Sharon 2007

Artifact Typology and Detailed Sampling Considerations

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The artifacts that were selected for analysis were subdivided into four general categories, in accordance with the GBY lithic analysis scheme. These categories include two tool categories (handaxes and cleavers) and two waste categories (flakes and cores), each analyzed in conformity with a specific attribute list (see below). In most cases, special emphasis was placed on handaxes and cleavers, as they are the focal point of this study. Large flakes and large cores were analyzed when present in significant numbers, although both categories proved rare in most of the sites. In choosing specific artifacts for analysis, the following guidelines were followed:

a. The shape and workmanship of artifacts did not favorably influence their selection; in other words, classically shaped, esthetic artifacts were not preferred over atypical forms, classified as such by many typological systems.

b. Tools that were abraded or encrusted in such a way as to interfere with technological observation (e.g. scar counts and direction) were not included in the sample. Broken tools whose fractures occupied more than 10% of their original size (roughly estimated) were also excluded.

c. When present, untrimmed large flakes were also studied, in an attempt to understand the technology of their manufacture. As noted above, untrimmed large flakes are rare in most assemblages. Their frequent presence in a site was deemed to indicate an assemblage that was unique in nature, perhaps one oriented toward a specific activity locale such as a workshop (see Chapter 4).

d. In the production of Acheulian LCTs, large-flake blanks were detached from large or giant cores (Madsen and Goren-Inbar 2004), a rarity in most Acheulian assemblages. Hence, all such samples were analyzed, regardless of their number.

Table 1. General typology of artifacts by site.

Site	Handaxes	Cleavers	Large Flakes	Large Cores
South Africa				
Power's Site	50	118	-	-

Pniel 6a	41	102	-	-
Riverview	47	76	-	5
Pniel 7b	40	100	-	-
Doornlaagte	17	14	-	15
Canteen Koppie	-	-	-	18
Northwest Africa				
STIC	83	5	10	9
Ternifine	57	47	41	8
Grotte des Ours	81	10	35	
Tachenghit	29	16	3	6
Sidi Zin		10	-	-
East Africa				
Olorgesailie DE89 Horizon B	330	88	-	-
Isimila K6	185	28	-	-
Isimila K14	25	56	-	-
Isimila K19	24	40	-	-
India				
Hunsgi	47	49	52	-
Yediyapur	5	12	8	-
Chirki	41	48	15	-
Levant				
Ma‘ayan Barukh	125	-	-	-
GBY NBA	171	93	-	-
GBY Layer II-6*	325	136	-	13
GBY Area C*	7	10	-	-

* The data from GBY are preliminary, as the lithic analysis of the assemblage is not yet complete.

Typological Classification: Handaxes and Cleavers

> “My analysis suggests that the sets of pieces classified into the named forms constitute a recurrent improbable combination of attribute states and that the field of morphological variation is consequently not random. However, the analysis also suggested that, in general, the form categories are not modes, but arbitrary zones within a structured continuum” (Isaac 1977, 120).

As defined and explained in Chapter 1, handaxes and cleavers are Acheulian mega-types. The typological-morphological borderline between cleavers and cleaver-edged handaxes was established by Roe, who defined cleavers as tools whose cutting edge measures more than half the maximal width of the tool (Roe 1994). Yet, strict definitions notwithstanding, in some cases it is still difficult to distinguish between Acheulian handaxes and cleavers, whose contours can be confused. Some of these classification dilemmas are demonstrated in Fig. 2, using tools from the site of Tachenghit.

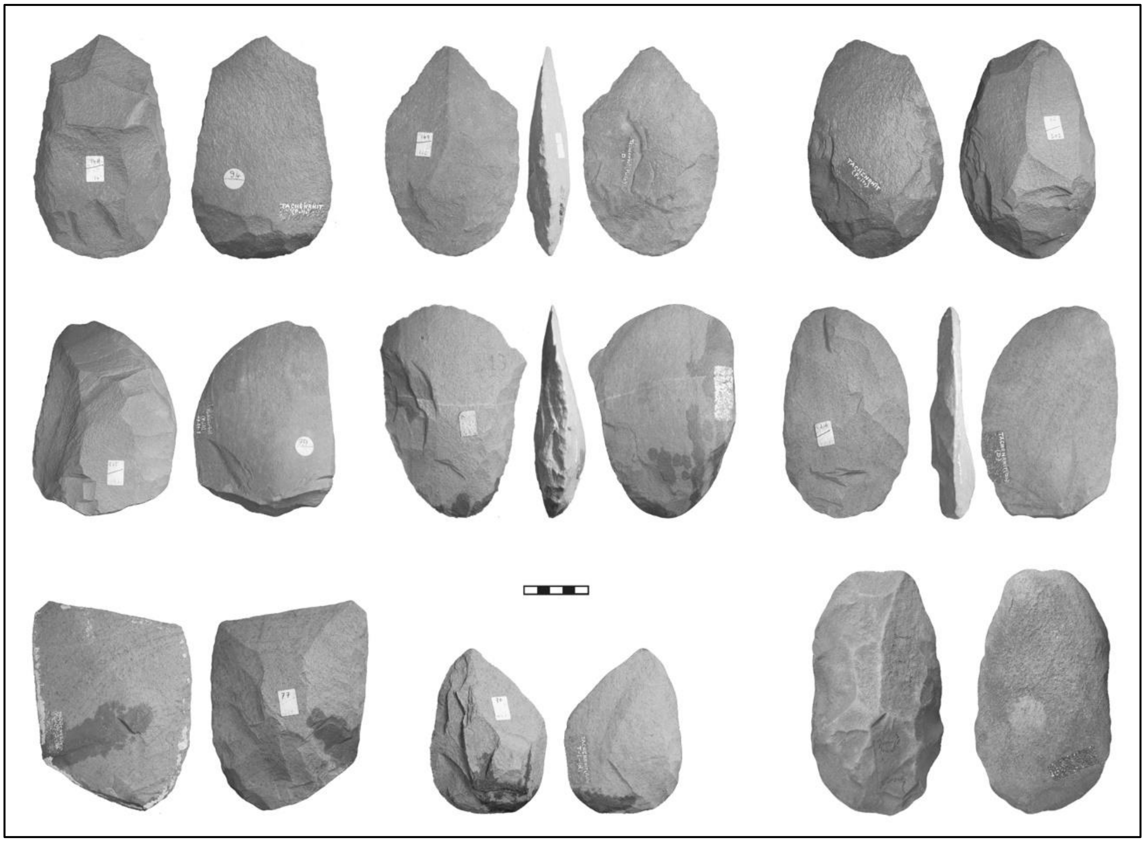

Figure 1. Cleaver/handaxe examples from Tachenghit.

Tools **a**–**c** are cleavers with a pointed tip. The cutting edge was formed by two scars, resulting from the removal of flakes from the giant core prior to the detachment of the flake itself (unlike the more frequent cases, in which only one such scar exists). They are considered to be cleavers, due to their technology of manufacture and the nature of their cutting edge. The main factor dictating their overall shape is the morphology of the blank selected for their manufacture (see below). They are tools made on large flakes, with an unretouched distal cutting edge and a clear separation between the edge and the lateral margins (Chapter 1). The cutting edge combines two straight edges. In his account of the LCTs from Kalambo Falls, Roe named these tools “double cleavers” (Roe 2001a, 501). He maintained that they were deliberately designed to have a pointed tip, although they proved to be somewhat problematic for Roe’s measurements of the edge angle and length and could not be included in his cleaver shape diagrams.

Tools **d**–**f** were made on large flakes and show very convex distal cutting edges. Of the three tools presented here, only **e** (made on a Kombewa flake) would have been traditionally classified as a cleaver, due to the visible meeting points between the distal edge and the lateral edges. Tool **d** is simply a large flake, because no secondary retouch is visible, and **f** should probably be classified as a handaxe.

Tool **h** represents an additional difficulty in definition. The tool has a clearly identifiable marginal cutting edge, unshaped by secondary retouch, which is tilted drastically to the side of the tool, forming a pointed tip. This is an extreme case of the “ultra-convergent” angle-edged cleaver that led Roe to base his shape diagrams on the measurement of edge angles (Roe 1994). These tools are also known as “guillotine-type”, chisels or bevels (Clark and Kleindienst 2001, 49). Tool **g** is undoubtedly a cleaver, although it too has a slanting edge.

Tool **i** is a large biface with a transverse cutting edge, representing another borderline case between handaxes and cleavers. It is also relatively weathered, rendering all observation difficult. It is unclear whether it has “distinct points of junction with the implement’s sides”, to use Roe’s definition (Roe 1994). It is also hard to determine a point from which to begin measuring the length of the tool’s cutting edge.

Despite the occasional quandary, as exemplified above, it should be noted that it is relatively easy to assign most Acheulian tools to their appropriate class (handaxes or cleavers). In this study, I have followed the definitions of cleavers and handaxes given in Chapter 1. Where these were found to be inadequate, I judged the relevant tool individually, usually basing my classification on such technological observations as the determination that the tool was produced on a large flake, and the treatment of minimal retouch on the ventral face of the tool as an indication that it is a cleaver.

Principles of Studying Lithic Assemblages

The concept of *chaîne opératoire* (Inizan et al. 1999; Roche and Texier 1995) has been adopted as this study’s approach. The *chaîne opératoire* is a way to “reconstruct and organize all the events having modified a block of raw material, from its selection to the ultimate discarding of all the elements coming from it” (Julien 1992, as quoted by Roche and Texier 1995). The concept combines such technological considerations as data retrieved from experimental knapping, raw material properties, refitting and an analysis of all the artifacts in a given assemblage, in an attempt to gain as full an understanding as possible of the entire lithic technological process. The life history" of a stone tool is termed a "project", which is composed of four successive sequences: raw material acquisition, tool production, tool utilization and tool discard. As this study deals with LCTs, constituting a restricted part of the Acheulian tool kit, it is self-evident that it cannot reconstruct the full *chaîne opératoire* typifying the Acheulian. Moreover, even when given the opportunity to study an Acheulian site's full assemblage, the best one can hope to achieve is a partial reconstruction of the *chaîne opératoire* (usually the first two sequences), due to the antiquity of the finds and the fragmented nature of the data (Roche and Texier 1995). In order to describe and interpret the *chaîne opératoire* of the Acheulian LCT assemblages, I shall use the multi-attribute analysis developed for the study of the GBY lithic assemblages. This method will be described below.

Nomenclature and Definition of Technological Terms

Acheulian LCTs and their technology of manufacture have been the subject of research for a hundred and fifty years. Over that time, many names, terms and definitions have come into use. The abbreviation "LCT" is itself quite new, replacing, albeit not completely, such terms as "bifaces". To add to the confusion, much of the terminology was developed in more than one language (usually English or French).

In this study, I have used those terms I deemed most suitable and explained my choices. Many of the terms follow the definitions of Inizan and others (1999). For a wider view on applying the *chaîne opératoire* method to the study of Acheulian LCTs, I followed Roche and Texier (1995) and Texier and Roche (1992). Clark and Kleindienst (1974, 2001) served as an additional source in defining many terms and tool types. Below is a list of key terms and their definitions as used here, while other, more specific terms will be defined in the appropriate chapters.

Large Cutting Tool (LCT): A single heading for unifacially and bifacially knapped Acheulian tools of all types (i.e. handaxes, cleavers, knives, picks, core axes, trihedrals and more), which emphasizes the importance of the cutting edge as the tools' main *raison d'être*. Some scholars prefer the terms "bifaces" or "bifacial tools", as they make no assumptions about the use of the tools. However, "bifaces" are sometimes perceived as being synonymous with handaxes, to the exclusion of cleavers and other tool types.

Pre-form: "… a subjective term used to distinguish between well-made artifact forms and less well-made tools" (Clark and Kleindienst 2001, 35), which is interchangeable with the terms "unrefined" and "unfinished". The term refers to Acheulian LCTs, unfinished in edge and shape, which bear a relatively low number of deep and unorganized scars. These tools were brought to their locale of discovery in an unfinished state for completion of their production process on-site, a task that was never accomplished. Thus, their crudeness indicates an incomplete technological sequence, rather than "primitive" technology.

Knapping Technique: This term takes into consideration both the tools used by the knapper during the tool-production process (e.g. hammers, anvils, etc.) and their function (Roche and Texier 1995). The main knapping techniques were percussion (either direct or indirect) and pressure flaking. During the Acheulian, direct percussion was probably the only technique applied, although different types of hammers (soft or hard) and anvils were in use. These will be discussed in connection with the term "technique".

Block: Raw material in its natural form prior to knapping. This general term groups together cobbles, boulders, nodules and any other natural form of raw material that was available to the Acheulian knapper (Roche and Texier 1995). Some scholars have used the term "chunk" for the same purpose (see, however, Clark and Kleindienst 2001, 62).

Core Method: A sequence of actions that reflects a specific concept of handling and manipulation, applied to a block of raw material during knapping for the purpose of detaching a desired flake (e.g. Levallois, Kombewa, Victoria West etc.). The definition is that of Roche and Texier (1995). Other scholars have used such terms as "core technology", or "core technique", but those are used in this study to describe other aspects of the knapping process (see below).

Blank: "Any element from which an object is knapped, shaped, flaked or retouched [see below]. It can be a nodule, a slab, a cobble, a debitage product (flake) etc." (Inizan et al. 1999). In this study, a "blank" represents a piece of raw material that has been worked to the stage just preceding shaping. Gamble and Marshall (2002) have suggested that large-flake blanks should be classified under the heading "debitage" and worked nodules (and any other natural block) under the heading "*façonnage*". I use the term "blank" as a general name for all implements at this production stage, with "flake blank", "slab blank" or "cobble blank" etc. serving in more specific contexts.

Shaping, Flaking (debitage) and Retouching: All of these terms denote stages in tool manufacture (Inizan et al. 1999; Roche and Texier 1995; Texier and Roche 1992). In the prevalent Acheulian LCT terminology, “shaping” usually refers to the main stage of production, prior to blank obtainment. “Flaking” normally refers to the detachment of a flake or a blade from a core. “Retouch(ing)”, sometimes called “secondary retouch(ing)”, is largely applied to a flake or a blade to modify its cutting edge. I use the general term “shaping” for all knapping activities that take place after a blank has been extracted. Newcomer (Newcomer 1971) distinguished between three stages in Acheulian handaxe shaping: “rough-out”, “shaping” and “finishing”. These have proven very useful in describing the bifacial tool-knapping sequence (Sharon and Goren-Inbar 1999; Sharon and Goring-Morris 2004 for definition, discussion and references), and are used here when applicable. Of course, the shaping of LCTs is only one stage in the *chaîne opératoire* sequence. Many other factors could have affected a tool’s flaking process: resharpening (McPherron 1999; McPherron 2006 for references), the tool’s history of use and such post-depositional occurrences as trampling. However, these elements are very hard to distinguish from scars that derived from shaping.

The Lithic Analysis Method

In order to ensure reliability in comparing widely separated Acheulian sites, the current study had to formulate a database of LCT samples that were documented in a uniform manner. This was achieved through the methodology of the attribute analysis developed for the GBY lithic assemblage (Goren-Inbar and Saragusti 1996; Goren-Inbar et al. 1992; Sharon 2000), combining a record of quantitative and qualitative attributes with typological observations (see below for detailed description). This method adopts the approach that understanding the cultural aspects of an Acheulian lithic assemblage depends upon studying as many stages of its tools’ *chaîne opératoire* as possible. The GBY attribute analysis method was selected for the following reasons:

a. The method was developed and adapted specifically for analyzing large-flake-based LCT technology, which is prominent in GBY.

b. The method is flexible, enabling one to add observations and attributes (e.g. a new type of raw material or retouch) into the system during the procedures of analysis.

c. The GBY lithic attribute analysis incorporates earlier approaches to lithic analysis into the examination. The measurements of the handaxes follow the method presented by Roe (1968, 1994, 2001). F. Bordes' typological definition was also used (Bordes 1961).

General Typological Classification

At the base of the GBY classification system lies the one developed for the lithic assemblage of 'Ubeidiya (Bar-Yosef and Goren-Inbar 1993). The latter, in turn, was based on M. D. Leakey's Olduvai Gorge lithic artifact classification (Leakey 1971). The lithic artifacts can be classified into the following general categories:

1. **Natural Pieces:** All pieces of stone (of any size) that bear **no clear evidence** of human modification or use (e.g. flake scars, battering marks, etc.). The fact that they lack any sign of utilization does not mean that their archaeological presence in a layer is due to a natural agent. In fact, a geomorphologic study of the GBY sediments has indicated that the water energy, involved in the accumulation of most of GBY Layer II-6 (Appendix 1), was insufficient for shifting lithic pieces larger in diameter than about 10 cm. This group includes manuports, potential hammer stones and anvils that due to insufficient evidence could not be assigned to any other tool category. From the technological perspective, these lithic artifacts preserve important information about raw material use strategies and other features.
2. **Flakes and Flake Tools:** All artifacts, tools as well as waste, that possess the morphological characters of a flake. Some of these artifacts display all of the characteristic flake attributes, including striking platform, ventral face with percussion bulb and conchoidal features. On others only a ventral face is identifiable, which is sufficient for ascribing an artifact to the "flake and flake tool" category.
3. **Cores and Core Tools:** All artifacts from which flakes have been removed by human agency. These include true cores as well as tools shaped on non-flake lithics, like chunks or natural cobbles (chopping tools, spheroids, etc.). The giant cores from which large flakes were produced for Acheulian LCT blanks are members of this group. Hammer stones, defined as cobbles and pebbles that show clear markings of battering, are also included in this group.
4. **Bifaces:** a) *Cleavers*: All knapped bifacial tools that fall under Roe's definition of "cleaver" (Roe 1994; see also above). b) *Handaxes*: All bifacially knapped tools that are not cleavers

are grouped into this category, encompassing handaxes of all types and such tools as picks and knives, which are very rare among GBY LCTs. In order to qualify for the handaxe category, a tool must have significant retouch on both faces. Retouch on only one face (unifacial) categorizes a tool as a flake rather than a handaxe, even though it may be similar in its morphology and flaking technology.

Attribute Analysis

Each of the above-mentioned typological groups (handaxes, cleavers, cores and core tools, flake and flake tools) was analyzed using a particular list of attributes, applicable to its specific character. These attributes include metric measurements, based largely on the methodology of Roe (1994, 2001), weight, circumference and the length of the cutting edge in handaxes. The qualitative attributes include such descriptive information as the raw material, state of weathering, patination and location and nature of any breakage. Other attributes refer to such technological features and observations as the type of blank used, the number and location of flake scars on a tool's face, the amount of residual cortex, the direction of the blows, the type and location of retouch, and more. The full version of the attribute lists is detailed in Appendix 2.

Defining a Tool's Face

Many lithic analysis attributes (e.g. number and location of scars, location and nature of the striking platform, residual cortex, etc.) are usually recorded separately for each face of the LCT. In order to facilitate comparison with other tools and assemblages, a consistent method of identifying each face was selected. Of the methods suggested by Goren-Inbar and Saragusti (1996) and Roberts and others (1997), Goren-Inbar and Saragusti's method was adopted in this study. The faces of a biface flake blank can be defined as dorsal (face 1) or ventral (face 2), depending upon the presence of a striking platform and other features, such as a percussion bulb or conchoidal waves. In those (rare) cases where two striking platforms are present on the same flake (Kombewa flakes), the definition of one of the faces as "ventral" is arbitrary. Problems arise when both tool faces are fully covered in flake scars, obstructing the identification of any of the blank's features. In such cases, the flatter of the two faces of the tool is treated as an equivalent of the ventral face (face 2).

Raw Material Identification

The type of raw material, used for LCT production in each assemblage was established through visual observation. When available, published data, or a site's excavator, provided additional assistance. Visual observation proved to be problematic in the following types of sites:

a. Sites whose different rock types are visually indistinguishable. An example is Ternifine, where quartzite and sandstone were used. The sand-rich quartzite made visual identification of the rock type impossible in many cases, forcing me to use the hybrid term "quartzite/sandstone" (see also similar discussion in Asensio 1996).

b. Sites at which various raw materials were in use, many of which require mineralogical testing for identification. A case in point is the East African sites, where a large variety of metamorphic and volcanic rocks were used alongside quartz, chert and others. It is fortunate that meticulous observations on these sites are available. With regard to Olorgesailie, Noll (2000) provided a detailed study of each artifact's raw material. In Isimila, several researchers studied the lithic assemblage, and the results of this work appear in a digital database at the Field Museum, Chicago. I have used these identifications when available.

Flake Scar Count

Flake scars, created by the knapper in the process of shaping a bifacial tool, are a key technological mark, attesting to a tool's production sequence. The number of scars and their morphology can tell us about the knapping method used, the time invested in production, and even the quality of workmanship. In analyzing LCTs, prehistorians contend with two main difficulties related to counting and interpreting flake scars:

1. Experimental studies have long demonstrated that the production of large cutting tools (particularly handaxes) generates many more flakes than the scars left on the finished tool (Madsen and Goren-Inbar 2004; Newcomer 1971). What, then, is the validity of counting scars on a finished and discarded biface?
2. The scars left on a biface are the result of different stages in the tool manufacturing process. Large, deep scars could have stemmed from giant core shaping prior to the removal of the large flake that was used as a blank for the tool. Other large scars could be the consequence of the "rough-out" stage of production. Long, shallow scars are attributable to the "thinning

and shaping" stage, and small scars, adjacent to a tool's edge, are probably the result of the "finishing" stage, in which the knapper prepared the cutting edge for use (all stages after Newcomer 1971). In addition, one cannot rule out the possibility that some scarring is the result of post-production tool use or post-depositional processes. The problem is distinguishing between the different types of scars, and the stages at which they were made. In many cases, it is not even possible to decide whether a specific scar was produced before or after blank production. This problem becomes even more crucial when dealing with coarse-grained and very old and weathered LCTs, similar to many of the tools depicted in this study.

These are problems that cannot be solved. Nonetheless, scar counts can teach us a great deal about the technology used in tool shaping and about the effort and dexterity involved in tool production. The method adopted here is a complete count of all scars, regardless of their stage of origin. Goren-Inbar and Saragusti (1996) defined the minimal length of a scar as 5 mm, but I have counted all of the tool scars I could identify, including the smallest ones. The rationale behind this approach is that according to many modern knappers (Goren-Inbar and Sharon 2006; Madsen and Goren-Inbar 2004; Newcomer 1971), finishing the edge by removing numerous micro-flakes and creating miniature scars on a biface's surface is an essential part of the knapping procedure. Since these tiny scars are virtually indistinguishable from those caused by tool resharpening, or use, I have counted all visible scars as a part of biface reduction. Studies that use the sequence of scars as an instrument for reconstructing technology and reduction strategy are very promising (Jöris 2006) in themselves, but are unsuitable for most of the tools under study here.

Metric Measurement

The following diagrams demonstrate the method of artifact placement during analysis, and the general measurements recorded for each artifact type-group (i.e. flakes and flake tools, cores and core tools, handaxes and cleavers). I have followed the methods of Roe (2001), both in tool grip and placement in the "Virtual Box" for measurement, and the measurement itself (with some exceptions, e.g. in measuring the length of a cleaver's edge).

Flake and Flake Tools

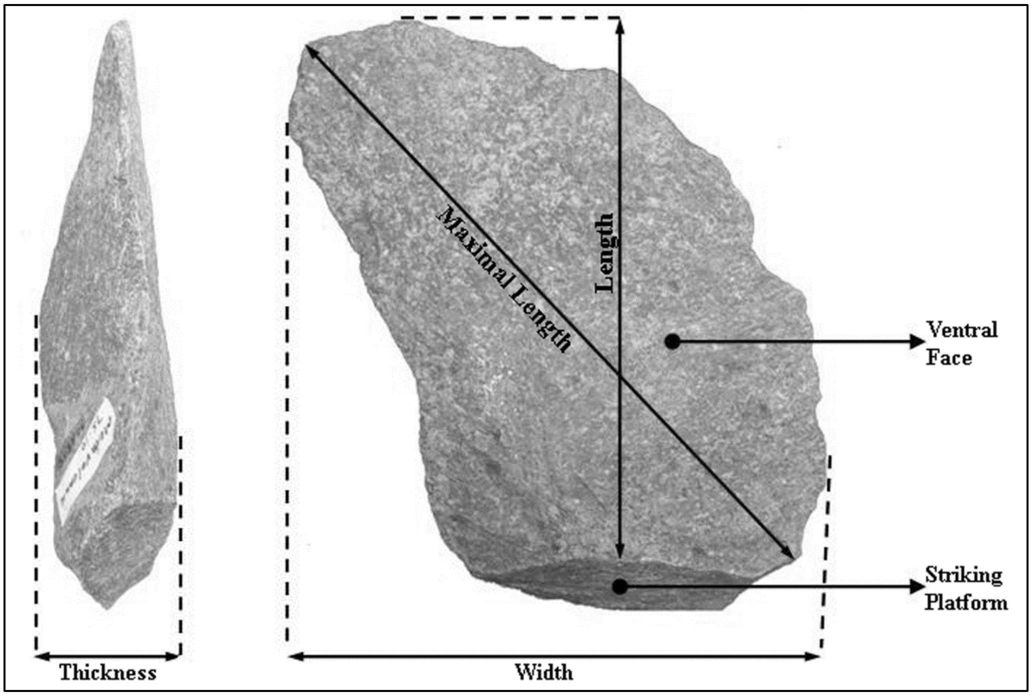

Figure 2. Flake position and measurement.

Cores and Core Tools

In cores bearing a scar that seems to have resulted from predetermined flake removal (in the sense of Boëda 1995), the scar's dimensions were recorded according to the axis of removal (Fig. 4). The weight of the core and its circumference were also measured.

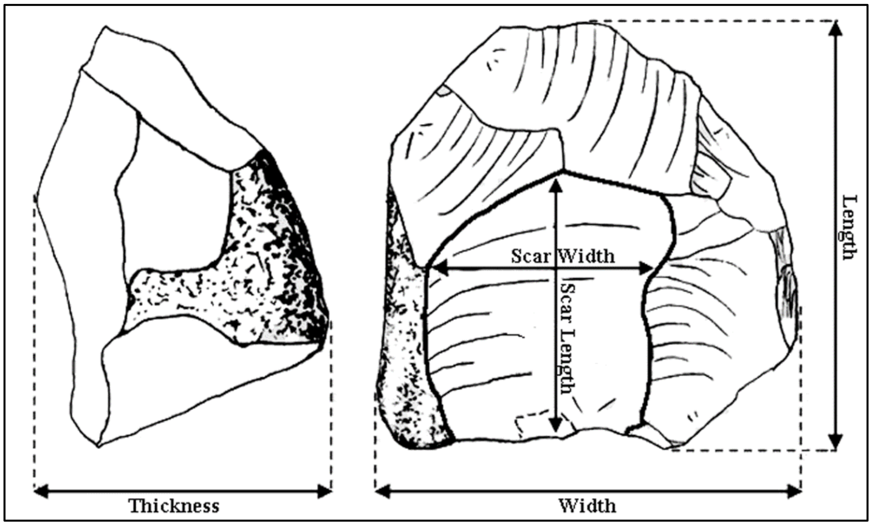

Figure 3. Core position and measurement.

Handaxes

In addition to the measurements specified in Fig. 5, the circumference of the handaxe was measured along its cutting edge perimeter, and the handaxe was weighed.

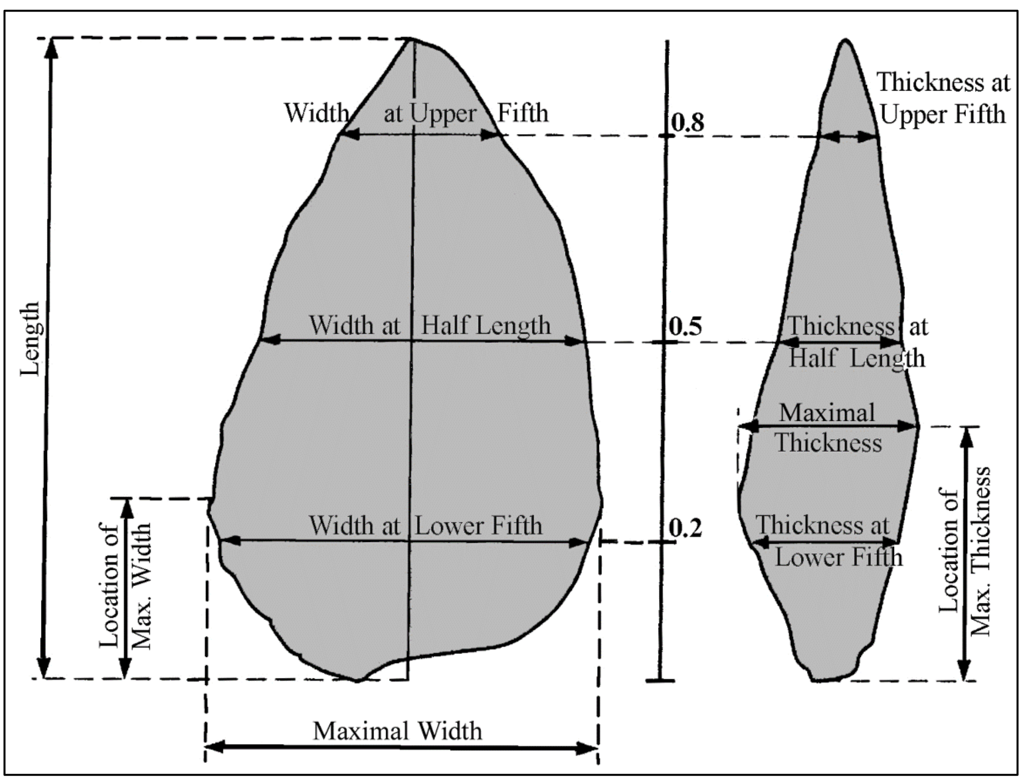

Figure 4. Handaxe position and measurement (after Goren-Inbar and Saragusti 1996).

Fig. 6 demonstrates possible handaxe cutting edge locations. The edge and its significance are discussed in detail in Chapter 4.

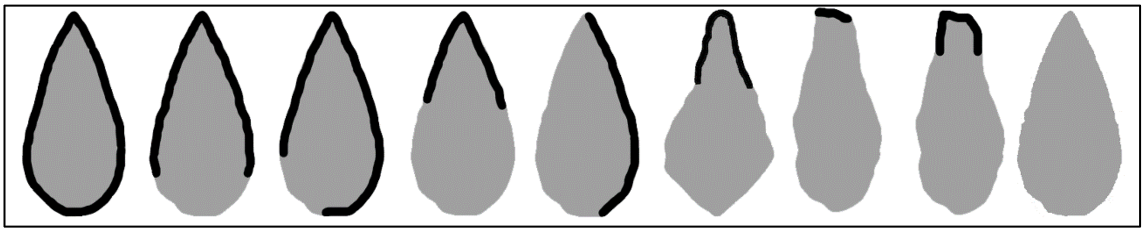

Figure 5. Locations of handaxe edges.

Cleavers

The circumference of the cleaver was measured along its maximal perimeter and its weight was recorded.

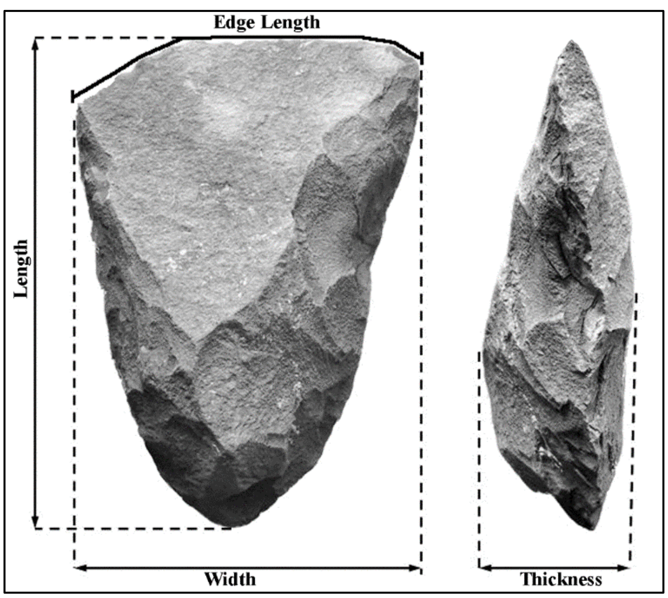

Figure 6. Cleaver position and measurement.