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Effects of Raw Materials on Biface Manufacture

Abstract. *It has been suggested that the degree of refinement of trimming seen on Lower Paleolithic bifaces reflects the level of technical sophistication of the toolmaker. This has been tested by a series of experiments carried out at Olduvai Gorge, Tanzania, and related to some of the archeological assemblages there. It is concluded that advanced ideas and increased mastery over raw materials do not necessarily result in stone tools that are more refined in appearance.*

It is a widespread assumption among prehistorians that the refinement of trimming on Paleolithic bifaces (hand axes) as measured by the number of flake scars indicates the technical level of manufacture. There is also a consensus of opinion that such refinement can be used to compare different stone assemblages and thereby assess their chronological relationships (*1–3*). However, Mary Leakey has noted with reference to Olduvai: "It can be stated that there is no progressive trend, in the manufacture of bifaces, from Bed 11 to the Masek Beds, nor does the degree of trimming become more refined in the later occurrences" (*4*). Other workers have noticed a similar phenomenon on a continental basis (*5*).

In this report I attempt to describe how the nature of a raw material affects both the form of a stone tool made from it and the refinement of retouch evident on such a tool.

Bifaces occur at Olduvai in six main lithic materials: quartzite, basalt, trachyandesite, phonolite, nephelinite, and trachyte (*6*). I studied the flaking characteristics of these materials during several months of experimental biface manufacture at Olduvai. In all cases tool blank weight and dimensions were taken, manufacture time was recorded, all debitage was collected, and the finished tool was measured. Experiments were performed with particular emphasis on the kinds of biface blanks most probably used at Olduvai (lower and upper Bed IV). Raw materials were obtained from the sources used by the early occupants of the Olduvai area (*6*). Bifaces were made by direct freehand percussion with basalt hammerstones. The aim was to produce an efficient biface in as short a time as possible from each of the different types of blanks. The data on tool production shown in Fig. 1 indicate differences in production and activity level from typical blanks in each of the main raw material categories. Data are available for 20 to 30 bifaces and cleavers in each material (*7*).

Quartzite outcrops at Naibor Soit, a Precambrian inselberg about 3.5 km from the confluence of the Olduvai Main and Side gorges (see Fig. 2). This material is coarse-grained and generally white, although sometimes green (*6*). It occurs both in the main outcrop and in the form of detached chunks and tabular slabs, which litter the surrounding slopes. Tools can be made either from one of the slabs or from a large flake struck from the outcrop. The procedure used for biface production depends on whether the blank is a tabular slab or a large flake. A slab blank requires only to be flaked around its perimeter to give the tool sharp edges and the desired shape. Bifaces made from loose slabs often show the original tabular surfaces in the central part of each face. On the other hand, a large flake detached from the outcrop generally requires little trimming, as it already has sharp edges that can be incorporated as edges of the biface. When made in this way, quartzite bifaces are more often triangular in transverse section and thinner than those made from slabs.

When used for skinning and cutting meat, quartzite bifaces are very efficient, because the tool edges remain sharp during use and, when blunted, can be easily resharpened by removing a second series of flakes from the edge. Flakes are most easily detached by long, swinging, follow-through blows throughout production. The coarse grain of the quartzite inhibits the use of fine retouch.

Basalt and trachyandesite are from the volcano Lemagrut, 18 km south of Olduvai (Fig. 2). They are generally gray or almost black, vary from medium- to fine-grained, and are available in the form of water-rounded cobbles and boulders (*6*). The resilience of these materials and the sizes and shapes in which they occur require that large flakes be struck from the boulders to serve as biface blanks. Secondary flaking of these blanks is best carried out by means of large, swinging, follow-through blows that produce deeply indented but short flake scars. My experiments indicate that the unretouched edge of a large primary flake is sharper than the retouched edge. It is probably for this reason that most Olduvai bifaces made in basalt and trachyandesite incorporate these primary edges. The experiments have also shown that basalt bifaces are efficient when used for skinning and cutting meat, but that the primary flake edges cannot be resharpened effectively after becoming blunted. Basalt edges are more easily blunted than quartzite edges but last longer during use than phonolite edges.

Phonolite occurs at Engelosin, a steep-sided volcanic neck that outcrops about 12 km from the confluence of the gorges. It is very fine-grained material and generally dark green or gray in color (*6*). It occurs both in slabs and in large blocks on the slopes surrounding the outcrop.

Phonolite bifaces, like those of quartz-

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ite, can be made either on slabs as core tools or on large flake blanks. The phonolite is flow-banded and has a preferred plane of cleavage (6). This means that flakes are easily struck with the grain but not across it. The primary flake edges of phonolite are very sharp, but brittle and easily blunted. Because of the fine grain of the material, the bifaces can easily be resharpened without greatly reducing their size. They can also be made more symmetrical, thinner, and with straighter edges.

Experimental results summarized in Fig. 1 illustrate the production time and the number of blows delivered during each 10-second period of biface manufacture. The graphs for quartzite and basalt show a low frequency of hammerstone blows; biface roughing-out and trimming stages in these materials do not differ noticeably. In phonolite core-tool production the roughing-out stage is clearly differentiated from the fine trimming stage by its low blow frequency. Biface manufacture from phonolite flake blanks lacks the roughing-out stage, and the production graph is very similar to the last 2 minutes of phonolite core-tool manufacture.

Flaking properties and edge qualities of three major lithic materials found in the archeological occurrences at Olduvai have been described above. The mechanical properties of these materials differ significantly, as do the qualities of their cutting edges. All of these factors affect production procedures and biface efficiency. They also affect the apparent degree of refinement of any particular biface. These results emphasize the need for considering types of raw materials when analyzing and comparing bifaces from different Paleolithic assemblages. Examples from the Olduvai archeological succession are used below to illustrate some of these points.

The WK (Waylands Korongo) Main Channel site is an Acheulean assemblage in upper Bed IV (4). Bifaces at this site are made in three main materials: basalt and trachyandesite (70 percent), quartzite (21 percent), and phonolite (7 percent). The bifaces are virtually all made on large flake blanks with very little secondary flaking. They are rarely symmetrical and the secondary flake scars are deep, giving the tool irregular edges. The average scar count for the sample is 10.5 per biface (4). The WK bifaces appear to be simple with unrefined trimming.

The vast majority of bifaces from HEB (Hebereros) level 3 in lower Bed IV appear to be made from large phonolite flake blanks. In contrast to WK, the HEB-3 bifaces are symmetrical, slim, and generally have straight edges. Secondary trimming appears to be highly refined and the bifaces have an average scar count of 20 per specimen (4). Several factors may account for differences between the HEB-3 and WK bifaces. A main factor appears to be the different properties of the lithic materials used in the two assemblages.

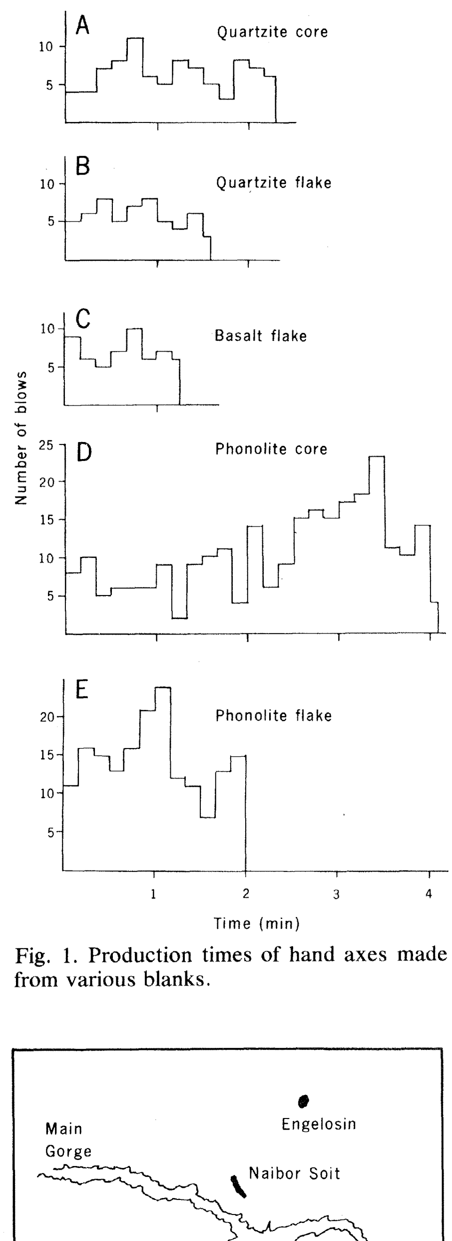

Fig. 1. Production times of hand axes made from various blanks.

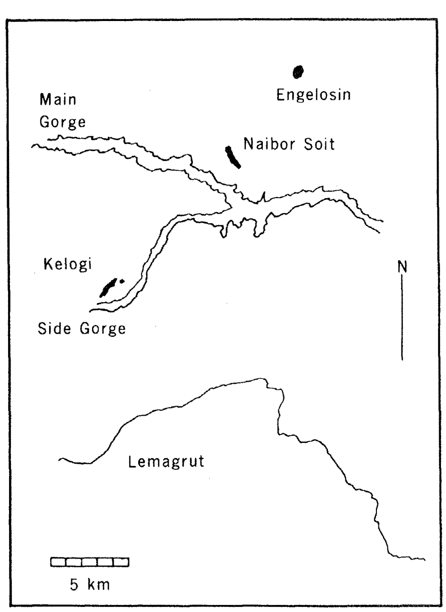

Fig. 2. Olduvai Gorge: main raw material sources.

The experimental results discussed above show that large flake blank production and seemingly simple secondary flaking require very little time on the part of the toolmaker. This economy seems evident in basalt and trachyandesite bifaces, where optimum working edges are quickly produced and the bifaces are not easily resharpened. It can therefore be suggested that the WK bifaces, in spite of their crude appearances, represent both technical skill and economy of material and effort. The seemingly more advanced HEB-3 bifaces represent a phonolite-oriented method of manufacture. Because of the nature of the material, these bifaces require a longer manufacturing time to obtain optimum edge conditions. These factors lead to an apparently higher level of refinement of retouch on the phonolite bifaces, as evidenced in the nature and number of flake scars and the thickness/breadth ratio.

It is concluded that a mere consideration of secondary flaking may be potentially misleading in the assessment of Lower Paleolithic bifaces. It is necessary to consider the size, shape, and flaking properties of the raw materials when assessing the level of technical sophistication evidenced in a stone tool assemblage. Experimental data on biface manufacture seem to indicate that some bifaces termed crude or primitive are, in fact, the products of sophisticated and efficient techniques of stone tool manufacture.

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