# MORPHOLOGICAL VARIABILITY IN ACHEULEAN HANDAXES FROM KARIANDUSI AND LEWA DOWNS ARCHAEOLOGICAL SITES IN KENYA.

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## DECLARATION

This project report is my original work and it has not been presented for a degree to any other university.

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## DEDICATION

This work is dedicated to my lovely parents John Munga and Edith Munga for their unwavering support and prayers.

## ABSTRACT

This study was carried out to investigate the variableness in Acheulean handaxes based on three factors, the choice of raw material used, the initial form and size of the raw material before shaping out, and the reduction on the handaxes. The project aimed at establishing a new method of looking at morphological variableness in an Acheulean handaxe collection, and a new reason to consider the possibility that certain factors remained constant throughout the years.

Metrical analysis was done on the handaxes, and a count of flake scars was done to quantify the removal intensity based on the flake scars present. The handaxes were also categorized into different raw materials and different initial forms of the raw materials used. The results indicated that, the difference in size of handaxes in both collections from Kariandusi and Lewa Downs was caused by the size and initial form of the raw material used before shaping was started. The choice of raw material use was however based on which material was abundant for use and still good for shaping. This also indicated that the larger handaxes were made from the most available and more abundant raw materials to the makers.

It was evident from the results of this project that the makers of both collections from Kariandusi and Lewa Downs both had the same reasoning in the choices they made. These choices include the type of initial form that was more convenient for them to use, the size of the raw material to use and the most convenient material to use in which they opted for the more available, abundant and easily accessible raw material. An excavation is needed in order to be able to get good metrical dates of the Lewa Downs collections and more advanced methods of analysis such as use-wear analysis to be used on the collection to be able to clearly understand the use of these tools.

**DEFINATION OF TERMS**

**Archaeological assemblage**: A collection of archaeological materials recovered from an archaeological site. It is also known as artifact or artefact assemblage.

**Lithics:** Stone tools.

**Stone Age:** The oldest and longest division of the Three-Age System that preceded the Bronze and Iron Ages. This is the oldest period of human culture that is characterized by use of stone tools.

**Levallois technique**: A very distinctive method of tool making in which tools are made from a prepared core with no or little modification**.**

**Biface:** A bevel formed by removing flakes from two faces of an edge.

**Acheulian:** An Early Stone Age industry that succeeded the Oldowan.

**Hand Axe:** A prehistoric biface used during the Early Stone Age period.

**Cleaver:** A large stone tool usually rectangular that resembles a bladed hatchet.

**Scraper:** A retouched flake tool that has been reshaped on one edge and left blunt on the other edge to allow grasping. It was probably used to scrape animal hides to make clothes.

**SASES:** Standard African Sites Enumeration System.

**Unwieldy:** Something too big or badly organized to function efficiently.

**Tapered:** Diminished or reduced in thickness towards one end.

**Old World:** The "Old World" consists of Afro-Eurasia (that is, Africa, Europe, and Asia), regarded collectively as the part of the world known to Europeans before European contact with the Americas.

**Metrical analysis:** Involves finding subtle variations in the sizes of chipped stone artifacts. Traits commonly measured are maximum length, maximum width and thickness.

**Butt:** The thicker, larger, or blunt end considered as a bottom, base, and support of the handaxe.

**Tip:** The slender or pointed end or extremity of the handaxe.

**Cortex:** The outer region of the handaxe. The outer covering before flaking was done.

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## LIST OF ABBREVIATIONS

**E.S.A:** Early Stone Age

**Ar.:** Argon

**p.:** page

**Chp.:** chapter

**SASES:** Standard African Sites Enumeration System

**IFA:** Institute for Archaeologists

**NMK:** National Museums of Kenya

# CHAPTER ONE

# INTRODUCTION

## 1.1 Introduction

This study entailed to look at the morphological variations between two Acheulean sites at Kariandusi found on the eastern Gregory wall of the Rift Valley and Lewa Downs found on the northern foothills of Mount Kenya. The study of these two collections was able to cut out a picture on the differences and similarities in the makers of the tools. In this project my main concern was to look at the variations caused by; choice of raw material, initial form of the material and its size and the reduction intensity and to analyze whether these factors have remained constant in both collection despite the difference in age. I made two assumptions before undertaking this study, such as:

a) The available field notes on the two sites are a true record of the activities that took place at the site during survey and excavations.
b) The materials at the museum are in the state they were in during survey and excavation meaning there were no new breakages or abrasions.

## 1.2 Background to the study

The Acheulean biface has been the focus of discussions (i.e. Archer and Braun 2009, McPherron 1999, Gowlett 2011) because it is the earliest artifact which shows the imposition of elaborate form, and because elements of that form are tantalizingly hard to explain. Those factors have led to an assumption of a plausible explanation, that the bifaces reflect primitiveness in the behavior of *Homo erectus*/*Homo ergaster* (*Homo ergaster* known to be the direct African ancestor of *Homo erectus*, acknowledging that *Homo ergaster* emigrated out of Africa and into Asia, branching into a distinct species. Both however are used interchangeably). It is also easy to assume that in the allometric adjustments we are dealing with some specific property of Acheulean bifaces, and that this again reflects some primitive aspect of the mind of *Homo ergaster* (Peregrine 2001).

Accepting the general importance of proportion in technology in the construction of Acheulean bifaces, it is still difficult for us to comprehend the factors which determine and limit particular proportions. The maker is probably influenced by the raw material block immediately available, and the immediate needs of the task, the two operating within the influence of the local cultural tradition and personal experience. As archaeologists, we see our trend lines but do we see the makers' view? They do not have any sight of the trend line. According to Gowlett (2011) these makers merely make each biface in the most appropriate way, judged in terms of the need, the material, and the cultural rules.

In Africa, there is a distinct difference in the bifaces made before and after 600,000 years ago with the older group being thicker and less symmetric and the younger being more extensively trimmed (Gowlett and Crompton 1994). There is evidence that over time, making handaxes became a refined procedure. In particular, early handaxes seem to have been sharpened by tip reduction alone, while later ones appear to have been resharpened along their entire form (Machin *et al*, 2007). Whether this is a reflection of the kind of tool that the handaxe had become, or of the increased stone-working capabilities of the makers, or probably a little of both is currently unknown. The Lewa Downs collection, dates at approximately 600,000 – 300,000 years (Kibunjia 1988; Leakey 1931) and appears to have more flake removal scars with resharpening along its entire form, while the Kariandusi collection dates between 1 million years to 700,000 years (Shipton 2011) and unlike Lewa Downs, the resharpening on the Kariandusi handaxes appears to have been concentrated on the tip.  This study has yielded important information on understanding morphological variability. I have tried to answer the question of size and reduction and how they correlate in these two collections, and whether or not the choices of raw material and initial form of the raw material influenced the variations.

### 1.3 Statement of the problem

Debate over the interpretation of inter-assemblage variability has been ongoing for decades and still continues today *(e.*g., Isaac 1971; Stiles 1979; Gowlett 1988; Semaw *et al*. 2009). In an attempt to explain Acheulean morphology Gowlett and Crompton (1994) carried out research to try and explain the question of shape variation and allometry by doing a comparative study of materials from Kariandusi, Kilombe and Kapthurian sites. Gowlett (2011) tackled the issue of variability in size within the Kariandusi collection and went ahead to compare size variability with the Kilombe collection. On the other hand, Kibunjia (1988), did a description of the Lewa Downs collection while Shackelton (1964:54) and Sirriainen (1984:24) only gave a brief description of the Laikipia area where the Lewa Downs Site is located.

No morphological variability study has been undertaken in the Lewa Downs site. In Kariandusi no research has been undertaken to study morphological variability specifically looking at initial form and size of the raw material, type of material and reduction intensity as a factor in causing variability. The research problem therefore is the need to investigate the morphological variability of the two collections of study as a way of understanding what caused the differences inspite of the age difference.

### 1.4 Goals and Objectives

**The goal** of this project was to explore the factors that could have led to morphological variability between the handaxes of Kariandusi and Lewa Downs

The **objectives** of the study were:

1) To analyze the differences and similarities in the choice of raw materials.
2) To assess the influence of initial form of raw material used on size.
3) To compare and contrast the reduction intensity of the Acheulean handaxes between the two sites.

## 1.5 Premises

a) The handaxes were made from different raw materials which eventually influenced the variability in the collections.

b) The sizes of the handaxes were influenced by the initial form of the raw materials used.

c) The Kariandusi and Lewa Downs handaxes had different levels of reduction done on them which influenced the variability.

## 1.6 Research Questions

This study was guided by the following research questions

1. Did the raw material types utilized in the manufacture of the handaxes influence variability among the collections?
2. What were the initial forms of the various handaxes and did their initial forms affect their size?
3. Did the reduction intensity of the handaxes from Kariandusi and Lewa Downs influence their size?

# CHAPTER TWO

# REVIEW OF RELATED LITERATURE

## 2.1 Introduction

Dating archaeological deposits is one of the goals to which lithic analysis is directed. From the very beginning of archaeological research, archaeologists realized that stone tool technology and stone tool forms changed regularly over time, and that those changes could be used to establish local and regional chronologies. The exploration of technology can lead to valuable insights about both ancient societies and ancient peoples themselves. More interesting are studies of lithics that consider how and why individuals may have chosen to make or use particular styles of stone tools. As stated in Peregrine (2001:162) archaeologist have also attempted to understand how stone tool makers thought by examining how stone tools were made, that is, how stone tool makers conceived the tool they wanted and how they shaped that tool out of the stone. The technological transition in early stone tool production – from knocking simple flakes from a core, to making specifically shaped tool (such as hand axes) from a core, to making large flakes of a particular size and shape (such as blades) and reshaping those flakes into the desired tools, mark dramatic advances in forethought and planning abilities. Wynn (1979) evaluated the intelligence necessary to produce Acheulean hand axes dating to roughly 300,000 years ago in terms of classic theories of child development. He found that the *Homo erectus* producing these hand axes were capable of several types of adult human thought and concluded that, in terms of organizational ability, *Homo erectus* were as capable as modern humans.

Humans made the first stone tools about two and a half million years ago, Ceramics came about ten thousand years ago. That means that lithics have been in use longer than ceramics have. Lithics are in fact the primary archaeological remains for more than 99% of human history and that’s really a very good thing because the analysis of stone tools can tell us an enormous amount about the past (Peregrine 2001:147).

According to Balme and Patterson (2006), only a limited number of stone types are well suited to making flaked stone artifacts, and these generally possess three qualities:

1. They are elastic, in that they will temporarily deform when force is applied to them.
2. They are brittle, in the sense that they will fracture if the applied force exceeds the capacity of the material to deform elastically.
3. They are isotropic, meaning they are equally susceptible to fracture in any direction and will not preferentially fracture along particular planes.

Peregrine (2001:148) also states that chipped stone stools are made by removing small chips or flakes of stone from a larger piece of stone called a core. A stone tool is shaped by carefully chipping away at a core until the desired thickness, form, and edge of the tool are achieved. The way chipping proceeds takes on some fairly standardized forms and is based on a unique facet of the stone used to make these tools. When struck some raw materials fracture in a concoidal manner. The force of the blow moves outward through the rock from the point of percussion, making a conical shape that, if the force meets an edge and is directed back into the rock, will break off a piece of the stone. The key for making stone tools is that if the force of the blow is directed at an edge, it causes a flake of stone, rather than a cone, to be knocked off. The force of the blow, distance from the edge, and its direction all factor into the size and shape of the flake that is chipped off. Stoneworkers learn to regulate how and where they hit rocks thus learn to control them. By carefully chipping away at a nodule, stoneworkers essentially carve the stone by removing flakes of particular sizes and shapes until they achieve the desired tool (Kelly 1998 *et al.*.,).

Peregrine (2001:149) continues to state that percussion flaking is the most common way stoneworkers remove flakes. In percussion flaking, flakes are driven off a piece of stone by striking it with another stone, an antler, or even a piece of hard wood. When flakes are struck off using a stone, it is called a hard hammer technique, and the flakes produced tend to be large and thick. Striking flakes from a piece of stone with an antler or piece of hardwood is called soft hammer technique, and the flakes produced tend to be long and thin. Pressure flaking, flakes are pried or pushed off a piece of stone by pressure from an antler or other soft tool. This results in very small and extremely thin flakes with no obvious bulb of percussion. The flakes produced during the process of making a chipped stone tool are distinct, and archaeologists have classified them into three basic types as follows; Primary flakes are large thick flakes struck off a nodule when removing the cortex and preparing it for working. They are fashioned by a hard hammer technique and can be easily identified because they have a piece of cortex on them. Secondary flakes (also called reduction flakes) are large flakes struck off a piece of stone to reduce its size and or thickness. They are usually produced using a hard hammer technique and can be identified by their size and by the number of flake scars (the marks where earlier flakes were struck off the nodule) they carry. Secondary flakes usually have only a couple of very large scars. Finally, tertiary flakes (also called production flakes) are smaller flakes struck off a piece of stone to shape it into a tool. These are usually created by a soft hammer technique and so are thinner and finer than either primary or secondary flakes. They usually carry more flake scars as well. Some kinds of tools require additional work, which produces unique types of flakes.  Pressure flakes are tiny, extremely thin flakes pinched or pushed off a tool to finish shaping it or to resharpen or reshape it. They are produced by a pressure flaking technique and are usually so thin that light can be seen through them (Peregrine 2001:150).

According to Balme and Paterson (2006:174) reduction can be either unifacial or bifacial (unifacial meaning reduction done on one side and bifacial meaning reduction done on both sides of the artifact). Bifacial reduction which is common in Acheulean handaxes is recognized on cores and flakes as flaking that is directed from either side of the platform edge or lateral margin. Modern knappers have identified a set of criteria that they believe can be used to consistently recognize the debris resulting from reduction of bifacial cores and bifacially retouched flakes. These include the high prevalence of bending initiations, pronounced curvature along the percussion axis, low platform angles, faceted and or ground platforms, and complex dorsal scar patterns that remove a portion of the opposite margin.

### 2.2 Lithics analysis

Techniques of lithic analysis can be divided into four major groups: form, use, manufacture and dimension. Formal analysis, and description of a stone item's physical form, is by far the most common and most fundamental aspect of lithics analysis. Formal analysis has deep roots in archaeology and is still one of the basic sets of knowledge they need to make use of. Formal analysis can also provide some important information on use (Peregrine 2001:154).

Peregrine (2001:154) continues to state that the use to which a particular stone tool was put can often be more adequately discovered through a technique called use-wear analysis. Use-wear analysis is based on examining, usually under a high- powered microscope, the patterns of wear, which have been found to be directly correlated with how the tool was used. In one interesting study, Lawrence Keeley (1977) examined Acheulean artifacts from three sites and found that handaxes were multipurpose tools for cutting meat and wood and even for digging.

He also found that, at one site, what archaeologists had defined as chopping tools were actually rarely used, but that flakes apparently struck from them were often used.

Peregrine (2001:155) also states that recently, archaeologists have realized that information about stone tool manufacture can often provide much of the information about style, cultural affiliation and use, in addition to an understanding of the organization of stone tool production. Particular types of flakes appear only when particular types of tools are being made. He continues to state that similarly, different groups worked stone in slightly different ways, and those subtle differences can be apparent in the flakes left from their stone working. More significantly, if all or most of those flakes can be recovered, then the process of how the tool was made can be reconstructed through refitting, and in turn, the tool can be readily inferred. Through refitting, archaeologist can see precisely how stone tool workers chose to work the stone and, in reality, come close to understanding the stoneworker's minds, seeing how decisions were made.

Finally, Peregrine (2001:156) notes that metric analyses are finding that subtle variation in the sizes and shapes of chipped stone artifacts that can yield a wealth of information about manufacture, use, and even social organization. Traits commonly measured for metric analyses include thickness, maximum length and maximum width. Archeologist have realized that by combining typological information gained through formal analysis with metric data, very fine typologies can be created, some of which can yield valuable insights (e.g., Shea 1997).

As noted in Balme and Paterson (2006:186) quantifying the extent of reduction allows estimations to be made of the amount of time and energy invested in the production of an artifact, the level of departure of the observed form from its original form, the amount of material likely to have been created as a product of the process, and the position in the sequence at which changes in manufacturing strategies took place and their likely effects on artifact morphology.

Balme and Patterson (2006:183) further states that both fracture mechanics and basic engineering principles would suggest that striking more and more mass from a core will affect its size and geometry, which will have direct consequences for the nature of force input, the viability of different reduction strategies, and the size and morphology of the flakes produced over the sequence. It can be speculated, that the gradual reduction of cores will result in more flake scars and less cortex, that continued use of a platform will result in a decrease in platform size, and that as more mass is struck from a core, the size of the core and resulting flakes might also decrease.

John Goodwin and Clarence van Riet Lowe published a seminal work in 1929 entitled *Stone Age cultures of South Africa*, in which they proposed that the Stone Age sequence be subdivided into the Early, Middle and Late Stone Age. By proposing their alternative scheme to the European sequence of Lower, Middle and Upper Paleolithic, Goodwin and Van Riet Lowe were emphasizing the distinctiveness of the African archeological temporal sequences and typological assemblages. The post-Second World War period witnessed the beginnings of a major overhaul of the archaeological discipline. Beginning with the advent of radiocarbon dating in the 1950's, archaeology drew upon and attempted to re-orientate itself within the hard sciences (Clarke 1973). Goodwin and Van Riet Lowe proposed a classificatory scheme that was formally approved by the third Pan African Congress held in 1955 (Clark 1957, xxxiii).

The classificatory schemes outlined above for Africa and Europe were taken a step further and recombined by J.G.D. Clark on the basis of dominant lithic technologies. His resulting modes of technology divide the history of stone tools into five Modes (Clark 1968, 1977).

The model, with the exclusion of Mode 3, was subsequently applied relatively uncritically by Foley and Lahr (1997) to the African archaeological record. Clark's technological modes supplied them with the framework required to "provide a coarse-grained means of comparing technologies across large regions and through evolutionary time" (Lahr and Foley 2001:25). The modes are held to be reflective of raw material availability, functional differentiation and manifestations of hominin technological strategies. The table below outlines the current status of lithic mode recognition and classification according to Clark (1977) and Foley and Lahr (1997

**Table 2.1:** ***Technological modes of the Stone Age industries (source: Clark (1977), Foley and Lahr 1997).***

| Technological mode | Industry |
|---|---|
| Mode 1 | Oldowan, Early Stone Age. (Choppers and flakes). |
| Mode 2 | Acheulean, Early Stone Age. (bifacial hand-axes) |
| Mode 3 | Middle Paleolithic, Middle Stone Age (prepared cores, points) |
| Modes 4 | Upper Paleolithic (retouched blades). |
| Mode 5 | Mesolithic and Late Stone Age (microlithic composite flakes and blades) |

These technological strategies are manifestations of behavioral adaptations whereby knowledge and culture are transmitted through social learning. The accumulated repertoire limits the risks of invention in technological and cultural evolution, but permits their expression in a wide diversity of situations through socially mediated responses to particular internal or external stimuli (Fitzhugh 2001; Henrich and McElreath 2003).

In this report the main industry we shall be concentrating on is the Acheulean which falls under the Early Stone Age period. Acheulean is the name given to an archaeological industry of stone tools manufacture associated with early humans during the Pleistocene across Africa and much of West Asia, South Asia and Europe. The Acheulean is believed to have first developed out of the more primitive Oldowan technology at about 1.76 million years and was made by *Homo erectus/ ergaster* up to 300,000 years ago. They are the first form-shaped tools used by the early hominins. Handaxes are large stone cobbles which have been roughly worked on both sides (bifacially worked) into an oval or triangular shape. They are pointed, or at least relatively pointy on one end, and some of those pointy ends are quite tapered. Some seem to be triangular in cross-section while some are flat, and this shows there is a lot of variability in this category.

The earliest Acheulean handaxe yet found is from the site of Kokiselei, West Turkana in Kenya dated about 1.76 million years ago (Lepre *et al.* 2011). From geological dating of sedimentary deposits, it appears that the Acheulean originated in Africa and spread to Asian, Middle Eastern, and European areas sometime between 1.5 million years ago and about 800 thousand years ago as stated in Goren-Inbar *et al..,(*2000) and Scott and Gilbert (2009). According to Scott (2000) he states that, in individual regions, this dating can be considerably refined; in Europe for example, the Acheulean methods did not reach the continent until around 500,000 years ago. The enormous geographical spread of Acheulean techniques also makes the name unwieldy as it represents numerous regional variations on a similar theme. The term Acheulean does not represent a common culture in the modern sense, rather it is a basic method for making stone tools that was shared across much of the Old World. The very earliest Acheulean assemblages often contain numerous Oldowan- style flakes and core forms and it is almost certain that the Acheulean developed from this older industry. These industries are known as the Developed Oldowan and are almost certainly transitional between the Oldowan and Acheulean.

Use-wear analysis on Acheulean tools such as (Dominguez-Rodrigo,2001; Binneman and Beaumont,1992) suggests that there was generally no specialization in the different types created and that they were performed several functions included hacking wood from a tree, cutting animal carcasses or butchering as well as scraping and cutting hides when necessary. Some tools however could have been better suited to digging roots or butchering animals than others. Alternative theories include a use for ovate hand-axes as a kind of hunting discus to be hurled at prey (O'Brien 1981). There are also examples of sites where hundreds of hand-axes, many impractically large and also apparently unused, have been found in close association. Sites such as Melka Kunture in Ethiopia (Chavaillon and Berthelet, 2004), Olorgesaille in Kenya (Potts, 1989), Isimila in Tanzania (Nowell and Chang, 2009), and Kalambo Falls in Zambia (Isaac, 1971), have produced evidence that suggests Acheulean hand-axes might not always have had a functional purpose. Gamble (1997), suggested that the Acheulean tool users adopted the handaxe as a social artifact, meaning that it embodied something beyond its function of a butchery or wood cutting tool. Knowing how to create and use these tools would have been a valuable skill and the more elaborate ones suggest that they played a role in their owners' identity and their interactions with others. This would help explain the apparent over-sophistication of some examples which may represent a "historically accrued social significance" (White 1998:15-44).

Acheulean tools were not made by fully modern humans, *Homo sapiens*, although the *proto-Neanderthal* species is believed to have used the Late Acheulean tools (Clark, 2003). Most notably, however, it is *Homo ergaster*, whose assemblages are most exclusively Acheulean, who used the technique. The symmetry of the handaxes has been used to suggest that Acheulean tool users possessed the ability to use language (Isaac 1976) as the parts of the brain connected with fine control and movement are located in the same region that controls speech. The wider variety of tool types compared to earlier industries and their aesthetically as well as functionally pleasing form could indicate a higher intellectual level in Acheulean tool users than in earlier hominines (Wynn 1995). Others argue that there is no correlation between spatial abilities in tool making and linguistic behavior, and that language is not learned or conceived in the same manner as artefact manufacture (Dibble 1989).

**2.3 Theoretical framework.**

A theory is a reasoned statement or groups of statements, which are supported by evidence, meant to explain phenomena. It is a systematic explanation of the relationship among phenomena (Kombo and Tromp, 2006). A theory provides the context and the reasoning behind studies. A theory does not depict the truth but just gives a connotation of prediction. Theoretical framework is therefore the guiding force of one’s thought in a research project

Most archeological research take place under two assumptions: 1) The archeological record accurately preserves the material remains of human behavior and 2) human behavior can be accurately reconstructed from its material remains. The truth is actually much more complex, and there are a variety of schools of thought on the nature of the archeological record. All of them, at some level, come back to one idea: We can know the past from the material record of human behavior, if only quite imperfectly (Peregrine 2001). Archeologists use a variety of theories to interpret and bring meaning to the archeological record to reconstruct the history of human habitation in a given locale.

**i. Behaviourist Theory**

Behaviourist theory, suggest that the archaeological record is really a snapshot of ancient behavior. The archaeologists’ job, in behaviourist theory, is twofold. First, they must determine how human behavior affects or is transmitted to the archaeological record. Second, they must determine how to apply that knowledge to reconstruct the behavior that is manifested in the archaeological record. One of the most influential behaviourist theorists is Lewis Binford. Binford (1978) examined how contemporary Inuit hunters created a material record of their behavior as they waited for game at a small hunting camp (Peregrine 2001). Binford compared the patterns of material remains he saw the hunters create to those he excavated at an ancient hunting camp nearby. Through this comparison, Binford was able to reconstruct the behavior of those ancient hunters who, not surprisingly, behaved quite similarly to the way contemporary ones did.

In attaining the objectives of this study on investigating how raw material typology initial form and size of the materials and reduction influenced the variability in both collections, I applied the behaviourist theory. The behaviourist theory complimented this study by looking at the past behaviour of the makers of the tools in the two sites. By this I was able to slightly comprehend, the thoughts and ways of the makers of the handaxes at both Kariandusi and Lewa Downs. With this study the behaviourist theory assisted in reconstructing the behavior of the makers, as a way of understanding the variables noted between the two collections.

# CHAPTER THREE

# METHODOLOGY

## 3.1 Study sites

### 3.1.1 Kariandusi

Kariandusi is located on the eastern side of the Gregory Rift Valley 120km northwest of Nairobi and 2km east of Lake Elmenteita. The site is around 1,880m above sea level and 75m above the present-day level of Lake Elmenteita (Gowlett and Crompton 1994). Lake Elmenteita and the nearby Lake Nakuru fluctuated in size considerably during the Pleistocene, reaching levels over 100m higher than at present, when they would have covered the entire width of the valley (Nyamweru 1980). The scarps of the Rift rise to the east of the site, reaching a height of 2,250m within 3km. The Kariandusi river flows from hot springs on the scarps to Lake Elmenteita, creating a gorge as it incises through the lacustrine sediments in its latter stages. The Acheulean deposits are exposed in a seasonal tributary gorge of the main river.

The broad geological and sedimentological sequence of Kariandusi was initially described by Gregory (1921), then by Solomon (1931), and Later by McCall *et al.* (1967). The basement rocks are the Gilgil trachyte and phonolite basalt lavas, which have undergone major faulting during the formation of the Rift valley. By the time the sediments overlying the lavas were deposited, the valley had largely assumed its present morphology. The sediments have only been affected by minor movements along old fault lines and by a slight westward down-warping of the valley floor (McCall *et al.* 1967),

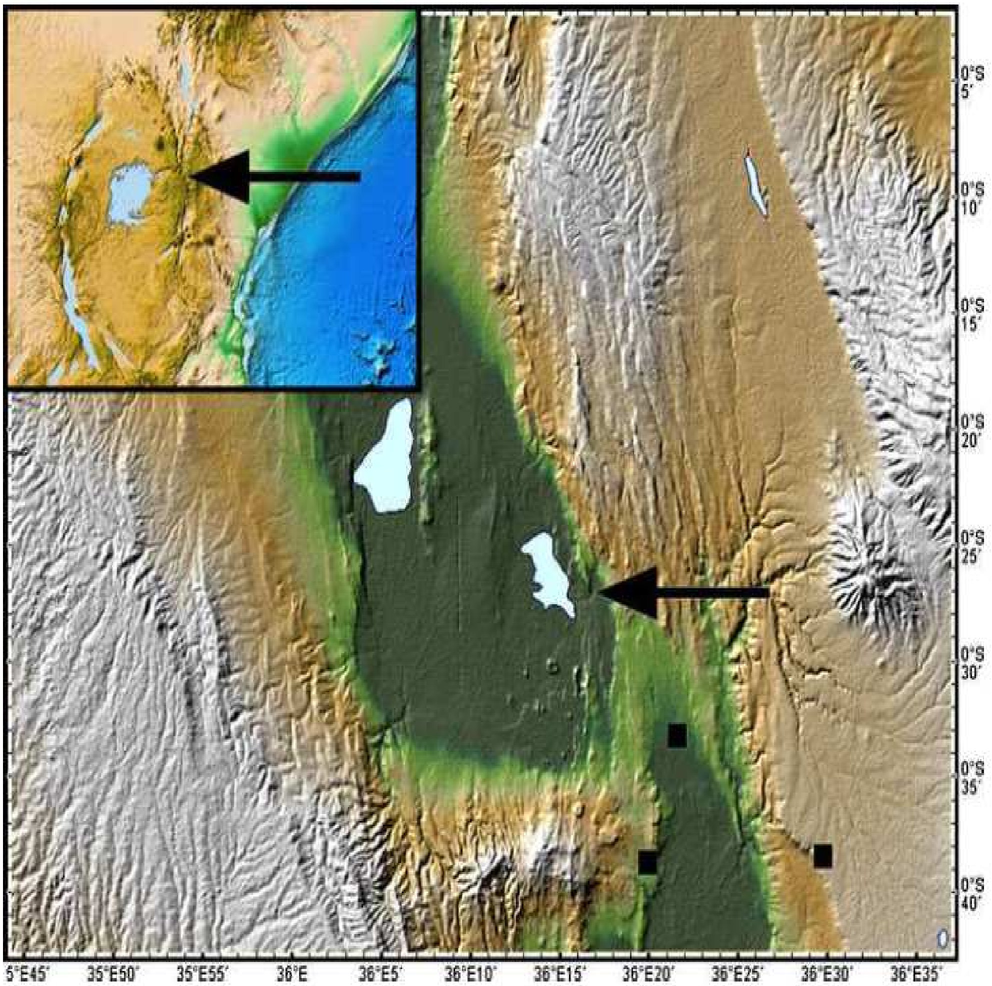


**Fig 3.1:** ***Map showing location of Kariandusi denoted by black arrows (Source: Shipton 2011:143).***

overlain by a band of tuffaceous sandy gravel above which occur fine stratified tuffs known as pumice beds. Solomon (1931) notes that the gravel only occurs in the vicinity of the river and is therefore probably fluvial in origin. Acheulean artefacts can be found both in the gravel and the pumice beds (Gowlett and Crompton 1994).

The majority of the Acheulean artefacts are made of the local Gilgil trachyte, an outcrop of which just 80m to the north of the Kariandusi site may have served as a raw material source (Gowlett and Crompton 1994). Phonolitic basalt is also locally available and was used to make the lava artefacts. A few artefacts are made on rhyolite, which may derive from the

Mount Eburru region, 15km to the south. Obsidian artefacts dominate some of the sub-localities at Kariandusi and this material is available from several sources within a 50km radius of Kariandusi (Merrick and Brown 1984).

Comparison of the Kariandusi fauna shows that it is similar to that from Olduvai Gorge Bed IV (Cole 1954), putting the site at around a million years old. Potassium argon dates for two pieces of tuff in association with hand axes yielded dates of 1.1 and 0.93 million years old (Evernden and Curtis 1965). Paleomagnetic analysis of pumice overlying the artefacts confirms they must be at least 0.73 million years old (Gowlett and Crompton 1994). A date of 0.98 million years was obtained through $^{40}Ar/\ ^{39}Ar$ comparisons of some of the sediments underlying the artefacts (Deino *et al.*. 2004).

Kariandusi was discovered on May 27, 1929 by Dr. J. D. Solomon and Miss E. Kitson during Louis Leakey's second East African Archaeological Expedition (Leakey 1936). Kariandusi was the first buried Acheulean site to be found in Africa (Leakey 1931). The importance of Kariandusi is recognized by the National Museums of Kenya who have gazette the site and established a site museum there. The principle written work on Kariandusi has been by John Gowlett who re-excavated the site in the 1970s (Gowlett 1979; Gowlett and Crompton 1994). The artefacts from Leakey's initial excavation campaign were distributed between the National Museum of Kenya in Nairobi, the Cambridge Museum of Archaeology and Anthropology and the Pitt Rivers Museum in Oxford. This project will be primarily based on handaxes housed in the National Museums of Kenya, of SASES number GrJj 22.

### 3.1.2 Lewa Downs

Lewa Downs prehistoric site is located on the northern foothills of Mount Kenya at an elevation of about 1690 meters above sea level. Its SASES number is GpJn-1 and it has variously been referred to as Lewa, Lewa Downs Swamp or Shackelton's Lewa site (Kibunjia

1988). It lies on a latitude of $0^0$ 13’ 12” and longitude $37^0$ 25’ 50” E. The site lies on the Lewa Downs estate near the turnoff to Isiolo on the Nanyuki-Meru road, Kenya. It is on a sedimentary basin which most likely is a site complex and covers an area of about 10,000$m^2$. In this and the surrounding areas several other Early Stone Age occurrences have been reported but no closer investigation or a systematic survey and documentation of the sites has been done. No excavations have been carried out at Lewa Downs or any of the other sites (Shackelton 1946:54; Sirriainen 1984:24) therefore the material analyzed for this study is from surface collections. Martin Pickford did a surface collection of the materials from Lewa Downs. Shackelton (1946) and Sirriainen (1984) both did only surveys in the Laikipia where Lewa Downs Is located and gave geological descriptions and the potentiality of the area but no extensive surface survey was undertaken by them. Kibunjia (1988) however, did a description of the Lewa Downs site, from the surface collection by Martin Pickford, an excavation was planned in order to get more information about the site, but the excavation never materialized.

The modern vegetation in this basin is that of open grassland growing on black cotton soil. These grasslands support an abundant game population at a nearby National Game Reserve, the Lewa Downs Wildlife Conservancy. Erosion on the basin where this site is located has exposed several hundred artefacts typical of the Acheulean Culture. Most of these artefacts now lie in derived positions on the ground as at the earlier discovered sites of Olorgesaille. The tool types represented include handaxes, cleavers, a few choppers, large blocks of phonolite and basalt with flakes removed, hammer stones and partly finished tools and flakes. According to Kibunjia (1988), the presence of such large numbers of unfinished tools on the one hand, and flakes on the other, suggest that this was probably a factory site and was occupied for a long time. Most of the bifaces (handaxes and cleavers) are of enormous size approximately 200mm in length, and are made on huge end-struck flakes. The tool making method of striking a large flake as a blank has been regarded as the distinguishing innovation separating the Acheulean from the 'core-tool' cultures of the Oldowan. The dominant raw material is the phonolite and basalt whose source could have been the nearby lava ridge (Kibunjia, 1989).

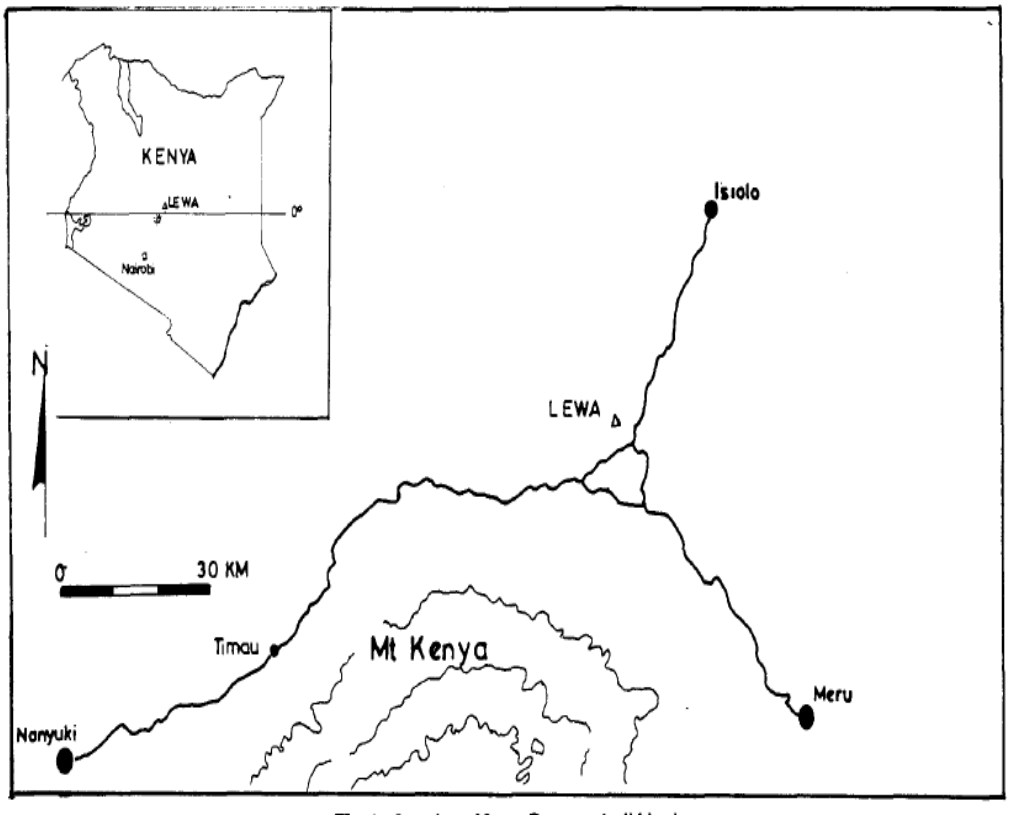


**Fig 3.2:** Map of Laikipia showing location of Lewa Downs site. *(source: Kibunjia 1988:31 issue 29)*

No dates are yet available for this site, during the early periods of research in Kenya, (L.S.B. Leakey 1931), assigned it to the Nanyukian or Kenya Fauresmith which is also known as the Late Acheulean today. According to Kibunjia (1986) detailed analyses of handaxe morphology using Roe's (1964) methodology, suggest that it belongs to the Upper Acheulean. Fossil animal bones and teeth collected from the eroding surface at the site are typical of Middle Pleistocene fauna. They include such animals as *pelorovis* (extinct buffalo), *Elephas recki* and *Hipparion* (Kibunjia 1989), therefore the Lewa Downs dates are relative and based on Stratigraphic and faunal correlation / biostratigraphy.

### 3.2 Sampling technique and sample size

The study population for this project was the collection from both Kariandusi and Lewa Downs. The unit of measurement is the individual handaxe used. Samples from both collections were analyzed. The Lewa Downs collection contained 49 handaxes (according to artifact accession document KNM- 911). The handaxes from Kariandusi are averaged at about 300 (according to artifact accession document KNM-3239). This number only includes the collection stored at the National Museum of Kenya laboratory of SASES number GrJj 22. A sample equal to the number of the Lewa Downs handaxes to be analyzed was used. With both collections, 30 handaxes from each site were picked using purposive sampling. I put into consideration the fact that the pieces had been made from different raw materials especially the Kariandusi collection therefore I first categorized them into the different raw material types and picked samples from the various raw materials the whole pieces that I required. It was important to use whole pieces for this study in order to get the maximum dimensions measurements. It was also necessary to use handaxe pieces with moderate to no weathering on them in order to be able to count the flake scars on the handaxes. Both sites are believed to be factory sites according to (Kibunjia 1988; Schick 1992) therefore the number of artifacts collected was assured of presence of variableness amongst each other. The number used for this study was therefore assured to have collected enough pieces to indicate variableness among the collection. Whether picked randomly or purposively variableness amongst the collection would still be present.

### 3.3 Data collection

This study obtained its data from the materials excavated from Kariandusi and surface collection from the Lewa Downs site. These materials are stored at the National Museums of Kenya. Acquiring data on the handaxes involved counting of flake scars that could be physically identified. The various raw materials used in the manufacture of each of the pieces were also noted. I also identified the initial forms of the handaxes, before shaping. This I did by observing for evidence on whether or not a piece had any characteristics of showing features of a flake such as any evidence of; bulb of percussion, fissures and ripples and a platform, which the makers tried to work on, or whether the pieces still had majority cortex on them to indicate that they were made from cobbles. All this was followed by measuring the maximum dimensions of each of the handaxe pieces and recording the values (see appendices A - D).

Library materials as secondary sources were also utilized. These sources included books, theses, and conference and published papers, journals and other online sources available. The data collected from these sources includes data on other researches done in the field of archaeology. Since these secondary sources have been interpreted, this research did not fully rely on them and treat them as undisputed sources of information. They were applied partially to provide insights that were tested through the archeological evidence.

Some of the research instruments that were used in this study include a pair of calipers that were used to take measurements on the handaxes. Measurements of length, width and thickness were measured. A camera was used to take various photographs of the collections which I have attached in chapter 5.

**3.4 Methods of data analysis**

The data collected from this study was analyzed using metrical analyses .Metric analyses involves finding subtle variations in the shapes of chipped stone artifacts. Traits commonly measured for metric analyses include thickness, maximum length and maximum width. The different handaxes were compared according to raw material typology (which raw material was more predominant in the collections), initial form of their raw materials (were they made from cobbles or flakes) and the number of flake scars evident on the handaxe pieces. A comparison was also made on the difference in length and size of the handaxes. The analysis included identifying the initial forms of the handaxes to be able to understand whether it affected the size of the tool and the amount of reduction or not. This data was presented in tables and graphs for easy comparison from both sites.

**3.5 Ethical Considerations**

According to the IFA code of conducts, principle 1, a member (an archaeologist) shall give appropriate credit for work done by others, and shall not commit plagiarism in oral or written communication, and shall not enter into conduct that might unjustifiably injure the reputation of another archaeologist. Due to this, all cited work was dully recognized and all original authors of any secondary material also acknowledged. To undertake this study, I had to obtain a letter from the National Museums of Kenya, to allow me to work on the materials and to display the data in this report. This materials used were not collected or excavated by myself, therefore due recognition was needed and permission to be able to work with the collections. The letter gave me the go ahead to work on the two collections, of which no active research is going on as of now.

### 3.6 Conclusion

The data acquiring methods described above, such as measuring the metrical dimensions were aimed at ensuring that the best results were acquired from the materials analyzed. I did the measurements thrice to confirm the results. The results of the analyses have been presented in chapter 4 and later on discussed in chapter 5.

# CHAPTER FOUR

# DATA PRESENTATION

## 4.1 Introduction

The materials analyzed from the Lewa Downs collection were from the surface collection made by Martin Pickford in 1981 (according to NMK accession artifacts record, KNM-911). Dr Mzalendo Kibunjia wrote an article in Nyame Akume about the site in 1988. The materials from the Kariandusi collection were excavated by Leakey (1947) and later on studied by John Gowlett (1979). A sample of 60 handaxes from these sites was analyzed for this project.

## 4.2 Data Presentation

### 4.2.1 Raw materials

The most predominant raw material in the Lewa Downs handaxe collection is basalt at 100% dominance and phonolite at 80% in Kariandusi. The second most dominant raw material used at the Kariandusi collection is basalt at 13.30%. Evidently the most common raw material in both collections is basalt, making an appearance in both the Lewa Downs and Kariandusi collection. The least used raw material in Kariandusi is obsidian at 6.67%. No obsidian or phonolite was spotted in the Lewa Downs collection. In comparing raw material to size/length of the handaxes, basalt handaxes from Lewa Downs were the longest with an average length of 213.901mm compared to the basalt handaxes from Kariandusi which had an average length of 158.865mm .In the Kariandusi collection the phonolite handaxes were the longest in size with an average of 174.26mm. The basalt and obsidian handaxes follow behind closely in length having an average length of 158.865mm and 153.87mm respectively.

As evident from the data, the most predominant raw materials used, For example, basalt in the Lewa Downs collection and phonolite in the Kariandusi collection produced the longest handaxes, indicating an abundance of the predominant material used. This data assists in answering the question of whether the raw material types influenced variability among the collection. The data acquired clearly shows that the various raw materials used in each of the sites produced different sizes of the handaxes.

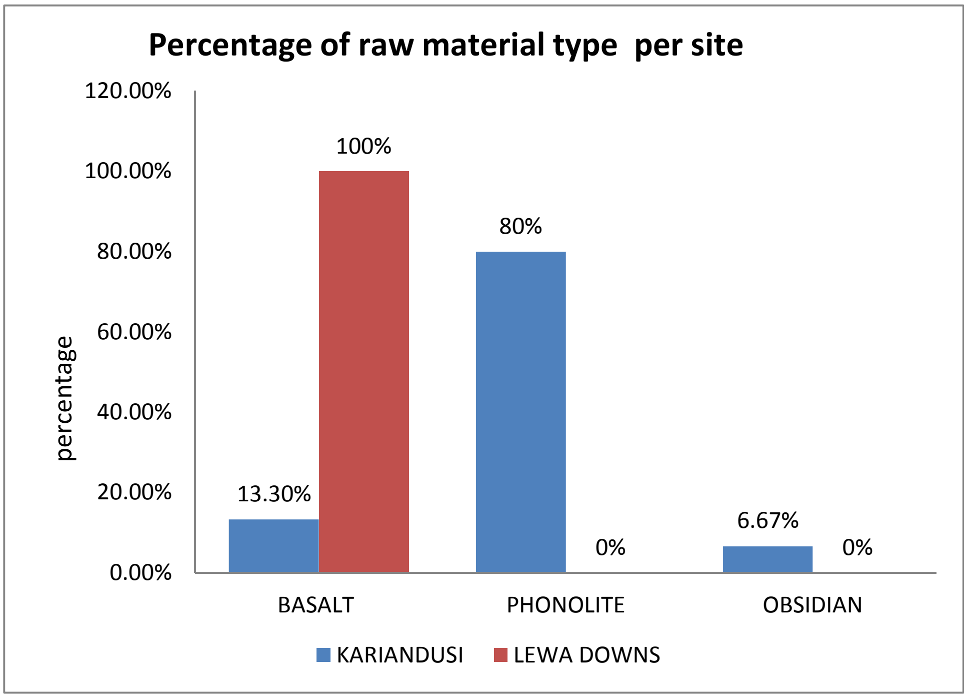


**Figure 4.1: Percentages of raw material types in both sites.**

**Plate 4.1: Basalt handaxes from Lewa Downs.**

**Plate 4.2: Phonolite handaxes from Kariandusi**

**Plate 4.3: Basalt handaxes from Kariandusi.**


**Plate 4.4:Obsidian handaxes from Kariandusi**

**Table 4.1: Average lengths of the most common material in both collections**

| | **KARIANDUSI**<br>**Ave. length (mm)** | **LEWA DOWNS**<br>**Ave. length(mm)** |
|---|---|---|
| **BASALT** | 158.865 | 213.901 |

**Table 4.2: Average lengths of all the raw materials types used.**

| Raw material | KARIANDUSI | LEWA DOWNS |
|---|---|---|
| | **Average length(mm)** | **Average length(mm)** |
| **PHONOLITE** | 174.26 | 0 |
| **BASALT** | 158.865 | 213.901 |
| **OBSIDIAN** | 153.87 | 0 |

### 4.2.2 Metric dimensions

In comparison Lewa Downs produced larger handaxes than Kariandusi based on length and width dimensions despite the raw material used. The handaxes from Lewa Downs exhibit a higher average length and width but a much lower average thickness in comparison to the Kariandusi handaxes irrespective of the raw material. The average length of handaxes from Lewa Downs is 213.901 mm while that from Kariandusi is 170.848 mm. Kariandusi handaxes were much thicker at 57.28mm compared to Lewa Downs at an average thickness of 47.064 mm.

The average tip width of the Kariandusi handaxes was 55.055mm compared to the average tip width of the Lewa Downs handaxes which was 37.90mm. This clearly indicates that the Kariandusi had wider tips, than the Lewa Downs handaxes. The tips of the Lewa Downs collection were more pointed unlike those from Kariandusi which were blunt and short. It was also noted that the tip sizes of the Lewa Downs collection were longer other than being thinner in size than the Kariandusi tips. The Kariandusi collection showed a thicker tip size having an average of 21.05mm. The Lewa Downs collection was much less thicker in tip size having an average thickness of 17.51mm. This indicates that the Lewa Downs handaxes were more pointed compared to the Kariandusi handaxes.

In comparing the butt sizes; butt thickness and butt width, the butts of the Lewa Downs collection were much more wider compared to the Kariandusi butts. The average butt widths of Lewa Downs and Kariandusi were 80.32mm and 78.98mm respectively. The butt thickness of the Lewa Downs collection was much lower at an average of 34.12 mm compared to the Kariandusi collection which had an average butt thickness of 36.70mm. In conclusion the butts of the Lewa Downs collection were wider and thinner compared to the Kariandusi butts which were thicker and less wide in size.

All the above measurements were irrespective of the raw material used. This metric analysis was done to bring out a clear picture of the sizes of the handaxes in both the Lewa Downs and Kariandusi collections. This was necessary in order to firstly understand that these two collections vary in size despite of the raw material and despite the initial forms and reduction done on them. The butt and tip measurements portrayed in Figures 4.2 and 4.3, were used in this study to show the general size of the whole dimensions of the handaxes. It was necessary to bring this out in order to not only showcase the lengths of the handaxes but the general size, from the base, which is the butt to the tips. This gives us a general estimate in the whole sizes of the handaxes in both collections.

**Table 4.3: Average length, width and thickness of the handaxes from the two sites irrespective of raw material used.**

| | KARIANDUSI | LEWA DOWNS |
|---|---|---|
| **LENGHTH (mm)** | 170.848 | 213.9006667 |
| **WIDTH (mm)** | 93.646 | 105.9993333 |
| **THICKNESS (mm)** | 57.28 | 47.064 |

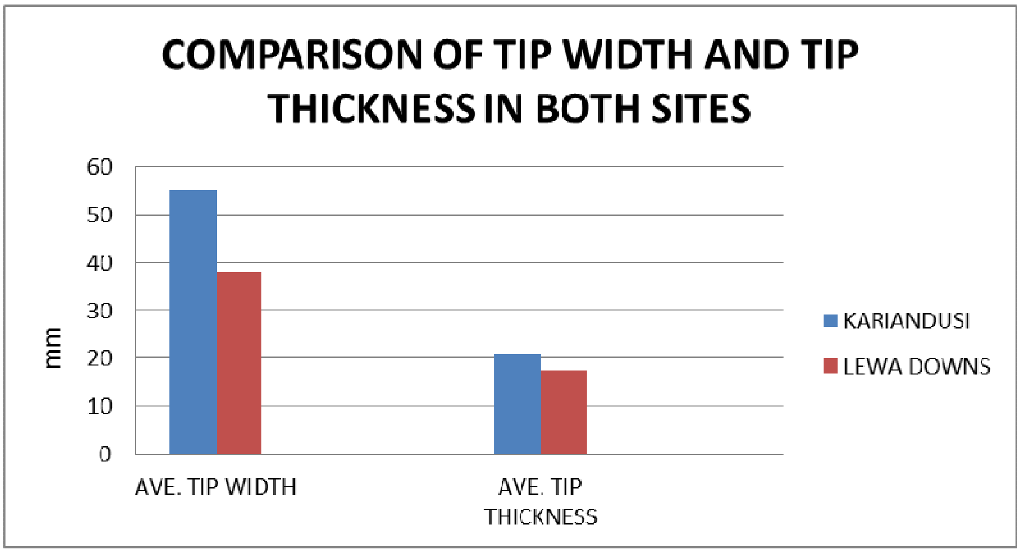


**Figure 4.2: Comparison of tip width and tip thickness**

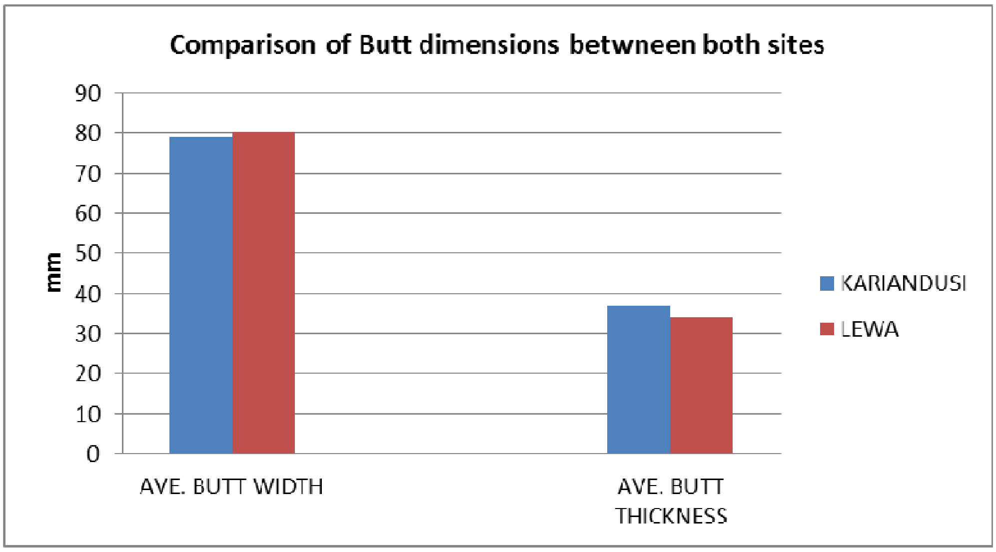


**Figure 4.3: Comparison of butt width and butt thickness**

### 4.2.3 Initial form

Handaxes made from cobbles make up 17% at Kariandusi and 7% at Lewa Downs. Handaxes made from flakes are the majority being represented by 83% in Kariandusi and 93% in Lewa Downs as shown in Figures 4.4 and 4.5 respectively. In comparing length to the initial form, handaxes made from Cobbles had an average length of 164mm in Kariandusi compared to 178.15mm in Lewa Downs. This indicates that the handaxes made from cobbles were much shorter in Kariandusi compared to the ones in Lewa Downs. The handaxes made from large struck out flakes have an average length of 172.157mm in Kariandusi compared to 217.913mm in Lewa Downs. The handaxes made from flakes are much longer in size both in Kariandusi and Lewa Downs compared to handaxes made from cobbles. Lewa Downs however has longer handaxes in both sets, both from flakes and cobbles than the Kariandusi handaxes as indicated in Table 4.6. This clearly indicates that the Lewa Downs collection whether made from a cobble or flake still remained longer in size despite the initial form used.  Tables 4.4 and 4.5 below highlight the initial forms according to the raw material used. In Kariandusi, the phonolite cobbles were longer in length at 164.81mm compared to the basalt cobbles, at 162.27mm. The phonolite flakes however were the longest with an average length of 176.15mm followed by the basalt flakes at 157.73mm and 153.87mm for the obsidian flakes. It is noted that the phonolite produced longer handaxes in the Kariandusi collection whether in cobble form or in flake form. In Lewa downs, since there is predominance of one raw material, basalt cobbles had an average length of 178.15mm and the basalt flakes had an average length of 216.45mm. In comparing the basalt cobbles from Lewa Downs to the ones in Kariandusi, basalt cobbles from Lewa Downs, were longer. In comparing the basalt flakes from Lewa Downs and Kariandusi, Lewa Downs had longer basalt flakes to Kariandusi. Therefore it is worth noting that the Lewa Downs initial forms were longer in size compared to Kariandusi initial forms despite the raw material used. This goes to answer the question of what were the initial forms of these handaxes and did the initial forms affect the size. Indeed , the initial forms did affect the overall size of the handaxes, as noted in the data the handaxes produced from flakes were longer in size, and that the raw material of the initial form also played a part in influencing the size of the handaxes.

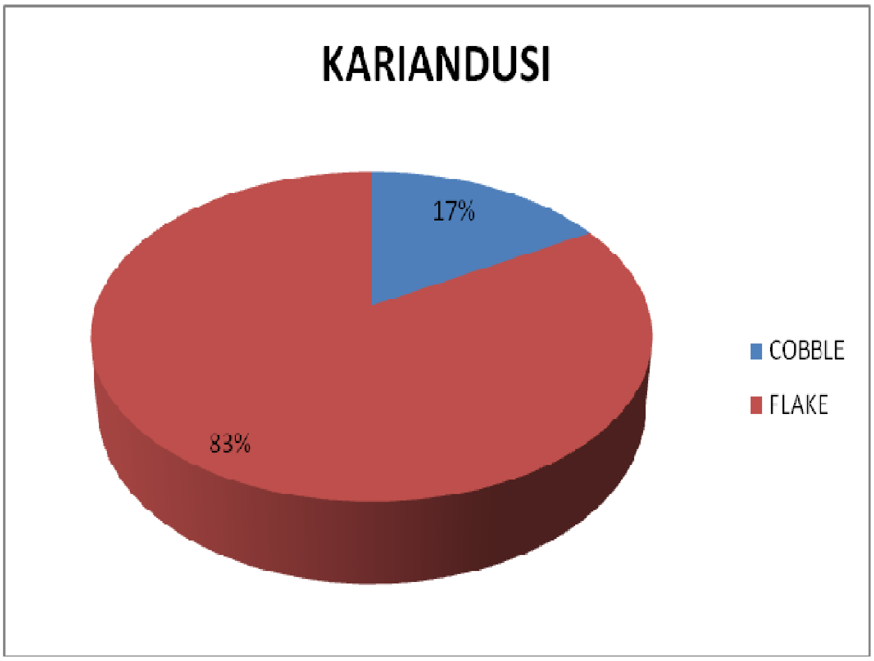


**Figure 4.4: Percentages per Initial forms, Kariandusi**

**Table 4.4: Average lengths of initial forms according to raw material type, Kariandusi.**

| | **KARIANDUSI** | |
|---|---|---|
| | **Raw material type** | **Average length (mm)** |
| **COBBLE** | Basalt | 162.27 |
| | Phonolite | 164.81 |
| **FLAKE** | Obsidian | 153.87 |
| | Basalt | 176.15 |
| | Phonolite | 157.73 |

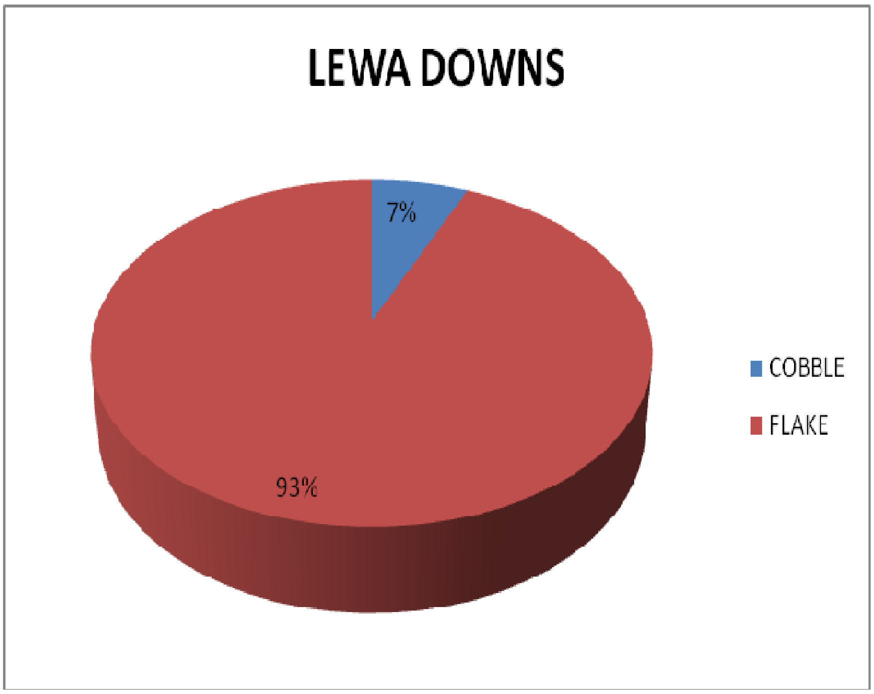


**Figure 4.5: Percentages per initial forms, Lewa Downs**

**Table 4.5: Average lengths of initial forms according to raw material type, Lewa Downs.**

| | **LEWA DOWNS** | |
|---|---|---|
| | **Raw material** | **Average length (mm)** |
| **Cobble** | Basalt | 178.15 |
| **Flake** | Basalt | 216.45 |

**Table 4.6: Comparison of lengths to initial form from both sites.**

| | **Kariandusi** | **Lewa downs** |
|---|---|---|
| | **Ave length (mm)** | **Ave length (mm)** |
| **Flake** | 172.157 | 217.913 |
| **Cobble** | 164 | 178.15 |

#### 4.2.4 Removals (Flake scars)

Lewa Downs had more handaxes with a majority number of removals. Only 6 of the handaxes from Lewa Downs had 20 and less flake scars. Kariandusi had 17 handaxes within a range of 40 to 50 removals which was the highest number of removals with majority of the handaxes. The amount of removals on the Kariandusi collection remained consistent throughout irrespective of the raw material used.

In comparing length to the amount of removals on a handaxe, the data showed that the longer the handaxe, the more the removals on it. This was indicated in both graphs on Fig 4.7 and 4.8 below. This however clearly indicates that the longer the initial form, the more removals the handaxes needed in order to reach the desired length and size.

Table 4.7 however highlights the average number of removals according to raw material type used. In Kariandusi, the obsidian handaxes had more removals at 31, followed by basalt at 24.75 and finally phonolite had an average of 19.67. It is worth noting that despite phonolite being more predominant in the collection, and phonolite having produced longer handaxes in the Kariandusi collection, in terms of removals, it had the least number of removals. In Lewa Downs, basalt handaxes had an average of 34.2 removals. The difference of the average removals of the highest reduced raw material was very minimal .In answering the question of whether the reduction intensity influenced the size of the handaxes, it is clearly noted that the reduction intensity did not influence the size, as observed from the evidence that the most predominant raw material which has been noted to produce the longest handaxes In the collections not necessarily having the most number of flake scars.

**Table 4.7: Average number of removals according to raw material type used.**

| | KARIANDUSI<br>Ave. Number of removals | LEWA DOWNS<br>Ave. Number of removals |
|---|---|---|
| **Basalt** | 24.75 | 34.2 |
| **Phonolite** | 19.67 | - |
| **Obsidian** | 31 | - |

**Table 4.8: Average number of removals according to initial form.**

| | KARIANDUSI<br>Ave. Number of removals | LEWA DOWNS<br>Ave. Number of removals |
|---|---|---|
| **Cobbles** | 24 | 25 |
| **Flakes** | 20.52 | 34.86 |

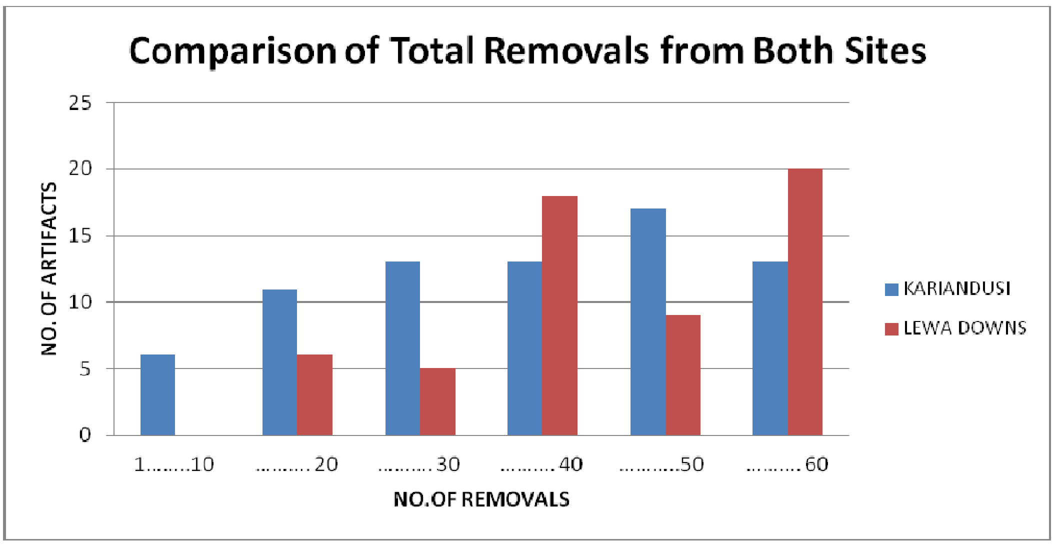


**Figure 4.6: Total removals vs number of handaxes**

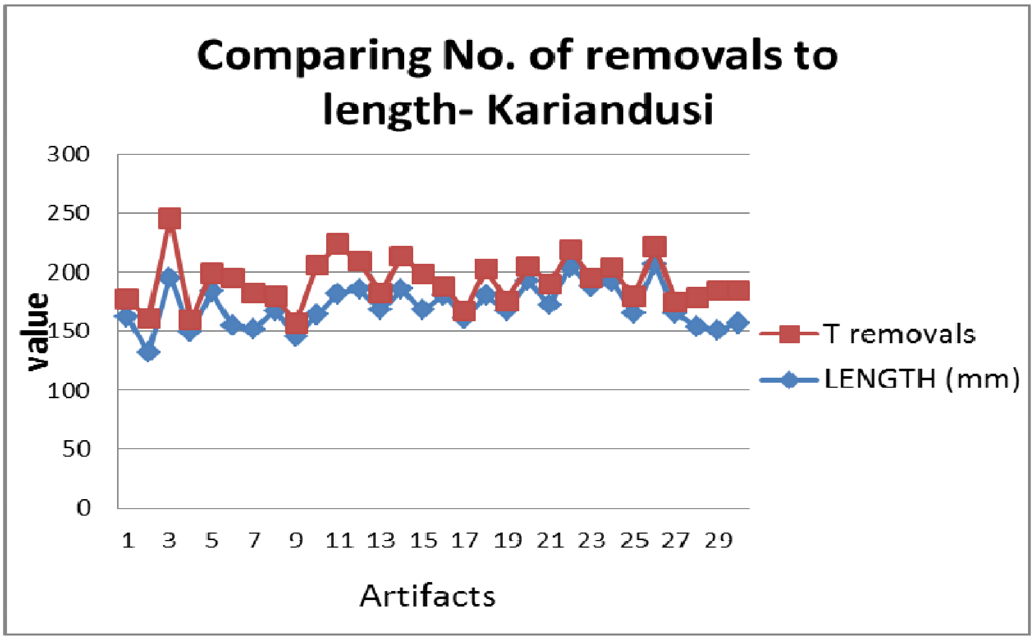


**Figure 4.7: Number of removals with length –Kariandusi.**

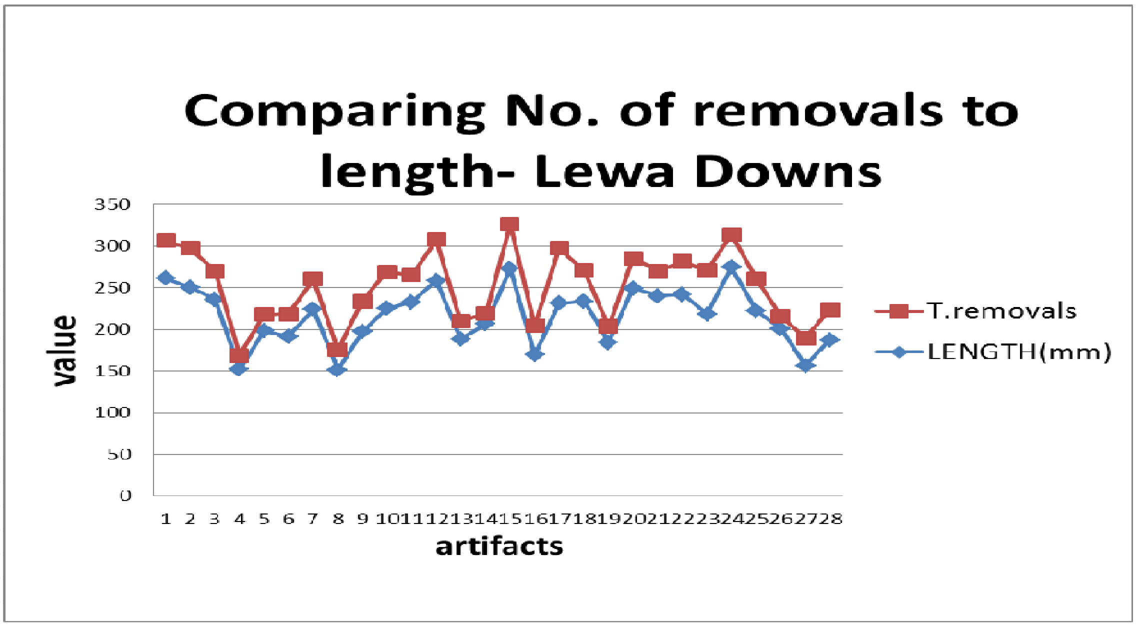


**Figure 4.8: Number of removals with length – Lewa Downs.**

**(The values on the verticle axis (*value)* represents the common value or numbers used in the comparison of length and removals)**

## 4.3 Limitation

In the course of carrying out this study, I encountered one minor problem while doing the metrical analysis of the handaxes. Some of the handaxes from the Kariandusi collection had sand layers which seemed impossible to clean off. With a little bit of effort I was able to clean out some of the thick layers of sand, but I was not able to completely remove the sand layers. However I was still able to count the flake scars from the handaxes with not much trouble.

## 4.4 Conclusion

The difference in the morphology of the two collections is an indicator of the difference in style and manufacture of the makers of the handaxes. The preference in specific raw materials, such as basalt and phonolite is evident and may be an indicator that the makers of these handaxes either preferred these materials because of their easiness in shaping and chipping, or may be that they were readily available. The presence of most of the handaxes made from struck out flake pieces may also indicate the presence of huge outcrops of the raw material indicating an abundance of the raw material wherever the makers were sourcing them from. This may also explain the large Lewa Downs handaxes, compared to the Kariandusi. Perhaps the raw material was readily available and the makers of these large cutting tools did not have to travel far to use and make the tools. In the next chapter we discuss the above results in explaining the various similarities and differences recorded.

# CHAPTER FIVE

# DISCUSSION

## 5.1 Introduction

This chapter takes a more deeper look into the data presented in the previous chapter. It outlines the correlations between the data acquired and its significance. This study contributes to the understanding of the variables noted between inter-assemblages. The subsytems approach used in this study through the systems theroy was able to clearly bring out how the various variable interacted and how they affected the overall morphology of the handaxes.

## 5.2 Discussion

Harold Dibble (1989) suggested that bifaces acquired their shape fortuitously through core reduction. The result was interesting because it showed that the heavily trimmed specimens were not shorter, but were markedly narrower (Gowlett 1996). One inference is that the makers seemed likely that to them maintaining the length of the piece and its cutting edge was a greater consideration. This is quiet evident with the Lewa Downs collection which, as we saw in the previous chapter, had slightly more removals done on the handaxes compared to the Kariandusi collection. The Lewa Downs collection was longer, with reduced tips, an indication that the makers were more interested in the tips and egdes of the handaxes which were extensively resharpened unlike the Karaindusi collection which only had resharpening marks on the tip.

The Lewa Downs collections were extensively worked on indicating that the makers were more refined in shaping and syling tools and had the time and ability to do this as well. The

Kariandusi collection seems to be a more basic collection, in terms of use and disposal after use.

Crompton and Gowlett (1993) were able to show that in a systematic way within each data set small bifaces have a different shape from large bifaces as shown in Plates 1 and 2. The photos in Plate 1 represent the Kariandusi handaxes, and as noted have a more stout look compared to the Lewa handaxes in Plate 2, which appear to be longer and more extensively reduced.  .

**Plate 5.1: Kariandusi handaxes from flaked pieces. (wider tips compared to the Lewa Downs handaxes in Fig 12).**

**Plate 5.2: Lewa Downs handaxes from flaked pieces.(resharpened edges and thinner tips).**

In discusing the raw material preferences, the most common raw material in the collections indicate the most available source of material to the makers, as indicated by the presence of majority phonolite in the Kariandusi collection and basalt in the Lewa Downs site. The makers of these handaxes probably did not have to travel far to source these materials, if so, then they would have travelled to procure the best raw material for shaping which would have meant traveling long distances to acquire obsidian which is the best raw material In the collection for shaping out tools. Obsidian produced the most flake scars in the Kariandusi collection and in general compared to the basalt and phonolite in Kariandusi and the baslat handaxes in lewa Downs as well. This clearly indicates that obsidian is easily flaked compared to the rest of the other raw materials, although the obsidian flake scars in Kariandusi and the basalt flake scars in the Lewa Downs does not really show a big difference.

The most common raw material produced the longest handaxes, indicating the use of larger pieces of these raw  materials due to its abundance in the area. The least common raw material For Example, obsidian in the Kariandusi collection produced the smallest handaxes. This points out the fact that the least common material was well uilized and used in measurable quantities. The obsidian was most probably sourced from areas not near to their immediate surroundings

The differences identified between length and flake scars, indicated that the length of the handaxe was not determined by the number of flake removals although the removals were consistent with increase in length leading to increase in number of removals on the handaxes. This means that the removals did not determine the size of the handaxe, giving us the chance to consider the raw material and initial form as the bigger influences on the size of the handaxes.

The metrics were used in this study to potray the differences in size between the handaxes in the Kariandusi and Lewa Downs collections without including the raw material, initial form and removals of the handaxes. A clear picture of the dimensions was first needed as shown in Table 4 before doing the comparison. The objectives of this study  included to assess the influence of the initial forms on size, how raw material may have influenced size and the reduction and size, and these metrics represent the dimension of these handaxes before categorizing them. Figures 4 and 5 are significant in this project as they help to show a general picture of how wide and thick the base and the tips are of these handaxes. The butt and tip assist in showing how wide or thick the initial form used in shaping was, therefore we can clearly say that the majority of the handaxes from Lewa Downs were made from wide struck out flakes and were shaped out all round the edges to produce the sharp long tips that are present in the Lewa collection. Evidence of this goes to confirm that the makers of Lewa Downs were technologicaly more advanced in shaping and retouching the  the handaxes produced, compared to the Kariandusi handaxes, which are very basic in terms of their shaping. The  Kariandusi collection is much older in dates with an age of atleast 0.7 million years and Lewa Downs at atleast 0.3 million years, therefore the Lewa Downs handaxes are bound to be more technologicaly advanced in terms of shaping and retouching.

### 5.2.1 Raw material

Schick and Toth (1993) observe a degree of selectivity for raw material quality, noting that the Koobi Fora tool makers systematically avoided vesicular lavas and cobbles with weathering flaws. Toth (1982:121) concluded that ‘it is likely that these hominids were able to discriminate between easily flaked, non-weathered material and less suitable rocks; however the actual selection of materials for their stone artifacts appears more opportunistic than selective with regard to specific rock type’. In the Kariandusi collection, presence of obsidian handaxes is noted but with very few handaxes. In terms of quality , obsidian is of very good isotropic quaility and produces the best tools compared to basalt and phonolite. In the Kariandusi collection however, a majority of the handaxes are produced from phonolite, therefore In the case of kariandusi it is worth noting that it was not about selectivity of the raw material , but rather more of what was available to them. As indicated by Toth (1982:121) these hominins were able to discriminate which raw materials were best for manufacturing tools therefore would not have ignored  the best available raw material to them. The choice of raw material at Kariandusi could have been determined by its abundance in the region. The quality of phonolite in flake manufacture may not be entirely the best , but perhaps in terms of availability, it appears to have been more available and abundant compared to the obsidian and basalt in the region. This is a factor that was much more favourable to the makers who perhaps did not see the need to move far in search of other materials while phonolite was in abundance in the region.

At yet another site, Olduvai in Bed 1 (1.85 –1.70 Myr), the archaeological assemblages are dominated by volcanic cobbles from local streambeds. These cobbles appear to have been selected for size and composition in much the same way as those form Koobi Fora (Hay 1976; Schick 1987), and the occurrence of minimally reduced cores of low quality , vesicular lava at some Bed I sites, further suggests that these undesirable materials may have been tested and rejected by hominid toolmakers (Ludwig and Harris 1998). Further more , published accounts from the Late Pliocene sites of Lokalalei LA1 (GaJh 5) and LA2C similarly suggest that raw material selection reflected local availability (Kibunjia 1994; Roche *et al.*.1999) at these sites. This perhaps explains the presence of a predominant basalt handaxe collection at Lewa Downs. It is probable that the only readily available raw material easily accesible at Lewa Downs was basalt.

Ludwig and Harris have argued that subtle raw material flaws account for a high incidence of step fractures observed on cores from LA1, raising the possibility that toolmakers at these sites were less attentive to cobble quality than those at LA2C, Koobi Fora and Olduvai (Ludwig and Harris 1998 ;Ludwig 1999). This is however also noted in the two collections Lewa Downs and Kariandusi. The makers of the handaxes had a particular preference when it came to their raw material choice. In Lewa Downs a majority of the handaxes are made from basalt, which is known to have good qualities in fracture mechanics. Basalt which is a fine grained igneous rock has isotropic qualities perfect for fracturing out flakes and produces sharp tools. This, I believe from the evidence observed in the previous chapter was also a major determining factor in the choice of raw materials for the makers of the Lewa Downs handaxes.

Biases in subsequent pattterns of material transport and discard on the landscape would likely have been based on direct experience actual flaking and/or using particular cores and flakes, although visual identification of desirable characteristics may still have been important if accumulated lithic scatters themselves served as secondary material sources (Schick 1987). Further research will be needed to define the relative importance of initial selection vis-a-vis subsequent transport and use. However, it is clear that both reflect hominid awareness of technologically desirable material characteristics. Even in modern, language- bearing humans, such practical technical knowledge is generally acquired through experience (Keller and Keller 1996 ; Stout 2002).

Artifacts from Kada Gona ( the world's oldest stone artifacts dated 2.6 – 2.5,from Gona , Ethiopia) appear remarkably refined, especially given their early date (Semaw *et al.*, 1997 ; Semaw 2007 ; Semaw *et al.*, 2003). Inspection of the artifacts themselves suggests that this apparent sophistication may be largely due to the quality of raw materials used. Not only is it easier to initiate and control fracture in fine-grained, isotropic rocks, such materials also tend to preserve more of the technological traces (e.g. flake scars, retouch, ripple marks, percussion bulbs) used by archaeologists to evaluate artifacts. The Gona artifacts provide evidence of well developed flaking skills (Semaw *et al.*, 1997 ; Stout and Semaw, in press), but are probably more remarkable for the materials from which they are made than for the specific techniques of their making. It is thus important to recognize that the dynamics of raw material procurement, selection, transport and use may be as revealing of technological and cognitive sophistication as are knapping plans and acquired perceptual motor skills (Stiles 1998 ; Inizan *et al*., 1999 ; Stout 2002).

Plate 5.3 highlights the Lewa Downs handaxes, produced from flakes, and Plate 5.4 highlights the handaxes from Kariandusi also produced from flakes.

**Plate 5.3:Lewa Downs handaxes** **Plate 5.4: Kariandusi handaxes**

### 5.2.2 Initial forms

Initial form types were determined by whether or not the handaxes had any evidence of flake scars before the later removals in reshaping the tool. Those I categorized as having been made from initial forms of flakes had flake scars, bulbs of percussions and points of percussion. Others had evidence of striking platforms, which were then further effectively reshaped to the handaxes that we have in the collection . The materials categorized as having been made from cobbles had no such evidence as described above. These were considered as having come from cobbles which the maker picked and struck out flakes to produce the handaxes. The cobbles also had untouched butts which showed clearly that they had not been initially struck from a parent rock. The handaxes shaped out from cobbles also still had part of the cortex visible which was a good indicator in categorizing them as having been made from.Plate 5 below shows the handaxes from Kariandusi made from cobbles. As seen in the photo the butts of the handaxes still have majority cortx on them..

**Plate 5.5: Handaxes made fom cobbles, Kariandusi.**

## 5.3 Conclusion

The progressive standardization and elaboration of tool types and processes of manufacture observed in later Acheulean assemblages may be interpreted as a further indication that their makers could talk to one another. The extraordinary and, in functional terms, probably unnecessarily fine finish of some handaxes suggests the existence of basically aesthetic standards, in turn implying that cultural values had extended into non-utilitarian spheres. Acheulean maker may thus be seen as having differentiated himself from his unthinking animal kindred to an extent probably not achieved by the makers of the Oldowan industries (Butzer and Isaac 1975).

This study attempted to place the debate of variation in a historical context, and to emphasize how far we still are from superseding earlier paradigms. It has been argued that even functional and Paleo-ecological explanations have a number of flaws, stemming both from the uncritical acceptance of Mary Leakey's original definitions and the very limited record available. We agree that the study of lithic inter- assemblage variability should not be an end in itself (Shea 2011), and evolutionary perspectives on stone tool analysis must consider the widest possible range of explanations for cultural change (Kuhn 2004). But a better knowledge of the organization of technology (Nelson 1991) and the role of cultural constraints (Lemonnier 1990) can only be achieved by combining these perspectives with a full understanding of the paleoecological and paleogeographical settings (Braun et al., 2008). Theoretical models such as those developed for the Oldowan (Blumenschine and Peters 1998) would help identify priorities of research on the origins of the Acheulean and its development.

Several studies have reinforced the importance of early hominin making transformations by showing that these complex – early tool makers seemed able to handle the relationships between several variables in a successful way. They were coping with a heavy cognitive load but sequencing of the manufacturing steps in a regularized routine (or script) probably served to reduce this load (Gowlett 2006).

# CHAPTER SIX

# CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Summary

In this report, we have been able to take a look at the cultural variations through development of style manufacture and thought of the makers of these tools. Time has brought about interesting changes in the Acheulean industry which was in existence for the longest time for almost 1.5 million years. Much is to be appreciated for the efforts and growth of the makers of this industry as we have seen through the variables between the same industries.

The first objective of this study was to analyze the differences and similarities in the choice of raw materials. As noted in chapter 4, this study was able to bring out the differences in the choice of raw material and how this could have affected the size of the collections. The makers of the collections both preferred specific raw materials. In Lewa Downs the makers had a preference for basalt while in Kariandusi, they chose the phonolite. This difference in the choice of material clearly indicates that these makers either had the knowledge of which materials produced better handaxes or this clearly points out the most reliable raw material to them at that point in time. In Lewa Downs, the results show that these collections produced longer handaxes compared to the Kariandusi collection. The results further demonstrate that the choice of raw material affected the size of the handaxes with the more reliable/available materials producing larger handaxes in both collections.

The second object of this study was to assess the influence of initial form of raw material on size of the handaxes. A majority of the handaxes were made from flakes rather than stone cobbles. This could have been due to availability of the materials and in which form they were more available. As noted, handaxes produced from struck out flakes produced larger pieces, compared to those made from cobbles. This is because, available pieces of cobbles used must have been generally smaller in size compared to the large pieces of flakes struck out from the parent rocks. When a comparison of initial form against length was done, it was noted that the longest handaxes were produced from flakes and the most predominant raw material in the specific collection. This objective was well achieved since the study was able to prove that the sizes of the handaxes were influenced by the initial forms of the raw material and the raw material type of the initial form used.

The final objective of this study was to compare and contrast the reduction of the Acheulean handaxes between Kariandusi and Lewa Downs.  I did a comparative analysis on this, and noted that in both collections the reduction was more or less the same. The removals on the Kariandusi collection were more consistent throughout the collection. This proves the hypothesis, ‘the makers of the handaxes had different levels of reducing their tools’ wrong. The reduction in the collections did not influence the size of the handaxes, but rather the size was more influenced by the initial form, therefore this was not a cause of any of the variabilities.

Therefore in explaining the morphological variability in the collections it is proved that, indeed the choice of material and the initial forms did influence the size and shaping of the two collections. However, the removal sequence did not have an effect in the size and shape of the handaxes. Both collections had almost similar numbers of flake scars, but the morphology of the collections still remained different.

In concluding, this study set out to bring out the probability that variability can be caused by other factors such as the sizes of the raw material and the initial form of the raw material and not necessarily due to the functionality of the tool, geographical and ecological factors. Perhaps this might help us understand more on why, these two factors, raw material type and its initial form caused a change in size among both collections despite the fact that these collections were made during different times. This goes to explain that certain factors during both times remained constant such as the choice of which raw material to use, which material was more convenient and which initial forms produced the best tools and was easily accessible to them. Perhaps it is more about time saving for the makers of these tools in the sense that they tried to save time by avoiding to travel long distances to acquire a certain raw material because it is good for shaping, but rather doing with what they had around in their immediate environment. It could also be that they opted to use the easiest form of raw material which was easier to shape into handaxes rather than spend time and effort shaping cobbles, explaining the abundant presence of handaxes shaped from flakes. All these probabilities and factors, all point out to one thing though, that as much as these collections were made at different times, the populations had the same reasoning in terms of sourcing for their raw materials and how they made the choices on what to utilize and what made their life easier.

## 6.2 Recommendations

Although this study investigated the collection from both Lewa Downs and Kariandusi, more studies need to be done on the Lewa Downs collections. Kariandusi has been well investigated over the years by various researchers' interested in the Acheulean industry from Leakey to Gowlett to Tom Wynn. However, nothing so far has been officially written about the Lewa Downs handaxe collection or the site itself. I believe this is a site that can yield a lot of information on the makers, their thoughts and ways of living. We can also know more about their unique tools and raw material procurement procedures.

Some of the findings pose challenges that require further studies. For example Lithics recovered from the surface during the survey were not fully reliable to acquire all the information. A comprehensive survey at this area site is recommended and if feasible then excavations should follow. An excavation would be able to yield better results needed in understanding the Lewa Downs handaxe collection.

Secondly, more advanced types of analyses could be used on the collection, as a way of trying to understand cultural differences between the assemblages. These types of analyses include use-wear analysis which is able to portray functionality of the tools. Use-wear analysis when used is able to tell exactly what the tools were used for. More advanced methods and formulas could also be used such as the index of invasiveness method, used in calculating the amount of retouch on a biface.

Finally, unlike Kariandusi which has good reliable dates, Lewa Downs needs good metric dates to be certain of the collection and to ease future work carried on this site and its collections. It is therefore recommended that an intensive study be conducted which would probably yield better information. I strongly believe that the results of this investigation open doors for future research.

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## APPENDICES

### Appendix A: lab data sheet for Lewa Downs (a)

**SITE 1 : LEWA DOWNS**

| NO. | RAW MATERIAL | LENGTH(mm) | WIDTH(mm) | THICKNESS(mm) | T.removals | INITIAL FORM |
|---|---|---|---|---|---|---|
| 1 | Basalt | 261.51 | 128.75 | 49.54 | 45 | flake |
| 2 | Basalt | 250.57 | 113.36 | 46.7 | 47 | flake |
| 3 | Basalt | 236.02 | 112.63 | 45.52 | 34 | flake |
| 4 | Basalt | 152.05 | 80.09 | 46.11 | 17 | flake |
| 5 | Basalt | 198.21 | 99.5 | 49.8 | 20 | flake |
| 6 | Basalt | 191.49 | 95.71 | 46.23 | 27 | flake |
| 7 | Basalt | 224.2 | 96.37 | 47.9 | 36 | flake |
| 8 | Basalt | 151.68 | 88.18 | 38.37 | 24 | flake |
| 9 | Basalt | 197.11 | 93.59 | 40.33 | 37 | flake |
| 10 | Basalt | 225.33 | 123.63 | 43.25 | 44 | flake |
| 11 | Basalt | 233.22 | 112.95 | 58.99 | 32 | flake |
| 13 | Basalt | 258.76 | 116.57 | 47.19 | 49 | flake |
| 14 | Basalt | 188.66 | 97.35 | 44.49 | 21 | flake |
| 15 | Basalt | 206.7 | 108.25 | 44.46 | 13 | flake |
| 16 | Basalt | 273.22 | 120.35 | 48.24 | 53 | flake |
| 17 | Basalt | 169.63 | 85.67 | 36.31 | 35 | flake |
| 18 | Basalt | 231.66 | 107.94 | 51.98 | 66 | flake |
| 19 | Basalt | 233.85 | 115.45 | 45.11 | 37 | flake |
| 20 | Basalt | 184.62 | 90.17 | 36.43 | 19 | flake |
| 21 | Basalt | 249.51 | 115.8 | 63.01 | 36 | flake |
| 22 | Basalt | 240.29 | 124.74 | 50 | 30 | flake |
| 23 | Basalt | 242.09 | 128.48 | 50.85 | 40 | flake |
| 24 | Basalt | 218.58 | 144.45 | 43.88 | 52 | flake |
| 25 | Basalt | 274.61 | 124.3 | 47.08 | 40 | flake |
| 27 | Basalt | 222.27 | 108.59 | 52.18 | 38 | flake |
| 28 | Basalt | 201.1 | 113.25 | 36.66 | 15 | flake |
| 29 | Basalt | 156.36 | 78.38 | 43.71 | 33 | flake |
| 30 | Basalt | 187.42 | 88.21 | 53.05 | 36 | flake |

**Appendix B: lab data sheet for Lewa Downs. (b)**

SITE: LEWA DOWNS

| NO. | RAW MATERIAL | TIP WIDTH(mı | TIP THICKNESS(mı | BUTT WIDTH(ı | BUTT THICKNESS(mm) |
|---|---|---|---|---|---|
| 1 | Basalt | 65.07 | 19.57 | 99.44 | 40.98 |
| 2 | Basalt | 45.65 | 19.1 | 94.18 | 36.31 |
| 3 | Basalt | 37.63 | 20.04 | 98.02 | 40.55 |
| 4 | Basalt | 41.86 | 21.55 | 68.95 | 38.16 |
| 5 | Basalt | 32.45 | 22.88 | 87.84 | 31.38 |
| 6 | Basalt | 39.09 | 21.31 | 96.29 | 45.86 |
| 7 | Basalt | 37.29 | 19.29 | 79.95 | 35 |
| 8 | Basalt | 49.72 | 15.95 | 69.1 | 21.24 |
| 9 | Basalt | 24.85 | 19.66 | 83.95 | 29.28 |
| 10 | Basalt | 30.63 | 14.45 | 99.15 | 34.46 |
| 11 | Basalt | 28.22 | 18.79 | 91.52 | 38 |
| 13 | Basalt | 24.61 | 13.88 | 90.96 | 29.25 |
| 14 | Basalt | 32.47 | 17.44 | 60.3 | 34.97 |
| 15 | Basalt | 54.94 | 21.83 | 73.32 | 29.98 |
| 16 | Basalt | 29.77 | 15.37 | 93.94 | 35.07 |
| 17 | Basalt | 41.14 | 14.95 | 61.66 | 28.73 |
| 18 | Basalt | 42.45 | 18.75 | 84.69 | 25.7 |
| 19 | Basalt | 37.41 | 15.2 | 93.33 | 31.16 |
| 20 | Basalt | 37.09 | 14.54 | 67.03 | 28.04 |
| 21 | Basalt | 41.74 | 18.88 | 57.9 | 38.29 |
| 22 | Basalt | 35.71 | 20.07 | 89.44 | 49.69 |
| 23 | Basalt | 31.59 | 16.28 | 92.78 | 39.49 |
| 24 | Basalt | 41.1 | 24.6 | 93.82 | 33.77 |
| 25 | Basalt | 28.57 | 15.48 | 84.06 | 42.77 |
| 27 | Basalt | 39.08 | 12.91 | 89.47 | 32.72 |
| 28 | Basalt | 35.02 | 11.04 | 82.64 | 36.59 |
| 29 | Basalt | 35.96 | 13.98 | 68.14 | 25.26 |
| 30 | Basalt | 38.56 | 17.6 | 46.6 | 39.72 |

**Appendix C: lab data sheet for Kariandusi. (a)**

**SITE 2: KARIANDUSI**

| NO. | RAW MATERIA | LENGTH (mm) | WIDTH (mm) | THICKNESS (mm) | T removals | INITIAL FORM |
|---|---|---|---|---|---|---|
| 1 | Phonolite | 145.15 | 69.6 | 28.64 | 12 | flake |
| 2 | Phonolite | 131.4 | 75.52 | 38.55 | 29 | cobble |
| 3 | Basalt | 154.27 | 91.32 | 45.72 | 41 | flake |
| 4 | Phonolite | 195.31 | 90.9 | 45.5 | 50 | cobble |
| 5 | Phonolite | 164.32 | 95.53 | 44.08 | 42 | flake |
| 6 | Phonolite | 181.66 | 95.04 | 52.22 | 42 | flake |
| 7 | Phonolite | 185.12 | 99.3 | 45.9 | 24 | flake |
| 8 | Phonolite | 167.58 | 104.39 | 41.42 | 15 | flake |
| 9 | Phonolite | 185.55 | 97.9 | 40.51 | 28 | flake |
| 10 | Obsidian | 150.8 | 79.98 | 38.34 | 34 | flake |
| 11 | Phonolite | 167.8 | 90.2 | 35.26 | 30 | flake |
| 12 | Phonolite | 180.55 | 93.36 | 37.46 | 7 | flake |
| 13 | Obsidian | 156.94 | 88.17 | 45.62 | 28 | flake |
| 14 | Basalt | 151.67 | 82.93 | 38.95 | 31 | flake |
| 15 | Basalt | 162.27 | 77.47 | 47.36 | 15 | cobble |
| 16 | Basalt | 167.25 | 104.14 | 45.15 | 12 | flake |
| 17 | Phonolite | 160.36 | 101.9 | 43.65 | 7 | flake |
| 18 | Phonolite | 179.96 | 103.88 | 37.71 | 23 | flake |
| 19 | Phonolite | 167.47 | 81.62 | 43.12 | 8 | flake |
| 20 | Phonolite | 192.62 | 108.34 | 53.9 | 13 | flake |
| 21 | Phonolite | 171.74 | 96.95 | 37 | 18 | flake |
| 22 | Phonolite | 204.28 | 107.9 | 48.98 | 14 | flake |
| 23 | Phonolite | 187.32 | 110.93 | 42.26 | 8 | flake |
| 24 | Phonolite | 191.69 | 112.88 | 48.41 | 12 | flake |
| 25 | Phonolite | 149.33 | 90.21 | 46.75 | 10 | cobble |
| 26 | Phonolite | 183.2 | 97.92 | 49 | 16 | cobble |
| 27 | Phonolite | 165.2 | 82.81 | 60.06 | 14 | flake |
| 28 | Phonolite | 206.47 | 101.6 | 48.6 | 15 | flake |
| 29 | Phonolite | 164.45 | 100.64 | 60.75 | 10 | flake |
| 30 | Phonolite | 153.71 | 76.05 | 50.34 | 25 | flake |

**Appendix D: lab data sheet for Kariandusi. (b)**

**SITE : KARIANDUSI**

| NO. | RAW MATERIAL | TIP WIDTH(mm) | TIP THICKNESS | BUTT WIDTH(mn | BUTT THICKNESS(mm) |
|---|---|---|---|---|---|
| 1 | Basalt | 63.6 | 33.25 | 74.8 | 38.57 |
| 2 | Basalt | 46.7 | 21.2 | 74.95 | 36.05 |
| 3 | Basalt | 46.1 | 16.55 | 67.81 | 47.36 |
| 4 | Basalt | 45.15 | 21.08 | 88.82 | 22.78 |
| 5 | Phonolite | 50.31 | 15.39 | 60.11 | 26.77 |
| 6 | Phonolite | 55.33 | 18.9 | 68.77 | 37.08 |
| 7 | Phonolite | 57.5 | 23.74 | 83.65 | 40.1 |
| 8 | Phonolite | 47.52 | 23.97 | 81.45 | 33.58 |
| 9 | Phonolite | 51.4 | 21.62 | 82.48 | 46.16 |
| 10 | Phonolite | 68.17 | 22.39 | 80.05 | 43.94 |
| 11 | Phonolite | 69.63 | 11.5 | 90.3 | 31.93 |
| 12 | Phonolite | 53.6 | 21.4 | 78 | 36.1 |
| 13 | Phonolite | 48.75 | 20.6 | 75.3 | 28.05 |
| 14 | Phonolite | 49.13 | 36.38 | 69.6 | 34.7 |
| 15 | Phonolite | 50.73 | 24.7 | 80.57 | 31.7 |
| 16 | Phonolite | 59.3 | 17.49 | 101.46 | 38.54 |
| 17 | Phonolite | 50.02 | 20.05 | 71.2 | 43.12 |
| 18 | Phonolite | 69.67 | 26.19 | 85.61 | 31.3 |
| 19 | Phonolite | 56.2 | 14.19 | 74.33 | 24.69 |
| 20 | Phonolite | 72.06 | 17.01 | 79.65 | 31.44 |
| 21 | Phonolite | 63.3 | 21.75 | 87.64 | 37.06 |
| 22 | Phonolite | 55.75 | 18.66 | 81.31 | 36.36 |
| 23 | Phonolite | 56.94 | 18.87 | 77.57 | 46.75 |
| 24 | Phonolite | 48.19 | 17.51 | 88.06 | 45.21 |
| 25 | Phonolite | 52.93 | 21.11 | 86.23 | 41.47 |
| 26 | Phonolite | 69.7 | 21.1 | 100.98 | 44.28 |
| 27 | Phonolite | 57.69 | 23.64 | 75.65 | 51.56 |
| 28 | Phonolite | 52.29 | 15.44 | 70.56 | 27.35 |
| 29 | Obsidian | 41.27 | 19.89 | 57.73 | 22.3 |
| 30 | Obsidian | 42.72 | 26 | 74.82 | 44.6 |

## Appendix E: Letter of authorization from NMK

NATIONAL MUSEUMS OF KENYA

WHERE HERITAGE LIVES ON

June 17th 2014.

**RE: AUTHORISATION FOR MS. JOANNE UMAZI**

This is a letter allowing Ms. Joanne Umazi to use archeological material from the National Museums of Kenya, Archaeology section laboratory. Ms Umazi will be working with archaeological material from the sites of Kariandusi (GrJj 22) and Lewa Downs (GpJn-1) prehistoric sites. Ms Umazi will be using these archeological materials on her research project studying the Morphological variability in the Acheulean handaxes.

There is no active research going on with the collection as of now or in the past 15 years, therefore Ms. Umazi has been allowed to use the collection in her study, and any publication work that might result from the use of the collections.

Sincerely,

Dr. Emmanuel K Ndiema,
Ag. Head of Archaeology.
National Museums of Kenya.

Address P.O. Box 40658 00100 GPO Nairobi Telephone 254 20 4448930/3 , 254 20 3742161/4 , 254 20 3742131/4 Fax 254 20 3741424 Website www.museums.or.ke