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APPENDIX C

TABLE OF CONTENTS

WYOMING
ARCHAEOLOGICAL SOCIETY, INC.

May , 1980

Fellow Members:

The amateur archaeologist is not a vanishing breed which was evidenced by the good, healthy debates at the 1980 Annual Spring Meeting in Sheridan. It was a good meeting primarily because those in attendance openly and freely discussed the various problems encountered by each chapter. Though some of the subjects appeared to be repeats of former years, tensions did disappear, and I felt that communication and understanding had returned to the Society.

First, may I thank all of you for expressing your support in my re-election as President, and the re-election of Larry Osborne as First Vice President, and Gerald Carbone as Second Vice President. Milford Hansen has accepted the post as Treasurer, George Brox will be our Editor, and Lori will remain as Secretary. My sincere appreciation to them for their unselfish contributions. Also, many, many sincere thanks to the Sheridan Chapter for hosting the 1980 meeting — they did a fine job; and, fortunately, they have volunteered to host the 1981 Annual Spring Meeting.

There were many topics discussed, but I shall briefly outline only a few as the minutes should be ready for publication in the next issue. First, the Treasurer's Report indicated that the Society is in a better financial position that the previous year primarily because of the reduced costs in postage for the Archaeologist. George Brox again encouraged submission of articles by the members, which was reinforced by Dr. Frison and all of the professionals who attended the meeting.

Dave Darlington was selected again as the recipient of the Mulloy Scholarship and was presented with $350.00 at the banquet. The annual membership dues will remain at $5.00 for single membership, and $7.50 for family membership, while the Institutional Dues were raised to $15.00 from $7.50.

What I consider to be a progressive change, was made. The Annual Business Meeting will be held on Friday night, and special programs will be scheduled for all day Saturday. A committee will be established to develop these programs for the 1981 meeting, and we hope that as many as possible will attend.

A lengthy discussion was held on a possible Certification Program. Tom Larson, of the Recreation Commission, gave an extensive report as to what neighboring states were doing with certification. It won't be an easy task, but it might well be a rewarding one. Tom accepted Chairmanship of the Committee, and the other members are: Dr. Frison and his state crew, Imogene Hanson, Dogue Olinger, Lou Steegie, Harry Palmer, Harry Baker, Henry and Clara Jensen. They will present a full report next year.

The Summer Meeting will be held at the Garret Allen Site on the 19th and 20th of July, this year. George Brox will have further details in this issue.

The student papers were excellent; and, on behalf of the Society, thanks to: Dave Eckles, "A Spanish Gunlock Found Near Shoshoni, Wyoming," Bill Fawcett, "An Early Union Pacific Railroad Station in the Red Desert," and Dave Darlington, "The Analysis of the Use Wear Patterns on Artifacts from 48FR440, the Bison Basin Site in Fremont County, Wyoming." And, of course, sincere thanks to Dr. Frison for his most interesting report on the Agate Basin Site.

Thanks to the Sheridan Chapter, the banquet was also excellent. And, Gerald Carbone was truly surprised when it was announced that he was the recipient of the Golden Trowel Award.

As Guest Speaker, Dr. Frison presented a truly outstanding program, "Early Man in the New World as Seen from Early Evidence in Alaska and Siberia." How fortunate we are, as a Society, to have Dr. Frison, and how fortunate for Wyoming to have him as the State Archaeologist. So much of the discussion this year was with regard to what we as members could gain from the Society, but none was given to what Dr. Frison has unselfishly contributed over the years, both to the Society and to Wyoming. In my opinion, Dr. Frison is one of Wyoming's most valuable resources, and what a shame that we in Wyoming rarely accord him the respect and recognition that is given him by our sister states and institutions throughout the world. I can't help but wonder if a few letters to the Governor and the University might help rectify this oversight.

All in all, it was a good meeting. Thanks to all of you who attended, and again, thanks for your support.

Sincerely,

C. Grover Phelan

Grover Phelan,
President

THE EDITOR'S NOTE - - -

Since the State Meeting of the Wyoming Archaeological Society in Sheridan, one paper has been submitted by an amateur. This is very gratifying and I hope all of you will recall Dr. Frison's concern of the importance of your contributions in writing about whatever you may have found or experienced or observed that pertains to Archaeology.

All of these papers will be published as space and time permit, so do not hesitate to keep those letters coming.

The Summer Meeting will be held July 19th and 20th at the Elk Mountain Site. Cherokee Trail Chapter is sending information to all chapters, giving mileage, directions, and information. We hope to see many of you at this rendezvous.

THE EDITOR.

# #

ARCHAE ANNIE - - -

Judy Myers of Pinedale has been corresponding with Wyoming Senators and Congressman concerning the Archaeological Resources Protection Act.

The results of this correspondence are published with full permission of the respective writers and Judy Myers.

We thank our elected representatives for their interpretation of this Act, and for their courtesy in responding to questions pertinent to all of us.

ARCHAE ANNIE.

# #

CONGRESS OF THE UNITED STATES
House of Representatives
Washington, D.C. 20515
DICK CHENEY - WYOMING

February 11, 1980

Dear Ms. Myers:

Thank you for writing about the Archaeological Resources Protection Act. Congress completed action on this legislation some time ago, and it has been signed into law. However, we were able to make a number of significant changes in the original version, and I believe the final bill resolves most of the problems you cited in your letter.

Senate is workable.

I appreciate your taking the time to write. Do keep in touch.

With best regards,

Sincerely,
/s/ Alan K. Simpson

United States Senator

* *

UNITED STATES SENATE
Washington, D.C. 20510

February 13, 1980

Dear Judi:

Thank you for contacting my office about the Archaeological Resources Protection Act of 1979, which is now PL 96-95.

The basic statute protecting significant archaeological finds on public lands had been the Antiquities Act of 1906, but a 1974 court decision found that law was unconstitutionally vague and legally unenforceable. That decision, coupled with a dramatic rise in illegal excavations on public and Indian lands, led to the need for changes in the law. H.R. 1825 and S. 490 were introduced in the House of Representatives and the Senate respectively, in order to give federal land managers the authority to protect archaeological sites on those lands.

Many people who responsibly collect surface artifacts on public lands were very concerned over the original provisions of these bills. However, the final legislation establishes a system of civil penalties to stop criminal activity while protecting the rights of hobbyists. Anyone lawfully possessing an archaeological resource before passage of this Act may retain it. Nothing in this Act applies to collecting rocks, coins, or bullets for private purposes unless found within an archaeological site. The collection of surface arrowheads is not a civil or criminal violation under this Act, although arrowhead removal may be currently prohibited on certain federal lands, such as national parks. If it was legal to use metal detectors on public lands prior to this Act, this Act does not diminish that use. If it was illegal to use metal detectors in certain areas, such as national parks, this Act does not allow such use.

I believe the final legislation represents a substantial improvement over earlier versions. This law should help stop archaeological depredation on public lands while encouraging public education about archaeological resources and safeguarding legitimate public lands use. I hope this information is useful, and the changes in the original version of the bill meet with your approval.

Sincerely,
/s/ Malcolm Wallop
United States Senator

* *

The law will not be applied retroactively to artifacts already possessed by people on the date of enactment. The fines and penalties were reduced. We tried during House Interior Committee consideration of the bill to delete the "bounty" clause, but were unsuccessful. Congress did, however, reduce the amount of the reward that could be offered to a maximum of $500. We also exempted from the act a number of artifacts of the kind most commonly sought on the public lands, and we said that in order for an item to be an "archaeological resource," it must be at least 100 years old.

The final bill includes two amendments I offered. One gives Governors authority to request the issuance of archaeological permits which would exclude many of the restrictions connected with federally-issued permits. The second amendment guarantees Governors and their designees access to information about the nature and location of resources found on public lands.

I understand and agree with your objections to the original version of this bill. Had we failed in the effort to amend it, I would have voted against it. However, I believe the final version is a great deal more acceptable.

I appreciated hearing from you.

Best regards,
/ s / Dick Cheney
Member of Congress

* *

UNITED STATES SENATE
Washington, D.C. 20510

February 11, 1980

Dear Judi:

Thank you so much for sharing with me the ideas and feelings you have with respect to legislation to protect archaeological resources and the bounty hunter clause.

The bill, as amended by the Senate, was agreed to in the House of Representatives on October 12 with an additional amendment that the Senate voted on and sent to the President for his signature October 17.

I do very much favor the concept of protecting archaeological resources. That is an important mission indeed. I think it can be performed in a manner which will not hinder the multiple use of national resource lands and it is that delicate balance that I will look toward preserving.

While the so-called bounty hunter provision was not completely deleted from the bill that has been sent to the President to be signed into public law, the reward provision has been reduced from $1,500 to $500 and persons with collections have been grandfathered into the law so that they can keep those cllections without fear of federal intervention. Bottles, coins and arrowheads on the surface have been exempted so that hobbyists will not have to worry about federal penalties.

It is my opinion that the compromise language agreed to between the House and

THE ANALYSIS OF THE USE-WEAR PATTERNS ON ARTIFACTS FROM 48 FR 440, THE BISON BASIN SITE, FREMONT COUNY, WYOMING

by
David Darlington

January 14, 1980

INTRODUCTION

This paper concerns the analysis of use-wear patterns on artifacts from site 48FR440 in Fremont County, Wyoming. This site was found in conjunction with an oil field survey for Gulf Oil Company during the summer of 1977. The original report was written by Charles Reher for the Gulf Oil Company for their Bison Basin Oil Field in Fremont County. The original report is on file at the State Archeologist's Office at Laramie, Wyoming.

An understanding of the human activities associated with an archeological site is vital to the understanding of the pre-history of an area. This includes small sites of low visibility such as surface lithic scatters as well as high visibility sites such as large bison kills of several hundred animals. Both extremes of site types were an integral part of the subsistence pattern of pre-historic peoples. Thus an understanding of all types and sizes of sites is essential to an understanding of the archeological record for any given area.

The major problem in understanding the pre-history of the North-Western plains area has been the paucity of cultural material found in most surface sites, and a corresponding lack of methodology to deal with such sites. The typical site of this nature consists of a few flakes and tools and perhaps some fire cracked rock. There is usually very little deposition and no stratification. Without the proper methodology such sites can never be fully understood, thus our understanding of plains pre-history can never be complete (Frison 1978:13).

Site 48FR440 provided a good opportunity to test methodology which might lead to a better understanding of low visibility sites. The lithic assemblages from such sites are too often only described with no attempt made to determine the use to which these artifacts had been applied. Due to the eroded nature of site 48FR440 the only remaining evidence of cultural activity is the lithic sample which was collected. Thus it was decided to analyze the lithic assemblage from the standpoint of use-wear.

Use-wear can be defined as the attrition of a tool edge caused by repeated contact with a foreign surface which is being physically and intentionally altered by the use of the tool edge.

Use-wear was selected as the primary analytical variable because it reflects the general types of use the tool assemblage was given. The specific type of wear on each tool is indicative of the type of use for which that tool was used. For example, scraping activities produce different wear patterns than do cutting activities (Ahler 1979). Thus general types of activities can be inferred from the types of wear found with the artifact assemblage. The general types of activities as evidenced by the wear patterns found on the artifact assemblage are in turn a reflection of a portion of the adaptation strategy associated with that specific site.

The complete adaptation strategy associated with a given site can never be known due to the fragmentary nature of the archeological record. However, general statements can be made using use-wear analysis regarding the general types of activities associated with different sites. For example, the artifact assemblage and its use-wear patterns should be fundamentally different between a bison kill site and a plant food processing site due to the differences between the food resources being processed. The assumption being that butchering will produce different wear patterns on tools than will plant food processing. If the methodology can be perfected to accurately distinguish between these two activities a better understanding of pre-historic adaptation strategies may result.

SITE LOCALITY DESCRIPTION

Site 48 FR 440 is located in Fremont County, Wyoming, township 27N, range 95W, center of the SE SE of section 20. It is situated in a topographic feature known as Bison Basin. This basin is from two to three miles across and lies at the head of Stinking Springs Draw. It lies from 6800 to 7200 feet above sea level and is bordered on the north, south, and west be steep slopes and a high rim which reaches an elevation of 7400 feet above sea level. The divide between the Wind River Basin to the north and the Great Divide Basin to the south runs along this rim and the surrounding high points.

The underlying geological formations are composed mostly of sandstone and shale which are exposed in some areas by extensive erosion. Also common to the area are beds of exposed quartzite cobbles which may have attracted pre-historic peoples in search of lithic material.

These cobble beds are composed mostly of a coarse grey quartzite which grades into a finer variety. Some cherts are also available locally in limited amounts, but the nearest source of chert in quantity is the south end of the Wind River Mountains which lie to the northwest of the site, or the Green Mountains which lie to the northeast of the site.

The site itself is located at the base of the rim surrounding Bison Basin on colluvial deposits which form a small bench. Several small draws tributary to Stinking Springs Draw head near the site.

FOOD RESOURCES

The vegetation surrounding the site is composed of a variety of plant types common to dry areas. There are stands of greasewood on the alluvial deposits of the larger drainages, with large sage and grasses growing where conditions permit. Small sage and short grass dominate most of the basin floor and surrounding area. Erosion has depleted the top soil in many places to the extent that large barren areas of exposed shale are common and support little plant life.

The area is highly diversified in regard to plant species. Seed grasses and other edibles are probably more common in this area than in surrounding areas. The talus slopes associated with the Bison Basin rim seem especially productive with regard to seed grasses. These slopes are the largest for several miles and could have been a major attraction to the area for pre-historic hunters and gatherers. An estimated 30 to 50 edible plant species exist within a one-day foraging distance from the site. Thus the site area would have been very attractive to pre-historic peoples from both the standpoint of edible plants and raw lithic materials (Reher 1977:4).

Two species of large game animals; antelope (Antilocarpa americana) and mule deer (Odocoileus hemionus) inhabit the area today and no doubt attracted pre-historic hunters as well. Bison also frequented the area in pre-historic times but were probably not a major attraction. The area is better suited to deer and antelope due to the lack of abundant grasses necessary for large bison herds (Reher 1977:3).

Various species of small game such as rabbits, rodents, and birds inhabit the basin today and no doubt did during pre-historic times. Both cotton tail (Sylvilagus nuttalli) and jack rabbit (Lepus townsendi) are common as are sage grouse (Centrocerus urophasianus). These species plus smaller birds and rodents could have served as food sources for aboriginal hunters and gatherers in the area.

GENERAL SITE DESCRIPTION

The site covers an area of about 160 acres. Most of which is a quarry area as evidenced by a thin scatter of quarry debris. Within this area there are three small concentrations of scattered cultural materials composed of chipped and ground stone and fire cracked rocks. The largest of these concentrations was mapped and collected. The three concentrations were distinctly different in character from the scattered quarry debris of the rest of the site and may indicate habitation or some kind of special use areas (Reher 1977:5).

The large concentration which was mapped and collected covered an area of 250 feet by 150 feet. It was gridded into 25 foot units and each unit was collected separately. Fire cracked rock indicating possible fire hearths were mapped but not collected. A total of 321 chipped and ground stone artifacts from this area were analyzed. A complete inventory of all analyzed artifacts is found in Table 1.

Due to the highly eroded nature of the site no intact fire hearths were present. There were sixteen concentrations of fire cracked rock, some of which may have been hearth cleaning dumps. Thus the exact number of original hearths is speculative. Because of the eroded condition of the site, no estimate of the number of cultural occupations was possible or of the probable number of people associated with the occupations.

ARTIFACT ANALYSIS METHODOLOGY

Each of the 321 collected artifacts was analyzed and described with the following sets of criteria.

1. The provenience of the artifact on the 25 foot grid system
2. The type of lithic material from which the artifact was made. Seven types of lithic materials were recorded. The color of the individual material types varied a great deal and so "lumping" was done to facilitate the analysis. The brown described for the chert and chalcedony is actually a range of color variations from red to grey. This lumping of color variations seemed valid in that the different colors seemed to be variations within the same geologic formation rather than separate sources. The lithic material types were divided into the following categories: fine quartzite; coarse quartzite; oolite chert; quartz; brown chalcedony; brown chert; clear chalcedony; and basalt.

Criteria 3-5 were designed to approximate a production sequence and thus labor input into the artifact. For instance, a biface requires more labor to manufacture than does a retouched flake. Thus the descriptive criteria in 3-5 will reflect the relative amount of labor which was required to manufacture each artifact (Binford 1976).

3. Core reduction sequence
   - core - block lithic material from which flakes have been removed during the course of tool manufacture
   - decortication flake - any flake with cortex on the dorsal surface and evidence of a bulb of percussion on the ventral surface
   - reduction flake - any flake without cortex and with a bulb of percussion on the ventral surface
   - retouch flake - very small flakes taken from a tool edge to resharpen it during use
   - core fragment - pieces of cores which have broken off of the main body of the core during flake removal and which show no evidence of a bulb of percussion

Criteria number 4 describes the type of modification which affected the size or shape of the flake tools. This is distinct from edge modification (criteria #5) which affects only the working edge of the tool. For example, bifacial reduction modification means only that the artifact has one or more flake scars across both the dorsal and ventral surfaces, implying some degree of size or shape modification in the manufacture of that artifact. The degree to which the artifact was modified was not recorded.

4. Basic size modification: no modification; bifacial reduction modification; unifacial reduction modification

Criteria number 5 describes only the type of modification which the edge of the artifact received, and thus the type of modification the cutting edge received prior to use. Thus an artifact may be bifacially size modified but the actual cutting edge could be unifacially modified depending upon the type of use intended or the habit of the individual manufacturer. For example the Late Plains Archaic period biface knife which was sharpened on one side only producing unifacial edge modification on a bifacially size modified tool (Frison 1978:79).

5. Edge preparation modification: no modification; unifacial edge modification; bifacial edge modification

Criteria 6-8 are measurements of the physical dimensions of the artifact in millimeters.

6. The length of the artifact
7. The width of the artifact
8. The thickness of the artifact

Criteria 9 is a measurement of the length of the edge which shows signs of use-wear. Criteria number 10 is a measurement of the total length of the artifact edge which could have been utilized in the same manner. For most flake tools this measurement amounts to the circumference of the tool less large step fractures which would have inhibited edge preparation and use.

9. The length of the edge which shows use-wear in millimeters
10. The total edge available for use in millimeters

Criteria number 11 describes the general shape of the artifact edge which shows use-wear. For example, what is commonly called a spoke shave would have a concave shape.

11. The shape of the edge which shows use-wear: concave; convex; straight

Criteria 12-13 describes the types of use-wear which may be found on a given artifact. Use-wear is produced on a tool due to a combination of several factors of force and material types. An understanding of this is necessary for the identification and analysis of the use-wear types. These factors are: a) The static orientation of the tool with respect to the material being worked; b) The relative motion of the tool with respect to the material being worked; c) The mode and amount of force transferred from the user to the material being worked through the tool; and d) The physical properties of the tool material and of the material being worked. (Ahler 1979)

Abrasive wear can be defined as the removal of small particles of the tool edge through repeated contact with the surface which is being intentionally altered. The abrasive wear types are relative degrees of this wear pattern.

12. Abrasive wear
    - grinding - extensive modification of the tool edge from contact with a very abrasive material such as sandstone
    - smoothing - The dulling or leveling of the tool edge from extensive contact with a moderately abrasive material such as wood or bone
    - polish - The formation of a high luster on the tool edge with minimal attrition of the edge, caused by contact with minimally abrasive materials such as meat or hide
    - non-determinable - no abrasive wear was observed
    - blunting - A form of abrasive wear that results from a smoothing wear rougher in texture than regular smoothing wear. This results from very fine micro-fracturing of the tool edge. (Ahler 1971:38).

Flake wear is defined as the removal of small "flakes" from the tool edge by repeated contact with the surface which is being intentionally altered. Flake wear is a result of the conchoidal fracturing properties of the tool material type.

13. Flake wear
    - step flaking - small flake scars which terminate in a stepped, transverse fracture (Ahler 1971:39)
    - irregular flaking - small flake scars which "feather" out rather than terminate with a step fracture
    - hinge flaking - small flake scars which "hinge" out rather than terminate in a step fracture
    - non-determinable - no observable flake wear was present
    - unifacial-irregular flaking - similar to irregular flaking except that flake scars occur only on the ventral or dorsal side adjacent to the used edge.

Criteria number 14 describes the intensity of the wear found on an artifact. This might be a reflection of the amount of use the artifact received. Each artifact was examined under a 6x-50x binocular microscope for signs of wear. The most productive power seemed to be from 6x to 25x. At 50x the smaller field of view made it hard to compare non-worked edge sections with worked edge sections, and so difficult to distinguish natural edges from used edges. However, as competence is gained in the use of the microscope and the analysis of use-wear the higher powers might become more productive.

14. Use-wear intensity
    - pronounced - macroscopic
    - moderate - visible under 6x to 12x magnification
    - light - visible only under 25x to 50x magnification

Criteria number 15 is a measurement of the angle of the utilized edge. The edge angle measurement taken on utilized and modified artifacts was measured with a spark plug feeler guage and a protractor. This measurement is very subjective in that the angle of an edge usually varies along its length, so an "average" edge angle for each artifact was recorded. If the artifact had more than one type of utilized edge, then separate edge angle measurements were reported.

15. Edge angle measurement

GENERAL DISCUSSION

Table 1 is an inventory of the separate artifact types as distinguished by the analysis. An interesting feature of the artifact type categories is the large proportion of unused bifaces (7) to used bifaces (4), and unused bifacial retouched flakes (4) to used bifacial retouched flakes (2). These high proportions of unused artifacts might be explained by one or more of the following reasons. Because the large numbers of unused but modified artifacts were not anticipated, no test was done to determine which reasons apply to this artifact assemblage.

a. The use-wear on the artifact is so slight as to be unobservable with the methods used. A binocular microscope of 6x to 50x was all that was available for this analysis. A microscope of higher power might have revealed signs of wear not observable at 50x.
b. The artifact may have been modified for use but prior to actual use it was lost or discarded for some reason.
c. The artifact may have turned out to be unsuitable for the task intended and so was discarded prior to use.
d. The artifact may have been broken during manufacture or prior to use and so was discarded.

The two most common categories of artifact tool types used were unifacial retouched flakes (11) and utilized flakes (14), which together total 52% of the utilized or modified tool assemblage (table 1). This might be significant in that these two artifact types require the least amount of time and labor to manufacture, but comparisons need to be made with other tool assemblages from other sites before any conclusions can be made with regard to curated versus expedient technological organization (Binford 1976).

A total of three projectile points were originally collected from the site. Two were complete and one was a point fragment. They were classified as Archaic dart points with the bilobe base form that is considered to be part of the McKean complex of the Middle Plains Archaic period. This dates the site to between 2500 and 5000 years in age. One of the points had part of one edge retouched either to repair it or to be used as a tool (Reher 1977:7). Unfortunately at the time of this analysis only one projectile point was present in the collection. Also missing were approximately 80 other artifacts which were tabulated in table 1 of the original report to Gulf Oil Company.

EDGE ANGLE ANALYSIS

Edge angle measurements were taken for 46 edges on the 45 artifacts which show evidence of intentional modification or utilization. Of these 45 artifacts, 33 show signs of use-wear with one artifact showing two kinds of wear. Thus 34 edge angle measurements were recorded for the artifacts which show signs of use-wear.

The artifact for which two edge angle measurements were recorded was a unifacial retouched flake of brown chert. One utilized edge had step flaking use-wear and the other utilized edge had irregular flaking use-wear.

The mean edge angle for the entire population of 46 edges is 60 degrees with a standard deviation of 10.3 (table 2a). The 34 edges which show signs of use-wear have a mean edge angle measurement of 62 degrees with a standard deviation of 10.6 (table 2b). And the mean edge angle for the 12 edges which show no use-wear is 56 degrees with a standard deviation of 7.6 (table 2c).

These are all relatively steep edge angle averages which might indicate generally heavy work such as scraping or shredding. Thus a possible conclusion might be that the general type of task associated with the occupation of site 48FR440 probably required a relatively steep edge angle. But this should not be taken to mean that only such tasks were performed. A steep edge angle can be used in place of an acute edge angle, but an acute edge angle cannot take the place of a steep edge angle. Thus there is a potential problem with tool assemblages such as this one where the average edge angle is relatively steep. If the steep edge angle mean a true representation of the types of tasks which were performed, or is it a cultural or technological tradition of tool manufacture? While this problem cannot be resolved specifically for this particular tool assemblage, other assemblages with a larger sample of tools indicate use is directly related to edge angle (Gould, Koster and Sontz 1971; Wilmsen 1968; Frison 1970:36).

Lithic material type as well as intended function also has an influence upon the edge angle produced for any given tool. The fine grained cherts had a more acute edge angle than did the quartzites. For the 34 edges showing use-wear, the brown cherts and chalcedonys had mean edge angles of 58 and 59 degrees respectively. The quartzites had mean edge angles of 67 and 64 degrees for the fine and coarse varieties respectively (table 2b). This represents a distinct difference between the edge angle means of the quartzites and the cherts. Perhaps indicating that cherts are capable of holding a more acute edge than the quartzites for the same type of task.

This implied difference of edge holding capabilities between material types is further demonstrated by an examination of edge angle measurement broken down by material type and use-wear type. If the difference in edge angle is due to the type of use the artifact received rather than to material type it should become apparent in the examination of edge angle means between material type and use-wear type. For instance if there was a preference between material types for specific types of tasks, this would produce different edge angle measurements between use-wear types.

Instead, the same pattern is observed with the quartzites averaging from 61 to 67 degrees, and the cherts averaging from 53 to 61 degrees for all types of flake wear where there is a sample of more than one (table 3). Thus supporting a relationship between edge angle and lithic material type.

The exact nature of the relationship between edge angle and material type was not tested in this analysis, but I expect that it is related in part to the following factors:
a. The strength of the bonding agent within the lithic material type
b. The elasticity of the bonding agent within the lithic material type
c. The size of the particles bonded together in the lithic material type.

USE-WEAR ANALYSIS

The type of use-wear found on a given artifact is directly related to the type of use to which it was put, and indirectly to the factors of preservation such as weathering and animal activity in exposed surface sites. The principle variables which affect the pattern of use-wear found on a given tool are direction and angle of applied force, and the hardness or resistance of the material being modified. These variables combine to produce certain characteristic patterns of use-wear. This type of analysis will not determine specific uses such as hide scraping, but it will indicate general types of use such as scraping versus cutting activities, and the relative resistance of the material being modified such as hide versus bone. For a detailed discussion of these variables see Ahler 1979.

The most common type of use-wear was step flaking followed by irregular flaking (table 4). Step flaking is usually associated with scraping or shredding activities which involve force applied across the edge of the tool. Irregular flaking involves cutting activities with the force being applied parallel to the tool edge as in any cutting or sawing motion (Ahler 1979). Step flaking totaled 41% of the use-wear assemblage and irregular flaking totaled 32% (table 4).

The ratio of step flaking to irregular flaking might be significant but needs to be compared to other sites for any conclusions to be drawn. I suspect that such comparisons of use-wear type frequencies between site tool assemblages could be valuable in distinguishing between different types of sites and perhaps between different subsistence patterns among cultural groups.

The determination of abrasive wear was not nearly as successful as that of flake wear. This could be a reflection of its relative absence, or it may be a result of the analytical techniques used. Ahler states that abrasive wear nearly always occurs in conjunction with flake wear (1979:305). On only 12 or 35% of the edges showing some sign of use-wear was any kind of abrasive wear observed. The most common form of abrasive wear was smoothing which accounted for 10 of the 12 tool edges showing that type of wear. The other two forms observed were blunting and polish (table 5).

At this time I do not feel that the abrasive wear frequency from this sample is indicative of anything. The low frequency of observed abrasive wear might in part be a result of the high number of quartzite tools in the assemblage. Quartzite tends not to show use-wear as readily as does chert. Smoothing could be a result of the normal attrition of an irregular edge when used as a cutting or scraping instrument. It perhaps is indicative of the amount of use the tool received, but due to the small sample in which it occurs I cannot draw any specific conclusions at this point in time.

MATERIAL TYPE

The preferred tool material types were fine quartzite and brown chert. The fine quartzite had an observed frequency of 10 utilized artifacts compared to an expected frequency of 8.25 giving an observed to expected ratio of 1.21. Brown chert had an observed frequency of 6 utilized artifacts compared to an expected frequency of .99 artifacts giving an observed to expected ratio of 6.06. Oolite chert was the only other material type which had an observed frequency greater than the expected frequency, but it had a sample size of only 2 artifacts thus is probably not reliable as an indicator of preferred material type, although the McKean projectile point was of this material (table 2b).

The preferences for the fine quartzite and brown chert is consistent for all artifact tool types and is also notable in that there was also a definite selection against the coarse quartzite in all tool types where there was a sample of more than two artifacts (table 6). For the total assemblage the observed frequency for coarse quartzite was 10 utilized artifacts to 15.51 expected artifacts giving an observed to expected frequency ratio of .64 (table 2b).

The coarse quartzite is very common at the site and occurs in large beds of exposed cobbles. The fine quartzite is also available locally but not in the same quantities as the coarse. The cherts are rare at the site although an occasional chert cobble is available. The bulk of the chert artifacts were probably imported to the site from other sources, perhaps from the Green Mountains or the south end of the Wind River Mountains (Reher, personal communication).

The preference for brown chert is further demonstrated by the ratio of modified or utilized tools to non-utilized flakes. This ratio is the number of tools divided by the number of non-utilized flakes of that material type. Thus a high relative ratio indicates very little on-site manufacture or modification of tools of that specific lithic material type.

There were only 2 non-utilized flakes of brown chert compared to 7 modified or utilized tools of the same material type thus giving a tool to flake ratio of 3.5 (table 7). This indicates very little on-site knapping activity with brown chert and thus perhaps the importation of manufactured tools of brown chert. Thus a preference for brown chert over the quartzite of the site locality.

By comparison the tool to flake ratio of fine quartzite is .25 and that of coarse quartzite is .11 indicating a large amount of knapping activity involving these lithic types (table 7).

REDUCTION SEQUENCE

The core reduction sequence was divided into three categories; decortication flakes, reduction flakes, and retouch flakes. There were no retouch flakes collected although it must be assumed that there were such flakes at the site due to the number of retouched flake tools of local quartzite that were collected. A retouched flake tool is a utilized flake tool which has been re-sharpened or "retouched" during the course of utilization, thus producing very small retouch flakes. The absence of retouch flakes from the collected artifact assemblage can be explained by the collection methodology. Only surface collection was employed, no screening was done which might have produced the smaller retouch flakes.

HYPOTHESES AND RESULTS

The following section of this paper deals with the hypotheses which were tested and the results of each test.

Hypothesis 1 :

The reduction sequence ratio will be higher for preferred lithic material types than for the non-preferred lithic material types.

Definitions:

a. Reduction sequence ratio - the number of reduction flakes divided by the number of decortication flakes of the same material type
b. Reduction flake - Any flake without cortex and with a bulb of percussion
c. Decortication flake - Any flake with cortex and with a bulb of percussion

Assumptions:

a. For any given core there will be more reduction flakes removed than decortication flakes if the core is reduced the maximum amount possible
b. If the core is of a preferred material type it will be reduced and utilized in such a way as to maximize the amount of raw lithic material it contains, thus producing a higher percentage of reduction flakes than decortication flakes
c. If the core is of a non-preferred material type it will be discarded before maximum utilization is achieved.

Results:

The hypothesis was accepted. The reduction sequence ratio is higher for the preferred lithic material types than for the non-preferred. The reduction sequence ratio for the fine quartzite was 1.55 compared to a ratio of .74 for the coarse quartzite (table 8). This is supported in table 2a by an observed frequencey for fine quartzite tools of 14 compared to an expected frequency of 11.25, and for the non-preferred coarse quartzite an observed frequency of 14 compared to an expected frequency of 21.25.

The brown chert was also found to be a preferred material type with an observed frequency of 7 tools to an expected frequency of 1.35 tools (table 2a). But as there were only 2 non-utilized flakes of brown chert in the collection, the reduction sequence ratio has little meaning for this material type due to the small sample size (table 8).

Hypothesis 2:

The average size of non-utilized flakes will decrease as the distance to the raw material source increases.

Definitions:

a. flake size - length x width x thickness

Assumptions:

a. The average size of the flakes removed from any given core will decrease as the core is reduced.
b. The average size of the flakes removed from any given flake tool or preform will decrease as the manufacturing sequence progresses.
c. Weight is a limiting factor in the transportation of raw lithic materials from a quarry source. Thus the tendency during pre-historic times was to reduce the raw lithic material as much as possible in order to conserve on weight when the finished tool is to be used at another location.

Results:

The hypothesis was accepted. All non-utilized flakes were measured in millimeters as to length, width, and thickness. The measurements were then multiplied by each other to give a size in cubic millimeters for each artifact. The average size in cubic millimeters for the fine quartzite was 9427, for the coarse quartzite it was 9688. The average sizes for the cherts range from 2388 to 5831 cubic millimeters (table 8). This is a large difference in average sizes between the cherts and the quartzites. If the assumption is true that the cherts are mostly non-local and the quartzites are local then this supports the hypothesis that the average size of non-utilized flakes will decrease as the distance to the quarry source increases.

Hypothesis 3:

The average edge angle for scraping activities will be greater than the average for cutting activities. Scraping activities are evidenced by step flaking use-wear and cutting activities are evidenced by irregular flaking use-wear (Ahler 1979).

Assumptions:

a. In cutting activities force is applied directly into the edge of the tool.

Thus the cutting edge is supported by the tool blade (figure 1).

b. In scraping activities force is applied across the edge of the tool. Thus the tool edge is not supported by the tool blade and so the tool edge requires a greater edge angle to resist the force applied from scraping activities as compared to cutting activities (figure 2).

Results:

The hypothesis was accepted. For all material types the average edge angle was greater for scraping activities as evidenced by step flaking use-wear than for cutting activities as evidenced by irregular flaking use-wear. Step flaking averaged 64 degrees and irregular flaking averaged 56 degrees thus supporting the hypothesis (table 4). A breakdown of edge angle by material type is found in table 3.

Hypothesis 4:

The tool to flake ratio will be higher for non-local lithic material types than for local material types.

Definitions:

a. tool to flake ratio - The number of tools divided by the number of non-utilized flakes of that material type.

Assumptions:

a. Weight is a limiting factor in the transportation of raw lithic materials from a quarry source. Thus the tendency during pre-historic times was to reduce the raw lithic material as much as possible in order to conserve on weight when the finished tool was to be used at another location.

b. Non-utilized flakes will not be carried from their point of origin but finished tools, preforms, and useable flakes will be if they are to be used at another location.

Results:

The hypothesis was accepted. The tool to non-utilized flake ratio was highest for the non-local cherts. Brown chert had a tool to flake ratio of 3.50, and oolite chert had a ratio of .67 as compared to the fine and coarse quartzites which had ratios of .25 and .11 respectively. However, a note of caution regarding the acceptance of this hypothesis. The brown chalcedony had a ratio of only .15 which was a result of its being represented by a total of 8 tools and 53 non-utilized flakes (table 7). If the hypothesis is to remain accepted the low tool to flake ratio must be explained by a local source for the brown chalcedony. This is possible as chert does occur locally although in limited amounts.

SUMMARY

1. The distribution of flake wear patterns indicate the primary activity at the site involved some kind of shredding or scraping (41%), followed by some kind of cutting activity (32%) (table 4). This is probably indicative of a very generalized hunting and gathering economy where plant food played an important

part in the diet although this needs to be substantiated with further work with use-wear analysis.

2. Although only one mano was collected it is consistent with the increase of the use of seed grinding tools during the Middle Plains Archaic (Frison 1978: 352). The site seems to be representative of that time period as evidenced by the McKean projectile points which were collected. Such a generalized hunting and gathering economy is typical of many Middle Plains Archaic sites (Frison 1978:46-49).

3. The relatively steep edge angle measurements found for the tool assemblage might also be supportive of a plant food oriented economy. Steep edge angles on cutting and shredding tools may have been necessary to prepare tough vegetable and wood resources for human use or consumption although this still needs to be demonstrated.

   The Glenrock buffalo jump near Glenrock, Wyoming offers a comparison of edge angle measurements. The edge angles for the Glenrock site are bimodal in distribution with cutting edges clustering between 37 and 42 degrees and scraping edges clustering between 48 and 53 degrees (Frison 1970:36). Edge angles for 48 FR440 were unimodal in distribution (figure 3) with means of 64 degrees for scraping activities and 56 degrees for cutting activities as evidenced by use-wear types step flaking and irregular flaking respectively (table 4). Thus there is a distinct difference between the edge angle measurements of the Glenrock site which is a bison kill and the Bison Basin site which has no faunal material preserved.

4. The implications for a plant food economy are further supported by the presence of several concentrations of fire cracked rocks which indicate pre-historic fire hearths. Such hearths became common during the Middle Plains Archaic and continued up until historic times. There pits are thought to have served as roasting pits for vegetable foods although similar features at the Wardell site in western Wyoming were used to cook large articulated parts of bison (Frison 1978:355).

5. The definite difference between the mean edge angles of step flaking and irregular flaking indicate intentional edge angle modification relative to specifice tasks (table 4).

6. There was a definite difference in edge angle means between the cherts and quartzites. Thus indicating a difference in edge characteristics between the two material types. The large grained quartzites required stronger or steeper edge angles than the fine grained cherts for the same general type of task.

CONCLUSION

The analysis of use-wear patterns on the artifacts from 48 FR 440 has proven useful in that it indicates the general types of activities which occurred with the occupation of the site. The basic problem in such an anlysis is the determination of the use-wear type and if it exists on that particular artifact. Such variables as material type, preservation, and analytical method used can influence the determination of wear on any given artifact. Very light cutting activities such as slicing meat may leave no discernible wear on the tool. This type of problem is especially true for the quartzites. The structures of which seems to inhibit the observation of wear patterns, and perhaps even the attrition which leads to a use-wear pattern.

The quality of the preservation of the site can be critical to the correct determination of use-wear type. If a site is sub-surface and was buried soon after occupation, preservation is usually good. But if it is a surface scatter then the effects of wind, water, temperature, and animal activity cannot be over-looked. The effects these factors have on a tool assemblage is variable, but patenation and smoothing through natural sandblasting is common to surface finds and certainly modifies and sometimes destroys the original use-wear pattern.

The skill of the researcher is also very critical to correct analysis. Use-wear is often only slightly different from the natural condition of the artifact and takes a practiced eye to distinguish. The proper equipment is also necessary. Good quality optics of an adequate power range with a good lighting system are absolutely necessary as are good laboratory conditions.

The application of this type of analysis to tool assemblages from other sites should define certain trends of use-wear patterns and edge angles for different types of sites. Kill sites should produce different frequencies of use-wear and tool types than plant food procurement sites because of the different types of activities which occurred at each site (Frison 1978:344). Such analysis might also define regional trends of use-wear and tool type frequencies due to different adaptation strategies. Thus the analysis of use-wear has great potential for the determination of pre-historic subsistence patterns and their relationship to the environment.

TABLE 1 - INVENTORY OF ARTIFACT TYPES FROM 48 FR 440

Type	Number	Percentage of Total
core	5	.02
core fragment	28	.09
used core fragment	1	.003
non-utilized flakes	240	.75
utilized flakes	14	.04
un-used biface	7	.02
used biface	4	.01
un-used uniface	0	.00
used uniface	1	.003
un-used unifacial retouched flake	1	.003
used unifacial retouched flake	11	.03
un-used bifacial retouched flake	4	.01
used bifacial retouched flake	2	.01
point (McKean point)	1	.003
hammer stone	1	.003
grinding stone	1	.003
Total analyzed artifacts	321	1.00

TABLE 2a
OBSERVED AND EXPECTED FREQUENCIES OF FLAKE TOOL ARTIFACTS INCLUDING BOTH UTILIZED AND NON-UTILIZED TOOLS

Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle[5] mean	S
fine quartzite	.25	14	11.25	1.24	64	7.8
coarse quartzite	.47	14	21.25	.66	62	8.6
oolite chert	.02	2	.90	2.22	52	26.1
quartz	.003	0	.13	0.00	--	--
brown chalcedony	.20	8	9.0	.89	55	9.2
brown chert[4]	.03	7	1.35	5.19	55	12.1
clear chalcedony	.02	0	.90	0.00	--	--
basalt	.003	0	.13	0.00	--	--
sandrock	.003	0	.13	0.00	--	--
Total	1.00	45	--	--	60	10.3

1 percentage is computed from total number of artifacts (321)
2 expected number of tools = percentage x total tools (45)
3 ratio of observed to expected frequency = observed/expected
4 one tool of brown chert had two utilized edges so two edge angle measurements were taken; thus the mean edge angle for brown chert is from a sample of 8 and the population mean is from a sample of 46
5 S equals the standard deviation of the edge angle mean.

TABLE 2b

OBSERVED AND EXPECTED FREQUENCIES BY MATERIAL TYPE OF FLAKE TOOL ARTIFACTS WHICH SHOW USE-WEAR

Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle[5] mean	S
fine quartzite	.25	10	8.25	1.21	67	7.9
coarse quartzite	.47	10	15.51	.64	64	8.9
oolite chert	.02	2	.66	3.03	53	26.1
quartz	.003	0	.10	0.00	--	--
brown chalcedony	.20	5	6.60	.76	59	8.7
brown chert[4]	.03	6	.99	6.06	58	11.7
clear chalcedony	.02	0	.66	0.00	--	--
basalt	.003	0	.10	0.00	--	--
sandrock	.003	0	.10	0.00	--	--
Total	1.00	33	--	--	62[4]	10.6[4]

1 percentage is computed from total number of artifacts (321)
2 expected number of tools = percentage x total tools (33)
3 ratio of observed to expected frequency = observed/expected
4 one tool of brown chert had two utilized edges so two edge angle measurements were taken; thus the mean edge angle for brown chert is from a sample of 7 and the population mean is from a sample of 34
5 S equals the standard deviation of the edge angle mean

TABLE 2c

OBSERVED AND EXPECTED FREQUENCIES BY MATERIAL TYPE OF MODIFIED ARTIFACTS WHICH SHOW NO USE-WEAR

Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle[4] mean	S
fine quartzite	.25	4	3.00	1.33	58	2.4
coarse quartzite	.47	4	5.64	.71	60	8.3
oolite chert	.02	0	0.24	0.00	--	--
quartz	.003	0	0.03	0.00	--	--
brown chalcedony	.20	3	2.40	1.25	51	10.0
brown chert	.03	1	0.36	2.78	47	0.0
clear chalcedony	.02	0	0.24	0.00	--	--
basalt	.003	0	0.03	0.00	--	--
sandrock	.003	0	0.03	0.00	--	--
Total	1.00	12	--	--	56	7.6

1 percentage is computed from total number of artifacts (321)
2 expected number of modified artifacts = percentage x total (12)
3 ratio of observed to expected frequency = observed/expected
4 S equals the standard deviation of the edge angle mean

TABLE 3
EDGE ANGLE MEASUREMENT BROKEN DOWN BY MATERIAL TYPE AND FLAKE WEAR TYPE

Material Type	Flake wear type	edge angle[1] mean	S	Number
Fine quartzite	non-determinable	--	--	0
	step flaking	67	12.4	3
	irregular flaking	63	1.2	4
	hinge flaking	80	0.0	1
	unifacial irregular	66	5.6	2
	Total	67	7.9	10
Coarse quartzite	non-determinable	--	--	0
	step flaking	66	10.5	4
	irregular flaking	62	10.5	3
	hinge flaking	--	--	0
	unifacial irregular	61	8.0	3
	Total	64	8.9	10
Oolite chert	non-determinable	--	--	0
	step flaking	71	0.0	1
	irregular flaking	34	0.0	1
	hinge flaking	--	--	0
	unifacial irregular	--	--	0
	Total	52	26.1	2
Brown chalcedony	non-determinable	--	--	0
	step flaking	59	4.2	2
	irregular flaking	53	13.4	2
	hinge flaking	--	--	0
	unifacial irregular	66	0.0	1
	Total	59	8.7	5
Brown chert	non-determinable	73	0.0	1
	step flaking	61	3.9	4
	irregular flaking	36	0.0	1
	hinge flaking	52	0.0	1
	unifacial irregular	--	--	0
	Total	58	11.7	7
For entire population		62	10.6	34

1 S equals the standard deviation of the edge angle mean

TABLE 4
FREQUENCY OF FLAKE WEAR TYPES

Flake wear type	Frequency	Percentage	edge angle mean
non-determinable	1	.03	73
step flaking	14	.41	64
irregular flaking	11	.32	56
hinge flaking	2	.06	66
unifacial irregular flaking	6	.18	64
Total	34	1.00	62

TABLE 5
FREQUENCY OF ABRASIVE WEAR TYPES

Abrasive wear type	Frequency	Percentage	edge angle mean
non-determinable	22	.65	64
grinding	0	.00	--
smoothing	10	.29	59
polish	1	.03	36
blunting	1	.03	73
Total	34	1.00	62

TABLE 6
OBSERVED AND EXPECTED FREQUENCIES OF ARTIFACT TYPES
BROKEN DOWN BY TYPE OF TOOL AND MATERIAL TYPE

Artifact Type	Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle mean	S
Un-used biface:	fine quartzite	.25	1	1.75	.57	55	0
	coarse quartzite	.47	3	3.29	.91	61	10.0
	oolite chert	.02	0	.14	00	--	--
	quartz	.003	0	.02	00	--	--
	brown chalcedony	.20	2	1.40	1.43	46	5.6
	brown chert	.03	1	.21	4.76	47	0
	clear chalcedony	.02	0	.14	00	--	--
	basalt	.003	0	.02	00	--	--
	sandrock	.003	0	.02	00	--	--
Total		1.00	7	--	--	54	--

Table 6 (continued)

Artifact Type	Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle mean	S
Used biface:	fine quartzite	.25	0	1	00	--	--
	coarse quartzite	.47	1	1.88	.53	80	--
	oolite chert	.02	0	.08	00	--	--
	quartz	.003	0	.01	00	--	--
	brown chalcedony	.20	1	.80	1.25	--	--
	brown chert	.03	2	.12	16.60	66	9.1
	clear chalcedony	.02	0	.08	00	--	--
	basalt	.003	0	.01	00	--	--
	sandrock	.003	0	.01	00	--	--
Total		1.00	4	--	--	69	9.2
Used uniface:	fine quartzite	.25	0	.25	00	--	--
	coarse quartzite	.47	0	.47	00	--	--
	oolite chert	.02	0	.02	00	--	--
	quartz	.003	0	.003	00	--	--
	brown chalcedony	.20	1	.20	5	62	00
	brown chert	.03	0	.03	00	--	--
	clear chalcedony	.02	0	.02	00	--	--
	basalt	.003	0	.003	00	--	--
	sandrock	.003	0	.003	00	--	--
Total		1.00	1	--	--	62	00
Unused unifacial retouch flake:	fine quartzite	.25	1	.25	4	60	00
	coarse quartzite	.47	0	.47	00	--	--
	oolite chert	.02	0	.02	00	--	--
	quartz	.003	0	.003	00	--	--
	brown chalcedony	.20	0	.20	00	--	--
	brown chert	.03	0	.03	00	--	--
	clear chalcedony	.02	0	.02	00	--	--
	basalt	.003	0	.003	00	--	--
	sandrock	.003	0	.003	00	--	--
Total		1.00	1	--	--	60	00
Used unifacial retouch flake:	fine quartzite	.25	5	2.75	1.82	62	6
	coarse quartzite	.47	3	5.17	.58	62	8
	oolite chert	.02	1	.22	4.55	71	00
	quartz	.003	0	.03	00	--	--
	brown chalcedony	.20	0	2.20	00	--	--
	brown chert	.03	2	.33	6.06	55	16.1
	clear chalcedony	.02	0	.22	00	--	--
	basalt	.003	0	.03	00	--	--
	sandrock	.003	0	.03	00	--	--
Total		1.00	11	--	--	61	9.7

Table 6 (continued)

Artifact Type	Material type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle mean	S
Unused bifacial retouched flake:	fine quartzite	.25	2	1	2.00	58	2.1
	coarse quartzite	.47	1	1.88	0.53	57	00
	oolite chert	.02	0	.08	00	--	--
	quartz	.003	0	.01	00	--	--
	brown chalcedony	.20	1	.80	1.25	62	00
	brown chert	.03	0	.12	00	--	--
	clear chalcedony	.02	0	.08	00	--	--
	basalt	.003	0	.01	00	--	--
	sandrock	.003	0	.01	00	--	--
Total		1.00	4	--	--	59	--
Used bifacial retouched flake:	fine quartzite	.25	0	.50	00	--	--
	coarse quartzite	.47	1	.94	1.06	73	00
	oolite chert	.02	0	.04	00	--	--
	quartz	.003	0	.01	00	--	--
	brown chalcedony	.20	1	.40	2.5	44	00
	brown chert	.03	0	.06	00	--	--
	clear chalcedony	.02	0	.04	00	--	--
	basalt	.003	0	.01	00	--	--
	sandrock	.003	0	.01	00	--	--
Total		1.00	2	--	--	58	20.5
Utilized flakes:	fine quartzite	.25	5	3.5	1.43	71	7.6
	coarse quartzite	.47	4	6.58	.61	58	6.2
	oolite chert	.02	1	.28	3.57	34	00
	quartz	.003	0	.04	00	--	--
	brown chalcedony	.20	2	2.80	.71	61	7
	brown chert	.03	2	.42	4.76	54	2.8
	clear chalcedony	.02	0	.28	00	--	--
	basalt	.003	0	.04	00	--	--
	sandstone	.003	0	.04	00	--	--
Total		1.00	14	--	--	61	11.6
Point:	fine quartzite	.25	0	.25	00	--	--
	coarse quartzite	.47	0	.47	00	--	--
	oolite chert	.02	1	.02	50	--	--
	quartz	.003	0	.003	00	--	--
	brown chalcedony	.20	0	.20	00	--	--
	brown chert	.03	0	.03	00	--	--
	clear chalcedony	.02	0	.02	00	--	--
	basalt	.003	0	.003	00	--	--
	sandrock	.003	0	.003	00	--	--
Total		1.00	1	--	--	--	--

Table 6 (continued)

Artifact Type	Material Type	% of total[1]	ob.	exp.[2]	ratio[3]	edge angle mean	S
Core:	fine quartzite	.25	2	1.25	1.60	--	--
	coarse quartzite	.47	2	2.35	.85	--	--
	oolite chert	.02	0	.10	00	--	--
	quartz	.003	0	.02	00	--	--
	brown chalcedony	.20	0	1.00	00	--	--
	brown chert	.03	0	.15	00	--	--
	clear chalcedony	.02	0	.10	00	--	--
	basalt	.003	1	.02	50.00	--	--
	sandrock	.003	0	.02	00	--	--
Total		1.00	5	--	--	--	--
Core fragment:	fine quartzite	.25	8	7	1.14	--	--
	coarse quartzite	.47	14	13.16	1.06	--	--
	oolite chert	.02	0	.56	00	--	--
	quartz	.003	1	.08	12.50	--	--
	brown chalcedony	.20	4	5.60	.71	--	--
	brown chert	.03	0	.84	00	--	--
	clear chalcedony	.02	1	.56	1.79	--	--
	basalt	.003	0	.08	00	--	--
	sandrock	.003	0	.08	00	--	--
Total		1.00	28	--	--	--	--
Used core fragment:	coarse quartzite	.47	1	.47	2.13	--	--
Total			1				
Hammer stone:	coarse quartzite	.47	1	.47	2.13	--	--
Total			1				
Grinding stone:	brown sandrock	.003	1	.003	333	--	--
Total			1				

1 percentage is computed from total number of artifacts (321)

2 expected number of tools = percentage x total tools for that artifact type

3 ratio of observed to expected frequency = observed/expected

TABLE 7
MODIFIED AND UTILIZED ARTIFACTS COMPARED TO NON-UTILIZED ARTIFACTS AND BROKEN DOWN BY MATERIAL TYPE

Material Type	Total utilized and modified artifacts	Total non-utilized flakes	ratio[1]
fine quartzite	14	56	.25
coarse quartzite	14	122	.11
oolite chert	2	3	.67
quartz	0	0	---
brown chalcedony	8	53	.15
brown chert	7	2	3.50
clear chalcedony	0	4	.00
basalt	0	0	---
Total	45	240	.19

1 the ratio of tool to non-utilized flakes = total tools/total flakes

TABLE 8
REDUCTION SEQUENCE OF NON-UTILIZED FLAKES

Material Type	cores	core frags.	decort.[1] flakes	reduc.[2] flakes	ratio[3]	mean size[4] mm^3
fine quartzite	2	8	22	34	1.55	9427
coarse quartzite	2	15	70	52	.74	9688
oolite chert	0	0	2	1	.5	5831
quartz	0	1	0	0	0	--
brown chalcedony	0	4	27	26	.96	2958
brown chert	0	0	1	1	1.00	2912
clear chalcedony	0	1	2	2	1.00	2388
basalt	1	0	0	0	0	--
Total	5	29	124	116	--	7914

1 decortication flakes - flakes with cortex

2 reduction flakes - flakes without cortex

3 ratio of reduction flakes to decortication flakes = reduction/decortication

4 mean size of all non-utilized flakes in millimeters cubed

TABLE 9
EDGE ANGLE MEASUREMENTS BROKEN DOWN BY MATERIAL TYPE AND ABRASIVE WEAR TYPE

Material Type	Abrasive wear type	edge angle mean	edge angle S	Number
fine quartzite	non-determinable	69	6.9	8
	grinding	--	--	0
	smoothing	58	7.07	2
	polish	--	--	0
	blunting	--	--	0
Total		67	7.9	10
coarse quartzite	non-determinable	62	6.9	6
	grinding	--	--	0
	smoothing	66	12.0	4
	polish	--	--	0
	blunting	--	--	0
Total		64	8.9	10
oolite chert	non-determinable	--	--	0
	grinding	--	--	0
	smoothing	52	26.0	2
	polish	--	--	0
	blunting	--	--	0
Total		52	26.0	2
brown chalcedony	non-determinable	62	4.1	4
	grinding	--	--	0
	smoothing	44	0.0	1
	polish	--	--	0
	blunting	--	--	0
Total		58	8.7	5
brown chert	non-determinable	59	6.05	4
	grinding	--	--	0
	smoothing	60	0.0	1
	polish	36	0.0	1
	blunting	73	0.0	1
Total		58	11.7	7
For entire population		62	10.6	34

TABLE 10
EDGE ANGLE STATISTICS

	edge angles which show use-wear	edge angles which show no use-wear
mean	61.85	56.00
variance	112.85	59.09
standard dev.	10.62	7.68
standard error	1.82	2.21
kurtosis	.58	- .40
skewness	- .67	- .60
range	46.00	29.00
minimum	34.00	42.00
maximum	80.00	71.00
number of edges	34	12

Total edges	46
Total measured artifacts	45

FIGURE 1

Simplified diagram showing the general direction of applied force used during cutting activities which produces irregular flaking use-wear.

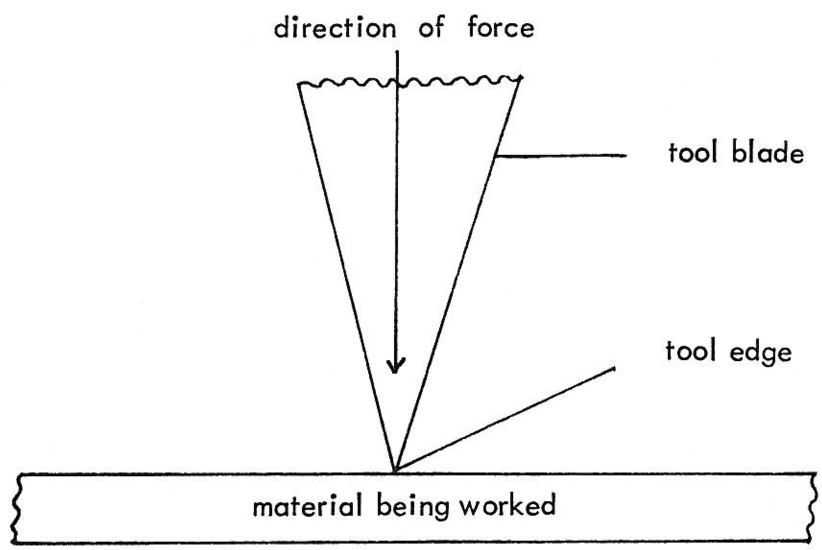


FIGURE 2

Simplified diagram showing the general direction of applied force used during scraping activities which produces step flaking use-wear.

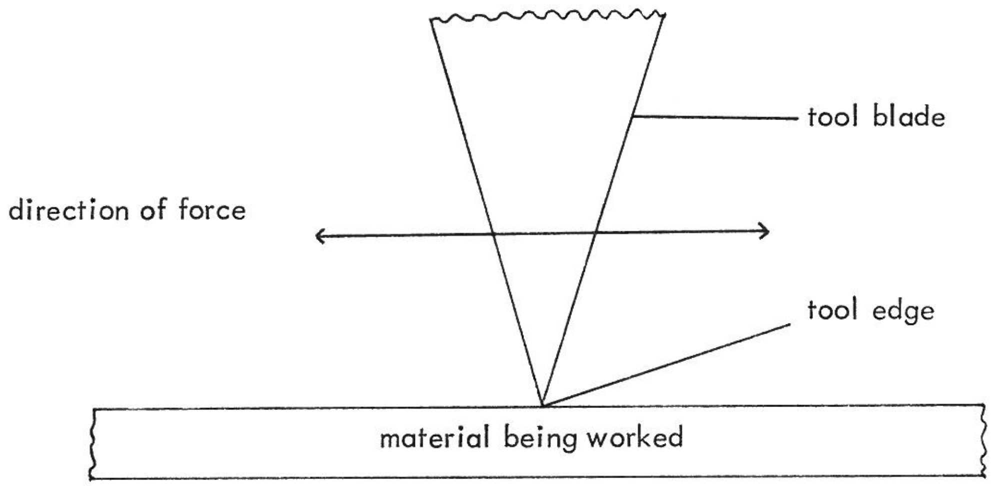
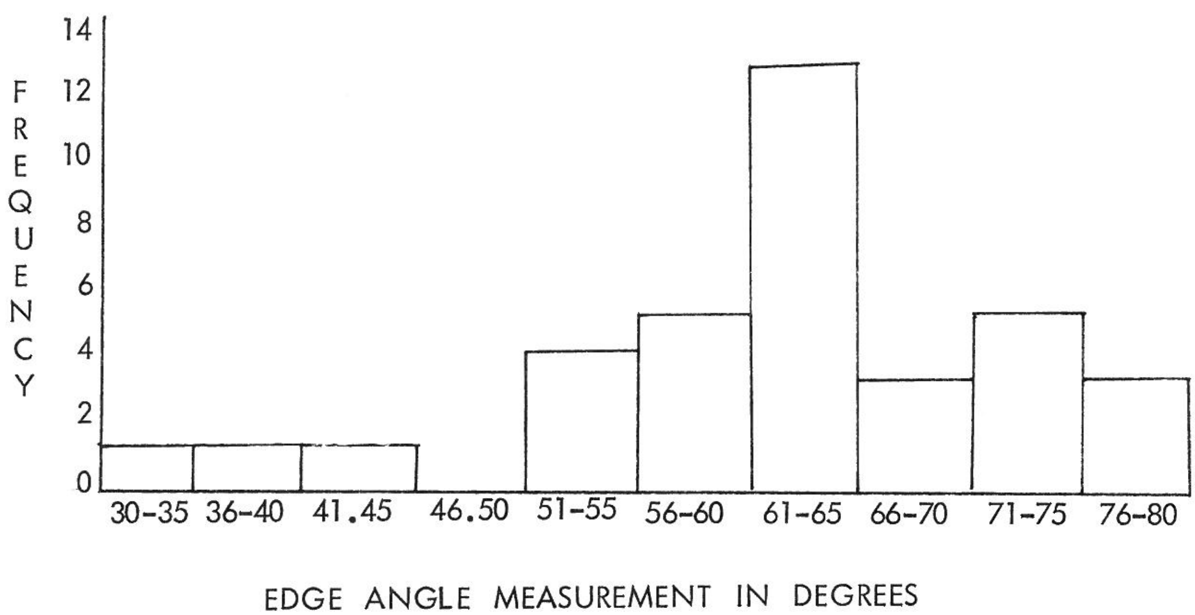


FIGURE 3

Histogram of edge angle measurements for those artifacts which show use-wear. Total artifacts = 33. Total edges = 34. This shows a unimodal distribution for the edge angle measurements from the Bison Basin site 48 FR 440.



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