either on or near the angled surface created by the removal or (depending upon the amount of force applied) plunge into an overshot.

Although more than 100 large flakes were recovered, most are too thin or contain problems such as humps, hinge terminations, or natural damage to be very useful in biface reduction. Large macroflake spalls, however, were utilized at Gault, as there are several examples of later stage bifaces that are flaked on large flake spalls.

A large blade-like flake (Figure 9a-b) that is of a sufficient size for biface manufacture does conform nicely with the Stage I blade-like flakes produced by Callahan (1979:55-56). This specimen is a secondary flake (measuring 164 mm wide

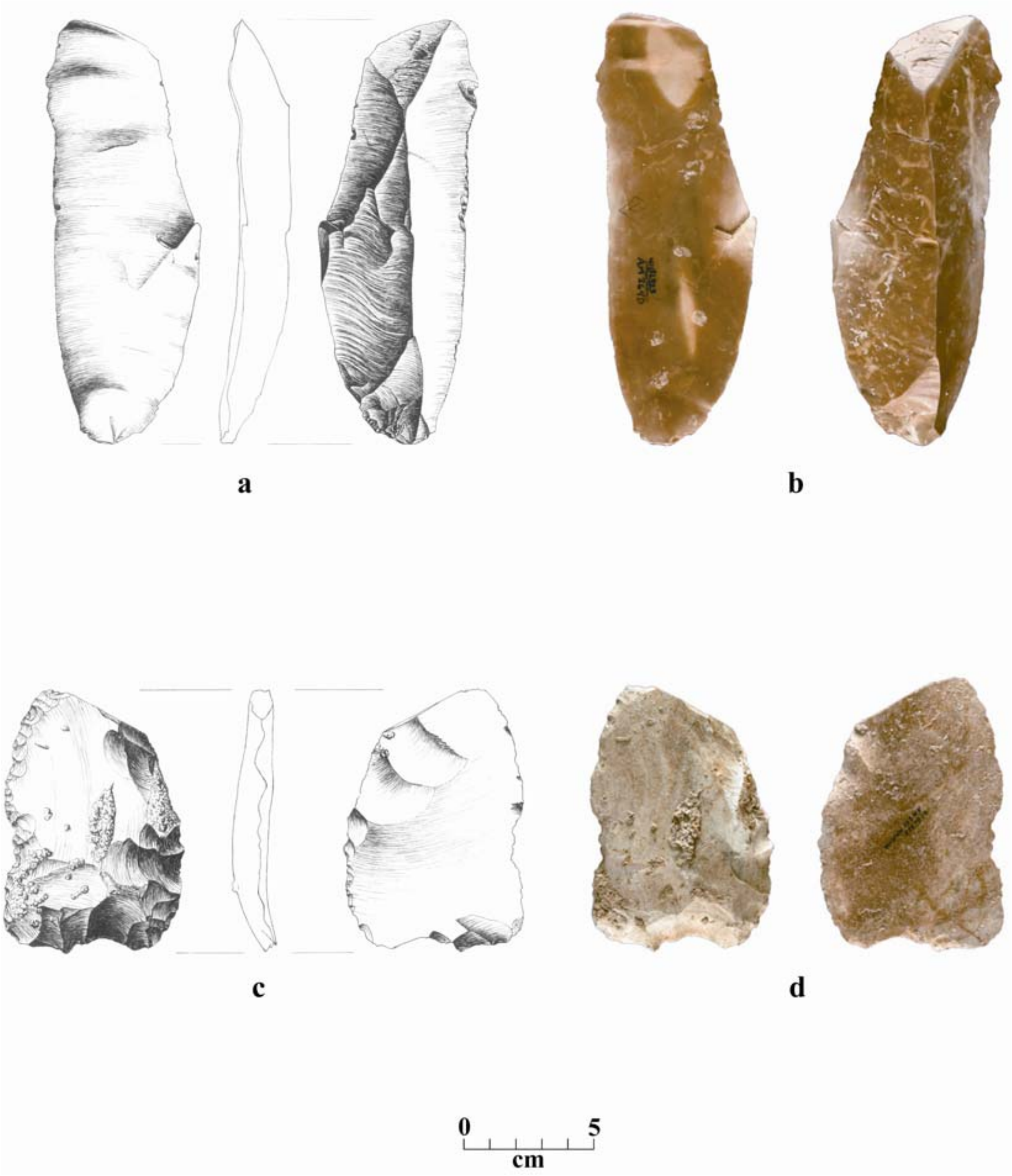


Figure 9. Alternate Blank Forms.

by 55.6 mm wide) is slightly curved, and has a dorsal scar pattern that is unidirectional with a prominent central ridge. This particular example has one lateral edge that contains good use-related wear indicating a probable function in some cutting or scraping activities, which probably precluded it from being bifacially reduced.

Briefly, the Stage I process began with selecting an unmodified piece of chert. This chert was either in the form of a thin to thick, roughly rectangular, tab or nodule from the adjacent hillside exposures or occasionally a cobble from chert deposits within Buttermilk Creek. A usable blank was initially formed by the removal of most of the cortex and irregularities from the dorsal and ventral surfaces. These were removed by large flakes that often plunged over the opposite edge (partial overshot flake) or terminated on or near the edge of the tab.

Several patterns of flake removal were noted. The first is an alternate removal pattern where a flake is removed first from one side and the second from the opposite edge (same face). Flakes removed from the same edge may be in a parallel sequence or spaced in intervals. A second pattern is a uni-directional sequence where one flake after the other is removed from same side terminating near or over the opposite edge. Like the alternate pattern, flake removals were not always next to each other, but were removed in intervals along the edge. Regardless of the pattern used, flake removals did not always proceed as planned. This necessitated a third pattern that gradually evolved from the first two. Due to material faults, misdirected blows, or any number of other knapping errors, some flakes terminated into deep hinges or stacks. These problems forced the knapper to flake from another direction or angle, in order to "clear" the problem; thus, creating a random bi-directional and radial pattern.

The vertical edges of these tabs were, most often, covered with a thick patina rather than cortex which did not impede flake removal or require additional alteration for a striking platform. However, if the striking angle was excessive or cortex was present, lateral flaking was necessary to establish a proper angle and/or a usable platform. In addition, the corners of some tabs were removed using a blading technique performed to regularize the edge or initializing lateral thinning. Large macroflake spalls and blade-like flakes were also used as biface blanks. These were probably selected from flakes produced during the decortication process of the tabs, or (in the case of blade-like flakes) through a more predetermined strategy of core preparation for the production large usable spalls.

Stage II, Initial Edging (N = 16)

This stage is a continuation of the thinning process with the primary intent to reduce all edges to a, more or less, sharp and sinuously shaped edge. Seven of the sixteen specimens are complete (Figures 9c-d, Figure 10), one of which was refitted together from two pieces. One is made on a large macroflake spall (Figure 9c-d), and the rest are on thick cores. Of the fractured specimens, only one was too small to provide any data. Nine were recovered from Geologic Unit 3a, 5 from geologic Unit 3b, and 2 from either geologic units 3a or 3b. Interestingly, one of the refitted specimens had one piece found in Geologic Unit 3a and the other in Geologic Unit 3b.

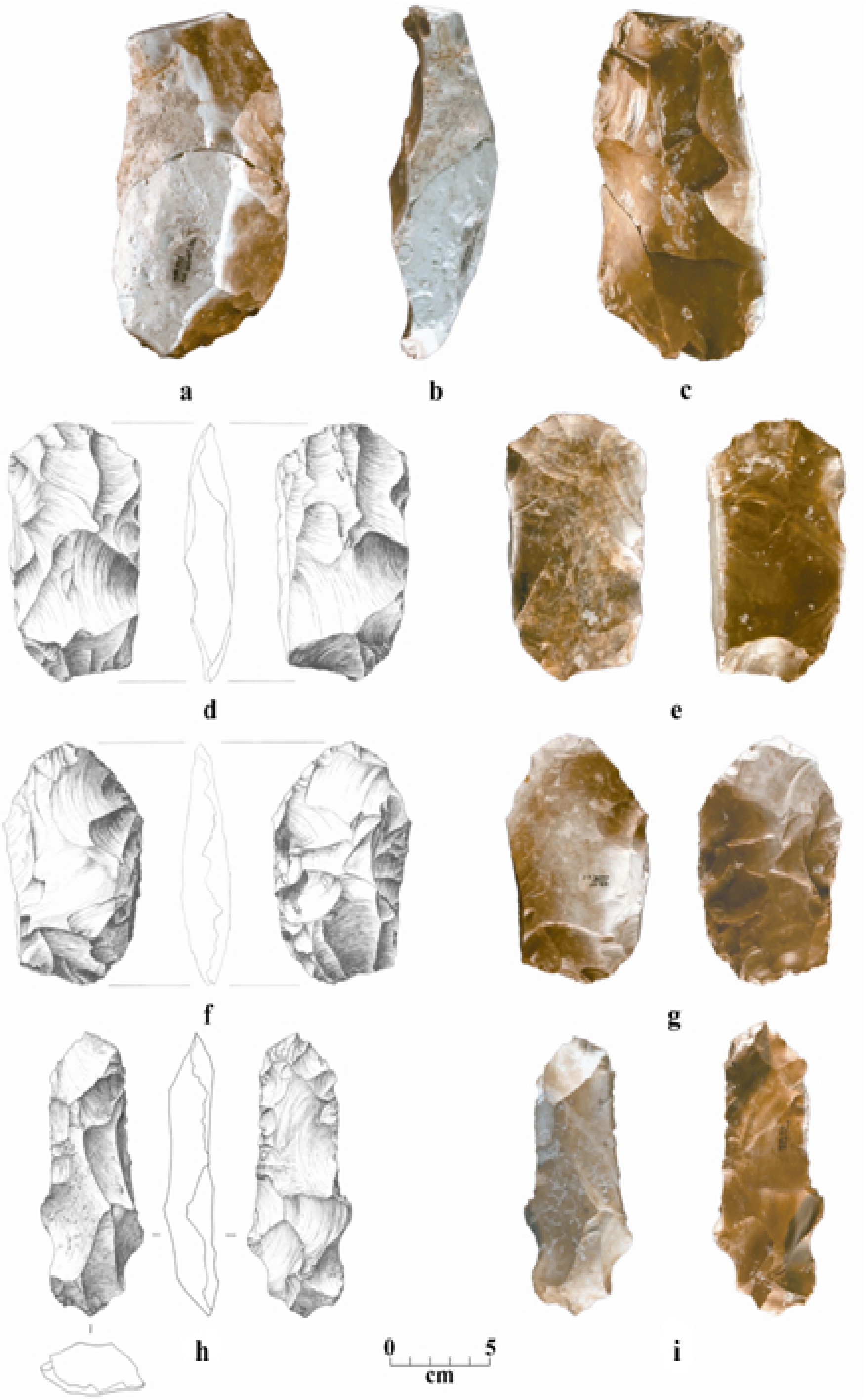


Figure 10. Stage II Bifaces

The metrics (Appendix A, Table 6) for the Gault Stage II bifaces are as follows: the whole specimens averaged 114.1 mm long, 62.6 mm wide, and 21.3 mm thick. A comparison of these averages (Appendix A, Table 6) with those for the Adams site and Callahan's replications show that the Gault Stage II bifaces are slightly longer, wider, and thicker than both the Adams site and Callahan's findings. The width/thickness ratios for Gault average 2.1:1 (cores only) with ranges of 2.0:1 - 3.1:1 for the cores and 5.0:1 for the flake spall. These ratios fall within the lower portion of Callahan's optimum range of 2:1 - 3:1 for core reduction with ranges that can be as high as 6:1 for flake reduction and are only slightly lower than the 2.4:1 ratio for the Adams site. A natural surface and/or cortex are present on all but five specimens. It is restricted to the lateral edges of 5 specimens, to the dorsal or ventral surfaces of 5, and to both the lateral and either the dorsal or ventral surfaces of 2. The flaked surfaces of the Stage II Bifaces contain large flake scars, some of which are overshot terminations. Most terminate past the middle or near the opposite edge. The negative bulb scars are deep with numerous hinge and step fractures present suggesting the use of hard hammer. Some of the edges on the more "developed" Stage II bifaces have portions that have had a number of small flakes removed for platform preparation.

The flaking process in Stage II began with a continuation of large flake removals flaked from the edges of the unmodified square sides. As thinning progressed and the corners of the dorsal and ventral surfaces approached each other, some portions of the edges were slightly beveled by small unifacial flake removals. These were flaked as part of the process of setting up striking platforms for thinning or removing knapping problems.

Partial overshot flakes (N = 5) continue to be removed, but the majority of the bifaces (N = 10) have flakes that terminate at or slightly over the midline of the biface. Numerous hinge and step fractures are present, but material flaws such as natural cracks, inclusions, and potlids from heat and frost fracture account for most of the failures.

Although, knapping errors such as hinges and stacks appear to be common, many were successfully removed. Evidence for this was confirmed through a study of a flake category termed "problem removal flakes". This category (N = 51) is composed of small to large flakes whose dorsal surfaces contain remnants or complete stacks, hinges, etc. that were successfully removed from a biface.

End thinning appears at this stage (with seven specimens having removals from either end, both ends, and/or on both faces). Figure 10a-c shows a refitted example that fractured during end thinning attempts. Since flakes are usually thickest near the platform and thin out distally, those flakes that terminate near the mid-line of the biface, remove less material at the point of termination than at the platform. This often results in a thickening along the mid-line. In addition, knapping errors such as hinges and step fractures also create surface irregularities in the form of humps or stacks. In order for thinning to continue, the thicker central portion and/or problems need to be removed.

The process of end thinning, therefore, was performed to rapidly thin and flatten the thicker central portions of the biface as well as removing any knapping problems. Some end thinning flakes were also flaked along a blank's lateral edge in a continued corner or lateral thinning process. Scars resulting from these removals were noted on the distal edges of some overshot flakes (Figure 8) indicating that the corners were flaked prior to overface flaking. Interestingly, as flaking from the lateral edges increases, subsequent corner removal "blades” would begin to approximate secondary, single sided crested blades.

The ends of the bifaces were thinned before the lateral edges. One reason for this may be the result of frequent platforming necessary for end thinning flake removals. Fourteen end thinning flakes were identified. Of these, 7 have complete platforms; all are strongly ground, 4 are plain, 3 are isolated, and 3 are dihedral. The preparation of these platforms all require some edge removal near the platforms, and after several preparations and removals have been performed from each face, it would naturally follow, that the biface ends would be thinned down more rapidly than flaking from the unmodified lateral edges. This idea, of course, is dependant upon the thickness of flakes removed.

A second reason would be to conserve blank width. Maintaining width on small rounded cobbles or thick narrow tabs would be a significant consideration. For example, a typical platform preparation may involve the vertical removal of small flakes from the edge as each individual platform is prepared. Additional flakes would also be removed from around the platform if it was to be isolated. Repetitive platforming from such a technique performed individually along an edge could easily result in a too rapid narrowing of the blank (Dickens 1995). However, width can be conserved by sacrificing some of the length by longitudinal blade-like flaking along the edges of the blanks. Such a flake removal would easily provide an acceptable flaking angle over much of the blanks edge that, requiring only minor preparation, would create a single platform along much of the blanks edge. Since only a few of these longitudinal flakes would have to be removed from one edge, width reduction would be minimized. The flake patterns on the Gault Stage II bifaces begin with a continuation of Stage I lateral uni-directional and bi-directional removals. As thinning progressed a few specimens (N = 7) begin to be flaked in a parallel oblique pattern (d-e, 10h-i)**.** This parallel flaking is either an alternate sequence (N = 5) from each edge (1 left-2 right-3 left-etc.), or was removed in a sequence (1-2-3-4) from same edge (N = 2). Both, of which, may be present on the same biface (N = 5). In addition, as end thinning removals increase, a radial pattern develops (N = 9) which also occurs, in conjunction, with the other patterns on the same biface (N = 2). Whatever the pattern, most of the lateral flake scars are wide with little overflaking from the adjoining scar.

The flake spall (Figure 9c-d) measures 100.0 mm long, 70.2 mm wide, and 14.0 mm thick, is roughly triangular (plano-convex) in shape, and the extreme distal end is missing. Flaking is confined to the marginal edges with only one flake reaching mid-line; thus, its placement in this stage. The pattern is radial with most flaking restricted to the convex dorsal surface. The only flaking on the ventral is along one margin where five small parallel flake scars were removed, which appears to be for platform preparation.

Failures can be attributed to the following reasons: 6 fractured due to material flaws, most notably from internal cracks; 2 from plunging terminations; 2 from overshot failures; and 2 were transverse snaps, one of which broke during an attempt to remove a deep hinge (Figure 10a-c).

Briefly, the Gault Stage II biface reduction process is as follows: continued thinning from the unmodified square sides with some flakes terminating in partial overshots, but most were between mid-line and the opposite edge. Although, hinging and stacking were common problems, many were successfully removed. The ends and lateral sides were thinned and flattened by longitudinal flakes removed from each end. Platforms were formed from lateral corner removals permitting lateral thinning to proceed with minimal width reduction. This process was repeated until the lateral edges were reduced to a single sinuous edge.

Stage III, Primary Thinning (N = 13)

Stage III bifaces are distinguished from the earlier stages by having the square vertical sides reduced to a more or less sharp sinuous edge, although, some remnants of the square edge may still be present. Large end thinning flake scars are abundant along with a few overshot flake scars. Small invasive flake scars, which end near the mid-line, or are concentrated in small areas around the edges, are frequent. The bifaces are still relatively thick in cross-section with occasional small areas of cortex remaining on the sides or on one of the faces. This cortex probably represents depressions on the surface.

Seven of the 14 Biface III's, including two that have been refitted, are complete (Figures 11-12). One specimen (Figure 11e-f) is made on a large macroflake, and the rest are on thick cores. The fractured specimens include 2 proximal or distal ends, 1 lateral, 2 medial-proximal, and 2 medial-distal fragments. Ten were recovered from Geologic Unit 3a (including one of the refitted specimens), 2 from Geologic Unit 3b, 2 from either geologic units 3a or 3b, and 1 found while stripping the baulk. In addition, one of the refitted specimens had one piece found in Geologic Unit 3a and the other in Geologic Unit 3b. The metrics (Appendix A, Table 7) for the Gault Stage III bifaces are as follows: the whole specimens averaged 104.2 mm long, 63.5 mm wide, and 23.2 mm thick.

A comparison of these averages and the overall size ranges (Appendix A, Table 7) with those for the Adams site and Callahan's replications show that the Gault Stage III bifaces are larger in all respects to those from both the Adams site and Callahan's findings. From these comparisons, it can be seen that the primary difference is in biface thickness, especially with those from the Adams site. This difference is probably related to initial blank size and shape (those from Gault being more brick-like), which forced (or allowed for) the Gault knappers to utilize alternate reduction techniques. The width/thickness ratio (Appendix A, Table 7) for Gault ranged between 2.1:1 and 3.5:1 with an average of 2.8:1. Callahan's acceptable range of between 3:1 and 4:1 with a mean of 3.3:1 and the average of 3.8:1 for Adams are both slightly higher than those

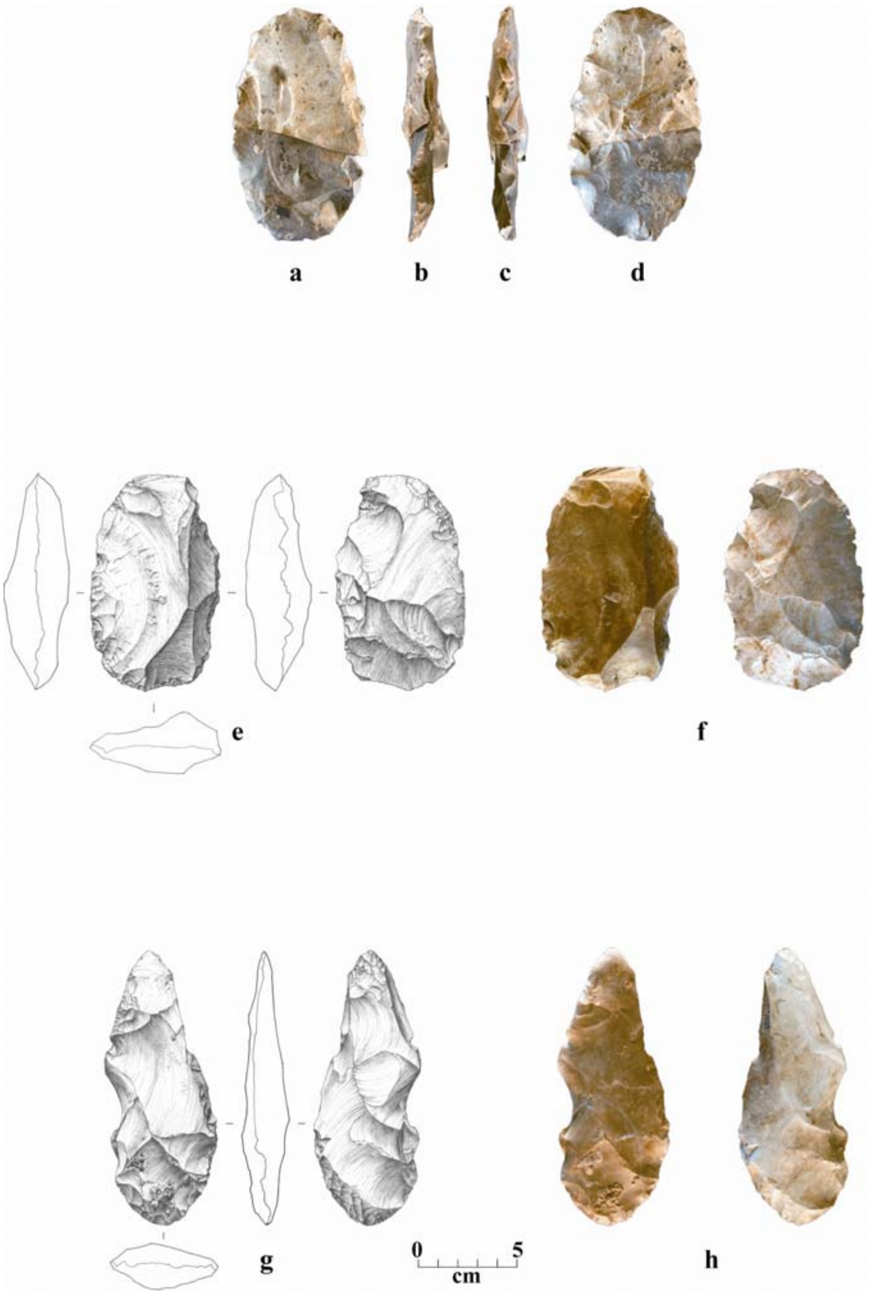


Figure 11. Stage III Bifaces.

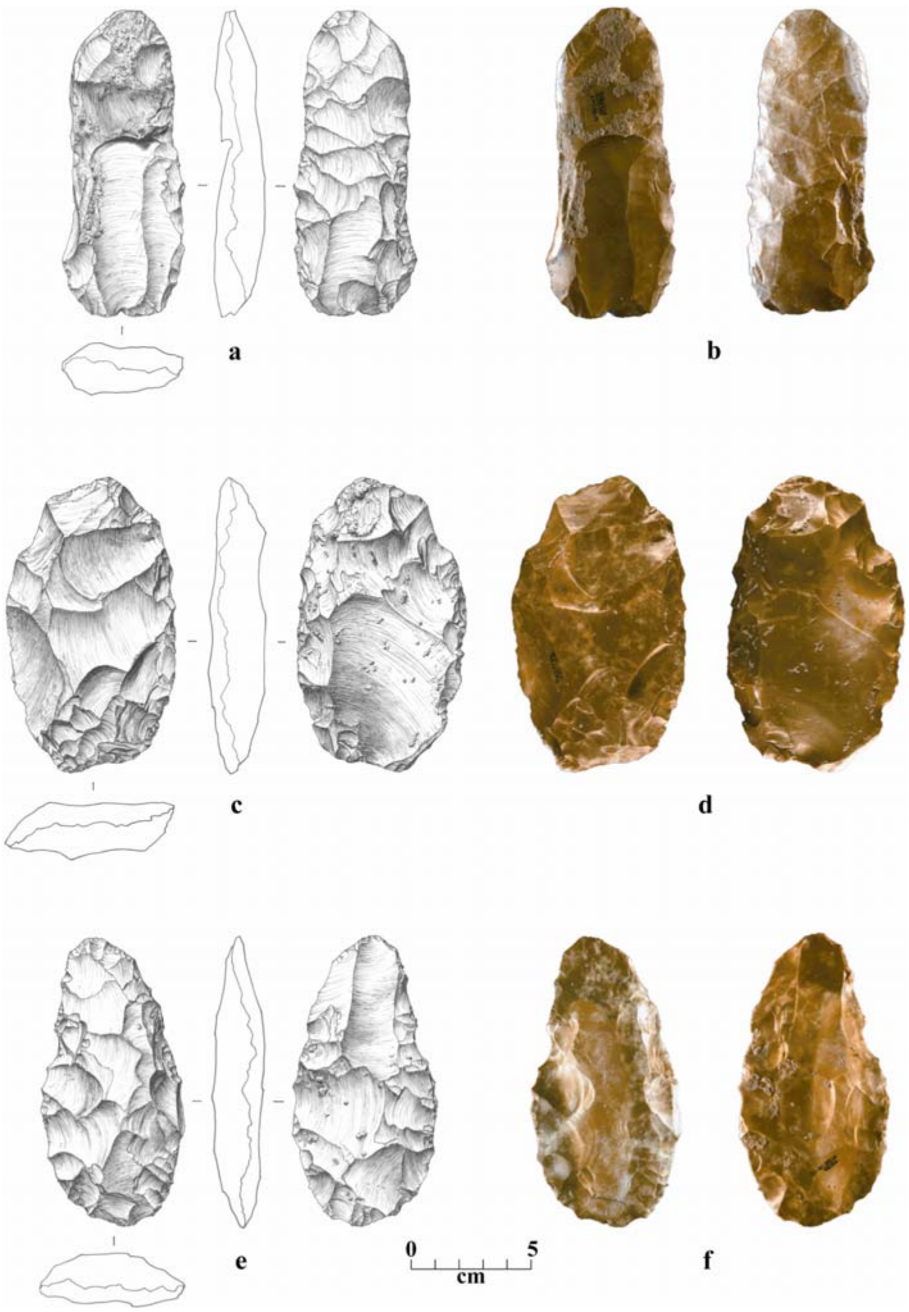


Figure 12. Stage III Bifaces with End Thinning.

from Gault. In addition, the length/thickness ratios of Callahan's and Adams are both higher than Gault's. The primary factor for these differences seems to be biface thickness.

This conclusion is supported when thickness is not factored in. Looking at the length/width ratio's, it can be seen that Callahan's ratio of 1.8:1 is only slightly less than the 1.9:1 for Gault, and very close to the 2:1 ratio from Adams. These findings suggest that, at this stage, the basic biface reduction strategies employed in these studies are similar with the primary difference being biface thickness.

The flake scar patterns on the Stage III bifaces are similar to the Stage II bifaces with both lateral and radial forms. The flake scars differ from Stage II scars in they are frequently longer and narrower, especially those flaked next to each other where some overlapping occurs. These lateral patterns occur in a variety of bi-directional sequences that may be combinations on alternate edges of the same face, a single edge, or on only the ventral or dorsal or both sides. and one with removals that are combinations of alternately spaced flakes from the Flaking sequences include a parallel sequence (1-2-3-4), one that alternates between sides (1 left-2 right-3 left-4 right), same edge (1-3-2-4). For example, one specimen contains a dorsal pattern on one edge that is obliquely flaked in a 1-3-4-2 alternating sequence with most flakes terminating past mid-line. The opposite edge is parallel flaked in a 1-2-3-4 sequence with no flakes terminating past the mid-line. These flakes are small and may have been removed as a platform preparation for ventral flaking. Whatever pattern or combination of patterns was used, most tend to be obliquely flaked.

The most common flake pattern is radial and is present on nine of the fifteen specimens. This may be due, in part, to an increase in platform preparation and end thinning. All specimens contain varying amounts of small flake removals along their edges. As the biface becomes thinner, less material remains on the edge to support a strong point of impact. Therefore, it becomes necessary to manufacture a point that will serve to both support the force of impact and insure that the intended flake fracture will be successful. Such preparations are essential when considering that the major flakes to be removed are large with the intention to terminate close to, or plunge over the opposite edge, and/or be removed from either end in long blade-like flakes. Thus, the platform and/or edge must be strong enough to handle the force of impact required to remove such flakes.

Not all of the small flake removals appear to have been for the preparation of a single platform. Rather, they are often flaked in varying lengths along an edge forming a slight bevel. This is also a form of platforming, but one that regularizes and sets up longer portions of the edge as opposed to a specific spot. This idea is supported by the numerous thinning flake scars, often noted in a parallel sequence, that initiated from these areas.

End thinning is very prominent in this reduction stage, being present on 11 of the 15 specimens (Figures 11a-b and Figure 12). Two, and sometimes three, flakes were removed from the same end with the more lateral (corner) removals often removing the extreme edge. These blade-like flakes are often wide and long and frequently terminate well past the biface's mid-length. For example, one extraordinary biface (Figure 12a-b), contains a large end thinning flake (one of two from the same end) that removed approximately 59% of the biface's longitudinal surface. Amazingly, it terminated in a deep plunging hinge fracture without causing biface fracture. A second biface (Figure 12c-d) has had a single end thinning flake that also terminated past mid-length but it's width is almost as wide as the proximal end of the biface.

Several methods of platform preparations are present. One method is evident on the large end thinning flake removed from the ventral surface of one biface. Its platform was formed by beveling the entire dorsal edge via small flake removals, followed by a light grinding of the edge. A single isolation flake may have been removed from the dorsal surface near the point of impact, but it was flaked over after the primary flake was detached. The point of impact on the platform is fairly wide (16.6 mm or .66 inch), and the negative bulb scar is deep, indicating a hard hammer type removal.

The second method involved the isolation of a platform on the biface's dorsal surface by removing two small flakes, each adjacent to the striking point. The only preparation on the ventral surface was a small flake removed at an angle across the basal edge. This may have been performed to help raise the point of impact above the basal edge. It is not evident if a nipple was formed or the extent of grinding applied, as the edge collapsed forming a small notch during flake fracture that effectively removed any such evidence. The "collapsed" point of the platform is very small (i.e., 3.3 mm wide) and has a small, but relatively prominent negative bulb which suggests that a punch was probably used to detach the flake.

Overshot flaking is present, but not as abundant as end thinning, and it is noted on only three Stage III bifaces (Figure 11g-h). Two of the specimens have only single overshot scars, while one contains multiple scars. Overshot flakes produced during this stage are the more classic *full overshot* type characterized by having their distal edges composed of remnants of both the dorsal and ventral surfaces as apposed to the *partial overshot* whose distal edge is made up of the dorsal surface and part of the vertical side of a tab.

One complete biface (Figure 11g-h) that demonstrates an excellent overshot flaking sequence was, unfortunately, recovered from a gravely surface (Geologic Unit 4b) that was exposed during both Clovis and Folsom times that contained neither 3a or 3b geologic units. It does contain the correct chemical staining as well as the classic Clovis large overface/overshot flaking, neither of which occur in the Gault Folsom period. For these reasons, this specimen (not addressed previously) is felt to represent typical Clovis reduction technology. It is an excellent example of a successful overshot flaking sequence and, for this reason, a detailed description of its reduction is provided below.

Both its dorsal and ventral surfaces have been almost completely overflaked by large overshot flakes. The dorsal contains two overshot flake scars and the ventral has two and, quite possibly, three, scars. The sequence began with a removal on the dorsal from the left lateral near the distal end. The termination edge of the flake scar was platformed with a series of small flake removals on the distal end. The biface was then flipped over, and a second, but smaller overshot, was flaked from the distal tip on the ventral surface. This was followed by another, larger overshot, flaked immediately next to the small distal on.

At this point, a third possible overshot flake was removed from the ventral's basal corner at an angle towards the distal end removals, but from the opposite edge. The termination edge of this flake scar has been removed due to subsequent ventral edging making it difficult to determine whether it actually plunged over the edge or not. This removal may have created a slight ridge or hinge between the juncture of the second and third flake as a smaller flake was removed at this point.

Next, the distal termination edge of the above flake scar was platformed, the biface flipped over again, and a second, large overshot flaked across the basal half of the dorsal surface. Some gap exists between this flake and the first dorsal removal on the distal end, and a platform was formed to flake this portion. Several flakes were removed, but a severe hinge developed. Further platforming to correct this problem resulted in a large portion of the edge to collapse (due to a crack), forming a large concavity and causing the biface to be abandoned.

Even though some additional flake removals would be necessary to completely smooth and continue to thin the remaining surface, the strategy of large overshot or overface flaking was enough to sufficiently flatten and/or smooth most of the dorsal and ventral surfaces by the removal of only four or five large flakes. It is apparent that, through the skill and control of the knapper, the plunging nature of overshot flaking was minimized. The result was that little of the opposite (termination) edges were removed, the flakes either terminating on the immediate edge, or removed only a slight portion of it. In addition, flakes were removed in an "as needed basis" where the knapper concentrated on the most immediate area to be removed (such as humps or knapping problems) rather than one following a specific flaking sequence.

Lateral thinning, in the form of longitudinal corner removals, continue to be performed. A good example of this flaking is present on a fragmented biface. This specimen is a proximal half that broke in a plunging fracture as a result of an end thinning attempt. The dorsal surface contains two large and two smaller end thinning flake scars that originate from the remaining proximal end, while one lateral edge is the distal end scar of a corner removal flake that originated from the missing distal end that terminated 12 mm from the basal end.

In addition, sixteen full overshot flakes contain similar corner-blade scars on their distal ends (Appendix A, Table 8). Most are unidirectional, but three contain bi-directional scars. These scars are present on both the dorsal and ventral surfaces of the termination edge. Fifteen of the overshot flakes have scars only on the ventral and two have scars on both the dorsal and ventral. It should be explained, that not all of these full overshot flakes may have originated in this particular reductive stage, but could also be products from later, and possibly earlier stages as well. The point is blade-like corner removals are being removed in conjunction with full overshot flakes. Interestingly, five of these full overshot flakes contain obvious end thinning flake scars on their dorsal surfaces. This suggests the possibility that corner/edge removals may be part of the overall end thinning strategy, and as such, represent those end thinning flakes removed from the lateral corners.

All of the broken specimens failed as a result of knapping errors. No observable material flaws that may have contributed to the failures were detected. Reasons for failures include: 2 from plunging end thinning flake attempts, 1 is a perverse fracture, the proximal end of 1 broke from a failed attempt at removing a large stack, 1 from an overshot failure, and the remaining 2 are bending fractures.

In short, the reduction process for the Gault Stage III bifaces is as follows: thinning commenced with overface flaking in oblique patterns that may be parallel (from the same edge), alternate (from opposing edges) to a radial pattern as platform preparation increased. Although the majority of the flake scars terminated between mid-line and the opposite edge, some flakes terminated either on the edge or plunged over the edge. The strategy most often followed seems to be flaking past mid-line with the intent that flakes terminate close to the opposite edge. However, many flakes failed to terminate past mid-line or resulted in hinges or broke in a step fracture resulting in a strong convex shaped surface, or the creation of humps and stacks formed from repeated attempts to remove these problems. An end thinning strategy with flakes removed from either end, along one or more edges, and down the central portions of the biface, was used to "clear" these problems.

Another characteristic of Stage III bifaces is an increase in small flaking around the edges. These flakes reflect the increase in platform preparation necessary for successful end thinning and overface flaking as the edges become thinner and more acute. In addition, some of the corner edge blade-like flaking mentioned above as part of the end thinning process may also have served as a base for platform preparation and/or possible edge contouring.

Stage IV, Secondary Thinning and Initial Shaping (N = 12)

Bifaces within this stage (Figure 13) continue to be thinned by the same techniques employed in the previous stage. The primary difference is that overface flaking and plunging overshot terminations become dominant over the practice of end thinning. In addition, as this stage develops, the edges are regularized and a more lanceolate shape begins to be formed.

Two specimens are complete and ten are fractured. One of the complete specimens was refitted from two fragments forming a complete biface (Figure 13a-b). The fractured specimens include 4 proximal, 1 medial, and 5 distal fragments. All but one specimen, have been reduced from tabular cores. The one exception is made on a blade or blade-flake (Figure 13e-f). Five were recovered from Geologic Unit 3a (including both refitted pieces), four from Geologic Unit 3b, and four from either geologic units 3a or 3b. Interestingly, one of the two refitted pieces was found in Geologic Unit 3a and the other in Geologic Unit 3b.

The average size for the complete Gault Stage IV bifaces is 105.5 mm in length, 50.0 mm wide, and 12.4 mm thick (Appendix A, Table 9). A comparison of these averages with Callahan's replications (Appendix A, Table 9) shows that the Gault Stage IV bifaces compare very favorably with his maximum range (i.e., 100 mm long, 50 mm wide, and 13 mm thick). No averages were provided.

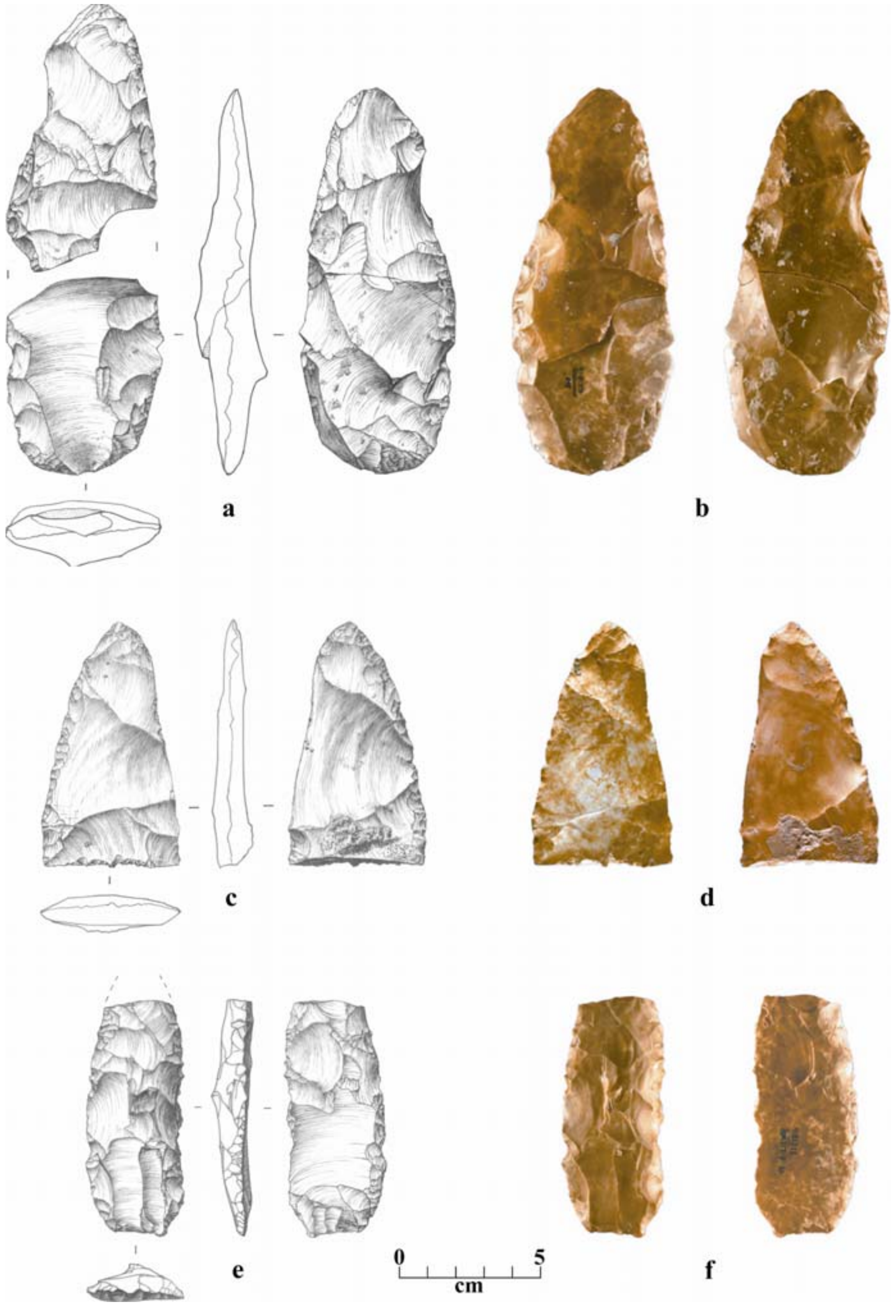


Figure 13. Stage IV Bifaces.

Previously, the greatest difference was in biface thickness where the Gault bifaces were significantly thicker than Callahan's replicative results. However, by this stage, the gap has been reduced with the Gault average thickness of 12.4 mm now falling comfortably within Callahan's maximum thickness of 13 mm and average of 11.4 mm. Although no complete Stage IV specimens were recorded from the Adams site, the average width and thickness for those able to be measured (Sanders 1990:40) shows that they are slightly narrower and thinner than both Gault's and Callahan's findings. The width/thickness ratios between Callahan, the Adams site, and Gault are close with 4:1 for Gault, 4.2:1 for Callahan, and 4.6:1 for the Adams site. The 4:1 ratio for Gault fits within the lower part of the 4:1 - 5:1 range, developed by Callahan as the optimum width/thickness ratio, and shows that the Gault bifaces continue to be slightly wider and thicker than the other two findings.

The rapid thinning of the Gault bifaces can probably be attributed to overface or overshot flaking. Seven of the Stage IV bifaces contain remnants of overface and overshot flaking (Figures 14 a-d). One difficulty in positively determining an overshot flake scar from an edge termination is that the edges are often modified by platform preparation flaking for the opposite face. This edge work ultimately removed any evidence that would substantiate whether the terminations were on an edge or plunged over. However, many of the remaining edges do contain obvious plunging terminations suggesting that this practice was probably intentional. Whether flakes terminated on or over the edge, either strategy is a very useful method for rapidly reducing biface thickness, as well as, smoothing and flattening the surface.

The flake removal sequences are similar to those in Stage III, with combinations of spaced removals on same edge, parallel on same edge, alternate edge, or alternate face flaking. The flake scars, as a result of the overface or overshot removals, are large and wide, having removed the majority of the smaller flake scars. In addition, many are angled obliquely across the surface, often in a parallel sequence.

The use of end thinning is much reduced in this stage with only one, the refitted specimen (Figure 13a-b), exhibiting end thinning scars. This biface broke during an end thinning attempt at removing a large stack along the mid-portion of one of its lateral edges. To remove this stack, an end thinning flake removal was attempted from the proximal end. This flake was angled slightly towards the edge containing the stack, but plunged underneath the stack fracturing the biface in half.

No scars indicating the use of lateral edge thinning or corner removals are present on any of these bifaces. However, such scars are present on the distal ends on some of the full overshot flakes referred to in the previous stages where overface and overshot flaking was also occurring. Although it is not possible to definitely ascertain at which stage these flakes were removed, it can be assumed that some corner edge thinning flakes were removed in this as well as the previous stages.

As reduction within this stage continues and becomes more "developed," initial shaping into the lanceolate form is began. Five bifaces, one complete and four fractured show evidence of this process. This process was initiated by small flake removals along all the edges. The dorsal surface contains a large overshot flake, partially removing a distal end thinning flake; however, the remaining portion of the surface has been overflaked with small flakes, some intrusively into the overshot scar. The ventral surface has had the majority of its surface overflaked by small flaking, also intruding into an end thinning scar. This flaking (on both surfaces) was performed to set up some platforms, but it obviously served to also regularize the lateral edges and shape the distal end.

The reduction process described above has been centered on those bifaces reduced from tabular cores. An additional specimen (Figure 13e-f) was made on a blade or blade-flake. It is made on a very narrow blank with a ventral surface still retaining a portion of the original unflaked surface showing that this surface was a single fractured plane. Flaking on the ventral is primarily restricted to the lateral edges, although some extend to the mid-line. The intent here was to begin forming some convexity to the flat ventral surface and, possibly, to thin the bulbar end, although this portion is missing.

The dorsal surface is heavily overflaked with numerous small flakes, many terminating just past mid-line. The edges are irregular and several prominent humps are evident. A severe stack developed near the mid-section as well as a smaller one on the opposite edge, the latter resulting from an attempt to remove the central stack from the opposite edge. Two basal end thinning flakes were removed in an attempt to remove this stack which resulted in an end snap. The basal edge has had three small flakes removed forming a slightly beveled edge setting up most of the edge as a platform for the end thinning flakes.

Reasons for the failure of the fractured specimens includes: 1 to an end thinning failure (refitted specimen), 3 to overface or overshot attempts, and 7 to simple bending fractures resulting from a number of thinning problems. Some of the latter may also have failed as a result of attempted overface flaking but this could not be determined with any certainty. No material flaws were noted.

Simply put, the reduction strategy for the Gault Stage IV bifaces involves the flattening and smoothing of both the dorsal and ventral surfaces with initial shaping into a lanceolate form. This was accomplished by large overface or overshot removals from both surfaces that removed any surface irregularities. This was followed by regularizing and shaping the edges through small flake removals. The latter flaking was probably accomplished by the use of both light percussion and pressure flaking, marking it the first time that pressure flaking has been noticed in any degree other than platform preparation.

Stage V, Final Shaping of the Preform (N = 5)

Reduction within this stage (Figure 14) involves the final shaping process before fluting. It should be explained that this final shaping process does not mean that the resulting product is in its final finished form; rather, it brings the preform to a stage that is ready for fluting to occur. The "finished" edges at the end of this stage are often slightly irregular and still in need of some shaping. Once the fluting process has been performed, the final edging or "fine tuning" of the fluted preform would commence. All seven of the specimens within this category are fractured. Two specimens are

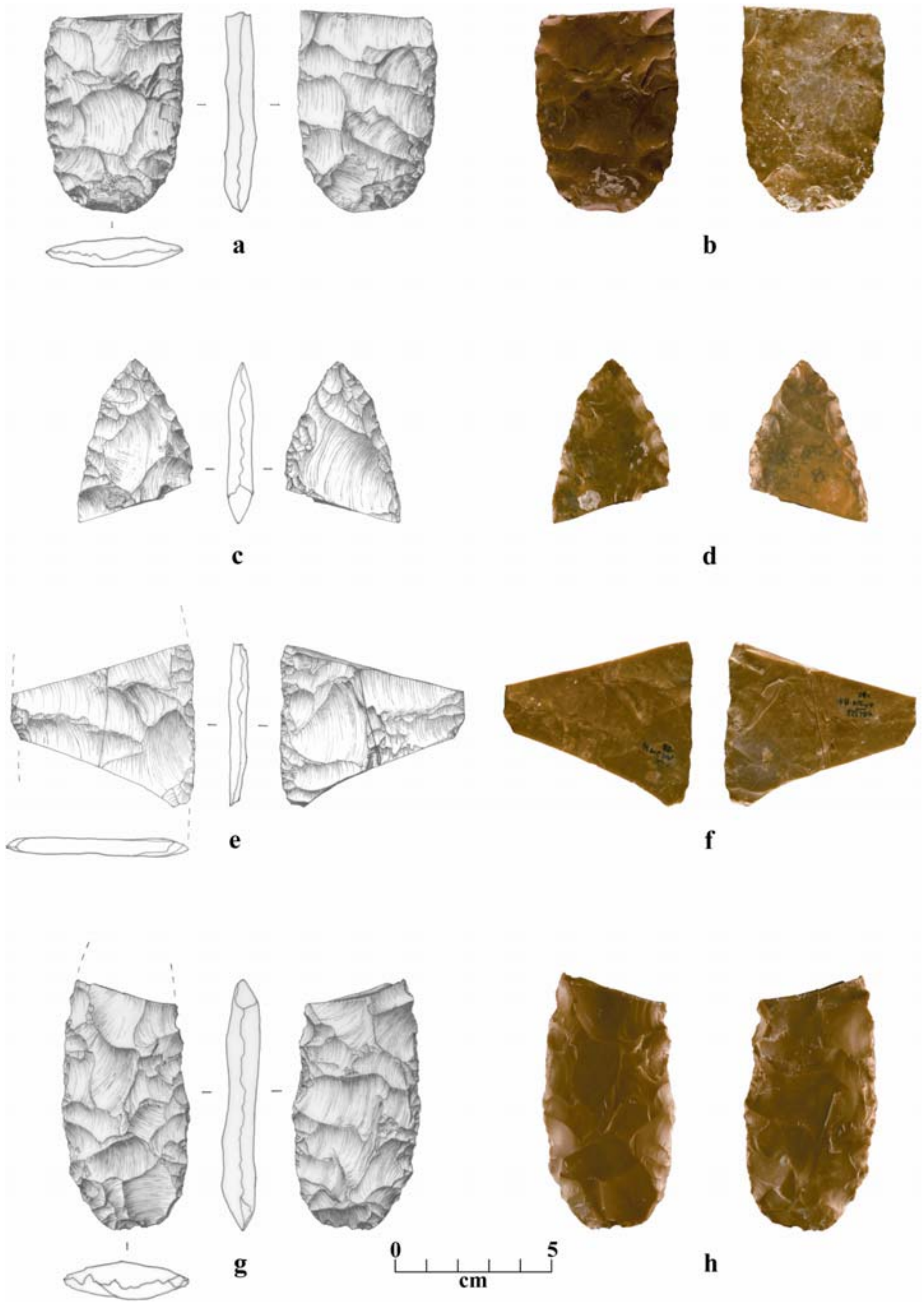


Figure 14. Stage V Bifaces.

proximal fragments, 1 is a medial fragment formed by the refitting of two small "ultra thin" fragments, and 2 are distal fragments (Figure 14e-f). Failure of these preforms include four transverse bending or end snap fractures and one that shattered. Not one appears to have failed due to material flaws or knapping errors such as stacking or hinging problems. The shattered specimen (the refitted "ultra thin" fragments) appears to have either been smashed or dropped onto a hard surface rather than breaking as a result of a knapping failure. Five were recovered from Geologic Unit 3a (including both refitted pieces), and one from geologic units 3a or 3b.

Since all the Stage V bifaces are fragmented, the measurements taken were performed only on those specimens that were believed to represent maximum width. For example, any fragments having one or more edges that were still expanding were excluded. The result (Appendix A, Table 10**)** was an average width of 39.20 mm and thickness of 8.75 mm giving a width/thickness ratio of 4.75:1**.** Table 10 shows how these figures compare to the Adams site and Callahan's findings. Unfortunately, Callahan does not provide any size ranges for his Stage V replications, but does establish a width/thickness ratio of between 4:1 and 6:1+. The Gault findings fall comfortably within his range, albeit, the Gault bifaces are still slightly thicker.

Sanders (1990:43) divided the Stage V bifaces from the Adams site into two categories: two finished non-fluted specimens possibly used as knives, and four distal fragments that were believed to have fractured during the Stage V reduction process prior to fluting. Measurements from these show that they are narrower and thicker than those from Gault. Sanders (1990:43-44) explains that the fragmented bifaces are not clear examples for Stage V preforms and were placed in this category as a matter of convenience and that they need additional reduction in thickness and width before the fluting process could proceed. This suggests that they may actually be late Stage IV or very early Stage V bifaces, as opposed to a more developed and recognizable Stage V. Regardless of the category, the difference in width between Gault and Adams (7.5 - 14.5 mm) is significant and may be related back to initial blank size, with those from Gault being made on thicker and wider blanks.

The Gault preforms were shaped by the removal of small flakes from the basal and lateral edges by light percussion and pressure flaking. This flaking removed any high spots or remaining surface irregularities while shaping the preform into a basic lanceolate form. Some portions of the surface are completely flaked over while remnants of large scars, such as overface or overshot flakes, may only have their immediate edges flaked. Two examples, a proximal fragment and a distal fragment (Figure 14a-b, g-h and Figure 14c-d), typify this strategy. These specimens contain remnants of large scars in the centers of both of their dorsal and ventral surfaces that have been isolated as a result of small flake removals from around their edges. This "edging" has completely eliminated the termination type of the larger flakes, leaving only a suggestion as to whether they terminated on the edge or plunged into an overshot type termination.

Two fragments representing the midsection of a very thin biface were refitted together (Figure 14e-f); however, it cannot be determined what part of the biface these fragments originated from other than they come from the approximate midsection. The point of this description is that it's width of 59.9 mm and thickness of 5.0 mm result in a width/thickness ratio of 11.98 (12:1), which is considerably higher than the average of 5:1 computed for the other specimens. This suggests that it may be a fragment of a very large and thin biface similar to the "ultra thin bifaces" that are often found associated with Folsom technology with width/thickness ratios that range between 7:1 and 13:1 (Collins 1999b:21-22). Although the flaking patterns on both surfaces of this specimen reflect Stage V characteristics, the extreme thinness indicates that it is probably a shattered fragment of an un-fluted tool and not part of the Stage V reduction process. Therefore, it is classified here as an "anomaly."

The final development within the Stage V reduction process is to form the preform into an approximate lanceolate shape. Through continued light percussion and pressure flaking, the preforms are shaped into narrow bifaces having rounded convex basal edges and "bullet "- shaped tips. Some portions of the basal and lateral edges have been ground for platform preparation. In longitudinal cross-section, they are flat and only taper towards the distal tip with the proximal half and mid-section retaining the (approximate) same thickness. The lack of tapering on the proximal end was retained to facilitate flute removal where some thickness is required.

Stage VI, Fluting and Finishing the Point (N = 3)

This is the final stage (Figure 15) in the Clovis point manufacturing process that is intended to prepare the base for the purpose of hafting. It should be mentioned that not all bifaces were reduced to produce a fluted product. The reduction process could

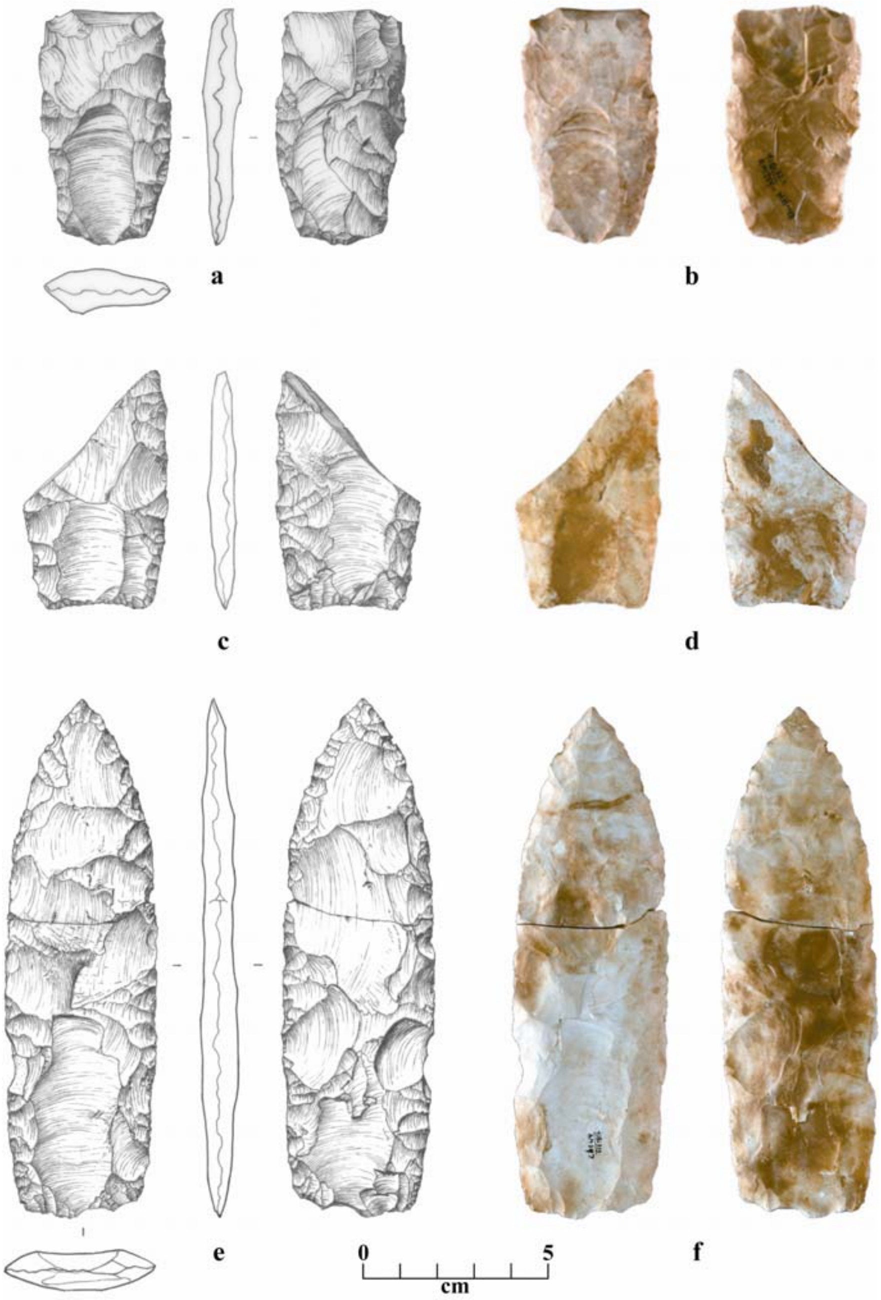


Figure 15. Stage VI Bifaces.

easily have been stopped at any point to satisfy a need for any number of specific tool forms such as choppers, adzes, and scrapers. However, for those selected for fluting, the preform has been sufficiently thinned and shaped to a form satisfactory for the fluting process to proceed.

Three specimens are assigned to the Stage VI category. They include two proximal fragments and a complete specimen formed by the refitting of two halves (Figure 15). All were found in Geologic Unit 3a. These specimens are unique enough that each will be described individually below.

Specimen 1

This specimen (Figure 15a-b) is the proximal half that fragmented due to a transverse fracture. Interestingly, it has not been chemically stained, typical of the majority of chert recovered, but is patinated a gray/white. It measures 63.3 mm long, 36.4 mm wide and is 10.2 mm thick. There is a flute on both it's dorsal and ventral surfaces and a large overface flake that terminated on the opposing lateral edge of the ventral surface. Small flake removals are present along the margins of both surfaces and several large flakes terminating near the mid-line are present on the dorsal surface. One of these flakes terminated in a step fracture and may have been the cause for the resulting failure. The lateral edges are slightly irregular and one side is slightly thicker than the other.

The first flute was a shallow flake removed from the dorsal surface. The type of basal preparation used has been removed by the subsequent beveling of the basal edge for the ventral flute removal. In addition to the edge modification, one of the lateral edges, beginning on the basal corner, has been obliquely flaked and intruded over the flute scar to the midline. This left only half of the flute channel, which appears, to angle towards the other edge. In all probability, there would have to be another flute removed before it would be considered "finished," and the lateral intrusion flakes may have been flaked to "contour" the surface for that purpose.

The ventral flute was successfully flaked but the preform probably end snapped as a result of it's removal. The striking platform was prepared by beveling the edge on the opposite (dorsal) surface. A slight protrusion (nipple) was formed with two isolation flakes removed; one on each side of the nipple. Then the entire edge was ground. The flute flake was probably removed with a punch leaving a small concavity at the point of impact. The fractured edge at this point measures 4.9 mm wide with the flake scar rapidly expanding to 17.7 mm in width and a maximum length of 38.4 mm.

Specimen 2

This specimen (Figure 15c-d) is the proximal portion that fractured just in front of the longest flute scar. The fracture is a perverse type that broke at a steep angle. It measures 64.3 mm long, 39.3 mm wide, and 6.7 mm thick. There are two flute scars on the dorsal surface and a single one on the ventral surface. There is a large flake scar on the dorsal surface in front of the double flute scars that have been isolated by marginal flaking. Most of the surface in front of the ventral flute scar was removed with the missing distal portion, but a remnant of one large scar from the left lateral edge remains. Marginal flaking is present on most of the remaining edges of both surfaces.

The first flute was removed from the ventral surface. It measures 42.1 mm in length and 23.3 mm wide. Remnants of some platform preparation, in the form of edge beveling, remains on the dorsal edge. Grinding is present on the extreme basal edge where it initially extended across the entire edge. At present, it occurs only near the corners. The rest of the edge was removed with the striking platform and flute flakes. Some ventral lateral intrusion is evident on both edges suggesting that basal shaping occurred prior to the dorsal flute removals.

There are two dorsal flute scars present. The presence of multiple flute scars is not surprising as they have been observed on other Clovis points (Meltzer 1987:55; Howard 1990:258-259). The first flute may have angled too far to one side, necessitating the removal of a second flute which probably caused the preform to break. The basal edge on the ventral surface has been beveled and intrudes over the entire basal width of the ventral scar. Other than this beveling, no other platform preparation is indicated such as a nipple or isolation flaking. The remnant of the first flute scar measures 24.4 mm in length by 8.7 mm in width, and the second is 28.1 mm long and 20.6 mm wide. Both the ventral and dorsal flute scars are shallow and wide with no evident negative bulb, indicating a probable soft hammer type removal.

Specimen 3

This specimen (Figure 15e-f) has been refitted together from two fragments forming a complete preform. It is an excellent example of how Clovis preforms were prepared for the final fluting process. As a result of it's breakage during the last fluting sequence, any further modifications were halted, thus, providing a good picture of the final development within the Stage V reduction process.

The refitted pieces measure 138.2 mm long, 41.7 mm wide, and 9.8 mm thick and have a width/thickness ratio of 4.3:1. There is a single large flute on each side. The edges are slightly irregular and contract slightly towards the base. The base is straight, the tip is sharp with no evident blunting, and both surfaces are flat with no central ridge. Two large flake scars on the distal half of the ventral may have been overshot flakes, but both edges around the entire distal tip have been heavily overflaked (with small flakes) removing all evidence of the type of termination. One overshot flake scar is present on the mid-section on the dorsal surface while the remaining flakes terminate near or just past the mid-line.

The first flute was removed from the ventral surface where it overflaked an earlier end thinning flake scar. A large nipple (14.2mm wide) was formed on the basal edge that protruded slightly from the edge. Two small isolation flakes were removed adjacent to each side of this nipple, but the basal edge does not appear to have been ground. The resulting flute scar measures 31.9 mm in length by 21.7 mm in width. The basal edge was subsequently flaked over slightly intruding onto the flute scar as part of reforming the platform for the dorsal removal.

The process for establishing the striking platform for the dorsal flute scar was accomplished in an identical manner as the first by re-forming and isolating a second nipple. However, during this fluting process, part of the basal edge collapsed removing most of the striking platform as well as end snapping the tip. This flute scar measures

54.3 mm in length by 23.4 mm in width. Both the dorsal and ventral flute scars are wide (with little expansion from the platform), shallow, and terminate with only a slight step fracture, indicating the use of a soft hammer billet.

Callahan does not provide any width/thickness ratios for those stages beyond Stage V. This is understandable as the modifications within Stage VI are restricted to the proximal portion solely for the fluting process and should not affect the maximum width or thickness. Therefore, Stage VI width/thickness ratios should fit well with those for developed Stage V preforms. Sanders (1990:45); however, did compute a width/thickness ratio for his Stage VI preforms from the Adams site (Table 13). There were thirteen fragmented specimens in this sample that provided a 4.6:1 ratio. The width/thickness ratio using the two Gault proximal specimens and the refitted specimen averaged at 4.5:1 with the refitted specimen computed at 4.3:1 which fits well with those from the Adams Site (Appendix A, Table 11).

Stage VII, The Finished Point (N = 4)

This stage represents the final step in the Clovis projectile point manufacturing process. It would follow that (after the fluting process was completed) all irregularities on the edges and base would be removed where needed, the tip given it's final shaping, and the basal edges ground in preparation for hafting. Unfortunately, the TAMU excavations did not recover any "freshly finished" projectile points. They did, however, recover four Clovis points that had been essentially "used up." That is, they had been extensively re-sharpened (or broken) and reduced to a stage where they were discarded and replaced.

The four points include three complete specimens and one proximal fragment (Figure 16). Three of these were found in Geologic Unit 3a, and one from Geologic Unit 3b. The following is an individual description of these points.

Point 1

This specimen (Figure 16a-b) is complete measuring 58.1 mm long, 23.9 mm wide, and 8.0 mm thick with a width/thickness ratio of 3:1 **(**Appendix A, Table 12). It may have been longer at one time and re-sharpened to its present length. The base is concave, the lateral edges are straight, and the tip has been re-worked and is "bullet" shaped. The basal edge is ground only on the corners, but both lateral edges are ground for approximately half the point's length. The fragmentary remnants of large lateral thinning scars are on the dorsal surface, but the rest of the point's surface has been obliquely pressure flaked.

The flutes are still prominent on both surfaces. The ventral flute was the first to be flaked and overflakes an earlier flute or end thinning flake. This scar measures 25.5 mm in length and 14.8 mm in width. No remnant of the striking platform for it's removal remains, as the basal edge has been re-shaped for the dorsal flute removal. The striking platform for the dorsal flute was prepared by beveling and grinding the center of the basal edge. There is a deep "notch-like" concavity in the center of the base that may have resulted from the use of a punch placed on the edge for the flake removal. This flute scar measures 24.3 mm in length and 16.7 mm in width.

Neither of the lateral edges along either of the flute scars has been intrusively flaked, indicating they are the original flute scars. This and the lack of any intensive

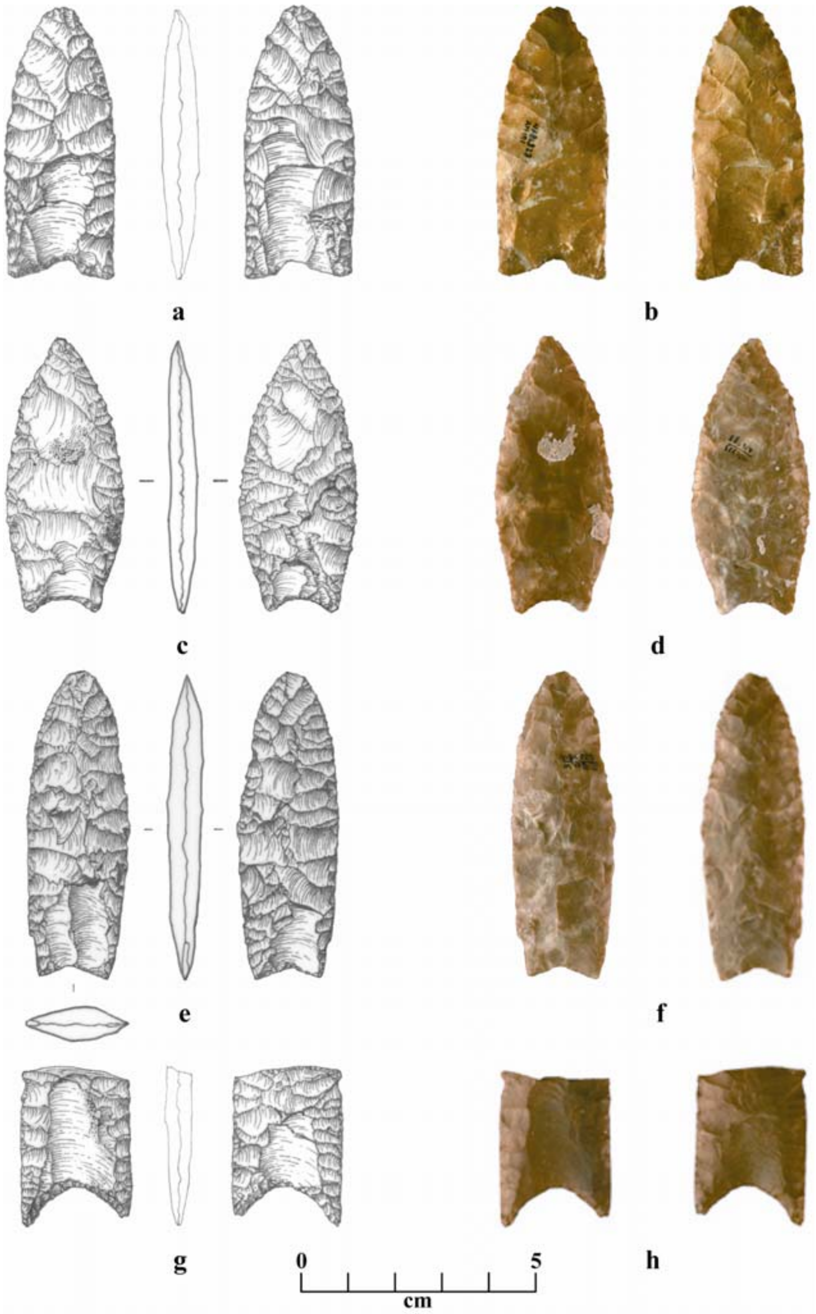


Figure 16. Stage VII Finished Points.

overflaking over the surfaces suggests that, aside from possible shortening, it may be close to its original length.

Point 2

This specimen (Figure 16c-d) is complete but has been extensively re-shaped. It measures 58.8 mm long, 25.4 mm wide, and 5.5 mm thick with a width/thickness ratio of 4.6:1 (Appendix A, Table 12). The proximal end is contracting with a concave basal edge. Grinding is present only on the proximal third of both edges, the lateral edges are convex, and the distal tip has been re-worked. Some remnants of earlier alternate edge overface flaking remain on the dorsal surface, but the margins and most of both surfaces have been heavily pressure flaked.

The base has been broken in the past, necessitating some re-shaping. The resulting modifications reduced the ventral flute scar to 10.2 mm in length by 12.4 mm in width, and the dorsal scar to 13.8 mm long and 12.4 mm wide, as well as narrowing the basal width.

Point 3

This specimen (Figure 16e-f) is complete but has been re-worked, especially on the distal half. It measures 65.1 mm long, 22.1 mm wide, and is 7.5 mm thick with a width/thickness ratio of 2.9:1 (Appendix A, Table 12). The proximal end is slightly contracting with a "V-like" concave basal edge. The lateral edges are convex and ground for approximately half their length, and the distal tip is rounded. The extreme distal tip and one lateral edge on the base have impact fractures with the more proximal one resembling a burin scar, and the distal one significantly rounding the tip. Both surfaces have been heavily pressure flaked with most flakes terminating at or near the mid-line.

There is a single flute scar on the ventral surface and two flute scars on the dorsal surface. The ventral flute was removed first and the extreme edge beveled slightly for the dorsal removals. This scar is 16.6 mm long and 11.6 mm wide and has some lateral intrusion on both sides. The dorsal scars are parallel flaked with no lateral intrusions and may be pressure flaked basal thinning scars and not true flutes. They measure 21.0 mm and 19.6 mm in length and 8.8 mm and 5.3 mm in width.

The base was re-worked with the ventral flute represented only by the distal portion of the original scar and the dorsal scars are evidently a re-flaking episode to re-thin the base. The distal end has been re-worked along one lateral edge for approximately half the point's length. A slight swelling at the juncture of this edging with the lateral grinding indicates that the point was definitely wider at one time.

Point 4

This specimen (Figure 16g-h) is a proximal half that measures 34.3 mm in length, 23.5 mm wide, and 5.9 mm thick with a width/thickness ratio of 4:1 (Appendix A, Table 12). The unground basal edge is deeply concave. The lateral edges are straight and ground to just below the fractured edge, and a distinct flute is present on both surfaces. The ventral flute was flaked first and is 25.5 mm long and is 16.2 mm wide. It is slightly irregular due to some lateral flaking and has overflaked an earlier flute or end thinning flake. The dorsal flute is 18.5 mm long and 14.7 mm wide and also contains some minor lateral flaking onto the flute scar. Some minor flaking has been conducted on the basal edge on both surfaces, but this was probably performed after fluting to regularize the edge and/or flatten any prominent flake scar ridges.

This point is the only artifact in this analysis that is made of a non-local material. Some quartzite and a few varieties of local chert have been noted in some of the other artifact categories, but this point is made of an unknown form of jasper. It's basic color is a chocolate brown whose Munsell color is 5YR3/4 (dark reddish-brown) that is speckled throughout with very small bluish-white spots. It has similarities to a number of jaspers, some occurring as far away as the Central Plains, however, without a definite match, no specific region can be assigned with any certainty.

It is also of a style unlike the other specimens, having a very prominent basal concavity. This form is more similar to some of the later types that occur in the Northern Plains or in the Northeast. However, it was found in one of the deepest contexts of the site, a "pocket" in Geologic Unit 1 at the base of Geologic Unit 3a, suggesting that it is contemporaneous with the earliest occupation of the site.

It can be deduced from the above descriptions that these points are not fresh finished points, but have been subjected to varying amounts of re-modifications. It is interesting to note that several of the points indicate that they had been curated for some time through careful maintenance procedures. Point 2, for example, suffered a broken base, necessitating the reforming and thinning of the entire base which resulted in the narrowing and removing of most of the flute scars. Point 3 also had it's base and tip fractured, and it too was re-shaped to a functional state. These attempts at maintaining their usefulness suggests that the original owners were not always in a position to replace these points; therefore, even after severe damage, there was a need to carefully repair them back to a useful stage.

A point that has not been addressed thus far concerns the use of abraders. It has already been mentioned that no identifiable percussors were recovered, but that some of the limestone nodules (common within the creek deposits) could have served as hard hammers. However, the use of these is only conjectural due to the eroded nature of the limestone found within the Clovis levels. Portions of the cortical surfaces remaining on the surfaces of several of the blade cores and a small fragment of a thick cortical material (not part of a limestone nodule) contained a number of incised straight lines concentrated on portions of their surfaces. The nature of these lines, especially the small cortical fragment whose surface is completely covered by deep incised lines, suggest that these areas were used to abrade or grind the edges of platforms or the proximal portions of finished points. Experimental use of such surfaces showed that with enough pressure they could successfully be used as edge abraders.

Bifacial Cores (N = 3)

The previous discussion has centered on the manufacture of fluted bifaces through a series of established stages using cores and blanks made from blocky to thin tabular chunks of chert, large flakes and blade-like flakes. The primary aim of this systematic reduction of bifaces from blocky cores (Lothrop 1989:108-113; Johnson and Morrow 1986:140-144; MacDonald 1968:66) was not only to produce fluted points, but also a number of other bifacial tools, such as knives, choppers, and adzes.

However, within the overall bifacial reduction technology, there is another strategy of core production designed to initially produce flakes for the manufacture of a number of simple flake and blade tools. This is a type of reduction known as *bifacial core technology* (Johnson and Morrow 1986:140-144; MacDonald 1968:62-67) where cores, produced within this category, provide flexibility within the tool manufacturing trajectory by allowing for the production of usable flakes without destroying the capability of producing larger bifacial tools, preforms, or projectile points. This strategy has been described as part of Clovis and other Paleoindian adaptations (Boldurian 1985, 1991; Lothrop 1989; MacDonald 1968; Morrow 1996; Stanford 1991) which incorporates a variety of biface cores ranging from large well crafted bifaces to thick and irregular bifaces. It is similar to another Paleoindian-Indian flaking strategy known as *opportunistic flake production* where flakes were produced from inferior pieces of raw material, without any particular reduction sequence in mind (Bouldurian 1985; Frison and Bradley 1980).

The bifacial core technology maximizes the choices available from a piece of stone (Johnson and Morrow :1986:144) while providing an excellent form of portable raw material (Goodyear 1979). The idea behind this strategy is to roughly reduce the core at the quarry where any material flaws or knapping constraints would be recognized and/or removed while providing a good knowledge of the flaking quality. Thus, the core would be reduced to a transportable state where all the waste flakes and debris would be left at the quarry site and platforms set up along one or more edges for usable flake production. If material flaws or other problems were found to be too great, the core would be discarded at the quarry. After all, it is not too productive to rely on or expend the energy to carry flawed or unusable material for any distance. For those cores that were accepted, they could be taken to other locations where all usable flakes would be removed from the prepared edge until exhausted, the opposite edge would then be set up for additional flake removals or the process halted to form a larger bifacial tool (MacDonald 1968:66).

All of the examples collected by TAMU are of the thick irregular form with no examples of the large well made types represented, although one of these (mentioned previously) was noted in the UT Gault collection. Three examples have been classified as possible candidates for bifacial cores (Figure 17). All three have flake scar patterns that do not conform to the patterns typical of any of the stages described previously. These are poorly flaked, thick, irregular shaped bifaces formed by hard hammer percussion. The percussion flaking has removed most of the cortex, but small amounts remain on all three specimens. All contain serious knapping errors such as large hinge terminations, step fractures, severe stacking, and/or serious cracks, inclusions, and other material flaws which caused them to be rejected. Two were found in Geologic Unit 3b and one in either Geologic Units 3a or 3b.

These cores have an average length of 135.5 mm, 78.0 mm wide, and 41.4 mm thick with an average width/thickness ratio of 1.9:1 (Appendix A, Table 13). They are bi-convex in cross-section and roughly ovoid in shape. The flake pattern consists of a random radial pattern of percussion flaking with most terminations ending near or just

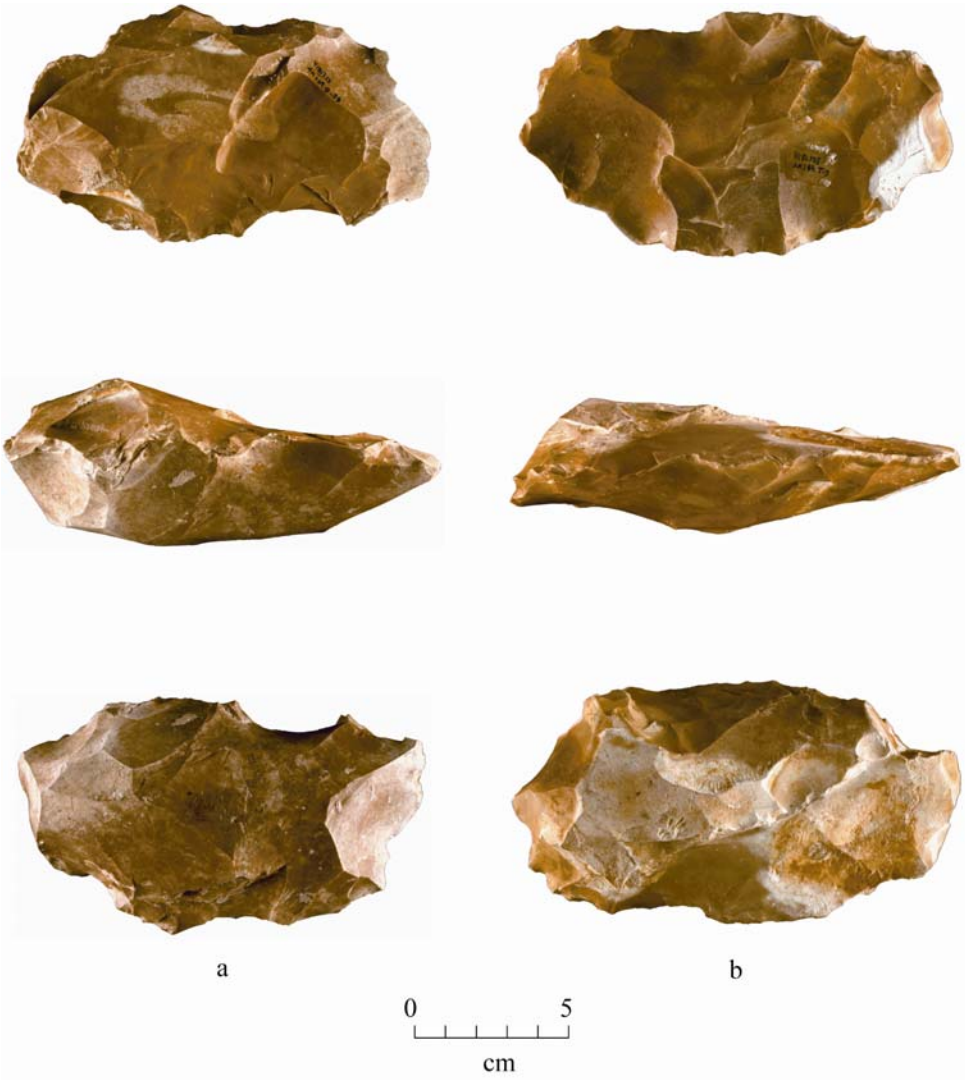


Figure 17. Bifacial Cores.

past the mid-line. Some remnant flake scars indicate that larger overface flakes may have been removed previously. The largest flake scars are typically found on only one of the surfaces, while the other, more convex, surface consists of smaller flaking around the margins with some overflaking of larger scars. This marginal flaking was performed to establish striking platforms along the edges for flake removals from the opposite face.

The descriptions of these cores fit fairly well within the idea of the bifacial core technology. But were they intended to be bifacial cores. Or, are they the result of some other process? As mentioned above, all examples contain knapping errors and material flaws, especially cracks, which probably led to their rejection. If they were never intended to be transported, but were made to produce flakes on site, the opportunistic flake production strategy utilizing poorer grades of material (Frison and Bradley 1980:22) may be appropriate here. However, Gault is a quarry and quarry camp situation (Dickens and Dockall 1993:64-65) and, unless they were intended to produce a specific type of flake, there should have been an abundance of flakes available on site as a result of other knapping episodes.

There is an alternate explanation for these poorly flaked bifaces and that is the idea of "novice knapping." Since this idea is often difficult to identify it is usually overlooked. However, quarries provide excellent opportunities for knapping lessons where material constraints are not an issue. This novice or practice flaking is already well known from Gault. During the Archaic, the site was active in the manufacture of *Andice* points, which are characterized by long barbs and very deep notches (Perino

1991:4; Turner and Hester 1993:71-71). Such notching requires great skill and many flakes or fragmented bifaces that were used for this "practice notching" have been recovered from Gault (Turner and Hester 1993:265-266). These activities would easily result in the production of an unknown number of crude bifaces and/or other tools. Typically, such bifaces would simply be "factored in" with other biface or tool discards in an analysis, resulting in some bias within the final conclusion. Therefore, identifying novice knapping, or at least recognizing it, may have an important role to play in studies such as this.

Specialized Flakes

The approach used in this analysis is to determine a reductive process for the Gault bifaces by separating the bifaces into appropriate reduction stages based on identifiable technological attributes predetermined for biface manufacturing sequences (Holmes 1890, 1891; Crabtree 1966, 1972; Muto 1971; Newcomer 1971; Collins 1975; Flenniken 1978; Callahan 1979; Sanders 1990). These sequences usually include a number of stages that are differentiated by the amount of cortex present and degree of edging, thinning, and shaping combined with visible flake scar size and patterns. The different stages are often substantiated by waste flake (debitage) analysis. The premise behind waste flake analysis is that the size distribution of debitage within an assemblage can reflect the stages of reduction. This is based on idea that the size of waste flakes from bifacially flaked artifacts will decrease systematically from the initial stages of manufacture to the final finishing stages (Newcomer 1971; Henry and Bradley 1976; Stahle and Dunn 1982). In addition, other discrete attributes, such as amount of cortex, platform angle, type, size, bulb and termination types would also be included within such an analysis.

The use of debitage in bifacial reduction studies, in most contexts, is a sound model and is one that has been used extensively, but it does not fully address assemblages containing variations within the reduction process. For example, the idea that waste flakes decrease as reduction continues is not valid within the Gault/Clovis reduction scheme where large overface or overshot flakes, having a maximum size limited by biface width, were being removed as late as Stage V. Although flake size is not the only indicator used for defining reductive stages, it was believed that relying on flake size along with their discrete attributes would not be very useful for the Gault analysis. Thus, a slightly different approach in analyzing the debitage was necessary in order to establish support in defining the technology for each of the different stages. This was accomplished by selecting from the debitage those flakes considered significant within the reduction sequence.

There are approximately 80,000 pieces of debitage that were recovered with small flakes (less than 1/4 inch) making up the majority of the total. Each flake was examined and the following categories were created: large flakes, problem removal flakes, winged flakes, and overshot flakes. These categories are discussed below.

Large Flakes (N = 114)

Large flakes are useful in determining the type and form of blank utilized, how the reductive process was initiated, and how it preceded. Some attributes for these flakes (i.e., size and dorsal scar patterns) (Appendix A, Table 5) were briefly discussed within the Stage I section. Only those flakes (whole and broken) that exceeded a minimum size of 45 - 50 mm were chosen (Figure 7). For inclusion, the broken flakes needed to contain the proximal end and/or estimated to be more than half of the original flake's size. They were analyzed using the standard attributes, such as, presence and amount of cortex, platform type, size and angle, presence and type of bulb of percussion, dorsal scar pattern, and termination type.

Tables 5, 14 through 15 (Appendix A) provide a listing for the various attributes for large flakes. Natural and plain platforms (Appendix A, Table 5) dominate all three (primary, secondary, and interior) flake categories with some dihedral and polyhedral types appearing in the secondary and interior flake categories. As would be expected, there is little platform preparation present on the primary flakes (only some minor grinding), while both platform isolating and grinding becomes predominant on the secondary and interior flakes.

The averages for the platform angles (Appendix A, Table 14) are high for each flake and platform type, averaging between 70° and 90°. Platform thickness (Appendix A, Table 15) for natural and plain platforms average between 8 mm and 9.4 mm on the primary flakes and decreases slightly to 5.3 - 8.0 mm on the secondary and interior flakes. Interestingly, the width of the natural platforms remains relatively constant (21.1 - 22.9 mm) within each flake type, while the plain platform decreases slightly (14.8 - 15.2 mm) on secondary and interior flakes. Understandably, dihedral and

Polyhedral platforms are slightly smaller (17.4 - 17.7 mm) and thinner (4.4 - 5.9 mm) on the secondary and interior flakes (Appendix A, Table 15).

Feathered terminations are the primary termination type on the secondary and interior flakes. Hinged terminations are the second most abundant type and are evenly distributed on the primary and secondary flakes with a slight increase on the interior flakes (Appendix A, Table 5). Not included here are the overshot flakes which are discussed separately below.

Although, the exact stage from which these flakes were removed cannot be determined**,** the findings do support the idea that large flakes were removed, not only during the early stage reduction, but from later stages as well. For example, it has been determined that higher edge angles are best suited for large flake removals and feathered type terminations (Bonnichsen (1977:170; Whittaker 1994:91). The closer to 90E the more the fracture, initiated from the applied force, will be directed into the blank, rather than bending outwards, resulting in longer flakes. The dorsal scar patterns on the secondary flakes are predominantly uni-directional with bi-directional flaking coming in second (Appendix A, Table 5). This trend shifts on the interior flakes where the uni-directional flaking was replaced with bi-directional and radial flaking, indicating large flakes continued to be removed during later reduction stages.

Natural and plain platforms are indicative of little edge preparation and, coupled with high edge angles and thick platforms, they suggest that flakes were being removed from relatively thick and square sided edges, even after most of the cortex has been removed. The presence of a few secondary and interior flakes having dihedral and polyhedral platforms as well as platform isolating and grinding, suggest that some flakes were carefully prepared to insure a more successful removal.

The presence of platform lipping and bulb sizes is often used as indicators for the use of hard-hammer or soft-hammer percussion (Andrefsky 1998:114-117; Crabtree 1972:44; Kooyman 2000:78-81). Hard-hammer flakes are usually described as having pronounced bulbs of force, no lipping, and slightly crushed platforms (Crabtree 1972:44), while flakes removed by soft-hammer have a lipped platform edge and diffuse bulbs (Crabtree 1972:74). This view, however, is not universal as some researchers have found that lipping may not always be a good indicator for soft-hammer percussion (Patterson and Solberger 1978) as lipping and/or diffuse bulbs can also be produced in hard-hammer percussion (Whittaker 1994:187).

Keeping these issues in mind, a study of the ventral surfaces of the large flakes showed a strong tendency for hard-hammer use for primary and secondary flake removals and only slightly less on interior flakes with natural, plain, and some dihedral platforms. Soft-hammer use was highest on flakes with polyhedral platforms, but was also used on plain and dihedral types as well. Interestingly, there are a number of flakes having obvious (strong) bulbs with lips suggesting the possible use of a "soft" hard-hammer percussor. Even though this was a quarry site, only one hardstone cobble that could qualify as a hammerstone (Figure 18) was recovered from the Clovis levels. This particular specimen is an elongated quartzite cobble that has some crushing on both of its ends. In addition to this crushing, one end has been fractured at an angle that is reminiscent of a bit used for a gouge. Although it can be argued that the crushing on

Figure 18. Hammerstone/Gouge.

the ends is indicative of use as a hammerstone, the fractured end also suggests its use as a gouge.

However, hundreds of small to medium sized limestone cobbles, many suitable for percussion use, were noted in the gravels. Flaking experiments (on Gault chert) using some of these limestone cobbles showed that they were effective as hammerstones and produced similar moderately-strong bulbs and small lips. Since all the limestone cobbles recovered from the Clovis levels and gravels were highly eroded, all evidence of battering would have been removed, which initially resulted in their going un-noticed as possible tools. Of some interest, the largest flake recovered is a secondary flake, measuring 149.2 mm long, 114.4 mm wide (5.9 X 4.5 inches) and 11.5 mm thick (Figure 7e-f). It has an isolated and ground dihedral platform (48°) that is strongly lipped with a diffuse bulb. These attributes are all typical of soft-hammer removal which shows that some very large flakes were removed by soft-hammer.

Problem Removal Flakes (N = 51)

This category consists of those flakes that represent a partial or successful removal of problems created either by a knapping error or material flaw (Figure 19). They serve as excellent indicators for the problems encountered and the manner in which they were corrected. The majority of the problems were stacks and humps created by failed flake removals (i.e., step fractures and hinge terminations). Other problems include deep concavities created by excessive bulbs and plunging fractures, and cracks within the material.

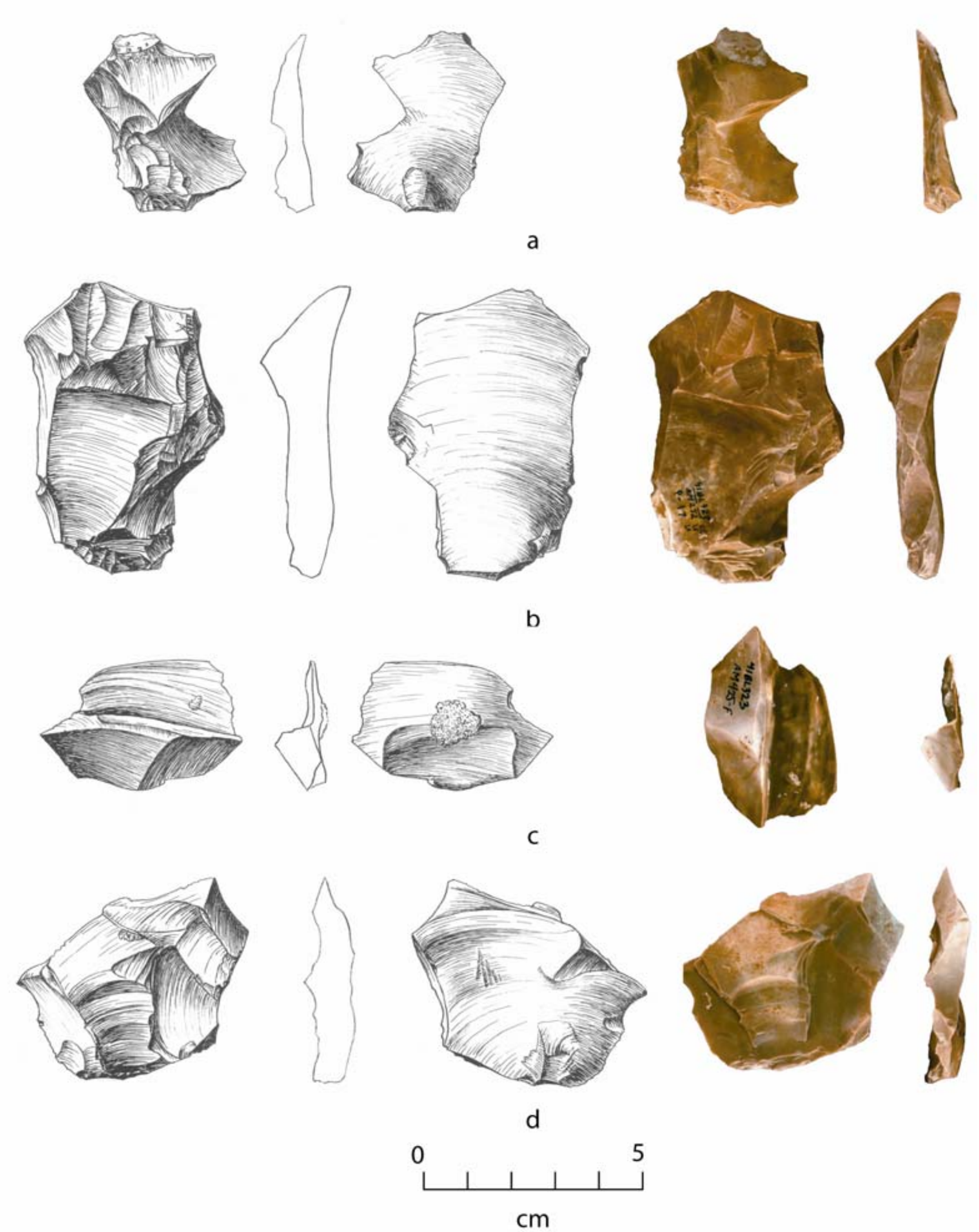


Figure 19. Problem Removal Flakes.

The stacks and humps were most often created by multiple flaking attempts to clear an earlier failed flake, crack, or remove surface irregularities. Insufficient force of blow, excessive striking angle, and cracks are some of the causes for flakes to terminate abruptly in a right angle. Subsequent flaking into these termination points often fails creating a "mass" of material to build up. As this mass builds up, flakes driven toward it will often stop and break at its edge resulting in an additional build-up of material. In addition, some of these flakes will plunge or hinge often creating deep concavities at the point of termination.

The idea behind correcting these problems is to run a flake under the mass, hump, crack, or depression with the intent that the fracture will pass under the problem without stopping. The Gault knappers were successful at "clearing" many of these problems. The flakes produced to remove these problems are thick with moderately strong to strong bulbs (only one contained a lip), indicating removal by hard-hammer percussion. Most of the platforms are plain (75%), but some were natural (25%). Platform thickness ranges between 2.3mm and 13.6mm, and platform angles range between 53° and 98° with most nearer to 90°.

Several problem removal flakes are hinges formed by two opposing flakes that terminated short of each other creating a railroad rail-like ridge between the two termination points. One of these was removed via a large flake; the other had only the ridge removed. Two other flakes contain plunging hinge fractures on their distal ends which also retain portions of the blank’s lateral edge. It was determined that the direction of the plunging flake scars originated on the opposite edge and were flaked across the face of the blank terminating a few millimeters short of the opposite edge. These flakes, therefore, are good indicators that some flakes terminated at or near the opposite edge. A few of the stacks were on or near a lateral edge where they had been built up by numerous small flake removals, probably as a result of platforming for flaking the other surface, or attempting to flake under some cracks. Some of the stacks contain radial-like scar patterns around them, indicating that there had been several earlier failed attempts at removing them before the knapper was successful.

Three flakes were obvious attempts at flaking under some cracks. Two were flaked from a distal or proximal end of a narrow tab; one was evidently unsuccessful (it broke at the crack) but removed an earlier step fracture, also caused by a crack. The other removed an end thinning flake scar that created a deep concavity from a very prominent bulb and terminated abruptly at a crack. The third flake is an excellent example of a successful problem removal flake. It is a long blade-like flake (154.2 mm) with a bi-directional blade-like dorsal scar pattern that is from either a blade core or a biface blank's lateral edge. This flake successfully passed under several prominent cracks, some small step fractures and two small bulbs (flaked from the flake's lateral side), all of which are on the distal third of the flake.

Sequent Flakes (N = 63)

The flakes within this category are not usually recognized nor included in a biface analysis; however, the relatively high numbers of these flakes recovered indicate that they could be relevant to this analysis. Sequent flakes are distinctively shaped (Figures 20-21), especially when viewed on their platform edges. They are shaped

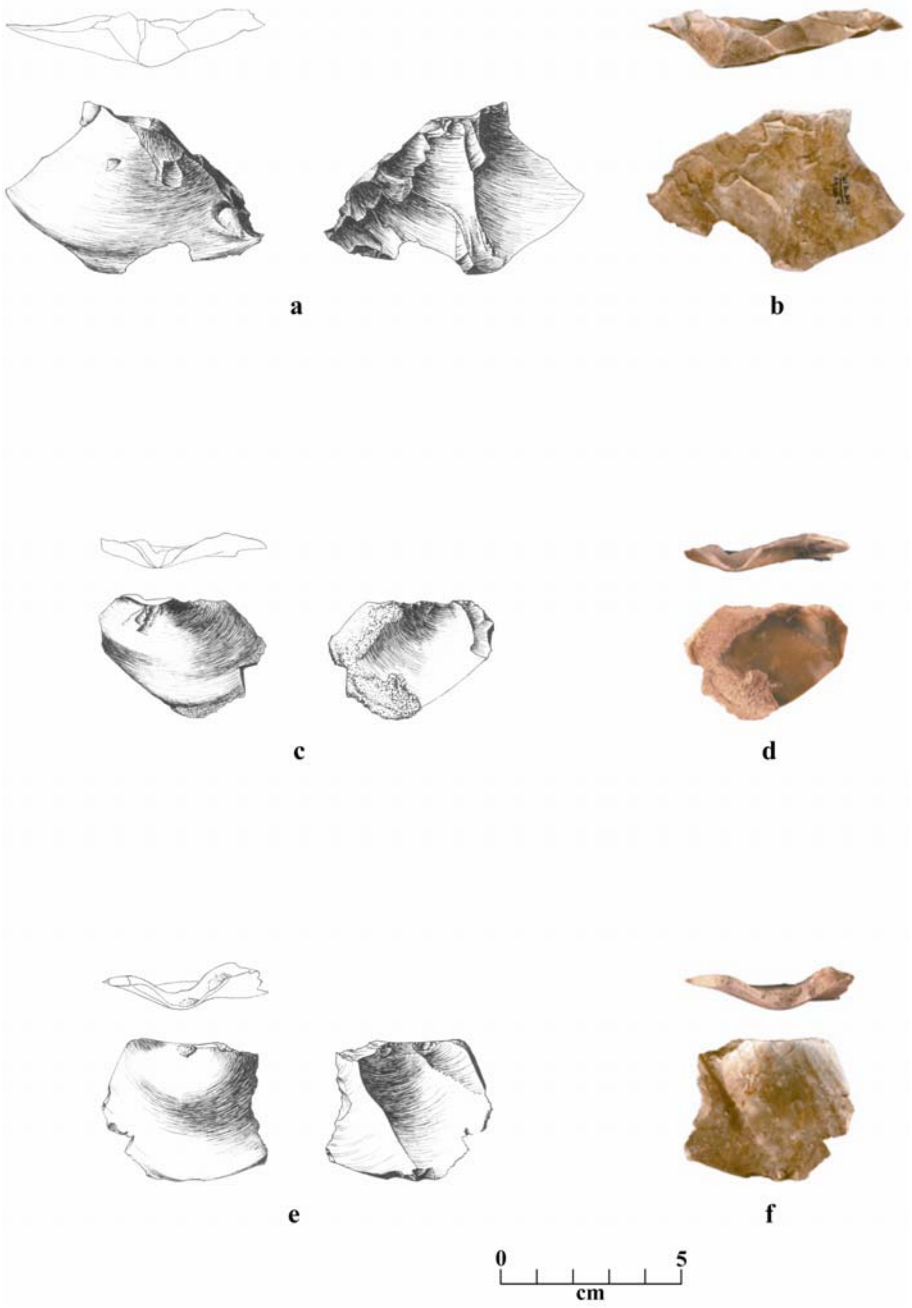


Figure 20. Sequent Flakes.

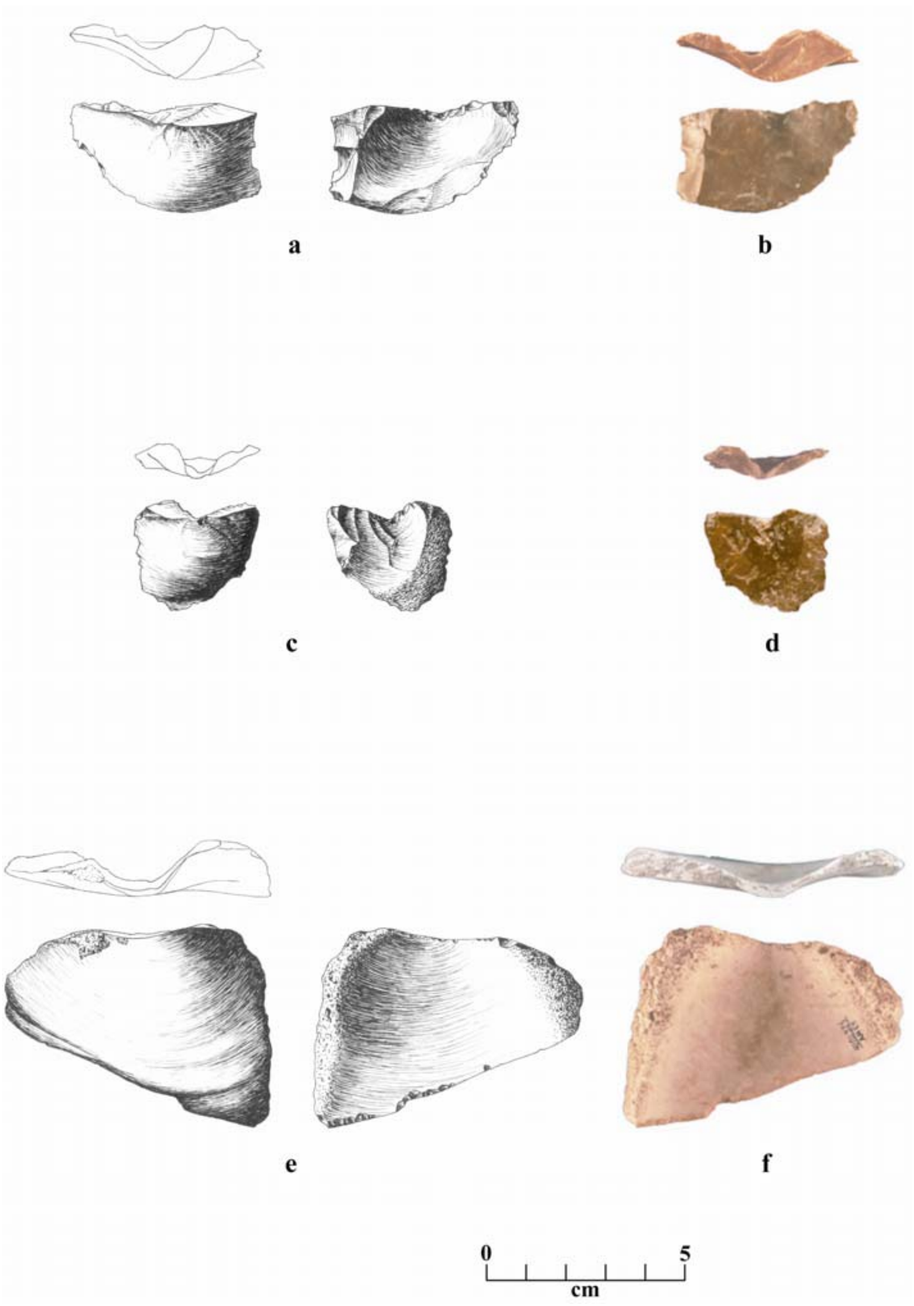


Figure 21. Sequent Flakes II.

much like a "V" where the platform angles sharply down into a steep depression while the edges flare up and outward forming a winged shape. The depth of the "V" varies and is directly related to their sequence of manufacture.

The various attributes for the sequent flakes are provided in tables 16 through 18 (Appendix A). Although they are often as long as they are wide, they are usually wider than long with widths ranging up to 37 mm (1.5 inches). The dorsal surfaces adjacent to the central depression may or may not contain cortex, indicating some production prior and after complete cortical removal has been accomplished. The dorsal flake scar patters may be uni-directional, bi-directional or radial, but most are uni-directional with 56% for primary flakes and 81% for secondary flakes (Appendix A, Tables 16-17).

The platform angles are steep with 78.3° for secondary flakes and 72.4° for interior flakes (Appendix A, Table 17). The platforms vary, but most are plain having little preparation with 53% for primary flakes and 65% for secondary flakes. Platform thickness (Appendix A, Table 18) varies with the size of the flake, but most are thick with 63% exceeding 3.0 mm for primary flakes and 80% exceeding 3.0 mm for secondary flakes.

These flakes were produced by a repetitive flaking from the same point. The flaking sequence began by knocking a small flake from the flat surface of a tab or blank using light hard-hammer percussion. Subsequent flakes were removed by striking directly below the point of impact struck by the previous removal. Each flake removed is slightly larger, with its corresponding negative bulb scars and respective bulbs becoming larger and more prominent than those from previous flake.

The term "sequent flake" was first used to describe a distinct flake type used as a scraper found at Amistad Reservoir in Val Verde County, Texas (Nunley et. al. 1965:74). These flakes were produced by the repetitive removal of flakes from elongated nodules, much like a loaf of bread. Each flake was struck at the same point directly behind the previous one which resulted in producing a bulb that increased in depth with each subsequent flake produced. Once, however, the bulb became to large or other material factors became evident that could affect successful flake removal, the point of impact was shifted to another point on the nodule's surface.

Another similar type of flake has been identified within the lithic debitage of the Mousterian Levallois, Egyptian Neolithic, and the Near Eastern Bronze Age of the Old World and is believed to have been produced during some forms of platform preparation. This is the proximal (butt) end of a flake, formed by the removal of two exactly superimposed flakes, that when viewed end-on, appears "winged" (Inizan et. al. 1992:80-82).

Frison and Bradley (1980:18,21) describe similar flakes that were produced during discoidal core manufacture at the Hanson site. These are described as flakes with thick, wide platforms, a simple flake scar pattern, low flake scar counts, and a triangular longitudinal cross-section. Although considered as part of the discoidal core manufacture at the Hanson site, Frison and Bradley recognized that similar flakes also occur in other flake production systems, especially during preliminary stages of manufacture.

Experimental replications showed that these flakes could be produced as part of a process for setting up and isolating platforms. Several members of the Belton Knap-in, a gathering of flint knappers first established by J. B. Solberger in the late 1960's, were asked to use this method during bifacial thinning. The result was that the platforms produced enabled large flakes, many terminating near or over the opposite edge to be easily removed suggesting a suitable use in biface reduction in addition to blade manufacture.

As mentioned previously, each flake produced resulted in a larger, more prominent bulb with the lateral edges of the flake flaring up and over onto the tab or blank's surface. When two widely spaced sets of these flakes are removed, a prominent and isolated "hump" is formed between them. The edge of this hump can then be modified into a raised and well-isolated platform. A single set may only be necessary if the surface already contains some undulations or concavities. A drawback could occur if the sets are flaked too close together or if too many flakes are removed which would begin to overflake and decrease the height of the hump. The dorsal surface of these humps often angle into the blank's mass, whereby minor flaking (of this surface) will easily flatten the surface or, in the case of blade production, produce a desired striking angle. The result is a pronounced platform that is very effective in removing large flakes. Although no such flake removal patterns were noted on any of the bifaces analyzed, some were evident on a few of the large and overshot flakes. This is not surprising, as any such evidence would easily be removed during bifacial edge trimming or additional platforming. They were noted, however, on many of the blade cores recovered where they may have been utilized more extensively for blade production.

Overshot Flakes (N = 185)

Recent interpretations of Clovis lithic technology have included the use of overshot or *outrepassé* flaking as a principal reduction technique (Bradley 1982, 1991, 1993; Morrow 1996; Johnson 1993; Collins 1999a, 1999b; Frison and Bradley 1999; Kooyman 2000; Dennis Stanford, personal communication 2003). Previous interpretations have recognized the presence of overshot flaking within the Clovis manufacturing sequence but considered it's presence as a knapping error and not as an intended strategy (Callahan 1979; Sanders 1983; 1990; Verrey 1986; Patten 1999). Indeed, most researchers and modern knappers consider overshot flakes as a flaking mistake often requiring substantial edge reshaping or resulting in rejection of the preform/blank. In contemplation of these issues, the high number of overshot flakes recovered from Gault provides an excellent opportunity to analyze their place within the Clovis lithic technology.

As discussed briefly in the bifacial stage reduction sequences, the overshot flakes recovered were divided into two types (i.e., partial overshots and full overshots). Of the 185 overshot flakes recovered, 121 were classified as partial and 64 as full overshots (Appendix A, Table 3). The partial type (Figure 5e-j) occurs on square sided core/blanks and is those flakes that fracture across the surface of the core/blank, plunging over the opposite edge, and terminating on the lateral edge. These flakes retain part of the "vertical" lateral edge without removing any of the ventral surface. Full overshots (Figure 5 a-d) are the more "classic" type that fracture across the surface of a core/blank whose dorsal and ventral surfaces have converged, plunging over the opposite edge retaining part of both surfaces.

Overshot flakes were recovered from within both geologic units 3a and 3b. Full overshots were split evenly between the two units with 31 from Geologic Unit 3a and 28 from Geologic Unit 3b, and the remainder from either geologic units3a or 3b. Partial overshots, however, were much more abundant in Geologic Unit 3a with 74, than in Geologic Unit 3b which totaled only 32, with 13 coming from either geologic units 3a or 3b (Appendix A, Table 2). These findings indicate a continued use of this strategy throughout the Clovis occupation.

Partial overshot flakes were flaked across the surface of thick, square or vertical sided core/blanks, often at an oblique angle, but some were removed across the proximal and distal corners. These flakes are generally thick with midsections averaging 12.0 mm for primary flakes, 11.1 mm for secondary flakes, and 10.8 mm for interior flakes. Seventy-five of the 121 partial overshot flakes are complete and 43% of these have platforms that exhibit grinding and 27% have isolated platforms. Platform types include natural, plain, dihedral, and polyhedral with the natural and plain types being the most common (Appendix A, tables 4, 19). Total platform angles (all platform types) average 78.5° for the primary flakes, 82.0° for secondary flakes, and 75.9° for the interior flakes. Platform thickness (all flake types) is highest for natural platforms which range between 6.4 and 9.1 mm, while the remaining platform types range between 3.1 and 6.0 mm (Appendix A, Table 4).

Partial overshot flakes occur within all the major flake types (i.e., primary, secondary, and tertiary or interior) (Appendix A, Table 3) indicating a continued removal pattern after the cortical surface had been removed. These flakes were useful in maintaining surface contour by removing humps, stacks, and hinged terminations, rapidly reducing thickness, and allowing for the creation of platforms by angling and bringing the edges of the dorsal and ventral surfaces together.

The removal of partial overshot flakes was also used in conjunction with corner or edge blade removals. Fourteen percent of the partial overshot flakes contain corner edge blade scars on the distal corners or edges. The flake patterns noted on these removals are predominately uni-directional removals, but a few are bi-directional.

Overshot flakes continued to be produced after the core/blank had been significantly thinned and both the ventral and dorsal surfaces had converged. The result is that the plunging fracture on the distal edges of these thinned blanks began to include both dorsal and ventral surfaces creating the full overshot type. Like partial overshots, these also occur in all three of the major flake types, with most (61%) falling within the interior flake type and only three within the primary flake type (Appendix A, Table 3). Most are broken, with only 21 of the 64 full overshot flakes being complete. Platform types are predominately natural (28.5%) or plain (33%), with dihedral and polyhedral types represented by single specimens each, and the rest having crushed or missing platforms (Appendix A, tables 19-20). No platform angles were obtained from the primary overshots, but the average platform angle (all platform types) for the secondary flakes is 82° with a range of 57° to 93°, and 72° with a range of 56° to 84° for the interior flakes.

Platforms are often thick with a 4.4 mm average for natural platforms on secondary flakes and a single thickness of 9.5 mm for interior flakes. Plain platform thickness averages 4.9 mm for secondary flakes and 2.8 mm for interior flakes. Only one dihedral platform was noted on the secondary flakes and it measures 10.6 mm thick, while dihedral and polyhedral platforms (one each) are present on the interior flakes and range between 4.3 mm and 2.4 mm respectively (Appendix A, Table 20). Platform isolation is present on 41.3% of the secondary flakes and 50% of the interior flakes. Grinding is present on 41.3% of the secondary types and 70% of the interior types. These figures show that both the partial and full types were prepared similarly; that is, high platform angles with relatively thick platforms on the thicker preforms and more carefully prepared platforms (i.e., increased isolation and grinding combined with steep angles) on the thinner, later staged preforms.

As was noted on the partial overshots, the distal edges on 22% (N = 17) of the full overshots also contain corner blade removals (Figure 8). One of these is on a primary flake, 7 are on secondary flakes, and 9 are on interior flakes (Appendix A, Table 8). Two specimens have corner removals present on both their dorsal and ventral surfaces with all but two of these being uni-directional removals. In addition, five contain remnants of end thinning scars on their dorsal surfaces. These flakes show that they were removed after end thinning removals were performed, fitting nicely within the late thinning sequences noted on the bifaces. Examples of end thinning flakes are shown in Figure 22.

The previous discussion has been a description of the basic attributes for the full overshot flakes recovered from Gault. These attributes substantiate that their manufacture was typical (i.e., establishing strong, often isolated, platforms with relatively steep angles that are set well above the center plane of a bifacial edge). The establishment of such platforms enables overshot or large oversurface flakes to be struck off by a heavy blow directed into the mass (as opposed to a more arching blow) which increases the ability of the fracture to travel completely across the blank's face (Bonnichsen 1977:128,132; Cotterell and Kamminga 1979:103-104).

It was found that the distal edges of the overshot flakes (all flake types) contain edge angles that range from a low of 38° to a high of 91° (Appendix A, Tables 21-23). Individual flake type averages include 73.5° for primary flakes, 64.9° for secondary flakes, and 62.5° for interior flakes. Forty-six percent (N = 43) of the flakes having measurable distal edges contain small flake scars on portions of the dorsal and/or ventral edges of their distal edges. These edge modifications suggest probable platform preparation where varying portions of an edge were beveled (higher edge angles) or flaked to more desired angle.

Beveling, for example, has been suggested by modern knappers as a possible control in limiting or preventing overshot terminations. The thought is that a steeper edge, as opposed to a more acute one, directs fracture to feather out on the edge rather

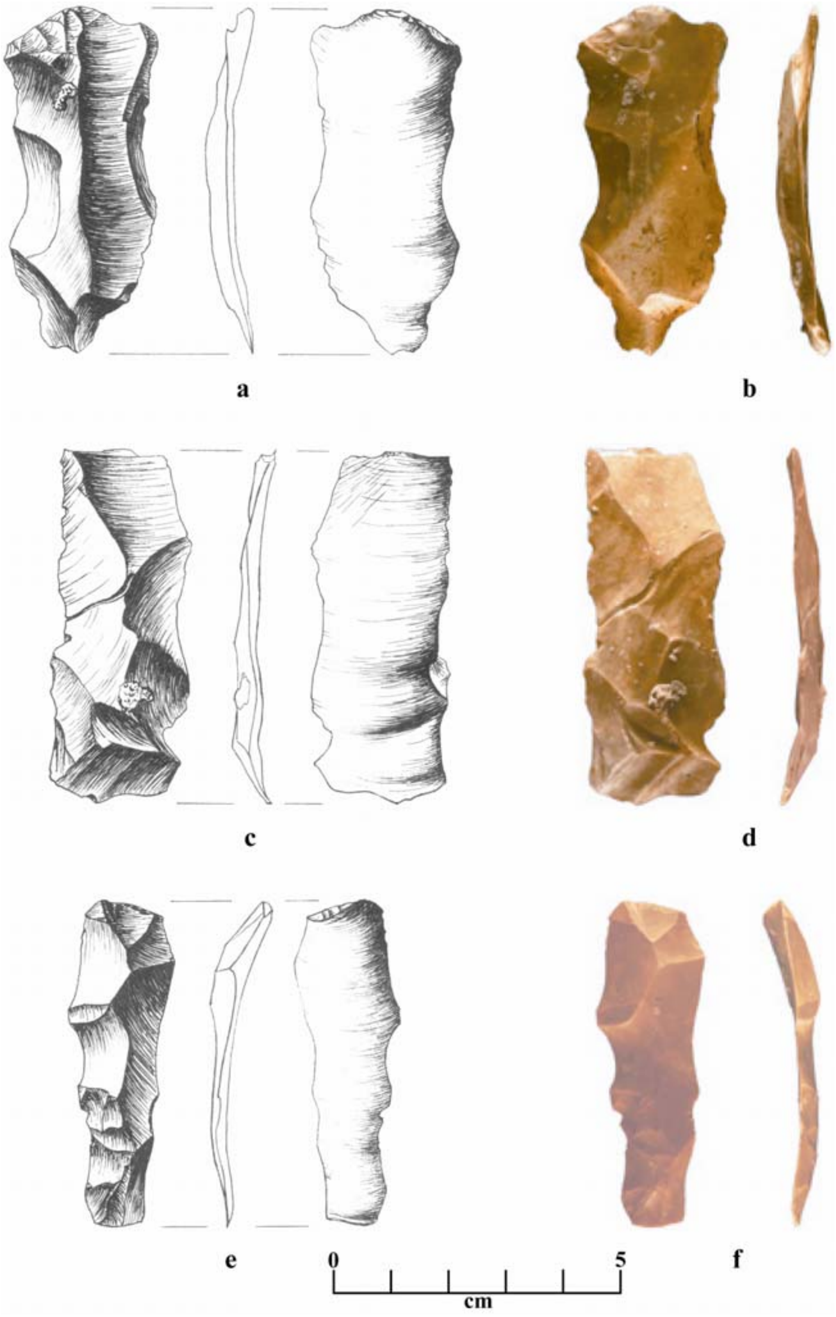


Figure 22. End Thinning Flakes.

than in a plunging fracture. The high number of overshots with distal edge angles over 60° (an approximation) suggests a possible use of this technique.

Another reason for higher edge angles is proposed by Patten (1999:93-94) where he describes an experimental method for early stage Clovis biface manufacture involving the beveling, battering, and abrading of the entire edge prior to flaking. Flaking from these edges is designed to flatten each surface with a minimum of flake removals terminating near the far edge. Although there is little to no battering or abrasion observed on the distal edges of the Gault examples, the edge beveling (angles exceeding 60°) is similar to Patten's method.

Another experiment by Dibble and Whittaker (1981) found that platform angles between 50° and 70° (with no appreciable difference between them) were optimum for producing large flakes. Dibble and Whittaker's angles fit well within the distal edge angle range found on the Gault overshot flakes. This supports the idea that large portions of the Gault biface's edges were being set up as platforms for large flake removals and that each edge was set up prior to each surface's flaking sequence.

There is no question that the production of partial overshot flakes was intended. The thickness of the blank's edge prevented the fracture from plunging to the opposite face and limited the amount of edge removed. However, full overshot removals performed on thinner blanks are more difficult to control and often remove more of the edge than intended. The question then is how much of the edge could be successfully removed without causing failure? To help determine this, the Gault overshots were used to calculate the amount of distal edge loss removed with each flake.

Twenty-one of the full overshot flakes were complete enough to determine the amount of the distal edge removed with each flake. A percentage of the distal edge loss was calculated for each flake by dividing the width of edge present on the ventral face by the length of the ventral fractured surface measured from the platform to the fractured edge (Appendix A, Table 24). Since these flakes were often detached in an irregular manner, ventral edge loss sometimes varied. Therefore, the measurements taken were averaged on those having close width variances or ranges on those with extreme variances. The latter (ranges) were considered due to the flaking direction of many overshots that angled across the biface resulting in a wider edge loss toward one side of the flakes width. These points could have been toward one end of the biface where wider edge loss may not have been as critical as that occurring in a more medial portion. The results of these calculations showed a ventral edge loss ranging between 6% and 56% with an average of 27%. This suggests that, on average, as much as one-quarter of the edge was removed with each flake. For comparison, an average of 20% was noted on two complete Archaic overshot flakes (the only complete flakes out of 14 total recovered).

The widths of the Stage IV and V Gault bifaces having overshot flake scars were compared to the two Stage VI specimens that broke during the final fluting process. It was believed that the two Stage VI bifaces represent the intended width for finished points (prior to final edge clean-up), and the difference in width between these and the Stage IV and V bifaces would provide the amount of edge reduction that occurred between the stages. In addition, it was determined that several of the Stage IV and V bifaces with overshot flake scars contain edges that had little, if any, edge removal after the overshot had been removed. The amount of edge loss on these was determined by measuring the difference between the original edge and the overshot scar edge. From these calculations, it was determined that a maximum of 10% to 15% edge loss per removal (limited to two removals per edge) would be an acceptable edge reduction. This is not to dismiss the idea that a single edge loss of 20% or more from a large biface could not be saved if the remaining removals were within an acceptable edge loss range or no further overshots were removed. Looking at these figures, it was found that only four of the twenty-one complete overshots contain a 15% or less edge loss.

In addition to the complete flakes (used to compute the above averages), there are an additional 45 broken examples. Although broken, the distal edges are present on all specimens. Therefore, it was believed that a review of the fractured flakes was necessary in determining edge loss. The problem, however, with these flakes is that the exact percentage of ventral edge loss cannot be determined due to their incomplete state.

The ventral edge loss on the complete flakes with 15% or less edge was all found to be 10 mm or less. Twenty-four (53%) of 45 broken flakes were found to have an edge loss of 10 mm or less. If one accepts the 10 mm figure as representative of acceptable ventral edge loss, then it suggests that approximately half of the broken full overshot flakes recovered may represent acceptable edge losses or successful overshot removals. It should be mentioned, however, that this conclusion is totally dependant upon actual flake length and that two of the complete flakes with measured ventral edge losses less than 10 mm also have edge losses of 21% and 24%, respectively.

The results of the overshot flake study support the idea that overshot flaking can be a successful strategy. The data shows that approximately 50% of the overshots may have been acceptable removals. However, these figures do not prove whether it was an intentional strategy or not, although the high number of overshot flakes recovered and the overshot scars present on many of the bifaces imply that it was a common occurrence. In all probability, the intended flaking strategy was to flatten and smooth the biface surface by removing large flakes from across the width of a blank/preform that terminate somewhere near the opposite edge. The best-case scenario would be for a flake to terminate either on the edge or plunge slightly over it. Of course, it takes an in depth knowledge of flake fracture mechanics as well as possessing a great deal of skill to be successful in either case.

Summary

The immediate region of the Gault site contains a number of natural resources that were considered valuable by prehistoric occupations. One of these resources is the presence of a variety of Edwards Chert, some of an excellent quality. Although the better chert has been heavily exploited in recent times by modern flintknappers, the extensive quantities of flake debris present throughout the site, indicate that in the past the higher quality chert had occurred there in large quantities. The better grades of chert have a flaked surface that is slick and shiny and are a light gray color with occasional darker gray banding. The chert is opaque, but some translucency is evident around the edges of some thin flakes.

Chert form played an important role in directing the reduction strategies followed by the Clovis knappers. Although chert at Gault occurs in a variety of shapes, the form preferred was thin to thick blocky rectangular shaped chunks with square to rounded edges. In some cases, gravels, formed from chert that eroded into the Buttermilk stream system from the surrounding limestone deposits, were also used.

Once the material was selected, it was either reduced as is, or large macroflakes or blades were spalled off. The most common form reduced was the blocky rectangular type. Initial reduction began with removing the corners (or rounded sides) on one or more edges. This was accomplished by the removal of blade-like flakes similar to those produced during blade-core preparation. In conjunction with the corner blading, flakes were removed across the surface of the tab, some across the ends and many plunging over the edge before terminating on the vertical portion of the side. Flakes produced during this process are thick, often very large, with thick platforms having little preparation. This initial flaking removed the cortex, reduced edge thickness while conserving blank width, and (with the angled nature of the corner removals) facilitated in the establishment of platforms for subsequent flaking, a primary factor in reducing thick square sided tabs.

As the thinning process continued, some flakes terminated short of the opposite edge. One reason for this is that flakes having thick platforms often fail to fracture very far due to a number of factors such as a lack of force or an excessive striking angle. As a result, many of these flakes terminated in a hinge or broke in step fractures that occasionally became stacked from repeated attempts to remove them. Such problems were removed through blade-like flaking from either the proximal or distal ends, a technique known as end thinning. This end thinning removed some of these problems as well as thinning the central portions of the tab/blank. Problems not removed by end thinning were often successfully removed individually. In addition, flakes terminating on the edge or in plunging overshot terminations continued to be removed.

During the reduction of the middle stages (stages II through IV), a rough lanceolate shape began to appear. As the tab was thinned into a preform, the techniques of end thinning and overface flaking alternated. After a series of end thinning flakes were removed, the surface was overflaked (some flakes terminating at or near mid-section). Then additional end thinning, which was followed by more overface flaking. Corner removals also continued. As the preform edges became "flatter," these flakes tended to become thinner and wider (now blade-like flakes) that often merged with or were flaked in conjunction with end thinning removals. The decision to use one or more of these techniques was based on the need to thin specific portions of the blank, remove certain problems, or re-contour and flatten the surface.

No specific single pattern of flake removal was observed; rather, the sequences included alternating faces with each removal, flaking in a parallel sequence from the same edge, alternating edges, or were combinations of one or more of these patterns. Flake scar patterns vary from lateral to oblique removals with oblique flaking varying in edge direction, but are generally from the upper left to the lower right.

Flakes produced during these middle reduction stages are thinner, but some are still very large. Platforms may still be thick but are becoming thinner with platform preparation in the form of faceting, grinding, and isolation increasing. Numerous "problem removal" flakes also occur in relatively high numbers. These flakes are the bi-products of material flaws (such as inclusions and internal cracks) or knapping problems (such as hinge and step terminations) that were successfully removed.

Once the thinning stages of the preform approached the thickness and size required prior to final fluting, end thinning and corner removals ceased. The final flaking pass was an overface flaking sequence with flakes ending both near the edge or in overshot terminations. This overflaking was usually limited to one or two flakes from either surface (probably dictated by surface irregularities) and not flaked over the entire surface. After this flaking sequence formed a suitable surface contour, the lateral edges were "cleaned-up," and the overall lanceolate shape was perfected.

The next step was to set up the base for fluting. There were several techniques used on the Gault preforms. The most common technique was to first bevel the base. Of the two specimens having their basal edges beveled, only one of these had a nipple. This striking nipple was formed during the beveling process of the basal edge which continued under the nipple. The entire edge is straight and ground with an isolation flake removed from each side of the nipple.

The edge on the second specimen is slightly concave with no discernable nipple or platform remaining and (like the previous specimen) the entire basal edge was also ground. Although there is a series of small flakes beginning near the basal corners and ending adjacent to each side of the ventral flute scar (which suggests possible platform isolating) these may have been removed for setting up the edge for the dorsal flute removal.

A third specimen was refitted together from two fragments. The tip has not been dulled and is still sharp. No basal edge beveling or grinding is present, but a large nipple was formed in the center of the basal edge. An isolation flake is present on each side of this nipple which was lightly ground.

Two methods of flute removal are indicated. The first is by indirect percussion with a punch and the other is from direct percussion with a billet. Of the finished points recovered, three have had their basal edges re-flaked or modified, effectively removing any evidence for fluting. One specimen retains a deep notch in the center of the basal edge, indicating flute removal via indirect percussion. Once the fluting process was complete, the edges were given a final clean-up with basal modifications that included grinding and/or lateral shaping that occasionally intruded onto the flute scars.

Most of the techniques discussed in this study are currently recognized as part of the known Clovis technology. However, some additional techniques were noted at Gault that have not been previously recognized. The first of these centers on the particular material form used by the Gault knappers. Other than quality, the raw material form is not unlike that used at other Clovis sites where blocky chert, large spalls, and flakes were commonly used blank forms. Whereas all these blank forms were used at Gault, the most commonly preferred raw material form were the thin to thick blocky tabs.

The large macroflakes and spalls (whether flake or blade) are generally relatively thin with most of their edges sharp, that is, the sides contain no or very little vertical edging. These edges require little manipulation to begin platforming or the shaping process. The blocky tabs, however, required a different approach to begin the thinning process, due to the thick vertical nature of the edges. This involved the removal of the extreme corners on both the edges and ends of the tab to begin bringing the surfaces together. This was accomplished by striking off long blades along the corners, a technique previously only associated with blade core preparation. Adapting the use of the blade technique for other applications is not surprising as blading is a common strategy within Clovis technology (Collins 1999a:19-26). Therefore, applying a blading technique in the manipulation of blocky tabs intended for biface manufacture should not be unexpected. Evidence for this flaking technique was observed, not only on the edges of a few of the bifaces, but also along the distal edges of some overshot flakes.

The initial blades removed are strongly triangular with cortex usually on one or more sides. As flaking from the sides occurs, the corner blades removed begin to resemble crested blades having one or more sides flaked. Corner blading continues until tab thickness is reduced and a flat surface contour establish. These removals often coincide with end thinning, another Clovis flaking technique, where one or more blade-like flakes are struck off from either end. On some of the Gault specimens several end thinning flakes were removed in a parallel pattern from the same end with one or more flaked along the extreme edge. In retrospect, one could view these edge removals as part of end thinning and not corner removals, but they are a continuation of the flaking technique begun early in the reduction process. These later corner removal blades are thin and wide and not as long as the first removals. These were flaked, not so much to reduce thickness, but to remove some near edge surface irregularities and the "smoothing" of the immediate edge with only one or two flake removals.

The use of the end thinning technique is a flaking trait that has been identified with Clovis manufacturing (Callahan 1979; Fogelman 1986; Sanders 1983, 1990). Its use was first described by Callahan (1979) in his experimental replication studies on fluted point manufacturing and since been observed from the Adams site (Sanders 1983, 1990) and presently at Gault. Other than these studies, end thinning has not received a great deal of attention. One of the reasons for not recognizing it may be its resemblance to fluting, causing some researchers to interpret end thinning as "early" fluting (Howard 1990:257-258) and not as a specific reduction flaking technique. However, the presence of end thinning at both the Adams and Gault sites was observed as occurring throughout the primary thinning stages, beginning with Stage II and continuing until the final shaping process (Stage IV) prior to actual fluting. In these cases, it was obvious that this flaking was separate from flute or channel flaking, and shows how some flaking strategies, in this case the knowledge of blade manufacturing, can be adapted for a number of applications.

Corner removal blades and early end thinning flakes may have been flaked from ends still retaining a square or vertical side. At this stage, platforms for these flakes are thick, natural, or plain types with little isolation and grinding. As the surfaces on the ends approach each other and the edges become sharp, platforms for end thinning or corner removal blades require more careful preparation than for the earlier removals. Seven complete flakes identified as end thinning flakes contain plain and dihedral platforms that are all ground, three of which are isolated.

Overshot flaking is another trait that is gaining a place within Clovis technology. Some believe it was an intentional technique (Bradley 1982, 1991, 1993; Ferring 2001; Morrow 1986; Collins 1999a, 1999b; Johnson 1993), while others feel these flakes are the result of knapping errors (Callahan 1979; Verrey 1986: Patten 1999, Sanders 1983, 1990). The results of the study of the Gault overshots suggest that, in part, it probably was intentional.

The data from the overshot study (all flakes) implied that a 10% to 15% edge loss per flake removal would not inhibit continuing reduction and that slightly over 50% of the flakes examined fall into this category. However, the range of edge loss, calculated on the complete flakes, was found to be between 6% and 56% with an average of 27% which reinforces the unpredictable nature of this type of termination. As any flint knapper can testify, it is difficult to control exactly where a plunging fracture will occur or how much edge will be removed. Using the above data, even with proper platforming and applied force, an acceptable overshot removal is 50/50 at best, and this is compounded when considering that multiple removals are often performed on each biface several times over.

If overshot flaking was intentional, what factors or controls are necessary for success? Even with all the proper platforming and edge preparation accomplished, success is not guaranteed. It takes a great deal of skill and years of repetitive practice to accomplish this. For example, knowledge of proper support is crucial in directing flake length and termination type. If the edge is loosely supported or the force is directed into the hollow of one's hand allowing the working piece to roll with the hand, the flake will have a tendency to curve (Crabtree 1972:12). Flake fracture can be lengthened or spread out by compressing or pinching a surface. In addition, plunging terminations or overshots can be created through excessive compression coupled with pressure exerted on the distal edge, which forces the bending fracture of these curving flakes, as they arc across the surface of a preform, to dive through to the opposite face forming an overshot (Patten 1999:40).

Granted, proper support alone does not always insure whether or not flake fracture will behave as intended and other factors that come into play, such as the angle of blow or the amount of applied force, will all influence the outcome in either a positive or negative manner. Thus, the need for skill, experience, and an expert knowledge of flake fracture are necessary factors required for success. It was obvious, after studying the Gault assemblage, that the Gault knappers had this skill and knowledge. Therefore, keeping these issues in mind and reviewing the analytical results, it was concluded that plunging terminations occurred as a part of overface flaking and those terminations that removed only a minimal amount of the opposite edge, were an accepted result of this strategy.

The distribution of the bifaces between geological units 3a and 3b showed that all stages of reduction were more prevalent in Geologic Unit 3a than Geologic Unit 3b where the presence of late stages V, VI, and VII were reduced or lacking. The single exception was a finished point found in Geologic Unit 3b. Although this implies a possible lack of late stage reduction in Geologic Unit 3b, an overview of the full overshot flakes suggests that late stage reduction also occurred in Geologic Unit 3b. The numbers of secondary overshot flakes in Geologic Unit 3b exceeded those found in Geologic Unit 3a, and the number of interior overshots from Geologic Unit 3b were about one-half of the total number from Geologic Unit 3a. This suggests that middle stage reduction, resulting in the final removal of cortex, was consistent within both units. And, if one can accept that interior overshot flaking continued until the final preform stage (fluting), it can then be inferred from their presence that late stage reduction also occurred in Geologic Unit 3b. The lack of later stage bifaces in Geologic Unit 3b can probably be attributed to sample size bias. The Gault site covers a very large area and reduction debris, as noted in other excavations, was scattered and recovered in varying numbers overall.

In conclusion, this study has showed that all stages of biface manufacture occurred at Gault and that this reduction was performed in a rapid manner utilizing a wide range of methods and techniques. Some of these techniques were modified for different applications, such as the knowledge of making blades, which was adapted for tab reduction in corner removals, end thinning, and final fluting. In addition, a variety of methods were used in both platform preparation and fluting. This indicates that the Gault knappers were not operating under a single strategy, but were aware of a number of alternative ways of proceeding and made choices based upon individual or specific needs or problems.

CHAPTER III

CLOVIS BLADE TECHNOLOGY

Blades, tools made on blades, and prepared blade cores have been reported from a number of Clovis aged sites (Green 1963; Cox 1986; Fogelman 1986; Dragoo 1973; Redder 1985; Sanders 1990; Frison and Bradley 1991; Henderson and Goode 1991; Gramley 1993; Nami et al. 1975; Collins 1999) as well as from sites of probable Clovis age (Soday 1954; Hammatt 1969; Long 1977; Hester, et al. 1992). The abundance of sites containing blades indicates that a blade technology had been firmly established by Clovis times. In fact, there is growing evidence for the existence of pre-Clovis blade technologies such as Meadowcroft Rockshelter located in southwestern Pennsylvania and Cactus Hill located on the Nottoway River in southeast Virginia. At the Meadowcroft Rockshelter, a "small blade" industry was noted in sediments that were dated between 11,300 and 16,000 years Before Present (B.P.) (Adovasio 2002:156-158), and blades were found eight inches below the established Clovis level by Michael F. Johnson at Cactus Hill (as cited in the *Mammoth Trumpet* 1998 13(3):14-15).

The existence of a blade technology present within North America's earliest tool assemblages should not be surprising as blades are among the World's oldest forms of tools. Blades first appeared in the Middle Paleolithic of Central Asia approximately 250,000 years ago. Although pyramidal cores are present in these early assemblages, the blades resemble elongated flake-blades more than true blades (Ranov and Schäfer 2000:80-82). More regular blade forms struck from prepared cores do not appear in large numbers until the latter part of the Lower Paleolithic (Acheulian) and the Middle-Paleolithic (Mousterian) transition of the Middle East (Rust 1950; Garrod 1970; Jelinek 1981:145-155; Bar-Yosef 1987:73; Ronen and Weinstein-Evron 2000:233) around 150-200 kyr B.P. (Copeland 2000:105). Blades continued in use during the Mousterian (often in high frequencies) then almost disappear before being "re-invented" again thousands of years later. This sequence of use, disappearance, and re-use continued and spread, often appearing only as "local" industries, from the Mousterian until recent times.

The continued re-invention of a blade technology should not be surprising as it is the result of a basic knapping principle (i.e., striking flakes along a ridge) (Whittaker 1994:221). These ridges can be natural, the result of previous flake removals or from purposely formed "crests" (Bordes and Crabtree 1969:4). Since fracture tends to follow these "high" points, larger and longer flakes are more likely to be successfully produced. With this principle in mind, some blades may actually be waste flake debitage produced, not only from blade core production (Jelinek 1981:155), but also as a result from the manufacture of other tool forms such as in biface preparation.

True blades vary little in width and thickness along their entire length, and (if a simple dorsal ridge pattern is present) the sides are parallel or convergent (Movius et al. 1968:4). They range in size from small microblades (Tixier 1963:35-39), less than 3 cm in length, to the larger, full sized macroblades such as those common to Clovis assemblages (Collins 1999a) and Mesoamerica knapping sites (Shafer and Hester 1983). Blades were produced from prepared cores having a striking platform at one or more ends, often with a crest formed on the longitudinal edge of the core that served as a guiding ridge for the removal of the first blade. As each blade is detached, the platforms are reformed by the removal of overhangs left by the negative bulbs of previously struck blades (Newcomer 1975:99).

Reasons for continued use of blades include an efficient use of raw material where little waste occurs during production (Sheets and Muto 1972:632-634) and the presence of a very effective elongated cutting edge (Whittaker 1994:33), both desirable factors in stone tool production. Blades are efficient tools used "as is" or broken into segments for hafting, but they were also modified into other cutting, scraping, boring, and in some cases, projectile points (Movius et al. 1968, Collins 1999a:10).

Previous Research

Clovis blade technology has not received much attention from prehistorians other than noting the occasional occurrence of blades and blade cores occasionally encountered within Clovis contexts (Collins 1999a:4). Collins' 1999 work *(Clovis Blade Technology)* is the most comprehensive study on Clovis blades produced to date. In his book, Collins presents a technological review of blade technology as well as providing a comparative study of those blades and blade cores from known Clovis and probable and non-Clovis contexts.

Collins (1999a:148) suggests that one reason for this lack of attention is that the occurrence of blades is limited and that most examples of these are fragmented. In some cases (such as at the Williamson site in Virginia) the presence of blades went unnoticed or unreported (McCary 1951) but were later noted from subsequent investigations (Cox 1986). In other cases (such as at the Graham Cave site in Missouri) blades were simply misidentified as "flake knives" (Logan 1952). Collins (1999a:148) lists only a few sites as having a "robust blade technology” such as the Stanfield-Worely site in Alabama and the Wells Creek site in Tennessee. But for the majority of sites reporting a blade or blade core presence, he describes the blades from these sites as being "pieces that barely meet the definition of a blade, tend to be small, and often occur in limited numbers.”

Another reason is that blades and blade cores are not widely distributed, nor do they occur in large numbers on northeastern Paleoindian sites. Rather they appear to be more prevalent on southeastern sites (Sanders 1990:67). Sanders reported true blades at only two Clovis sites, the Adams site in Kentucky and the Wells Creek site in Tennessee, but mentions several other southeastern Paleoindian sites such as the Nuckolls and LeCroy sites in Tennessee and the Quad and Pine Tree sites in Alabama as having a probable blade core industry (Sanders 1990:52-60,67).

This view is in basic agreement with Collins (1999a) where he noted small numbers of "marginal" blades found on the majority of northeastern sites. However, both fall short in concluding that a true blade core industry is absent in the northeast. This may be due in part that most of the northeastern sites, often referred to as the "Eastern Clovis" or represent an "Eastern Fluted Point Tradition," are dated to the end of the Clovis period (i.e., around 11,000 radiocarbon years B. P.) (Taylor et al. 1996:517) or younger. This suggests that these sites may represent more of a "transitional period" as opposed to the more "classic" Clovis period. Sanders, however, restricted his research to eastern Clovis and Paleoindian sites and did not include any western or southern Plains sites on which blades are fairly abundant (Stanford 1991:2). In fact, the first site to describe a Clovis blade assemblage was a cache of 17 blades recovered from Blackwater Draw, New Mexico (Green 1963). Since then, blades have been found at other sites, such as Pavo Real in central Texas (Henderson and Goode 1991:26-28), Gault in Bell County Texas (Collins 1998:5-11), Murray Springs in southern Arizona (Hemmings 1970: as cited in Collins 1999a:159), the Richey Clovis Cache from East Wenatchee, Washington (Gramley 1993:45,50), Horn Shelter 2 in central Texas (Redder 1985; Collins 1999a:160-161), and the Kevin Davis Cache in Navarro County (Collins 1999a:75-153). In addition, Clovis "type" blades are found at a number of sites containing either probable or indefinite Clovis contexts (Collins 1999a:162-165), some of which are Domebo in Oklahoma, Cedar Creek in western Oklahoma (Hammett 1969:193-198), Anadarko in western Oklahoma (Hammatt 1970:145), McFaddin Beach on the upper Gulf Coast of Texas (Long 1977:10, 24), Spring Lake in central Texas (Takac 1991:46-48), and Crockett Gardens in Willimson County, Texas (McCormick 1982:12.135-12.166).

An interesting behavior among Clovis groups is the "caching" of artifacts (Butler 1963; Green 1963; Lahren and Bonnichsen 1974; Gramley 1993; Stanford and Jodry 1988; Young and Collins 1989; Frison and Bradley 1991; Mallouf 1994). These caches usually consist of a variety of Clovis artifacts (i.e., projectile points, preforms, fragments of ivory and other unusual materials such as quartz crystal and ocher) (Stanford 1991; Collins 1999a). However, several caches (i.e., the Green [Green 1963] and the Keven Davis [Young and Collins 1989; Collins 1999a] caches) are composed only of blades. The Green Cache consists of 21 fragments that ultimately represented 17 blades (Green 1963:148), while the Kevin Davis Cache is composed of 27 blade fragments that represent 14 blades (Collins 1999a9:93). In addition, a small number of blade cores have also been reported found in possible caches (Goode and Mallouf 1991:67-70; Collins and Headrick 1992:26-39; Kelly 1992:29-33).

Caches are significant to the researcher as they can provide specific insights of a group of similar tools produced and used at the same moment of time. Technological attributes, for example, can be compared and quantified to produce a reliable picture for that individual tool type which can be used within greater regional or temporal studies. Collins (1999a) did this with the Kevin Davis Cache (and possibly with additional specimens from Pavo Real) to create a description for Clovis blades from which, he used to compare with blades from other sites and contexts.

Collins (1999a:84-92) used 13 measurements and indices in his analysis. These include: maximum length, width, and thickness; platform angle; weight; platform width; platform depth (thickness); index of curvature; width-to-length ratio; length + width + thickness; length divided by length + width + thickness; width divided by length + width + thickness; and thickness divided by length + width + thickness. In addition, he recorded completeness, interior and exterior surfaces, platform type, presence/absence of lipping, and type of fracture planes on the incomplete blades.

From these observations and calculations, Collins (1999a:63,178) defines Clovis blades as having small platforms; with almost no bulbs, minimal ripple marks on the interior surface giving a smooth aspect to the surface, and usually curved in longitudinal section. They are generally long, often exceeding 100 mm, have narrow and robust cross-sections**,** and relatively even and sharp lateral margins with a parallel to sub-parallel dorsal flake scar pattern. The length-to-width ratios always exceed 3 to 1, commonly exceed 4 to 1, and occasionally exceed 5 to 1.

The initial definition of a blade according to Francois Bordes (1961) is "any flake that is twice or more as long as it is wide." This definition, however, was believed to be too broad, and a more evolved definition was proposed by Don Crabtree. Crabtree's (1972:42) definition states that a blade is "a specialized elongated flake with parallel to sub-parallel edges, its length equal to at least twice its width. Cross or transverse section may be plano-convex, triangular, subtriangular, rectangular, often trapezoidal, and (on the dorsal face) one or more longitudinal crests or ridges. On the dorsal side of the blade there should be two or more scars of previously removed blades with force lines and compression rings indicating that force was applied in the same direction as blade detachment." Although more concise that Borde's earlier definition, it is inclusive for all blades without any cultural or temporal distinctions. Therefore, Collin's definition provides a much more definitive description for the distinctive Clovis type blades.

Blade Manufacture

Raw Material

The first step in blade manufacture is the acquisition of suitable raw material. Clovis blades (as well as other Clovis tools) are usually made of high quality materials

(Collins 1999a:178); thus, a reliable source would be required. Although a variety of materials can be utilized (such as obsidian, jasper, agate, chalcedony, or some quartzites) high quality chert or flint is one of the most common materials used. Cherts and/or flints occur in a variety of forms that range from irregular to rounded nodules or cobbles to flattened forms of ledge cherts. Ledge chert is often fractured from overburden pressures while in the parent limestone matrix and, as they weather out, break into thick blocky chunks. Not all ledge chert was subjected to overburden fracturing, and these erode out as thinner plate-like tabs that can occur in sizes up to several feet across.

Initial Core Preparation

For blade production to be successful material shape is critical. Since fracture tends to follow ridges (Whittaker 1994:220-221), materials with one or more natural ridges,such as rectangular blocky forms were desirable (Bordes and Crabtree 1969:3; Whittaker 1994:221; Patten 1999:56). For those materials without ridges, or if existing ridges are irregular, the surface is prepared by removing small flakes from the edge, either unifacially or bifacially, that straightened or created a ridge. The edge thus formed is called a *crest,* and the blade removed is called a *crested blade* or *lamé à crête* (Bordes and Crabtree 1969:4,15; Crabtree 1972:72; Collins 1999a:19). A suitable ridge can also be made on material without having angular edges by the removal of one end forming a striking platform from which blades can then be struck off from one or more sides (Bordes and Crabtree 1969:3-4; Whittaker 1994:221). Once the first blade has been removed, two or more guiding ridges are created (Patten 1999:56) which sets up the surface for subsequent removals.

Platforms

Before any blade could be removed, a good platform must be established on the core. A platform can be natural; that is, needing no preparation or it may require some form of preparation. As indicated above, to establish a platform where no suitable natural platform exists, one of the ends of a tab or cobble will have to be removed. This can be accomplished by striking the end against an anvil stone or by direct hard hammer percussion. Once the end has been removed, portions of the surface may contain a satisfactory angle that require only minimal isolation or surface grinding to form a desired platform. If the angle at the point of blade detachment is unsatisfactory, additional trimming and facetting may be necessary (Whittaker 1994:224). The desired exterior platform angles should be acute, but the closer the angle is to 90E the longer the blade will be (Whittaker 1994:223; Collins 1999a:22).

Both of these methods, however, often result in step or hinge fractures. To avoid these terminations, Bordes and Crabtree (1969:5) describe another method to form a promitory that will become the striking platform. The first step is to isolate the area where the promitory is to be formed. This is accomplished by pressing and thrusting a hammerstone downward and outward along the core's edge adjacent to the area to be isolated. This action is continued until the isolated area forms a promitory whose center is above the ridge and in line with the axis of the future blade. The result is a small, isolated, and strong platform is formed as well as removing any previous overhangs. To add strength, the top of the platform can be abraded by rubbing it with a granular stone.

An additional problem often results on the tops of conical cores. As platforms were formed around the periphery of the core, such as conical or polyhedral cores, some flakes terminated in step or hinge fractures and combined with angles created by the deep negative bulb scars that resulted from platform isolating, a central hump or knot is often formed (Collins 1999a:51). The resulting angles and stacking around the edges of this knot made it difficult for re-platforming. Therefore, the entire top of the core was removed in order to create a surface suitable to reform new platforms.

Blade Removal

Once a platform has been formed, a blade can be struck off. Removals were accomplished by direct percussion with either a hard hammer or soft hammer, indirect percussion using a punch (Bordes and Crabtree 1969:6; Whittaker 1994:221; Collins 1999a:13-15), or by pressure (Crabtree 1972:14; Clark 1987: 266-268; Whittaker 1994:221). Since blades are fragile and easily broken, a strong platform, good platform angle, proper applied amount of force, precision, and support are all considerations that must be met for success.

Direct percussion is the least precise method of the techniques available (Whittaker 1994:221,223). Blows, whether with a hard hammer or soft hammer, can be easily mis-directed, striking either to one side or too deep into the core. Although hard hammer percussion can successfully produce blades (Moore 2003:41), its use is not considered the best way to produce long blades as it produces too great a stress and shock, a problem that results in frequent breakage (Whittaker 1994:223; Patten 1999:57). In addition, hard hammer removals produce large bulbs and strong waves on the flake or blade's ventral surface, a trait Collins (1999a:30-31, 63) stresses are not generally found on Clovis blades.

Through experimental replication, Collins found that a soft hammer billet could produce many of the traits seen on Clovis blades. For this study, Collins enlisted the help of Glenn T. Goode, an archaeologist and expert flintknapper from Austin, Texas. Over a period of six years Goode produced a few thousand blades and a few hundred blade cores. Goode concluded from these replications that soft hammer percussion combined with the proper support could reproduce identifiable Clovis blade traits (Collins 1999a:27-32).

Indirect percussion utilizing a punch is a widely used and successful method for blade removal, especially on brittle materials such as obsidian (Bordes and Crabtree 1969). The primary reason for this is that a punch can be set directly on the platform, which allows for the very precise placement of the force and control of the angle of force (Whittaker 1994:221). As a result of Goode's replications and his study of known Clovis blade cores, Collins (1999a:63-66) suggests that both direct soft hammer and indirect (punch) percussion were both used in Clovis blade production with the indirect method being the more common. However, it has been determined that blade attributes cannot be used to definitely distinguish between direct soft hammer percussion and indirect-percussion (Newcomer 1975:100; Whittaker 1994:224).

Pressure flaking can be used to produce blades (Crabtree 1972:14). Because blades are larger than normal pressure flakes, they require the use of a specialized pressure tool (Whittaker 1994:221). Such a tool was successfully used by Crabtree in replicating Mesoamerican blades utilizing a chest crutch (Crabtree 1968), and J. B. Solberger who developed a "lever assisted fluting jig" to flute Clovis, Folsom, and Cumberland points (Solberger 1978:6-7). In reference to Clovis blade manufacture, however, there is no indication that a pressure technique was applied (Collins 1999a).

Support

It is generally believed that proper support is a key element in successfully producing blades (Bordes and Crabtree 1969:8-10; Whittaker 1994:225; Collins 1999:30). Experimentally, various methods have been employed. Francois Bordes, for example, favored holding the core between his feet, while Jacques Tixier preferred to pin a core down under one foot and strike blades off sideways (Whittaker 1994:225).

Crabtree found that by holding a core between his knees the core was allowed to freely move when struck with a punch. This resulted in blades that were strongly curved. He also was able to punch curved blades from uni-directional cores without a rest by simply placing the core on the ground. When he immobilized a core by supporting it on a hard surface, the resulting blades were flat or gently curved. Upon examining a large conical core from Comanche County, Texas (Green 1963:161), Crabtree found many of the flake scars to be flat, not curved, and by all indications, they had been flaked with a punch. This led him to conclude that, occasionally, curved blades could be produced with a hard rest, but that straight blades could also occur with a soft rest or none at all (Bordes and Crabtree 1969:9-10).

In Goode's experiments, blades struck from cores supported on a firm base also resulted in greater blade breakage with less refined attributes (i.e., larger bulbs and more rippled interior surfaces). Like Crabtree, Goode found that it was necessary to allow the core to move slightly upon impact. He also found that, up to a point, the less firmly a core is supported the smoother the ventral surface, but if held too loosely the core can recoil under impact, dissipating the force and ruining the core (Collins 1999a:30).

Core Maintenance

Clovis blades were produced from two types of cores, conical and wedge-shaped. Conical cores are described as having the general plane of the platform at right angles to the long axis of the core and to the proximal blade facets. A blade facet is formed as each blade is removed and as additional blades are removed. These facets form a convex face, sometimes around the circumference of the core. The result is that the distal ends of these cores begin to converge to a point (Collins 1999:50-59). The platform plane is composed of multiple, short, deep flake scars that emanate from its periphery. The negative bulb scars from each of these flakes form an acute angle of approximately 60° to 70° with the core face. These flake scars are the result of platform maintenance flakes and, as they are removed around the periphery of the core's surface, they often terminate in hinges eventually forming the large central knot. When this occurred the entire top of the core needed to be removed in order to reform new platforms. The removed portion or tops of the cores are called *core-tablets*.

Wedge-shaped cores differ from conical cores by having a different overall shape, being made on thinner or flattened chert tabs, as apposed to the more chunky cherts selected for conical cores. These cores have an acute angle between the platform and the core face, a narrow core face with multifaceted platforms. Platform maintenance flakes are simpler than those of the conical type, consisting of trimming an acute bifacial edge. In addition, a single core face may contain two opposing platforms with blades detached from these being less curved in longitudinal section (Collins 1999a:51).

Problems begin immediately as blade removals progress. The knots formed from platform maintenance flaking on conical cores often becomes so prominent that, during direct percussion, it prevents further blade removals by interfering with the arching swing of the billet. To correct this problem, the platform surface was rejuvenated by the removal of the entire surface and such flakes removed are known as core-tablet flakes (Collins 1999a:51, 58). Collins (1999a:59) noted that negative bulb scars on core faces and on the exterior of blades were infrequent, suggesting that core-tablet removals occurred at frequent intervals.

As each blade is removed, the ridges formed become the guides for additional blade removals. Unsuccessful blade detachments, in the form of hinge and step terminations or from material flaws, were frequent. To correct these problems, flakes were removed from the lateral edges (Collins 1999a: 8) and/or the distal end (Collins

1999a:58). The narrower nature of the flaked surface on the wedge-shaped cores was more easily corrected than those on conical cores. Hinge and step terminations were also removed by alternating the ends. However, the wider and multi-faceted nature of the conical cores offers special problems. On these cores hinge and step terminations could also be removed by flaking from the core's distal end, but in some cases, corrective flakes were laterally flaked from ridges flaked adjacent to the failed blade attempt or from ridges next to unflaked surfaces. Collins (1999a:54) noted that some flaking from these ridges was also performed to correct irregularities resulting from misdirected blade removals.

Blade Types

During Clovis blade manufacture, a variety of blade-like flakes and blades are produced, beginning with initial core preparation and continuing throughout the reduction process of the cores. This is particularly evident on lithic manufacture sites containing large amounts of debitage. Many of these flakes conform to the basic definition of a blade (i.e., twice as wide as they are long) but fall short of being a regular "classic" blade, usually thought of as the intended end product. Collins (1999a:90-92) addressed this problem by categorizing the blades into six stages. He stresses, however, that these stages are somewhat subjective and not absolutely sequential, but were designed as a generalization of where the blades fit in the sequence of removals in an idealized blade-core reduction.

Collins's (1999a:90-91) blade stages are as follows:

1. Primary blades with natural exterior surfaces; natural exteriors are cortex or partially cortex; lateral edges are regular; both bulb and platforms are often large suggesting hard hammer, direct percussion, longitudinal sections are straight to slightly convex.
2. Secondary cortex blades with prepared crests and possibly one or two scars of prior blade removals, usually multiple flake scars of varying orientations, edges are irregular, usually with flake scars; slight longitudinal curvature in most specimens, but moderate curvature in a few; large bulbs, possibly produced by hard hammer percussion.
3. More regular blades with minor cortex or crest remnants; usually one or two, sometimes more, prior blade scars on the exterior; core preparation flake scars present on the exterior; edges regular; flat bulbs and large bulbs both occur; variable, but generally relatively little, longitudinal curvature.
4. Moderately regular blades, little or no cortex, multiple prior scars and some core-preparation flake scars, flat bulbs, moderate curvature.
5. Regular blades, no cortex, multiple prior blade scars, flat bulbs, strong curvature.
6. Very regular blades, no cortex, multiple prior blade scars, flat bulbs, strong curvature; some scars of prior blades removed from distal end of core (some relatively narrow blades are seen in this stage).

Another flake form that resembles a blade is the *blade-like flake*. These flakes are large (twice as long as they are wide) are relatively straight, and have one or more dorsal ridges. It is felt that flakes of this type were detached from large cores by direct percussion and possess a mix of flake and blade characteristics (Collins 1999a:32).

Gault Blade Analysis

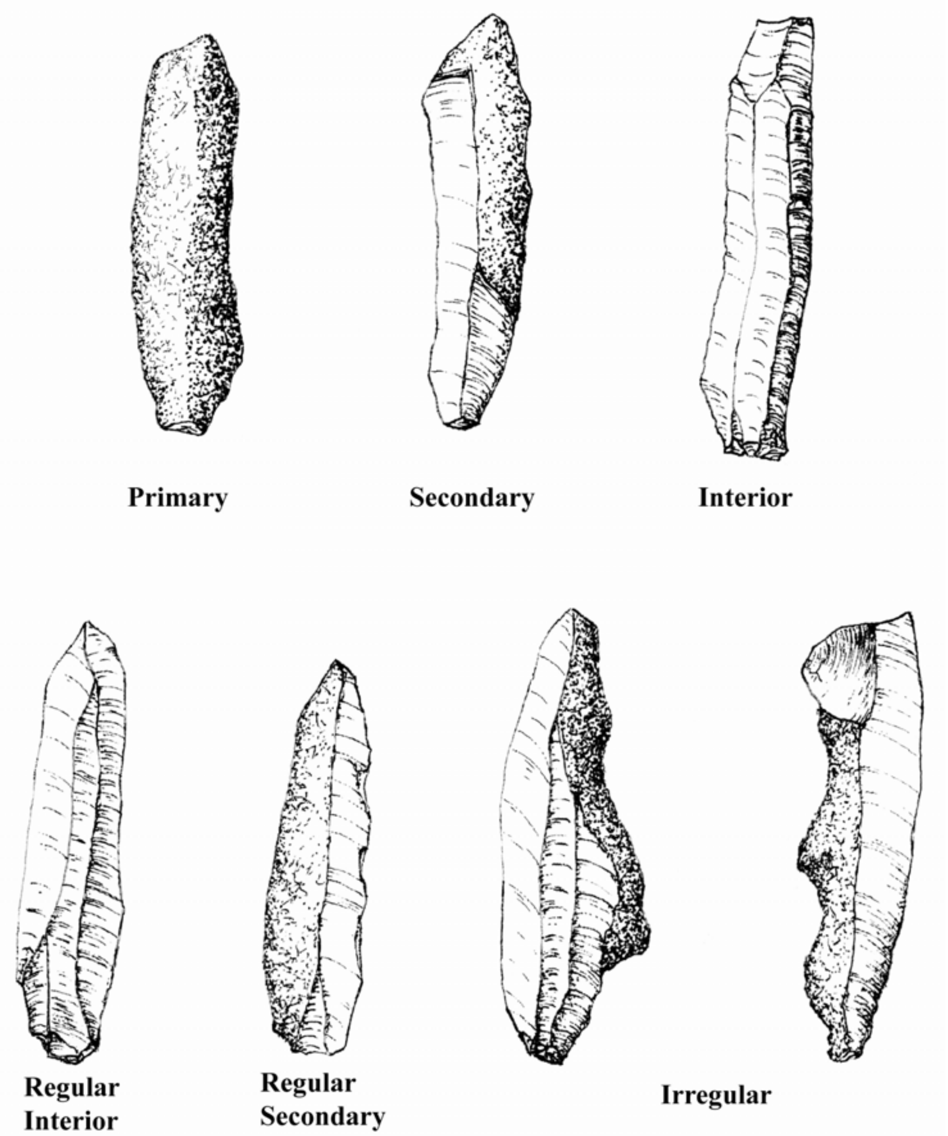
Analytical Procedures

In all, 464 blades (all types), 50 blade cores, and 36 core tablets were recovered. In addition, 3 blades, 4 blade-flakes and 1 core were refitted into three separate co-joined pieces. Two hundred and ninety-seven blades were thoroughly analyzed, and the remaining 167 were too fragmented for a complete analysis but were examined for any specific individual attributes that remain. Unless otherwise noted, all specimens utilized in this study were recovered from the Clovis soil (Geologic Unit 3a) or Clovis clay (Geologic Unit 3b) (Figure 2). At times, during excavation, geologic units 3a and 3b were indistinguishable from each other; therefore, artifacts from these situations are placed in a Geologic Unit 3a or Geologic Unit 3b category. The majority of the blades (N = 275) were found within the Clovis clay Geologic Unit 3a, 131 were found in the Clovis soil Geologic Unit 3b, and 48 were found in geologic units 3a or 3b (Appendix A, Table 1)**.**

A number of attributes were coded. These include blade type, maximum length, width, thickness, condition, platform type, platform angle, platform width, platform thickness, type of platform preparation, dorsal scar pattern, blade profile, termination type, and edge angles. In addition, each blade was illustrated noting any modifications, the ventral or interior surface attributes, such as presence or absence of platform lipping, size of the bulb of percussion, and the degree of ventral surface smoothness.

Analyzing began by initially dividing the blades into the three primary flake types, for example primary, secondary, and interior flakes (Figure 23)**.** Primary blades are those blades that are 90% or more covered in cortex, secondary blades are those having less than 90% cortex, and interior blades are those having no cortex. Blades within each of these categories were then sub-divided into groups based on individual blade attributes (i.e., regular and irregular forms). Regular blades are those blades having uniformly straight sides, and irregular, or those blades whose sides undulate, have portions of an edge that protrude or are jagged. More specialized blade types such as crested blades, corner/side removal blades, end thinning blades, and core maintenance blade\blade-flakes were each analyzed separately.

Platforms are an essential aspect in understanding how lithic tools were made (Figure 24). The manufacture and control of platforms are critical factors for successful flaking and the types of platforms are good indicators as how, and in some cases, when this was accomplished. For example, initial flaking usually commenced on an unprepared or natural surface or one that has had minimal preparation, such as a single flake removal or plain surface. As reduction continues, more carefully prepared platforms are required for specific flake removals to be successful as well as preventing material failure. Platforms are usually made by careful pressure or light percussion flaking of a core or blank's edge. In addition, isolating (flaking adjacent to the platform) and the grinding or abrading platform surface are used in guiding flake fracture and the strengthening of the platform itself. The types of platforms include



Primary

Secondary

Interior

Regular Interior

Regular Secondary

Irregular

Figure 23. Blade Types.

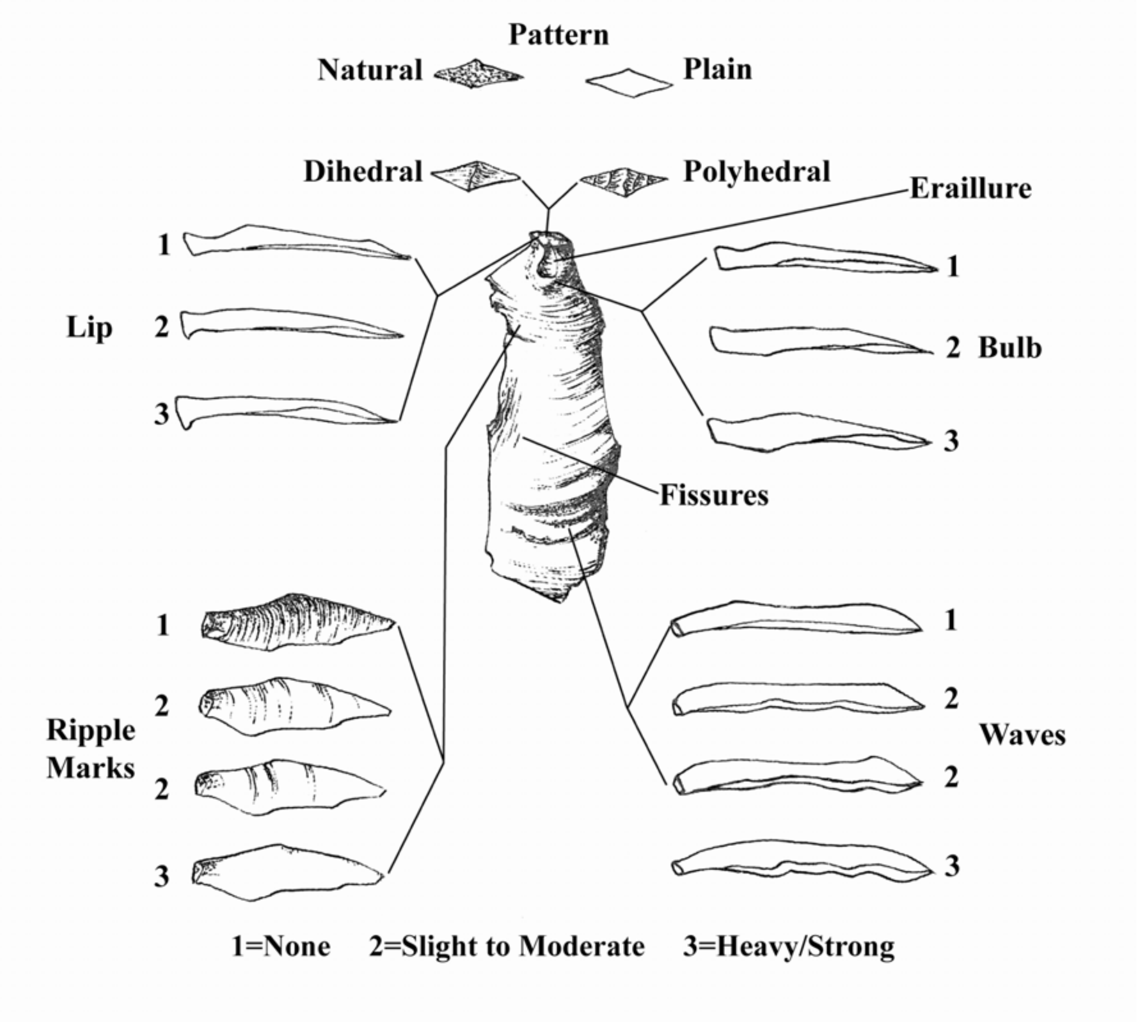


Figure 24. Blade Ventral Characteristics.

(1) natural, or those completely covered in cortex, (2) plain, or those without cortex or facets (small flakes removed from the surface), (3) dihedral are those with two facets, and (4) polyhedral are those having three or more facets, that are and crushed or broken.

Bulbs of percussion are often considered as indicators for the type of percussor or hammer used in manufacture. Briefly, a bulb of percussion (Figure 24) is a swelling located in front of the platform (Crabtree 1972:48; Whittaker 1994:14) and is usually considered as evidence for hard-hammer percussion (Whittaker 1994:185). On some flakes, the ventral surfaces are flat or diffuse with no swelling. In these cases, this is considered as an indicator for the use of a soft-hammer or one made of a soft material such as antler or wood. The bulbs recorded in this analysis were categorized as (1) diffuse (none), (2) slight to moderate swelling, and (3) strongly present.

Platform lipping is another indicator for the type of percussor used and often considered in conjunction with type of bulb. Lips are small projections or overhangs found on the proximal ventral surfaces of some flakes (Figure 24) and are thought to be a trait for soft-hammer or pressure flaking (Crabtree 1972:74; Whittaker 1994:187). Platform lipping in this analysis was recorded as either (1) absent, or (2) slight to strongly evident.

Because the presence of ripples and/or waves on the ventral surfaces of flakes and blades is thought to indicate the type of percussor utilized, their presence or absence was noted. Ripples (Figure 24) are small concentric lines that often emanate from the center of the bulb of percussion on fine grained materials and are directly related to the force of blow and the crack that results as it moves through a piece of material (Whittaker 1994:14). These ripples or compression rings are thought to be created by the back and forth shifting in the knapping force, while the amplitude and frequency of these rings are seen as a rough measure of the energy available during each stage of flake fracture (Patten 1999:52). Because soft hammers distribute energy more evenly than hard hammers, some feel that an absence of ripples on the ventral surface of a flake or blade indicates the use of a soft hammer or punch (Collins 1999a:66).

Some control of the force and direction of fracture influencing the creation of ripples can be manipulated through support of the core. For example, Glenn Goode, in his experimental replication of Clovis blades, found that, up to a point, the less firmly he supported a core, the smoother the surface and smaller the bulb will be. However, resting a core on the ground or on a piece of wood caused larger bulbs and a more rippled interior surface (Collins 1999a:30).

Waves (Figure 24) are larger, less frequent undulations created by the fracture front shifting inward and outward as fracture develops. These are often created by a mechanical imbalance such as damage to a platform or tool, poor control, or type of tools utilized. For example, hesitations in the development of a fracture cause the trajectory of this fracture to waver due to the relaxation of compression allowing the fracture to veer toward the free surface. The greater the force the larger the undulation. The use of hard hammers are more likely to cause undulations as soft hammers tend to transform energy slowly and evenly enough for fracture to be more stable, thus reducing their formation (Patten 1999:52,82,86,108). Ripples and waves were recorded in this analysis as (1) none, (2) slight to moderate, and (3) heavy or strong. The blades were also categorized by shape and profile (Figure 25). Cross-sections (view taken from proximal end) include (1) flat (plano) with no dorsal curvature, (2) rounded (convex) with dorsal curvature, (3) triangular, and (4) polyhedral, or those with multiple vectors. The edges range from acute to steeply angled or abrupt. Blade profiles (side view) recorded include (1) flat with no curvature, (2) twisted, (3) proximal bend, (4) medial bend, or (5) distal bend.

The dorsal surfaces of the blades were categorized as (1) uni-directional (those surfaces with one or more flake scars flaked in the same direction), (2) bi-directional (those with flake scars originating from two directions - may be proximal-ventral or from the lateral), and (3) radial (those having flake scars originating from all sides) (Figure 26). In addition, combinations of these directions, such as uni-directional from lateral, uni-directional from distal or proximal, bi-directional from proximal or distal and lateral, etc. were individually recorded.

The termination types (Figure 27) were also recorded as (1) straight or blunt (those terminations that are "square" such as from step fractures or fracturing on a straight edge), (2) overshot or plunging (those that fractured over an edge), (3) feathered (those that fractured into a thin sharp edge), (4) hinged (those that terminate in a rounded or blunt edge), and (5) broken. In addition, the distal ends of blades were noted as (1) expanding, (2) converging, (3) rectangular, (4) bend to one side or the other (*de bordant*), or (5) asymmetrical.

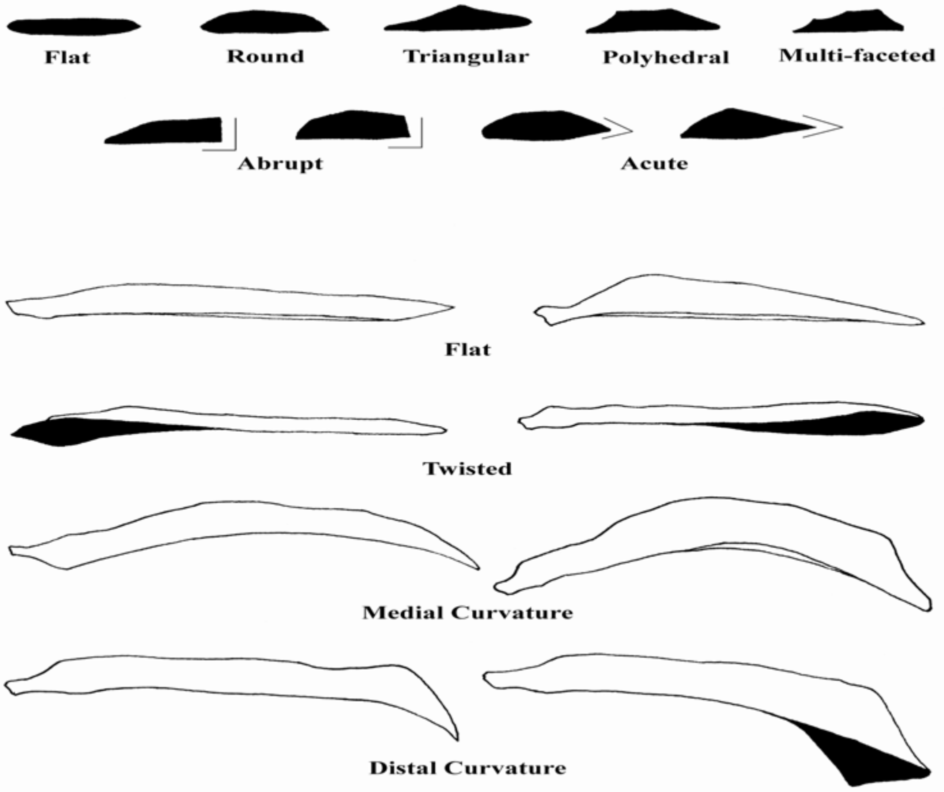


Figure 25. Blade Cross-Sections and Lateral Profiles.

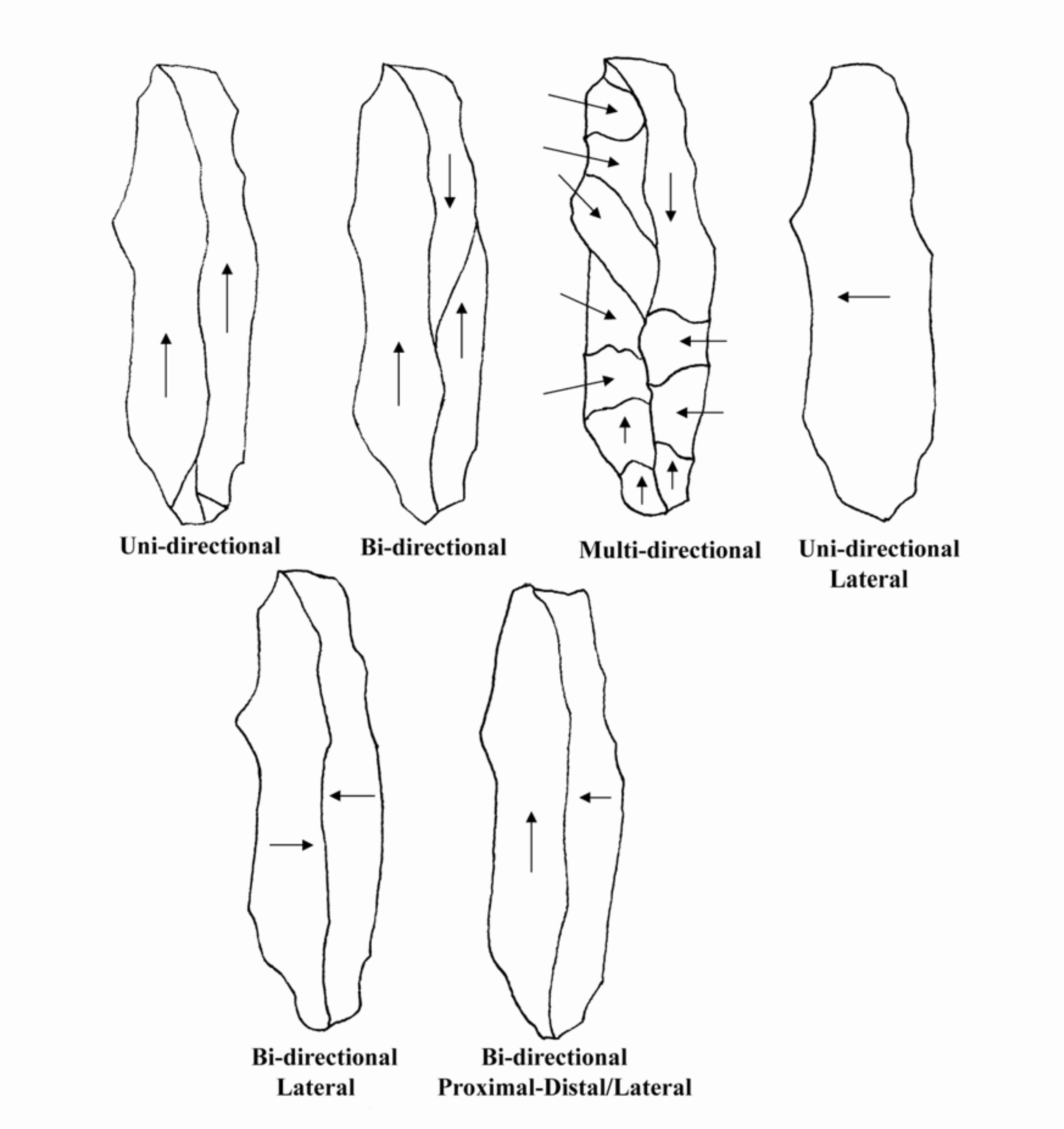
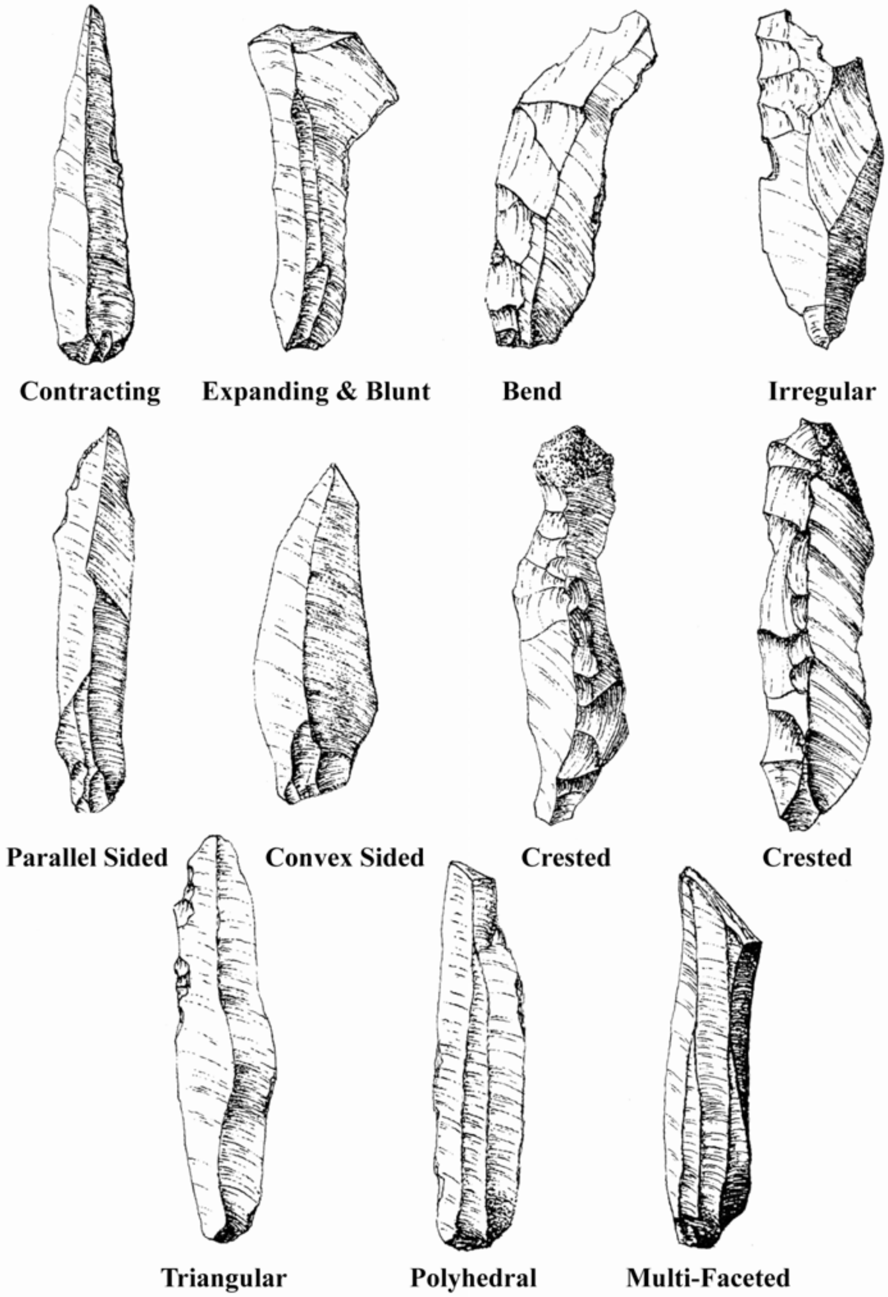


Figure 26. Dorsal Surface Scar Patterns.



Contracting

Expanding & Blunt

Bend

Irregular

Parallel Sided

Convex Sided

Crested

Crested

Triangular

Polyhedral

Multi-Faceted

Figure 27. Blade Termination and Shape.

A number of calculations were computed for measurements taken on the length, width, and thicknesses for each blade. In most cases, these measurements were taken only on those blades that were complete or contained an observable specific attribute. These measurements include the following:

1. Length and width averages.
2. Index of curvature (Figure 28). This is a ratio of two linear measurements taken on the interior surface of the blade. These measurements are (1) the straight line (length between the proximal and distal ends) and (2) a perpendicular measurement between the perpendicular plane and the interior surface of the blade. This is a generalized expression of curvature where the greater the value of index the more curved the blade (Collins 1999a:86-87; Figure 5.3)**.**
3. Width to length ratios. This is an arithmetic expression of the maximum length in relation to maximum width, with width given an arbitrary expression of one (Collins 1999a:86).
4. Length + width + thickness. This is the sum of the measurements of the maxim length, maximum width, and maximum thickness. It is simply a generalized value of size and is used in the calculations of the three following ratios (Collins 1999a:86).

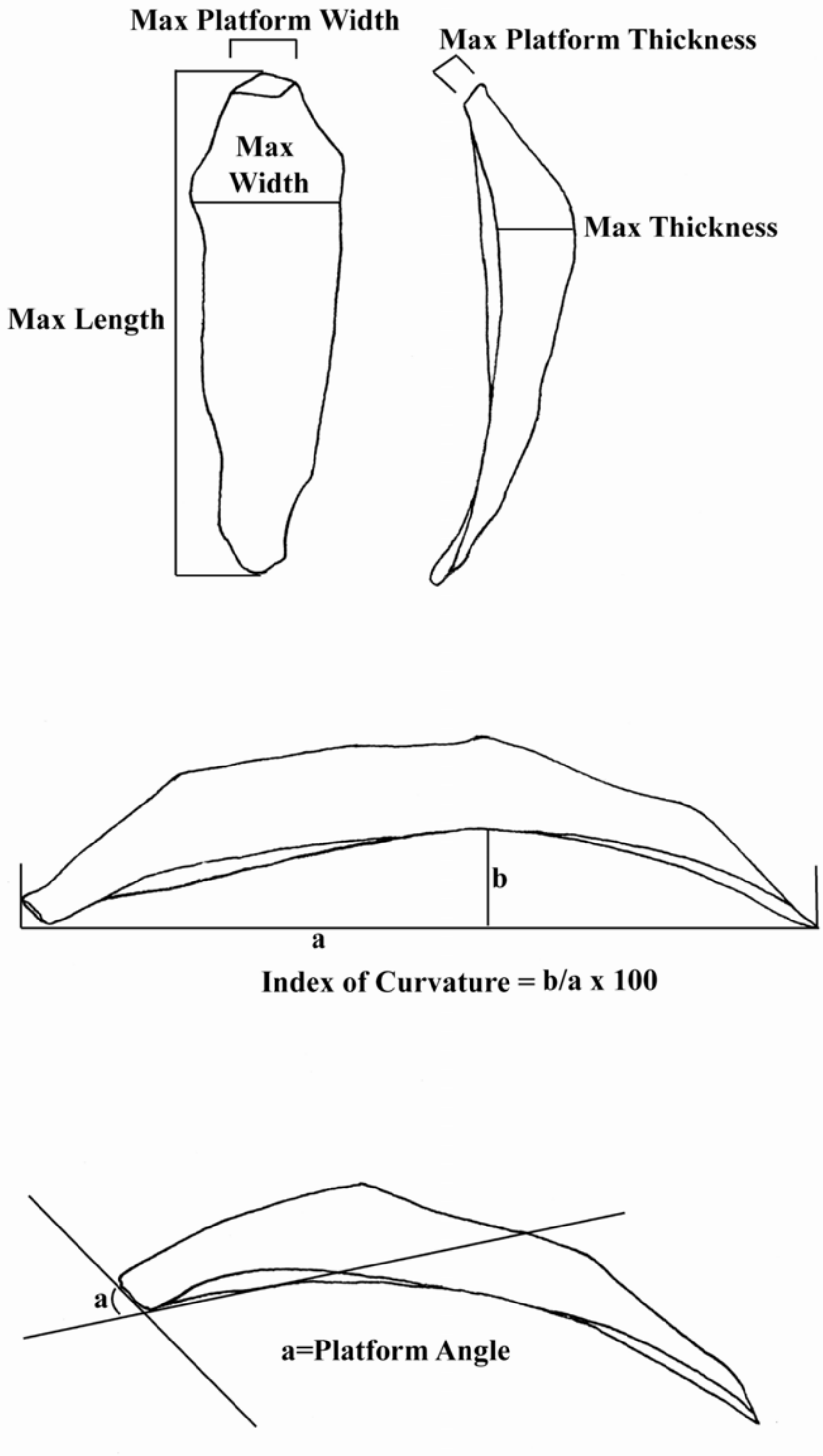


Figure 28. Blade Measurement and Calculation Points.

5. Length divided by length + width + thickness ratios. This is a ratio of length to the sum of the primary dimensions used to provide a graphic presentation of shape (Collins 1999a:86).
6. Width divided by length + width + thickness ratios. This is a ratio of the width to the sum of the primary dimensions used to provide a graphic presentation of Collins (1999a:86).
7. Thickness divided by length + width + thickness ratios. This is a ratio of the thickness to the sum of the primary dimensions used to provide a graphic presentation of shape (Collins 1999a:86). Clovis blade manufacture is a process of constant platform rejuvenation and core maintenance procedures that re-occur after each blade removal and continued until the core was exhausted. Blades produced from conical cores were detached around the periphery of a core made from rounded cobbles or thick blocky cherts. Once the initial core preparation was accomplished and the first series of blades were removed, all subsequent blades produced are interior with no cortex.

However, blades made from wedge-shaped cores were continually removed from the narrow (end) face of thinner chert tabs. The repetitive removal of blades from the ends of this core type includes not only interior types but also numbers of secondary types removed from each of the core edges as well**.** With wedge-shaped cores being the more abundant type, the result would be a significant increase in the number of secondary blades. The secondary blades may be as regular and desirable as the interior blades with the only difference being the presence of some cortex. Using Collins' model, these secondary blades would be placed variously within his stages 4, 5 or 6. The result of this could result in a skewing effect in their analysis. Therefore, based on the core differences, it was felt that a better understanding of the Gault blades would be derived from a more traditional method of core reduction sequences.

Blade Analysis

The following is a discussion of the individual blade types analyzed for this study.

Primary Blades (N = 37, Figure)

Primary blades are those blades removed during the initial preparation of the core for blade manufacture. The surfaces are 90%-100% covered in cortex and/or a white patina. White patina has commonly been thought to be produced when silica was replaced by lime salts; however, it is currently thought to have formed when silica is removed from the surface of cherts buried in alkaline environments, such as soil (Luedtke 1992:109) or standing water (Purdy 1981:127).

The patina noted on the chert from Gault ranges from a bluish-white film to a heavy, almost thickened grayish-white covering that has formed over the fractured surfaces of the chert nodules. Most of these fractured surfaces were created from overburden pressures exerted on the chert bearing beds while in their parent limestone matrix. As the chert eroded from the limestone matrix, it broke into variously sized blocky chunks where over time this patina formed over the exposed fractured surfaces.

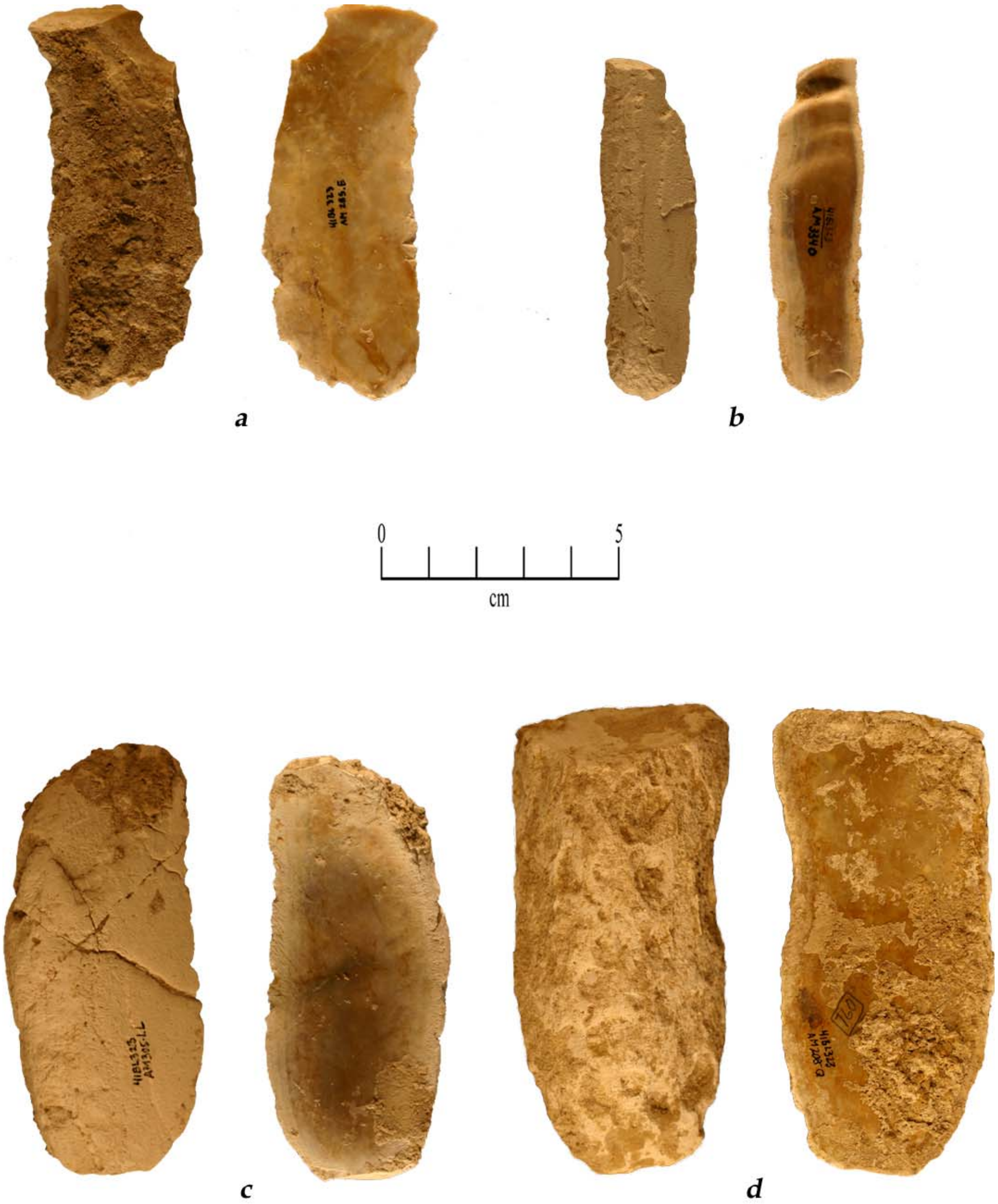


Figure 29. Primary Blades.

In some cases, the cracks did not cause immediate fracture of the nodule. In these cases, the cracks became stained a yellow brown, from (1) humic substances and iron in the groundwater (Stapert 1976:12-13) that seeped into these cracks or (2) from iron that has been leached from the chert while lying in stagnant and acidic water and redeposited on its surface (Hurst and Kelly 1961:254-255). During periods of freezing, moisture that gravitated into these cracks expanded causing the material to fracture exposing the stained surface.

The primary blade shapes are highly variable and range from regular to irregular forms to some that bend, are converging, expanding, or rectangular. Cross-sections are often flat or rounded, but most of the Gault specimens are triangular (38%) or are lateral steep (33%); that is, one side having an acute angle. Most of the Gault specimens have medial (38%) and distal (21%) curvatures closely followed by blades that are flat or flat and twisted (42%).

Two basic types of primary blades were identified. These are cortical removal (N = 2) and corner/side removed blades (N = 34). The condition of these blades (both types) includes 18 complete blades, 4 proximal, 5 distal, 5 medial, 2 proximal-medial, and 3 medial-distal fragments.

Primary Cortical Removal Blades (N = 2, Figure 29a)

These were usually removed from a low ridge on the natural surface of a core lacking any previous removals. Most of these blades were probably more accidental than intentional as wide flakes or blade-like flakes are the normal flake types produced during the cortical removal process. Only one such blade was complete enough to provide data, but several secondary blades that had been removed from across the narrow end of a tab contain a central scar with cortex along both lateral edges, suggesting that these blades were occasionally intentionally removed.

The single complete cortical removal blade is 82.3 mm long, 32.9 mm wide, and 6.3 mm thick. It is flat, slightly irregular, has a natural platform with no preparation, a platform angle of 83°, a moderately strong bulb of percussion, and a straight or blunt type termination. The index of curvature is 5.70, the width to length ratio (W:L) is 2.5, the length ratio (L/L+W+T) is .68, the width ratio (W/L+W+T) is .27, and the thickness ratio (T/L+W+T) is .05.

Primary Corner/Side Removal Primary Blades (N = 35, Figure b-d)

As mentioned above, these are blades flaked down the square, or rounded edge of a blocky core or tab that removed the extreme corner. On occasion, they were flaked across one or more of the chert tab's ends or along the vertical side. This flaking was intended to remove any surface irregularities or natural flaws as well as to establish a ridge, or platform. This blade type was flaked in both blade core preparation and initial bifacing, where reducing the thickness of the square edges is a critical step in the thinning of blocky tabs.

Twenty-three of these blades were complete enough to provide data. The primary blades range 51 mm - 101 mm in length with an average of 82 mm. The widths range between 19.1 mm - 45.8 mm with an average of 31.9 mm, and thicknesses range between 6.1 mm and 23.8 mm with an average of 13.8 mm

(Appendix A, Table 2). Twelve (50%) have natural platforms, 4 (16%) are plain, and the rest are either crushed or unknown. One of the natural platforms and two of the plain platforms have been prepared by grinding or abrasion (Appendix A, Table 3). The platform averages (all types) are 11.7 mm wide with a range of 3.3 mm to 21.7 mm, and 4.4 mm thick with a range of 1.6mm to 11.8mm. Platform angles range between 41°and 89° with an average of 74°. The natural platforms are slightly wider and thicker and contain a greater range in platform angles than the plain platforms (Appendix A, Table 4).

The bulbs of percussion on blades with natural platforms include one that is lipped with a diffuse bulb. The rest are unlipped with four having diffuse bulbs, and four with bulbs (slight to strong). Those with plain platforms include two with lipped platforms, both with diffuse bulbs, the rest are unlipped with one diffuse, and one strong bulb. The remaining blades are too fragmentary or damaged to determine platform characteristics or bulb type (Appendix A, Table 3). Terminations include feathered, hinged, overshot, and straight or blunt types with the straight or blunt types the most common (Appendix A, Table 2)**.**

Sixteen of the 24 primary blades are complete enough to calculate the index of curvature. Unlike the blades measured in Collins's study, only complete blades were used to calculate this and the following measurements. Collins (1999a:86) calculated his index of curvature computations on both whole and incomplete blades. However, it is easily demonstrated that as a blade is shortened, the index of curvature is lessened, thus calculating an index on incomplete blades biases the curvature index. This bias, however, only influences the overall curvature of complete blades as removed from the core and not the fact that many of these blades, whether complete or not, still have significant curvatures. Eight of the 16 complete blades are flat and/or twisted with no curvature present. Those with some curvature have an index of curvature ranging from 2.8-10.5 with an average of 7.0 (Appendix A, Table 5).

The width to length ratios (W:L) for 16 complete primary blades range between 1.9 and 3.6 with an average of 2.7. The length ratios (L/L+W+T) range between 0.58 and 0.74 with an average of 0.65, the width ratios (W/L+W+T) range between 0.17 and 0.30 with an average of 0.25, and the thickness ratios (T/W+L+T) range between 0.05 and 0.15 with an average of 0.10 (Appendix A, Table 5).

The ventral surfaces of 22 of the 23 primary blades are smooth with no ripples with slight to moderate ripples noted on only two. Waves or undulations are absent on 12 blades; however, nine contain slight to moderate waves. The waves on four of the blades cover the entire ventral surface, two have waves only on the distal half, and the rest are too fragmentary to determine (Appendix A, Table 6).

In sum, the primary blades are fairly large and most have natural platforms that are relatively wide and thick. Those with plain platforms present are also wide but are slightly thinner. Interestingly, some lipping is present on both platform types with diffuse bulbs of percussion the more prevalent. This tends to indicate some removal by soft-hammer percussion. In addition the majority of the ventral surfaces are smooth with no ripples, which further indicates soft hammer use.

However, most of the blades have diffuse or slight bulbs with no lipping. This may be explained by the angle or direction of impact. The platforms on both platform types are high, averaging 71° - 76°, and it has been established that a heavy blow directed into the mass of the material, as opposed to an arching blow, will increase fracture to travel farther across the face of a core or blank (Cotterell and Kamminga 1979:103-104). In addition, the angle of impact relative to the longitudinal axis of the core or blank is critical to the formation of a bulb (Bonnichsen 1977:166). In other words, the closer to 90° a blow is directed, the longer a flake can be produced and the less likely a bulb will be formed.

Another factor may also have an influence on the blade's ventral surface characteristics. As previously discussed, the type of percussor indicated by the various attributes indicates the use of soft-hammers. Other than an elongated quartzite cobble, no antler, ivory billets, or other hard-hammers were recovered in the Clovis levels. The single quartzite cobble (Figure 18) contains battering on both ends with one end that has been broken at an angle that is reminiscent of bits used in gouges. That battering is present along the fractured edge suggests that it may have served as a gouge, as well as a hammerstone. There was, however, an abundance of limestone nodules of varying sizes present throughout the Clovis deposits. Although the surfaces of these nodules appeared to be soft, they are hard enough to serve as hammerstones. The fact that none exhibited wear can be attributed to the degradation of their surfaces through the erosional and chemical weathering of the Clovis sediments. To test this assumption, some of these nodules were employed in the experimental knapping of some of the local Gault chert. The result was that similar diffuse to slight bulbs with occasional lipping on some of the platforms were produced. Therefore, it can be assumed that some of these limestone nodules may have been used by the Clovis knappers as hammerstones.

Comparison of Primary Blades with other Clovis Sites

A comparison of the Gault primary blades to primary blades from other Clovis sites found only two sites, Pavo Real in central Texas, and the Adams site in Kentucky, have blades that could be classified as primary. Two were recovered from Pavo Real (Collins et al. 2003:120-121), and one complete specimen was identified from the Adams site (Sanders 1990:60).

Attributes for the Pavo Real site (Collins et al. 2003:121) and the Adams site (Sanders 1990:60) blades are provided in Appendix A, Table 7**.** From these values it can be seen that the primary blades from Gault are smaller (all dimensions) than Pavo Real, are the same width, but are shorter and thinner than the Adams site blades The average platform width for Gault is smaller, and thickness is larger than those from Pavo Real (no sizes were given for the Adams site). No platform descriptions for individual blades are provided for either site, although, Sanders does include a general description of platform types as being flat (unfaceted), cortical, transverse flaked, lateral flaked, and crushed for the Adams site (Sanders 1983:78, 1990:60).

The dimension ratios for Pavo Real are the only statistics on primary blades available for comparison. These ratios (i.e.; width to length) (W:L), length (L/LWT), width (W/LWT), thickness (L/LWT), and index of curvature, compare favorably with those from Gault. The average width to length ratios are 3.6 for Pavo Real and 2.7 for Gault. The average length ratio is .70 for Pavo Real and .65 for Gault, the average width ratio is .20 for Pavo Real and .25 for Gault, and the average thickness ratio is .11 for Pavo Real and .10 for Gault.

The index of curvature averages differ widely between Pavo Real and Gault with 4.1 for Pavo Real and 7.0 for Gault. The average index of curvature values were calculated only on those blades that exhibit some curvature. In the Gault sample, 50% of the complete blades are flat or flat and twisted, and, as such, were not included in the curvature average. One of Pavo Real's blades has an index of 0, indicating that it is flat. The average platform angles for the two sites differ slightly with 80° for Pavo Real and 74° for Gault. Descriptions of the ventral surfaces, i.e., presence/absence of platform lipping, bulb size or surface attributes, for the Pavo Real or the Adams site blades were not available.

Secondary Blades (N = 190, Figure 30)

Secondary blades, like secondary flakes, are defined as having varying amounts of cortex (<90%) on their surface. As previously discussed, some of the tabular chunks of chert chosen for tool manufacture at Gault contain a heavy white patina on portions of their sides or ends. Although this surface weathering does not have the chalky nature of typical cortex, it does represent unaltered portion's of the material's surface and, as such, is considered the same as cortex. Three types of secondary blades were established (i.e., regular, irregular, and corner/side removal).

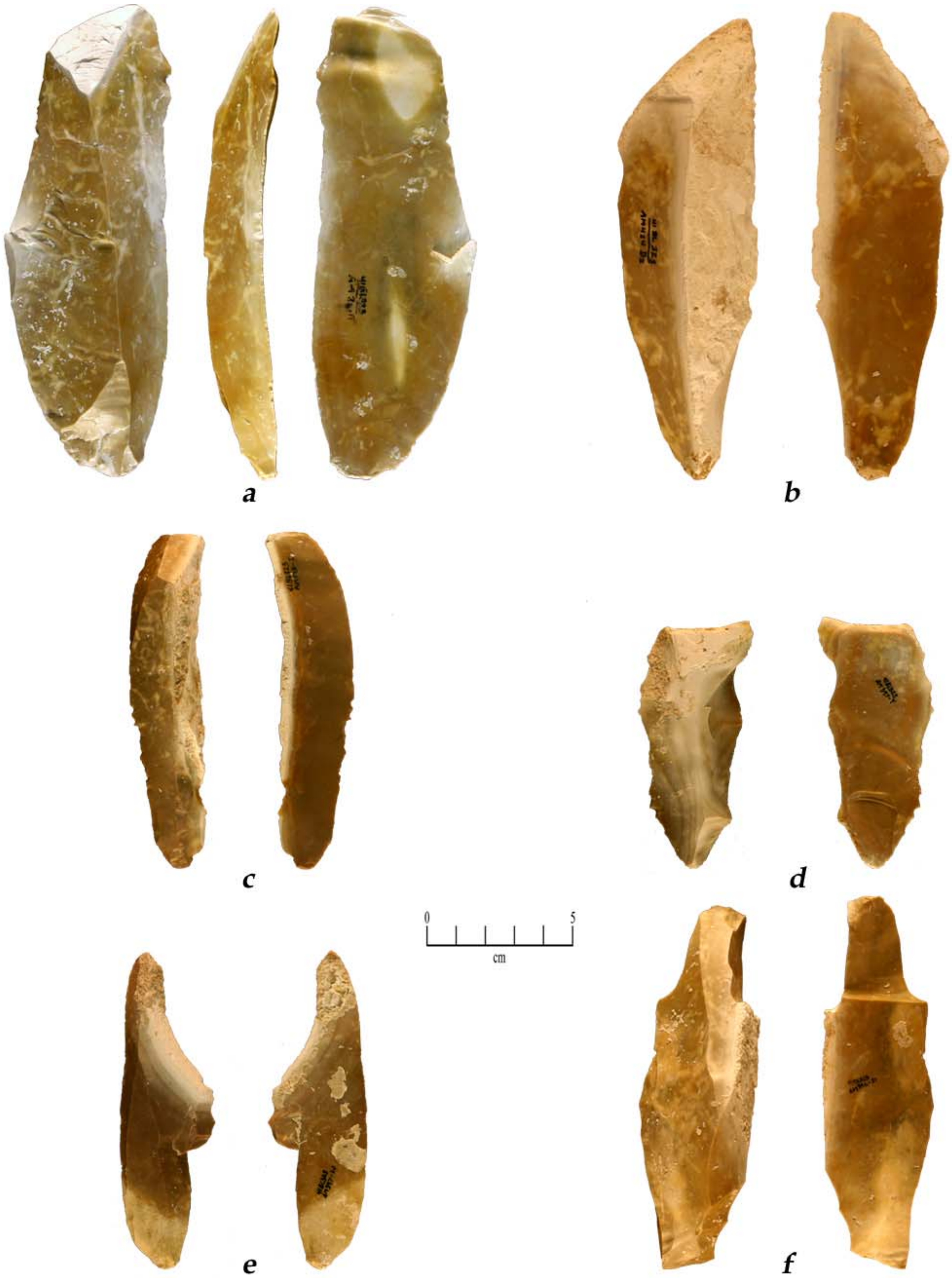


Figure 30. Secondary Blades.

Regular Secondary Blades (N = 57, Figure 30 a-c)

Regular secondary blades have more or less straight or contracting parallel sides, but occasionally a bend to one side or the other (*de bordant*) is present on the distal end. Cross sections may be flat, triangular, polyhedral with edges that range from acute to abrupt. The dorsal scar patterns are, usually uni-directional or bi-directional, but occasional radial patterns are noted. Profiles are flat, twisted, or incurvate, either medially or distally.

Forty-nine of the regular secondary blades were complete enough to evaluate, but eight were too fragmented or lacked their primary attributes to analyze. Of the 49 analyzed blades, 24 are complete, and the remaining 25 are broken. They range in length between 41.5 mm and 163.9 mm with an average of 78.5 mm. Widths range between 17.7 mm and 55.6 mm with an average of 22. 9mm, and thickness range between 4.6 mm and 30.7 mm with an average of and 6.4 mm (Appendix A, Table 8). Termination types include straight or blunt (18%), overshot or plunging (6%), feathered (20%), and hinged (20%). The remainder (36%) are either broken or re-worked (Appendix A, Table 8).

A number of platform types are present. Seven (14%) are natural, 15 (31%) are plain, 3 (6%) are dihedral, 2 (4%) are polyhedral types, and the remaining 22 (45%) have platforms that are missing or crushed. No platform preparation is evident on 28 of the blades with platforms, but 11 are ground or abraded and another 11 are both isolated and ground/abraded. Platform widths (all types) range between 3.0 mm and

19.9 mm with an average of 9.7 mm, and thicknesses range between 1.7 mm and 6.0 mm with an average of 3.7 mm (Appendix A, tables 9-10). Platform angles for all platform types range between 46° and 87° with an average of 74°. Individually, natural platforms average 78.4°, plain platforms average 73.4°, dihedral platforms average 74°, and polyhedral platforms average 61° (Appendix A, tables 9-10).

The presence/absence of bulbs of percussion with and without platform lipping was found to vary between platform types. The bulbs of percussion on those blades with natural platforms include three with diffuse bulbs and no platform lipping, and one with a strong bulb and no lip. Those with plain platforms include no platform lipping and diffuse bulbs (6%), no platform lipping with bulbs (slight to strong) (12%), platform lipping and diffuse bulbs (18%), and platform lipping and bulbs (slight to strong) (40%). The remaining blades are too fragmentary to determine platform characteristics or bulb type (Appendix A, Table 9)**.**

Twenty of the regular secondary blades are complete enough to calculate an index of curvature. Like those calculated for the primary blades, only complete blades were included in this computation. In addition, nine (18%) of the blades have a flat and/or twisted profile and, having no curvature, were also excluded. The findings for the index of curvature resulted in a range of 2.76 to 15.15, with an average of 8.34. (Appendix B, Table 11).

The width to length (W:L) ratios for the 29 complete regular secondary blades average 3.0 with a range of 1.95 to 4.54. The length ratios (L/L+W+T) average .70 with a range of .53 to .76. The width ratios (W/L+W+T) average .25 with a range of

.16 to .32, and the thickness ratios (T/L+W+T) average .08 with a range of .06 to .16. Individual specimen tabulations and their totals for the width to length, length, width, and thickness ratios are listed in Appendix A, Table 11).

The ventral surfaces on 28 (58%) of the regular secondary blades are smooth with no ripples, although 8 (29%) of these also have slight to moderate waves. Nineteen (40%) of the blades have slight to moderate ventral ripples with 15 (80%) of these also having slight to moderate waves. Only one blade has strong ventral ripples, which also contains a slight to moderate waves (Appendix A, Table 12).

The majority (57%) of these blades have a uni-directional dorsal scar pattern with dorsal scar counts ranging from one to five scars. Bi-directional scar patterns compose the next largest group comprising 29% of the total. A variety of patterns, however, are noted within the bi-directional group. These include proximal-distal, lateral-proximal, lateral-lateral, and lateral-proximal/distal patterns. In addition, these blades are often a little thicker and less uniform than the uni-directional examples. The remaining blades (14%) have dorsal scar patterns that are radial to sub-radial. Dorsal scars within this group are smaller and more numerous, occasionally exceeding eight. Many of these scars may represent cresting and edge straightening procedures performed during initial core preparation or from failed or poor removals (Appendix A, Table 8).

Although, there is an increase in platform preparation and smaller platforms, the average platform angle of 74° and ventral surface attributes are much the same as was noted on the primary blades (i.e., platform lipping combined with diffuse bulbs or bulbs [slight to strong] of percussion), and ventral surfaces having obvious rippling and waves of force. This indicates the continued use of hard or soft-hard hammers. However, a slight increase in the number of smaller and more prepared platforms and platform lipping combined with diffuse bulbs was also noted, suggesting that the use of soft hammers was becoming more prevalent

In summary, regular secondary blades are relatively long and narrow and may be flat, but most are curved. Platform angles remain similar to those on primary blades but with generally smaller and better prepared platforms. The ventral surfaces continue to have a variety of bulb types and platform lipping combinations, and (although variances in ripples and waves continue) there is an increase in ventral surfaces that are smooth. Uni-directional, bi-directional, and radial/subradial dorsal surfaces occur with most being uni-directional.

*Irregular Secondary Blades (N = 25***,** *Figure d-f)*

Irregular blades are defined as having fluctuating, non-uniform shaped edges that may contract, expand, or bend (*de bordant*). The dorsal surfaces are occasionally part of an edge that often contain stacks, hinges or other knapping problems with cross sections that may be roughly triangular, polyhedral, or contain a number of additional vectors. Regular blades usually represent the intended product; that is, produced for use as a tool while irregular blades represent a number of strategies, such as failed blade removals, core preparation and maintenance flaking, or waste flaking from other manufacturing tasks.

Only thirteen of the 25 irregular secondary blades are complete enough to provide an attribute analysis, while the remaining 12 are too fragmented to analyze. Three of the irregular secondary blades are initial core preparation blades. These were flaked to remove cortex from the sides and dorsal/ventral surfaces as well as removing any surface irregularities. The remaining nine blades are all clean-up or maintenance blades. The dorsal surfaces on these blades all contain multi-directional flake scars, hinging terminations, or material flaws, such as cracks.

The blades average 89.2 mm long with a range between 67.3 mm and 111.6 mm. They average 37.6 mm wide ranging between 17.9 mm and 56.4 mm. They average 10.9 mm thick with a range between 5.6 mm and 18.2 mm (Appendix A, Table 13). Only seven of these blades contain platforms which include 1 natural, 5 plain, and 1 faceted. The remainder has platforms that are either crushed or missing. Four (33%) of the platforms have been ground or abraded, 3 (25%) have also been ground or abraded but have been isolated, and 5 (42%) have no preparation or are crushed. Platform widths range between 3.2 mm and 14.7 mm, with an average of 9.11 mm and thicknesses range between 2.0 mm and 12.6 mm with an average of 4.6 mm. Platform angles range between 68° and 83° with an average of 75.4° (Appendix A, Table 14).

All, but one of the five blades, having platform lipping contain diffuse bulbs. Three blades are unlipped and all have bulbs (slight to strong). The platform types for those blades without platform lipping are either natural or plain, while those with lipping are all plain (Appendix A, Table 14).

A variety of terminations are present that include straight or blunt (33%), feathered (33%), and hinged (33%) types (Appendix A, Table 13). Most (58%) of the complete irregular blades are flat or are flat and twisted. The remainder (42%) has an index of curvature that ranges between 3.09 and 10.83 with an average of 5.43 (Appendix A, Table 13).

The width to length (W:L) ratios range between 1.88 and 3.84 with an average of 2.61. The length ratios (L/L+W+T) range between .58 and .72 with an average of .66, the width ratios (W/L+W+T) range between .18 and .31 with an average of .26, and the thickness ratios (T/L+W+T) range between .05 and .12 with an average of .08 (Appendix A, Table 15).

The ventral surfaces on most (42%) of the irregular secondary blades are smooth with no ripples or waves, however, two blades having no ripples have waves. Slight to moderate ripples and waves are present on 4 (33%) blades, and one blade has both heavy ripples and waves (Appendix A, Table 16).

The dorsal surfaces, as mentioned earlier, often contain multi-directional flake scar patterns. These patterns represent previous surface preparations and the removal of knapping problems and material flaws. In order to remove these problems or establish a good flaking surface, they could only be removed by flaking from alternate directions. This flaking results in multi-directional scar patterns which, in turn, have to be removed in order to create a clear and uniform flaking surface (Appendix A, Table 13).

However, not all of the irregular blades have dorsal surfaces that are multi-directional. About one half of the blades studied have multiple dorsal scars that are uni-directional (Appendix A, Table 13). These scars are small, narrow, or terminate in hinge or step fractures on various places on the dorsal surface. While on the core, the surfaces created by these terminations would not be suitable for blade production and, as such, have to be cleared in order to create a suitable flaking surface. Many of these blades, therefore, are the by-products of this core re-surfacing strategy.

In addition to the dorsal surface and edge morphologies, these blades can be summarized as being flat or having little curvature with platforms that are often well prepared by grinding and/or isolation and are relatively wide and thin with steep angles. Platform lipping with diffuse bulbs predominate, but blades with slight to strong bulbs, some with platform lipping, are also present. Ventral surfaces are, also, predominately smooth with little or no rippling or waves, but evident ripples and waves also occur. These attributes suggest that both soft, hard, and soft-hard hammer techniques continued to be utilized.

Corner/Side Removal Secondary Blades (N = 111, en 53.2 mm and 185.8 mm with an)

Corner removal blades comprise the largest category of secondary blades in the assemblage. They are defined as blades removed from the corners, ends, or sides of squared or blocky chert tabs. They may be regular or irregular with cross-sections that are triangular, polyhedral, occasionally rounded, with edges that are often steeply angled or abrupt. The dorsal surfaces consist primarily of uni-directional or bi-directional scar patterns with a few that are radial or are uni-directional with some

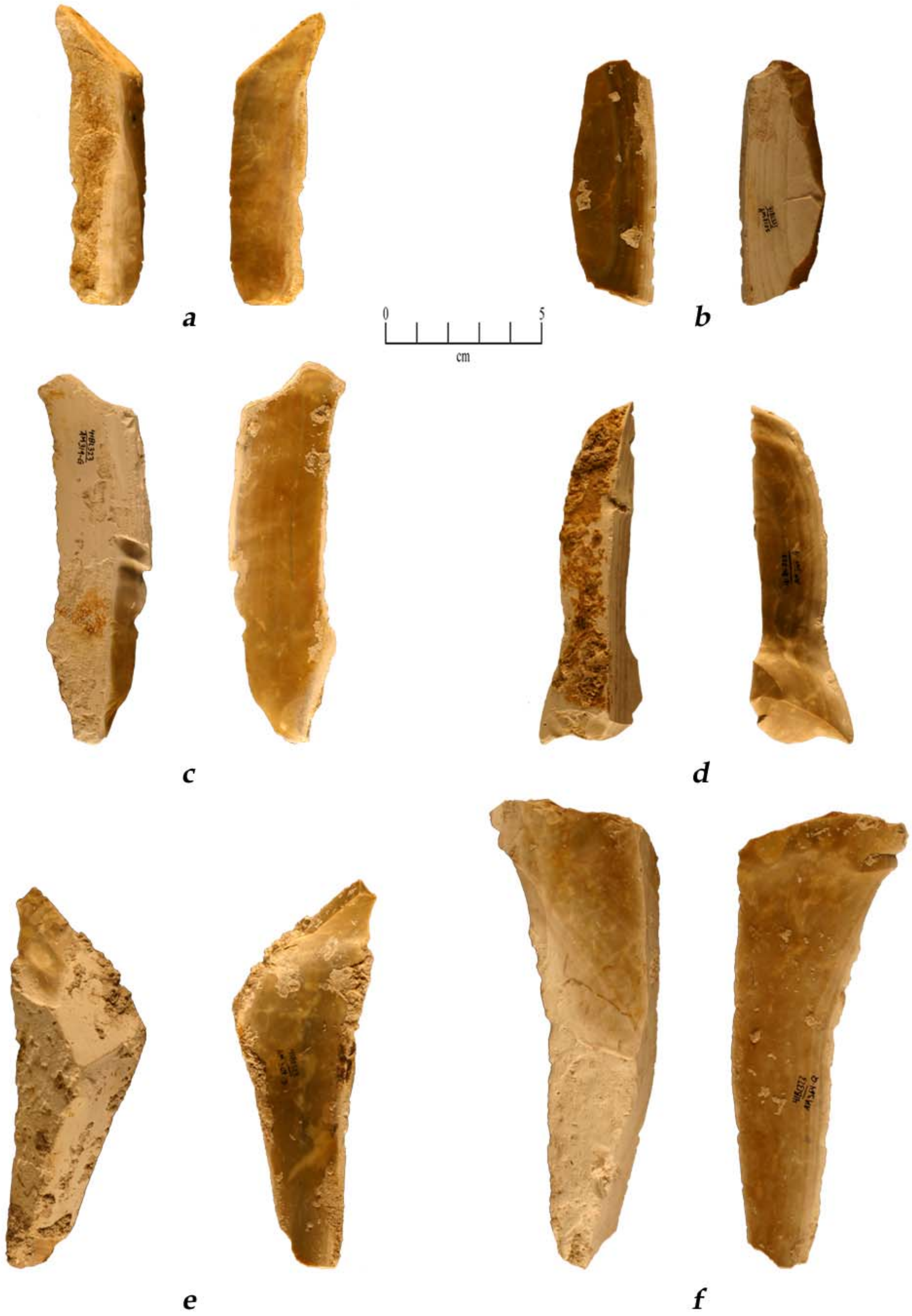


Figure 31. Corner/Side Removal Secondary Blades.

lateral flaking. On occasion, some of these blades contain a central blade scar bordered by cortex on one or more sides. These represent cases where an attempt to remove the corner resulted in only removing a small portion of the extreme edge of the tab.

Like the previous blade types, these blades represent a number of flaking strategies. By far the more abundant secondary blade corner/side removal blades represent core preparation or re-surfacing removals. Such blades were removed in both initial bifacing and blade core preparation. These are identified by having dorsal surfaces containing varying numbers of short removals, often originating laterally, many ending in step or hinge type terminations, and edges that may be regular or irregular.

Another type of secondary corner/side removal blades is a blade removed during the primary blade production sequence. Secondary blades removed from conical cores were produced only until the decortication of the cores surface continued. Once this decortication process was complete, all blades produced were of the interior type. Secondary blades detached from wedge-shaped cores, however, continued to be produced until the core was exhausted or abandoned. For example, as each blade removal sequence was completed and a proper flaking surface for the next set of removals was established, the next series of blades removed would include blades from each side (corner) of the core, as well as its interior. Those removed from the core’s edges would retain varying amounts of cortex along one of the lateral edges. Along with the interior blades, many of these secondary blades were the intended product which would have been (and were) selected for tool use, the cortical "backing" along one edge aiding in their grasping or holding capabilities. Because the same removal strategy was utilized in core maintenance and primary blade removals, all the secondary corner/side removal blade types were lumped together for the statistical computations. Fifty-two blades were complete enough to provide width, length, and thickness tabulations. The lengths range between 53.2 mm and 185.8 mm with an average of 91.2 mm. Widths range between 17.3 mm and 52.6 mm with an average of 32.4 mm and the thicknesses range between 4.9 mm and 25.7 mm with an average of 14.5 mm (Appendix A, Table 17).

Thirty-seven of the blades contain identifiable platforms. These include 12 (32%) natural, 22 (60%) plain, and 3 (8%) dihedral. Platform widths (all types) have a range of 3.5 - 22.6 mm with an average of 12.9 mm, and thicknesses of 1.6 mm - 9.5 mm with an average of 5.0 mm. Platform angles (all types) range between 53° and 85° with an average of 73.3° (Appendix A, tables 18-19).

Two of the natural platforms and six of the plain platforms have been ground/abraded. One natural, 6 plain, and all 3 of the dihedral platforms have been both isolated and ground/abraded. The rest are un-modified (Appendix A, Table 18). The majority (74%) of the platforms are unlipped with 14 (40%) having diffuse bulbs and 12 (34%) with bulbs (slight to strong). Lipping (slight to strong) with diffuse bulbs was noted on four (11%) blades (all plain platforms), and lipping with bulbs (slight to strong) is present on five (14%) blades (three natural and three plain platform type) (Appendix A, Table 18).

Distal end termination types were recorded for 56 secondary corner/side removal blades. These include 19 (34%) with straight or blunt terminations, 11 (20%) with overshot or plunging terminations, 19 (34%) feathered, and 7 (12%) hinged. Two additional blades have had their distal ends modified (Appendix A, Table 17).

Fifty blades are complete enough to determine an Index of Curvature; however, 16 (32%) of these have flat or flat and twisted profiles. The 34 remaining blades, with a measurable curvature, range between 2.10 and 16.47 with an average of 7.38 (Appendix B, Table 20).

Fifty-one specimens are complete enough to determine the following size calculations. The width to length ratios (W/L) range 1.52 to 4.48 with an average of 3.07. The length ratios (L/L+W+T) range between .52 and .79 with an average of .67, the width ratios (W/L+W+T) range between .15 and .34 with an average of .23, and the thickness ratios (T/L+W+T) range between .05 and .16 with an average of .10. Tabulations and totals for individual specimens for the width to length, length, width, and thickness ratios are listed in Appendix B, Table 20. The presence of ripples and waves on the ventral surfaces of the secondary corner/side removal blades are varied. Seventy-two blades were found to be complete enough to provide good descriptions on their ventral surfaces. Fifty-four (75%) of these are smooth with no ripples; however, 28 (52%) of these also contain slight to moderate and heavy waves. Slight to moderate rippling occur on 18 (25%) blades with 10 (56%) of these having slight to moderate and heavy waves (Appendix A, Table 21).

In sum, the secondary corner/side removal blades are relatively long, wide, and thick with cross-sections that are predominantly triangular, some with a steeply angled or abrupt edge and profiles that are relatively flat or with a slight to moderate curvature. This description is not surprising when one considers that they were removed from the corners, edges, or sides of square or blocky chert tabs. Those with the more extreme curvatures were generally removed across the ends of these tabs where the short widths of the tabs increased the ability of flake fracture to plunge.

The dorsal scar patterns often contain multiple and irregular scarring indicating earlier removals that were either not successful, as in the case of those hinging or stepping short, or represent core maintenance and re-surfacing procedures. Others are more regular with uni-directional and bi-directional patterns and represent removals performed during initial biface thinning or primary blade production. The abundance of these blades is attributed to the reduction of wedge-shaped cores, which continually produce secondary blades throughout the manufacturing process.

The platform types are predominately natural or plain, generally wide and thin with steep angles. Most have little preparation although some have been well prepared by grinding and/or isolation. Some platform lipping is present, but most are unlipped with an even distribution between blades with and without bulbs. The majority of the ventral surfaces are smooth with little rippling or waves, although, there is a significant presence of both rippling and waves. These attributes support a predominant hard or soft hard-hammer type removal where blows were directed more into the tab’s mass (longitudinally along the edge) as opposed to an arching blow. Fractures from such blows have more diffuse bulbs, minor to no lipping, and relatively smooth surfaces. As the force of fracture begins to dissipate, waves often appear towards the distal end of the fracture. Arching blows (especially hard-hammer) have similar attributes but with more prominent bulbs and an increase in rippling.

Comparison of Secondary Blades to Other Clovis Sites

Five sites containing attributes for secondary blades are available. These are Pavo Real in Texas (Collins 1999a:98-99; Collins et al. 2003:120-123), the Keven Davis Blade Cache from Texas, the Richey Roberts site in Washington (Collins 1999a:97-99), the Adams site in Kentucky (Sanders 1990:60), and the Greene Cache from Blackwater Draw in New Mexico (Green 1963: 151-156) (Appendix A, Table 22). There are additional Clovis aged sites known to have blades (i.e., Blackwater Draw "B" in New Mexico, Murray Springs in Arizona, Horn Shelter 2 in Texas, and the Fenn cache from Utah), but unfortunately, no specific stage designations or cortical presence are available (Collins 1999:98-99). The blades described from the Green cache are listed by Collins as Blackwater Draw "A." However, all descriptions and measurements utilized for comparative purposes in this study are from Green's original report.

The total number of secondary blades having usable attributes available for comparison include: 1 from the Keven Davis Cache, 1 from the Richey Roberts site, 12 from the Pavo Real (five complete and seven incomplete blades), 3 from the Adams site, and 4 from the Green Cache. Both the Keven Davis and the Richey Roberts blades were extracted from Collins's 1999 listing as Stage 4 blades. In the Pavo Real report, Collins (et al. 2003:121,127) lists an irregular blade category, in which, he includes both partial cortex and no cortex blades. However, in the data tables there is no differentiation between the two types, making it impossible to determine individual data between the two blade types. The Green Cache has an overall total of 17 blades consisting of 8 complete blades of which, 4 are identified as regular secondary type blades (Green 1963:151-156). Secondary blades from the Adams site include 3 complete specimens, 5 proximal, 1 distal, and 2 medial (Sanders 1990:60). Sanders does not differentiate between blade condition, so it is assumed that the size ranges and means computed are taken from complete blades only (Appendix A, tables 22-24).

The Gault blades are approximately the same size as the Adams site specimen**,** are generally shorter and thinner than those from the other sites, but have approximately the same widths as those from the Kevin Davis and Richey Roberts caches. The width to length ratio for Gault is also approximately the same as the Richey Roberts Cache and Pavo Real, slightly larger than the Adams specimen, and less than those from the other sites. The index of curvatures for complete blades show that the Gault blades are significantly flatter than those from the Keven Davis cache, Green cache, and Richey Roberts, but slightly more curved than those from Pavo Real. The length ratios for Gault are approximately the same or slightly smaller for all sites except for the Keven Davis and Green caches which are longer. The width ratios for all the sites are narrower than Gault, except for the single specimen from the Adams site, which is almost equal, and the thickness ratios are the same except for Pavo Real and the Green cache, which are thicker. Although they are almost identical to each other, the secondary blades from the Green and Keven Davis caches show the least similarity to the Gault blades. The overall average platform dimensions for the Gault blades (all types) are both wider and thicker than those from the Keven Davis Cache, but are smaller than those on the Pavo Real blades (no platform size data was available for blades from the Green cache, Richey Roberts, or the Adams site. The platform angles vary widely between the sites. For example, the average platform angle for Gault is 74.2°, 60° for Keven Davis, 69.4° for Pavo Real, and 42.5° for the Green Cache (Appendix A, Table 22). The variances between the platform angles, as well as some of the other attributes, may be attributed to the different categories of blades (regular, irregular, and corner/side removal) used in this analysis that were not recognized within the other assemblages.

Interior Blades (N = 181, Figure)

Interior blades are those blades having no cortex on their exterior surfaces, although, in a few cases, some retain cortex on their platforms. These blades were placed into two distinct categories (i.e., regular and irregular).

Regular Interior Blades (N = 142, Figure 32a-b)

This category comprises the largest number of blades recovered. These blades have profiles that vary from flat to curved, have edges that may be straight, undulate slightly, or be convex with distal ends that expand or contract. Cross-sections are triangular, polyhedral, or may contain more than three vectors with dorsal scar patterns that include uni-directional, bi-directional, or occasionally radial types.

Figure 32. Interior Blades.

The condition of these blades can be broken down as follows: 45 complete blades, 22 proximal, 16 distal, 39 medial, 9 medial-distal, and 11 medial proximal sections. Sizes range from 49.8 mm to 111.9 mm in length averaging 95.7 mm. The widths range from 11.5 mm to 48.2 mm with an average of 22.0 mm, and thickness ranges from 2.9 mm to 18.9 mm averaging 8.9 mm (Appendix A, Table 25). Feathered (51%) and straight or blunt (25%) terminations make up the majority of the termination types, followed by hinged (20%) and overshot (4%) terminations (Appendix A, Table 25).

The majority (43%) of the platforms are plain. Dihedral platforms are the next abundant (17%), followed with polyhedral/faceted (10%) and natural (4%) types. The remainder is crushed, reworked, or undetermined (Appendix A, Table 26). Fifty percent of the platforms are both ground/abraded and isolated, followed by 24% with only ground or abraded platforms, 4% isolated, and 2% having no preparation (Appendix A, Table 26). The platform widths range from 2.4 mm to 14.1 mm with an average of 10.7 mm and thicknesses ranging from 1.3 mm to 5.22 mm with an average of 2.9 mm. Platform angles are widely varied ranging between 38° and 89° with an average of 68.5° (Appendix A, tables 26-27).

Platform lipping is present on 62% of the regular interior blades (all platform types), but varies on the presence of bulbs of percussion. Forty-seven percent of the blades have lipping (slight to strong) but no bulbs (diffuse), and blades with lipping and bulbs (slight to strong) occur on only 15%. No lipping with diffuse bulbs was found on 18%, and no lipping with bulbs (slight to strong) present included 15%. The remainder has platform characteristics or bulbs that are undetermined (Appendix A, Table 26).

Thirty-seven blades are complete enough to calculate the index of curvature; however, 12 (32%) of these are flat or twisted and have no curvature. The index of curvature for the remaining 25 complete blades (68%) with a measurable curvature range between 3.17 and 14.88 has an average of 7.61 (Appendix B, Table 28). Of those blades with the greatest curvature (i.e., exceeding 9.00), only one appears to have been removed from the corner/end of a core, having a strongly angled dorsal surface. The others contain uniform continuous curvatures on their dorsal surfaces.

Briefly, the width to length ratio (W:L) averages 3.71 with a range of 2.15 - 7.84. The length ratio (L/LWT) averages .71 with a range of .56 - .82, the width ratio (W/LWT) averages .21 with a range of .11 - .36, and the thickness (T/LWT) ratio averages .08 with a range of .04 - .13 (Appendix A, Table 28).

The ventral surfaces of these blades are smoother with fewer waves than was seen on the previous blade categories. These surfaces showed that 57% have no ripples or waves and another 18% with no ripples and only minor waves. Obvious rippling combined with varying degrees of waves was noted on only 13% of the blades (Appendix A, Table 29).

As was indicated in the initial interior blade description, the dorsal scar patterns on these blades include uni-directional, bi-directional, or radial patterns. The uni-directional pattern is, by far, the most abundant with 55% of the blades exhibiting this characteristic. The basic bi-directional pattern; that is, one that contains both proximal and distal initiated scars, was noted on 18% of the blades. Interestingly, an additional 18% of the blades contain another type of bi-directional pattern where scars may initiate from either end but also contain laterally initiated scars. These laterally directed scars may or may not initiate on the blades edge, most often originating from another part of the core. The least noted scar pattern was the radial/subradial type with only 8% exhibiting this pattern.

Irregular Interior Blades (N =142, Figure 32 a-b)

These blades are primarily core maintenance and problem removals, or failed regular blade removals. They are defined as having lateral edges that are erratic and jagged, often bending severely to one side or the other. Cross-sections vary from triangular to having many vectors, often with one side being very steeply angled or abrupt. The dorsal surfaces may have as few as two or three longitudinal scars, but more often have four or more scars in radial or bi-directional-lateral patterns, some, of which, end in step or hinge terminations.

This group includes 19 complete blades, 5 proximal, 10 distal, 3 medial, and 3 medial-distal fragments. Sizes range 40.0 mm - 78.0 mm in length with an average of 62.7 mm. Widths are between 11.5 mm - 39.3 mm with an average of 24.5 mm, and thicknesses between 5.0 mm - 11.6 mm with an average of 7.8mm (Appendix A, Table 30). Blade terminations include 44% feathered, 25% straight or blunt, 13% hinged, the rest are broken or re-worked (Appendix A, Table 30).

Seventy percent of the platforms are plain; 15% natural, 5% are polyhedral, and 10% are crushed (Appendix A, Table 31). Forty-four percent of the platforms have been ground and isolated, 22% are ground or abraded only, 11% isolated, and 22% have no modification (Appendix A, Table 31). Platform widths average 10.7mm wide with a range of 6.4mm to 15.6mm, and thicknesses average 4.0mm with a range of 2.0mm to 5.8mm. Platform angles average 68.3° with a range between 60° and 81° (Appendix A, Table 31).

The presence/absence of platform lipping and the bulbs of percussion are closely split. Platform lipping with diffuse bulbs are present on 31%, and lipping combined with bulbs (slight to strong) are present on 20% of the blades. On the other hand, 28% of the blades have no lipping and bulbs (slight to strong), and 22% have no lipping with diffuse bulbs (Appendix A, Table 31).

Eleven of the irregular blades are complete enough to compute the index of curvature; however, 5 (45%) of these are flat. The remaining six blades (55%) with a measurable curvature have an index that averages 7.48 with a range of 3.62 to 12.87. Only two blades exceed an index of 9.00, these being 10.11 and 12.87, the latter being the only corner removal within this category (Appendix A, Table 32).

Dimension ratios were calculated on 13 of the irregular interior blades. The calculations for width to length ratio (W:L) averaged 2.40 with a range of 1.65 - 3.46. However, these figures include three very short, almost flake-like blades. They were all prepared and struck off in the same manner as the other blades, but terminated short. If they were eliminated from the width to length ratio, the average is raised to 2.56. The length ratio (L\LWT) averaged .60 with a range of .58 - .74, the width ratio (W\LWT) averaged .28 with a range of .21 - .35, and the thickness ratio (T\LWT) averages .08 with a range of .05 - .11 (Appendix A, Table 32).

The ventral surfaces of these blades are, like the regular blades, predominately smooth with little rippling or waves. No ripples or waves were found on 27%, no ripples with waves (slight to moderate and strong) were found on 46%. Ripples (all types) combined with waves (all types) was seen on 20% and the remaining 7% have no waves (Appendix A, Table 33).

The major dorsal scar pattern noted on the irregular blades is the bi-directional type that has lateral directed scars combined with either proximal or distal directed scarring. This type comprised 44% of the total, and was followed by a radial or subradial type with 22%. The proximal-distal bi-direction type comprised 11% and a lateral bi-direction type was noted on the remaining 11% (Appendix A, Table 30).

To summarize the interior blades, both the regular and irregular forms have profiles that vary from flat to gently curved, with a few examples that are strongly curved. The regular blades are slightly longer than the irregular blades, which is understandable when considering that the irregular forms were produced primarily as core maintenance, re-surfacing removals, or are failed primary blade removals as opposed to the regular blades which were more of the intended end product. These differences are also supported by the dorsal scar patterns, which are significantly more complicated on the irregular blades.

The platforms are well prepared by isolating and grinding, but (although plain platforms dominate) they are closely followed by dihedral and faceted types. Platform sizes on both forms are fairly small, with both forms having approximately the same widths, but are thicker on the irregular blades. Although still fairly steep, the platform angles are less than those recorded for both the primary and secondary blades.

The ventral surfaces are smooth with little rippling or waves noted on either of the forms. There is an increase in platform lipping with diffuse bulbs in secondary blades. Lipping, combined with bulbs of all types, and no lipping, with and without bulbs, are well represented between both blade forms. The combination of these attributes suggests that both soft and hard hammers continued to be utilized for blade removal. However, the decrease in platform angle and an increase in platform lipping combined with diffuse bulbs are an indication of an increase in soft-hammer use.

Comparison of Interior Blades to Other Clovis Sites

Six sites were found to have attributes available for a comparison of interior blades (Appendix A, Tables 34-36). These sites include the Green Cache from Blackwater Draw, New Mexico (Green 1963:151-156), the Keven Davis Blade Cache from Central Texas, Richey Roberts from Washington, Gault 1 from Central Texas (Collins 1999a:97-103), Pavo Real from central Texas (Collins et al. 2003:126), and the Adams site from Kentucky (Sanders 1990:60). The Gault specimens were obtained from an earlier study conducted by UT.

As with the secondary blades, a considerably larger sample of interior blades was available than those for any previous study which, like the secondary blades, revealed additional attributes not noted previously. The total number of interior blades used in the comparison include 3 from the Green Cache, 4 from the Keven Davis Cache, 4 from Richey Roberts, 36 from Pavo Real (11 complete and 25 incomplete blades), 5 from Gault 1 (1 complete and 4 incomplete), and 3 from the Adams site (Appendix A, Table 34). Unless otherwise noted, all comparisons are made from overall averages.

The average length between the Gault regular and irregular blades differs by 32 mm. Not surprisingly, the regular blades are longer than the irregular as the latter were primarily a result of core maintenance and re-facing preparations. The regular blades from Gault were found to be shorter than those from Pavo Real, the Green Cache, Keven Davis Cache, and the single Gault 1 specimen, but larger than the blades from the rest of the sites. The irregular blades are shorter than the blades from all the other sites. The Green, Richey Roberts, Keven Davis, and the Adams blades are the widest, with the blades from the rest of the sites being approximately the same width. The Gault blades (both types) are thinner than those from all of the other sites, but are only slightly thinner than those from Pavo Real (Appendix A, tables 35-36).

The width-to-length ratios are very similar between all sites with the smallest ratios occurring within Gault and the Adams sites and the largest from Richey Roberts and the Keven Davis blades. The length and width ratios are essentially the same between all sites except for the Keven Davis and Green blades, which are larger and thinner than the others. The Adams site has the largest thickness ratio while the rest have approximately the same thickness (Appendix A, Table 35).

Platform dimensions are provided for only the Keven Davis cache, Pavo Real, and the single Gault 1 blade. The platform widths for both the regular and irregular Gault blades are wider than those from Keven Davis and the Gault 1 blade but narrower than those from Pavo Real. The Keven Davis blades have the thinnest platforms, while Pavo Real and both regular and irregular Gault blades are the thickest. The platform angles between the sites vary little, ranging between 60° (Green Cache) and 70° (Keven Davis Cache) (Appendix A, Table 36).

The Pavo Real blades have the lowest average index of curvature with 5.7, closely followed by the Gault blades (both types) with 7.5 **.** Some of these averages may give the impression that there are few blades with strong curvatures. This, however, is not necessarily the case, especially when taking the low number of blades available from some of the sites. Most of the sites have individual blades with very high curvature indexes. For example, a single blade from Pavo Real has a very high index of 13.8**,** and two of Gault's regular blades and one irregular blade have indices that exceed 14.0**.** The highest average curvatures are found on the Keven Davis and Richey Roberts blades with 15.0 and 14.3, respectively (Appendix A, Table 35). However, a broken blade from the Gault 1 sample has an index of 22.5**,** the highest recorded. The curvature ratios show that, although overall averages within a single assemblage may be low, individual specimens having extreme curvatures may occur on any of the sites.

These comparisons show that the regular blades from Gault are more similar to those from Pavo Real. As should be expected, the single complete Gault 1 blade is only slightly larger than the current Gault blade average, otherwise fitting well within the present Gault sample. Not surprisingly, attributes for the Keven Davis blades are widely dissimilar from Gault with only platform angle and the thickness ratio being compatible. In fact, the Keven Davis blades more closely share attributes with blades from the Green Cache and the Richey Roberts sites than any of the others.

The dimensions for the irregular blades are more similar to those from the Adams site. However, the description provided for the complete Adams site blades lumped all the types (i.e., primary, secondary, and interior) together, describing them as six with parallel sides and one with a contracting side. It can be inferred from this description that the interior blades from Adams are regular and (other than basic size dimensions) have no other similarity with the Gault irregular blades.

Crested Blades (N = 55, Figure 33)

Crested blades, or a lamé à crête, are specialized blade forms that were prepared by the removal of small unifacial or bifacial flakes from the edge of a core. The purpose of this preparation is to establish a ridge on a core that will serve to guide for the removal of a blade (Bordes and Crabtree 1969:4,15, Crabtree 1972:72). In some cases, materials chosen for blade production contain no prominent ridges. If existing ridges are present, they may be too irregular to allow for the removal of a blade. Therefore, the edges are flaked to either establish a ridge or straighten one out. Depending upon how much of a ridge is required or the amount of irregularity is present, flaking may be unifacial, bifacial, and involve either part of, or the entire edge. Once a ridge is established and a platform created, a blade can be removed with each of

Figure 33. Crested Blades.

the lateral edges forming an additional guide ridge for additional blade removals. proportional to the thickness of the platform and force of blow. In cases where this removal is not wide or long enough, additional flakes, or flaking from the opposite end may be required. If successful, an angle suitable for lateral flaking (crest formation) will be established along the side of the core.

This process is usually considered only as evidence for blade core preparation, but during the analysis of the Gault bifaces it was found that it was also employed during initial biface reduction as well. The cresting along the edge of a cobble or blocky tab serves the same purpose in establishing an edge for bifacing as it does in setting up ridges for blade production. Blocky tabs often have edges that are irregular or contain some material defects that inhibit or reduce length of fracture. The technique of cresting was employed in order to clear these problems and establish a surface or edge suitable enough to remove a flake along the tabs entire length. Once a ridge is aligned along an edge, the entire corner (or side) can be removed creating a surface that angles toward the opposite face. This brings the two faces close together allowing for the formation of platforms, at various points along the fractured surface, which will enable transverse flaking across the surface of the blank. This differs from the repeated longitudinal flaking along one or more axes on cores used in blade production. Unfortunately, there is no differentiation between individual crested blades identifying their removal from either process. However, the use of cresting in biface reduction was established from flake scar patterns noted on overshot and some large flakes associated in biface thinning.

Typically, the crests are formed by removing flakes from a common edge. Within the Gault sample, 50% of the crested blades have an edge that was entirely flaked unifacially and 37% were flaked bifacially, 9% have sides that were only partially flaked, and (in 4% of the sample), one side was entirely flaked and only a part of the opposite side was flaked. In a few cases (10%), some flaking originated laterally, and terminated on the crested edge. It was found that 78% of the Gault crested blades have had previous removals performed, with 50% of these having multiple removals, some from both ends (Appendix A, Table 37). Those with flaking originating from another edge may have been to aid in edge straightening, as well as for establishing a flakable edge.

The condition of the crested blades includes 19 complete blades, 2 proximal, 11 distal 10 medial, 5 proximal-medial, and 8 medial-distal sections. Blade shapes are highly varied and may be regular, expanding, converging, bending, and asymmetrical, but most (59%) are irregular. As would be expected, cross-sections are primarily triangular (91%), but many of these (43%) have one lateral edge that is abrupt (lateral steep). Edge angles on the abrupt side often exceed 75° with a high angle of 111° (Appendix A, Table 38). Most blades bend slightly medially or distally, but 30% of the sample are flat or twisted with no curvature.

The Gault crested blades average 97.9 mm long with a range of 43.3 mm - 165.6 mm. Widths average 29.6 mm with ranges of 13.4 mm - 48.7 mm, and thickness averages 16.2 mm with a range of 10.6 mm - 28.8 mm (Appendix A, Table 39).

Termination types include straight or blunt (54%), feathered (24%), hinged (11%), and plunging or overshot (11%) (Appendix B, Table 39).

Many of the platforms are missing (48%) or crushed (7%) but (of those containing platforms) the majority are plain (24%), followed by natural (13%), dihedral (7%), and faceted (2%) types (Appendix A, Table 40). Eleven percent of the platforms are ground or abraded, 13% are ground/abraded and isolated, 19% have no preparation, and preparation on the remainder (57%) cannot be determined due to missing or damaged platforms. Platform widths (all types) range 4.0 mm - 27.5 mm with an average of 9.3 mm, and thicknesses range 2.4 mm - 12.1 mm and average 4.8 mm. Platform angles are usually steep with a range between 48° and 89° and an average of 72.5° (Appendix A, tables 40-41).

Twenty blades retain platform and bulb characteristics. Platform lipping is present on seven (35%) of the crested blades, but vary on the presence of bulbs. Lipping on blades with diffuse bulbs were noted on only 3 (15%), lipping with bulbs (all types) were found on 4 (20%) of the blades. No lipping with diffuse bulbs was found on three (15%) of the blades, and no lipping with bulbs (all types) is present on 10 (50%) of the blades (Appendix A, Table 40).

Forty-two of the blades were complete enough to calculate the index of curvature. However, as mentioned above, 30% (N = 14) of the blades are flat and/or twisted and have no curvature. The index of curvature on the remaining 28 blades ranges between 3.46 and 13.44 with an average of 7.97 (Appendix A, Table 42). The strongest curvatures (i.e., those having an index exceeding 9.00) were found on only five blades. Three of these are on the longest blades, whose lengths range between 100 mm and 124 mm, while the other two are among the shortest, ranging between 43.3 mm and 46.6 mm in length. The longer blades were obviously removed along the long axis of a tab but the shorter blades were vertical removals from the corners of moderately thick tabs.

The width to length ratio (W:L) averages 3.40 with a range of 1.91 - 5**.**91**.** The low figure of 1.9 is from one of the short vertical corner removal blades mentioned above. This blade has a very irregular or asymmetrical outline resembling more of a blade-like flake than a true blade, but due to the presence of prominent cresting on its dorsal surface, it is included within this sample. The length ratio (L/LWT) averages .68 with a range of .56 - .74, the width ratio (W/LWT) averages .21 with a range of .13 - .30, and the thickness ratio (T/LWT) averages .11 with a range of .06 - .15 (Appendix A, Table 42).

Although ventral rippling is present, the ventral surfaces of 81% of the sample are predominately smooth with no or little rippling and no or minor waves (Appendix B, Table 43). This is interesting when considering the findings that 53% of the blades have no platform lipping and moderately strong to strong bulbs and 16% have no lipping and diffuse bulbs. These attributes and the high platform angles indicate that at this stage of manufacture the angle of impact was directed into the mass (along the edge) as opposed to an arching swing. Fractures from such impacts result in smooth ventral surfaces having minor or no lipping and are an indication of the use of hard and soft-hard hammer percussion. The use of soft hammers, however, also produces similar attributes, especially on those blades with smooth ventral surfaces combined with prominent lipping and diffuse bulbs. The combination of these attributes was noted on only three (7%) of the blades, therefore, the use of soft hammer percussion should also be considered as an additional method for flake removal.

Summarizing the crested blades, the Gault specimens comprise some of the larger blades in the overall blade assemblage as well as some of the shortest. The dorsal scar patterns contain specimens that are unifacial, bifacial, contain portions that are both unifacial and bifacial, and contain some with flaking only on part of the blade. Many of the specimens also exhibit previous blade removals, albeit, some terminating short of the blades total length. Profiles range from flat and twisted to some with moderate medial and distal bending with a few examples that are more strongly curved. The cross-sections are usually triangular, but the overall shapes vary, with most being irregular**.** The platforms are moderate to large and are often well prepared by isolating and grinding. The ventral surfaces are usually smooth with little rippling or waves, have slight to no platform lipping and bulbs that may be diffuse to moderately strong.

Comparison of Crested Blades to Other Clovis Sites.

Crested blades are known from three established Clovis sites (Appendix A, Table 44) (i.e., Keven Davis Cache from Central Texas, Pavo Real from Central Texas, and the Green Cache from Blackwater Draw, New Mexico). In addition, blades from two additional sites (i.e., 41RN107, an open site located in the Colorado River valley of west-central Texas, and Anadarko in Oklahoma), described as containing probable and indefinite Clovis contexts (Collins 1999a:97-101) were referenced. Three blades are listed from the Keven Davis site, two from Pavo Real, and two from Green. A single complete blade was recovered from 41RN107, a site from which Early Archaic, Folsom, Midland, and Plainview artifacts have been recovered (Bryan and Collins 1988). Among the artifacts recovered were a tip and a complete patinated blade, having attributes comparable to Clovis blades. The Anadarko blades are from a cache of blades, having similar Clovis blade attributes (Collins 1999a:166) that were excavated from a corral near Anadarko, Oklahoma (Hammatt 1970). Within this assemblage were two blades, described as Stage 2 blades or secondary blades with prepared crests (Collins 1999:90). These two sites are not considered as having good Clovis contexts, but due to the scarcity of recorded crested blades, they are included here for a comparison.

A comparison of the attribute averages and ranges for each of the sites with Gault is provided in Appendix A, tables 45-46. It can be seen from these tables that the Gault specimens more closely resemble those from Pavo Real and RN107 and are most dissimilar with the blades from the Keven Davis cache and Anadarko. Unfortunately, not all attributes are available for blades from the Green cache, where only a few measurements for each blade are available. Those that are, i.e., blade width and thickness, are very comparable to Gault.

Blade Cores

A total of 46 blade cores (all types) were recovered during the excavations carried out by TAMU. In addition to these cores, a blocky core was refitted with three blade-like flakes; however, this specimen will be discussed later in the section on reitted pieces. The core types consist of 3 conical cores, 31 wedge-shaped cores, and 10 cores miscellaneous irregular cores and core fragments.

Conical Cores (N = 3, Figure 34 and 35)

These cores are defined by Collins (1999a:51) as having the blade facets on the long axis of the core at approximate right angles to the platform plane and most of the core's circumference flaked. The angles on the Gault specimens easily fall within this description, ranging from 83° to 89° with an average of 88°. Two of the cores were made on blocky to rounded tabs of chert and the third on a creek cobble. The cobble is grainy and cracked which probably led to its discard.

Blade manufacture from these cores began with the removal of the cortex and the establishment of ridges for subsequent blade removals. The blocky tabs usually contain several corners that are adequate for the first removal (Figure 35). The blocky nature of these tabs usually precludes the initial use of cresting. Most of these tabs also have flat surfaces adjacent to a corner that will also serve as a platform. If the surface is rounded or cortical covered, it was flaked off to a suitable condition. Once the first blade (primary) is removed, additional blades could then be removed, each following the lateral ridges formed by the first blade. Unless another blade was removed from one of the other corners, the blades from this first sequence of removals will be secondary until all cortex is removed. Blades removed subsequently will be interior types (Figure 35).

Cobbles and gravels are usually more rounded and lack the prominent ridges or corners seen on blocky tabs. For this reason, a slightly different approach for blade

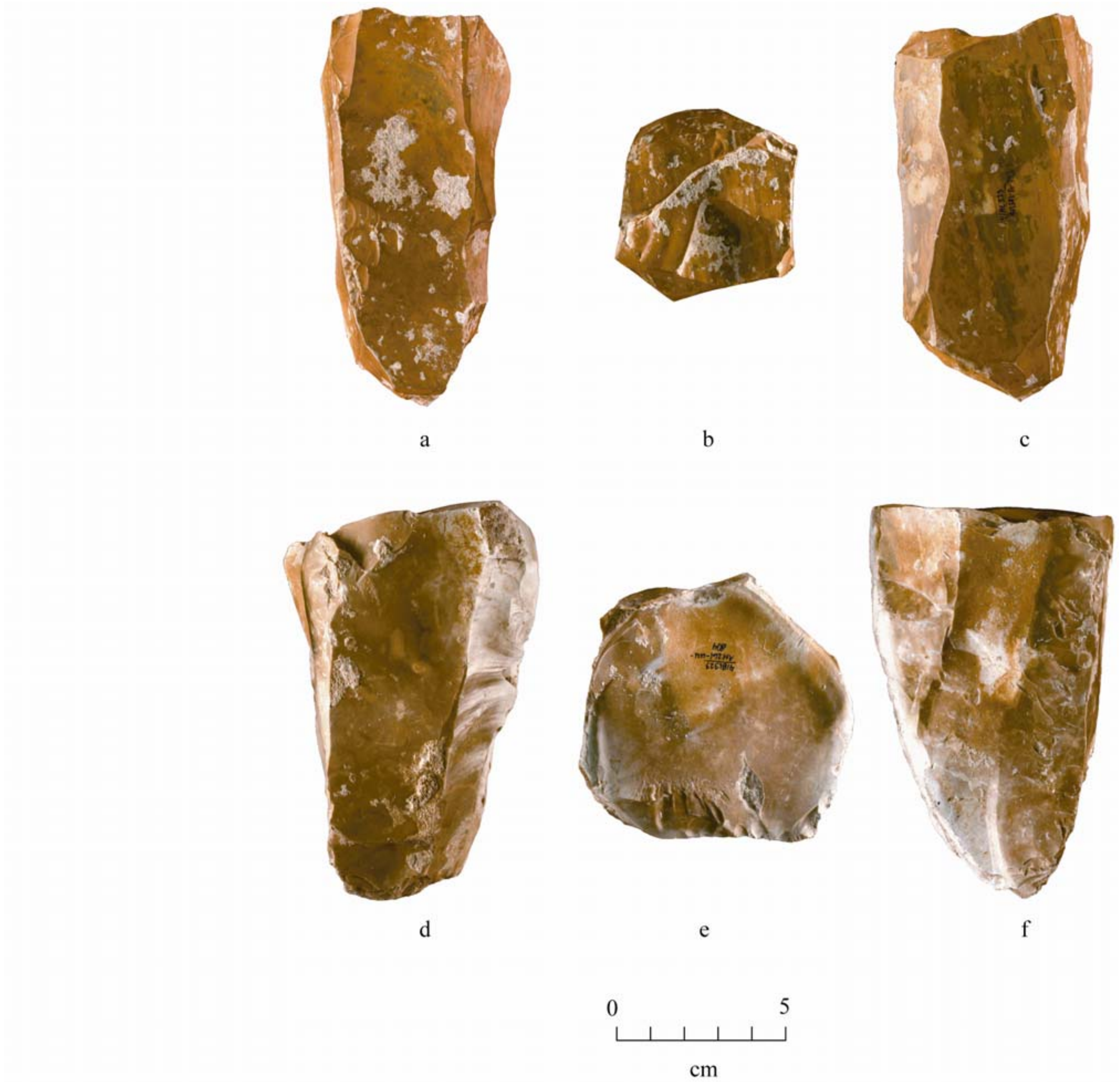


Figure 34. Conical Cores.

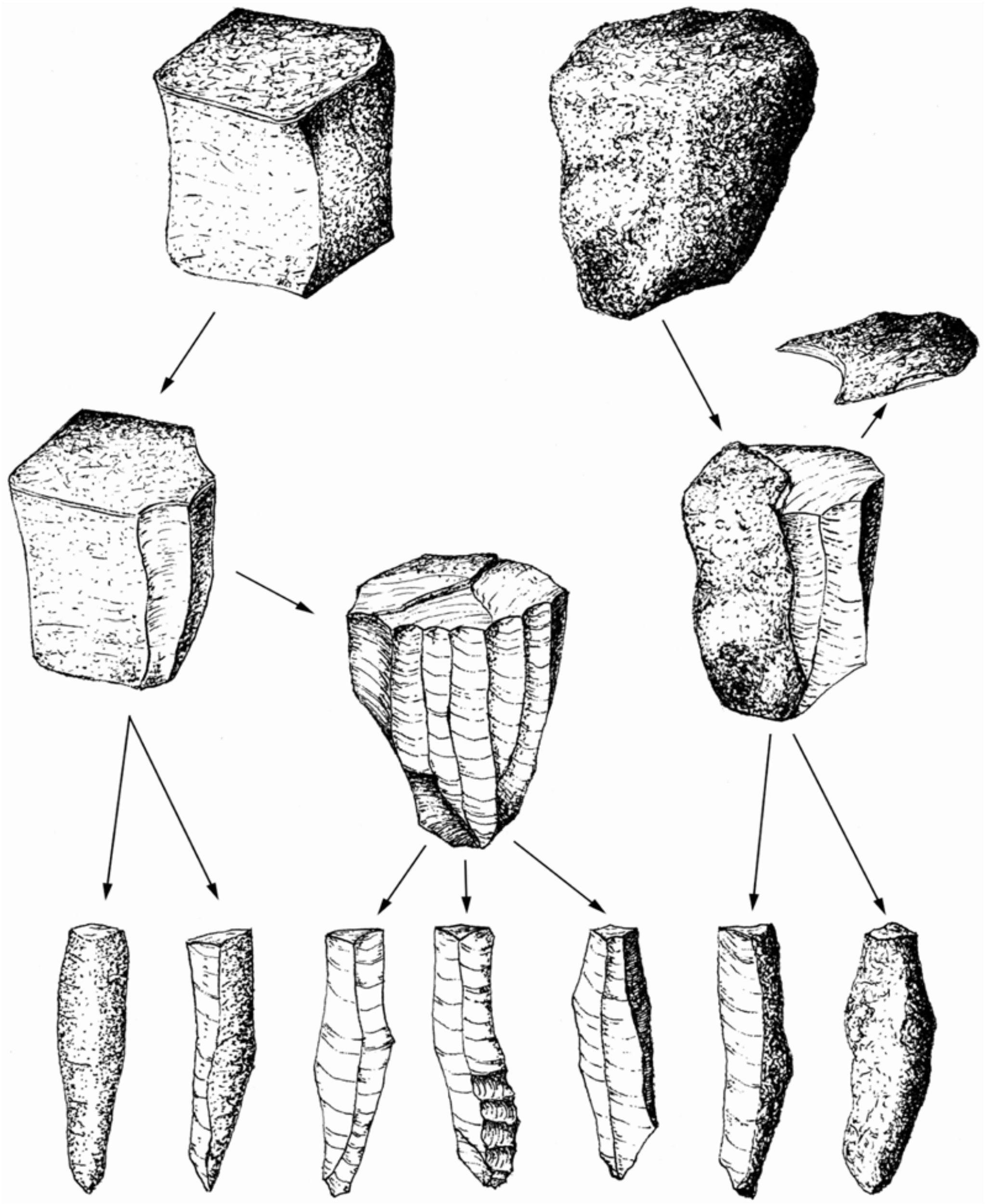


Figure 35. Conical Core Blade Manufacture Sequence.

removal is required. If no ridge or corner is present, or if one is present and it is not adjacent to an adequate platform surface, the end or top of the cobble is removed to serve as a platform surface. Once the surface is established, an initial blade could then be removed. Typically, if the cobble's surface is too rounded or the lateral edges are not prominent enough to facilitate additional blade removals, the lateral edges from the first removal were flaked back forming a more prominent crest for fracture to follow. However, because the cobbles at Gault originated from the surrounding slopes, most still retain one or more corners or ridges that are suitable for initial removal without the use of the cresting procedure.

Sizes range from 86.7 mm to 130.5 mm in length, 59.7 mm to 78.4 mm wide, and 56.2 mm to 79.6 mm thick (Appendix A, Table 47). All have multiple bi-directional blade scars with widths ranging between 28 mm and 46 mm. The entire circumference on one specimen is completely flaked, while the other two still retain varying amounts of cortex. The bi-directional flaking suggests that as platforms were exhausted on the proximal end, the core was reversed and flaking commenced from that (distal) end.

This type flaking has been described as producing flatter blades as opposed to those that bend (Bordes and Crabtree 1969:2). For example, a core face on a conical core illustrated from the Green cache (Green 1963:161) was described by Bordes and Crabtree (1969:10) as having uni-directional blade scars that appear to have produced flat blades with feathered terminations. A close examination of the illustration reveals that there has been some flaking from the distal end, as well as at least one scar flaked in a lateral direction. These may be core maintenance flakes, but they may have also served to reduce curvature.

Recently, a Clovis conical core was reported from Victoria County (Birmingham and Bluhm 2003:55-58). It is described as being 182 mm long and 70mm across the platform with 11 primary blade facets flaked in a uni-directional direction. In addition to the primary blade facets, there has been some lesser flaking from the distal end which is interpreted as having been performed to straighten the core face, to remove hinges from failed blade removals, and/or to reduce curvature of the blades removed. The illustration of this core shows the blade facets to be relatively flat with little curvature.

The Victoria County core and the core from the Green Cache indicate that some Clovis core faces were modified to maintain or create flatter surfaces, indicating that blades having little or no curvature were intentionally produced. Two of the Gault conical cores have blade scars that are flat, but additional scars on one of these cores also bend medially, while the third core (Specimen Number 793) contains only scars that bend.

The platform ends of two specimens (Figure 34) have had their dorsal surfaces completely flaked by a single flake (core tablet) removal. The distal end on one specimen also has had its distal end flaked in a radial pattern that includes several small blade removals along the margin. The platform end on the third core has multiple bi-directional flake removals, with several terminating in hinge and step type terminations. The negative bulb scar of one of these flakes is deeply concave with this concavity centered between two adjacent platforms, from which, each have had a blade struck.

All of these specimens contain a number of flake removals flaked in both lateral and perpendicular directions. This flaking was performed to remove problems, re-establish satisfactory ridges, and/or a good flaking surface. One specimen is heavily cracked and more blocky than the other two and, as evidenced by the small blade scars on the margin of the distal end, may have had its flake direction changed to circumvent the cracks. Material flaws, such as cracks and inclusions, were the probable reasons for the abandonment of cores (specimens 804 and 823). In addition, the distal end on one core (Figure 34 d-f) is heavily battered, suggesting a final use as a possible chopping tool.

Wedge-Shaped Cores (N = 31, Figures 36, 37, 38, and 39)

These cores differ from the conical type by having a more acute angle between the platform and the blade surface, are generally narrower, being made on more slab-like tabs than the blocky forms used for conical cores, and having multi-faceted platforms (Collins 1999a:51). The Gault cores fit well within this definition, but with the larger number of specimens within the assemblage, a greater range of variability became evident.

Material selected for these cores was almost exclusively rectangular to blocky tabs of chert found on the slopes surrounding Gault. In some rare cases, cobbles from the creek were also utilized. Initial flaking of the core began along one of the narrow ends having, either a natural or prepared corner with an angle around 90° or slightly

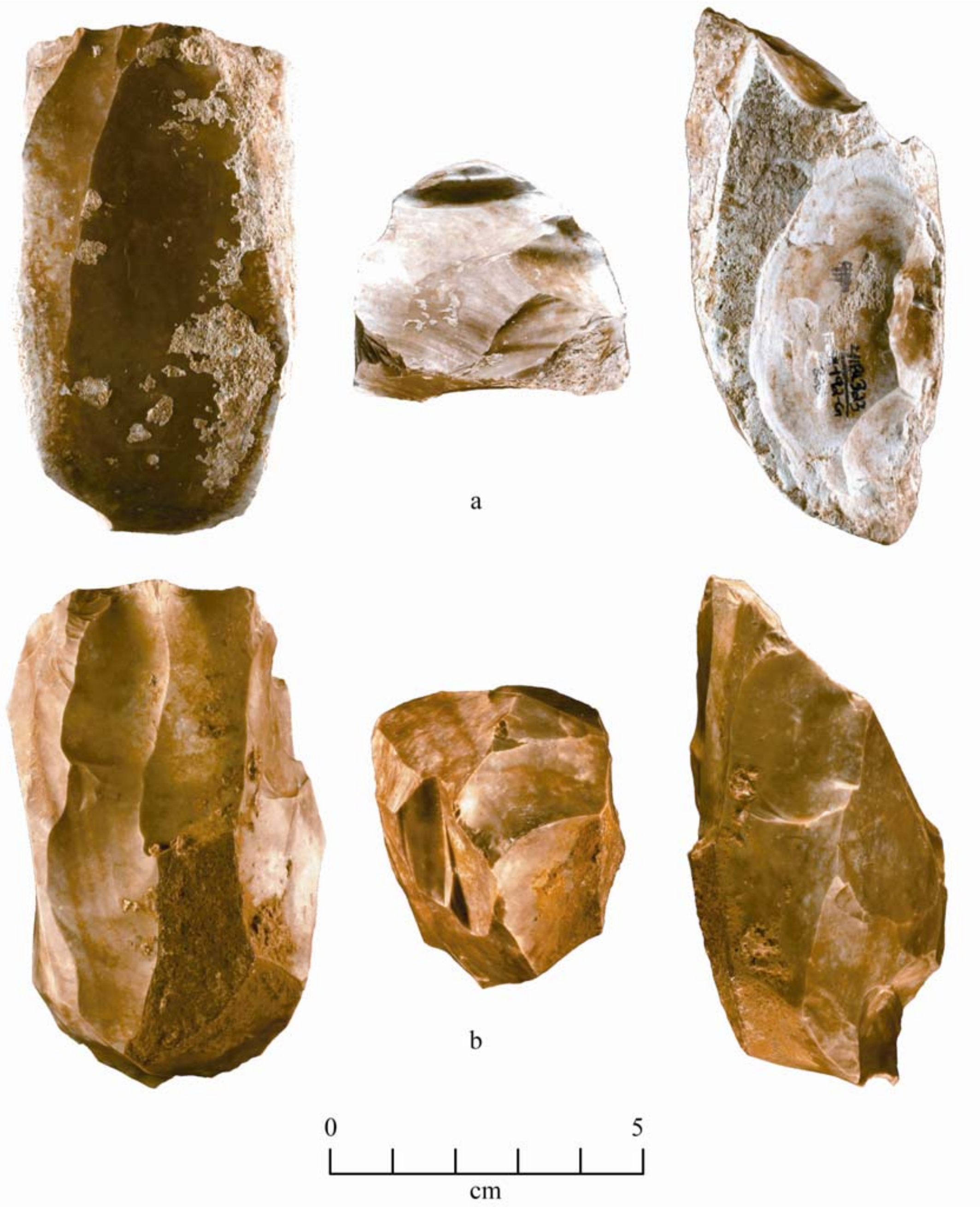


Figure 36. Wedge-Shaped Core (Unidirectional).

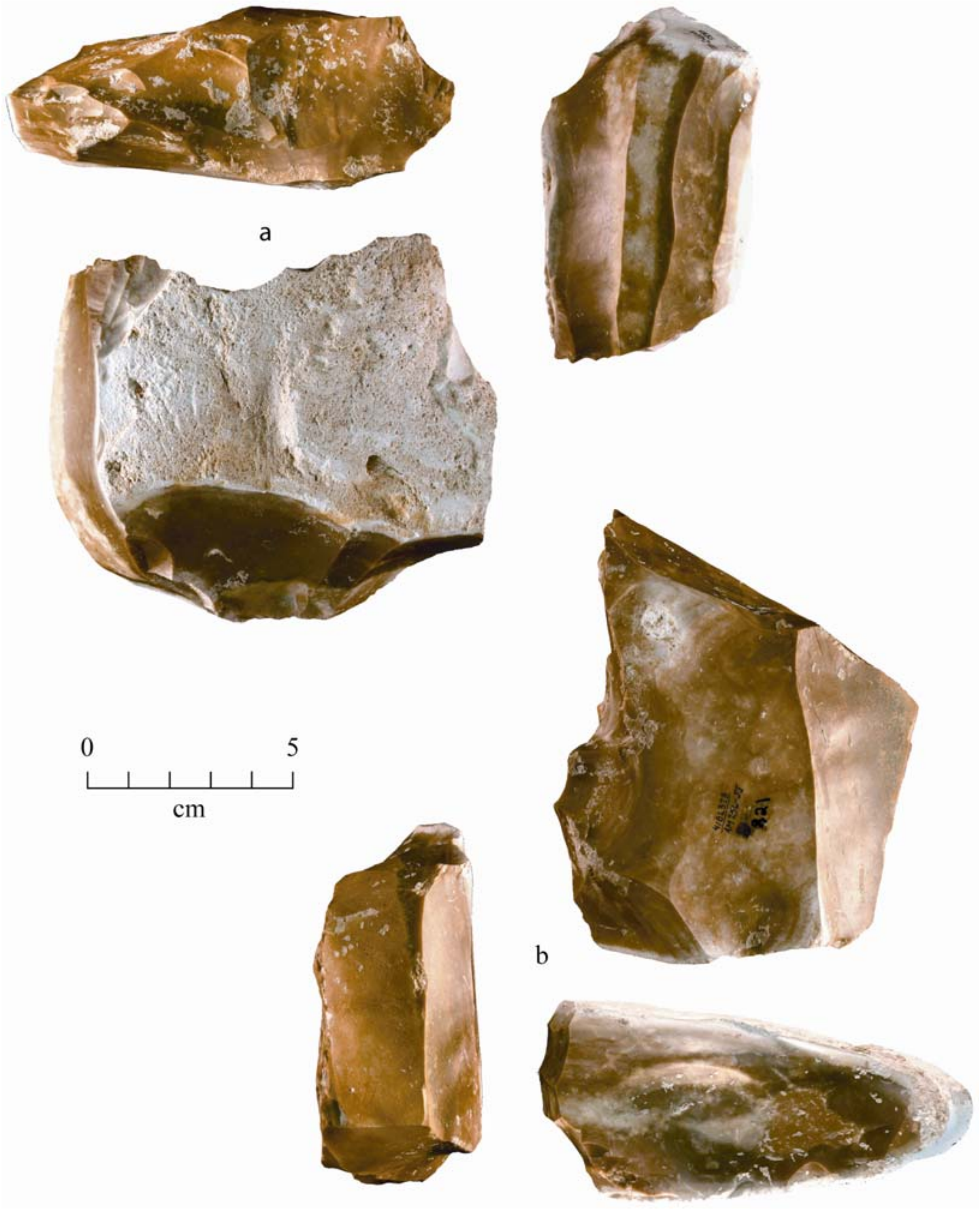


Figure 37. Wedge-Shaped Core (Bi-directional).

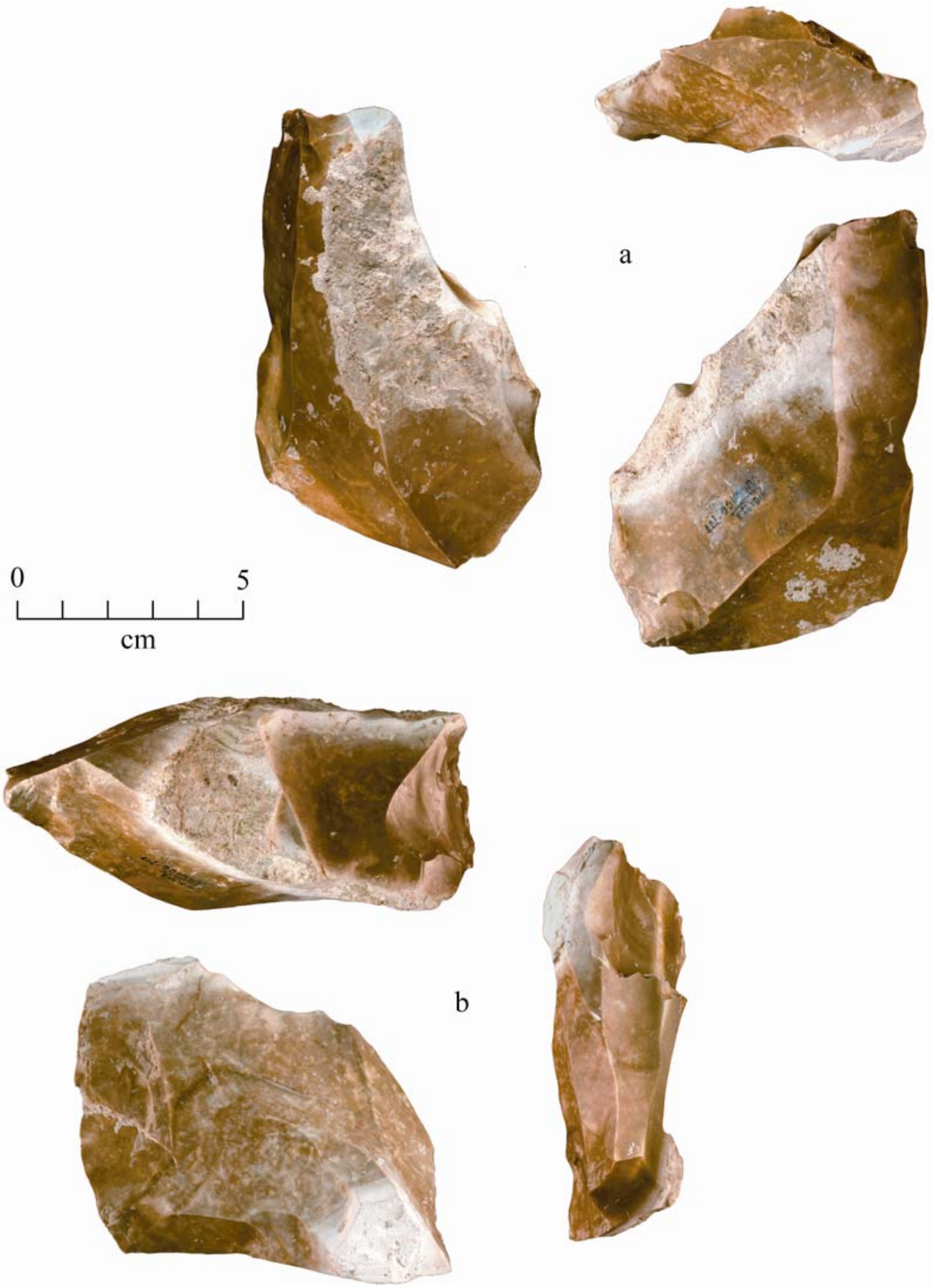


Figure 38. Wedge-Shaped Core (Multi-directional).

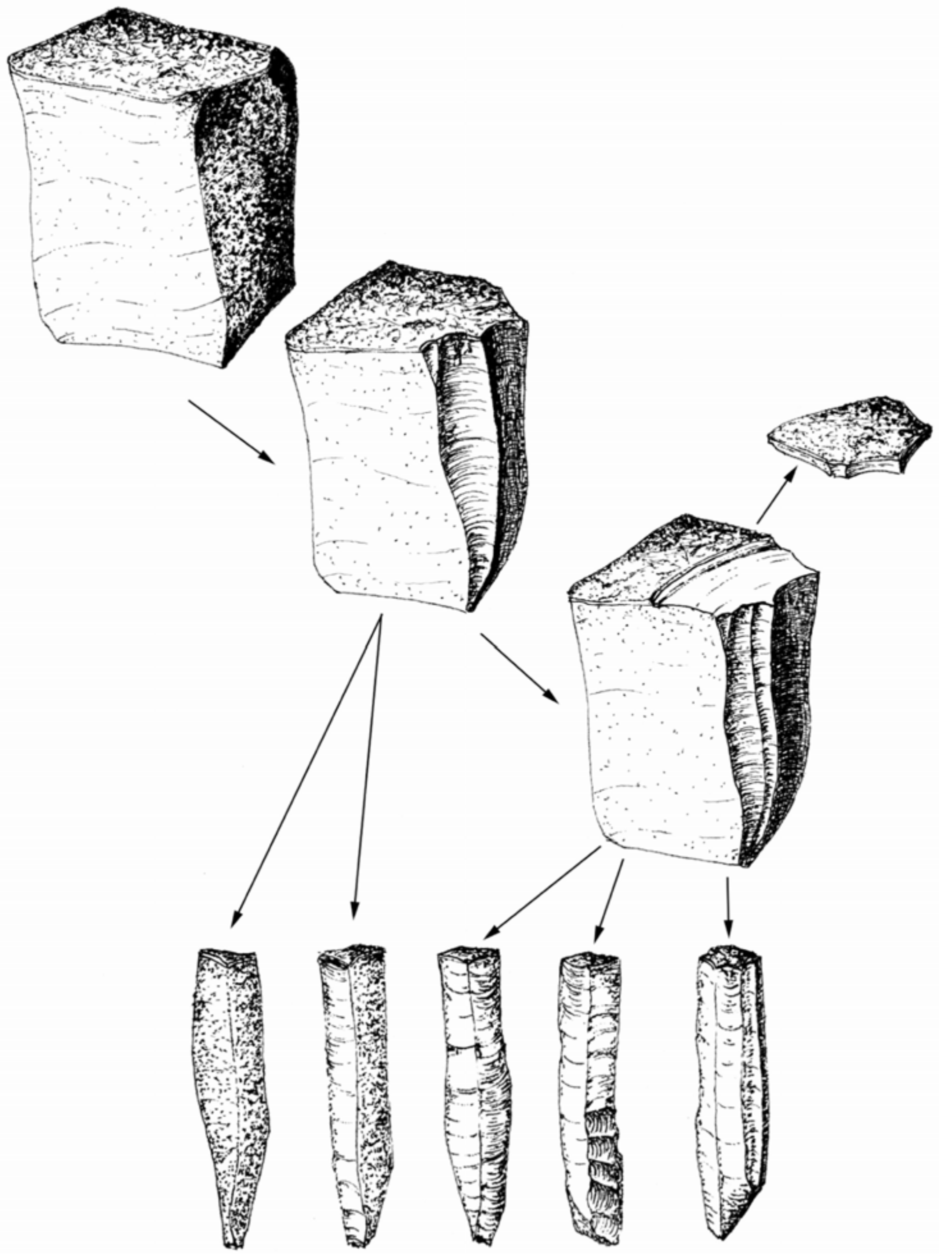


Figure 39. Wedge-Shaped Core Blade Manufacture Sequence

less. The first removals would remove the cortex and establish ridges for subsequent blade production. Once the cortex was removed, the next sequence of removals could commence. Blades removed from this sequence, and all others that followed would include both secondary and interior types (Figure 39).

Blades were flaked in a series around the core's end until the usable platform surface was exhausted. Each removal not only reduced the platform surface, but (as each blade was removed) the negative bulb caused a slight concavity to form immediately below the platform edge. This edge could be removed by flaking down the core’s longitudinal surface, grinding back or down, or flaking back onto the platform surface. These procedures eventually resulted in an edge angle that was unsuitable for a successful blade removal. This situation and the reduced platform surface from previous removals necessitated the re-forming of a new platform surface by flaking the dorsal surface back from the edge. This flaking often angled or plunged into the tabs surface forming a slight acute angle, while on many of the more exhausted cores, the entire dorsal surface had been totally flaked by a single blade-like flake.

The repeated flaking back from the cores edge or side often created a platform edge that was very acute or sharp. Not only was the striking angle too steep, but also the edge was so thin and weak that it would crush upon impact. A suitable striking angle and strengthening of the platform edge was easily adjusted by simple abrasion or minor flaking back from the edge. The abrasion of these edges and/or corners strengthens and re-aligns the platform angle. This preparation often created a platform surface composed of many small microflake scars or facets. In some cases flaking of the platform surface produced a very deep central concavity with the lateral edges of this concavity flaring up onto one or more of the tabs corners. This flaring up onto or near one of the corners formed a well defined projection that was also easily modified into a well isolated platform by the same procedure of minor abrasion and/or pressure flaking.

Not all blade removals were successful. Many hinged or broke prematurely hindering additional removals. These problems may or may not have been corrected by flaking from either the distal end or one of the sides. In addition, material flaws, such as inclusions and cracks, also create flaking problems. As a result of some of these issues, the flaking direction was often changed in attempts to avoid these problems. Therefore, as a core was reduced, blade flaking may occur on either end, over one or more sides, or laterally across the dorsal or ventral edges. Thus, wedge-shaped cores will have flake scar patterns that include uni-directional, bi-directional, or multi-directional patterns, as well as surfaces having a number of overlapping flake scars, some with hinge or step terminations.

Thirteen of the Gault wedge-shaped cores have uni-directional scar patterns (Figure 36), 12 are bi-directional (Figure 37), and 6 are multi-directional (Figure 38) (Appendix A, tables 48-50). Most of the uni-directional cores (N = 8) have blade facets on one end, 1 is flaked on both ends, 3 are flaked on both the sides and an end, and 1 is flaked only on one side. Blade facets average three per end with platforms ranging between 64° and 87° (Appendix A, Table 48). Seven of the uni-directional cores have blade facets that are flat, but five of these also contain blade facets that bend either medially or distally. The remaining cores only have bending type blade facets.

The majority (N = 5) of the bi-directional cores have blade facets on two ends and one or more sides, while the remaining cores (represented by one each) have blade facets on two ends, one side, or one side and the basal edge. Specimen (806), flaked on only one side, has blade facets that contain a number of material flaws and irregularities and have had a number of small flake (non-blade) removals that seem to have been attempts at finding enough "clear" material. This flaking failed to uncover enough good material for blade flaking and the core abandoned. The number of blade facets on these cores, increases to an average of six with remaining platform angles ranging between 63° and 89° (Appendix A, Table 49). Flat blade facets are present on all cores except one, but all the cores with flat facets also have facets that bend medially or distally.

The blade facets found on the multi-directional cores vary widely with flaking occurring randomly on both ends, sides, and either the dorsal or ventral edges. The highest number of blade facets (N = 9), were found on the multi-directional cores but have an overall average of 6**,** the same as on bi-directional cores. The platform angles remain high ranging between 67° and 92°, but most fall within the 78° to 84° range (Appendix A, Table 50). All of the cores, except one, contain flat blade facets, as well as facets that bend medially and/or distally.

The sizes of wedge-shaped cores, whatever the scar pattern, vary widely. This is not unexpected as many of these cores were abandoned only after a few blade removals while others were extensively flaked. Sizes range between 55.5 mm and 124.1 mm in length with an average of 91.5 mm, widths range 47.3 mm and 99.2 mm with an average of 69.0 mm, and thickness range 30.4mm and 78.8 mm with an average of 44.9 mm.

Other Cores (N = 12)

This category is made up of a group of miscellaneous irregular cores and core fragments that do not fit the descriptions for either of the previous types. Due to the fragmentary shape of some of these specimens, a few of these may actually be fragments of early stage bifaces, cores resulting from flake production, or practice pieces and not true blade cores. The idea of some being biface fragments is a distinct possibility since blades and blade-like flakes were also removed during early bifacing. In addition, the site is a quarry workshop and practice knapping would have been included in some of the activities conducted during its occupation, which could account for some of the irregular specimens. However, placement in this category was based on the predominant number and placement of existing blade or blade-like scars.

This group includes 6 core fragments, 2 core clean-up flakes, and 4 tested cobbles. The core fragments consist of 1 lateral, 1 distal, and 4 unknown fragments. It is difficult to say with any certainty what type of cores these fragments originated from. Any blade scars present are remnants only, and much of the remaining surfaces on these fragments have been flaked over by small core maintenance and/or recovery flaking.

Two of these cores are interesting enough to deserve some description. The first specimen appears to be the pointed distal end of a conical core, but it is possible that this specimen is a very much reduced conical core. Its entire surface has been flaked, with most occurring after its removal from the parent core. The ventral surface (or the platform surface of a conical core) contains several deep concave negative bulb scars that were flaked to set up platforms for the lateral flaking, all of which ended in hinge terminations.

The second core (Figure 40) is a very large and irregular shaped core has been flaked from both ends. Although several large flakes have been removed, the remaining flaking consists of small blade scars flaked on the sides from each end. In addition to the side flaking, several narrow blades were removed from the proximal end in a manner typical of wedge-shaped cores. Although the scars indicate some blades were removed from both ends, the flaking on the proximal end forms a thin bit-like edge and in conjunction with its overall shape, this specimen may have been modified into a chopping type tool instead of a blade core.

The last category of miscellaneous cores is made up of tested chert cobbles or tabs (Figure 41). The four specimens in this group are made on blocky forms of chert that have had varying amounts of their surfaces flaked. All have material flaws, such as grainy or rough textured interiors, inclusions, and cracks. The surfaces of each have been partially flaked in an attempt to locate interior portions free of material problems that would permit successful blade or large flake production. Evidently, none of these cherts were found to be satisfactory for further flaking, and they were rejected.

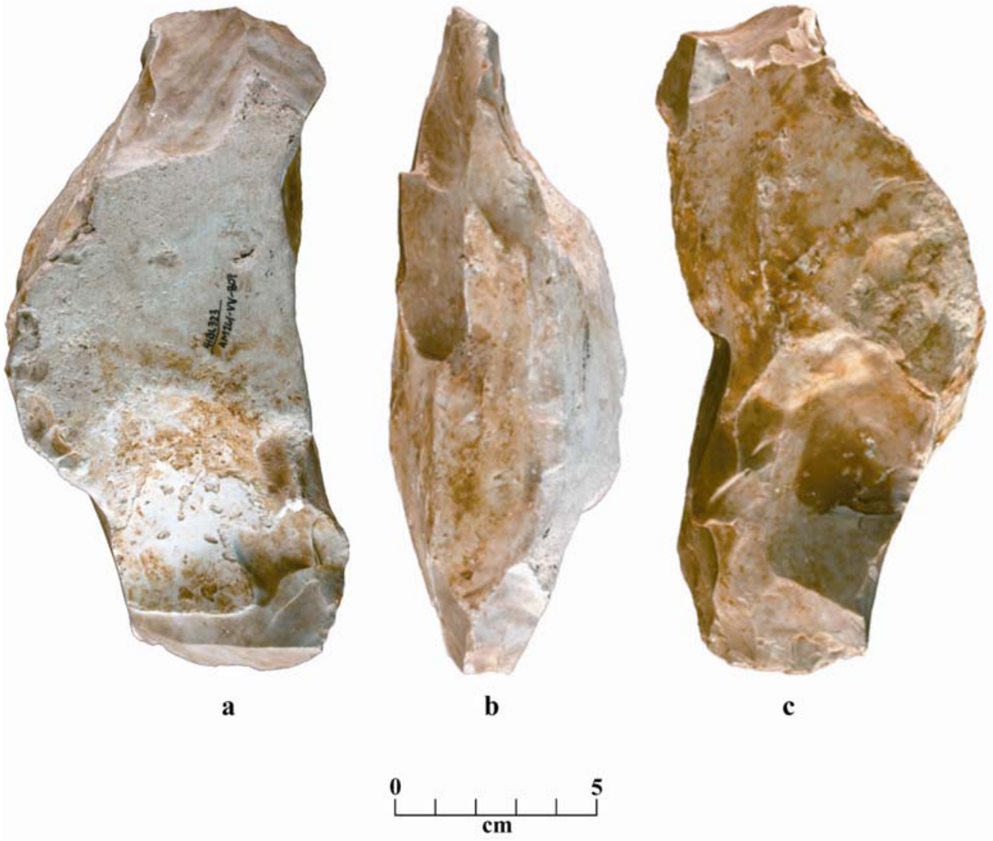


Figure 40. Bifacial Core Tool.

Figure 41. Tested Cobbles.

Platform Rejuvenation Techniques

Successful Clovis blade production was dependant upon establishing and maintaining proper platforms and surfaces. As each sequence of blades was flaked, the striking platforms for each blade was removed or damaged beyond re-use, resulting in the need to be re-formed or adjusted. The following is a discussion of several of these techniques.

Core Tablets (N = 42, Figure 42)

One of the primary rejuvenation techniques was to remove the entire top of the core after all of the platforms were exhausted and to establish new platforms on a fresh surface. The removed tops of these cores are a very recognizable flake form and are called *core tablets* (Collins 1999a). These core tablets contain excellent records and attributes of the exhausted platforms on their dorsal surfaces, which can provide additional information on Clovis platform strategies.

The classic description for a core tablet is one that has removed the top of a conical core. If successful, and the entire top of the core was removed (many are only partial removals), the circumference of the tablet will retain the proximal portions of several blade scars. The size of the tab and the exact number of blade scars will vary as they are dependant upon how many blades have been removed from around the core's circumference. The dorsal surface of these core tablets may have multiple deep negative bulb scars around the periphery of the tab's edge, or a central knot formed by the cumulative flaking of platform maintenance flakes that often hinge or step fracture (Collins 1999a:51).

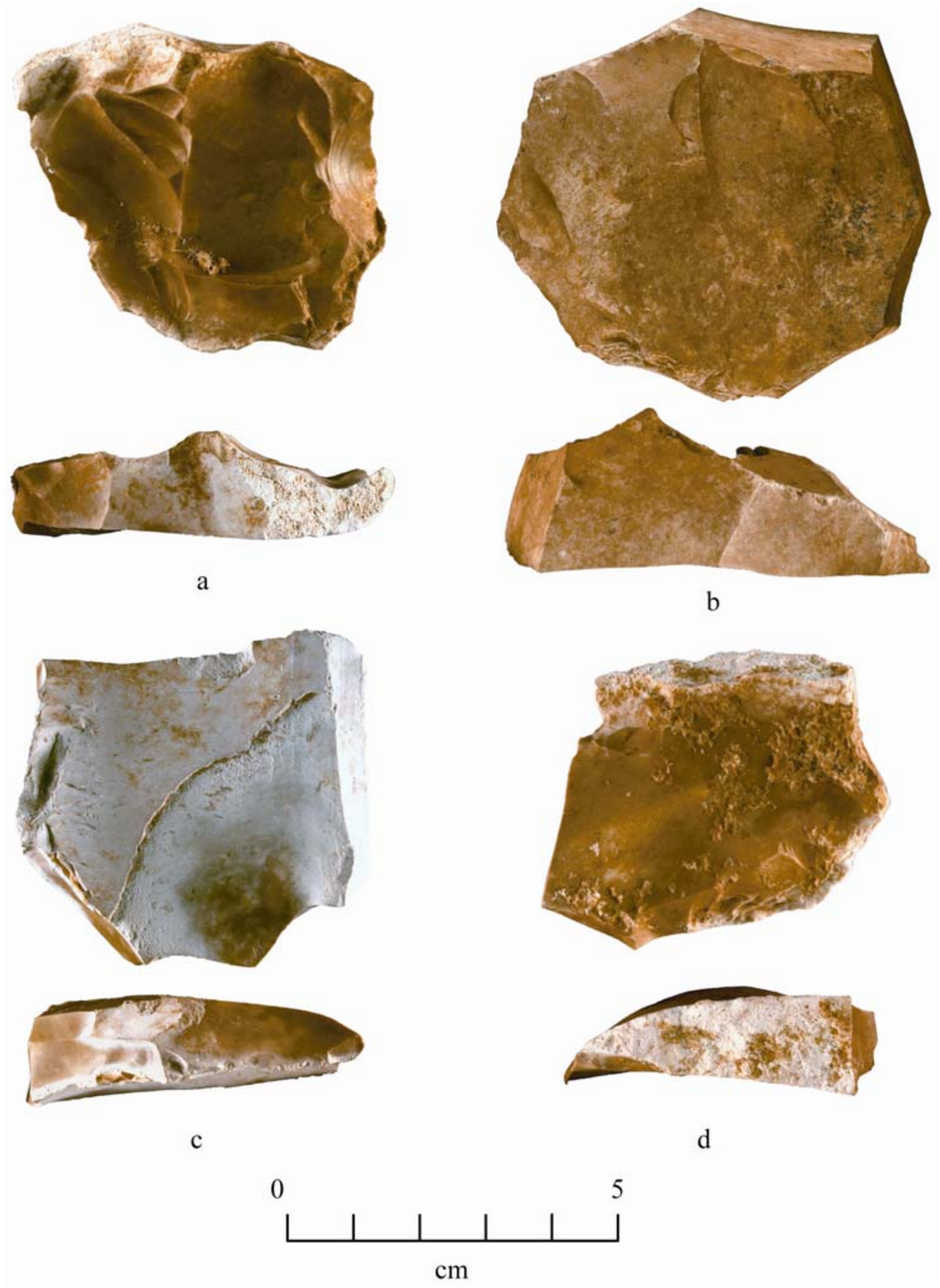


Figure 42. Core Tab (a and b) Conical (c and d) Wedge.

The core tablets from Gault, however, revealed that some tabs were removed from wedge-shaped cares as well as from conical cores (Figure 42c-d). These differ from the conical core tablets (Figure 42a-b) by being much narrower and having blade facets on one or more of its ends, or occasionally, onto one of the sides. Although, some deep negative bulb scars are present, no central knots were noted, rather they were replaced by one or two large hinge or step terminations.

The removal of core tablets was accomplished by either utilizing an existing blade facet or a cortex free surface (Figure 43). The only platform modification noted was occasionally grinding the edge near the point of impact. Most are un-lipped and have a prominent bulb indicating removal by hard hammer. However, some examples have slight lipping and weaker bulbs suggesting that a soft hard hammer, such as one of the many limestone nodules that abound on the site, may have been used.

Not all of the core tablets successfully removed the entire platform surface. Some removed only a part of the surface, requiring additional removals to completely clear the surface (Figure 44). Of the 42 core tablets recovered from Gault, there were only 8 representing the entire platform surface, 6 are from conical cores and 2 are from wedge-shaped cores. Another problem that would have required additional removals occurred when a tab fractured at an angle across the top of the core. In such cases, suitable flaking angles would be created on only a portion of the cores surface, with the remainder of the edges having angles too severe (i.e., exceeding 90°) for establishing platforms. This excessive angle, however, may not be an issue if it is adjacent to a side or portion of the core that is not intended to be flaked.

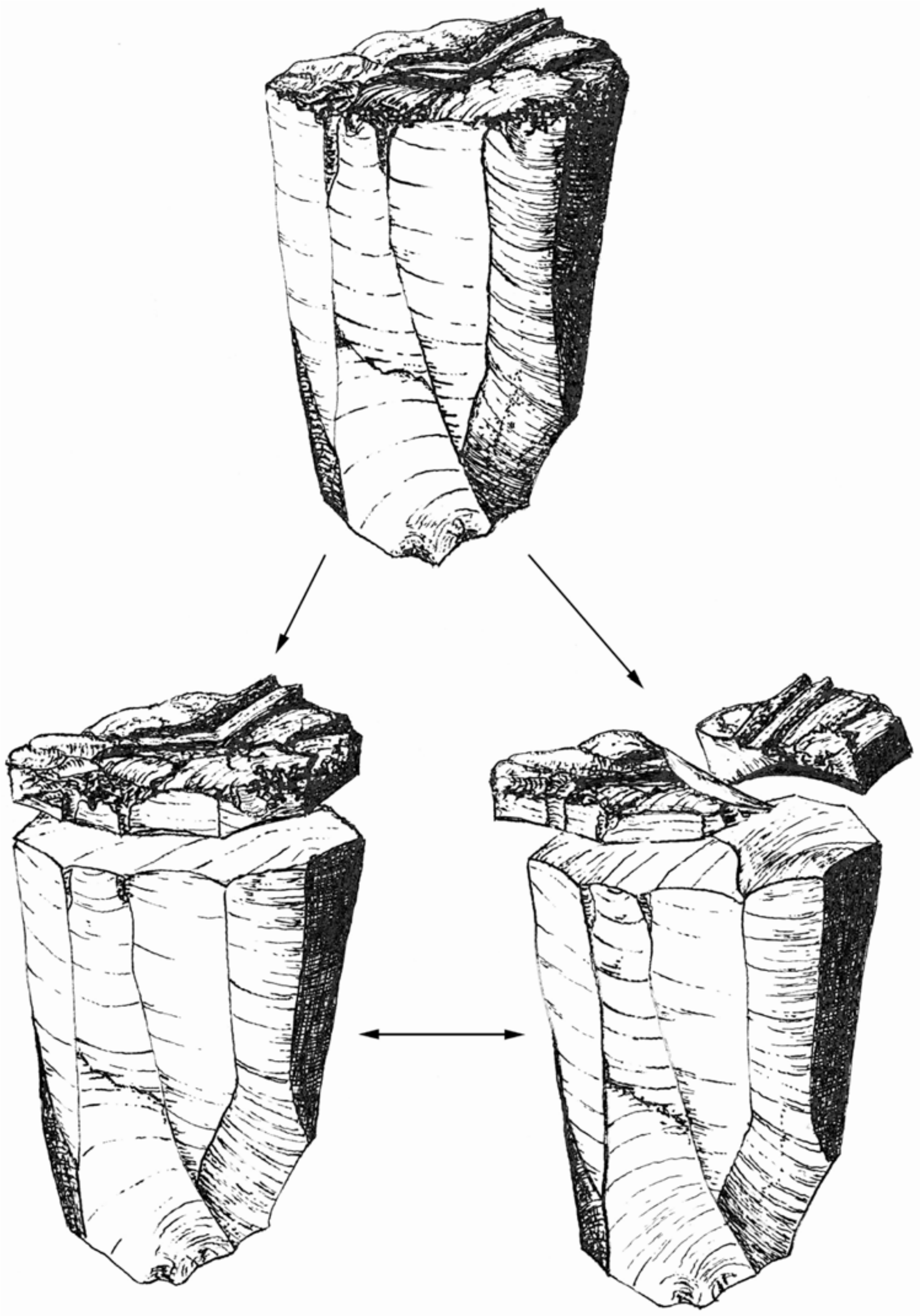


Figure 43. Core Tab Removal Sequence.

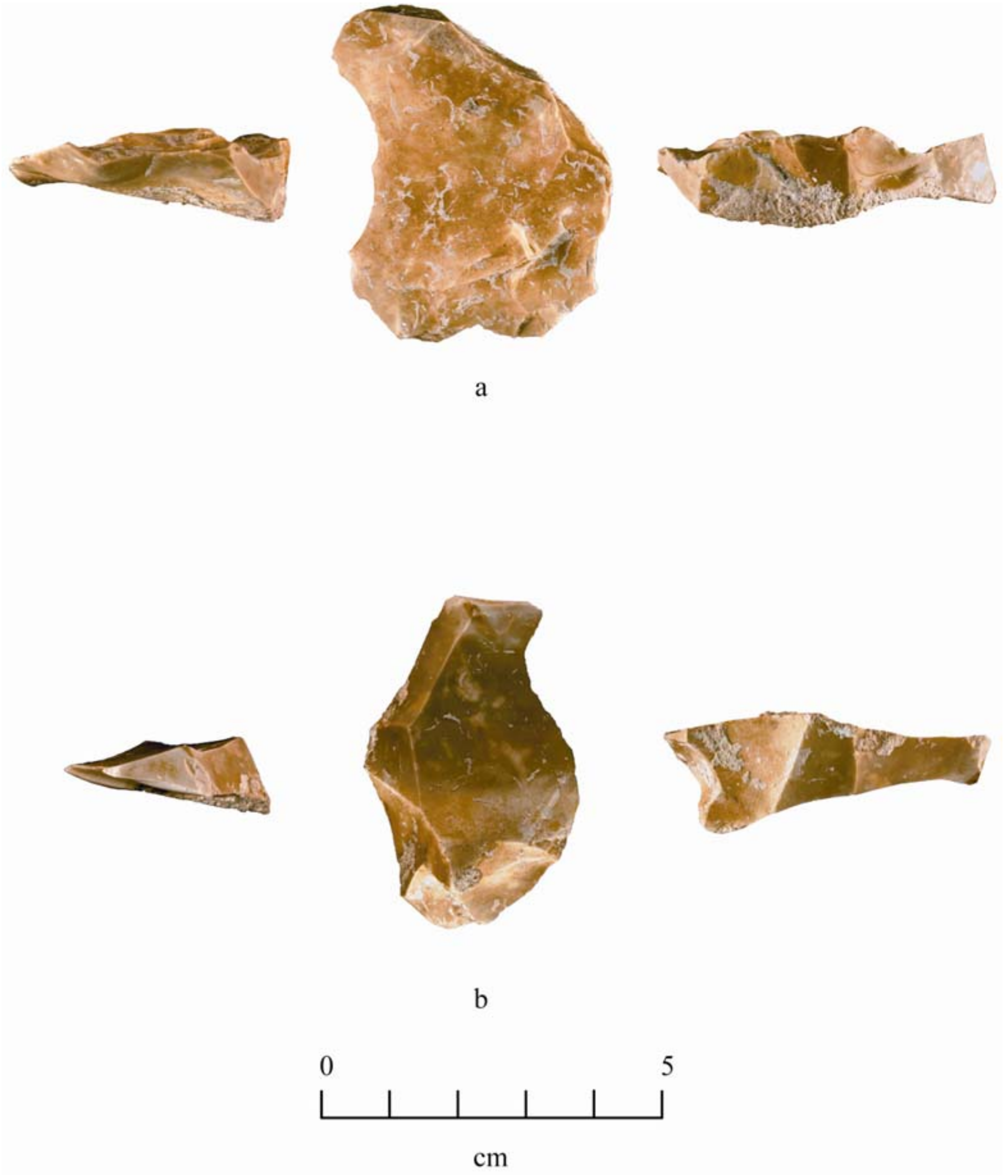


Figure 44. Core Tab (Partial).

An example that exemplifies these issues is an extraordinary specimen recovered from Pavo Real. This specimen is a refit consisting of a blade core, six core tablets, and a blade (Collins et al., 2003:167,171-173). Although some pieces are missing, the refitted core tablets placed together almost double the length of the core. It can be seen from the illustrations that some of the core tablets only partially removed the platform surface and most detached at an angle. Its description suggests that only a minimal number of blades were detached compared to the number of core tablets removed. The reason for this can be attributed to the angle of the core surface created by those core tablets that detached at an angle. Such angles allowed only a portion of the core's perimeter to be suitable for blade removal without further modification, such as a partial surface removal or by minor percussion flaking.

Platform rejuvenation was an easier process on wedge-shaped cores than on conical cores due to the narrower flaking surface on wedge-shaped cores (Collins 1999a:51). Although, two of the core tablets from Gault had removed the entire dorsal or platform surface from a wedge-shaped core, most were only partial removals. Generally, platforms were rejuvenated by forming an acute edge through the removal of short flakes that were flaked back from the platform edge into the mass of the core. This was accomplished by flaking either from each side of the platform or removing a single flake from the center of the core face.

Most of the flakes removed in this process either hinged or step fractured and increased in size with each platform renewal eventually forming a more prominent stack. These stacks are created when the initial flake removal fractured at a slight angle on the platform surface, terminating as the mass of the cores interior became great and fracture force dissipated. This stack builds up as each succeeding flake fracture continues to follow the angle of the surface, terminating at the point where the fracture encounters the mass of the stack. This not only adds to stack formation, but will also increase the acuteness of the edge. If the angle becomes too acute, it can easily be abraded or pressure flaked back to a more appropriate flaking angle. Once the stack became too large or the platform edge was reduced to a point that was too close to the stack for either platform maintenance or use of a billet, the entire surface was removed by striking the core face lower down on the core face from the platform edge or from the opposing edge. If successful, this process, also utilized on conical cores, removed either the entire top of the core, or enough of the surface containing any stacks or remaining portions of the exhausted platform, thus creating a "fresh" surface for the next platform.

Sequent Flakes (N = 63, Figures 20-21 and 45)

One of the attributes noted, not only on the core tablet flakes but also on some platform surfaces remaining on discarded cores, are very deep concavities formed by the negative bulbs of flakes removed on the platform surfaces. These concavities have been described as having sides with acute angles of 60°- 70°, that enabled a punch to be placed in the center for blade removal (Collins 1999a:51).

During the initial flake debitage examinations, a very distinctive and re-occurring flake form was noted. These flakes occur in varying sizes, but are consistently shaped like a "gull-wing" or "V" having a very deep central, or slightly lateral concavity, and lateral edges that flare up and to the side (Appendix A, Table 19). Once recognized, they began to turn up in relatively large numbers and were called "sequent flakes.”

The term sequent flake was first used to describe a distinct flake type produced for use as scrapers found at the Amistad Reservoir in Val Verde County, Texas (Nunley et. al. 1965). These flakes were produced by the repetitive striking off of flakes from elongated nodules, much like a loaf of bread. Each flake was struck at the same point directly behind the previous one which resulted in producing a bulb that increased in size and depth with each subsequent flake produced. Once, however, the bulb became too large or other material factors became evident that could affect successful flake removal, the point of impact was shifted to another point on the nodule's surface.

Another similar type of flake has been identified within the lithic debitage of the Mousterian Levallois, Egyptian Neolithic, and the Near Eastern Bronze Age of the Old World. This flake type is believed to have been produced during some forms of platform preparation. This flake is described as being the proximal (butt) end of a flake, formed by the removal of two superimposed flakes, that when viewed end-on, appears "winged" (Inizan et. al. 1992:80-82).

Frison and Bradley (1980:18,21) describe similar flakes that were produced during discoidal core manufacture at the Hanson site. These are described as flakes with thick, wide platforms, a simple flake scar pattern, low flake scar counts, and a triangular longitudinal cross-section. Although considered as part of the discoidal core manufacture at the Hansen Site, Frison and Bradley recognized that similar flakes also occur in other flake production systems, especially during preliminary stages of manufacture.

The sequent flakes recovered from Gault are often as long as they are wide, but most are wider with widths up to 37mm (1.5 inches). The dorsal flake scar patterns may be uni-directional, bi-directional, or radial, but most are uni-directional. Thirty-five percent of the flakes are secondary and 65% are interior flake types (Appendix A, Table 51). The platform angles are steep, averaging 78.3° for secondary flakes, and 72.4° for interior flakes (Appendix A, Table 52). The platforms vary, but most are plain with little preparation, averaging 53% for the secondary flakes and 65% for the interior flakes. Platform thickness varies with the size of the flake, but most are thick with 63% exceeding 3.0 mm for secondary flakes and 80% exceeding 3.0 mm for interior flakes (Appendix A, Table 53). These flakes were produced by a repetitive flaking from the same point. The flaking sequence began by removing a small flake from the flat surface of a tab or blank using light hard hammer percussion. Subsequent flakes were removed by striking directly below the point of impact struck by the previous removal. Each flake removed being slightly larger with their corresponding negative bulb scars and respective bulbs becoming larger and more prominent than those from the previous flake (Figure 45).

Experimental replications showed that these flakes could be produced as part of the process for setting up and isolating platforms. Several members of the Belton Knap-in (a gathering of flint knappers first established by J. B. Solberger in the late

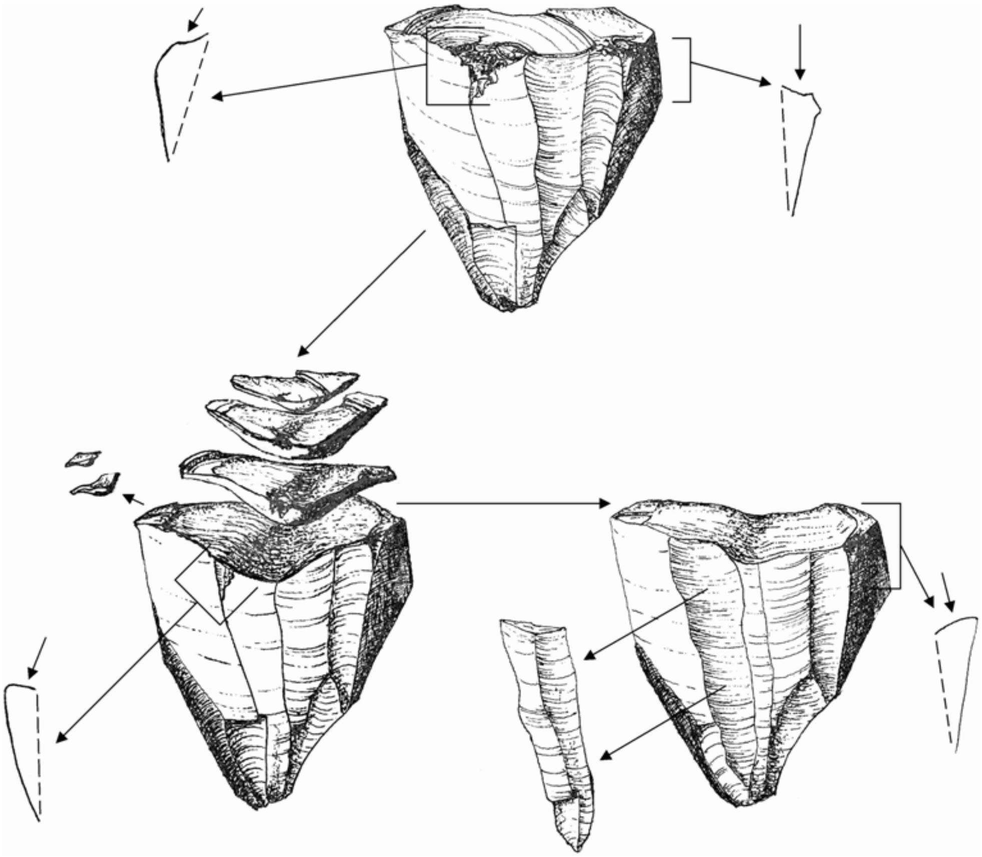


Figure 45. Sequent Flake Sequence.

1960's) were asked to use this method during bifacial thinning. The result was that the platforms produced were prominently isolated which enabled large flakes, many terminating near or over the opposite edge to be easily removed. In addition, platforms on blade cores were set up using this method and were found to be very effective. These results suggested that this may be a suitable method in both biface and blade core preparation. As noted previously (with each flake produced) the resulting scars produced are larger and have deeper more prominent negative bulbs. When two widely spaced sets of these flakes are removed, a prominent and isolated "hump" is formed between them.

With careful execution, these humps can be formed directly over an existing ridge or corner on the core face, requiring little modification to form them into a raised and well-isolated platform (Figure 45). A single set may only be necessary if the platform surface already contains some undulations or concavities, or if the width of the platform surface is narrow, such as on wedge-shaped cores. A drawback could occur if the sets are too close together, or if too many flakes were removed which would begin to overflake and decrease the height of the hump. The dorsal surface of these humps are often very acute, angling back into the blank's mass with edges that are sharp. This condition is easily corrected by minor flaking of the edge, which will strengthen the edge and alter the promontory to a desired striking angle.

Because evidence for this type of platform preparation would be removed during bifacial edge trimming or additional platforming, no evidence was noted on any of the bifaces. However, the presence of the deep scars on the core tablets and platform surfaces of some of the cores, suggests that this method was commonly used in blade core platform preparation.

Refits

Blade and Blade Core Re-Fits (N = 3, Figures 46, 47, and 48)

One of the studies conducted on the artifacts and lithic debitage was to attempt to retrofit together any broken flakes, blades, or core fragments. The successful re-fitting of pieces together, such as broken projectile points, bifaces, and superimposed blades can be an important aid in determining a number of technological aspects, such as reasons for failure, flaking sequences, and platform rejuvenation techniques. Within the Gault assemblage, a number of refits were successful, but only 2 sets of superimposed blades and 1 core are considered here.

Refit 1

This refit (Figure 46) consists of a single blade (Specimen 953) that was superimposed over a larger blade-flake (Specimen 954). The distal end of both of these flakes contains the heavy white patina noted on the ends and sides of many of Gault's chert tabs. In addition, one lateral edge on the blade and both lateral edges on the blade-flake retain the thick, chalky type of natural cortex typically present only on the chert's dorsal and ventral surfaces.

The blade measures 89.6 mm long, 39.4 mm wide, and 14.4 mm thick. It has a 7.8 index of curvature and a width to length ratio of 2.28. The blade-flake measures 113.4 mm long, 54.0 mm wide, and 20.8 mm thick, with a 7.9 index of curvature and a 2.1 width to length ratio. Both platforms are natural, the blade having a platform that is

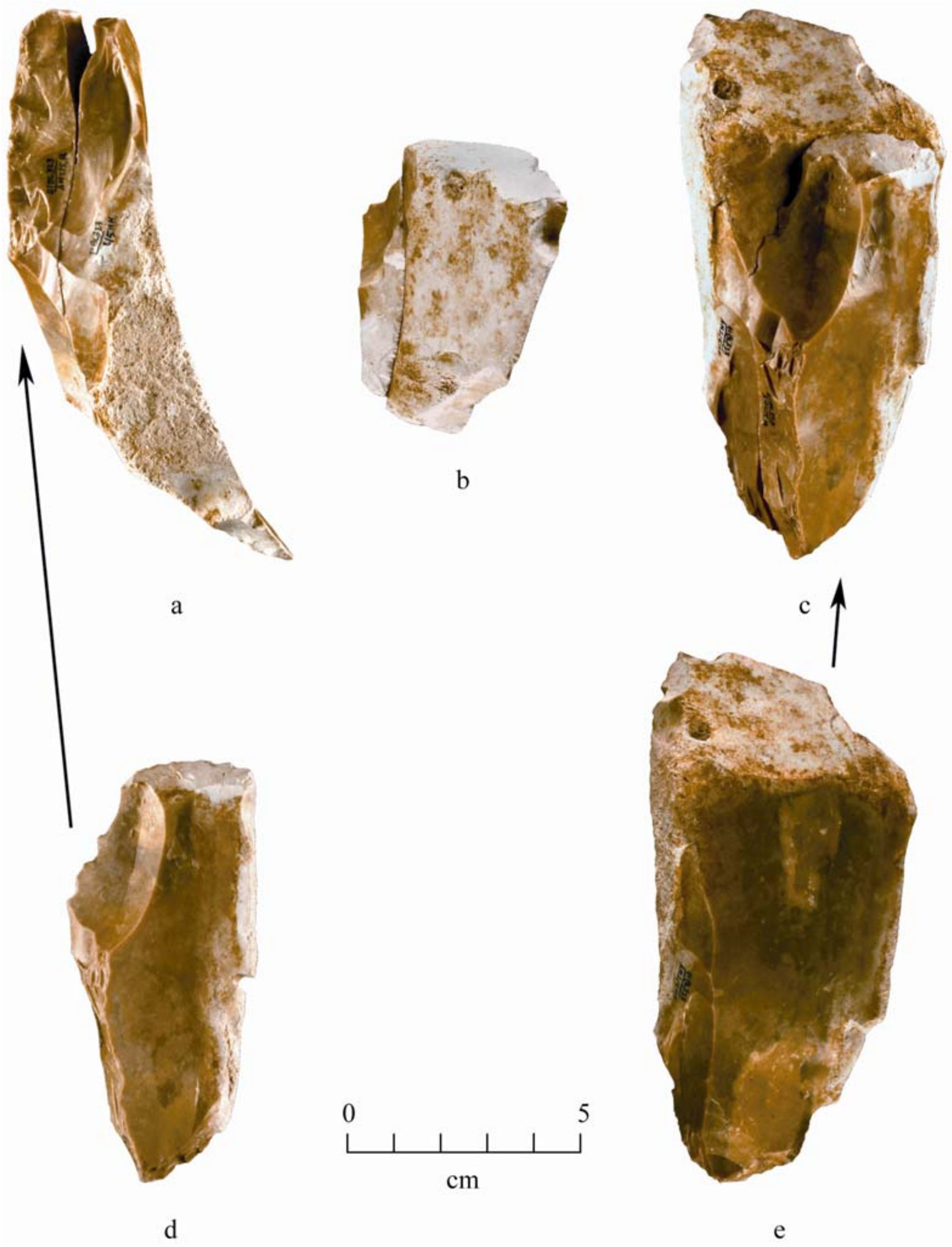


Figure 46. Refit 1.

9.4 mm wide by 3.1 mm thick with a platform angle of 70°. The platform on the blade-flake measures 12.5 mm wide and 6.3 mm thick with a platform angle of 83°. The platforms on both flakes have been isolated and ground, however, the grinding on the blade-flake is slight.

Aligning this refit into its approximate position at the time of removal shows that they were struck off at a very acute angle and from the narrow end of a tab, indicating their probable removal from a wedge-shaped core. The dorsal surface on the blade contains an earlier blade removal scar. Evidently, after the earlier blade was removed, the more central positioned ridge was straightened by the partially cresting of the proximal half of the ridge before the platform was isolated and ground. The lack of a lip and a large bulb of percussion on its ventral surface indicate removal via hard hammer percussion.

Once the blade was struck off, the platform on the blade-flake was isolated and slightly ground. Like the blade, the platform on the blade-flake is natural, indicating no special attempt at establishing a flaking angle or surface occurred. As no material flaws or knapping problems are present, it is not exactly clear whether a blade was the intent of this removal or if the removal of the entire end of the tab was intended. It has been observed, however, that during experimental blade replications, the ends of narrow tabs were frequently removed unintentionally by plunging type fractures, either by striking too far into the core's mass and/or applying too much force. This suggests that the blade-flake's removal of the tab's entire end may have been unintentional.

Refit 2

This refit (Figure 47) consists of two superimposed blades (specimens 951 and 952). The distal ends of both of these blades are partially covered with a heavy white patina, otherwise they are cortex free. The uppermost blade (specimen 951) measures 86.0 mm long, 34.7 mm wide, and 18.2 mm thick, has a 14.1 index of curvature and 2.47 width to length ratio. The lower blade (specimen 952) measures 87.3 mm long, 42.0 mm wide, and 23.4 mm thick, has a 8.3 index of curvature, and a 3.73 width to length ratio. The platform on Specimen Number 951 (blade**)** is plain, measuring 10.7 mm wide and 5.7 mm thick with an approximate platform angle of 76° and has been isolated and ground. The platform on Specimen Number 952 (blade) has been crushed with an approximate width of 18.5 mm and 5.2 mm thick. Its platform angle cannot be determined due the crushing damage, but it has been isolated and ground. No platform lipping is present on either blade, but the bulbs of percussion on both are diffuse. Positioning the blades together and aligning them to their position at the time of removal shows that they were struck off at a very acute angle from a narrow wedge-shaped core. Prior to the removal of Blade 951 from Blade 952, both of the lateral sides on both of the blades had been flaked at 90° to the direction of their final removals. Blade 951 was detached at an angle across and over Blade 952 creating the extreme curvature of 14.1. After its removal, the central portion of the primary ridge on Blade 952 was straightened by cresting.

The lateral flaking noted on the sides of these blades indicates that the flaking direction on their parent core was altered to a multi-directional pattern. The lateral

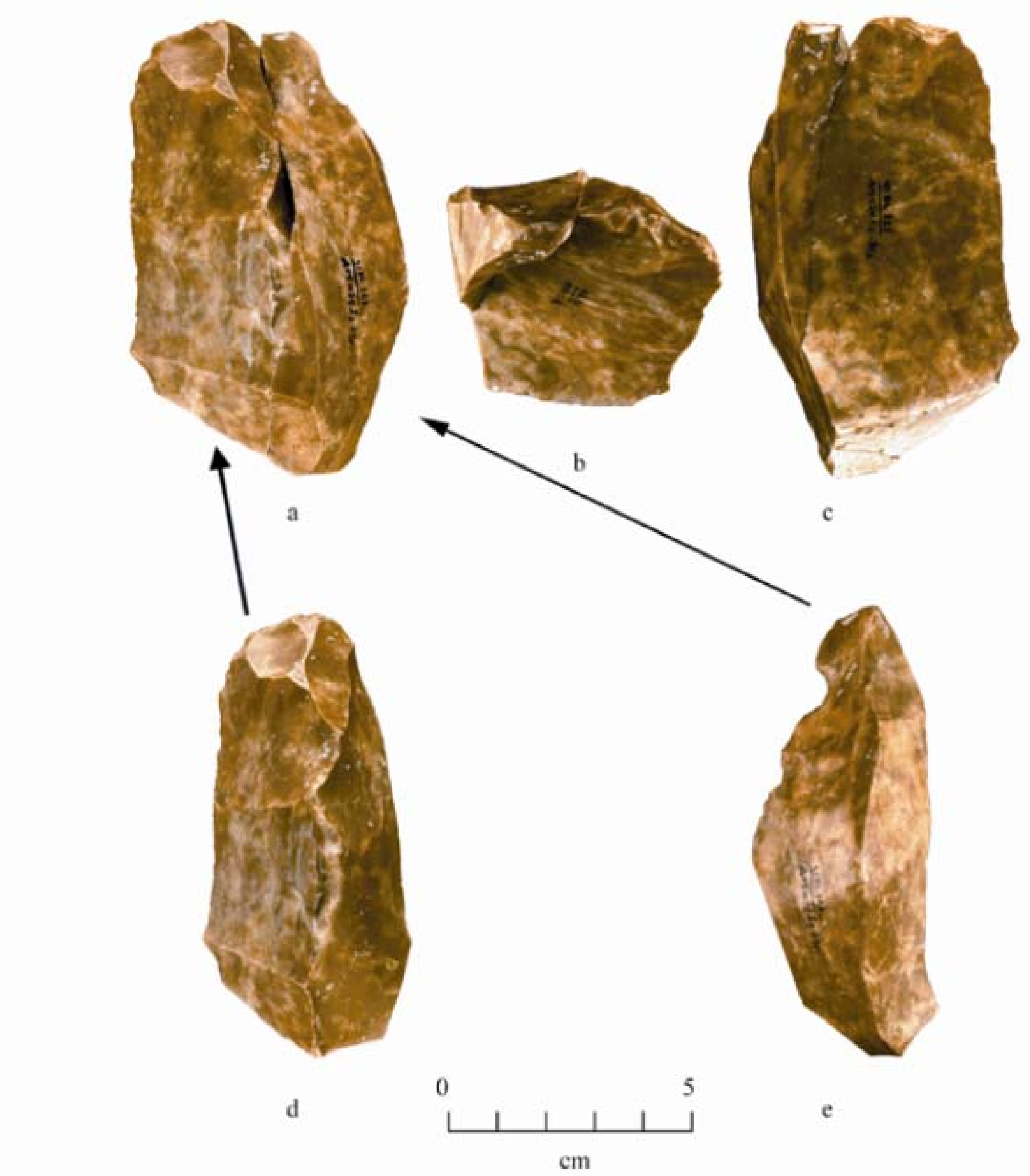


Figure 47. Refit 2.

flake scars are not core preparation or re-facing removals as they are wide and typical of blade type flaking with no apparent problems noted. It cannot be determined if flaking occurred on both ends, but it does appear that initial flaking began on one end, then was switched to the lateral sides before flaking was again changed back to the first end.

Refit 3

This refit consists of three blade-flakes superimposed onto a blocky core fragment (Figure 48). The three blade-flakes (specimens 956, 957, and 958) are all flat irregular shaped flakes with the platform ends covered in a heavy white patina and onelateral edge (on each) covered in a thick chalky type cortex. The core fragment has a white patina on two of its sides and the chalky cortex on only on side.

The flakes range 56.4 mm - 70.6 mm in length, 34.6 mm - 40.1 mm wide, and 11.2 mm - 15.2 mm thick, with the core fragment measuring 84.8 mm long, 56.7 mm wide, and 39.8 mm thick. Additional flakes had been removed, but these were not found. The platform angles range between 64° and 71° and consist only of the natural patinated surface of the core with no additional modification performed. None of the flakes would have been suitable for use as tools as they are all irregular with some containing cracks. The core fragment also contains a number of pressure cracks as well as several hinged terminations. It is probable that the cores reduction was an attempt at testing the internal quality of the core, which was found unacceptable, and all were discarded. Since the site is located at a quarry, this core may, alternately, have served as a practice piece for an inexperienced knapper. After all, it is more practical to

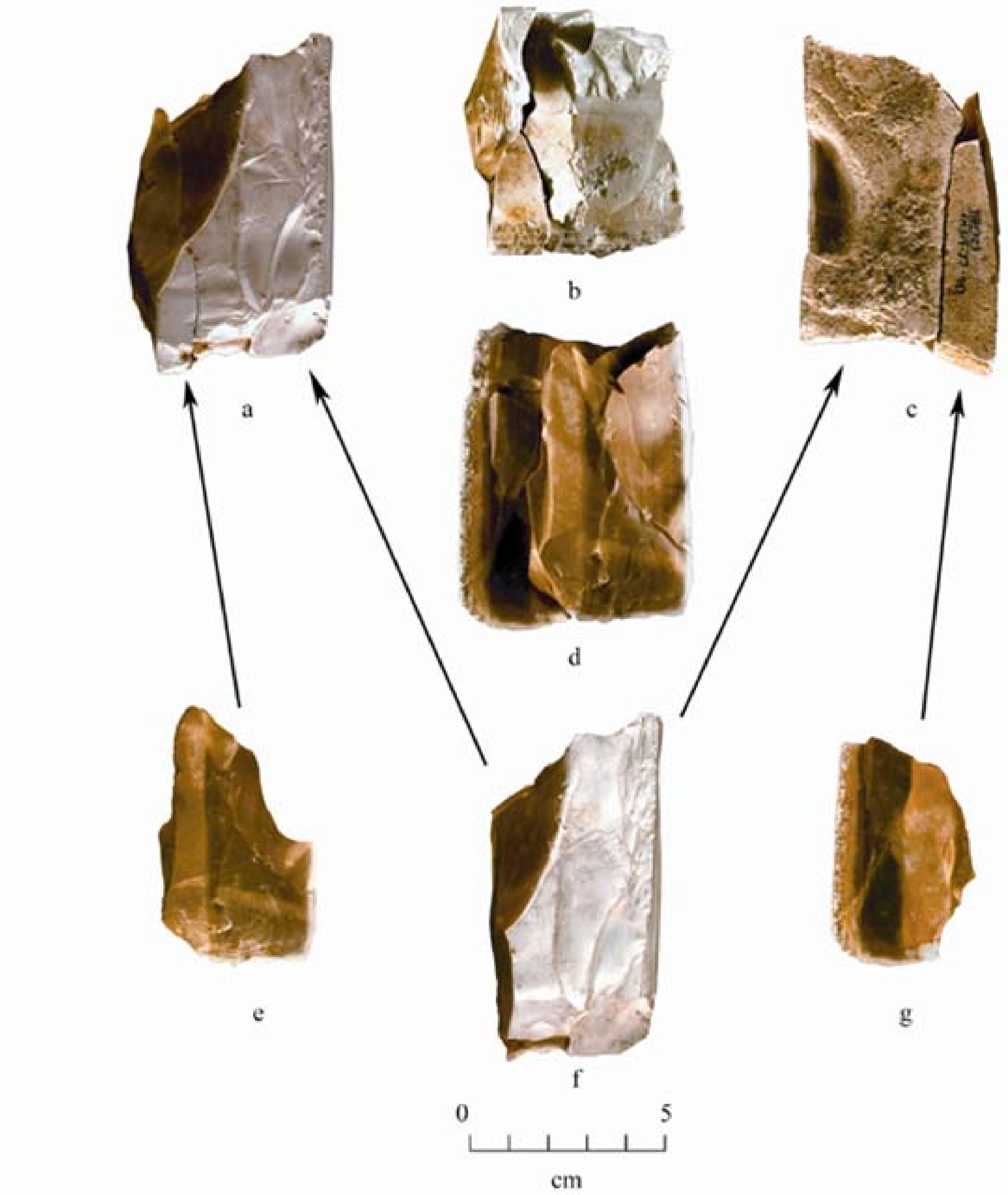


Figure 48. Refit 3.

practice knapping at a site containing abundant lithic resources than in regions where they are scarce.

The analysis of these refits provides us with several interesting insights into Clovis blade technology. First, it substantiates that the flake direction on wedge-shaped cores was altered from either a uni-directional or bi-directional flaking of one or more ends to a multidirectional flaking of all sides. As indicted previously in the core analysis, reasons for the change in direction may include material flaws, uncorrectable knapping errors, or re-platforming problems. However, once the flaking direction was changed, and the core further reduced, surface conditions or platform re-forming possibilities may have changed, making it possible to switch back to flaking from the original, more suitable, surface.

The second, and most interesting, revelation from the refits is the continued use of cresting in straightening or establishing prominent ridges. Previously, the technique of cresting or forming a crested blade or *lame à crête* has been described as being performed primarily during initial blade core preparation in which a bifacial ridge is formed for the first blade removal (Bordes and Crabtree 1969; Crabtree 1972; Whittaker 1994; Collins 1999a). However, both of the blade re-fits show that the Gault's Clovis knappers used the cresting strategy, not only during initial blade core preparation, but throughout the entire blade production sequence as well.

Geologic Placement

The primary geological units (Appendix A, Table 1; Figure 1) at Gault from which the Clovis lithic materials were recovered are defined as Clovis clay (Geologic

Unit 3a) and Clovis soil (Geologic Unit 3b). Two gravel units, Geologic Unit 1 and Geologic Unit 2, underlie the Clovis clay. Geologic Unit 1, the oldest colluvium, is composed of a limestone gravel that originated from the surrounding slopes, and Geologic Unit 2 is composed of a cherty gravel alluvium from Buttermilk Creek. The Clovis soil does not come into contact with Geologic Unit 2 gravels, but does contact some Geologic Unit 1 gravels near the base of the slope. Capping the Clovis soil is a thick deposit (Geologic Unit 4b) that contains late Paleoindian projectile forms such as *Folsom* and *Midland* types.

The Geologic Unit 1 limestone gravels accumulated at the base of the surrounding slope forming a narrow bar that gradually pinches into the Geologic Unit 2 cherty gravels which, in turn, is bordered by Buttermilk Creek. Between the Geologic Unit 1 and Geologic Unit 2 gravels is a slight depression in which a small pond formed. The sediments deposited within this pond formed the Clovis clay (Geologic Unit 3a) and the whole was eventually covered over by overbank (floodplain) deposits from Buttermilk Creek which became the Clovis soil (Geologic Unit 3b). The Clovis soil deposit was in turn covered over by soil, classified as Geologic Unit 4b, that eroded from the slopes.

Table 1 (Appendix A) provides a listing of the number of blade types, cores, core tablets, and wing flakes recovered from each of the individual geologic units. While in the field, it was sometimes difficult to distinguish the two units in horizontal with the vertical position. Therefore, if it was later determined that a level from an excavation unit contained a mix of two different geological units, the geological designation for that level was given as geologic units 3a or 3b.

Artifacts were occasionally recovered on the surface of the gravels (at the base of the Clovis clay), but were found not to penetrate them. It is believed that artifacts accumulated on these surfaces as a result of the Clovis folks sitting on the surface of these gravels while performing knapping or subsistence activities. As such, any units containing levels composed of Clovis Clay and gravels were condensed into a single unit (Geologic Unit 3a).

The artifact counts show that approximately twice the number (or better) of most of the lithic artifacts occur within the Clovis clay unit (Geologic Unit 3a) than were recovered from within the Clovis soil unit (Geologic Unit 3b). The major differences in this count occur within the crested blades, cores, and core tablets. The number of crested blades and core tablets are almost equal between the units and wedge-shaped cores have a ratio of 3 to 4 between the Clovis soil and Clovis clay. Only two conical cores were recovered from the 3a and one from mixed geologic units 3a or 3b.

These counts suggest that blade manufacture from conical cores may have been more prevalent in Geologic Unit 3a than Geologic Unit 3b. This assumption is substantiated by the fact that the numbers of blades (all types) are approximately twice the number in Geologic Unit 3a than in Geologic Unit 3b. As opposed to conical cores, that utilize more squared, blocky or rounded cobbles, larger rectangular tabs of chert can be used for wedge-shaped cores. This difference in material form would easily allow for larger numbers of blades, especially secondary and corner removal types, to be produced. However, if interior blades are the more preferred type, fewer may be produced from wedge-shaped cores than conical cores, and many of the blades, may represent rejections or, more simply, are waste flakes. Therefore, the larger number of blades in Geologic Unit 3a may reflect a more prevalent use of wedge-shaped cores over the conical type.

Aside from the increase in blades in Geologic Unit 3a, no technological differences in blade production are apparent. Platforming strategies utilizing core tablets and wing flakes are prevalent in both units. Although core tablets are generally considered as produced primarily from conical cores, it was found that some were also produced during wedge-shaped core platform rejuvenation as well. Therefore, not all of the core tablets can be assigned to a particular core type, and their presence within both units can only be concluded that the practice of this strategy continued throughout both units, regardless of the difference in the number of core types recovered.

Summary

This analysis has studied a large assemblage of Clovis blade manufacturing debris consisting of 464 blades, 50 blade cores, 36 core tablets, and 63 specialized platform preparation flakes (winged flakes). In addition, a small number of blades, blade-flakes, and a core fragment were refitted together into three groups. The large number of artifacts studied within this assemblage afforded an opportunity to study Clovis technology that has not previously been available. The result of this study, not only substantiated much of our current understanding of Clovis technology, but also has added several new and interesting aspects as well.

Collins (1999a:63,178) describes Clovis blades as having small platforms that may be wide but not deep, flat bulbs of percussion, minimal ripple marks on the ventral surface giving a smooth appearance, are generally long (frequently exceeding 100 mm), and are curved in longitudinal section. However, this analysis has found that a larger diversity in blade forms exists than is covered by this definition. For example, the Gault blades analyzed include both regular and irregular forms, some broken or rejected during manufacture, but many obviously suitable for tool use. The cross-sections of these blades were found to vary from almost flat to prominently triangular with edge angles ranging from acute to abrupt. They have single or multiple longitudinal, or occasionally, lateral ridges, and longitudinal sections that may be strongly curved or flat. Blade lengths are long with averages (for all types) that range between 63 mm and 96 mm with platforms averaging 10.2 mm wide and 4.1 mm thick. Platform angles are generally high with an average of 72.7° and platform preparations that may be unprepared or heavily modified by isolation, grounding and faceting (Appendix A, Table 54). The bulbs of percussion on many blades are flat or diffuse (Appendix A, Table 55), but some also have moderate to strongly prominent bulbs with ventral surfaces that may be smooth or contain varying amounts of ripples and waves. These variations should not be surprising as the Gault site is a quarry workshop and camp where a variety of lithic tools were manufactured. During the manufacturing process numbers of rejected or failed pieces would accumulate, as well as large amounts of waste debitage from reduction and core/blank preparation. It is also apparent that as reduction/manufacture progressed, platform preparation changed from unprepared platforming during initial core preparation to those that are more carefully prepared as more "refined" products began to be produced (Appendix A, tables 54, 56). For these reasons, many of the blades would not conform to the standard Clovis blade definition.

It is apparent that the standard definition for Clovis blades was developed primarily from blades recovered from caches or isolated finds that probably represent the best blades produced that were intended for transport and use while away from lithic sources. One could reasonably argue that these blades represent the true blade form and that all others are merely marginal or unsuitable and rejected examples. Undoubtedly, this supposition is true. However, even though the majority of the blades left at the quarry site do not conform exactly to the current definition, many of these were utilized as tools as the use-wear analysis conducted on them confirms (Lohse, et. al. 2002). Therefore, the Clovis folks utilized a wide range of blade forms, at least in proximity to lithic sources, not restricting use only to blades agreeing with the established definition.

The most interesting finds stemming from this analysis center within the manufacturing process. Although there are a number of excellent chert sources occurring within a 20 to 30 kilometer radius of Gault, all the blades and blade cores utilized at Gault (with a single exception), came from the surrounding slopes. The one exception found within the blade assemblage is a fragmented regular interior blade that is made of quartzite. Two forms of raw materials were utilized at Gault. The first are chert cobbles from Geologic Unit 2 that originated as chert that weathered from the slopes and, through alluvial action, washed into Buttermilk Creek. These cobbles are moderately sized, commonly found approaching 10 inches in length, are rounded with some angular portions, and are covered with a thin hard cortex. Experimental testing of these gravels showed that many flake well, but that most are unsuitable for tool manufacture due to interiors that are grainy and/or contain a number of inclusions. Suitable material would be selected only after intensive "testing" of a number of the individual cobbles to determine which ones would be knappable. Cobble use, however, was minimal, being confirmed on only a few examples.

The other form, used for the majority of the blade manufacture, were abundant square sided, blocky chert tabs that eroded from the surrounding slopes. Not all of these chert tabs have interiors that are knappable, many having interiors that vary in color and are grainy with inclusions. It is evident that these compose the source for the grainy cobbles found within the Unit 2 gravels. The favored form is dark gray colored chert, having a fine-grained, almost slick interior that flakes with ease. Although few of the better forms of chert presently remain on the site, the fine grained form was evidently in abundance at the time of Clovis (and later) occupation. Cores were initially prepared in several ways. Cobbles, for example, usually have one or more ends that are rounded and unsuitable for initial flaking without modification. Therefore, one of the ends has to be removed in order to establish a platform from which flakes or blades could be longitudinally flaked. The blocky chert tabs, however, usually contain one or more square sides formed by overburden pressures that fractured the chert while in the parent limestone matrix. The sides became covered by a thick white patina that formed over the fractured surfaces. The patinated surfaces are hard and serve as excellent platforms for initial flaking requiring little or no additional modification. The platforms utilized during this flaking stage are natural (cortical or patina covered) or plain, are generally not isolated or ground, and may be fairly wide and/or thick.

Regardless of the raw material type selected, once the platform surface is reduced or becomes unusable due to flaking angle or surface irregularities, a new platform surface has to be created. This was accomplished in several ways. The first method was to flake back from the edge forming a slight concavity adjacent to specific points, such as a ridge or corner, of which the up-flaring lateral sides (of the concavity), form and isolate the platform and point of impact. This flaking on conical cores was performed around their circumference often terminating near mid-section forming a slight hump in the core's center. The flaking on wedge-shaped cores commonly removed only a portion of the core's width, either the center or one of the sides, and frequently terminated in step or hinge fractures.

A prominent flake type removed during this process is the distinctive looking *sequent flake*, easily recognized by a deep negative bulb scar on the ventral surface that forms a "V" shaped profile with outflaring sides. As discussed previously, these flakes were formed by the removal of several superimposed flakes from the same point on an edge, each successive flake removed being slightly larger than the last, each forming a deeper, more prominent negative bulb. The lateral sides of these flakes flare up and out forming a slight prominence, the height determined by the depth of the concavity formed by the negative bulb scar. The prominence formed may angle back towards the cores center forming a sharp edge, which is easily corrected by abrading or pressure flaking it back from the edge. This not only strengthens the edge, but allows for a desired flaking angle to be easily formed. It should be mentioned that not all platforms were formed in this way, that many were also formed and isolated through simple pressure flaking methods.

The result of multiple sequent flake removals and platform isolating from other flaking methods create a flaking surface that is very irregular containing large knots, stacks, or other problems. Before flaking can continue, these problems need to be removed. One method employed to correct this was to remove the entire top of the core. Flakes removed in this process are called core tablets, and when complete, those from conical cores are circular containing a varying number of blade facets created by lateral blade removals. Core tablets were also removed from wedge-shaped cores, but these are usually squarish, rectangular, and short tabs that, occasionally, removed the entire top (originally the side of a chert tab), but more often, removed only a portion of the core's surface.

Blades were removed in several ways. It has been generally accepted that blades were removed by either soft-hammer direct-percussion or indirect-percussion. Collins (1999a:63) believes that direct-percussion was used on wedge-shaped cores as platforms on this core type are better isolated and more prominent which allows for an unobstructed blow. However, he also states that on conical cores, as the knot forms in the center of the platform surface due to the platform maintenance, it begins to force the arch of the blow at too low an angle for successful blade detachment. Therefore, he feels that only indirect-percussion could be used to accurately direct force at the proper point and at the correct angle in the sunken platform areas around the perimeter of the core's top.

Although this view appears probable, the blade scars on the conical cores in this study show that the last blades removed were at or near the higher (or flatter) points on the platform surface, while the blade scars, on the cores surface, underneath the sunken areas (winged flake scars) are all remnant scars, having had their proximal ends removed in the formation of the depression, or an earlier core tablet removal. This suggests that the platforms were on the higher and/or flatter points rather than in the depressions. This interpretation is not to say that indirect-percussion was not used, as evidence of its use was recognized in the fluting process of bifaces. Rather, it is intended to show that platforms on conical cores were also placed at points that would not inhibit an arching blow.

Many of the Gault blades contain moderately strong to prominent bulbs of percussion and ventral surfaces that have ripples and waves. Some argue that bulb size and smooth ventral surfaces are indicators of soft hammer use. Usually, large bulbs and ventral ripples are an indication of hard-hammer percussion. However, Glenn Goode, who produced a large number of experimental blades using soft-hammer percussion (Collins 1999a:27-32), found that bulb size increased and ventral smoothness decreased on blades struck from cores having their bases supported on a hard surface.

In addition, bulb size is also reduced in hard-hammer percussion as the direction of force approaches 90E. Since both methods can create similarities in bulb and ventral attributes, these cannot be used as sole indicators for soft-hammer percussion.

A wide range of platform sizes, bulb sizes and ventral smoothness exist on the Gault blades (Appendix A, tables 55-56). Although exceptions occur, the tendency is that larger, less prepared platforms, moderate to strong bulbs, with prominent ripples and waves on the ventral surfaces are found on more of the primary and some secondary types than on regular secondary and interior types. Some of the blades with moderate and even strong bulbs also contain platform lipping, another attribute associated with soft-hammer percussion, but with diffuse type bulbs. Thus, there is an indication that soft-hammer percussion may have become more prominent as the blade manufacturing process progressed.

No punches, billets, or hammerstones were recovered in the Clovis levels. However, there were a large number of various sized limestone cobbles originating from the Geologic Unit 1 gravels. Many of these limestone cobbles are of an appropriate size and shape to serve as hammerstones, but due to chemical weathering effects within the deposit, the surface of all these gravels are eroded to the extent that no battering or other marks remain that may identify them as hammerstones.

To test their usability, a few were selected and tested on some Gault cherts, as well as a few types of other local cherts. The result of these experiments found that they worked well, easily removing a good number of blades and flakes, but that the soft surface rapidly wore away and the striking surface easily crushed and became flattened that required a frequent shifting of the cobble's striking surface. In addition, their density and weight often made it difficult to remove large or thick flakes from some of the cherts. Depending the amount of force applied and the striking angle, bulbs on flakes removed using these limestone hammerstones varied from diffuse to prominent types with some of the bulbed specimens also having a slight platform lipping. The combination of these findings and the abundance of these cobbles suggests a probable chance that they played a part in the Clovis knapping activities at Gault.

In sum, the study of the blade and core attributes (i.e. platform preparation, platforms, bulbs of percussion, ventral smoothness, indicate that indirect percussion, hard-hammer direct percussion, and soft-hammer direct percussion) were used to produce Gault's blades. The fact that some attributes, such as increased bulb size for example, can be produced either by hard-hammer (or soft-hard hammer) percussion or by soft-hammer percussion when cores are supported on a hard surface, often makes it difficult to determine the exact method used. However, it is doubtful that any one method was used throughout the entire process, whatever the core type, but that the extent of use, for any one method, was dependant upon individual skill and knapability of the raw material.

Regardless of the care taken in platform preparation or the method used to remove blades, not all blade removals were successful. For example, a misdirected glancing blow may only remove a thin narrow blade with varying termination types, a blow too far back from the edge may result in a large blade-like flake, split the core, or cause fracture to plunge and remove the entire distal end of the core. Additional factors, such as insufficient force, improper angle of blow, inclusions, or cracks may result in short or wide blades and blade-like flakes, irregular or bending blades, and hinging or step fracture terminations.

Each of the above failures created an individual problem that must be corrected if flaking was to continue on the core. The primary concern was to maintain prominent straight ridges and when hinges, stacks, or other problems occur, specific flaking procedures were employed in order to re-establish the ridge. Many of these problems were corrected by lateral flaking directed into or under the problem. This procedure can be noted on blades having radial and or lateral scars on their dorsal surfaces. Occasionally, flaking from the distal end of the core will restore the core face. Blades having bi-directional dorsal flaking often reflect this procedure. However, flaking from both ends may have been performed if a better platform presented itself on the opposing end, which would also produce a bi-directional dorsal surface. Flakes removed during these procedures are called *trimming flakes* (Movius, Jr., David, Bricker, and Clay 1968:5) or *recovery flakes* (Collins 1999a:23).

One of the more interesting findings noted during this analysis centers on the use of the cresting technique. Cresting is usually considered as a technique associated with initial blade core preparation where either an entire edge or portions of an edge are straightened and isolated that will serve as a guide for beginning the blade removal process. However, two blades re-fitted together show that cresting was also used to straighten ridges throughout the blading process.

The two blades were co-joined together with one blade fitting directly over and angling to the side of the other. Both blades are interior types with the uppermost blade being a typical blade and the lower blade having a partial cresting, which exemplifies that cresting was being performed after the blade removal process, had begun. This fact also explains the relative abundance of crested blades recovered in the assemblage, especially because the favored raw material forms were square sided tabs, which did not need cresting. Even most of the cobbles examined were found to contain enough suitable angles to initiate the blade removal process without the necessity for cresting.

The lithic materials (i.e., blades, cores, core tablets, and associated reduction debris) were found within two geologic units, the Clovis clay (Geologic Unit 3a) and the Clovis soil (Geologic Unit 3b). The majority of the lithics were found in the Clovis clay unit, which accounted for approximately twice the number than was found in the Clovis soil unit. A study of the technological traits between the two units found no difference in the manufacturing strategies employed, but did note an increase in blade production during the occupation of the Clovis soil.

The Gault blades were compared to six other Clovis aged sites having blade assemblages. These sites are the Adams site in Kentucky, Pavo Real in central Texas, Green Cache from Blackwater Draw in New Mexico, Gault 1 (1990 UT excavation), Richey Roberts site in Washington, and the Keven Davis Cache in central Texas. Where possible, the blades from each of these sites were divided into the major blade categories (i.e., primary, secondary, and interior) and compared to the appropriate category established for Gault.

The Adams site and Pavo Real are the only sites with data available on primary blades for comparison to Gault. It was found that the Gault primary blades are slightly smaller than those from either of the two sites but are almost equal in the dimension ratios (index of curvature, width-to-length, length, width, and thickness ratios) for Pavo Real (the only site of the two having computed ratios). This is not surprising as both Pavo Real and Gault are primary quarry and quarry camps where the entire manufacturing sequences were performed, therefore, it is more likely that primary blades would occur in greater numbers on these sites than at non-quarry camps. Although, the Adams site is also a manufacturing site, there is no natural chert source at the site, which places it as either a quarry or base camp (Dickens and Dockall 1993:64-65). Platform size and angles for primary blades are available for only Pavo Real, which are smaller than Gault's, but have almost identical angles.

Five of the sites have data available on secondary blades. From these data, it was found that the Gault blades are smaller and thinner than those from all sites except the Adams site whose single specimen is approximately the same size as the average for the Gault blades. The index of curvature ratios show that the Gault secondary blades (all types) are significantly flatter than those from all the other sites except for Pavo Real, which are less, curved than Gault. The width-to-length ratio for Gault are less than all sites except for Richey Roberts and the Adams site which are approximately the same. Some slight variances between the length, width, and thickness ratios occur between most of the different sites, with the largest differences occurring between the Green and Keven Davis blade caches.

The only dimensions provided for platform width and thickness are from the Keven Davis cache and Pavo Real from which Gault was found to be wider and thicker than the Keven Davis blades and very close to Pavo Real. However, the platform angles vary widely between all sites with a range between 42.5° (Green cache) and 78° (Pavo Real). The Gault platform angles average 74.2°, which are closest to Pavo Real than any of the others. The variances in platform angle may be attributed to a number of factors, which include raw material type, method of removal, blade type (i.e., regular irregular, or corner/side removal, and/or sample size).

All six of the sites have comparable data for interior blades. The Gault interior blades were found to be shorter than those from the Keven Davis and Green caches but longer than from the other sites with the widest blades coming from the Adams site, and the Keven Davis and Green caches. The Gault blades have the lowest index of curvature closely followed by Pavo Real with the highest curvatures from the Richey Roberts site and the Keven Davis cache. The dimension ratios are very close between all the sites except for the Keven Davis and Green caches which have the largest width-to-length and length ratios and the Adams site and Pavo Real which are the thickest.

The platform dimensions for Gault are wider than the interior blades from the Keven Davis cache and the Adams site, but are narrower than those from Pavo Real. The platform angles were found to vary little between all sites with a range of 60° (Green Cache) and 70° (Keven Davis Cache).

These comparisons show that Gault and Pavo Real blades (all types) share the closest affinities between each other with minor variances in blade curvature, platform size and thickness. As mentioned previously, this similarity can be attributed to the fact that both sites are primary quarry or quarry camp sites, while the other sites, some of which are also manufacturing sites, are not located on or near a raw material source. This fact indicates that initial testing and reduction were performed at a quarry some distance from the final manufacturing site, which explains the lack of primary and other blade debris found. The sites having the biggest differences from Gault are the blades in the Keven Davis and Green caches. The fact that these blades were found grouped together suggests that they were regarded with some significance. Aside from some ceremonial or spiritual context, the answer may be as simple as that they represent the preferred blade form. That is, these blades were selected out of all those produced at the quarry or manufacturing site as having the most value. Their size and shape being the form most favored for transport and use when seasonal movements took these folks away from any suitable raw material sources. Thus, the blades that were left at the manufacturing site represent rejects or manufacturing failures and debris.

This view, however, does not mean that these "rejects" did not have some value. It is apparent that (although they were not selected for transport) many contain modifications and obvious use-related wear that indicate their use as tools. This conclusion may indicate a strategy for a reluctance to utilize the "best" blades at a site where so many other, less preferred blades (and other flake debris) abound, most of which, easily serve as efficient tools suitable for whatever tasks are required during the occupation of the quarry or manufacturing site.

In conclusion, this chapter presents a study of the largest assemblage of Clovis blades, blade cores, and manufacturing debris recovered from a site in North America. Previously, the largest number of Clovis blades and cores available for study were found in caches of several dozen (or less) blades and blade fragments or occasional finds from sites having known Clovis aged contexts. The result of this study has expanded our current views on the Clovis tool kit and added a number of new insights into our knowledge of Clovis lithic technology.

CHAPTER IV

CONCLUSIONS

This study has been an analysis of 1026 Clovis lithic artifacts recovered during two field schools conducted by TAMU during 2000 and 2001 at the Gault site (41BL323), a multi-component site located in Bell County, Texas. The site is located in a small valley adjacent to Buttermilk Creek whose headwaters originate near the upper portion of the valley. The Clovis artifacts were found in two geologic units (3a and 3b). Geologic Unit 3a is a clay that formed in a small pond behind a gravel bar at the edge of an ancestral Buttermilk Creek. Geologic Unit 3b is clay that comprised the floodplain of an ancestral Buttermilk Creek. This unit has undergone slight pedogensis. Both of these units were capped over by younger deposits.

The analyzed artifacts include 4 projectile points, 55 bifaces, 1 hammerstone, 464 blades, 3 blade refits, 50 blade cores, 36 core tablets, 185 overshot flakes, 114 large flakes, 63 sequent flakes, and 51 problem removal flakes. All but three of these artifacts were made from local chert. The three exceptions include a blade fragment and a hammerstone made of quartzite and the proximal half of a projectile point made of a yellow jasper. Although quartzite often occurs within some of the regional gravel deposits, it has not been noted locally. However, the single hammerstone made from a quartzite cobble does indicate a probable occurrence in the near vicinity. No jasper occurs within the region. Some forms of red and yellow jaspers do occur within and east of the Brazos River as well as in south Texas. It is rare or absent within the central Texas region.

The remaining lithic artifacts were all made of local chert. The immediate region surrounding the Gault site contains a number of excellent varieties of chert. Several varieties of chert, including one excellent type, occur on the valley slopes adjacent to Gault. This type is a fine-grained opaque gray chert that was abundant and much favored, not only by the Clovis knappers but also by later peoples as well. This is evident in the upper cultural layers where tremendous numbers of large flakes and chunks can still be found.

Unfortunately, very little of this chert remains in its tabular or nodular form. Over the last 20 years or so, modern flintknappers exploited the site by on site spalling and removing nodules. Currently, numerous flake debris from these activities litters the site and has been mixed with much of the prehistoric surface debris. Chert, however, is still abundant in the area, but most is a coarse grained lighter colored type that is of an inferior flaking quality.

Interestingly, the chert materials recovered in the Clovis levels have a chemical staining that has colored the surface of this material a yellow-brown or green. Since the Clovis materials were excavated from a creek bank deposit, this staining obviously occurred as a result of chemicals within the waters within Buttermilk Creek that commonly covered the site. This is substantiated by the fact that those types of chert found above the creek banks are not colored. Instead, they remain in their original gray color or, occasionally, have patinated a gray-white. Although, at first it was thought this staining appeared to be a signature of Clovis materials from Gault, it has now been determined that some other sites in the near vicinity also contain similarly stained materials.

Although local chert occurs in a number of shapes, the shape selected for biface reduction manufacture was thin to blocky rectangular shaped tabs with square to rounded edges. The cherts formed as bedded cherts within the limestone matrix. Pressures exerted from the overburden limestone and soil caused the chert to crack. Once the limestone weathered away exposing the chert, it eroded out in squared to rectangular tabs. Some portions of the chert that formed around the edges of the beds were rounded, which resulted in some of the tabs having one or more rounded edges. In some cases stream gravels, (formed from chert that eroded into the Buttermilk Creek stream system from the surrounding slopes) were used. However, these gravels also contained poorer quality chert as well as the better variety, thus requiring constant testing to evaluate the quality.

Chert selected for bifacial reduction was either reduced as is, or large macro flakes or blades were spalled off. The most common form utilized for this process was the blocky rectangular form. Reduction began with the removal of the corners (or rounded edges) on one or more sides of the tab. Flakes removed during this initial removal (Stage I) are blade-like flakes and thick cortical covered triangular blades. The latter are termed "corner removal blades" that were removed from either one of the ends or along a lateral edge. In addition to these removals, flakes were removed across the surface or ends of the tab. Some of these removals plunged over the edge terminating on the vertical edge. These flakes have thick platforms with little to no preparation. This step was necessary in order to begin to bring both the ventral and dorsal surfaces together to form a sharp edge and remove cortex while conserving blank width. The corner removals also facilitated the establishment of platforms for subsequent flaking by creating an angled edge, a primary step in the reduction of tabs with thick squared edges.

Thinning continued by overflaking of the tab’s surface. The intent was to flake completely across the tab’s surface with termination occurring either on or just over the opposite edge. Those flakes terminating over the opposite edge are termed "overshot flakes." Such flakes terminating on the face of the vertical edge and not plunging to the opposite face are "partial overshot flakes." Once plunging terminations incorporate the opposite side the flake is termed a "full overshot flake."

Flakes often terminated short of the opposite edge due to thick platforms or a lack of force resulting from an excessive striking angle. These flakes commonly plunged into a hinge type termination or broke in step fractures that occasionally became stacked from repeated attempts to remove them. Such problems occurring in the medial portion of the blank were removed by blade-like flaking initiated from either end, a technique known as end thinning. This end thinning not only removed these problems but also thinned and flattened the central portion of the tab or blank. If a hinge or step fracture occurred near an edge, it was simply removed from the nearest edge. Flakes exhibiting this type of removal contain hinges, step fractures, and stacks on their dorsal surfaces and are termed "problem removal flakes.”

During the next series of reductive stages (stages II through IV) a lanceolate form appears, and the tab is thinned into a preform. As the preform is reduced, the techniques of overface flaking and end thinning alternated; that is, after the surface was overflaked and some flakes terminated, mid-section end thinning was performed followed by additional overface flaking. Corner removals continued during stages II and III, but (as the preform edges became thin) the flakes became flatter and wider (now blade-like flakes) that often merged with or were flaked in conjunction with end thinning (Stage IV).

As the lateral edges merged into a sharp edge, full overshot flakes replace the partial type. End thinning began to decline during Stage IV, but lateral overface removals continued with full overshot flake terminations increasing. In addition, pressure flaking to regularize and shape the edges appears during this stage. The decision to use one or more of these techniques was based on the need to thin specific portions of the blank, remove problems, or re-contour and flatten the surface rather than in a response to a patterned removal sequence.

The final shaping stage (Stage V) brings the preform to a point where the fluting process is ready to occur. A final narrow lanceolate shape is formed with a rounded convex basal edge and a "bullet" tip. The surface is flattened and tapers longitudinally to the tip with the proximal half and central section retaining the approximate same thickness. This lack of tapering towards the proximal end was retained to facilitate flute removal. Both the dorsal and ventral surfaces may contain a number of overface or overshot flake removals, many of which are obliquely angled. The increase in pressure flaking during edge shaping often removed evidence differentiating whether a flake terminated at or near an edge or if it was an overshot.

The next stage (Stage VI) prepared and fluted the basal edge of the preform. There were several techniques used to set up the basal edge for fluting. The most common technique was to first bevel and grind the entire basal edge. Of the two specimens with beveled basal edges, only one had a nipple formed, which was done during the beveling process. The edge under the nipple was also beveled and an isolation flake removed from each side of the nipple. Another specimen had a nipple formed in the center of its basal edge. The edge was not beveled or ground, but isolation flakes are present on each side of it.

Flute removal was accomplished in two ways. The first was by direct percussion with a soft hammer billet such as antler, and the other method was by indirect percussion with a punch. One of the specimens retains a deep notch on its basal edge left by the point of a punch. In some cases, the first flute was unsatisfactory, and a second was removed. Once the fluting was complete, the edges and proximal tip were given a final clean up and with basal modifications that included lateral edge shaping (that often intruded onto the flute scar) and grinding.

Interestingly, several of the Gault specimens had obviously been curated for long periods of time. The bases on two of the specimens had been broken at some point and new flutes flaked. These were obviously pressure flaked as they were short and in both cases had two flutes flaked side by side on one side each. In addition to the basal modifications, the distal half of these specimens had been heavily re-sharpened. Because damage on projectile points utilized as projectile points normally results in severe damage such as transverse snaps or impact fractures, they rarely require repeated edge re-sharpening. Thus, these specimens may have been salvaged from their initial use as projectiles and used in other functions such as cutting or incising tasks.

The reductive techniques discussed above are generally recognized as part of the known Clovis technology. However, some of the techniques observed at Gault were either not previously recognized or looked at in a different perspective. Not unlike other Clovis sites, the material form used at Gault included thin to blocky chert and large spalls, blades, and flakes. Whereas, all these blank forms were used at Gault, the most common form used at Gault was the thin to blocky tabs.

The reduction of large macro-flakes (whether flakes or blades) are relatively thin with most of their edges sharp. Because these edges are already sharp, they require little manipulation to begin platforming for the overface flaking and shaping process. In addition, the flatter and thin nature of these blanks also enable the knapper to skip some of the reduction " stages" usually identified by analysts. However, the blocky tabs require a different approach to begin the thinning process, due to having steep vertical edges.

As mentioned above, the initial step in this process was to strike off long blades from the corners along the longitudinal edges or ends of the tab. This technique has previously only been associated with blade core preparation. However, adapting blade techniques in other applications is not surprising as blading is a common strategy within Clovis technology (Collins 1999a:19-26). The fluting process, for example, is also a specialized form of blading; therefore, applying a blading technique in the manipulation of blocky tab reduction should not be unexpected. Evidence for this flaking technique was observed, not only on the edges of some of the bifaces but also on the distal edges of some overshot flakes.

The end thinning technique is a flaking trait that has been only occasionally identified within the Clovis manufacturing process (Callahan 1979; Fogelman 1986; Sanders 1983, 1990). It was first described by Callahan (1979) in his replication studies on fluted point manufacturing and later observed within the reductive process at the Adams site (Sanders 1983, 1990). One of the reasons for not recognizing it may be its resemblance to fluting, causing researchers to interpret end thinning as "early" fluting (Howard 1990:257-258) and not as a repeated reduction technique. However, the use of the end thinning technique was observed at both the Adams and Gault sites throughout, not only in the primary reductive stages, but continuing until the final shaping process prior to fluting.

Another trait gaining significant recognition with Clovis technology is the use of overshot flaking. Some feel this technique is an intentional flaking strategy (Bradley 1982, 1991, 1993; Morrow 1986; Collins 1999a, 1999b; Johnson 1993), while others feel it to be the result of knapping errors (Callahan 1979; Verrey 1986; Patten 1999; Sanders 1983, 1990). The results of the study of the Gault overshots suggest that, in part, overshot flaking probably was an intentional strategy.

Two types of overshot flakes were identified from the Gault assemblage. These are partial overshots which were removed from the squared edges of the blocky tabs and terminated only partway on the tab's vertical edge, and full overshots which were removed from thinner preforms and whose terminations plunged completely through the preform removing portions of both the dorsal and ventral surfaces. Partial overshots were obviously intentional removals. These were removed beginning with initial cortex removal and continued until both the dorsal and ventral surfaces came together into a sharp edge. Not only did these removals begin to bring the edges of the two faces together, but the plunging nature of the termination also aided in guiding additional flake fracture and subsequent platform formation.

Full overshot removals, however, contain a different set of problems. One of the primary factors surrounding full overshot flaking is the unpredictable nature of its termination. As any modern flint knapper can readily testify, it is difficult to control exactly where a plunging fracture will occur or how much of the edge will be removed. Through a comparison of the width of the different biface stages and the data derived from the full overshot flakes, it was concluded that a 10% to 15% edge loss per flake removal did not inhibit continued reduction. However, it was found that only slightly over 50% of the full overshots fell with this category and that the average of edge loss was 27%, reinforcing its unpredictability. Thus, an accepted full overshot flake removal, even if all the criteria (i.e., proper platform, support, applied force and striking angles) were met, was 50/50 at best. This conclusion is further compounded when considering that multiple removals were performed on each biface.

Keeping these issues in mind, why was full overshot flaking intentionally performed? In retrospect, full overshot terminations were probably not the intended result. Rather, they were probably the result of overface flaking where the intention was to remove flakes completely across the face of the preform with the idea that termination would occur at or near the opposite edge. Some edge removal was considered acceptable, but (because it is difficult to consistently control all factors and criteria for such removals) terminations often plunged near the edge removing more of the edge than was intended. Where flakes terminated near the edge, as well as some that overshot, the edge was often flaked back from the opposite edge to flatten or smooth the termination point and/or realign the edge. This often makes it difficult to distinguish flakes that terminated near the edge from those that plunged over.

The second part of this study centered on blade manufacture. It was immediately apparent that the blade assemblage was comprised of a number of different blade types. Initial divisions began with both regular and irregular forms separated into primary, secondary, and interior types and a specialized form known as crested blades. As analysis proceeded, the primary and secondary blades were further divided into another specialized form termed corner removal blades.

Not surprisingly, this variation in blade types also varies in their descriptions. These variations include blades as having cross-sections that vary from almost flat, to prominently triangular, with edge angles that range from acute to abrupt, have single or multiple longitudinal, or occasionally, lateral flake scar ridges, and longitudinal sections that range from strongly curved to flat. Blade lengths (for all types) average between 63 mm and 96 mm in length, have platforms averaging 4.1 mm wide and 10.2 mm thick, with an average platform angle of 72.7°, and platform preparations that may be unprepared or heavily modified by isolation, grinding, and faceting. The bulbs of percussion are often flat or diffuse. They may also contain moderate to strongly prominent bulbs with ventral surfaces that may be smooth or have varying amounts of ripples and waves.

These findings differ from the previously accepted Clovis blade definition which describes Clovis blades as having small platforms that may be wide but not deep, flat bulbs of percussion, minimal amounts of ripple marks on the ventral surface giving a smooth appearance, are generally long and curved in longitudinal cross-section (Collins 1999a:63,178). However, the presence of so many blade variations should not be surprising as the Gault site is a quarry workshop and camp where a variety of lithic tools were manufactured. During the blade manufacturing process, blade types and methods of removal changed as the process continued. This resulted in the accumulation of varying amounts of blade core preparation debris, blades that failed or were rejected, and additional amounts of waste debitage, from core and biface reduction.

On the other hand, successful blades, or those that met the criteria for the intended product, would have been removed for utilization elsewhere. It is these blades, often found in individual caches (Green 1963:145-163; Collins 1999a:75-143) that formed the initial Clovis blade descriptions. Therefore, one could reasonably argue that such blades represent the true blade form and that all the others are merely marginal or unsuitable and rejected forms. Undoubtedly, this supposition is true; however, even though many of the blades left at the quarry site do not fit into the classic definition, many were utilized as tools (Lohse et. al. 2002). Therefore, it is apparent that the Clovis folks utilized a wide range of blade forms, at least in the proximity of lithic sources, if not elsewhere.

Blade manufacture began with the selection of the raw material. With the single exception of a quartzite blade fragment, all the blades were made of local chert. Both creek gravels and the blocky tabs from the surrounding slopes were utilized. Cobble use was minimal, which was probably due to the fact that cobble accumulations within the creek include both the better flaking cherts and those of an inferior flaking quality. The selection, therefore, of acceptable cores would have involved a continual process of testing. Thus, it may have been easier to select the more obvious forms from the slopes.

Initial preparation of the cores was accomplished in two ways. Because cobbles often contain one or more rounded ends unsuitable for flaking, one of the ends has to be removed in order to create a platform from which flakes or blades could be longitudinally flaked. Some cobbles, however, retain more of their original blocky form, retaining some angular edges that do not require an end removal. Such edges, found on these and the blocky forms often coincide with squared sides that easily served as natural platforms. These square edges were formed when the bedded chert layers fractured from overburden pressures while in the parent limestone matrix. Once eroded out of the matrix, the fractured surfaces began to patinated, eventually becoming covered by a hard gray-white covering. Because this "patina" was hard, it did not inhibit flaking and, as such, did not need immediate removal. In addition, it's presence on some blades, overshot flakes, and large flakes, also served to determine initial tab width and thickness.

Two types of blade cores were noted: conical and wedge-shaped. The conical core type is very distinctive. These were usually made on blocky tabs and were flaked around their entire circumference with removals plunging towards the distal end, eventually forming a cone-like polyhedral shape. The more common type is the wedge-shaped core which is made on those cherts that are flatter and more tabular in shape. These were flaked only on one or more of their ends, but occasionally portions of their sides were also flaked, usually in an alternate direction for both blade and core preparation removals. Whether cores were conical or wedge-shaped, the tabs selected often contained flaws, such as inclusions or cracks that made them unsuitable for biface reduction. In these cases, only a few blades were removed.

The initial removals were performed to set up ridges on the longitudinal sides from which blades could be removed. Blades removed during this procedure were primary types and those removed from the edges often were often thick and triangular in cross-section. These are the corner removal type blades. As mentioned previously, these blades were also formed during initial biface reduction as well. As removals continued, some failed by terminating short in hinge or step fracture type terminations, had these problems "cleared" by flaking either from the distal end or laterally. Those flaked from the distal end of the core required little modification, as those surfaces were usually flat, while the lateral flaking required a more intensive platform preparation.

Primary platforms, or those serving for blade removals, soon became exhausted and required re-juvenation. This was accomplished in several ways. One of the better-known techniques utilized on both the conical and wedge-shaped types was to remove the entire exhausted platform surface. In some cases, the entire surface was removed in a single flake, known as a core tablet. These are very distinctive where their lateral edges retain the proximal portions of the core's longitudinal blade scars. More often, however, it required several flakes to completely remove the old surface. Ideally, these removals would create a flat and squared surface that required little additional modification to set new platforms.

These removals, however, often detached at an angle, leaving only a portion of the surface having a suitable angle for platforming. If the entire surface was not re-flaked, platforms were established and blades removed from the suitable portion before the surface was again removed.

Another, less recognized, method for platform formation was performed through a technique of sequent flake removals. These flakes are distinguished by having profiles that appear as a bird in flight that is having a prominent bulbar center with outflaring sides. These were produced by the repeated flake removal at the same point. Initial flakes were small. As each subsequent flake was removed the bulb became more exaggerated and prominent, as well as an increase in lateral width. The upward and out flaring of the flakes edges and the deep concavity formed by the negative bulb scar formed a raised lateral portion or prominent hump. If two sets were flaked near each other or if one side was near the tabs edge, the hump formed easily served as the basis for establishing a platform, requiring only minimal back flaking or grinding to form a suitable flaking angle. The terminations from this sequent flaking usually plunged forming stacks or knots on the platform surface. These required complete removal (i.e., the core tablet technique) in order to create a fresh surface.

Crested blades are another specialized blade form. Usually this blade type is associated with initial blade core preparation where a ridge is formed by bifacial flaking on the surface of a cobble having an unsuitable surface for the removal of the first blade (Collins 1999a:19). Interestingly, 55 such blades were recovered. This number seemed unusual, especially in the light that most of the raw material used were blocky cores having a number of edges easily suitable for initial flaking. Many of the cobbles from Buttermilk Creek also contained angular edges.

Looking at the crested blades, it was noted that they varied from examples with both sides adjacent to the central ridge flaked to those flaked only on one side. Some were partially flaked in combinations of both sides, and others were flaked partially only on one side. Fortunately, three sets of blades were refitted together; that is, two individual blades removed sequentially were put back together. One of the sets contained a single interior type blade that was removed over the top of a second crested blade. Due to the placement of the uppermost blade, it was obvious that the cresting could not have occurred until after the upper blade was removed. This, then, showed that cresting was not used solely for initial ridge formation, but was also a technique employed to straighten edges throughout the blade production process.

Blade removals were probably removed utilizing a number of different percussors. Collins (1999a) believed that the smooth ventral surfaces on blades and small platforms indicated removal by either soft hammer indirect percussion. However, many of the Gault blades have ventral surfaces that contain varying amount of ripples and waves, as well as large platforms. This suggests that hard hammer removals were also utilized. The lack of ventral ripples and flat bulbs do not, in themselves, support only a soft hammer removal as the same result can be produced by hard hammer if the angle of blow is directed into the core's mass rather than in an arching swing.

Other than a single elongated quartzite cobble, no hammerstones were recovered. This cobble contained batter on both its ends as well as having one end fractured back at an angle reminiscent of a gouge. Prominent within the creek gravels, were limestone nodules of varying sizes and shapes. Many of these seemed suitable for use as a hammerstone. Subsequent flaking experiments showed that these nodules could have been used as hammerstones, but that their surfaces rapidly crushed and became inefficient. No direct evidence for indirect percussion was noted, but the fact that several of the projectile points appeared to have been fluted by this means, one cannot entirely rule out its use. The majority of both the bifaces and blades were more prevalent in the Clovis clay (Geologic Unit 3a) geologic unit than the Clovis soil (Geologic Unit 3b). The presence of late stage bifaces (i.e., stages V, VI, and VII) were much reduced or totally lacking in Geologic Unit 3b. A single exception, was a finished point found in Geologic Unit 3b**.** However, there were more secondary full overshot flakes and approximately one-half the number of interior full overshot flakes in Geologic Unit 3b than Geologic Unit 3a. This suggests that middle stage reduction occurred consistently within both units. Since evidence indicates that interior full overshot flaking continued until the final preform stage prior to fluting, it can be inferred from their presence that late stage reduction also occurred in Geologic Unit 3b. Because the Gault Site covers a large area, the lack of late stage bifaces from Geologic Unit 3b can be attributed to sample size bias.

A study of the manufacturing debris for blades (i.e., blades blade cores, core tablets, and associated debris) found that(like the bifaces) most were found in the Clovis clay (Geologic Unit 3a). This accounted for approximately twice the amount than was in the Clovis soil (Geologic Unit 3b). In addition, there was no indication that the blade manufacturing technologies employed changed between the occupations of the two units.

There were, however, a higher number of crested blades recovered from Geologic Unit 3b (almost equaling those from Geologic Unit 3a), but because this is a technique used to re-align flaking ridges, it does not indicate a technological change.

The technological traits from the Gault assemblage were compared to seven other Clovis sites. These sites include the Adams site in western Kentucky, Aubrey site in north-central Texas, the Pavo Real site in south-central Texas, the Green Cache from Blackwater Draw in New Mexico, Gault 1 (1990 UT excavation), Richey Roberts site in Washington, and the Keven Davis Cache in central Texas. Two of these sites are blade caches with no bifaces present, and the Aubrey site contained only a fragment of a Clovis point.

One of the most abundant attributes for Clovis technology is the overshot flaking technique. Evidence for this type flaking has been noted at a number of Clovis sites as well as remnant scars noted on many finished points found in both isolated and site contexts. It should be stressed that overface flaking noted on the Gault bifaces resembles overshots but terminates near the opposite edge without plunging over it. Any subsequent flaking back of that edge may obscure whether that flake terminated near the edge or actually plunged over it. Of the sites investigated for this study, the use of overshot flaking was identified at the Adams site Sanders (1990), Pavo Real (Collins et al. 2003), the Richey Roberts site (Gramley 1993), and the Aubrey site (Ferring 1990:11) where a possible overshot flake was recovered.

One attribute rarely discussed with Clovis reduction is the end thinning technique. Such a strategy was noted at the Adams site where it was identified during the reduction stages II through IV (Sanders 1990:32-42) and on a single early stage bifacial fragment from Pavo Real (Collins et al. 2003:100). Although not specifically assigned to any particular reductive stage, end thinning was observed on some illustrations of the bifaces and "knives" from the Richey Roberts site (Gramley 1993:37,41-42).

The Gault blades were also compared to six sites having blade assemblages. These sites include the Adams site, Pavo Real, the Green Cache, Gault 1, Richey Roberts, and the Keven Davis Cache. Although a few blade fragments and a core tablet were recovered from the Aubrey site (Ferring 1990:11), no descriptions are available. In order to properly evaluate blades from each site with the Gault analysis, the blades from each site were divided into primary, secondary, interior, or specialized (crested) categories.

The only site, other than Gault, with primary blades is the Adams site, and the dimensions for both sites (index of curvature, width-to-length, width, and thickness ratios) are almost equal. The comparison of secondary blades with five sites (i.e. Adams, Green and Keven Davis caches, Pavo Real, and Richey Roberts) having secondary blade types found that the Gault blades were smaller and thinner from all sites except the Adams site. The index of curvature calculations, however, show the Gault blades to be flatter than all sites except for Pavo Real and the width-to length ratios are less for all sites except for Richey Roberts and Adams which are approximately the same. The interior blades from all sites are very similar with the Gault blades being slightly shorter than those from both the Green and Keven Davis caches but longer than those from the other sites. In addition the Gault blades have the lowest index of curvature, closely followed by Pavo Real.

The only sites with available platform widths and thicknesses are Pavo Real and the Keven Davis Cache in which Gault was found to be wider and thicker from Keven Davis and very close to Pavo Real. The platform angles between Pavo Real and Gault were also very similar and steeper than those from the Keven Davis Cache.

These findings show that blades from the Adams and Pavo Real sites are more similar to Gault than from the other sites. This, however, is not surprising when one considers that Gault, Pavo Real, and Adams are lithic manufacturing sites containing large numbers of rejected and failed blades along with intended forms, while the Green and Keven Davis caches and, to some degree, Richey Roberts are isolated concentrations composed solely of intended blades. This conclusion, however, does not mean that the failed and/or rejected blades left at the manufacturing sites were not valued as tools. In fact, it was noted that many of these blades at Gault contain wear patterns supporting evidence of use. Rather, it appears that those chosen for transport contain certain specific preferred characteristics not present on those left behind.

In conclusion, this analysis has found that a number of different reduction strategies were employed at the Gault site. Although several strategies (i.e., overface flaking on bifaces, core tablet and sequent flake removals for platform rejuvenation and formation on blade cores) were consistently used, there was no specific sequence followed for the occurrence of their use other than as a result of variances in raw material forms and as flaking problems developed. In addition, some techniques (such as blading) were modified and incorporated into the reduction of both biface and blade manufacture.

Thus, this study has expanded our current views and added a number of new insights into our current knowledge of Clovis lithic technology.

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APPENDIX A

BIFACE TABLES

Table A- 1. Bifacial Stages and Geologic Unit Where Found.

BIFACES BY GEOLOGIC UNIT

BIFACE STAGE	UNIT 3a	UNIT 3b	UNIT 3a or 3b	TOTAL
2	*9	*5	2	**16
3	*10	*2	2	**14
4	*5	4	4	13
5	*5	-	1	6
6	*4	-	-	4
7	3	1	-	4
TOTAL	39	12	8	57
BIFACIAL CORES				
	-	1	2	3
TOTAL	-	1	2	3

Key:

Stage 2...* = count includes 1 re-fit with both pieces from 3a.

Stage 3...* = count includes 2 re-fitted sets: 1 with one piece from 3a and the other from 3b, and the other with both pieces from 3a.

Stage 4...* = count includes 1 re-fit with one piece from 3a and the other from 3b.

Stage 5...* = count includes 1 re-fit with both pieces from 3a.

Stage 6...* = count includes 1 re-fit with both pieces from 3a.

** = Total counts for Stages 2 & 3 exclude one specimen each having unknown geologic placement.

Table A- 2. Overshot Flakes and Geologic Units Where Found.

OVERSHOT FLAKE TYPES BY GEOLOGIC UNIT*				
	UNIT 3a	**UNIT 3b**	**UNITS 3a or 3b**	**TOTAL**
FULL OVERSHOT FLAKES				
PRIMARY	2	1	-	3
SECONDARY	9	11	-	20
INTERIOR	20	16	3	39
TOTAL	31	28	3	*62
PARTIAL OVERSHOT FLAKES				
PRIMARY	13	7	1	21
SECONDARY	32	10	6	48
INTERIOR	29	15	6	50
TOTAL	74	32	13	*119

* = Counts reflect exclusion of 3 specimens having unknown geologic placement.

Table A- 3. Overshot Flake Counts by Overshot and Flake Type.

OVERSHOT FLAKE TOTALS				
OVERSHOT TYPE	**PRIMARY FLAKE**	**SECONDARY FLAKE**	**INTERIOR FLAKE**	**TOTAL**
FULL	3	22	39	64
PARTIAL	20	48	52	121
TOTAL	23	70	91	185

Table A- 4. Platform Types, Angle and Thickness Averages for Partial Overshot Flakes.

PARTIAL OVERSHOT FLAKE CHARACTERISTICS PRIMARY FLAKES			
PLATFORM TYPE	**No.**	**AVERAGE PLATFORM ANGLE**	**AVERAGE PLATFORM THICKNESS**
Natural	6	85°	9.1 mm
Plain	4	72°	4.7 mm
Dihedral	0	-	-
Polyhedral	1	-	3.8 mm
Unknown	2	-	-
TOTAL	13		
SECONDARY FLAKES			
Natural	10	88°	7.4 mm
Plain	12	77°	4.4 mm
Dihedral	4	87°	4.4 mm
Polyhedral	3	77°	3.4 mm
Unknown	4	-	-
TOTAL	33		
INTERIOR FLAKES			
Natural	6	84.0°	6.4 mm
Plain	14	71.2°	6.0 mm
Dihedral	2	79.0°	6.0 mm
Polyhedral	3	76.3°	3.1 mm
Unknown	4	86.0°	-
TOTAL	29		

Table A- 5. Large Flake Platform Type, Flake Direction, Termination Type for each Flake Type

LARGE FLAKE CHARACTERISTICS			
PLAT. TYPE	**PRIMARY**	**SECONDARY**	**INTERIOR**
Natural	8	15	4
Plain	2	16	15
Dihedral	0	8	6
Polyhedral	0	3	6
Unknown	2	6	3
Reworked	1	8	5
Crushed	1	3	2
FLAKE DIRECTION			
None	14	0	0
Unidirectional (proximal)	0	31	6
Bidirectional	0	21	18
Radial	0	7	16
Unidirectional (distal)	0	0	1
FLAKE TERMINATION			
Feathered	3	39	19
Hinged	9	9	16
Blunt	2	11	6
AVERAGE LENGTH/WIDTH (mm)	82.7 x 69.5	85.3 x 67.9	73.9 x 61.5
TOTAL	14	59	41

Table A- 6. Comparison of Biface II ratios and sizes with Callahan (1979) and the Adams Site.

BIFACE II RATIO COMPARISONS

GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	2.00 - 5.00	2.10
L/W RATIO	1.40 - 2.40	1.86
L/T RATIO	4.10 - 7.10	5.50
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	2.00 - 3.00	2.80
L/W RATIO	-	1.80
L/T RATIO	-	5.03
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	-	2.40
L/W RATIO	-	1.58
L/T RATIO	-	3.69

BIFACE II SIZE COMPARISONS

GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	100.00 - 134.30	114.12
WIDTH	48.50 - 71.00	62.55
THICKNESS	14.O0 - 24.50	21.27
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	90.00 -115.00	115.30
WIDTH	55.00 – 75.00	64.20
THICKNESS	15.00 – 25.00	22.90
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	60.00 - 112.00	86.40
WIDTH	38.00 - 85.00	56.10
THICKNESS	15.00 - 50.00	24.90

Table A- 7. Comparison of Biface III Ratios and Sizes with Callahan (1979) and the Adams Site.

BIFACE III RATIO COMPARISONS		
GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	2.10 - 3.50	2.83
L/W RATIO	1.40 - 2.50	1.83
L/T RATIO	3.40 - 6.40	5.30
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	3.0 - 4.0	3.32
L/W RATIO	-	1.81
L/T RATIO	-	5.92
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	-	3.82
L/W RATIO	-	2.03
L/T RATIO	-	6.31

BIFACE III SIZE COMPARISONS		
GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	104.20 - 125.50	114.73
WIDTH	52.50 - 73.10	63.48
THICKNESS	15.80 - 32.30	23.20
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	80.0 - 110.0	103.0
WIDTH	50.0 - 65.0	56.8
THICKNESS	13.0 - 20.0	17.4
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	73.0 - 137.0	91.0
WIDTH	37.0 - 67.0	51.3
THICKNESS	11.0 - 19.0	13.6

Table A- 8. Full Overshot Flakes with Edge or Corner Blade Removals.

Specimen No.	Flake Type	Direction of Corner Removal
Incomplete Specimens		
425-117	1	Unidirectional
246-57	2	Unidirectional
252-192	3	Unidirectional
292-156	3	Unidirectional
314-149	3	Unidirectional
421-113	3	Unidirectional
320-64	3	Unidirectional
255-200	3	Unidirectional
Complete Specimens		
287-79	2	Bidirectional
293-80	2	Unidirectional
118/425	2	Unidirectional
421-110	2	Unidir. Dorsal
133/364	2	Unidirectional
BHT-173	2	Unidirectional
BHT-174	2	Unidir. Dorsal
319-132	2	Bidirectional
192-155	3	Unidirectional

Table A- 9. Comparison of Biface IV Ratios and Sizes with Callahan (1979) and the Adams Site.

BIFACE IV RATIO COMPARISONS

GAULT	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	2.7 - 5.3	4.1
L/W RATIO	1.6 - 2.4	2.0
L/T RATIO	5.6 - 7.7	6.7
CALLAHAN	**RANGE (mm)**	**AVERAGE**
W/T RATIO	4.0 - 5.0	4.2
L/W RATIO	-	-
L/T RATIO	-	-
ADAMS SITE	**RANGE (mm)**	**AVERAGE**
W/T RATIO	-	4.6
L/W RATIO	-	-
L/T RATIO	-	-

BIFACE IV SIZE COMPARISONS

GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	74.9 - 136.1	105.5
WIDTH	34.3 - 77.3	50.3
THICKNESS	7.517.6	12.4
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	75.0 - 100.0	-
WIDTH	40.0 - 50.0	49.0
THICKNESS	8.0 - 13.0	11.4
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	-	-
WIDTH	35.0 - 65.0	43.4
THICKNESS	7.0 - 12.0	9.5

Table A- 10. Comparison of Biface V Ratios and Sizes with Callahan (1979) and the Adams Site.

BIFACE V RATIO COMPARISONS

GAULT	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	-	4.75
L/W RATIO	-	-
L/T RATIO	-	-
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	4.0 - 6.0+	-
L/W RATIO	-	-
L/T RATIO	-	-
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	-	4.0
L/W RATIO	-	-
L/T RATIO	-	-

BIFACE V SIZE COMPARISONS

GAULT	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	-	-
WIDTH	31.30 - 44.80	39.20
THICKNESS	7.5 - 9.40	8.75
CALLAHAN	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	-	-
WIDTH	-	-
THICKNESS	-	-
ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	-	-
WIDTH	-	-
THICKNESS	7.00 -8.00	-

Table A- 11. Comparisons of Biface VI Ratios and Sizes with the Adams Site.

BIFACE VI RATIO COMPARISONS

GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	3.60 - 5.9	4.53
L/W RATIO	3.30	3.30
L/T RATIO	14.10	14.10

ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
W/T RATIO	-	4.60
L/W RATIO	-	-
L/T RATIO	-	-

BIFACE VI SIZE COMPARISONS

GAULT SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	138.20	138.20
WIDTH	36.40 - 41.60	39.10
THICKNESS	6.70 - 10.20	8.86

ADAMS SITE	**RANGE (mm)**	**AVERAGE (mm)**
LENGTH	-	-
WIDTH	29.00 - 48.00	36.10
THICKNESS	7.00 - 10.00	7.90

Table A- 12. Measurements and Width/Thickness Ratios for the Gault Biface VII or Finished Points.

GAULT SITE INDIVIDUAL BIFACE VII MEASUREMENTS				
Specimen No.	**Length**	**Width**	**Thickness**	**W/T Ratio**
1	58.1mm	23.9mm	8.0mm	3.0
2	58.8mm	25.4mm	5.5mm	4.6
3	65.1mm	22.1mm	7.5mm	2.9
4	-	23.5mm	5.9mm	4.0

Table A- 13. Measurements and Ratios for the Gault bifacial Cores

GAULT BIFACIAL CORE MEASUREMENTS			
SPECIMEN NO.	**LENGTH (mm)**	**WIDTH (mm)**	**THICKNESS (mm)**
285-7	137.1	76.0	37.5
269-38	131.0	75.0	48.4
421-42	132.5	83.1	38.3
AVERAGE	135.5	78.0	41.4

GAULT BIFACIAL CORE RATIOS			
SPECIMEN NO.	**W/T RATIO**	**L/W RATIO**	**L/T RATIO**
285-7	2.00	1.80	3.70
269-38	1.50	1.70	2.70
421-42	2.20	1.60	3.50
AVERAGE	1.90	1.70	3.30

Table A- 14. Large Flake Platform Angles and Averages.

AVERAGE LARGE FLAKE PLATFORM ANGLES						
PLATFORM TYPE	**PRIMARY FLAKE**		**SECONDARY FLAKE**		**INTERIOR FLAKE**	
	Total	Angle	Total	Angle	Total	Angle
Natural	8	82.5°	15	81.0°	4	90.8°
Plain	2	69.0°	16	74.0°	15	79.7°
Dihedral	0	-	8	77.0°	6	72.8°
Polyhedral	0	-	3	79.0°	6	73.2°
Unknown	2	-	6	-	3	-
Reworked	1	-	8	76.0°	5	88.0°
Crushed	1	-	3	-	2	
Flake Type Average		79.0°		77.4°		80.9°
TOTAL	14		59		41	

Table A- 15. Large Flake Platform Widths and Thicknesses.

AVERAGE LARGE FLAKE PLATFORM MEASUREMENTS						
PLATFORM TYPE	**PRIMARY FLAKE**		**SECONDARY FLAKE**		**INTERIOR FLAKE**	
	Width (mm)	Thick. (mm)	Width (mm)	Thick. (mm)	Width (mm)	Thick. (mm)
Natural	21.1	8.1	22.4	8.0	22.9	5.6
Plain	25.6	9.4	14.8	5.9	15.2	5.3
Dihedral	-	-	17.4	5.8	17.7	4.9
Polyhedral	-	-	13.4	4.4	19.4	5.5
Unknown	-	-	-	-	-	-
Reworked	9.6	-	7.6	4.2	13.9	9.4
Crushed	-	-	-	-	-	-
TOTAL	14		59		41	

Table A- 16. Winged Flake Platform Type, Flake Direction, and Termination Type for each Flake Type.

WINGED FLAKE CHARACTERISTICS

PLATFORM TYPE	SECONDARY FLAKE	INTERIOR FLAKE
Natural	4	1
Plain	11	16
Dihedral	-	9
Polyhedral	2	4
Unknown	-	-
Reworked	4	3
Crushed	1	8
TOTAL	22	41

FLAKE DIRECTION	SECONDARY FLAKE	INTERIOR FLAKE
None	0	0
Unidirectional	18	22
Bidirectional	4	7
Radial	-	12
TOTAL	22	41

FLAKE TERMINATION	SECONDARY FLAKE	INTERIOR FLAKE
Feathered	8	26
Stacked	3	1
Hinged	5	8
Overshot	0	1
Unknown	6	5
TOTAL	22	41

Table A- 17. Totals of Winged Flake Platform Types and Angles.

AVERAGE WINGED FLAKE PLATFORM ANGLES				
PLATFORM TYPE	**SECONDARY FLAKE**		**INTERIOR FLAKE**	
	Total	Angle	Total	Angle
Natural	4	78.0°	1	-
Plain	11	73.0°	16	74.5°
Dihedral	-	-	9	61.1°
Polyhedral	2	84.0°	4	66.0°
Unknown	-	-	-	-
Reworked	4	-	3	88.0°
Crushed	1	-	8	-
FLAKE TYPE AVERAGE		78.3°		72.4°
FLAKE TOTAL	22		41	

Table A- 18. Winged Flake Platform Measurements and Averages for each Platform Type.

WINGED FLAKE PLATFORM MEASUREMENTS				
PLATFORM TYPE	**WIDTH RANGE (mm)**	**AVERAGE WIDTH (mm)**	**THICKNESS RANGE (mm)**	**AVERAGE THICKNESS (mm)**
SECONDARY FLAKES				
Natural	11.0 - 21.2	15.0	2.5 - 6.1	4.0
Plain	10.5 - 29.5	19.1	1.9 - 10.6	4.4
Dihedral	-	-	-	-
Polyhedral	11.4 - 23.5	17.5	1.6 - 4.6	3.1
Unknown	-	-	-	-
Reworked	6.8 - 18.8	12.8	4.7 - 5.7	5.2
Crushed	-	-	-	-
INTERIOR FLAKES				
Natural	9.2	9.2	2.1	2.1
Plain	7.0 - 34.1	16.8	1.8 - 5.4	3.0
Dihedral	11.4 - 36.7	18.7	2.5 - 10.9	4.4
Polyhedral	18.7 - 26.4	23.8	2.7 - 7.5	4.6
Unknown	-	-	-	-
Reworked	7.2 - 18.5	11.4	1.1 - 4.0	2.6
Crushed	-	-	-	-

Table A- 19. Totals and Averages for Platform Angles and Types for Full and Partial Overshot Flakes

AVERAGE OVERSHOT PLATFORM ANGLES (ALL TYPES):			
Full Overshot	76°		
Partial Overshot	76°		
Average Platform Angles:			
Full Overshot	**Primary**	**Secondary**	**Interior**
Natural	N.A.	84°	84°
Plain	N.A.	80°	60°
Dihedral	N.A.	N.A.	N.A.
Polyhedral	N.A.	N.A.	N.A.
Partial Overshot			
Natural	85°	88°	84°
Plain	72°	77°	64°
Dihedral	N.A.	87°	86°
Polyhedral	N.A.	77°	76°

Platform Type Totals:

Natural Platform	Full Overshot	Partial Overshot
Primary	N.A.	6
Secondary	5	10
Tertiary	1	6
Total	7	22

Plain Platform	Full Overshot	Partial Overshot
Primary	N.A.	4
Secondary	4	12
Tertiary	3	14
Total	7	30

Dihedral	Full Overshot	Partial Overshot
Primary	N.A.	N.A.
Secondary	1	4
Tertiary	N.A.	2
Total	1	6

Polyhedral	Full Overshot	Partial Overshot
Primary	N.A.	1
Secondary	N.A.	3

Table A-19 continued

AVERAGE OVERSHOT PLATFORM ANGLES (ALL TYPES):		
Tertiary	1	3
Total	1	7

Table A- 20. Platform Types, Angle, and Thickness Averages for Full Overshot Flakes.

FULL OVERSHOT FLAKE CHARACTERISTICS			
Platform Type	**No.**	**Average Platform Angle**	**Average Platform Thickness**
PRIMARY FLAKES			
Natural	0	0	0
Plain	0	0	0
Dihedral	0	0	0
Polyhedral	0	0	0
Unknown	0	0	0
Total	0	0	0
SECONDARY FLAKES			
Natural	5	84°	4.4 mm
Plain	4	80°	4.9 mm
Dihedral	1	0	10.6 mm
Polyhedral	0	0	-
Unknown	3	0	2.8 mm
Total	13		
INTERIOR FLAKES			
Natural	1	84°	9.5 mm
Plain	3	60°	3.1 mm
Dihedral	0	-	4.3 mm
Polyhedral	1	-	2.4 mm
Unknown	3	-	-
Total	8		

Table A- 21. Primary Full Overshot Flake Distal Edge Angles.

PRIMARY FULL OVERSHOT FLAKES	
Specimen No.	**Edge Angle**
291-167	72°
425-117	77°
397-68	66E-77°

Table A- 22. Secondary Full Overshot Flake Distal Edge Angles.

SECONDARY FULL OVERSHOT FLAKES	
Specimen No.	**Edge Angle**
328-123	45°- 65°
392-134	46°
BHT-173	53°
208-165	53°- 81°
293-80	55°- 65°
285-89	55°- 66°
425-118	56°
217-90	57°
311-106	57°
288-190	58°
BHT-174	61°
205-194	62°- 67°
47-225	64°
BHT-175	65°
364-133	66°
319-136	67°
BHY-176	67°
296-57	67°- 77°
223-92	68°
421-110	71°
287-79	73°- 81°
77-96	74°- 88°
244-191	91°

Table A- 23. Interior Full Overshot Flake Distal Edge Angles.

INTERIOR FULL OVERSHOT FLAKES			
Specimen No.	**Edge Angle**	**Specimen No.**	**Edge Angle**
256-101	38°	**364-143**	61°- 68°
421-113	40°- 55°	**276-168**	61°- 70°
49-236	46°	**179-778**	62°
179-180	50°	**227-141**	62°- 68°
235-49	51°	**425-121**	64°
311-103	51°- 69°	**347-81**	64°
311-103	52°	**121-179**	64°
254-170	52°- 62°	**294-125**	65°
252-780	53°	**319-132**	66°
423-108	53°- 64°	**229-185**	66°
244-198	53°- 68°	**392-142**	67°
320-64	54°	**320-65**	67°
196-144	54°- 66°	**4-100**	67°
33-234	55°	**55-233**	68°
255-200	56°	**353-76**	70°
288-193	56°- 67°	**252-192**	70°- 87°
296-58	57°- 65°	**285-85**	72°- 80°
422-109	57°- 73°	**144-199**	74°
163-276	58°	**156-161**	75°
120-424	58°- 63°	**353-70**	75°
314-149	59°	**311-105**	82°
5-231	61°	**192-155**	87°
228-195	61°		

Table A- 24. Percentage of Clovis and Archaic Full Overshot Edge Loss.

CATALOG No.	MAX. DORSAL LENGTH (mm)	VENTRAL LENGTH: PLATFORM TO FRACTURE EDGE (mm)	VENTRAL EDGE LOSS (mm)	VENTRAL WIDTH LOSS
353-70	54.3	43.8	10.7	24%
287-79	72.4	70.1	2.3-17.7	3-25%
293-80	82.5	70.1	6.3-20.3	9-29%
223-92	46.0	36.0	7.7	21%
421-110	107.7	81.1	45.3	56%
425-118	68.9	63.5	9.3	15%
319-132	60.0	36.2	17.0	47%
364-133	60.7	58.7	8.4	14%
319-136	115.1	110.5	9.4	9%
392-142	58.7	58.5	3.6	6%
192-155	69.5	55.6	14.5	26%
156-161	73.7	58.9	17.2	29%
BHT-173	88.2	64.5	23.7	37%
BHT-174	106.4	80.0	27.4	34%
BHT-175	91.4	65.7	18.4	28%
BHT-176	90.2	75.8	7.5	18%
179-180	79.1	86.2	14.1	16%
424-186	73.2	65.3	12.1	19%
244-191	91.9	65.4	31.6	48%
205-194	79.9	63.1	18.2	29%
252-780	38.6	27.2	8.3	31%
ARCHAIC				
47-225	86.5	77.2	16.1	21%
55-233	53.8	43.1	8.6	20%

Clovis (21) Average Width Loss = 25% - 27%
Archaic (2) Average Width Loss = 20%

APPENDIX B

BLADE TABLES

Table B- 1. Blade Types, Core Types, and Specialized Flake Counts by Geologic Unit.

BLADES AND CORE COUNTS PER GEOLOGIC UNIT

ARIFACT TYPE	3a	3b	3a or 3b
Primary Blades	21	15	1
Regular Secondary Blades	39	14	4
Irregular Secondary Blades	15	9	1
Secondary Corner Removal Blades	65	34	12
Regular Interior Blades*	89	38	13
Irregular Interior Blades	29	12	1
CrestedBlades*	28	23	2
* Total	285	145	34
Wedge-ShapedCores	29	16	2
Conical Cores	2	-	1
Core Tablets	19	16	1
Wing Flakes	34	19	10

* = 4 from Baulk not included in total count (2 from Regular Secondary Blade and 2 from Crested Blade categories)

Table B- 2. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Complete Primary Blades.

PRIMARY BLADE MEASUREMENTS

Specimen No.	Length (mm)	Width (mm)	Thickness (mm)	Flake ScarPattern	Termin. Type
251	82.3	32.9	6.3	8	1
268	72.3	20.4	8.3	8	1
275	50.9	21.9	10.1	8	3
282	95.9	34.0	20.8	1	3
287	69.4	28.1	6.1	10	3
288	90.6	40.5	18.1	8	1
294	55.4	22.8	11.6	8	1
464	61.9	19.8	7.7	8	3
673	101.3	35.4	10.6	8	1
684	80.3	19.1	10.1	8	1
691	94.4	42.9	10.6	2	4
696	90.0	24.9	13.3	8	4
705	76.3	41.3	20.4	8	1
715	93.7	41.4	20.8	8	2
719	98.8	40.1	21.4	8	1
760	97.4	45.8	23.8	8	2

Key:

Flake Scar Pattern:
1 = Unidirectional (prox. end) 8 = None
2 = Bi-directional (Prox-distal) 9 =
Undetermined
3 = Radial/Subradial10 = Bi-directional
4 = Irregular(lateral - proximal/
5 = Unidirectional (distal end) distal)
6 = Unidirectional (lateral)
7 = Bi-directional (lateral

Termination Type:
1 = Straight (blunt)
2 = Overshot
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B- 3. Platform Types, Measurements, Lip and Bulb Presence for Primary Blades.

PRIMARY BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat. Thick (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
251	1	3.3	1.6	83°	5	-	-
268	1	4.8	3.0	79°	5	N.L.	Dif.
275	1	9.3	1.7	-	5	-	-
282	2	14.3	2.1	74°	5	N.L.	Dif.
288	1	21.5	9.6	83°	5	N.L.	S.M.
294	1	17.0	8.7	63°	5	N.L.	Dif.
318	1	8.8	3.7	71°	5	N.L.	Dif.
406	7	9.7	4.2	72°	2	Lip	S.M.
464	2	7.4	1.9	77°	2	Lip	Dif.
684	1	7.0	2.3	41°	2	Lip	Dif.
691	2	8.1	3.2	64°	2	Lip	Dif.
696	1	6.7	6.6	89°	5	N.L.	Dif.
705	2	17.9	6.1	71°	5	N.L.	S.
715	5	8.8	3.8	87°	5	N.L.	S.M.
719	1	17.7	11.8	87°	5	N.L.	S.
760	1	21.7	6.9	77°	5	N.L.	S.M.

Key:

Platform Type:

1 = Natural Lip
2 = Plain
3 = Dihedral
4 = Polyhedral
5 = Unknown

Lip type:

Lip = Present
N.L.= None Present

Platform Preparation:

1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Bulb Type :

Dif. = Diffuse
S.M. = Strong to Moderate
S. = Strong

Table B- 4. Primary Blade Platform Width, Thickness, and Angle Ranges and Averages.

PRIMARY BLADE PLATFORM WIDTH, THICKNESS, AND ANGLES							
Blade Type	**Plat Type**	**Width Range (mm)**	**Avg. Width (mm)**	**Thick. Range (mm)**	**Avg. Thick (mm)**	**Plat. Angle Range**	**Avg. Plat. Angle**
Primary	1	3.3 - 21.7	11.5	1.6 - 11.8	5.4	41° - 89°	76.5°
	2	7.4 - 17.9	11.9	1.9 - 6.1	3.3	64° - 79°	71.5°
	3	-	-	-	-	-	-
	4	-	-	-	-	-	-

Table B- 5. Primary Blade Length, Width, Thickness, and Curvature Ratios.

PRIMARY BLADE STATISTICS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX CURV.**
251	121.5	.68	.27	.05	2.50	5.70
268	101.0	.72	.20	.08	3.54	Flat
275	82.9	.61	.26	.12	2.32	Flat & Twisted
282	150.7	.64	.23	.14	2.82	5.81
287	103.6	.67	.27	.06	2.47	Flat & Twisted
288	149.2	.61	.27	.12	2.24	7.33
294	89.8	.62	.25	.13	2.43	10.20
464	89.4	.69	.22	.09	3.13	Twisted
673	147.3	.69	.24	.07	2.86	Flat & Twisted
684	109.5	.73	.17	.09	4.20	Flat
691	147.9	.64	.27	.07	2.20	2.83
696	128.2	.70	.19	.10	3.61	10.53
705	138.0	.55	.30	.15	1.85	9.11
715	155.9	.60	.27	.13	2.26	6.58
719	160.3	.62	.25	.13	2.46	-
760	167.0	.58	.27	.14	2.13	4.56
Average	127.6	.65	.25	.10	2.69	6.96

Table B- 6. Presence of Ventral Ripples and Waves on Primary Blades.

VENTRAL RIPPLES AND WAVES ON PRIMARY BLADES					
Spec. No.	**Ripples**	**Waves**	**Spec. No.**	**Ripples**	**Waves**
251	SM	SM	**406**	N	N
261	N	SM	**464**	N	N
268	N	SM	**673**	N	SM
275	N	N	**684**	N	N
282	-	-	**691**	N	N
287	N	SM	**696**	N	N
288	N	N	**705**	N	N
294	N	N	**715**	N	N
348	N	SM	**719**	N	N
360	SM	SM	**751**	-	-
369	N	SM	**760**	N	N

Key:
N=None Present
SM=Slight to Moderate Presence
H=Heavy

Table B- 7. Primary Blade Attributes for Pavo Real and the Adams Site.

L (mm)	**W (mm)**	**T (mm)**	**PLW (mm)**	**PLT (mm)**	**L/ LWT**	**W/ LWT**	**T/ LWT**	**IC**	**W:L**
PAVO REAL PRIMARY BLADE VALUES									
145.0	37	22	9.0	3.0	0.75	0.18	0.11	4.13	3.3
105.0	32	16	7.0	3.0	0.69	0.21	0.10	0	3.9
ADAMS SITE PRIMARY BLADE VALUES									
92.0	31.0	11.0	-	-	-	-	-	-	-

Table B- 8. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Complete Regular Secondary Blades.

REGULAR SECONDARY BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
259	-	31.2	14.1	3	6
260	113.7	30.9	10.8	3	7
262	-	27.0	13.4	1	3
272	71.4	29.0	7.8	2	1
273	-	25.8	10.1	1	4
274	65.3	22.4	6.9	1	1
278/279	124.8	27.6	12.0	3	7
280	74.6	23.9	8.1	1	3
281	41.5	20.6	5.3	1	4
283	115.8	25.5	15.7	2	1
300	75.9	19.8	7.8	2	3
302	88.6	19.7	8.4	10	3
309	56.0	25.0	5.1	1	3
328	81.5	41.8	23.0	1	2
333	61.1	17.7	6.7	1	4
334	66.5	20.2	6.8	1	4
338	91.3	20.6	10.8	1	5
349	50.3	25.8	3.8	1	3
384	60.7	29.8	9.6	10	3
403	124.5	38.5	20.1	3	2
407	102.5	41.7	13.8	10	3
439	51.5	19.3	8.2	1	1
452	35.1	25.5	5.8	2	6
483	55.6	20.8	7.9	1	1
497	61.7	29.7	7.3	1	5
508	-	33.1	12.3	2	1

Key: Flake Scar Pattern:

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (Lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/distal)

Termination Type:

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B-8 continued

REGULAR SECONDARY BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
698	73.4	21.8	6.6	1	4
710	78.2	29.7	7.5	10	1
726	76.5	26.6	7.6	1	5
732	95.1	26.5	12.2	-	2
742	66.7	24.1	6.6	7	1
946	54.3	18.8	4.6	1	4
947	163.9	55.6	19.5	1	4

Key: Flake Scar Pattern:

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (Lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/distal)

Termination Type:

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B- 9. Platform Types, Measurements, Lip and Bulb Presence for Regular Secondary Blades.

REGULAR SECONDARY BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat. Thick. (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
259	5	-	-	-	4	-	-
260	3	3.0	1.7	-	3	-	-
262	5	-	-	-	4	-	-
272	7	8.5	-	-	3	N.L.	S.M.
273	5	-	-	-	4	-	-
274	7	-	-	-	3	N.L.	Dif.
278/279	5	-	-	-	4	-	-
280	2	5.9	2.8	75°	2	N.L.	Dif.
281	2	7.0	4.1	82°	5	N.L.	S.M.
283	2	5.8	2.2	70°	2	Lip	Dif.
300	2	13.6	5.2	85°	5	N.L.	S.M.
302	5	-	-	-	4	-	-
306	1	14.0	2.3	72°	2	N.L.	S.
309	4	11.3	3.1	59°	2	Lip	Dif.
328	1	12.9	5.2	72°	5	-	-
333	2	9.4	3.5	81°	3	N.L.	S.M.
334	2	4.1	2.4	79°	3	-	-
338	1	7.0	4.7	81°	2	N.L.	Dif.
356	2	13.0	5.0	71°	5	N.L.	S.
381	1	5.9	2.3	81°	5	N.L.	Dif.
384	2	11.1	4.4	77°	3	N.L.	S.
403	3	8.0	4.6	80°	2	Lip	Dif.
407	1	12.4	5.7	85°	2	N.L.	Dif.
476	2	9.9	2.4	71°	2	Lip	S.M.
483	1	6.0	3.4	67°	5	-	-
686	2	11.2	5.0	59°	3	Lip	Dif.
710	1	10.0	3.9	87°	5	-	-
726	2	14.2	4.4	73°	2	Lip	S.

Key

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/faceted
5 = Unknown

Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Lip Presence:
Lip = Present
N.L. = None Present

Bulb Type:
Dif. = Diffuse Bulb
S.M. = Slight to Moderate Bulb
S. = Strong Bulb

Table B-9 continued

REGULAR SECONDARY BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat. Thick. (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
732	2	6.2	2.4	75°	2	Lip	S.M.
742	2	12.2	4.8	46°	2	Lip	S.M.
947	7	17.8	5.0	82°	1	Lip	S.
353	4	8.9	4.9	62°	3	N.L.	Dif.
378	2	8.7	2.1	76°	3	N.L.	Dif.
353	3	18.9	6.8	68°	3	N.L.	S.M.

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/faceted
5 = Unknown

Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Lip Presence:
Lip = Present
N.L. = None Present

Bulb Type:
Dif. = Diffuse Bulb
S.M. = Slight to Moderate Bulb
S. = Strong Bulb

Table B- 10. .Regular Secondary Blade Platform Width, Thickness, and Angle Ranges and Averages.

REGULAR SECONDARY BLADE PLATFORM WIDTH, THICKNESS, AND ANGLES							
Blade Type	**Plat. Type**	**Width Range (mm)**	**Avg. Width (mm)**	**Thick. Range (mm)**	**Avg. Thick (mm)**	**Plat. Angle Range**	**Avg. Plat. Angle**
Secondary	1	5.9 - 17.0	9.9	2.3 - 5.7	4.2	67° - 87°	78.5°
	2	3.2 - 14.2	9.0	2.2 - 12.6	4.5	46° - 89°	74.9°
	3	3.0 - 8.0	5.5	1.7 - 4.6	3.2	80°	80°
	4	11.3 - 12.0	11.7	3.1 - 3.3	3.2	55° - 59°	57°

Table B- 11. Regular Secondary Blade Length, Width, Thickness, and Curvature Ratios.

REGULAR SECONDARY BLADE STATISTICS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX. CURV.**
260	155.4	.73	.20	.07	3.68	2.76
272	108.2	.66	.27	.07	2.46	-
274	94.6	.69	.24	.07	2.92	Flat
278-279	164.4	.76	.17	.07	4.52	11.46
280	106.6	.70	.22	.08	3.12	5.99
281	67.4	.62	.31	.08	2.01	Flat
283	157.0	.74	.16	.10	4.54	12.85
300	103.5	.73	.17	.08	3.83	Flat
302	116.7	.76	.17	.07	4.50	11.63
309	86.1	.65	.29	.06	2.24	Flat
328	146.3	.56	.29	.16	1.95	13.47
333	85.5	.71	.21	.08	3.45	9.85
334	93.5	.71	.22	.07	3.30	Flat
338	122.7	.74	.17	.09	4.43	6.90
349	79.9	.63	.32	.05	1.95	Flat
384	100.1	.61	.30	.10	2.18	5.96
403	183.1	.68	.21	.11	3.23	14.46
407	158.0	.65	.26	.09	2.46	Flat
439	79.0	.65	.24	.10	2.67	11.16
452	66.4	.53	.38	.09	-	-
483	84.3	.66	.25	.09	2.67	15.15
698	101.8	.72	.21	.06	3.37	4.09
710	115.4	.68	.26	.06	2.63	4.65
726	110.7	.69	.24	.07	2.88	5.49
732	133.8	.71	.20	.09	3.59	10.79
742	97.4	.68	.25	.07	2.77	Flat
946	77.7	.70	.24	.06	2.89	Flat
947	239.0	.69	.23	.08	2.95	4.59

Table B- 12. Presence of Ventral Ripples and Waves on Regular Secondary Blades.

VENTRAL RIPPLES AND WAVES ON REGULAR SECONDARY BLADES					
Specimen No.	**Ripples**	**Waves**	**Specimen No.**	**Ripples**	**Waves**
259	N	SM	**381**	N	N
260	N	N	**384**	N	N
262	N	N	**395**	N	SM
272	SM	SM	**403**	SM	SM
274	SM	SM	**407**	N	N
278/279	SM	SM	**439**	N	N
280	N	N	**452**	N	N
281	SM	SM	**465**	SM	SM
283	SM	SM	**468**	SM	SM
290	N	SM	**476**	SM	SM
300	N	N	**480**	N	SM
302	N	N	**483**	N	N
306	SM	SM	**489**	N	N
309	SM	N	**497**	N	SM
314	N	N	**508**	SM	SM
323	N	N	**686**	SM	SM
324	N	N	**698**	SM	SM
328	N	SM	**710**	N	N
333	SM	N	**726**	N	N
334	N	N	**732**	N	SM
338	H	SM	**742**	N	N
349	SM	N	**946**	N	N
356	SM	N	**962**	N	SM
373	SM	SM	**947**	SM	SM

Key: N = None Present
SM = Slight to Moderate Presence
H = Heavy Presence

Table B- 13. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and termination Types for Complete Irregular Secondary Blades.

IRREGULAR SECONDARY BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
257	73.7	24.7	6.7	3	3
258	-	31.2	14.1	10	4
385	85.7	38.2	5.7	3	3
413	111.6	39.2	18.2	10	1
468	72.6	36.1	6.5	3	5
495	67.3	26.1	5.6	1	3
721	84.9	35.5	6.8	3	4
722	110.2	24.6	8.4	1	1
738	68.7	17.9	10.4	5	1
757	68.6	36.5	14.0	10	4
945	78.7	36.7	11.8	1	5

Key:

Flake Scar Pattern
1 = Unidirectional (proximal end)
2 = Bi-directional (prox.-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/distal)

Termination Type:
1 = Straight/Blunt
2 = Overshot/Plunging
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/Retouched

Table B- 14. Platform Types, Measurements, Lip and Bulb Presence for Irregular Secondary Bulbs.

IRREGULAR SECONDARY PLATFORM MEASUREMENTS							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat. Thick. (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
257	2	3.2	3.3	75E	3	Lip	Dif.
258	5	-	-	-	4	-	-
385	2	8.1	5.2	88E	2	Lip	Dif.
413	7	11.4	4.5	70E	2	Lip	Dif.
468	7	4.7	2.0	67E	2	N.L.	S.
495	4	12.0	3.3	55E	2	-	-
721	7	-	-	-	4	-	-
722	2	9.2	4.2	66E	3	Lip	Dif.
738	2	7.5	3.0	81E	5	Lip	S.M.
757	2	11.6	12.6	89E	5	N.L.	S.
945	1	14.7	5.8	83E	5	N.L.	S.

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral Bulb Type:
5 = Unknown

Lip Type:
Lip = Present
N.L. = None Present
Dif. = Diffuse
S.M. = Slight to Moderate Bulb
S. = Strong Bulb

Platform Preparation:

1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Table B- 15. Irregular Blade Length, Width, Thickness, and Curvature Ratios.

IRREGULAR SECONDARY BLADE RATIOS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX CURV.**
257	105.1	.70	.24	.06	2.98	Flat
385	129.6	.66	.29	.04	2.24	3.09
413	169.0	.66	.23	.11	2.85	7.99
468	115.2	.63	.31	.06	2.01	5.27
495	99.0	.68	.26	.06	2.58	Flat
721	127.2	.67	.28	.05	2.39	Flat
722	153.2	.72	.23	.05	3.18	6.18
738	97.0	.71	.18	.11	3.84	Flat
757	119.1	.58	.31	.12	1.88	4.59
945	127.2	.62	.29	.09	2.14	Flat

Table B- 16. Presence of Ventral Ripples and Waves on Irregular Secondary Blades.

VENTRAL RIPPLES AND WAVES ON IRREGULAR SECONDARY BLADES		
Specimen No.	**Ripples**	**Waves**
257	SM	SM
258	SM	SM
373	SM	SM
385	N	N
413	N	N
468	SM	SM
495	N	SM
721	H	H
722	N	N
738	N	SM
757	N	SM
945	N	N

Key:

N = None SM = Slight to Moderate H = Heavy

Table B- 17. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Complete Secondary Corner/Side Removal Blades.

SECONDARY CORNER/SIDE REMOVAL BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
263	76.7	28.8	13.6	7	5
264	52.6	22.3	10.1	1	1
284	116.4	52.2	17.9	1	3
289	71.3	28.9	6.9	1	3
293	79.2	18.9	5.3	1	3
315	74.6	36.7	16.0	1	4
331	112.1	21.2	9.6	3	2
344	84.3	18.4	11.0	10	1
345	78.5	16.9	4.0	5	1
351	79.8	18.2	7.1	1	3
355	92.0	35.6	11.7	2	1
359	121.0	31.0	10.6	1	1
367	124.5	41.3	25.0	8	1
368	140.1	52.6	18.8	5	2
370	102.2	37.7	11.5	1	3
374	88.0	36.0	17.6	10	2
375	115.0	32.9	10.4	1	6
376	111.7	28.8	21.5	8	4
388	94.9	17.9	6.8	1	1
390	143.0	40.6	15.1	2	1
394	75.8	29.1	13.2	1	3
397	70.5	18.9	7.7	5	5
408	91.4	17.3	6.6	1	1
409	70.1	28.1	14.9	5	4
411	66.3	31.5	8.4	6	2
427	108.0	30.4	112.7	9	1
431	129.2	40.3	22.7	10	1
434	54.7	28.9	7.6	1	4
435	185.8	35.9	23.9	3	1
457	85.9	39.0	13.3	10	3
471	91.6	34.2	15.7	8	1
475	82.3	23.1	7.3	10	7
485	53.2	18.9	7.8	5	3
494	75.1	30.1	11.9	1	4
498	84.4	37.6	10.7	1	3

Table B- 17 continued

SECONDARY CORNER/SIDE REMOVAL BLADE MEASUREMENTS

Specimen No.	Length (mm)	Width (mm)	Thickness (mm)	Flake Scar Pattern	Termin. Type
499	102.8	46.4	17.5	1	2
500	76.5	18.8	10.0	5	6
512	108.4	44.6	25.7	10	2
672	69.9	30.8	11.6	1	3
687	97.3	31.1	23.9	6	3
692	46.8	30.7	11.8	10	2
694	140.9	42.5	17.6	1	3
697	89.4	31.8	15.2	1	3
708	56.3	19.5	7.0	2	3
713	63.0	25.7	12.4	2	1
718	96.1	26.4	7.6	7	4
723	68.4	23.6	9.0	1	1
724	109.9	29.5	11.2	2	5
725	97.0	24.6	13.2	1	1
745	101.6	32.5	18.3	1	3
948	103.4	45.9	20.2	2	2

Key:

Flake Scar Pattern:

1 = Unidirectional (Proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (distal end)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/distal)

Termination Type:

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B- 18. Platform Types, Measurements, Lip and Bulb Presence for Secondary Corner/Side Removal Blades.

SECONDARY CORNER/SIDE REMOVAL PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat.Thick. (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
263	1	7.9	2.2	81°	5	N.L.	Dif.
284	1	21.8	8.1	83°	5	N.L.	S.M.
315	2	20.6	6.5	67°	5	Lip	S.
331	2	10.4	4.4	80°	3	N.L.	S.
335	2	11.1	5.3	93°	5	N.L.	Dif.
339	1	6.8	2.2	83°	2	N.L.	S.M.
344	2	5.0	4.0	58°	2	Lip	Dif.
345	1	14.5	4.4	80°	5	N.L.	Dif.
351	3	10.5	6.5	76°	3	N.L.	Dif.
355	2	13.7	7.1	64°	3	Lip	S.
359	2	10.8	5.5	75°	2	-	Dif.
370	7	13.4	6.9	61°	2	Lip	S.M
375	2	12.0	4.7	77°	2	Lip	Dif.
376	1	9.1	3.1	-	2	-	-
397	1	5.1	2.6	85°	3	Lip	S.M.
409	1	18.0	7.2	72°	5	N.L.	Dif.
457	2	7.5	3.3	72°	3	Lip	S.
471	2	16.4	3.8	68°	3	N.L.	S.M.
475	2	7.1	5.6	71°	5	N.L.	S.
494	2	16.8	8.2	71°	5	N.L.	S.M.
498	1	22.6	9.5	71°	5	N.L.	S.
499	1	19.5	5.8	77°	5	N.L.	Dif.

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/Faceted
5 = Unknown

Lip Presence:
Lip = Present
N.L.= None Present

Bulb Type:
Dif. = Diffuse
S.M. = Slight to Moderate
S. = Strong

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Table B- 18 continued

SECONDARY CORNER/SIDE REMOVAL PLATFORM ATTRIBUTES

Specimen No.	Plat. Type	Plat. Width (mm)	Plat.Thick. (mm)	Plat. Angle	Plat. Prep.	Plat. Lip	Bulb Type
500	2	6.7	3.5	71°	5	N.L.	S.M.
502	2	3.5	1.6	-	3	Lip	Dif.
512	3	11.8	4.1	78°	3	N.L.	Dif.
672	2	9.1	2.7	64°	2	Lip	S.M.
687	1	9.8	4.3	75°	5	N.L.	Dif.
692	2	8.2	5.0	77°	5	N.L.	Dif.
694	2	9.4	6.6	56°	3	N.L.	Dif.
697	2	21.4	7.2	69°	5	N.L.	S.
708	1	9.9	3.6	74°	5	N.L.	Dif.
713	2	7.4	4.2	79°	2	Lip	Dif.
718	7	8.9	2.7	-	2	N.L.	Dif.
723	2	5.7	2.6	-	2	N.L.	Dif.
724	2	9.6	3.6	53°	3	Lip	Dif.
725	2	11.3	5.7	76°	5	N.L.	S.
745	2	20.2	6.9	80°	5	N.L.	S.

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/Faceted
5 = Unknown

Lip Presence:
Lip = Present
N.L.= None Present

Bulb Type:
Dif. = Diffuse
S.M. = Slight to Moderate
S. = Strong

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Table B- 19. Secondary Corner/Side Removal Blade Platform Width, Thickness, and Angle Ranges and Averages.

SECONDARY CORNER/SIDE REMOVAL BLADE PLATFORM WIDTH, THICKNESS AND ANGLES							
Blade Type	**Plat. Type**	**Width Range (mm)**	**Avg. Width (mm)**	**Thick. Range (mm)**	**Avg. Thick. (mm)**	**Plat. Angle Range**	**Avg. Plat. Angle**
Secondary Corner/ Side Removal	1	5.1 - 22.6	11.5	1.6 - 9.5	4.6	71° - 85°	76°
	2	3.5 - 21.4	13.1	2.6 - 7.2	5.0	53° - 83°	71°
	3	10.5-19.9	14.1	4.1 - 6.5	5.5	68° - 78°	73°
	4	-	-	-	-	-	-

Table B- 20. Secondary Corner/Side Removal Blade Length, Thickness, and Curvature Ratios.

SECONDARY CORNER/SIDE REMOVAL BLADE RATIOS

Specimen No.	L+W+T	L/L+W+T	W/L+W+T	T/L+W+T	W:L	INDEX CURV.
263	119.1	.64	.24	.11	2.66	5.68
264	85.0	.62	.26	.12	2.36	Flat
284	186.5	.62	.28	.10	2.23	-
289	107.1	.67	.27	.06	2.47	6.99
293	103.4	.77	.18	.05	4.19	2.10
315	127.3	.59	.29	.13	2.03	Flat
331	177.3	.63	.25	.12	2.55	9.64
344	113.7	.74	.16	.10	4.48	6.22
345	124.1	.63	.23	.14	4.38	4.00
351	105.1	.76	.17	.07	4.38	Flat & Twisted
352	116.5	.60	.29	.10	2.05	8.55
355	139.3	.66	.26	.08	2.58	Flat
359	162.6	.74	.19	.07	3.90	4.59
367	190.8	.65	.22	.13	3.01	16.47
368	211.5	.66	.25	.09	2.66	7.69
370	151.4	.68	.25	.05	2.71	5.16
374	141.6	.62	.25	.12	2.44	2.76
375	158.3	.73	.21	.07	3.50	Flat & Twisted
376	162.0	.69	.18	.13	3.88	Flat
388	119.6	.79	.15	.06	5.30	5.97
390	198.7	.72	.20	.08	3.52	Flat
394	118.1	.64	.25	.11	2.60	12.22
397	97.1	.73	.19	.08	3.73	4.98
408	115.3	.79	.15	.06	5.28	Flat
409	113.1	.62	.25	.13	2.50	Flat
411	106.2	.62	.30	.08	2.10	10.81
427	138.4	.78	.22	.09	3.55	3.50
431	192.2	.67	.21	.12	3.21	7.22
435	245.6	.76	.15	.10	5.18	5.75
457	138.2	.62	.28	.10	2.20	6.99
471	141.5	.65	.24	.11	2.68	6.33
475	112.7	.73	.20	.06	3.56	Flat
485	79.9	.67	.24	.10	2.81	3.91
494	117.1	.64	.26	.10	2.50	-
498	132.7	.64	.28	.08	2.24	-
499	166.7	.62	.28	.10	2.21	6.89
500	105.3	.73	.18	.09	4.07	9.34
512	178.7	.61	.25	.14	2.43	7.60

Table B-20 continued

SECONDARY CORNER/SIDE REMOVAL BLADE RATIOS

Specimen No.	L+W+T	L/L+W+T	W/L+W+T	T/L+W+T	W:L	INDEX CURV.
672	112.3	.62	.27	.10	2.27	6.88
687	152.3	.64	.20	.16	3.13	10.15
692	90.8	.52	.34	.15	1.52	11.76
694	201.0	.70	.21	.09	3.32	14.72
697	136.4	.66	.23	.11	2.81	6.47
708	82.8	.68	.24	.08	2.89	7.16
713	101.1	.62	.25	.12	2.45	7.57
718	130.1	.74	.20	.06	3.64	Flat & Twisted
723	101.0	.68	.23	.09	2.90	Flat & Twisted
724	150.6	.73	.20	.07	3.73	7.40
725	134.8	.72	.18	.10	3.94	-
745	152.4	.67	.21	.12	3.13	7.33
948	169.5	.61	.27	.12	2.25	-

Table B- 21. Presence of Ventral Ripples and Waves on Secondary Corner/Side Removal Blades.

VENTRAL RIPPLES AND WAVES ON SECONDARY CORNER/SIDE REMOVAL BLADES					
Specimen No.	**Ripples**	**Waves**	**Specimen No.**	**Ripples**	**Waves**
263	N	SM	**370**	N	SM
264	SM	SM	**374**	N	SM
265	SM	N	**375**	N	N
269	N	N	**376**	N	SM
284	N	H	**388**	SM	SM
286	N	N	**389**	N	SM
289	N	SM	**390**	SM	SM
293	SM	SM	**394**	N	N
313	N	SM	**397**	N	N
315	SM	SM	**408**	N	SM
317	SM	SM	**411**	N	SM
322	SM	SM	**415**	N	SM
329	N	SM	**427**	N	N
331	N	N	**429**	N	N
335	N	N	**430**	N	N
339	N	N	**431**	N	SM
340	N	SM	**433**	N	SM
344	SM	SM	**434**	N	H
345	N	SM	**435**	N	N
351	SM	N	**437**	N	SM
352	N	N	**441**	N	N
355	H	SM	**457**	N	N
358	N	SM	**471**	N	SM
359	N	H	**475**	SM	SM
367	N	N	**484**	N	N
368	N	SM	**485**	SM	N
490	N	SM	**694**	N	N
494	N	N	**697**	N	SM
498	N	SM	**708**	N	N
499	N	N	**713**	N	N
500	N	N	**718**	SM	N
502	SM	SM	**723**	N	N
512	N	SM	**724**	N	N
672	SM	N	**725**	SM	SM
687	SM	N	**745**	N	SM
692	N	N	**948**	N	N

Key:

N = None SM = Slight to Moderate H = Heavy

Table B- 22. Comparison of Secondary Blade Values Between Clovis Sites.

KEVEN DAVIS SECONDARY BLADE VALUES										
L (mm)	**W (mm)**	**T (mm)**	**PLW**	**PLT**	**L/ LWT**	**W/ LWT**	**T/ LWT**	**IC**	**W:L**	**PL. ANG**
119	32.0	11.0	7.3	2.1	.73	.20	.07	13.4	3.68	50°
105	25.0	13.0	5.0	2.2	.73	.18	.09	16.5	4.13	70°
GREEN CACHE (BLACKWATER DRAW "A") SECONDARY BLADE VALUES										
138	34.0	13.5	-	-	.74	.18	.07	-	4.05	45°
156	33.0	12.0	-	-	.78	.16	.06	-	4.73	44°
140	30.5	14.5	-	-	.76	.16	.08	-	4.59	38°
103	29.0	13.0	-	-	.72	.20	.08	-	3.55	50°
RICHEY ROBERTS SECONDARY DLADE VALUES										
124	47.0	15.0	-	-	.67	.25	.08	-	2.64	-
PAVO REAL SECONDARY BLADE VALUES										
-	31.0	14.0	-	-	-	-	-	5.7*	-	65°
85.0	23.0	15.0	15	7	.69	.19	.12	2.4	3.70	70°
-	42.0	11.0	11	4	-	-	-	9.3	-	80°
-	30.0	12.0	11	4	-	-	-	0.0	-	75°
134	41.0	15.0	21	2	.71	.22	.08	1.5	3.27	85°
153	37.0	20.0	21	7	.73	.18	.10	2.1	4.14	55°
-	28.0	11.0	-	-	-	-	-	-	7.5*	-
151	42.0	24.0	11	5	.70	.19	.11	8.0	3.6	65°
-	21.0	8.0	-	-	-	-	-	4.0*	-	-
-	21.0	8.0	10	3	-	-	-	8.6*	-	55°
99	29.0	19.0	19	10	.67	.20	.13	7.0	3.41	75°
-	18.0	10.0	-	-	-	-	-	1.4*	-	-

Note:

* = values calculated on incomplete specimens

Table B- 23. Comparisons of Average Secondary Blade Values Between Sites.

Length (mm)	Width (mm)	Thick. (mm)	Index Curv.	W:L	L/ LWT	W/ LWT	T/ LWT
AVERAGES FOR SECONDARY BLADE VALUES BY SITE							
GAULT SITE							
78.5 (Regular)	22.9	6.4	8.34	3.0	.70	.25	.08
89.2 (Irregular)	37.6	10.9	5.43	2.6	.60	.24	.07
91.9 (Corner/side Removal)	32.4	14.5	7.38	3.1	.67	.23	.14
ADAMS SITE							
85.3	33.7	13.7	-	2.53	.65	.26	.10
GREEN CACHE							
134.3	31.6	13.0	-	4.23	.75	.18	.07
KEVEN DAVIS CACHE							
112.0	28.5	12.0	15.0	3.90	.73	.19	.08
PAVO REAL							
124.4*	30.3	13.9	5.6*	3.62*	.70*	.20*	.11*
RICHEY ROBERTS SITE							
124.0	47.0	15.0	14.8	2.64	.67	.25	.08

Note: * = values calculated on complete blades only

Table B- 24. Ranges of Secondary Blade Lengths, Widths, Thicknesses, Index of Curvature, and Platform angle By Site.

SECONDARY BLADE ATTRIBUTE RANGES BY SITE				
Length Range (mm)	**Width Range (mm)**	**Thickness Range (mm)**	**Index of Curvature**	**Platform Angle Range**
		GAULT SITE		
41.5 - 163.9 (Regular)	17.7 - 55.6	4.6 - 30.7	0.0-15.15	59°-87°
67.3 - 111.6 (Irregular)	17.9 - 56.4	5.6 - 18.2	0.0-10.83	55°-89°
46.8 - 185.8 (Corner/Side Removal)	17.9 - 52.6	4.9 - 25.7	0.0-16.47	53°-93°
		ADAMS SITE		
74.0 - 107.0	30.0 - 40.0	11.0 - 18.0	_	-
		GREEN CACHE		
103 - 156.0	29.0 - 34.0	12.0 - 14.5	-	38°-50°
		KEVEN DAVIS CACHE		
105 - 19.0	2.0 - 32.0	11.0 - 13.0	13.4 - 16.5	50°-80°
		PAVO REAL		
85.0 - 134.0	8.0 - 42.0	10.0 - 21.0	2.1 - 7.0*	55°-85°
		RICHEY ROBERTS SITE		
124.0	47.0	15.0	14.8	-

Note: * = values calculated from complete blades only

Table B- 25. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Complete Regular Interior Blades.

REGULAR INTERIOR BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
252	65.9	19.0	7.7	10	2
274	65.3	22.9	6.9	1	3
255	106.4	19.7	10.0	2	7
276	100.2	46.5	22.1	2	4
291	54.8	13.5	2.9	2	4
298	101.4	48.2	18.9	2	2
319	78.0	20.1	6.3	1	7
341	74.7	26.8	15.5	1	3
371	104.1	32.1	8.2	10	5
379	75.5	25.7	6.6	1	3
380	56.6	15.3	3.8	1	3
391	81.7	23.0	4.9	1	1
392	119.3	20.3	9.9	2	4
393	98.1	25.6	13.7	3	3
399	49.8	13.4	6.1	3	7
418	85.5	23.9	9.8	10	1
443	87.9	20.1	7.9	1	1
447	74.3	24.0	5.2	10	3
449	73.0	19.1	6.2	10	7
455	83.9	10.7	7.1	1	3
477	98.3	20.6	9.2	2	1
481	87.2	23.8	9.5	1	4
506	51.6	15.3	3.6	1	3

Key:

Flake Scar Pattern

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/

Termination Type

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

TableB-25 continued

REGULAR INTERIOR BLADE MEASUREMENTS					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Flake Scar Pattern**	**Termin. Type**
509	68.8	12.7	7.0	10	4
681	51.7	33.2	7.8	1	4
683	54.7	21.1	5.1	1	3
685	90.6	28.0	5.8	2	3
689	66.5	24.1	5.0	1	3
693	97.5	27.8	14.3	10	5
695	111.9	27.5	12.1	1	3
714	61.6	25.8	4.7	1	4
716	84.5	19.0	10.0	3	3
737	65.0	19.0	5.9	1	3
741	55.5	16.0	5.2	1	4
746	82.1	22.1	10.5	10	3
453	81.7	21.1	10.6	1	5

Key:

Flake Scar Pattern

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/

Termination Type

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B- 26. Platform Types, Measurements, Lip and Bulb Presence for Regular Interior Blades.

REGULAR INTERIOR BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width**	**Plat. Thick**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
252	4	14.1	4.4	84°	2	Lip	Dif.
253	4	8.9	4.9	62°	3	Lip	Dif.
276	3	11.4	3.9	51°	3	Lip	SM
296	4	6.8	2.5	61°	2	Lip	Dif.
298	3	7.2	2.8	65°	3	Lip	Dif.
301	4	12.6	4.3	89°	2	-	-
371	2	5.6	2.9	52°	3	Lip	Dif.
377	3	13.9	5.2	67°	2	Lip	SM
382	2	4.7	1.9	56°	3	Lip	Dif.
383	2	7.2	1.8	81°	3	Lip	Dif.
391	7	5.9	3.0	83°	3	N.L.	Dif.
393	2	6.3	3.6	78°	3	N.L.	S
399	2	6.2	2.9	73°	3	Lip	SM
410	7	6.7	2.4	67°	2	N.L.	Dif.
418	3	8.1	3.5	65°	2	Lip	Dif.
436	2	6.2	3.6	55°	3	Lip	Dif.
447	2	7.2	1.9	64°	2	N.L.	SM
449	2	8.0	3.0	75°	3	Lip	SM
450	3	10.7	2.3	79°	2	N.L.	Dif.
469	4	9.3	3.6	46°	3	N.L.	SM
477	2	11.4	4.6	38°	2	-	-
487	4	4.2	1.6	-	4	Lip	Dif.
501	2	12.1	5.0	50°	3	Lip	Dif.
506	2	4.2	2.6	79°	5	N.L.	S

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/Faceted
5 = Unknown

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Unknown
4 = None
5 = Unknown

Lip Type:
Lip = Present
N.L. = None Present

Bulb Type:
Dif. = Diffuse
SM = Slight to Moderate
S = Strong

Table B-26 continued

REGULAR INTERIOR BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width**	**Plat. Thick**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
509	7	6.7	2.3	72°	3	Lip	Dif.
681	1	9.9	2.4	76°	2	N.L.	-
683	2	6.8	3.6	69°	3	N.L.	S
685	1	5.4	1.3	68°	3	N.L.	Dif.
689	2	5.9	2.4	81°	3	Lip	Dif.
693	2	5.7	1.8	83°	3	Lip	Dif.
695	3	10.1	2.8	78°	3	N.L.	Dif.
714	4	7.2	2.7	66°	3	-	-
716	3	6.2	2.1	73°	3	Lip	Dif.
734	3	5.9	2.5	66°	3	Lip	Dif.
741	2	2.4	1.7	-	3	N.L.	Dif.
746	4	10.9	3.5	74°	3	Lip	SM
965	3	15.1	3.2	86°	1	N.L.	S

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/Faceted
5 = Unknown

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Unknown
4 = None
5 = Unknown

Lip Type:
Lip = Present
N.L. = None Present

Bulb Type:
Dif. = Diffuse
SM = Slight to Moderate
S = Strong

Table B- 27. Regular Interior Blade Platform Width, Thickness, and Platform Angle Ranges and Averages.

REGULAR INTERIOR PLATFORM RATIOS AND AVERAGES

Blade Type	**Plat Type**	**Width Range (mm)**	**Avg. Width (mm)**	**Thick. Range (mm)**	**Avg. Thick (mm)**	**Plat. Angle Range**	**Avg. Plat. Angle**
Regular Interior	1	5.4 - 9.0	7.4	1.3 - 4.6	2.8	60° - 87°	68.0°
	2	2.4 - 15.6	8.6	1.7 - 7.4	3.9	46° - 89°	67.7°
	3	5.9 - 15.1	9.8	2.1 - 5.2	3.1	80°	70.0°
	4	4.2 - 14.1	8.4	1.6 - 4.9	3.4	55° - 89°	68.9°

Table B- 28. Regular Interior Blade Length, Width, Thickness, and Curvature Ratios.

REGULAR INTERIOR BLADE STATISTICS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX. CURV.**
252	92.6	.71	.21	.08	3.45	8.13
255	136.0	.78	.14	.07	5.40	10.67
256	136.3	.66	.21	.13	3.24	7.45
274	96.1	.68	.24	.09	2.85	Flat
276	168.8	.59	.28	.13	2.15	9.67
291	71.1	.77	.19	.04	4.06	3.17
298	169.0	.60	.29	.11	2.10	14.88
319	104.4	.75	.19	.06	3.88	6.90
341	116.9	.64	.23	.13	2.80	Flat
371	144.4	.72	.22	.06	3.24	6.73
379	107.7	.70	.24	.06	2.94	6.00
380	75.7	.75	.20	.05	3.69	Flat
391	109.6	.75	.21	.04	3.70	6.58
392	149.5	.80	.14	.07	5.88	6.74
393	137.4	.71	.19	.10	3.85	7.93
399	73.3	.68	.24	.08	2.86	Flat
418	118.7	.72	.20	.08	3.65	12.43
443	115.8	.76	.17	.07	4.37	3.81
447	103.5	.72	.23	.05	3.10	5.85
449	98.2	.74	.19	.06	3.82	Flat
455	101.7	.82	.11	.07	7.84	Flat
477	128.1	.77	.18	.07	4.77	Flat
481	120.5	.73	.20	.06	3.66	Flat
506	70.5	.73	.22	.05	3.37	Flat
509	88.5	.78	.14	.08	5.42	4.29
681	92.6	.56	.36	.08	1.56	Flat
683	81.6	.67	.27	.06	2.51	4.31
685	76.1	.72	.20	.08	3.58	9.47
689	95.7	.70	.25	.05	2.76	4.91
693	139.6	.70	.20	.10	3.51	7.10
695	151.4	.74	.18	.08	4.70	9.71
714	95.2	.65	.27	.05	2.39	Flat
716	113.5	.75	.17	.09	4.44	14.79
737	89.9	.72	.21	.07	3.48	6.19
741	76.4	.73	.21	.07	3.53	Flat
746	114.6	.72	.19	.09	3.71	7.70
453	113.3	.72	.19	.09	3.87	4.75

Table B- 29. Presence of Ventral Ripples and Waves on Regular Interior Blades.

VENTRAL RIPPLES AND WAVES ON REGULAR INTERIOR BLADES					
Spec. No.	**Ripples**	**Waves**	**Spec. No.**	**Ripples**	**Waves**
252	N	SM	**379**	N	SM
253	N	SM	**380**	N	N
255	SM	SM	**382**	SM	N
266	N	N	**383**	SM	N
270	N	N	**391**	SM	SM
271	N	N	**392**	SM	SM
276	N	N	**393**	SM	SM
277	N	N	**396**	N	SM
291	H	N	**398**	N	N
295	N	N	**399**	N	N
296	N	SM	**401**	N	N
298	N	N	**410**	SM	N
301	SM	SM	**412**	SM	SM
311	N	N	**416**	H	N
319	N	SM	**418**	N	N
320	SM	SM	**419**	N	SM
325	N	N	**420**	N	N
330	SM	N	**423**	N	N
341	SM	SM	**424**	N	SM
343	N	N	**426**	N	N
354	SM	N	**428**	N	N
361	N	SM	**436**	N	N
364	N	SM	**438**	N	N
371	N	N	**443**	H	SM
372	N	N	**447**	N	SM
377	H	SM	**449**	SM	SM
450	SM	N	**678**	N	N
453	N	N	**681**	N	N
455	N	N	**683**	H	N
466	SM	SM	**685**	N	N
469	N	N	**689**	N	N
470	N	N	**693**	SM	SM
477	SM	SM	**695**	N	N
478	N	N	**701**	SM	N
481	SM	SM	**702**	SM	N
487	H	N	**706**	N	N
501	N	N	**714**	H	N
503	N	M	**716**	N	N
504	N	N	**734**	SM	SM
506	N	N	**737**	N	N
509	N	N	**741**	H	SM
677	N	M	**746**	N	SM

Key:

N = None SM = Slight to Moderate H = Heavy

Table B- 30. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Irregular Interior Blades.

IRREGULAR INTERIOR BLADE MEASUREMENTS

Specimen No.	Length (mm)	Width (mm)	Thickness (mm)	Flake Scar Pattern	Termin. Type
267	76.6	39.3	11.2	2	1
387	78.0	29.6	6.9	3	3
400	40.0	24.2	5.0	1	3
402	48.4	25.0	8.3	10	3
405	70.5	25.0	10.0	10	3
451	65.2	27.9	11.6	1	4
454	65.8	19.0	4.4	10	1
503	56.7	24.5	6.4	1	2
679	68.0	27.2	5.9	10	1
682	63.0	25.3	10.0	3	3
712	86.3	31.2	7.6	10	3
720	46.4	21.6	7.5	7	7
733	50.0	23.1	7.0	4	4

Key:

Flake Scar Pattern:

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (lateral)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral–proximal distal)

Termination Type:

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/Retouched

Table B- 31. Platform Types, Measurements, Lip and Bulb Presence for Irregular Interior Blades.

IRREGULAR INTERIOR BLADE PLATFORM ATTRIBUTES							
Specimen No.	**Plat. Type**	**Plat. Width (mm)**	**Plat. Thick (mm)**	**Plat. Angle**	**Plat. Prep.**	**Plat. Lip**	**Bulb Type**
267	2	12.2	4.4	53°	3	Lip	Dif
387	2	11.2	2.7	71°	3	Lip	Dif
402	2	11.0	7.4	81°	1	Lip	S
405	2	8.2	2.6	71°	2	Lip	SM
679	2	12.9	3.3	63°	5	NL	S
682	2	11.7	3.3	79°	3	NL	S
712	2	6.4	2.0	73°	3	Lip	S
720	1	7.0	4.6	60°	5	Lip	SM
733	2	15.6	5.9	64°	2	NL	S

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral
5 = Unknown

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Lip Type:
Lip = Present
NL = None Present

Bulb Type:
Dif = Diffuse
SM = Medium Strong
S = Strong

Table B- 32. Irregular Blade Length, Width, Thickness, and Curvature Ratios.

IRREGULAR INTERIOR BLADE STATISTICS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX CURV.**
267	127.0	.60	.31	.09	1.95	6.78
387	114.5	.68	.26	.06	2.62	4.65
400	69.1	.58	.35	.07	1.65	Flat
402	81.8	.59	.31	.10	1.93	6.85
405	105.5	.67	.24	.09	2.82	Flat
451	104.7	.62	.27	.11	2.34	Flat
454	89.3	.74	.21	.05	3.46	Flat
503	87.7	.65	.28	.07	2.31	5.99
679	101.1	.67	.27	.06	2.50	10.11
682	98.2	.64	.26	.10	2.50	12.87
712	125.1	.69	.25	.06	2.77	3.62
720	75.6	.61	.29	.10	2.15	Flat
733	80.0	.63	.29	.09	2.17	Flat

Table B- 33. Presence of Ventral Ripples and Waves on Irregular Interior Blades.

VENTRAL RIPPLES AND WAVES ON IRREGULAR INTERIOR BLADES					
Spec. No.	**Ripples**	**Waves**	**Spec. No.**	**Ripples**	**Waves**
267	N	N	**454**	N	SM
365	N	SM	**503**	N	SM
366	N	N	**679**	SM	SM
387	N	N	**682**	SM	SM
400	N	N	**712**	N	SM
402	SM	N	**720**	N	N
405	N	SM	**733**	SM	SM
451	N	SM	**736**	N	SM

Key: N = None Present
SM = Minor
H = Heavy

Table B- 34. Interior Blade Attribute Between Sites.

L (mm)	W (mm)	T (mm)	PLW (mm)	PLT (mm)	L/ LWT	W/ LWT	T/ LWT	IC	W:L
BLADE VALUES BY SITE									
GAULT 1									
106.0	33.0	11	14.5	5.7	.71	.22	.07	9.8	3.21
KEVEN DAVIS									
139.0	28.0	16.0	8.3	2.7	.76	.15	.07	15.2	4.97
95.0	28.0	9.0	5.3	2.1	.72	.21	.07	13.6	3.38
94.0	24.0	9.0	5.4	2.1	.74	.19	.07	14.8	3.91
118.0	29.0	13.0	-	-	.74	.18	.08	16.2	4.07
GREEN CACHE									
140.0	30.0	19.0	-	-	-	-	-	-	-
99.0	30.0	10.0	-	-	-	-	-	-	-
101.0	33.0	11.0	-	-	-	-	-	-	-
ADAMS SITE* (Average Only)									
75.0	32.0	11.7	-	-	.65	.26	.08	-	2.48
RICHEY ROBERTS									
80.0	24.0	9.0	-	-	.71	.21	.08	13.8	3.33
68.0	24.0	6.0	-	-	.69	.24	.06	13.4	2.83
85.0	32.0	8.0	-	-	.68	.26	.06	14.6	2.66
120.0	32.0	18.0	-	-	.71	.19	.11	15.3	3.73
PAVO REAL									
60.0	20.0	4.0	10.0	3.0	.71	.24	.05	5.0	3.00
-	15.0	6.0	-	-	-	-	-	5.0	-
-	16.0	4.0	-	-	-	-	-	0.0	-
-	16.0	6.0	-	-	-	-	-	3.7	-
170.0	45.0	14.0	12.0	6.0	.74	.20	.06	2.5	3.78
-	22.0	6.0	-	-	-	-	-	4.6	-
-	29.0	9.0	-	-	-	-	-	7.7	-
78.0	21.0	5.0	8.0	3.0	.75	.20	.05	5.7	3.71
-	25.0	9.0	12.0	8.0	-	-	-	4.3	-
82.0	31.0	13.0	24.0	17	.65	.25	.10	5.0	2.65

Note: * = Calculations taken from Collins 1999:99)
Note: Measurements expressed in millimeters

BLADE VALUES BY SITE

L (mm)	W (mm)	T (mm)	PLW (mm)	PLT (mm)	L/ LWT	W/ LWT	T/ LWT	IC	W:L
-	26.0	8.0	-	-	-	-	-	8.0	-
-	22.0	7.0	-	-	-	-	-	10.0	-
-	19.0	8.0	-	-	-	-	-	6.7	-
-	31.0	13.0	-	-	-	-	-	6.0	-
87.0	30.0	10.0	10.0	3.0	.69	.24	.08	13.8	2.90
-	37.0	15.0	-	-	-	-	-	4.8	-
103.0	38.0	9.0	12.0	3.0	.69	.25	.06	4.0	2.71
104.0	32.0	20.0	6.0	4.0	.67	.21	.13	6.3	3.25
-	37.0	14.0	-	-	-	-	-	2.5	-
-	24.0	4.0	11.0	2.0	-	-	-	2.5	-
-	37.0	12.0	23.0	15	-	-	-	1.3	-
-	45.0	21.0	9.0	3.0	-	-	-	5.6	-
-	48.0	12.0	-	-	-	-	-	0.0	-
78.0	28.0	12.0	10.0	3.0	.66	.24	.10	10.7	2.79
-	33.0	14.0	22.0	10	-	-	-	0.0	-
-	30.0	6.0	8.0	4.0	-	-	-	0.0	-
126.0	25.0	11.0	12.0	4.0	.78	.15	.07	1.7	5.04
-	14.0	5.0	-	-	-	-	-	4.8	-
-	19.0	5.0	-	-	-	-	-	5.7	-
57.0	19.0	8.0	6.0	3.0	.68	.23	.10	2.5	3.00
-	20.0	3.0	-	-	-	-	-	2.0	-
-	20.0	7.0	7.0	4.0	-	-	-	6.0	-
-	21.0	6.0	-	-	-	-	-	6.0	-
55.0	37.0	10.0	25.0	9.0	.54	.36	.10	6.0	1.49
-	20.0	9.0	-	-	-	-	-	6.0	-
-	28.0	13.0	-	-	-	-	-	6.0	-

Note: * = Calculations taken from Collins 1999:99)

Note: Measurements expressed in millimeters

Table B- 35. Comparison of Average Interior Blade Values Between Sites.

AVERAGES FOR INTERIOR BLADE VALUES BY SITE								
Length (mm)	**Width (mm)**	**Thick (mm)**	**IC**	**W:L**	**L/LWT**	**L/LWT**	**T/LWT**	**PLAT. ANGLE**
GAULT SITE								
62.7 Reg.	22.0	8.7	7.61	3.71	.71	.21	.08	69E
62.7 Irreg.	24.5	7.8	7.48	2.56	.60	.28	.08	68E
GAULT 1								
79.2	23.3	8.3	7.54	3.21	.71	.22	.07	68E
ADAMS SITE								
75.0	32.0	11.7	-	3.13	.63	.27	.10	-
GREEN CACHE								
113.3	31.8	12.8	11.8	3.65	.72	.20	.08	60E
KEVEN DAVIS								
111.5	27.3	11.8	15.0	4.08	.74	.18	.07	70E
RICHEY ROBERTS SITE								
88.3	28.0	10.3	14.3	3.14	.70	.23	.08	-
PAVO REAL								
90.9	24.3	9.4	5.7	3.12	.69	.23	.08	73E

Table B- 36. Ranges of Interior Blade Length, Width, Thickness, Index of Curvature, and Platform Angles by Site.

INTERIOR BLADE ATTRIBUTE RANGES BY SITE				
Length (mm)	**Width (mm)**	**Thickness (mm)**	**Index of Curvature**	**Platform Angle**
		GAULT		
49.8-111.9	11.5-48.2	2.9-18.9	0.0-14.88	38°-89°
Regular				
40.0-78.0	19.0-39.0	5.0-11.6	0.0-12.87	53°-73°
Irregular				
		GAULT 1		
106.0	33.0	11.0	9.8	60°
		ADAMS SITE		
68.0-87.0	31.0-33.0	10.0-15.0	-	-
		GREEN CACHE		
99.0-140.0	30.0-34.0	10.0-19.0	9.0-13.8	65°
		KEVEN DAVIS CACHE		
94.0-139.0	24.0-29.0	5.3-8.3	13.6-16.2	60°-80°
		RICHEY ROBERTS SITE		
68.0-120.0	24.0-32.0	6.0-18.0	-	-
		PAVO REAL		
56.0-170.0	14.0-48.0	3.0-21.0	1.7-13.8	55°-85°

Table B- 37. Counts and Extent of Edge Flaking Noted on Crested Blades.

COUNTS AND EXTENT OF EDGE FLAKING ON CRESTED BLADES				
Partial (1/2)	**One Side (1)**	**One Side and Partial Other (1-1/2)**	**Two Sides (2)**	**Total**
4	23	2	17	46

Table B- 38. Crested Blade Edge Angles.

CRESTED BLADE EDGE ANGLES (DEGREES)					
Specimen No.	**Angle 1 (Left)**	**Angle 2 (Right)**	**Specimen No.**	**Angle 1**	**Angle 2**
49	81	44	**674**	68	44
250	62	26	**675**	111	30
285	51	47	**676**	71	29
316	56	41	**680**	77	37
327	72	63	**688**	94	35
332	51	44	**703**	77	30
337	72	30	**709**	56	40
346	64	56	**727**	55	45
350	76	36	**728**	64	36
357	69	32	**729**	46	39
362	79	29	**730**	81	37
404	63	57	**743**	56	32
417	74	34	**744**	65	49
425	61	57	**747**	68	21
432	56	28	**752**	53	48
440	57	40	**753**	49	40
446	71	27	**754**	64	26
460	51	33	**755**	60	57
472	58	53	**756**	52	52
482	64	38	**758**	41	30
492	42	27	**759**	50	31
493	55	31	**762**	56	55
507	33	32	**764**	65	59

Table B- 39. Length, Width, Thickness Measurements, Dorsal Flake Scar Patterns, and Termination Types for Crested Blades.

CRESTED BLADE MEASUREMENTS

Specimen No.	Length (mm)	Width (mm)	Thickness (mm)	Flake Scar Pattern	Termin. Type
49	54.4	13.4	10.6	3	1
250	100.5	30.7	13.0	3	1
285	85.3	22.5	11.9	3	4
327	-	33.0	28.8	7	-
337	68.3	26.9	12.7	1	3
357	99.3	27.6	11.5	10	1
362	-	31.9	16.1	3	-
404	-	33.4	20.7	10	1
440	-	36.4	17.4	7	1
446	124.8	30.0	21.1	10	1
460	128.8	48.7	18.2	7	3
482	129.6	28.6	16.8	3	3
492	101.5	30.7	13.4	10	4
674	165.6	28.0	17.2	3	1
675	99.1	30.5	14.4	1	1
676	91.2	27.3	13.4	3	3
680	113.1	40.9	19.9	10	1
688	124.0	38.3	17.9	3	1
703	134.3	43.8	27.0	10	2
728	96.6	27.3	22.7	3	4
729	107.8	26.2	13.2	10	3
743	66.6	20.5	11.9	7	1
744	-	23.4	12.5	3	1
747	111.0	38.0	18.8	10	3
752	43.3	22.7	10.9	3	3
753	46.6	19.6	11.4	10	2
755	61.9	19.1	12.9	10	1

Key:

Flake Scar pattern:

1 = Unidirectional (proximal end)
2 = Bi-directional (proximal-distal)
3 = Radial/Subradial
4 = Irregular
5 = Unidirectional (distal end)
6 = Unidirectional (Lateral)
7 = Bi-directional (lateral)
8 = None
9 = Undetermined
10 = Bi-directional (lateral-proximal/ distal)

Termination Type:

1 = Straight (blunt)
2 = Overshot (plunging)
3 = Feathered
4 = Hinged
5 = Broken
6 = Undetermined
7 = Reworked/retouched

Table B- 40. Platform Types, Measurements, Lip and Bulb Presence for Crested Blades.

CRESTED BLADE PLATFORM ATTRIBUTES

Specimen No.	Plat. Type	Plat. Width	Plat. Thick	Plat. Angle	Plat. Prep.	Plat. Lip	Bulb Type
49	3	4.1	5.4	74°	3	NL	Dif
250	3	10.1	3.6	85°	2	NL	S
285	1	15.6	6.8	89°	5	NL	Dif
327	1	11.1	6.6	69°	5	-	-
337	7	6.2	2.6	-	3	Lip	Dif
357	2	9.2	6.0	75°	5	NL	S
417	2	5.9	2.5	72°	5	NL	SM
460	2	27.5	12.1	73°	4	NL	SM
482	2	4.0	3.0	79°	2	NL	S
674	2	7.8	2.4	84°	2	NL	SM
675	2	11.8	8.2	70°	5	NL	SM
676	2	7.5	4.7	79°	2	NL	S
688	3	8.3	3.3	48°	3	Lip	Dif
703	2	13.0	5.6	66°	2	NL	S
728	4	10.5	5.4	79°	3	NL	S
729	2	5.6	2.6	71°	3	Lip	SM
743	1	7.9	4.1	73°	5	Lip	SM
747	2	9.1	3.7	61°	3	Lip	SM
752	1	7.4	4.5	69°	5	-	-
753	2	5.3	3.3	77°	5	NL	Dif
755	1	11.4	5.5	75°	7	Lip	SM
762	1	5.9	3.8	54°	3	Lip	Dif

Key:

Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral
5 = Unknown

Bulb Type
Dif = Diffuse
SM = Slight to Strong
S = Strong

Platform Preparation:
1 = Isolated
2 = Ground/Abraded
3 = Both 1 & 2
4 = Unknown
5 = None

Lip Type:
Lip = Present
N.L. = None Present

Table B- 41. Crested Blade Platform Width, Thickness, and Angle Ranges and Averages.

CRESTED BLADE PLATFORM WIDTH, THICKNESS, AND ANGLES						
Plat Type	**Width Range (mm)**	**Avg. Width**	**Thick. Range (mm)**	**Avg. Thick (mm)**	**Plat. Angle Range**	**Avg. Plat. Angle**
1	59.0 - 15.6	9.7	3.8 - 6.8	5.2	54° - 89°	72°
2	5.3 - 27.5	9.7	2.5 - 12.1	4.09	61° - 84°	73°
3	4.1 - 10.1	7.5	3.3 - 5.4	5.0	48° - 85°	69°
4	10.5	10.5	5.4	5.4	79°	79°

Table B- 42. Crested Blades Length, Width, Thickness, and Curvature Ratios.

CRESTED BLADE STATISTICS						
Specimen No.	**L+W+T**	**L/L+W+T**	**W/L+W+T**	**T/L+W+T**	**W:L**	**INDEX CURV.**
49	78.4	.69	.17	.14	4.06	Flat
250	144.2	.70	.21	.09	3.27	9.74
285	119.7	.71	.19	.10	3.79	6.88
337	107.9	.63	.25	.12	2.54	-
357	138.4	.72	.20	.08	3.60	4.26
446	175.9	.71	.17	.12	4.16	Twisted
460	195.7	.66	.25	.09	2.64	3.46
482	175.0	.74	.16	.10	4.53	10.41
492	145.6	.70	.21	.09	3.31	5.43
674	210.8	.79	.13	.06	5.91	6.96
675	144.0	.69	.21	.10	3.25	8.23
676	131.9	.69	.21	.10	3.34	4.57
680	173.9	.65	.24	.11	2.77	6.50
698	180.2	.69	.21	.10	3.24	13.44
703	205.1	.65	.21	.13	3.07	Twisted
728	146.6	.66	.19	.15	3.53	Flat & Twisted
729	147.2	.73	.18	.09	4.11	7.97
743	99.0	.67	.21	.12	3.25	Flat & Twisted
747	167.8	.66	.23	.11	2.92	5.11
752	76.9	.56	.30	.14	1.91	9.79
753	77.6	.60	.25	.15	2.38	10.0
755	93.9	.66	.20	.14	3.24	Flat

Table B- 43. Presence of Ventral Ripples and Waves on Crested Blades.

VENTRAL RIPPLES AND WAVES ON CRESTED BLADES					
Spec. No.	**Ripples**	**Waves**	**Spec. No.**	**Ripples**	**Waves**
49	-	-	**674**	N	SM
250	SM	SM	**675**	N	N
285	N	N	**676**	N	SM
316	N	SM	**680**	N	SM
327	N	SM	**688**	N	N
332	N	SM	**703**	N	N
337	SM	SM	**709**	N	N
346	N	N	**727**	N	N
350	N	N	**728**	N	N
357	N	SM	**729**	N	N
362	N	N	**730**	N	N
404	N	SM	**743**	N	N
417	N	N	**744**	N	N
425	SM	SM	**747**	N	N
432	N	N	**752**	N	SM
440	N	N	**753**	N	N
446	N	N	**754**	SM	N
460	N	N	**755**	N	SM
472	N	N	**756**	N	N
482	SM	SM	**758**	H	SM
492	SM	N	**759**	SM	SM
493	N	N	**762**	-	-
507	N	N	**764**	-	-

Key:

N = None
SM = Slight to Moderate
H = Heavy

Table B- 44. Crested Blade Attributes Between Sites.

CRESTED BLADE VALUES BY SITE									
L (mm)	**W (mm)**	**T (mm)**	**PLW (mm)**	**PLT (mm)**	**L/ LWT**	**W/ LWT**	**T/ LWT**	**IC**	**W;L**
				KEVEN DAVIS CACHE					
88.0	20.0	10.0	6.9	4.6	.74	.17	.09	14.1	4.34
80.0	26.0	12.0	9.4	4.2	.68	.22	.10	10.0	3.15
75.0	13.0	7.0	4.2	2.0	.78	.14	.08	12.0	5.57
				GREEN CACHE					
-	29.0	19.0	-	-	-	-	-	12.5	-
-	22.0	14.0	-	-	-	-	-	-	-
				PAVO REAL					
-	39.0	24.0	11.0	4.0	-	-	-	7.3	-
-	22.0	7.0	18.0	4.0	-	-	-	9.5	-
				RN107					
100	30.0	14.0	9.5	5.5	.69	.21	.10	8.5	3.33
				ANADARKO					
105	48.0	7.0	-	-	.66	.30	.04	2.5	2.19
100	50.0	9.0	-	-	.63	.31	.06	2.5	2.00

Note: * = calculations taken from Collins (1999)

Table B- 45. Comparison of Average Crested Blade Values Between Sites.

AVERAGES FOR CRESTED BLADE VALUES BY SITE

Length (mm)	Width (mm)	Thick (mm)	IC	W:L	L/LWT	W/LWT	T/LWT	PLAT. ANGLE
				GAULT				
97.9	29.6	16.2	8.0	3.40	.68	.21	.11	72.5°
				KEVEN DAVIS CACHE				
81.0	19.7	11.1	12.0	4.35	.73	.18	.09	66.7°
				GREEN CACHE				
-	29.0	16.5	12.5	-	-	-	-	-
				PAVO REAL				
-	30.5	15.5	8.5	-	-	-	-	70.0°
				RN107				
100.0	30.0	14.0	8.5	3.33	.69	.21	.10	60.0°
				ANADARKO				
102.5	49.0	8.0	2.5	2.95	.65	.31	.05	80.0°

Note: * = Calculation taken from Collins (1999)

Table B- 46. Ranges of Crested Blade Length, Width, Thickness, Index of Curvature, and Platform Angles by Site

CRESTED BLADE ATTRIBUTE RANGES BY SITE				
Length (mm)	**Width (mm)**	**Thickness (mm)**	**Index of Curvature**	**Platform Angle**
GAULT				
43.3-134.3	13.4-40.9	10.6-27.0	3.5-13.4	54°-89°
KEVEN DAVIS CACHE				
75.0-88.0	13.0-26.0	7.0-12.0	10.0-14.1	50°-70°
GREEN CACHE				
-	29.0	14.0-19.0	12.5	-
PAVO REAL				
-	22.0-39.0	7.0-24.0	7.3-9.5	70°
RN107				
100.0	30.0	14.0	8.5	60°
ANADARKO				
100.0-105.0	48.0-50.0	7.0-9.0	2.5	80°

Note: * = Calculation taken from Collins (1999)

Table B- 47. Dimensions of Conical Cores.

DIMENSIONS OF CONICAL CORES

Specimen No.	Length	Width	Thickness	Scar Pattern	No. Scars
793	122.1	59.7	56.2	5	5
804	130.5	78.4	79.6	2	5
823	86.7	72.3	76.0	2	3

Key:

Scar Pattern:

1 = Unidirectional
2 = Bi-directional
3 = Radial
4 = Other
5 = Multidirectional
6 = Undetermined

Table B-48. Size Dimensions, number of Blade Scars, and Measurable Blade Scar Angles for Unidirectional Wedge-Shaped Cores.

DIMENSIONS OF UNIDIRECTIONAL WEDGE-SHAPED CORES					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thick (mm)**	**No. Scars**	**Measurable Scar Angles**
794	101.3	70.3	50.0	3	83°, 84°, 86°
803	82.2	62.2	54.6	3	78°, 68°,84°
805	92.3	76.9	43.7	3	-
809	83.2	47.4	30.4	3	74°, 70°, 66°
811	124.1	107.3	52.0	2	-
813	116.4	60.1	61.1	2	81°, 64°
814	99.9	64.6	50.0	2	64°, 71°
819	55.5	90.4	56.9	3	72°
824	90.9	84.6	45.7	4	65°, 63°, 73°, 88°
825	89.4	44.1	38.7	3	63°, 66°, 81°
828	71.0	55.6	40.8	2	85°, 86°
829	95.6	59.7	49.5	2	87°, 66°
832	89.5	48.8	38.3	5	83°, 81°, 81°

Table B- 49. Size Dimensions, Number of Blade Scars, and Measurable Blade Scar Angles for Bi-directional Wedge-Shaped Cores.

DIMENSIONS OF BI-DIRECTIONAL WEDGE-SHAPED CORES					
Specimen No.	**Length (mm)**	**Width (mm)**	**Thick (mm)**	**No. Scars**	**Measurable Scar Angles**
800	77.8	49.6	53.2	4	65°, 69°, 88°, 79°
802	91.3	71.4	50.6	7	81°, 88°, 89°
806	92.8	106.6	78.8	1	83°
808	109.6	55.1	41.5	6	63°, 69°, 75°
812	115.5	99.2	55.8	7	84°, 87°, 89°
815	71.0	51.2	32.6	7	70°, 81°, 72°
816	75.1	47.3	36.3	6	84°, 78°, 74°, 84°
817	99.1	65.9	44.3	5	79°, 84°, 68°, 55°
821	82.8	113.3	46.6	4	64°, 86°
827	118.2	62.9	47.0	3	83°
833	79.4	70.8	40.5	5	71°, 70°, 74°
834	73.1	42.3	31.7	4	63°

Table B- 50. Size Dimensions, Number of Blade Scars, and Measurable Blade Scar Angles for Multi-directional Blade Scars.

DIMENSIONS OF MULTI-DIRECTIONAL CORES

Specimen No.	Length (mm)	Width (mm)	Thick (mm)	No. Scars	Measurable Scar Angles
790	80.9	66.8	36.8	9	80°, 84°
792	106.8	69.2	50.3	7	89°, 69°, 81° 67°, 73°
801	90.7	87.3	33.9	9	78°, 81°, 70° 67°, 81°, 81°
807	151.5	75.6	56.4	5	69°, 83°
818	58.7	50.0	32.5	5	90°, 79 °, 76°
826	66.9	63.1	39.1	6	87°, 92°

Table B- 51. Winged Flake Platform Type, Flake Direction, and Termination Type for each Flake Type.

WINGED FLAKE CHARACTERISTICS		
PLATFORM TYPE	**SECONDARY FLAKE**	**INTERIOR FLAKE**
Natural	4	1
Plain	11	16
Dihedral	-	9
Polyhedral	2	4
Unknown	-	-
Reworked	4	3
Crushed	1	8
TOTAL	22	41
	FLAKE DIRECTION	
None	0	0
Unidirctional	18	22
Bidirectional	4	7
Radial	-	12
TOTAL	22	41
	FLAKE TERMINATION	
Feathered	8	26
Stacked	3	1
Hinged	5	8
Overshot	0	1
Unknown	6	5
TOTAL	22	41

Table B- 52. Totals of Winged Flake Platform Types and Angles.

AVERAGE WINGED FLAKE PLATFORM ANGLES				
PLATFROM TYPE	**SECONDARY FLAKE**		**INTERIOR FLAKE**	
	TOTAL	**ANGLE**	**TOTAL**	**ANGLE**
Natural	4	78°	1	-
Plain	11	73°	16	74.5°
Dihedral	-	-	9	61.1°
Polyhedral	2	84°	4	66°
Unknown	-	-	-	-
Reworked	4	-	3	88°
Crushed	1	-	8	-
FLAKE TYPE AVERAGE		78.3°		72.4°
FLAKE TOTAL	22		41	

Table B- 53. Winged flake platform measurements and averages for each platform type.

WINGED FLAKE PLATFORM MEASUREMENTS				
PLATFORM TYPE	**WIDTH RANGE (mm)**	**AVERAGE WIDTH (mm)**	**THICKNESS RANGE (mm)**	**AVERAGE THICKNESS (mm)**
SECONDARY FLAKES				
Natural	11.0 - 21.2	15.0	2.5 - 6.1	4.0
Plain	10.5 - 29.5	19.1	1.9 - 10.6	4.4
Dihedral	-	-	-	-
Polyhedral	11.4 - 23.5	17.5	1.6 - 4.6	3.1
Unknown	-	-	-	-
Reworked	6.8 - 18.8	12.8	4.7 - 5.7	5.2
Crushed	-	-	-	-
INTERIOR FLAKES				
Natural	9.2	9.2	2.1	2.1
Plain	7.0 - 34.1	16.8	1.8 - 5.4	3.0
Dihedral	11.4 - 36.7	18.7	2.5 - 10.9	4.4
Polyhedral	18.7 - 26.4	23.8	2.7 - 7.5	4.6
Unknown	-	-	-	-
Reworked	7.2 - 18.5	11.4	1.1 - 4.0	2.6
Crushed	-	-	-	-

Table B- 54. Comparison of Platform Preparation and Counts Between Blade Types.

PLATFORM PREPARATION BY BLADE TYPE

Blade Type	Plat. Type	Isolate (1)	Ground/ Abraded (2)	Both 1 & 2	Unknown	None
Primary	Natural	-	1	-	-	10
	Plain	-	2	-	-	2
	Dihedral	-	-	-	-	-
	Polyhed.	-	-	-	-	-
Second.	Natural	-	3	-	-	5
	Plain	-	7	7	-	5
	Dihedral	-	1	1	-	-
	Polyhed.	-	2	-	-	-
Inter.	Natural	-	1	1	-	1
	Plain	1	5	16	-	2
	Dihedral	1	3	5	-	-
	Polyhed.	-	2	4	1	-
Second. Corner Removal	Natural	-	2	1	-	9
	Plain	-	6	6	-	9
	Dihedral	-	-	3	-	-
	Polyhed.	-	-	-	-	-
Crested	Natural	-	-	1	-	-
	Plain	-	4	2	-	2
	Dihedral	-	1	2	-	5
	Polyhed.	-	-	1	-	-

Table B- 55. Platform Lipping and Bulb Type Comparisons

PLATFORM LIPPING AND BULB TYPE COMPARISONS

Blade Type	Plat. Type	N.L. D.	N.L. M.S.	N.L. S.	L. D.	L. M.S.	L. S.
Primary	1	4	3	1	1	-	-
	2	1	-	-	2	-	-
	3	-	-	-	-	-	-
	4	-	-	-	-	-	-
Secondary	1	3	-	1	-	-	-
	2	1	3	2	3	3	1
	3	-	-	-	1	-	-
	4	-	-	-	1	-	-
Interior	1	2	-	-	-	1	1
	2	1	1	6	9	4	2
	3	1	-	1	4	2	-
	4	-	-	1	4	1	-
Secondary Corner Removal	1	6	2	1	-	1	-
	2	5	3	5	9	4	2
	3	2	1	-	4	2	-
	4	-	-	-	4	1	-
Crested	1	1	-	-	1	2	-
	2	1	4	4	-	2	-
	3	-	-	1	1	-	-
	4	-	-	1	-	-	-

Key: Platform Type: Platform Lipping:
1 = Natural N.L. = No Lip M.S. = Medium Strong
2 = Plain L. = Lip present Bulb
3 = Dihedral S. = Strong Bulb
4 = Polyhedral

Table B- 56. Platform and Blade Type Comparisons.

PLATFORM TYPE BY BLADE TYPE

Blade Type	Total Blades	1	2	3	4	5	6	7
Primary	24	12	4	-	-	7	-	1
Secondary	60	8	19	2	2	20	1	8
Interior	101	3	24	9	8	46	2	9
Secondary Corner Removal	73	12	22	3	-	28	1	7
Crested	46	6	11	3	1	22	-	3
Total	304	41	80	17	11	123	4	28

Key:
Platform Type:
1 = Natural
2 = Plain
3 = Dihedral
4 = Polyhedral/faceted
5 = Unknown
6 = Reworked/retouched
7 = Crushed

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