THE LOW ANGLE
CUTTING EDGE IN STONE TOOLS

The interpretation of the diverse functional uses of stone tools has been difficult for a long time. 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 device? Did they adhered to other materials or were they 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, lithic debris, flakes, exhausted cores, or general manufacturing by-products.

The use of the obtuse angles on artifacts as 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 edges of ninety degrees or less. The use of the obtuse angle has been a revealing experience and has opened the door to further experiments.

Experimental results show that the obtuse angle on stone tools made of material 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 lintles 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 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.

I made replicas of low angle tools and put them to work in several ways. 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. 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 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 ninety and one hundred thirty degrees, a low angle can be used to work softer materials while a steeper angle is used to work more resistant material. 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. 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 of a skilled aboriginal workman.

One source of a low angle cutting edge is a blade scar ridge on a polyhedral core. The parallel blade scars are slightly concave between the ridges, leaving the ridges as satisfactory low angle working edges. 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. The modern draw plane can only be pulled toward the user but the low angles on a polyhedral core can be pushed or pulled. The polyhedral core is drawn at a slight angle rather than at right angles as one would use a modern 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 ninety degree edge. When soaked 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 with the speed of the obsidian core tool. The cuts are very clean and smooth with no bruising of the surface being planed. When the core planer is used on very hard wood, the finish is excellent and the core can be used to make surfaces flat. It is surprising how durable the edge can be. Use flake scars result from holding the tool at the wrong angle or contamination of the 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 sharp cutting edges. Or the entire polyhedral core can be rejuvenated by removing a series of blades around the 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 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 would crush due to micro step flake scars forming on the margin. However, if the burin blade was removed at more or less than a ninety degree angle to the margin of the core, both acute and obtuse 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 ninety degrees or less is probably due to a lack of understanding of the proper use of the many prehistoric styles 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).

Another functional experiment involved the use of a strangulated blade. Archaeological specimens from the El Inga site in Eucador were brought by Carl Phagan to the 1970 Idaho State University Flintworking Field School. We made replicas of the originals from obsidian. In archaeology this 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 straitions 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 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.

Robert Heizer has let me examine obsidian cores from Papalhuapa; Guatemala. This site is important because it is near its source of raw material and should illustrate many manufacturing steps. The cores were used for making blades but also show the effects of other uses. The blade scars (ridges) on the cores 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 signs of wear. Obsidian polyhedral cores from the Metro excavations in Mexico, D.F. were shown to me by Jose ~~Louise~~ Luis Lorenzo in 1970. Again, the cores showed apparent use of blade scar ridges, including one core showing that the distal end was used as a drill until the core was worn to a smooth cylindrical shape. I collected obsidian polyhedral cores from Teotihuacan, Puebla, Colima, and on the coast in the State of Nayarit and they bear evidence of use of the blade scar ridges. Through personal communication with Denise de Sonneville Bordes (1970) I learned that she has noted evidence of functional scars 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, Arizona (1969) showed intensive wear and polish on the dorsal ridge while the lateral margins were still quite sharp. This suggests that the 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 found at Murray Springs (Haynes and ~~Henning~~ TOM HEMMINGS 1968). Occasionallly cores are noted which are not exhausted for further blade detachment but the ridges bear evidence that they were used for shaping tools while they still retained their size.

In conclusion, limited experiments, limited examination of paleolithic implements indicate that more lithic debris 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, sharp acute-angled edge will not perform as well as a low-angled edge.