~~COMMENTS ON USING THE LOW OR OBTUSE ANGLE OF STONE TOOLS AS A CUTTING EDGE~~

THE ~~LOW~~ ANGLE

CUTTING EDGE IN STONE TOOLS

The interpretation of the diverse functional uses of stone tools has ~~long been~~ a theoretical ~~enigma~~. What materials was ancient man forming, altering or modifying with his stone tools and at what angle did he hold the working tool? Were they held just in the hand when performing these tasks or were they affixed to a handle or holding devise, adhered to other materials or lashed to stocks and shafts? Many stone artifacts have been placed in typological categories which imply function. Some are correctly typed because of actual observation and ethnographic accounts. Other functions are based on theory which places ~~like~~ implements bearing certain technological characteristics into useful typological categories. As a result, artifacts not conforming with these categories are said to be non-diagnostic and are often discarded as debitage ~~and~~ lithic debris, flakes, exhausted cores ~~and~~ general manufacturing by-products.

The use of the obtuse angles on artifacts as a working edges has generally been overlooked or ignored. Recent functional experiments indicate these ~~low~~ angles provide additional diagnostic traits. Careful study of the obtuse edge on artifacts may reveal functional scars and wear patterns. We know from experiment and archaeological evidence that the acute angle on a flake or blade is an excellent cutting edge for yielding materials, but we have failed to consider the functional value of the obtuse angles of more than ninety degrees and less than one hundred and thirty degrees.

Functional experiment reveals that the obtuse angle on stone tools can perform tasks impossible to complete with stone tools having acute angle edges of ninety degrees or less. The innovation ~~of functionally using the~~ use of the obtuse angle as a cutting edge has been a revealing experience and has opened the door to further experiments to determine the diversity of this angle as a functional edge.

Experimental results show that the obtuse angle on stone tools made of material even as fragile as obsidian can be used to remove spiral shavings with accuracy and control from dry bone and the tool will still retain its cutting edge. For example, the use of an obtuse angle on stone tools provides a clue to the elaborate carving of lintels & other cuttings of extremely hard wood (sapodillia) used in temple construction by the Maya in Yucatan. Using the obtuse angle of a stone tool may also explain the modification of other resistant materials such as bone, horn, antler, and ivory. When the acute edge is used to form this type of resistant material, the tool will break or the edge will dull before the task is completed.

~~Problems developed during the functional experiments regarding the effective and efficient use of an obtuse angle as a cutting edge and were only resolved by replicating the prehistoric cutting implements and then experimenting with diverse~~

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These were compared with archaeological specimens for striations, polish, and flakes.

In each case my raw materials are the same as in the prehistoric specimens.

I made replicas of obtuse angle tools and then used them in many ways - cutting at different angles, holding in different positions, and cutting and forming a variety of materials. Then both the cutting tool and the material being worked were compared with archaeological specimens to estimate the striations, polish and functional flake scars. In each case, the raw materials of both the toolsand the material being cut or formed was the same as those employed in prehistoric specimens.

functional techniques. After comparing the results of functional use on the replica with the original artifact, the edges were checked for similarities of wear patterns and compared with those found on aboriginal tools. It is imperative that the experimenter k have his replica with a fresh edge and duplicate angle as the genuine tool and, after the functional experiment, the replica should bear the same striations, the same degree of polish and the same use flake scars as the aboriginal artifact.

3rd. It is necessary to functional experiments that the worker use the same materials for modification as those available aboriginally, whether they are being gouged, planed or chopped. Some implements having acute angle edges - like the obsidian blade - require light force for xx cutting soft materials and the thumb and index finger furnish sufficient force for light cutting tasks. But when the obtuse angles of tools are used for cutting, more force is required - much the same principle as our modern tools. Between 90 Different and 130° materials react differently - The acute angle 0 - 90° a low angle can be used to work softer materials while a an obtuse angle - 90° - 130° steeper angle is used to work more resistant material. The angle of the tool edge must correspond to the resistance of the material being worked. Any functional experiment must consider the brittle nature of the stone tool. They cannot be twisted, used in a levering way, and one must be familiar with their strong and weak areas. Also, The stone tool must be kept in alignment with the opposing resistance of the material being worked. Skill in using any hand tool requires practice and reason which demands continued experiment.

Even after the experiments yield good results, they may not compare to the work 0f a xxNxx skilled aboriginal workman.

One ~~use~~ of ~~the~~ ~~obtuse angle as a~~ cutting edge is ~~the~~ blade scar xxdesx ridges on a polyhedral core. ~~These~~ parallel blade scars are slightly concave between the xixdx xxx ridges, leaving the ridges as ~~a very~~ satisfactory ~~low~~ angle working edge. The core is used as one would use a draw plane - holding the proximal and distal ends of the core with the right and left hands. ~~Whereas~~ the draw plane can only be ~~drawn~~ toward the user, the ~~low~~ angles on ~~the~~ polyhedral core can be ~~used as a plane in both a forward and backward motion.~~ The polyhedral core is drawn at a slight angle rather than at right angles as one would use a plane. When used in this fashion, the depth of the cut may be accurately adjusted by a slight change of angle of the bearing surface. The obtuse angle of the cutting edge is far stronger than a xxx ninety degree edge. ~~It is astounding how a material as fragile as obsidian can possibly remove spiral shavings on dry bone, but such is the case.~~ When soaked xxgx antler is worked, shavings three inches long may be removed with a single pass of the core. I know of no single edged metal tool which will remove material wxk with the speed ~~and rapidity~~ of the obsidian core tool. The cuts are very clean and xx smooth with no bruising of the surface being planed. When the co re planer is used on very hard wood, the finish is excellent and the core can be used to make surfaces flat. Surprising, too, is the durability of the edge. Use flake scars are usually due to holding the tool at the wrong angle or contamination of the mxxterixx material being planed rather than from function. When the low angle of the core is used repeatedly on resinous wood, resin will build up and impare the cutting action. Then the resin must be scraped off or removed with solvent or a new blade detached from the core to expose two new sharx sharp cutting edges. Or the entire polyhedral xx core can be xejuvenatxd rejuvenated by removing a series of blades around the pxrimetex perimeter to expose new low angle cutting edges.

The surprising and excellent results of using the low angles of a core as a shaping and forming tool for antler, hard wood and bone prompted me to look for similar angles on other artifacts for cutting experiments. Similar experiments with both burin blades and cores resulted inx in only moderate success. Using the burin core in the manner of an engraving tool resulted in the core slipping and its corners breaking after a few passes - generally when the tip was lifted upward to terminate the cutting action. After a minimum amount of work on hard material, the right angle edges of the burin core were would xxx crush due to micro step flake scars forming on the margin, causing the edges to crush. However, if the burin blade was removed at more or less than a 90 $^{o}$ angle to the margin of x the core, both acute and obtuse w angles were formed on the core's edge.

The acute angle was excellent for working soft woods and the obtuse angle was good for forming more resistant materials. Failure to adequately use an angle of 90° or less is probably due to a lack of understanding of the proper use of the many prehistoric styles ~~ofxxxxxxx~~.of burins.

The natural facets on quartz crystals can also be used as forming tools but are not as efficient or effective as the artifically made obtuse angles on cores and other tools. The natural facets on the crystal are plane surfaces, while those made by removing a blade or flake from a core leave concave surfaces between the obtuse angles giving a sharper cutting edge. If the crystal is made into a blade core by removing blades longitudinally, the obtuse angles of the blade scars are a far more efficient cutting tool than the natural facets. However, a quartz crystal from Bandarawela Celon showing bruises on the natural obtuse angles may well be the result of function, (Allchin 1966; Fig. 30).

~~Axtx Axxothx~~ Another functional expeiriment involved the use of a strangulated blade. Archaeological specimens from the El Inga site ~~inxEaxx~~ Eucador were brought by ~~xGax~~ Carl Phagan to the 1970 ~~Lithic Technology~~ I see Flint working field school. We made replicas of the originals from obsidian. In archaeology this ~~xtax~~ strangulated blade has been classified as a spokeshave.

We attempted to use it by placing the concave edge on a wooden shaft and pulling the ventral side of the blade toward the worker. This removed only a slight amount of wood and left a very irregular cut on the shaft. If additional pressure was applied to the blade, it broke. We then noticed striations on the ventral side of the El Inga specimen between the two opposing concavities which comprised the strangulation. These striations gave us a clue to the manner in which the implement was held and used. The striations indicated that the slightly convex ventral side of the blade was placed flat on the wooden shaft being shaped. The convex surface acted as a bearing and aided the adjustment of the depth of the cut being made. When we used the strangulated blade in this manner, it made a flat smooth cut and required little force to remove a clean shaving. Both concavities serve well as cutting surfaces. The opposite concavity on the blade permitted the worker to tilt back the blade to terminate the cut. When used in this manner, the blade did not break because little force was necessary to remove shavings from the material being worked.

Further functional experiments with the strangulated blade showed that the angle of the cutting edge of the blade could be made acute for soft materials or obtuse for cutting harder materials. If the cutting edge were too acute or were used improperly, then use flakes were removed from the ventral side of the blade rather than the concave portion of the strangulation.

Many tools other than blades w exhibit a low angle which are simple and rapid to make or resharpen. Often by a simple removal of a single flake a new working edge is exposed. It is possible to misinterpret this single sharpening flake as a tool when it is only a reconditioning or resharpening flake. Dr. Robert Heizer ~~has let me examine~~ showed me obsidian cores fxx from Papalhuapa; Guatamela. This site is important because it is near its source of raw material and should illustrate many manufacturing steps. ~~The cores~~ ~~xxx were used~~ for making blades but also show the effects of other uses. The blade scars on the cores d were dulled which indicated they could have been used as planes, wedges, reamers, drills, anvils, pointed percussors for making soft stone figures and some could have been sectioned to be used as preforms for ear plugs. A preliminary report has been published of this site by John A. Graham and Robert F. Heizer (1968). Through the courtesy of Dr. Junius Bird I was given a collection of six obsidian polyhedral cores from Oaxaca, Mexico, 1970 and all cores ~~showed~~ show signs of wear. Obsidian polyhedral cores from the Metro xxxx excavations in Mexico, D.F. ~~were~~ shown to me by Dr. Jose ~~Louise~~ Luis Lorenzo in 1970. ~~Again, the cores~~ showed apparent use of blade scar ridges, including one core showing that the distal x end was used as a drill until the core was worn kxxxxsxxxxtxxxsxxxxx to a smooth cylindrical shape. I collected Obsidian polyhedral cores from Texxthx Teotihuacan, Puebla, Colima, and on the coast in the IX State of Nayarit wxxxx and they bear evidence of use of the blade scar ridges. Through personal communication with Dr. Denise de Sonneville-Bordes (1970) I learned that she has noted evidence of functional scars x on the dorsal ridges of blades from the Upper Paleolithic of Southern France. Personal examination of a blade from the Clovis site at Murray Springs, x Arizona (1969) showed intensive wear and polish on the dorsal ridge while ;the lateral margins were still quite sharp. This suggests that the xidx ridge was used as a cutting implement before the blade was detached from the core and when the ridge became dulled was detached from the core to expose two fresh useful ridges. The core with multiple low angle ridges would have been an ideal implement for rapidly shaping the shaft wrench made from the long bone of a mammouth ffxx found at Murray Springs (Hayex Haynes and ~~Henning~~ Hemmings 1968). Occasionally cores are noted which are not exhausted for further blade detachment but tx the ridges bear evidence that they were used for shaping tools while they still retained their size.

Inxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx In conclusion, limited experiments, limited examination of paleolithic implements indicate that more lithic debris xxxxxxx should be retained and intensively examined and not discarded as non-diagnostic. It is entirely possible that definite technological traits, characteristic modes of use, manners of holding or hafting, and the nature of the material being worked can possibly be defined by this lithic debris and we may find multiple-purpose implements. It has been a revelation to find that for some tasks a ~~thin~~ thin, sharp acute-angled edge will not perform as well as an obtuse ~~low~~-angled edge. *